April 5, 1960 A. B. LEAMAN 2,931,874

EXPLOSIVE SWITCH

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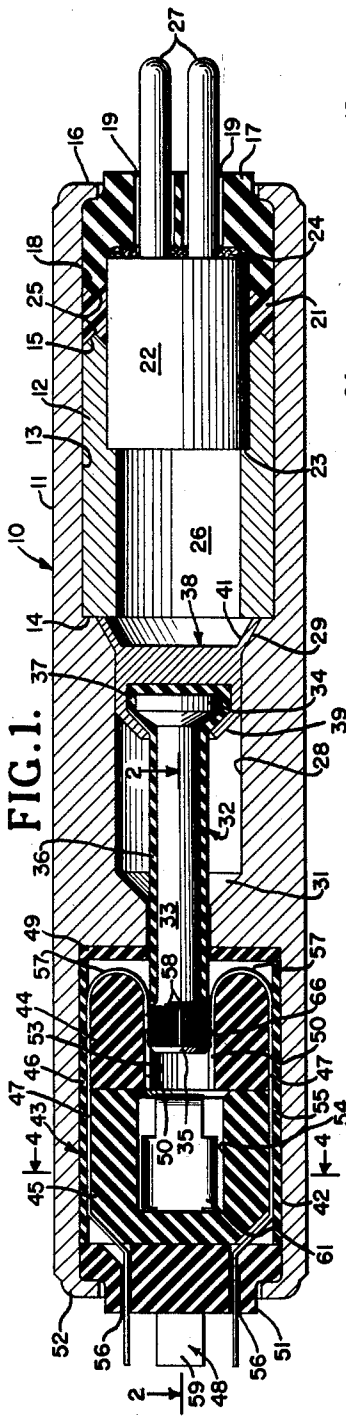

FIG. 1.

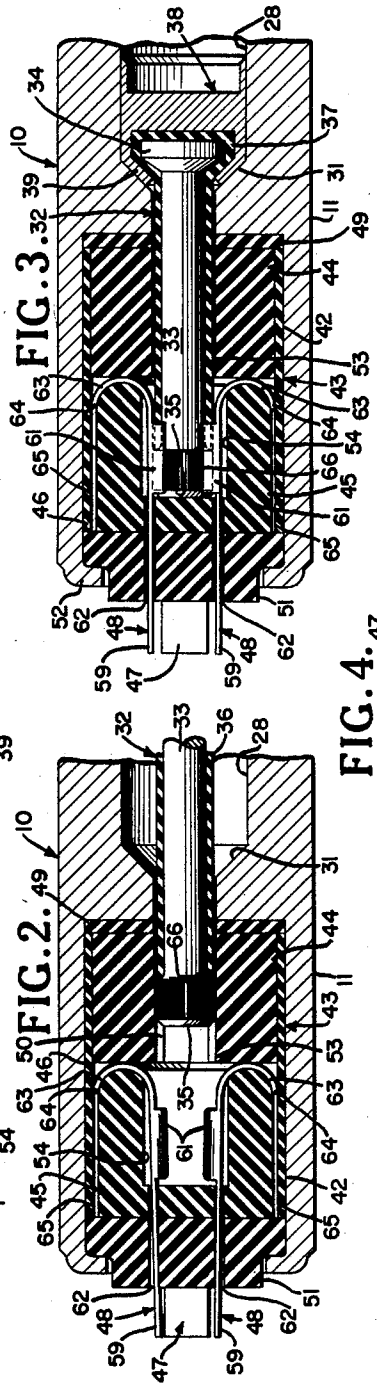

FIG. 3.

FIG. 2.

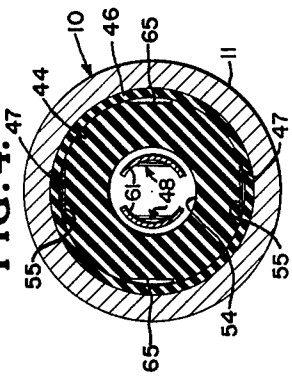

FIG. 4.

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EXPLOSIVE SWITCH

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3 Claims. (Cl. 200—142)

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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.

