

Dec. 8, 1942.

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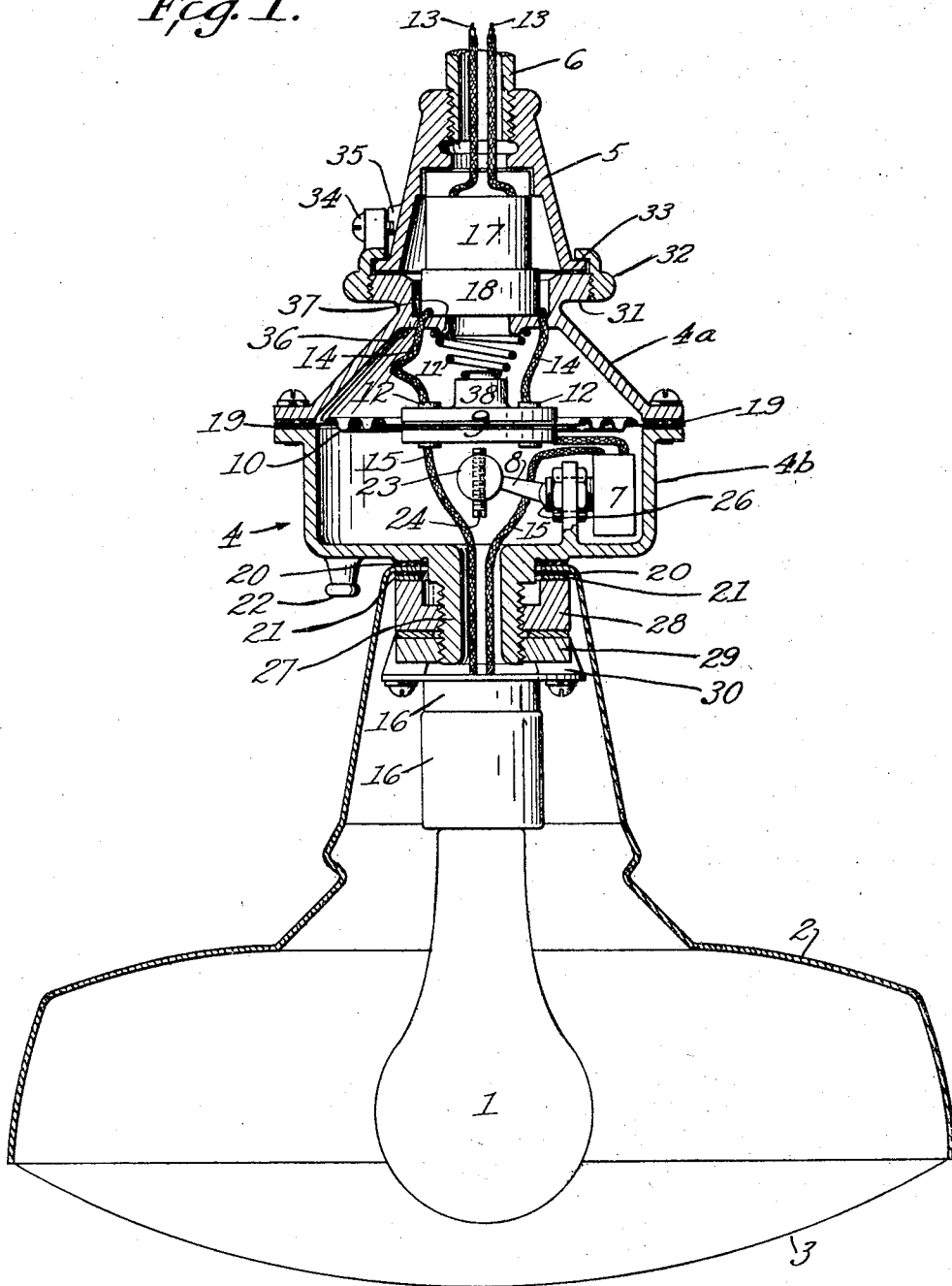
2,304,085

EXPLOSION PROOF LIGHTING UNIT

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2 Sheets-Sheet 1

Fig. 1.



