MULTIPLE CIRCUIT SWITCH

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Filed Mar. 26, 1957, Ser. No. 648,751

14 Claims. (Cl. 200—81.4)

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

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 pressure-operated switch having a movable shorting plate which moves in one direction in response to pressure to close a plurality of main circuits and position a shorting member, movement of the plate in the opposite direction, due to release of pressure, serving to break the main circuits and substantially simultaneously close a secondary circuit by engagement of a shorting member mounted on said plate and movable with the shorting plate, the shorting member being cammed to a cocked position by movement of the plate in said one direction and cammed to pass between said pair of contacts upon movement of the plate in the opposite direction.

In the operation of certain hydrostatic mechanisms, for example, underwater ordnance items, such as mines and the like, it has been found necessary to employ switches capable of simultaneously closing a plurality of circuits in response to hydrostatic pressure for arming the items and to provide means to break such circuits with decrease of hydrostatic pressure due to surfacing and substantially simultaneously to make and break a secondary circuit for the purpose of stabilizing or scuttling the mine in accordance with international convention. Formerly, these functions were accomplished by use of separate switch devices which resulted in switch means more complicated and bulky than desired and requiring a casing for the ordnance item of more complex design.

A switch in accordance with the present invention performs the desired functions by the provision of a compact arrangement operating in a novel and simple manner and comprises a plate movable in response to variations in pressure for closing certain circuits by movement of the plate in one direction and for breaking said circuits and making and breaking a secondary circuit with return of the plate to the starting or unoperated position of the switch.

It is therefore an object of the present invention to provide a single switch mechanism having movable parts capable of closing certain circuits by movement of said parts in one direction and breaking of said circuits and the making and breaking of an additional circuit with return of said movable parts.

Another object is the provision of a switch mechanism employing a resilient shorting pin for closing certain circuits and a shorting pin carried by a resilient element mounted on said plate and movable therewith for making and breaking an additional circuit.

A further object is to provide a switch mechanism having a movable plate carrying segmented metallic portions and a flat leaf spring member carrying a shorting pin.

The final object of the present invention is the provision of a switch mechanism comprising a movable segment and a shorting pin mounted on said plate by means of an elongated resilient member and cam means adapted to engage the shorting pin during movement of said plate in one direction and deflect said pin to a cocked position, the cam means also serving to deflect the shorting pin to a position between a pair of secondary contacts upon movement of the plate in the opposite direction.

The exact nature of this invention as well as other objects and advantages thereof will be more readily apparent upon consideration of the following specification relating to the annexed drawings in which:

FIG. 1 is a fragmentary side view, in section, of the switch mechanism of this invention; the section being taken generally along line 1—1 of FIG. 2;

FIG. 2 is a sectional view of the switch mechanism taken along line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 1; and

FIG. 4 is a detail sectional view taken generally along line 4—4 of FIG. 1.

The body 11 includes the shorting plate shown in operated position and the shorting pin in the cocked position.

Referring now to the drawing, wherein like reference numerals designate like or corresponding parts throughout the several views, there is shown in FIG. 1, which illustrates a preferred embodiment of the switch mechanism of this invention, a body designated by numeral 11. The body 11 is provided with a piston chamber 12 in which a piston 13 is adapted to move, the piston being fixed to a connecting rod 14 about which a coil spring 15 is disposed. The spring 15 is of the compression type and at one end thereof engages the inner side of piston 13 and at the other end thereof reacts against a shoulder 16 formed in the body 11 for urging the piston 13 outwardly and normally holding the switch mechanism open, the dimensions of the spring depending upon the pressure at which it is desired that the switch mechanism operate. For the purpose of sealing the piston 13 against the entry of moisture, a suitable diaphragm means (not shown) may be provided, in a manner understood by those skilled in the art.

It will be noted that the connecting rod 14 extends beyond shoulder 16 and the body 11 and has mounted thereon a plate 17 composed of insulating material, the plate being mounted on the end by means comprising a disk 18 and a retainer 19. Secured to disk 18 by suitable fastening means such, for example, as screws 21, or the like, is a mounting means 22 which includes a short column 23. The column 23 is provided with a cross-sectional slot in which one end of a leaf spring 24 is disposed, the leaf spring being held in the slot by a pin 25, or the like, passing through the column and the leaf spring member. Carried by the other end of the leaf spring member 24, and suitably insulated therefrom, is a shorting pin 26 having a longitudinal axis disposed parallel to the plate 17 and generally in the plane of the leaf spring member.

