

Dec. 10, 1957

R. G. DAUDELIN

2,816,196

DETONATOR ELECTRICAL SWITCH

Filed May 4, 1951

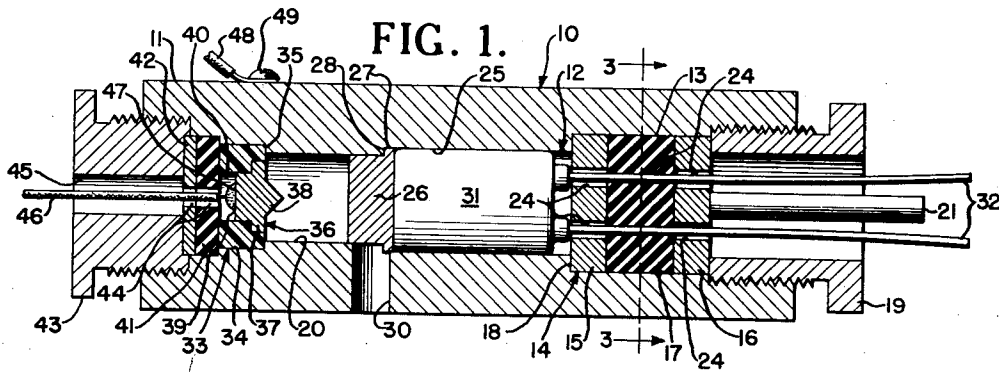
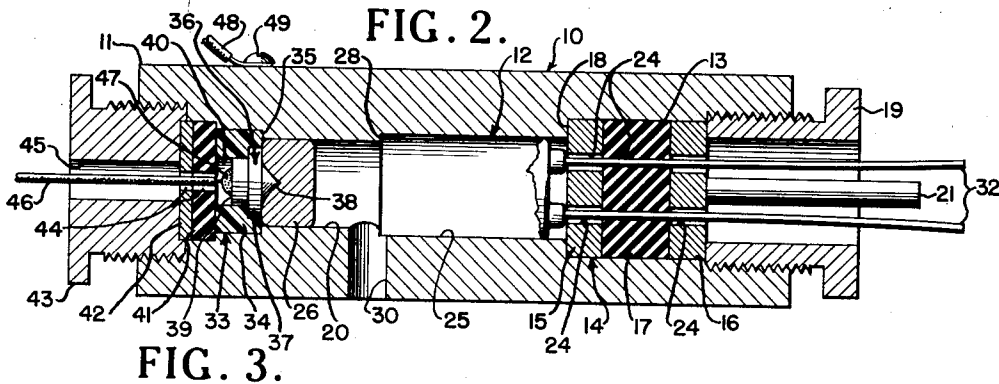
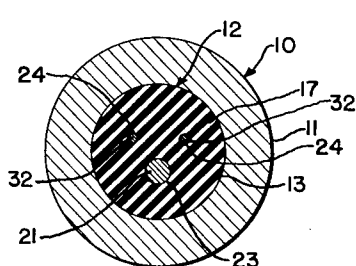
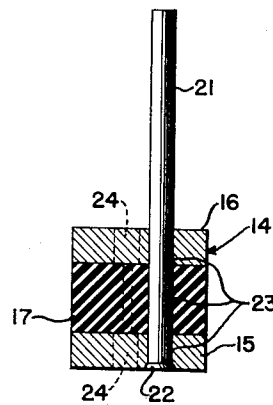


FIG. 5.



INVENTOR.
R. G. DAUDELIN
BY *G. D. Brown*
R. M. Hicks

ATTYS.

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2,816,196

DETONATOR ELECTRICAL SWITCH

Roland G. Daudelin, Silver Spring, Md., assignor to the United States of America as represented by the Secretary of the Navy

Application May 4, 1951, Serial No. 224,631

6 Claims. (Cl. 200—142)

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

This invention relates to a switch and more particularly to an explosive pressure operated detonator 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 in response to pressure within a normally sealed chamber arranged within the switch casing, the pressure being generated as the explosive charge arranged within the detonator casing is detonated in response to an electrical firing signal of low value applied to an electroresponsive igniter element arranged within the casing and embedded in the aforesaid charge.