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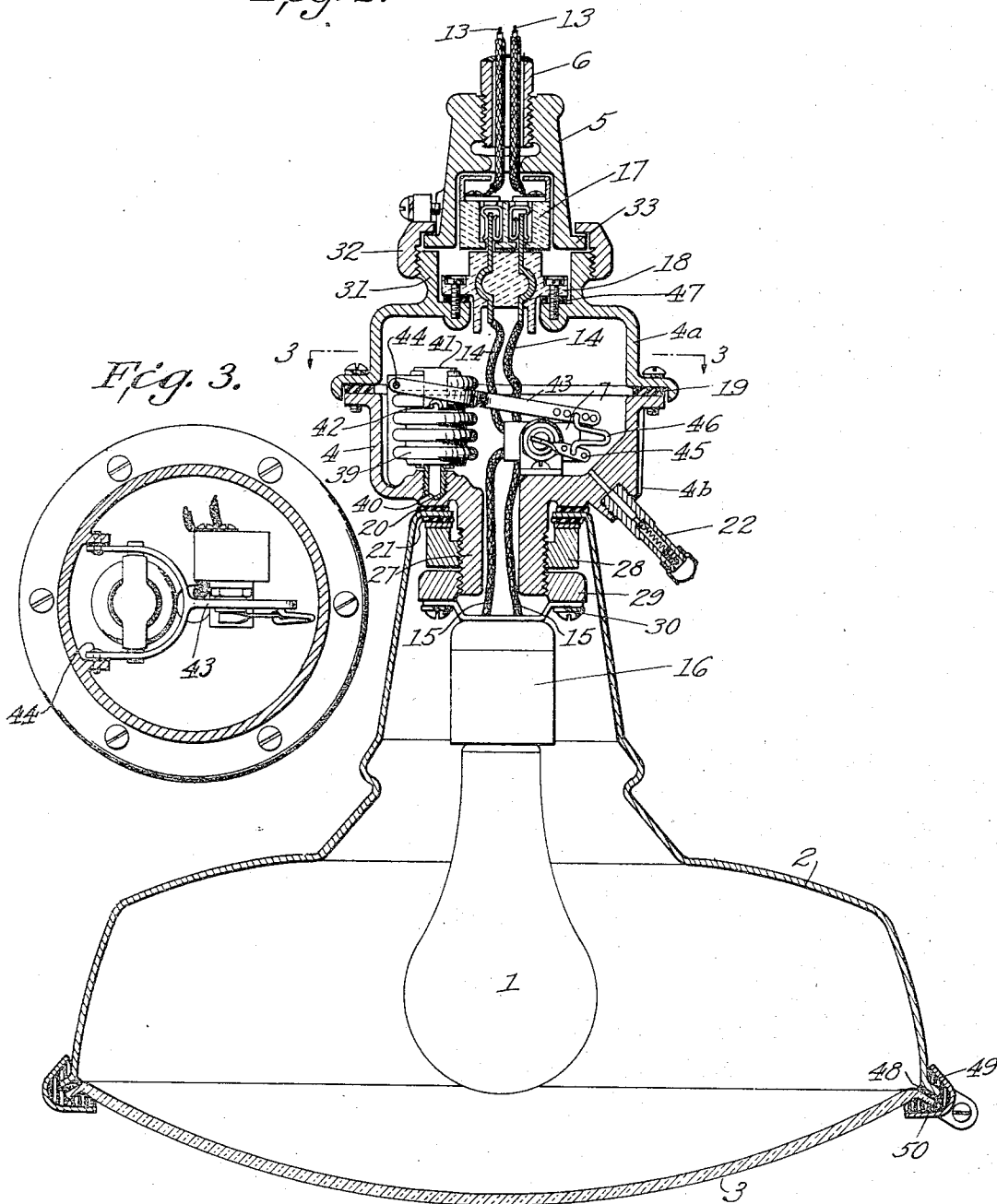
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2 Sheets-Sheet 2

Fig. 2.