The body 11 has secured thereto, by as screws 27, or the like, a support casing 28, the casing constituting an extension of the body and encompassing the movable plate 17. A cover or cap 29 is attached to the casing 28 by screws or similar means 31, the cover being made of an insulating material with a lining of a transparent plastic, if desired. Within the cover 29 is a contact support member 32 which is composed of insulating material and is suitably fastened to the cover 29, for example, by screws 33, there being three such screws disposed 120 degrees apart around casing 28.

Turning now to FIG. 3, the plate 17 of insulating material is shown provided with a plurality of metallic shorting segments 34 suitably secured thereto, the segments
being separated by spaces 35 to the end that the segments be insulated from each other. Each of the segments 34 is adapted to engage a plurality of spaced-apart spring contacts 36, as shown in FIG. 4, for the purpose of shorting or electrically interconnecting the contacts and thereby closing main circuits (not shown) having the contacts incorporated therein. The contacts 36 are carried by the contact support member 32 and are secured thereto by rivets 37, or other type fasteners.

In order that the metallic shorting segments 34 be maintained in proper orientation with respect to the spring contacts 36, an elongated key or guide member 38 is fastened to the casing 28 and has a web 39 received in a slot 41 formed in one of the spaces 35 between a pair of the segments, the slot being of sufficient size not to impede the movement of plate 17, better understood by reference to FIG. 3. For properly orienting the contact support member 32, a slot 42 may be formed therein for receiving an end-portion of web 39, as shown in FIG. 2.

As will be apparent from FIGS. 1, 2 and 4, the contact support member 32 is fashioned with a cylinder-like portion 43, which has affixed to interior wall 44 thereof a pivot for retaining material 45 having an arcuate surface 46 fitted to wall 44 and a projection 47 extending laterally into the interior of portion 43. Projection 47 constitutes a cam member, diamond-shaped in cross-section, as shown in FIG. 4, with a pair of surfaces 48, 49 generally parallel to the plane of the leaf spring member 24 and a generally parallel pair of surfaces 51, 52 diagonal to surfaces 48, 49.

In surface 49, there is imbedded a contact 53 and disposed adjacent thereto is a contact 54 carried by a resilient member 55 attached to piece 45 by any suitable means. Contacts 53 and 54 are adapted to be incorporated in a secondary circuit (not shown) and are so disposed that the space therebetween is less than the transverse extent of the shorting pin 26, for a reason which will hereinafter be made clear.

It will be appreciated that pressure upon piston 13 will cause plate 17, and shorting pin 36 carried thereby, to move toward the projection of cam member 47, and that in the movement of the shorting pin toward said cam member, the shorting pin will engage surface 51 of the cam member and be deflected laterally until movement of the plate carries the pin past the cam member, after which the resiliency of the leaf spring member will restore the position of the shorting pin in the plane of the leaf spring member, i.e., the cocked position of the shorting pin, as shown in FIG. 4. After the pressure upon the piston has been relieved, the piston will move in the opposite direction under the urging of spring 15 and the shorting pin will engage and follow the surface 51 of the cam member and be deflected laterally to pass between contacts 53 and 54, brushingly engaging the contacts in such passage and thereby making and breaking the secondary circuit (not shown).

The operation of the switch mechanism should be apparent from the foregoing description. However, briefly and in summary, as the piston 13 is forced inward plate 17 is moved and the shorting segments 34 are brought into contact with the main contacts 36, shorting them together in pairs, or other arrangement, and the shorting pin 26 engages the cam member 47 and follows surface 51 thereof until the cam member is cleared, resiliency of the leaf spring 24 returning the shorting pin to the plane of the leaf spring. As the pressure is removed, and the piston is returned by the force of the spring, the main contacts 36 are disengaged from the shorting segments and the main circuits (not shown) are broken. Substantially simultaneously, the shorting pin 36 engages and follows surface 51 of cam member 47, after which the shorting pin passes between resiliently mounted contact 54 and the stationary contact 53, thereby shorting contacts 53 and 54 to complete the secondary circuit (not shown) and clears the cam for return to the plane of the leaf spring 24.

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 the invention may be practiced otherwise than as specifically described. For example, the main contacts could be arranged in a variety of patterns and circuits and the switch could be operated hydrostatically or mechanically, and be employed in other environments than underwater ordnance.

From the foregoing it should be clear that there has been provided a new and improved switch mechanism capable of performing dissimilar switch functions; the switch being rugged, easily manufactured, and small, and achieving wiping contact at all points of contacts thereby resulting in low resistance.