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 fail to withstand the severe shock to which the missiles are subjected particularly when the missiles are fired from a submarine or a launching rack, as the case may be, and also for the reason that such prior art 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 switch constructed and arranged to withstand a sudden and severe shock without damage thereto and to the component parts thereof 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 movable element for completing an electrical circuit through the switch is forcibly driven into a locked position and 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 explosive switch having a low electrical energy detonator for operating the switch to locked position in response to an electrical impulse.

Another object of the invention is the provision of a new and improved normally open electrical switch in which a soft copper slug is provided for closing the switch suddenly in response to an explosion pressure generated within a normally sealed switch casing.

Another object of the invention is the provision of a new and improved switch device in which a minute explosive charge is employed for generating a sufficient amount of gas pressure within a normally sealed casing to cause the switch to be actuated from a normally open position to a closed position as the charge is fired, and in which means are provided for venting the casing as the switch is closed.

A further object of the invention is the provision of a new and improved shockproof switch having a soft copper slug for completing an electrical circuit as the slug is forcibly and suddenly driven to an operated position and into a restricted bore arranged within the switch casing in response to an explosive pressure applied thereto where-

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upon the slug becomes fixed within the bore and maintains the switch in a closed position.

A still further object of the invention is the provision of a new and improved switch having a normally sealed casing in which means are provided for closing the switch suddenly and permanently in response to an explosive pressure generated within the switch casing and in which means are provided for relieving the pressure as the switch is actuated to a closed position.

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 drawing wherein:

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

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

Fig. 3 is an enlarged cross sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a perspective view of the plug assembly; and Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4.

Referring to the drawings 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 preferably composed of any suitable nonmagnetic material suitable for the purpose such, for example, as stainless steel or the like and having a bore generally indicated by the numeral 12 extending therethrough.

Disposed within an enlarged portion 13 of the bore 12 is a plug assembly generally indicated by the numeral 14 and comprising a pair of washers 15 and 16 composed of brass and having arranged therebetween a gasket 17 composed of rubber or the like, the gasket being in sealing engagement with the wall defining the portion 13 of the bore 12. As more clearly shown on Figs. 1 and 2 the washer 15 is arranged in abutting engagement with a shoulder 18 formed on the casing, the washer 16 being in abutting engagement with an annular nut 19 secured to the casing as by threaded engagement therewith. By this arrangement it will be understood, that when the nut 19 has been threaded into the casing sufficiently to engage and move the washer 16, the rubber or resilient gasket 17 is compressed between the washer 15 and 16 whereupon the gasket is forced into sealing engagement with the portion 13 of the bore 12. The washers 15—16 and the gasket 17 comprising the plug assembly 14 are secured together by a rod or shaft 21 secured to the washer 15 as at 22 and extending through complementary openings 23 formed in the gasket 17 and washer 16, the rod 21 extending beyond the outer surface of the nut 19 to facilitate assembly and disassembly of the switch. As more clearly shown on Figs. 4 and 5, the washers 15—16 and the gasket 17 are provided with complementary bores 24, the purpose of which will become more clearly apparent as the description proceeds.

Disposed within the portion 25 of the bore 12 is a soft copper slug 26 comprising a flange 27 in abutting engagement with a shoulder 28 formed on the casing and having a body portion 29 of reduced diameter with respect to the flange 27 and arranged within a restricted portion 20 of bore 12.

Arranged within the portion 25 of the bore and disposed between the slug 26 and the washer or disc 15 is an electroresponsive detonator 31 having a pair of spaced electrical terminals 32 secured thereto and extending through the aforesaid spaced openings 24 formed in the washers 15 and 16 and beyond the outer extremities of the nut 19, Figs.

1 and 2, thereby to establish an external electrical connection to the detonator.

As more clearly shown on Figs. 1 and 2, the casing 11 is provided with a normally sealed vent 30, the port being sealed by the slug 26 and adapted to be unsealed when the plug is forcibly driven therefrom and into the portion 20 of the bore in response to the force of the explosion as the detonator 31 is fired in response to an electrical impulse received thereby.