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UNITED STATES PATENT OFFICE

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EXPLOSION-PROOF LIGHTING UNIT

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18 Claims. (Cl. 240—11.3)

The present invention relates to explosion-proof lighting units adapted to be used in mines, industrial plants and other places where an explosive atmosphere is apt to be present.

It is a principal object of the invention to provide an electric lighting unit, wherein all parts which might ignite an explosive atmosphere are isolated from that atmosphere in an enveloping body of high pressure, non-combustible gas.

It is a further object of the invention to provide an automatic circuit controlling device within the isolated area, responsive to a drop in pressure to extinguish the lamp. Hence, the light bulb and associated parts will cool down below the ignition point of the explosive atmosphere before the latter can come into contact with the bulb or other hot parts of the lighting unit.

It is a further object of the invention to provide a lighting unit of the class described which cannot be relighted after a drop in its internal gas pressure by simply re-establishing that pressure, for instance, by re-inflating the unit. A unit constructed in accordance with the present invention must be removed from its supporting structure before it can be relighted, thereby substantially completely obviating the danger of inflating the unit with an explosive mixture of gas and air.

In the past, lighting units have been constructed wherein internal pressures above atmosphere have been maintained, in an attempt to prevent the entrance of explosive gases into the units, and pressure responsive switches to de-energize the lamp circuit upon a drop in pressure have been provided. However, in all such devices, the circuit controlling switches were adapted to be shifted to circuit-closing position simply by re-inflating the units. Hence, a careless or ignorant person, in an attempt to re-light the unit, might inflate the same with air containing explosive gases, with the result that an explosion might occur.

As stated above, the principal object of the present invention is to construct an explosion-proof lighting unit of the high pressure type which cannot be made operative after a pressure drop by merely raising the pressure within the casing.

It is a further object of the invention to provide a simplified and improved housing for the unit and to combine therewith, improved circuit-controlling and pressure-responsive devices.

Further objects and advantages of the invention will be apparent to one skilled in the art from a consideration of the illustrative embodiments of the invention shown in the accompanying drawings and described below.

In the drawings:

Figure 1 is a vertical sectional view of a light-

ing unit in accordance with the invention, certain parts being shown in elevation.

Figure 2 is a similar view of a modification, and

Figure 3 is a horizontal sectional view, taken on line 3—3 of Figure 2.

The modification of the invention shown in Figure 1 comprises generally an illuminating device such as a lamp 1, a reflector casing 2 with a light permeable portion 3. The casing 2 is attached to a housing 4 carried by an outlet fixture 5 mounted on a power conduit 6.

In the housing 4, there is positioned a snap-action toggle switch 7 having an operating arm 8 adapted to be moved by contact with an insulated block 9 carried by a thin flexible, metallic diaphragm 10. This diaphragm 10 is normally forced downwardly by a coil compression spring 11 mounted between the top side of the diaphragm and the top of the housing 4.

The casing 2, 3 and the housing 4 below the diaphragm 10 constitute a single high pressure chamber. Gaskets 19 between the upper and lower parts of the housing 4 make an air-tight joint between the diaphragm 10 and the housing 4. Gaskets 20, 21 at the point of junction between the casing 2 and the housing 4 prevent any leaks therebetween. A hollow boss 22 projecting from a wall of the casing carries a one-way valve such as a standard pneumatic tire valve, which will allow a pressure to be built up within the lower half of the housing 4 and the casing 2, 3.

Attached to the end of the switch arm 8 is a weighted ball 23 having adjustable screw 24 mounted therein. By adjusting the screw 24, the position of the diaphragm 10 when it begins to move the arm 8 may be very carefully controlled. The weighted member 23 is a very important feature of my invention. Its mass is so proportioned to the resistance of the switch 7 that it will be insufficient to move the switch arm 8 from the circuit-closing position shown in Figure 1 by the force of gravity, but its mass is sufficient to move the arm 8 upwardly by a sudden downward movement of the whole unit. Of course, the unit cannot be moved downwardly until the housing 4 is separated from the fixture 5.

