July 12, 1949. J. P. CORNISH 2,475,696

PUSH-BUTTON OPERATED ELECTRIC SWITCH

Filed Oct. 24, 1946 2 Sheets-Sheet 1

FIG. 1.

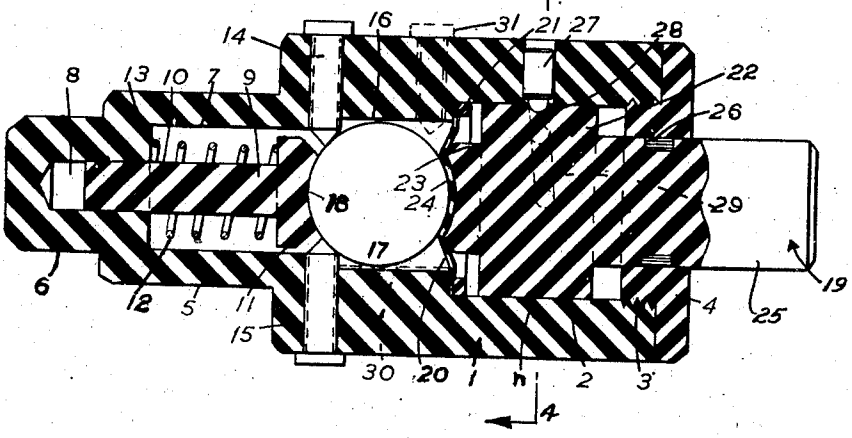


FIG. 2.

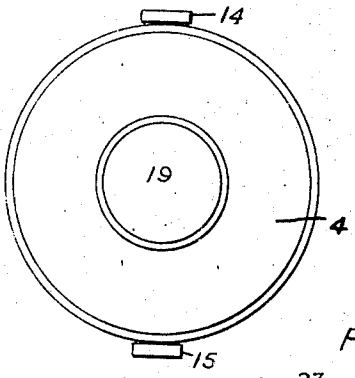


FIG. 3.

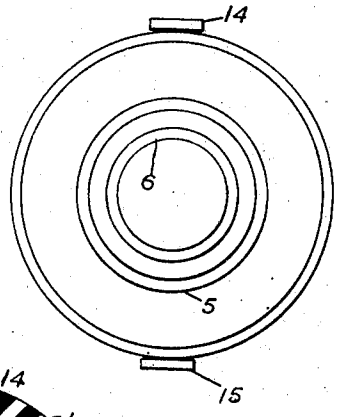
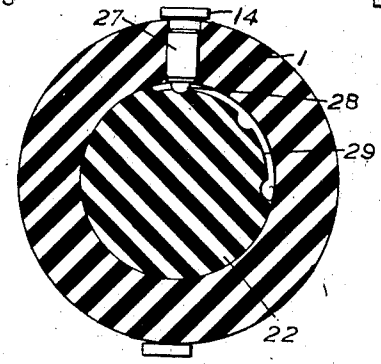


FIG. 4.



Inventor
John P. Cornish
By
John E. Eastlack
Attorney

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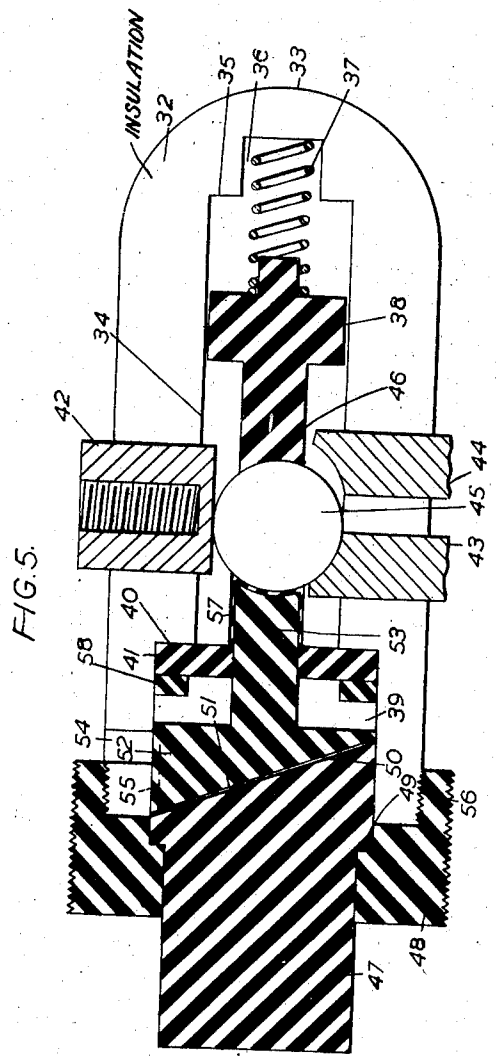