A contact assembly generally indicated by the reference character 33 is disposed within the portion 20 of the bore 12 in spaced relation with respect to the slug 26 and comprises a disc 34 in abutting engagement with a shoulder 35 formed on the casing and composed of any material suitable for the purpose such, for example as phenolic material. A contact element 36 composed of steel or the like is embedded in the disc 34 and comprises a flange 37 having a spear or sharp-pointed member 38 formed thereon and extending therefrom and a crown portion 39 disposed within a bore 40 formed in the disc 34.

A gasket 41 is arranged in engagement with the disc 34 and casing 11, the gasket having a washer 42 composed of brass or the like disposed thereon. By this arrangement the gasket is forced into sealing engagement with the disc 34 and casing 11 as the nut 43 is threaded into the casing sufficiently to move the washer 42 and compress the gasket 41. As more clearly shown on Figs. 1 and 2, the gasket 41 and washer 42 are provided with complementary openings 44 in registration with a bore 45 formed in the nut 43 through which a conductor 46 extends, the conductor being soldered to the contact element 36 as at 47 thereby to establish an external electrical circuit thereto, the circuit being completed by way of conductor 48 secured to the casing as by a screw at 49 and thence by way of slug 26 and contact element 36 when the switch has been actuated.

By the aforesaid sealing arrangement it will be understood that the detonator is sealed within the bore 12 in abutting engagement with the soft copper slug 26 and thus when the detonator 31 is fired in response to an electrical impulse the full force of the explosion is directed against the slug 26.

When this occurs, the slug is forcibly driven completely into engagement with the wall defining the restricted portion 20 of the bore 12 and impaled on the spear 38, Fig. 2, whereupon an electrical circuit is completed through the switch by way of conductor 46, contact element 36, slug 26, casing 11, screw 49 and thence to conductor 48.

From the foregoing it will be apparent 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 as the detonator is fired, the detonator 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, or the like, included within the circuit arrangement in which the switch is employed, whereupon the pressure developed within the sealed casing causes the ductile slug to be forcibly moved into engagement with the contact element 36 and the casing 11 and concurrently therewith the pressure within the casing is vented by way of port 30. When this occurs and the switch is closed, and an electrical circuit is completed therethrough, the slug thereafter remains in continuous contact with the element 36 and the casing 11 by reason of the ductile material of which the slug 26 is composed and the form which the slug has assumed in response to the explosive 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 device, 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 main-

taining 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 and having a normally sealed casing adapted to be unsealed as the switch is closed, and in which means including a ductile preformed slug are provided for closing the switch in response to a predetermined amount of explosive pressure generated within the switch casing as the low energy detonator therein is fired by an electrical impulse and in which the switch is irrevocably locked in a closed position by the slug as the slug is forcibly driven into a restricted bore formed in the casing and impaled upon a sharp-pointed contact member.

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 normally sealed casing having a vent therein, a detonator arranged within said casing and adapted to be fired in response to an electrical impulse for generating gas pressure therein when said detonator is fired, a contact element and ductile contact closure means initially sealing said vent and having a shearable portion thereon for engagement with said casing and adapted to be sheared at said portion for movement of said means into a permanent closed contacting relationship with said contact when operated by said gas pressure as the detonator is fired for closing said switch by deforming said ductile means into closed circuit relationship with said contact and unsealing said vent thereby to relieve the pressure therein.

2. In a normally open switch of the character disclosed, a normally sealed casing having a bore therein and a port arranged transverse to said bore, an electro-responsive detonator arranged within said casing and adapted to be fired in response to an electrical impulse for generating gas pressure therein when said detonator is fired, ductile means having a deformable portion arranged within the casing, said means being in sealing engagement with said port and movable along said bore in response to said pressure as the detonator is fired for deforming said portion and thereafter permanently closing said switch by additional deformation of said ductile means and contemporaneously therewith unsealing said port thereby to relieve the pressure from the casing, and means including a pair of resilient members disposed at opposite end portions of said bore for sealing said casing.