The present invention relates to a switch and more particularly to a new and improved explosive operated switch for interrupting an initially closed circuit and for closing an initially open circuit as the switch is operated in response to an explosive pressure generated therein.

Explosive operated switches heretofore employed, particularly in ordnance missiles, have not proven to be entirely satisfactory under all conditions of service for the reason that such devices failed to withstand the severe shocks to which they were subjected, particularly during transportation, launching and firing as the case may be and also for the reason that such devices required an electrical firing impulse of a relatively high degree to cause the switch to operate and oftentimes as the explosive charge within the switch casing is fired, the pressure developed therefrom would cause the casing to be shattered and thus causing switch failure.

In the device of the present invention the aforesaid difficulties have been overcome by providing a normally locked explosive switch constructed and arranged to withstand a sudden and severe shock without damage thereto and in which means are provided for operating the switch from an initial position to a moved position as the explosive charge therein is fired, the explosive pressure being sufficient to operate the switch, however, insufficient to damage the switch casing.

Furthermore, the invention contemplates the provision of a new and improved normally locked explosive switch wherein means responsive to an explosive force operates the switch from an initial position to a moved position whereupon an initially closed control circuit may be opened and an initially opened control circuit may be closed. While the device of the present invention is particularly adapted for use in an ordnance missile such, for example, as a rocket, bomb, submarine mine or depth charge, it may be advantageously used with any type of electrical apparatus for controlling a plurality of electrical circuits.

An object of the present invention is to provide a new and improved switch wherein means responsive to an explosive pressure generated within the switch casing operates the switch from an initial closed position to a moved closed position.

Another object of the invention is the provision of an explosive switch wherein a normally locked plunger actuated in response to an explosive pressure operates the switch to interrupt one control circuit and complete another control circuit.

A further object of the invention is the provision of an explosive switch wherein a pressure responsive element maintains one pair of switch contacts in an initial closed position and actuates a second pair of initial open contacts to a closed position as the pressure responsive

element is actuated in response to a predetermined pressure applied thereto.

A still further object of the invention is the provision of a new and improved switch wherein an electroresponsive detonator generates a sufficient amount of pressure to release and move a normally locked plunger from an initial position to a moved position as the detonator is fired in response to an electrical impulse.

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 explosive switch in accordance with the present invention with the component parts thereof in an initial position;

Fig. 2 is a fragmentary sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary sectional view similar to Fig. 2 with the switch actuating element in a moved position; and

Fig. 4 is a cross sectional view taken on the line 4—4 of Fig. 1.

Referring now to the drawing and more particularly to Fig. 1 thereof, the numeral **10** generally indicates the explosive switch of the present invention comprising a casing **11** composed of any material suitable for the purpose such, for an example, as brass or the like. A sleeve **12** composed preferably of brass is disposed within a bore or recess **13** formed in the casing **11**, having one end thereof in abutting engagement with a shoulder **14** arranged on the casing, the other end thereof terminating in an annular conical portion **15**.

Disposed within the recess **13** and maintained therein by a flange **16** formed by crimping the end portion of the casing **11** into abutting engagement therewith is a closure or cap **17**. The cap is composed of suitable plastic such, for example, as "nylon," and provided with an annular conical portion **18** similar to the portion **15** and a pair of mutually spaced openings or bores **19** formed therein. It will be noted in Fig. 1 that a sealing gasket **21** is disposed between the conical portions **15** and **18** and in sealing engagement with the casing and detonator.

An electroresponsive detonator **22** is arranged within the sleeve **12** and cap **17**, one end of the detonator being in engagement with a shoulder **23** formed in the sleeve and the other end thereof being in sealing engagement with a washer **24** composed of felt and disposed between the detonator and cap. It will be apparent, however, that as the detonator **22** and felt washer **24** are inserted into the recess **13** and the end of the casing crimped as shown, the felt washer is compressed into sealing engagement with the detonator and cap, the conical portions **15** and **18** on the sleeve and cap are moved into sealing engagement with the pair of V-shaped grooves **25** respectively, formed on the gasket **21**, whereupon the gasket is moved into sealing engagement with the detonator. Thus by this arrangement, a leakproof connection is maintained between the aforesaid elements thereby to prevent escape of gas pressure from explosion chamber **26** as the detonator is fired in response to an electrical impulse received thereby. The firing connection to the detonator is established by way of a pair of mutually spaced terminals **27** connected to the detonator in the conventional manner and extending through the openings **19** formed in the cap and terminating a predetermined distance therebeyond.