FIG. 5.

Inventor
John P. Cornish
By
John E Eastlack
Attorney

Patented July 12, 1949

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PUSH-BUTTON OPERATED ELECTRIC SWITCH

John Peter Cornish, Penarth, Wales, assignor to The Concordia Electric Safety Lamp Company Limited, Cardiff, Wales, a British company

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5 Claims. (Cl. 200—159)

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This invention relates to electric switches and has among its objects to provide a switch that is proof against the passage of liquid or gas that may corrode the contacts, to provide a self-contained switch that is applicable to articles such as electric handlamps, and to provide such a switch that is available for the control of more than one circuit.

According to the invention the switch comprises terminal contacts and a circuit-closing element sealed within a casing, and control means for the circuit-closing element projecting outside the casing.

The circuit-closing element may conveniently take the form of a ball, drum, cylinder or plunger of conductive metal or it may comprise a body of non-conductive material, such as a plastic material, in or upon which conductive strips or surfaces are fitted or formed for engagement of the terminal contacts.

The invention further comprises the features of construction hereinafter described.

The invention is illustrated, by way of example, in the accompanying diagrammatic drawings.

Figure 1 is a longitudinal section of a construction of the switch.

Figure 2 is an end view of the switch represented in Figure 1 viewed from the operating end of the switch.

Figure 3 is an end view of the switch represented in Figure 1 viewed from the opposite end of the switch.

Figure 4 is a cross-section taken on the line 4—4 of Figure 1.

Figure 5 is a longitudinal section of a modified construction of the switch.

In carrying the invention into effect, by way of example, in the construction of a self-contained switch that is proof against the passage of liquid or gas and that is adaptable to a hand lamp, such as a miner's electric lamp, as illustrated in Figures 1 to 4 of the accompanying drawings, the casing consists of a body 1 of ebonite or other insulating or non-conductive material such as a plastic material, that comprises three parts of differing and graduated diameters axially disposed and is closed at the smaller end, the first part, of largest diameter, having a bore that is in two parts of differing diameters, the part 2 of the bore of larger diameter being at the outer end of the casing and being formed with a screw thread 3 for the reception of a closing plate or ring 4 having a cooperating threaded portion. The second part 5 and the third part 6

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of the casing, of the smaller diameters, are bored each to an appropriate diameter as at 7 and 8.

The second and third parts 5, 6 of the casing serve to house the spring-pressed plunger 9 made of ebonite or other non-conductive material or of a plastic material, which is formed with a stem 10 of a diameter slidably to fit the bore 8 of the third part 6 of the casing, of smallest diameter, and with a head 11 that is a clearance fit within the bore 7 of the second part 5 of the casing. The spring 12 is helical and is disposed between the head 11 and the shoulder 13 formed by the reduction of diameter at the junction of the bores 7, 8 of the second and third parts 5, 6 of the casing. The bore 7 of the second part 5 is continued for a short distance into the first part of the casing 1 and there are here disposed two terminal contacts 14, 15 extending radially through the wall of the said part and having pointed or spring ends protruding into the bore 7, or as may be required. Within the inner part 16 of the bore of the first part of the casing 1 there is disposed a ball 17 of silver, brass or other conductive metal that is a rolling fit in the bore. The head 11 of the spring-pressed plunger 9 is shaped to avoid engagement with the terminal contacts 14, 15 and also to form an axial recess 18 of spherical curvature to serve as a seat for the ball 17. Thus, so long as the ball 17 is not subjected to pressure to overcome the force exerted by the spring-pressed plunger 9, the latter will press the ball out of engagement with the terminal contacts 14, 15. It is the purpose of the operating element 19 to control this tendency at will.