Mounted in the insulated block 9, carried by the diaphragm 10, are two air-tight conducting portions 12 which are connected to power lines 14—14 and 15—15. Wires 13 are attached to any suitable source of power, and, by means of a suitable plug and socket construction 17 and 18, are connected to the wires 14—14.

The operation of the device shown in Figure 1 and broadly described above is as follows:

A high pressure fluid such as air or a non-inflammable gas is forced into the housing 4 through the valve 22 until any desired pressure is

built up within the housing 4 and the casing 2, 3. When this pressure is established, the diaphragm 10 will be in the position shown in Figure 1, that is, the pressure within the housing 4 will just balance the force of the spring 11 tending to move the diaphragm 10 downwardly. If the pressure for any reason should fall within the housing and casing, the spring 11 will force the diaphragm 10 downwardly to contact the adjustable screw 24 in the weighted ball 23 attached to the end of the switch arm 8. Continued downward movement of the diaphragm 10 will move the switch arm 8 past the dead center position of the toggle switch 7 and the switch arm 8 will be snapped to its lowermost position and the circuit to the lamp 1 will be opened. If some unauthorized person should attempt to re-light the lamp by applying a source of air pressure to the valve 22, the diaphragm 10 will move upwardly but the switch arm 8 will stay in its lowermost position and the switch 7 will remain open. In order to put the lamp back into operation, it is necessary to separate the housing 4 from the fixture 5, build up the pressure within the housing 4 and then shake the whole unit so that the mass of the weighted member 23 will move the switch arm 8 upwardly. When the housing 4 is again attached to the fixture 5 and the socket 17 and plug 18 are properly positioned, the lamp will be ready for operation.

By thus making it necessary to completely remove the housing 4 from the fixture 5, the chance of some unauthorized or ignorant person re-inflating the housing is very slight. Anyone who will go to the trouble of removing the housing from its fixture will normally ascertain where the leak is and repair it forthwith. In order to absolutely prevent any unauthorized person from resetting the switch, a lock may be provided between the housing 4 and the fixture 5 so that the housing cannot possibly be removed. No lock is shown in the accompanying drawings as any conventional type may be used.

In addition to the broad features described above, the invention also includes certain features of construction which make the unit particularly inexpensive to manufacture and simple to assemble. The housing 4 is divided into upper and lower portions 4a and 4b respectively, which facilitates ready access to the switch members. Mounted on the portion 4b is an upwardly extending flange 25 upon which any standard toggle switch may be mounted by means of nuts 26. The housing 4b has a downwardly extending throat 27 externally screw-threaded to receive a nut 28 adapted to hold the casing 2 in air-tight relationship to the housing 4. Screwed below the nut 28 is another nut 29 which holds the bracket 30, which in turn supports the lamp base 16.

Portion 4a of the housing 4 has an upwardly and outwardly extending lip 31 which is externally screw-threaded to hold a ring nut 32 adapted to engage a laterally extending flange 33 on the fixture 5. A set screw 34 on the ring nut 32 engages a portion 35 on the fixture 5 and holds the ring nut against movement.

An inwardly extending flange 36 at the top of section 4a of the housing has an annular ridge 37 which acts as a seat for the spring 11. The other end of the spring 11 is seated on an upwardly projecting lug 38 on the insulating block 9 carried by the diaphragm 10.

In the modification in the invention shown in Figure 2, many of the features of construction are similar to those shown in Figure 1. The

main points of difference are that, in this construction, a Sylphon bellows is used, instead of a flexible diaphragm, and the switch actuating arm is of slightly different construction. As in Figure 1, the lamp 1 is enclosed in a casing 2 having a light permeable portion 3 all connected to the housing 4. Mounted in the housing 4 is a switch 7 which may be a rotary snap switch instead of the toggle switch shown in Figure 1. A Sylphon bellows 39 is disposed within the housing 4, with its interior in communication with the outside atmosphere through a passage 40. Attached to the top of the bellows 39 is a saddle 41 having downwardly and outwardly projecting lugs 42, which are disposed beneath the arms of a forked lever 43 pivoted at 44 on the housing 4 as shown in Figure 3. The other end of the lever 43 is connected to the switch arm 45 by means of an adjustable link 46. The top of the housing 4 is sealed by means of the plug 18 and the gaskets 47.

