Oct. 18, 1955 H. C. FILBERT, JR 2,721,240

EXPLOSIVE PRESSURE OPERATED SWITCH

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FIG. 1.

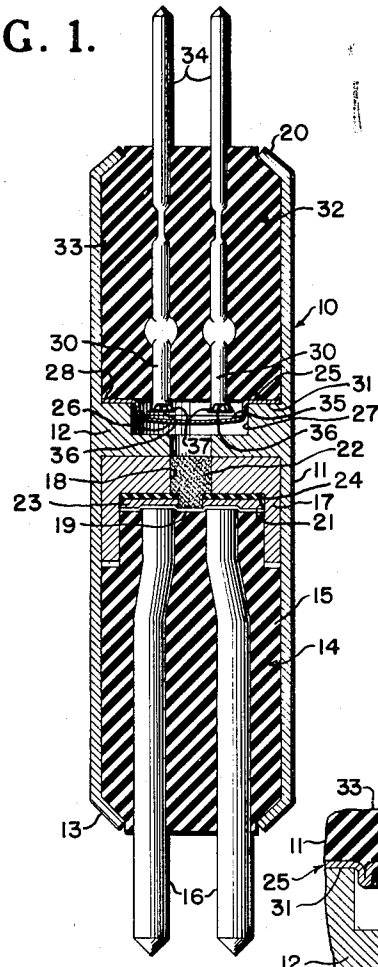


FIG. 2.

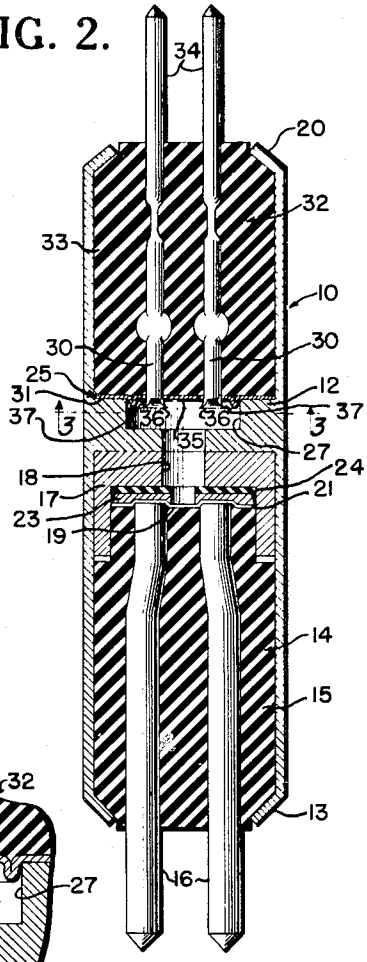


FIG. 5.

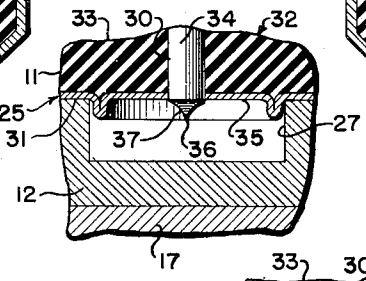


FIG. 3.

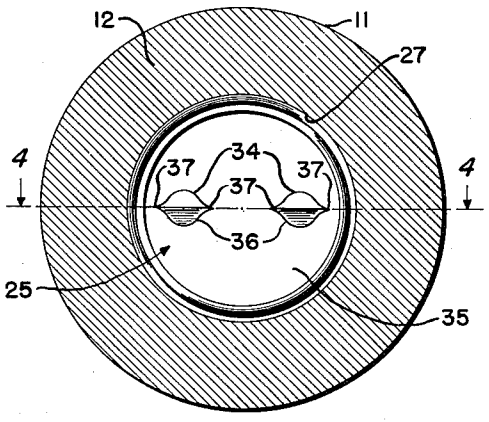
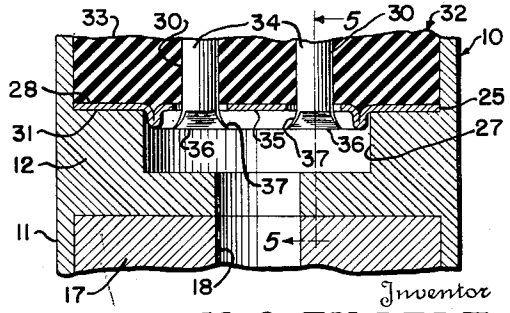


FIG. 4.