At the shoulder formed by the change in diameter of the parts 2 and 16 of the bore of the first part of the casing there is seated a transverse diaphragm 20 of rubber or a synthetic material of the required elasticity effectively sealing the bore against the passage of liquid or gas and retained in position by a retaining ring 21. The ring 21 may be of ebonite or other non-conductive material or of plastic material.

The operating element 19 is formed of ebonite or other non-conducting material or of plastic material and comprises a cylindrical body 22 that is a sliding fit within the outer bore of the first part of the casing and is formed at the inner end with a cylindrical extension 23 of reduced diameter to pass freely through the diaphragm-retaining ring 21 and to bear upon the diaphragm 20 by means of its end face 24 which is formed to a spherical curvature to correspond with that of the ball 17. At the outer end the element 19 is

formed with a cylindrical part or extension 25 of a diameter to fit slidably in the closing ring or plate 4 of the casing 1 and of a length to extend outwardly to serve as a knob or handle by which the operating element 19 may be manipulated. A sealing washer or packing ring 26 of a plastic material or other material for the purpose is recessed into a peripheral channel at a position to bear upon the inner surface of the bore of the closing ring or plate 4. The operating element 19 is thus adapted to press the ball 17 into engagement with the terminal contacts 14, 15 through the medium of the diaphragm 20. The positions of the operating element 19 may be determined by the engagement of a spring ball catch 27 set radially in the wall of the casing 1 with any one of a number of circular recesses 28 formed in the bottom of a groove or channel 29 in the peripheral surface of the body 22 of the element and set at a small angle to a plane transverse to the axis. The engagement of the ball catch 27 in the groove or channel 29 constrains the possible movement of the element to a limited movement of rotation that is accompanied by a slight axial movement to move the ball 17 into, or to permit it to move out of, contact with the terminal contacts 14 and 15, the recesses determining the required positions.

The switch may be mounted upon the lamp or other article to which it is applied as may be required by the construction of the lamp and the electrical connections may be made to the terminal contacts in any conventional manner, such as by soldering, by the use of clamping screws or by other means.

The switch hereinbefore described may be adapted to control two or more circuits in a simple manner as indicated, for example in broken lines in Figure 1, by the provision of a strip contact 30 extending longitudinally along the bore 16, of the casing from one of the terminal contacts 14, 15 and disposed so as always to be in contact with the ball 17 throughout its axial movement and an additional terminal contact 31 with which the ball 17 may come into contact when retracted from the two terminal contacts 14, 15, to a determined extent under the force of the spring-pressed plunger 9. The strip contact 30 may be a spring contact.

It is not essential that the body of the casing should be formed in three parts of differing diameters. The outer shape of the casing 1 may be adapted to the article with which the switch is to be used.

In a construction of switch adapted for the control of two circuits alternatively, as illustrated in Figure 5 of the accompanying drawings, the body of the housing or casing is a cylinder 32 of ebonite or other non-conducting material, such as a plastic material, that is moulded or otherwise formed with a closed end 33 and a cylindrical bore 34 that may have the inner closed end 35 centrally recessed at 36 to form a seating for a helical spring 37 to act upon the plunger 38 and increased in diameter at 39, towards the outer end to form a shoulder 40 upon which may be seated the flexible diaphragm 41. At a position at the inner side of the shoulder but not far removed the housing or casing is prepared to receive at one side a common terminal plug contact 42 and in opposed positions but spaced apart the complementary pin contacts 43, 44, that protrude into the bore 34 of the housing or casing and have their inner ends bevelled or otherwise shaped effectively to contact the ball 45. The contacts 42, 43 and 44 and the ball 45 are advantageously of silver but may be of other conducting metal or alloy. The ball is a clearance fit in the bore 34 and while remaining always in contact with the common terminal contact 42 is pressed always in the direction of the outer pin contact 43 by the plunger 38 under the action of the spring 37. The plunger 38 may be of a material such as that of the housing or casing. It has the outer part reduced in diameter to clear the inner pin contact 44 and the outer end 46 advantageously of concave curvature to fit the ball.