A one-way valve 22 is provided for pumping air or other fluid into the housing 4 and the casing 2, 3. The valve structure may include an ordinary pneumatic tire valve inside and valve cap. Gaskets 19, 20, 21 similar to those shown in Figure 1, make the housing 4 and its connection with the casing 2 air-tight. The joint between the reflector casing 2 and the glass plate 3 may be sealed by a gasket 48, a V gasket 49 and a compression ring 50.

In the operation of this modification of the invention, air or gas under pressure is introduced into the housing 4 and the casing 2, 3 through the valve 22. When suitable pressure is built up in the unit, the bellows 39 will be in the depressed position shown in Figure 2. If a leak occurs, the pressure differential between the inside and outside of the bellows is decreased and the bellows will rise, thereby swinging the lever 43 upwardly around the pivot 44. The movement of the lever 43 will move the switch arm 45 by means of the link 46 to open the switch 7. An increase in pressure will contract and depress the bellows, but since there is no positive connection between the outwardly extending lugs 42 on the saddle 41 and the lever 43, there will be no force tending to move the arm 43 downwardly and the switch will remain in the open position. Switch actuating arm 43, like switch actuating arm 8 and weighted ball 23 described in Figure 1, is comparatively heavy. Its mass is so adjusted that the force of gravity tending to rotate the lever 43 downwardly around the pivot 44 will be insufficient to cause a movement due to the resistance of the snap switch 7. However, its mass is sufficient to cause a downward motion when the casing is moved suddenly upwardly, or moved downwardly and stopped suddenly. Thus it will be apparent that the whole unit shown in this modification will have to be removed from the fixture 5 before the switch can be reset after the pressure has been built up within the housing and casing.

In the normal use of my invention, these lighting units will be operating in a highly explosive atmosphere and the danger of repressuring these units when there is any explosive gas inside of the unit will necessitate their careful supervision. By making the whole unit removable, whenever the pressure drops therein, the unit may be detached from the fixture 5 and taken out of the gas zone to be inspected. The whole unit may be taken apart and new gaskets inserted where necessary or any other leaks re-

paired. The pressure will then be built up within the unit and the switch may be reset by merely shaking the unit. The whole unit in its reset condition may then be moved back to the gas zone and reattached to the fixture. By providing the straight line type of plug at the top of the unit, it is a simple matter to attach this unit to the electrical outlet.

There are many other features of construction of the device shown in Figure 2 which are similar to corresponding parts shown in Figure 1. The housing 4 is divided into upper and lower portions 4a and 4b, respectively, while portion 4b has a downwardly extending, internally threaded throat 27 upon which are screwed the nuts 28, 29 and the bracket 30 supporting the lamp socket 16.

The top construction of portion 4a likewise has a laterally extending lip 31 and a ring nut 32 adapted to engage a laterally extending flange 33 of the fixture 5. The plug 18 and socket 17 are of the usual type and need not be discussed in detail.

The different wires shown in Figure 2 correspond to like wires in Figure 1.

From the above description, it will be readily apparent that I have invented an extremely simple lighting unit which may not be re-lighted after failure by an ignorant or unauthorized employee, thus completely obviating the danger of an explosion caused by turning on the switch while any explosive gases are inside of the casing. A further advantage is that the whole unit may be readily transported to any safe place for repairs and reset only by some person who has carefully inspected the lamp to correct any failures. This lighting unit is extremely simple to construct and repair and may be readily applied to lighting systems now in use.

It is, of course, obvious that I do not intend to limit my invention to the particular features shown and described above since many modifications of the illuminating devices, switch structures, pressure responsive devices, etc., may be made without departing from the spirit of my invention, and all such modifications should be considered as being within the scope of my appended claims.

