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SQUIB SWITCH

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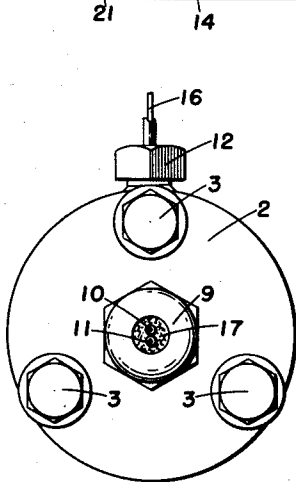
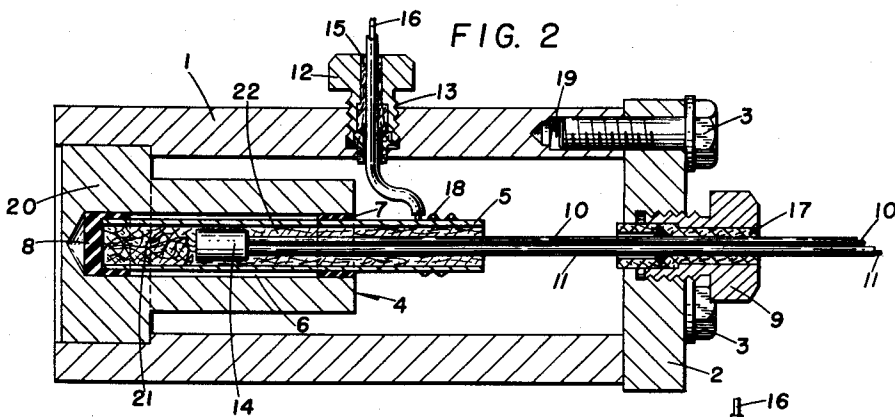
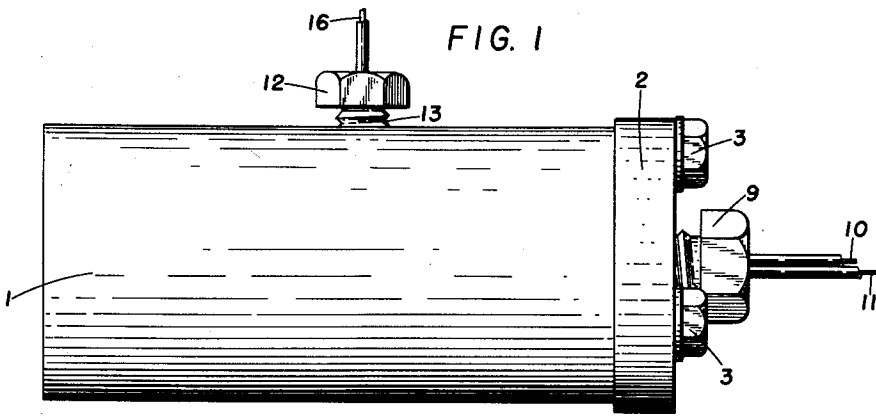


FIG. 4

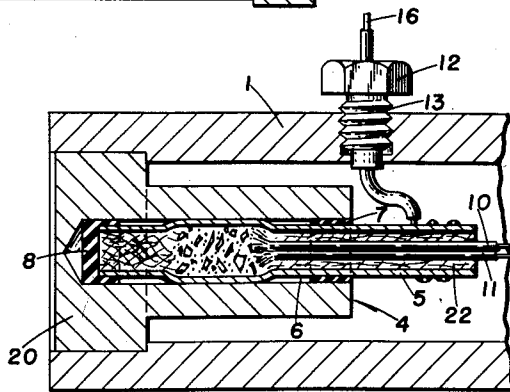


FIG. 3

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**SQUIB SWITCH**

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6 Claims. (Cl. 200—142)

The present invention relates broadly to an electrical circuit closer, and more particularly to a switch capable of carrying a relatively heavy current, of the order of ten amperes or more, for example, but which nevertheless may be closed by relatively weak impulses, such as radio signals with moderate amplification.

Heretofore devices for closing circuits that carry relatively heavy currents, by remote control and/or actuated by very small electrical impulses, have been complicated and expensive, and often not entirely reliable, because they usually included one or more sensitive relays that were correspondingly sensitive to mechanical shocks and easily deranged by handling. The present invention makes it possible to control even a very heavy electrical current by very simple means, completely free from delicate apparatus such as relays; by making use of an explosive charge to do the actual mechanical work involved in closing the switch, said explosive charge requiring only a relatively weak electrical impulse for its ignition.

An object of the present invention is therefore to provide a switch of this kind, wherein the actuation is accomplished by the explosion of a squib, which causes the switch members to move, relatively, into contact-making condition.

A specific object of the invention is to provide a switch which consists essentially of two conductors located near one another, together with an explosive charge means for detonating said charge. Explosion of the charge has the purpose of forcing a portion of one of the conductors into electrical contact with the other, by reason of the gas pressure thus produced. Preferably one of the conductors is hollow and encloses the explosive charge, whereby the explosion causes said hollow conductor to expand and in so doing to come into permanent contact with the other conductor, thus in effect closing a switch.

Another object is to provide a strong, sealed, water-tight enclosure for a switch of this type, to make it suitable for underwater use.

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

Fig. 1 is a side elevation of a switch unit, embodying the invention, and including a sealed case or housing;

Fig. 2 is a longitudinal axial section through said unit, showing the structure with the switch open;

Fig. 3 is a corresponding fragmentary sectional view, showing the switch in closed condition; and

Fig. 4 is an end view of the device.