The operating element is in two parts, the outer of which is a cylindrical body 47 that protrudes axially through a retaining ring 48 to a degree determined by a shoulder 49 formed by an increase in diameter of the body 49, which shoulder is received in a corresponding annular recess at the inner side of the retaining ring 48. The protruding part of the cylindrical body 49 serves by its rotation by hand to effect the operation of the switch. For this purpose the inner end face 50 of the cylindrical body is inclined to the axis and is set in contact with a similar and complementary end face 51 formed on the second part of the operating element which is a cylinder 52 of a length sufficient to permit the formation of the inclined end face 51 and which has an axial stem 53 by which it may move the ball through the diaphragm 41. The second part 52 of the operating element is constrained for movement only in the axial direction by the provision in the wall of the housing or casing of a guide pin 54 that engages in a longitudinal channel or groove 55 in the periphery of the cylinder 52. The retaining ring 48 has the inner face recessed and internally screw-threaded at 56 to engage a screw thread formed on the periphery of the housing or casing 32 at the outer end. The ring 48 is thus effective to retain the parts of the operating element in the relative positions to permit them to function.

The diaphragm 41, of rubber or a synthetic material, is advantageously provided as a relatively thick annulus of an inner diameter slightly greater than that of the stem 53 of the second part 52 of the operating element and with an axial pocket-like part 57 of relatively thin walls into which the said stem 53 extends and through which pressure is applied to the ball 45. The diaphragm 41 is maintained in position on the shoulder 40 of the bore 39 of the housing or casing 32 by a locking ring 58 fitting the said bore.

In the operation of the switch the rotation of the outer or first part 47 of the operating element relatively to the second part 52 impels the latter to move axially to press the ball 45, against the force exerted by the spring-pressed plunger 38, into contact with the inner pin contact 44 and thus establish a circuit through the said contact and the common terminal contact 42. On further rotation of the first part of the operating element in the same direction or in the reverse direction, the plunger 38 is permitted to force the ball 45 out of contact with the inner pin contact 44 and thus break the circuit. Further rotation permits the ball to be forced by the plunger 38 into contact with the outer pin contact 43 for the closure of the second circuit.

The parts of the operating element and the retaining ring may be of the materials hereinbefore mentioned or of other materials adapted for the purpose. The retaining ring 48 may be peripherally screw-threaded to serve also as means for mounting the switch.

By predetermining the distance between the contacts **43**, **44** and the angle of the inclined end faces **50**, **51** of the operating element the switch may be adapted as a micro-switch, the travel of the ball **45** being reduced as required for example to 20 thousandths of an inch.

The switch according to the invention may be used with advantage particularly for marine equipments and in all situations where the content of moisture in the air is high.

I claim:

1. An electric switch comprising an insulating casing having one end open and the other end closed by an integral wall, said casing further having at least three internal bores of different diameters, the smallest bore being at the closed end and the largest bore being at the open end with an intermediate bore therebetween, a shoulder formed on the intermediate bore by the largest bore, a flexible diaphragm held against said shoulder to provide a seal between said largest and intermediate bores, terminal contacts extending through the wall of the casing into the intermediate bore, a circuit-closing element movable lengthwise of the intermediate bore for engagement with said contacts, a plunger in slidable engagement with the wall of one of said bores, a spring holding said plunger in engagement with the circuit-closing element to urge the latter toward said diaphragm, and an operating element fitting within the largest bore and being rotatably adjustable therein for movements axially of the bore to press the diaphragm into engagement with the circuit-closing element for selectively maintaining the latter in circuit-opening or circuit-closing position.

2. An electric switch according to claim 1, in which the possible movement of the operating element in the casing is determined by a guide channel or groove.

3. An electric switch according to claim 2, in which the operative and inoperative positions of the operating element are determined by spaced recesses and cooperating stop devices.

4. An electric switch according to claim 1, in which the operating element is comprised of more than one part and the parts are relatively movable on the rotation of one part to effect an axial movement of a second part for the purpose of moving the circuit-closing element.

5. An electric switch according to claim 4, in which the relatively movable parts of the operating element are provided with co-operating cam surfaces.

JOHN PETER CORNISH.

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