3. In a normally open switch of the character disclosed, a casing, an electroresponsive detonator sealed within the casing and adapted to be fired in response to an electrical impulse received thereby for generating gas pressure therein when the detonator is fired, means including a pair of nuts respectively secured to the ends of the casing for sealing the detonator therein, a pair of electrical terminals secured in mutual spaced relation within the detonator and extending exteriorly of the casing for establishing an external electrical connection to the detonator, a normally sealed port in said casing for relieving the pressure within the casing as said port is unsealed, an electrical conducting slug supported within the casing in substantially abutting engagement with said detonator and sealing engagement with said port and operated as the detonator is fired for closing said switch and unsealing said port, a contact element secured in one end of said casing by one of said nuts in proximate spaced rela-

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tion with respect to said slug and insulated from said casing for establishing an electrical connection therethrough as the slug is forcibly driven into engagement with said element and casing by said pressure.

4. A normally open switch of the character disclosed comprising a casing, a pair of sealing elements respectively arranged within the ends of said casing in sealing engagement therewith and forming a pressure chamber therebetween, means threadably secured respectively to one end of the casing in engagement with said sealing means respectively for maintaining the sealing elements in sealing engagement with said casing, an electroresponsive detonator sealed within said chamber and adapted to be fired in response to an electrical impulse received thereby for generating gas pressure therein, a pair of electrical terminals secured to said detonator in sealing engagement with one of said sealing elements and extending therethrough for establishing an external electrical connection to said detonator, a normally sealed port in said casing in communication with said chamber for relieving said pressure therein as the detonator is fired, an electrical conducting slug supported within said chamber in sealing engagement with said port and operated by said pressure for closing said switch and unsealing said port, flange means on said slug, complementary means within said chamber and adapted to coact with said flange means for supporting said slug within the chamber in sealing engagement with said port, a contact element secured within the casing by the other one of said sealing elements and insulated from said casing for establishing an electrical connection therethrough as the slug is forcibly driven into electrical engagement with said contact element and the casing by said pressure, and conductor means secured to said casing for completing an electrical connection through the switch when said slug has been driven into engagement with said contact element and casing.

5. In a normally open switch of the character disclosed, a casing, a pair of elements respectively arranged within the ends of the casing in sealing engagement therewith and forming a pressure chamber therebetween, a pair of nuts threadably secured to the ends of said casing in engagement with said sealing elements respectively for maintaining the elements in sealing engagement with said casing, an electroresponsive detonator sealed within said chamber and adapted to be fired in response to an electrical impulse received thereby for generating gas pressure therein, a pair of electrical terminals secured to said detonator in sealing engagement with one of said sealing elements and extending therethrough for establishing an external connection to said detonator, a normally sealed

port in said casing in communication with said chamber for relieving said pressure therein when the detonator is fired, an electrical conducting slug supported within said chamber in sealing engagement with said port and operated by said pressure for closing said switch and unsealing said port, flange means on said slug in engagement with said detonator, complementary means on said casing and within said chamber and adapted to coact with said flange means for supporting the slug within the chamber in sealing engagement with said port, a contact element arranged within said chamber and maintained therein by the other one of said sealing elements, means enclosing said contact element for electrically insulating the element from the casing, a sharpened portion on said contact element for establishing an electrical connection through said contact element as the slug is forcibly driven into engagement therewith and with the casing by said pressure, conductor means extending exteriorly of the casing and secured to said contact element for establishing an external electrical connection thereto, and means secured to said casing for completing an electrical connection through the switch when said slug has been driven into engagement with said sharpened portion and casing.

6. In a switch of the character disclosed, the combination of a sealed conductor casing having a bore therein, said bore having a reduced end portion forming a shoulder in said casing, a ductile conductor slug having a main body portion disposed within said reduced bore portion in close fitting relation therewithin and a flange portion disposed within the other portion of said bore and in engagement with said shoulder, a contact supported within said reduced bore portion normally in spaced relation to said slug and electrically insulated from the casing, a detonator disposed within said other portion of the bore and having sufficient explosive force when fired to move said slug forcibly into electrical engagement with said contact and casing thereby to complete an electrical connection therebetween, and a venting port in said casing normally sealed by said slug and adapted to be unsealed thereby when the slug is moved.

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