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EXPLOSIVE PRESSURE OPERATED SWITCH

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11 Claims. (Cl. 200—83)

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

This invention relates to a switch and more particularly to an explosive pressure operated switch for use in closing an electrical circuit as the switch is operated. The present invention provides a new and improved normally open switch in which means are employed for operating the switch to a closed position and locking the switch irrevocably in response to pressure within a sealed chamber arranged within the switch casing, the pressure being generated by detonation of a squib or minute explosive charge in response to an electrical firing signal of low value applied to an electroresponsive igniter element associated therewith.

Explosive operated switches heretofore devised when used in an ordnance missile have not proved to be altogether satisfactory under all conditions of service for the reason that such devices failed to withstand the severe shock to which they were subjected particularly when the missile was fired from a launching rack or gun, as the case may be, and also for the reason that such devices require an electrical impulse of a high degree of strength to cause the switch device to operate.

In the device of the present invention the aforesaid difficulties have been overcome by providing a shockproof switch constructed and arranged to withstand a sudden and severe shock without damage thereto and in which means are provided for operating the switch in response to an electrical impulse of low degree of strength and in which the switch remains locked in an operated position regardless of shock subsequently received thereby.

One of the objects of the present invention is the provision of a new and improved switch having a low electrical energy detonator for operating and locking the switch in response to a weak electrical impulse.

Another object of the invention is the provision of a new and improved normally open electrical switch in which means are provided for closing the switch suddenly in response to an explosive pressure generated within the switch casing.

Another object of the invention is the provision of a new and improved device in which a minute explosive charge is employed for generating a sufficient amount of gas pressure to cause the switch to be actuated from a normally open position to a closed position as the charge is fired in response to an electrical impulse.

A further object of the invention is the provision of a new and improved shockproof switch having flexible means for completing an electrical circuit as the flexible means is forcibly and suddenly moved to an operated position in response to an explosive pressure applied thereto and in which the flexible means is employed to maintain the switch in a closed position after being operated regardless of subsequent shocks received thereby.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a central longitudinal sectional view of the switch of the present invention according to a preferred embodiment thereof and showing the switch in an initial open position;

Fig. 2 is a view of the switch similar to Fig. 1 and showing the switch in a closed position;

Fig. 3 is an enlarged cross sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary sectional view taken on the line 4—4 of Fig. 3; and,

Fig. 5 is a fragmentary sectional view taken substantially on the line 5—5 of Fig. 4.

Referring now to the drawing wherein like reference characters are employed to designate like parts throughout the several views and more particularly to Fig. 1, the numeral 10 generally indicates the explosive switch of the present invention. The switch comprises a casing 11 composed of any material suitable for the purpose such, for example, as brass or the like and having a partition 12 arranged therein and preferably formed therewith, the partition being disposed substantially midway between the ends of the casing. Secured within the casing and having one end in abutting engagement with the partition and the other end thereof clamped by a flange 13 formed on the casing 11 is an initiator generally indicated by the reference numeral 14.

The initiator comprises a plug 15 composed of phenolic material and having a pair of spaced contact prongs 16 molded therein, the prongs extending beyond one end of the plug 15, Figs. 1 and 2, thereby to establish an external electrical connection thereto. Secured to the other end of the plug in any suitable manner such, for example, as by a pressed fit therewith is an explosive cap 17, the cap being composed of aluminum or the like and having a bore 18 extending axially therethrough. Disposed within the bore 18 and surrounding a bridge portion 19 of an initiator wire 21 is a small quantity of explosive charge 22 suitable for the purpose such, for example, as lead azide or the like, Fig. 1. The initiator wire is of fine construction and secured to one end of the plug 15 and to the prongs 16 in any convenient manner as by spraying molten metal 23 thereon as disclosed and claimed in the copending application of Richard H. F. Stresau et al. for Method and Means for Producing a Low Energy Detonator, Serial No. 69,547, filed January 6, 1949. As shown most clearly on Figs. 1 and 2 the spray metal is insulated from the cap 17 by a disk 24 composed of any material suitable for the purpose such, for example, as Bakelite, the disc being arranged between the cap and spray metal. By the aforesaid arrangement the initiator wire is secured to the plug 15 and in electrical connection with the spaced prongs 16.