I claim:

1. An explosion-proof lighting unit comprising an electric illuminating device, an air-tight casing surrounding said device, means for introducing gas under pressure into said casing and for normally maintaining a superatmospheric pressure therein, a switch in circuit with said illuminating device, a switch operating member movable in opposite directions between a switch opening position and a switch closing position, and means responsive to the pressure in the casing including an element movable in opposite directions in response to increases and decreases in said pressure, said switch operating member when in switch closing position being disposed directly in the path of movement followed by said element when the pressure in the casing falls below a predetermined minimum, said member being movable from switch closing to switch opening position by contact with said element during such movement to open the switch and said circuit, said member when in switch opening position being out of the path of movement of said pressure responsive element whereby said element is free to move in the opposite direction independently of said switch operating member

upon an increase in the pressure in the casing above said predetermined minimum.

2. An explosion-proof lighting unit of the type described in claim 1 wherein said switch is of the snap type and positively maintains itself at either of the two positions to which it is moved by the switch operating member.

3. An explosion-proof lighting unit of the type described in claim 1 wherein said switch operating member and said pressure responsive element are so arranged as to provide a lost motion, one-way connection therebetween.

4. An explosion-proof lighting unit of the type described in claim 1 wherein said pressure responsive means comprises a bellows, the inside of which is in communication with atmosphere outside of said casing.

5. An explosion-proof lighting unit of the type described in claim 1 wherein said pressure responsive means comprises a movable diaphragm one side of which is in communication with atmosphere outside of said casing.

6. An explosion-proof lighting unit comprising an illuminating device, an air-tight casing surrounding said illuminating device, means for maintaining a super-atmospheric pressure within said casing, a switch in circuit with said illuminating device, means movable in response to variations in the pressure differential between the inside and outside of said casing, a switch operating member, said pressure responsive means being operable to move in one direction upon decrease in said pressure differential and to move in another direction upon increase in said pressure differential, said switch operating member when in switch closing position being in the path of movement of the pressure responsive means in the first mentioned direction, whereby a decrease in the pressure differential moves the member and opens the switch, the switch operating member when in switch opening position being out of the path of movement of the pressure responsive means in the second mentioned direction, whereby an increase in the pressure differential moves only the pressure responsive means and leaves the switch unaffected.

7. An explosion-proof lighting unit comprising an illuminating device, an air-tight casing surrounding said illuminating device, means for maintaining super-atmospheric pressure within said casing, a switch in said casing and in circuit with said illuminating device, pressure responsive means, a switch operating member positioned in the path of movement of said pressure responsive means to be moved thereby to actuate said switch to open said circuit whenever the pressure differential between the pressure inside said casing and outside said casing falls below a predetermined minimum, said pressure responsive means being movable independently of said member upon an increase in said pressure differential, thereby leaving the switch in the circuit opening position, said switch operating member being pivotally mounted for movement to switch closing position and having sufficient mass to be moved to that position by shaking said unit when the pressure differential is above said predetermined minimum.

8. An explosion-proof lighting unit comprising an illuminating device, an air-tight casing surrounding said illuminating device, means for maintaining a super-atmospheric pressure within said casing, a switch having a predetermined mechanical resistance to movement in said casing and in circuit with said illuminating device, pres-

sure responsive means, a switch operating member in the path of movement of said pressure responsive means to actuate said switch to open said circuit whenever the pressure differential between the pressure inside said casing and outside said casing falls below a predetermined minimum, said member having a mass insufficient to cause movement of said connecting means by gravity against the mechanical resistance to movement of said switch but sufficient to cause movement of said member to close the switch by a sudden movement of said casing.

9. An explosion-proof lighting unit comprising an illuminating device, an air-tight casing surrounding said illuminating device, means for maintaining a super-atmospheric pressure within said casing, a switch in said casing in circuit with said illuminating device, a pressure responsive bellows having one side in communication with the atmosphere outside of said casing, a switch operating member, an element on said bellows positioned to engage said member to move the same and open said switch upon movement of said bellows in response to decrease in pressure differential between the inside and outside of said casing, said member when in switch opening position being out of the path of movement of said element, whereby the element is free to move independently of the member in response to an increase in said pressure differential.