The bore **13** communicates with a bore **28** somewhat smaller in diameter than the bore **13**. A seat **29** is formed at one end of the bore **28** and a seat **31** is formed substantially at the other end thereof, Fig. 1.

An actuating plunger generally indicated by the reference character **32** is releasably locked within the bore **28** and comprises a shaft **33** composed of any material suitable for the purpose such, for example, as beryllium copper, the plunger being adapted to be released and operated slidably from an initial position to a moved position in response to a predetermined pressure applied thereto. The shaft **33** has formed on one end thereof a flared head **34**, the other end thereof having formed thereon a contact element **35**. As shown more clearly in Fig. 1, the shaft **33** and flared head is enclosed in a casing composed of any suitable insulating material comprising a tubular member **36** applied to the shaft **33** and a flared portion **37** applied to the head **34**, the aforesaid insulating casing being applied to the shaft and head in any conventional manner, preferably by a suitable molding operation.

It will be noted that the plunger **32**, Fig. 1, is locked in an initial position by a locking member generally indicated by the numeral **38** composed of suitable ductile material such, for example, as aluminum. The member **38** is secured to the flared portion **37** of the plunger by a flange **39** formed thereon and crimped into engagement with the flared portion. The element **38** is provided with a conical member **41**, Fig. 1, integral therewith in sealing engagement with the seat **29** and constructed and arranged to yield in response to a predetermined pressure applied thereto, the conical member being maintained in sealing engagement with the seat **29** by the aforesaid brass sleeve **12**. Furthermore, by the aforesaid conical member and seat arrangement the plunger **32** is normally locked to the casing in an initial position. While the angle of the conical element **41** is shown to be substantially 30°, it will be understood that this angle may be varied as desired to effect locking engagement between the element and the casing whereupon the element may be actuated by a greater or lesser pressure as the case may be.

Disposed within a well or recess **42** formed in the casing **11** is a contact assembly generally indicated by the reference character **43**. The assembly comprises a pair of supports **44—45** enclosed within a sleeve or casing **46** and a pair of normally closed contacts **47** mounted in support **45** and a pair of normally open contacts **48** mounted in the support **45**, the aforesaid support and sleeve being composed of any suitable insulating material such, for example, as "nylon." The contact assembly **43** is disposed between a washer **49** and a cap or closure **51** composed of suitable insulating material and maintained within the recess **42** by a flange **52** formed on the casing **11** and crimped into abutting engagement with the cap **51**. Furthermore, by the aforesaid cap, washer and sleeve arrangement the contacts **47** and **48** are adequately insulated from the casing **11**.

The support **44** is provided with a centrally disposed bore **53** extending therethrough in registration with a bore **54** formed in the support **45** thereby to permit the plunger **32** to be actuated from an initial position to a moved position, Fig. 3, as the detonator **22** is fired.

Each contact **47** is disposed within matching grooves **55** formed on the supports **44—45** with one end thereof extending through an opening **56** formed in the cap **51** and terminating beyond the cap. The other end of each contact **47** is provided with a bight portion **57** which terminates in a yieldable element **58** disposed within grooves **50** in engagement with the contact or bridging member **35**. Each contact **48** is provided with a yieldable member **59** disposed within the bore **54**, having a semicircular contact element **61** formed thereon, Fig. 4. One end of each yieldable member extends through an opening **62** formed in the cap **51**, the other end thereof being provided with a bight portion **63**, the terminal portions **64** thereof being disposed within a groove **65** formed in the support **45**, Fig. 3.

It will be noted in Fig. 1 that the contact member **35** is serrated as at **66**. Furthermore, the contact member **35** is composed of hard conductive material while the contacts **47** and **48** are composed of relatively soft or ductile conductive material. Thus by this arrangement, the serrations on member **35** will tend to bite into the soft material of contacts **47** and **48** in such a manner as to establish an exceptionally good electrical connection therebetween.