Referring first to Figs. 1 and 4, the case or housing 1, which may be thick-walled and made of strong metal, such as steel, has a tightly fitting cover 2, held thereto in any desired way, for example by cap screws 3. Water-tightness may be assured by a suitable coating such as Glyptal varnish, applied to the abutting surfaces before the screws are tightened.

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A screw plug 9 is threaded into the said cover 2, and wires 10 and 11 enter the case 1 through said plug, which affords means for providing a tight seal around the wires by suitable packing, as shown at 17, Fig. 2, for example.

The case 1 constitutes one terminal of the switch, and a suitable connection may be made thereto in any desired way. The other terminal of the switch is the insulated wire 16 which enters the housing 1 through the screw plug 12, threaded as shown at 13, suitable packing 15, Fig. 2, being provided to make a proper seal.

Referring now to Fig. 2, it will be seen that the cap screws 3 enter threaded bores such as 19 in the cylindrical wall of case 1. The other end of this case 1 is closed water-tightly by a cylindrical member 4 having an enlarged end or flange 20, fitting into a corresponding bore in case 1, as shown. The parts 1 and 20 may be connected by a press-fit or by welding, or both, as may be necessary or desirable in any given instance.

As the entire unit may be intended for use submerged in sea water, appropriate coatings may be provided to prevent corrosion and/or to assure a water-tight and pressure-tight joint between head 2 and case 1, etc.

A metal tube 5, having a relatively thin wall, is located partly in the bore 6 of cylinder 4, but insulated therefrom by the ring 7 and the cap 8, which may be made of any desired insulating material, for example, rubber or other plastic.

Conductor 16 has its bare inner end 18 wound several times around the exposed end of tube 5 and electrically and mechanically secured thereto in any suitable way, as by welding or soldering.

A squib 14, also commonly known as an electric blasting cap, having lead-in wires 10 and 11 associated therewith, is mounted within the tube 5, and preferably about half-way between ring 7 and cap 8. A plug 21 of compacted cotton fibers or the like may be placed at the inner end of the tube 5 to locate the squib 14 correctly, and additional packing 22 may be forced around the wires 10 and 11 to keep them in place within the tube 5.

The operation is as follows: When a suitable firing impulse is introduced to the squib 14 through wires 10 and 11, said squib will explode, and in so doing will cause the tube 5 to expand until a considerable part of its outer surface is in intimate contact with the wall of the bore 6, somewhat as shown in Fig. 3, thus establishing a low-resistance electrical connection capable of carrying a heavy current.

Preferably tube 5 is of soft relatively inelastic metal, such as copper, and thin enough to expand readily. The outer cylinder 4 is relatively rigid, so that it will not expand appreciably when the squib is fired. The electrical result of the expansion of tube 5 is that wire 16 becomes "grounded" to cylinder 4, and thus in effect closes a switch. Where mechanical resistance to external disturbances or other influences is not important, for example, if the switch is to be used when surrounded by ordinary air, instead of when submerged in sea water, the protective case 1 may be omitted.

It is to be understood that it is immaterial from what source the squib is detonated. A direct connection to a suitable battery or generator may be used, or a relay or amplifier initially operated by a radio or light signal, or by a telegraphic wire signal may be used, the precise circuit constituting no part of the present invention.

It will be obvious that while the invention has been disclosed as dependent on the expansion of an inner tubular conductor by the squib, it is likewise possible to reverse the relationship of the rigid and yieldable elements, and to cause the squib explosion to contract the outer tube against the outside of an inner rigid conductor. Such construction, however, is mentioned only as a possibility, and except where unusual conditions make it de-

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sirable or essential, would not be utilized as it is more complicated than the preferred form already described in detail.

An important feature, however, regardless of its exact structure, is that a relatively feeble impulse, sufficient only to ignite the squib, will serve to close a circuit capable of heavy current flow, so that an electric motor or other apparatus may be started directly by said circuit. The present device thus lends itself readily to remote control of such apparatus.

The heavy case 1, when used, makes it possible to operate in great depths of sea water, and/or in the presence of high pressures resulting from explosions of weapons such as atomic bombs, depth charges, mines, etc.

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 practised otherwise than as specifically described.

What is claimed is:

1. A switch comprising an outer cylindrical conductor, an inner cylindrical conductor spaced therefrom, and an explosive device within the inner conductor, whereby said inner conductor will be inelastically deformed into electrical contact with the outer conductor when explosion of said device occurs.

2. A switch comprising two electrically conductive elements, one of which is substantially tubular and encloses a portion of the other but is out of electrical contact therewith, one of said elements being inelastically deformable to an extent sufficient to make permanent electrical contact with the other, and an explosive charge so located that the inelastically deformable element lies between it and the other element, whereby detonation of said charge will force a portion of said deformable element into permanent electrical contact with the other element.

3. A switch comprising two electrically conductive tubular elements, one of which is within a portion of the

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bore of the other, but out of electrical contact therewith, an explosive charge within the bore of the inner element, and means for igniting said charge, said elements being spaced apart a distance less than the permanent deformation of the inner element producible by the explosion of said charge.

4. A switch for under-water use, comprising a water-tight metal case, having a bore in a portion thereof, a tubular metallic element in said bore but out of electrical contact with the case, and an explosive charge within said element and of sufficient strength to force the outer surface of the tubular element into permanent contact with the inner wall of said bore upon detonation of the explosive charge.

5. A switch as defined in claim 4, wherein the explosive charge is an electrically ignitable squib.

6. A switch comprising two electrically conductive elements, one of which substantially encloses a portion of the other but is out of electrical contact therewith, one of said elements being inelastically deformable to an extent sufficient to make permanent electrical contact with the other, and an explosive charge so located that the inelastically deformable element lies between it and the other element, whereby detonation of said charge will force a portion of said deformable element into permanent electrical contact with the other element.

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