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

1. An electric switch of the class disclosed, comprising, in combination, a support, a switch mechanism including a member movably mounted on said support, shorting means resiliently carried by said member and movable therewith, cam means mounted on said support and disposed in alignment with said shorting means, said cam means having surfaces effective to engage and deflect said shorting means during movement of said member in one direction, said movement being sufficient to carry said shorting means past said cam means, a pair of contacts, one contact being supported on said cam means and the other contact being supported on said support adjacent said one contact, said cam means having other surfaces adapted to engage and deflect said shorting means during movement thereof in an opposite direction for effectuating shorting of said contacts and closing an electrical circuit.

2. An electric switch as defined in claim 1, wherein said shorting means includes a pin carried by a planar leaf spring, said pin extending laterally from the spring and being disposed generally in the plane thereof.

3. An electric switch according to claim 2, further characterized in said cam means having a pair of surfaces generally parallel to each other and to the plane of said leaf spring.

4. An electric switch as defined in claim 3, further characterized in said one contact being imbedded in one of said last-named surfaces and forming a part thereof.

5. An electric switch as defined in claim 1, wherein said cam means has a generally diamond-shaped cross-section.

6. An electric switch as defined in claim 1, wherein said one contact is imbedded in said cam means and forms part of one of the surfaces thereof.

7. A multiple switch of the type disclosed, comprising, in combination, a body, a shorting plate mounted for movement in said body in response to pressure, a contact supporting member supported on said body, a plurality of contacts supported by said member, said plate being adapted to move in one direction into engagement with said contacts for closing circuits containing the contacts, a resilient element carried by said plate and movable therewith, a shorting pin carried by said element, cam means supported by said member in alignment with said pin, said cam means having surfaces effective to engage and deflect said pin during movement of said plate in said one direction, the movement of said plate being sufficient to carry said pin beyond said cam means, a pair of secondary contacts, said secondary contacts being disposed in close adjacency with one mounted on said cam means and the other supported on said member, movement of said plate in the opposite direction in response to reduction of pressure carrying said pin into engagement with said cam means, said cam means having surfaces effective to deflect and cause said pin to brushingly engage said secondary contacts during movement of the pin in said opposite direction for closing and breaking a secondary circuit.

8. A switch as recited in claim 7, additionally characterized by said resilient element being a planar leaf spring
and said shorting pin being disposed generally in the plane thereof.

9. A switch according to claim 8, further characterized by said cam means having a pair of surfaces generally parallel to each other and to the plane of the leaf spring.

10. A switch according to claim 9, further characterized by said one contact being imbedded in one of said last-named surfaces and forming a part thereof.

11. A switch as recited in claim 7, additionally characterized by said resilient element being a planar leaf spring, said cam means being generally diamond-shaped in cross-section and having a pair of surfaces generally parallel to the plane of the leaf spring and a pair of surfaces diagonal thereto, and said shorting pin being generally disposed in the plane of the leaf spring and parallel to said surfaces.

12. A switch according to claim 11, further characterized by said one secondary contact being imbedded in one of said surfaces generally parallel to the plane of the leaf spring and forming a part thereof.

13. A multiple circuit switch for use in an underwater ordnance item, comprising in combination, a body for disposition in an ordnance item, piston means mounted for movement in said body, a shorting plate carried by said means and movable therewith, a plurality of metallic shorting segments and a leaf spring carried by said plate, a plurality of contacts supported on said body, said segments being effective to engage said contacts for closing a plurality of circuits and thereby arm the ordnance item, a shorting pin carried by said leaf spring, a cam supported on said body in the path of movement of said pin, said cam having a surface with one secondary contact imbedded therein and forming a part thereof, another secondary contact resiliently mounted on said body closely adjacent said one secondary contact, said cam also having a surface effective to engage and deflect said shorting pin into engagement with said secondary contacts for closing a secondary circuit and scuttling the ordnance item in response to movement, said movement of said plate and pin causing said first-named contacts to be disengaged and said secondary circuit to be closed and broken selectively whereby to effectuate disarming and scuttling of the ordnance item.

14. An electric switch comprising a movable member, shorting means carried by said member and movable therewith, control means disposed in alignment with said shorting means, said control means having control surfaces adapted to engage said shorting means and cause the same to travel along one path of movement during movement of said member toward said control means and to cause said shorting means to travel along another path of movement during the latter movement of said member away from said control means, and a pair of spaced contacts, said shorting means being adapted to electrically interconnect said contacts during travel along said last-named path of movement for shorting said contacts and closing an electrical circuit.

No references cited.