It will be noted in Fig. 1 that the plunger **32** is normally locked to the switch casing by the conical ductile member **41** disposed within and in sealing engagement with the seat **29** formed thereon whereupon an electrical connection is established through the contact member **35** and the contacts **47** and a control circuit is rendered effective until the detonator **22** is fired in response to a low order of electrical energy supplied thereto from a suitable source of power such, for example, as a charged condenser included in the control circuit. When the detonator is fired a sufficient amount of gas pressure is generated within the sealed chamber **26** and applied to the conical ductile member to cause release of the conical member from the seat **29** and forcibly move the plunger **32** a predetermined amount. When this occurs, the flange **39** on the ductile member **38** is forcibly driven into engagement with the seat **31** and the conical member thereon is forcibly driven into engagement with the wall defining the bore **28** with sufficient force to lock the plunger to the casing with the contact member **35** in engagement with contacts **48** of Fig. 3. Thus an electrical connection is established through the contact member **35** and the contacts **48** and a control circuit is rendered effective, however, the contacts **47** are now open whereupon the control circuit thereof is interrupted.

From the foregoing, it will be apparent that a new and improved normally locked explosive switch has been devised wherein means responsive to a predetermined pressure generated within a sealed chamber operates the switch from an initial position to a moved position whereupon an initially closed circuit may be open and an initially open circuit may be closed.

Whereas, the invention has been described in detail in connection with 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 electrical circuit arrangements for interrupting an initially closed circuit for closing an initially open circuit as the switch is operated from a normally locked position to a subsequent lock position.

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.

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

1. In a switch of the character disclosed, a sealed casing having a conical surface formed therein, a pair of normally closed contacts and a different pair of normally open contacts carried interiorly by said casing and insulated therefrom, movable means initially locked to said casing for opening said normally closed contacts and for closing said normally open contacts, an enlarged head on said movable means, a yieldable conical member secured to said head and in engagement with said conical surface for locking the movable means to the casing in an initial position until the yieldable member has been disengaged from said surface, said movable means being released and moved from said initial position to a final position in response to a predetermined explosive pressure generated within said casing sufficient to deform and disengage the conical member from said conical surface, and explosive means arranged within said casing and fired in response to an electrical impulse received thereby for generating said pressure within the casing.

2. In a switch of the character disclosed, a sealed cas-

ing having a conical surface formed therein, a pair of normally closed contacts carried interiorly by said casing, a different pair of normally open contacts carried interiorly by said casing in spaced relation with respect to said normally closed contacts, a plunger releasably locked within the casing and movable from an initial locked position to a final position when released, means on said plunger for maintaining the normally closed contacts closed only while the plunger is locked in said initial position and for closing said normally open contacts as the plunger is actuated to said final position, a yieldable conical member mounted on said plunger in sealing engagement with the said conical surface of the casing for releasably locking the plunger to the casing in said initial locked position until the conical member has yielded suddenly in response to a predetermined explosive pressure applied thereto sufficiently to be disengaged from said conical surface, and explosive means sealed within said casing and fired in response to an electrical impulse for applying said pressure to said conical member.

3. An explosive actuated switch comprising a sealed casing having a conical surface formed therein, a pair of normally closed contacts carried interiorly by said casing, a different pair of normally open contacts carried interiorly by the casing in spaced relation with respect to said normally closed contacts, means for supporting and insulating said contacts from the casing, a plunger slidably and releasably arranged within said casing and movable from an initial locked position to a final position when released, a yieldable conical head on said plunger normally in engagement with said conical surface for maintaining the plunger in said initial locked position until a predetermined explosive pressure has been applied thereto sufficient to disengage said conical head from said conical surface, an electroresponsive detonator fired in response to an electrical impulse for applying said pressure to said conical head, and means on the plunger and insulated from the casing for maintaining the normally closed contacts closed only while the plunger is in said initial locked position and for closing said normally open contacts as the plunger is actuated to said final position.

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