Arranged within the casing 11 is a diaphragm generally indicated by the reference character 25 and composed of any ductile metal suitable for the purpose such for example as gold, copper or the like. The diaphragm comprises a crown-shaped portion 26, Fig. 1, disposed within a recess 27 formed in the partition 12 and having a flange portion 28 arranged thereon. The flange 28 is disposed between a shoulder 31 formed on the partition 12 and a plug 32 arranged within the other end of the casing 11, the flange being clamped therebetween in any suitable manner but preferably by rolling or crimping the end of the casing in engagement with one end of the plug 32 as indicated at 20, Figs. 1 and 2.

The plug 32 comprises a body portion 33 composed of "polystyrene" or any other suitable insulating material and having a pair of spaced contact prongs or terminals 34 molded therein and extending therethrough. As shown on Fig. 1 one end of each terminal extends beyond the inner surface of the plug and into proximate relation with respect to the end wall 35 of the diaphragm 25,

the aforesaid end of each of the terminals being drawn to a point or sharpened as at **36** and having a pair of mutually opposed barbs **37** respectively formed thereon as more clearly shown on Figs. 3 and 4, the other end of each terminal extending beyond the outer surface of the plug **32** sufficiently to establish an external electrical connection thereto.

As shown more clearly on Figs. 3 and 4 the barbed and sharpened portions on each of the contact members **34** extend beyond the outer periphery of the cylindrical portions **30** thereof. By this arrangement it will be understood that when the end wall **35** is forcibly moved into engagement with the aforesaid barbed and sharpened end portions of the contact members in response to the pressure exerted thereon as the charge **22** is fired, a pair of elongated slits are formed therein by the barbed and sharpened portions of sufficient length to permit the crown portion of the diaphragm to be vented during movement thereof to a locked position. It will be understood, however, that as the end wall **35** of the diaphragm is forced beyond the aforesaid barbed and sharpened portions in response to the aforesaid pressure and into engagement with the inner surface of the plug **32**, the end wall is also forced into electrical engagement with the cylindrical portions **30** of the contact members and thus the contact members are bridged by the end wall, whereupon an electrical connection is established therebetween, and locked in a closed position by the diaphragm thereafter regardless of subsequent shocks received thereby.

From the foregoing it will be understood that the normally open switch of the present invention is constructed and arranged to be closed in response to a predetermined amount of gas pressure generated within the switch casing caused by the detonation of a squib or the like, the squib being operated in response to a relatively low amount of electrical energy supplied thereto from any suitable source such, for example, as from a charged condenser included within the circuit arrangement in which the switch is employed, whereupon the pressure developed within the sealed chamber arranged within the switch casing causes the ductile diaphragm to be forcibly moved into engagement with the pair of terminals **34** secured within plug **32**. When this occurs, the sharpened end **36** of each terminal **34** punctures a slot in the end wall **35** of the diaphragm as the diaphragm is moved suddenly and forcibly thereagainst in response to the aforesaid gas pressure, the pressure being sufficient to further move the end wall beyond the aforesaid pointed and barbed end portions of each terminal and into electrical contact with the cylindrical portion thereof and into engagement with the inner surface of the plug **32** in such a manner as to bridge the terminals thereby to close the switch. The diaphragm thereafter remains in continuous contact with the terminals **14** by reason of the ductile material of which the diaphragm is composed and the form which the diaphragm has assumed in response to the explosion force received thereby.

Whereas the invention has been described in detail with respect to an explosive operated switch particularly adapted for use in an ordnance missile, it will be understood that it may be employed, if desired, in similar devices and electrical circuit arrangements for closing an electrical circuit as the switch is operated and for maintaining the circuit closed regardless of subsequent shocks received by the switch.