10. An explosion-proof lighting unit comprising an illuminating device, an air-tight casing surrounding said illuminating device, means for maintaining a super-atmospheric pressure within said casing, a switch in said casing in circuit with said illuminating device, a pressure responsive bellows one side of which is in communication with the atmosphere outside of said casing, a saddle on said bellows, a bifurcated arm having connection at one end with said switch, said bifurcated portion being positioned to be engaged by said saddle but not connected thereto.

11. An explosion-proof lighting unit comprising an illuminating device, an air-tight casing surrounding said illuminating device, means for maintaining a super-atmospheric pressure within said casing, a snap switch mounted in said casing having an operating arm connected thereto, a vertically positioned bellows having communication with the outside atmosphere at its lower end, said arm having a bifurcated portion positioned to extend partially around said bellows, a saddle on said bellows having horizontally positioned lugs adapted to engage the underside of said bifurcated arms whereby upward movement of said bellows and said saddle due to decrease in pressure within said casing will move said bifurcated arm upwardly to turn off said switch, but the downward movement of said bellows, when said switch is in the off position, will be inoperative to turn said switch on.

12. An explosion-proof lighting unit of the type described in claim 11 wherein said operating arm has sufficient mass to close said switch when said bellows is in its depressed position and said casing is moved suddenly upwardly but has insufficient mass to move downwardly against the resistance of the switch under the influence of gravity.

13. An explosion-proof lighting unit of the type described in claim 11 wherein said casing comprises an illuminating device enclosing portion, a switch and bellows enclosing portion, and

an insulating portion in said last named portion having upwardly extending electrical contact prongs, all of said portions being in communication with each other and forming an air-tight casing.

14. An explosion-proof lighting unit comprising an illuminating device, an air-tight casing surrounding said illuminating device, means for maintaining a super-atmospheric pressure within said casing, a switch in circuit with said illuminating device, a movable diaphragm responsive to the pressure differential between the inside and outside of said casing and a switch arm on said switch positioned to be contacted by said diaphragm when said diaphragm moves in one direction in response to a decrease in pressure differential, said diaphragm being free to move in the opposite direction independently of said arm in response to an increase in pressure differential.

15. An explosion-proof lighting unit of the type described in claim 14 wherein a spring is mounted on the low pressure side of said diaphragm.

16. An explosion-proof lighting unit of the type described in claim 14 wherein said arm has on its end remote from said switch a weight of sufficient mass to cause movement of said arm when said casing is moved suddenly, but of insufficient mass to move said arm by gravity against the resistance of the switch.

17. An explosion-proof lighting unit comprising an illuminating device, an air-tight casing surrounding said illuminating device, means for maintaining a super-atmospheric pressure within said casing, a switch in circuit with said illuminating device, a movable diaphragm responsive to the pressure differential between the inside and outside of said casing and a switch arm on said switch positioned to be contacted by said diaphragm when said diaphragm moves in one direction in response to a decrease in pressure differential, said diaphragm being free to move in the opposite direction independently of said arm in response to an increase in pressure differential, and an adjustable contact on said arm to vary the pressure differential at which said diaphragm will contact said arm and move said arm to open said switch.

18. An explosion-proof lighting unit comprising an illuminating device, an air-tight casing surrounding said illuminating device, an electrical power outlet, a two-part housing, a first part of said housing being removably attached to said outlet, a second part of said housing being removably attached to said casing, a flexible diaphragm mounted between the junction of the two parts of said housing, the second part of said housing, said diaphragm and said casing forming an air-tight compartment, means for maintaining a super-atmospheric pressure in said compartment, a switch mounted in said second part of said housing in position to be moved to circuit opening position by movement of said diaphragm in response to a decrease in the pressure in said air-tight compartment, an electric plug mounted in said outlet and a cooperating electric plug mounted in said first part of said housing and power leads extending from said second mentioned plug through said diaphragm to said switch and said illuminating device.

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