Briefly stated in summary, the present invention contemplates the provision of a new and improved normally open switch for use in electrical circuit arrangements having a low energy squib therein and in which means including a ductile preformed diaphragm are provided for closing the switch in response to a predetermined amount of explosive pressure generated within the switch casing by the aforesaid squib as the squib is fired by the electrical impulse and in which the switch is irrevocably locked in a closed position by the diaphragm.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

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

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a normally open switch of the character disclosed, a casing, a plug secured within one end of said casing, an explosive squib in said plug for generating gas pressure within the casing when the squib is fired, means responsive to an electrical impulse for firing said squib, ductile means sealed within the casing and operated by said pressure as the squib is fired, prong means secured within said casing in proximate relation with respect to said ductile means for closing said switch as the ductile means is forcibly driven into engagement with said prong means by said pressure with sufficient force to pierce and lock the diaphragm on said prong means, and means including said plug for sealing said ductile means within the casing.

2. In a normally open switch of the character disclosed, a casing, a plug secured within one end of said casing, an explosive charge disposed within said plug for generating gas pressure within the casing when the charge is ignited, igniter means arranged within said plug and responsive to an electrical impulse for igniting said charge, a ductile diaphragm sealed within the casing and operated by said pressure as the charge is fired, prong means secured within said casing in proximate relation with respect to said diaphragm for closing said switch as the diaphragm is forcibly driven into locking engagement with the prong means by said pressure, and means including said plug for sealing said diaphragm within the casing.

3. In a normally open switch of the character disclosed, a casing, a plug secured within one end of said casing, an explosive charge disposed within said plug for generating gas pressure within the casing as the charge is ignited, an igniter arranged within said plug and responsive to an electrical impulse for igniting said charge, a pair of electrical terminals secured within the plug and connected to said igniter for establishing an external electrical connection to the igniter, a diaphragm sealed within the casing and operated by said pressure as the charge is ignited, a second plug secured within the other end of the casing in abutting engagement with the diaphragm for sealing the diaphragm within the casing and prong means secured to said second plug in proximate relation with respect to said diaphragm for closing said switch as the diaphragm is forcibly driven into engagement with the prong means by said pressure and locked thereto.

4. In a normally open switch of the character disclosed, a casing, a plug secured within one end of said casing, means on said casing and in engagement with said plug for securing the plug within the casing, an explosive charge disposed within said plug for generating gas pressure within the casing when the charge is ignited, an ignited arranged within said plug and responsive to an electrical impulse for igniting said charge, a pair of electrical terminals secured in mutual spaced relation within the plug and connected to said igniter for establishing an external electrical connection to the igniter, an electrical conducting diaphragm sealed within the casing and operated by said pressure as the charge is ignited for closing said switch, a second plug secured within the other end of the casing in abutting engagement with the peripheral portion of the diaphragm for sealing the diaphragm within the casing, and a pair of contact pronged elements secured to said second plug in proximate spaced rela-

tion with respect to the diaphragm and adapted to be engaged by the diaphragm as the diaphragm is actuated by said pressure for establishing an electrical connection therethrough.

5. A normally open switch of the character disclosed comprising a casing, a pair of plugs respectively secured within each end of said casing and forming a pressure chamber therebetween, an explosive charge disposed within one of said plugs for generating gas pressure within said chamber as the charge is ignited, means arranged within said one plug and responsive to an electrical impulse for igniting said charge, a diaphragm sealed within the chamber between said plugs, said diaphragm being composed of ductile electrical conducting material and having a central crown portion adapted to be actuated by said pressure, means on said casing and including the other one of said plugs for sealing said diaphragm to the casing and within the chamber, and means including a pair of contact elements secured within said other one of the plugs in initial proximate spaced relation to said crown portion for closing the switch as the diaphragm is moved into engagement therewith in response to said pressure.

6. A normally open switch of the character disclosed comprising a casing, a pair of plugs respectively secured within each of the ends of said casing and forming a pressure chamber therebetween, an explosive squib disposed within one of said plugs for generating gas pressure within said chamber as the squib is ignited, an igniter arranged within said one plug and responsive to an electrical impulse for igniting said squib, an electrically conducting diaphragm sealed within the chamber between said plugs and constructed and arranged to be moved by said pressure, a partition within the casing, means including said partition and the other one of said plugs for sealing the diaphragm within the chamber, and a pair of terminals secured within said other one of the plugs and adapted to be engaged by said diaphragm thereby to close the switch as the diaphragm is forcibly moved into engagement therewith in response to said pressure.

7. A normally open explosive actuated switch of the character disclosed comprising a casing, a pair of plugs respectively secured within each of the ends of said casing and forming a pressure chamber therebetween, an explosive squib disposed within one of said plugs for generating gas pressure within said chamber as the squib is ignited, an igniter arranged within said one plug and responsive to an electrical impulse for igniting said squib, contact members secured within said other one of the plugs, each of said members including a cylindrical portion and a sharpened end portion, an electrically conducting diaphragm sealed within the chamber between said plugs and constructed and arranged to be moved by said pressure from an initial position in proximate spaced relation with respect to the sharpened end portions of the contact members to an operated position in abutting engagement with the other one of said plugs, a partition within the casing, and means including said partition and the other one of said plugs for sealing the diaphragm within the chamber in communication with the squib whereby the diaphragm is punctured by said sharpened end portions of the contact members and forcibly driven on said cylindrical portion thereof as the diaphragm is moved to said operated position.

8. A normally open explosive actuated switch of the character disclosed comprising a casing, a pair of plugs respectively secured within each of the ends of said casing and forming a pressure chamber therebetween, a partition disposed within said casing and having a bore extending therethrough in communication with said chamber, an explosive charge disposed within one of said plugs in communication with said bore for generating gas pressure within the chamber as the charge is ignited, an igniter arranged within said one plug and responsive to an electrical impulse for igniting said charge, contact members secured within said other one of the plugs, each of said members including a cylindrical portion and a knife edge portion, a diaphragm composed of ductile electrical conducting material and including a flat annular portion clamped between said partition and said other one of the plugs and a centrally disposed extruded crown portion arranged within said chamber, said crown portion being adapted to be moved by said pressure from an initial position in proximate spaced relation with respect to the knife edge portions to an operated position in abutting engagement with the other one of said plugs whereby the crown portion is punctured by said knife edge portions of the contact members and forcibly driven on said cylindrical portions thereof as the crown portion is moved to said operated position.

9. In a normally open switch of the character disclosed, a casing, an explosive charge disposed within said casing for generating gas pressure within the casing as the charge is fired, means for firing said charge, a diaphragm composed of electrical conducting material arranged within said casing and operated by said pressure, and prong means composed of electrical conducting material disposed within the casing in proximate relation with respect to said diaphragm for establishing an electrical connection therebetween as the diaphragm is forcibly driven into locking engagement with the prong means by said pressure thereby to close the switch.

10. In a normally open switch of the character disclosed, a casing, a plug secured within one end of said casing, an explosive charge disposed within said plug for generating gas pressure within the casing as the charge is fired, means responsive to an electrical impulse for firing said charge, terminal means molded in said plug and connected to said firing means for establishing an external electrical connection thereto, a diaphragm composed of conductive material disposed within said casing and operated by said pressure, a second plug secured within the other end of the casing for sealing the diaphragm therein, and contact means molded in said casing and having a tine formed on one end thereof in proximate relation with said diaphragm for establishing an electrical connection therebetween as the diaphragm is forcibly driven into locking engagement with the tine by said pressure thereby to close the switch.

11. A circuit controlling device comprising a casing, an electrical conducting diaphragm disposed within said casing for movement from an initial position to a moved position by pressure generated within the casing, and contact means having prong elements thereon for locking said diaphragm and establishing an electrical connection therebetween as the diaphragm is forcibly moved from said initial position to said moved position by said pressure.

References Cited in the file of this patent

UNITED STATES PATENTS

1,461,268	De Laney et al.	July 10, 1923
1,620,062	Bosshart	Mar. 8, 1927
2,164,821	Katcher	July 4, 1939
2,400,103	Bobb	May 14, 1946