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3,437,770

AUTOMATIC UNDERWATER "AND" GATE SWITCH

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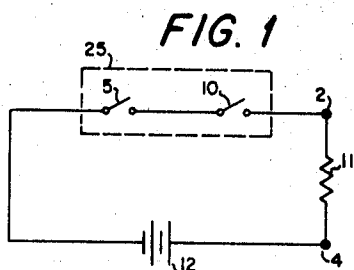


FIG. 2A
NON-IMMERSED

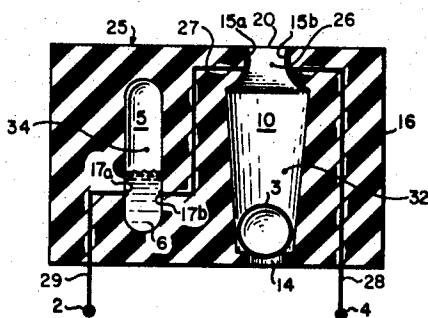


FIG. 2B
IMMERSED

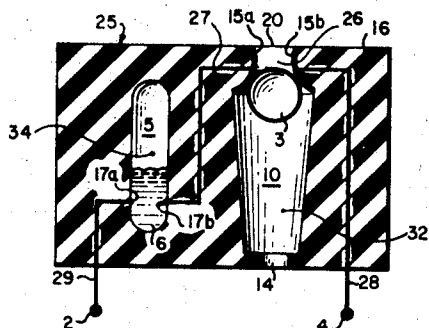


FIG. 2C
NON-IMMERSED INVERTED

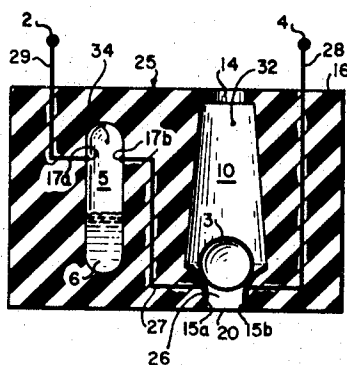
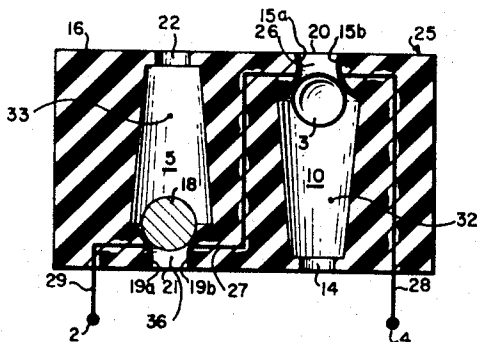


FIG. 3
IMMERSED



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AUTOMATIC UNDERWATER "AND" GATE SWITCH

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11 Claims

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 an AND Gate Switch and more particularly to an automatic fluid operable switch for controlling the operation of a Homing Beacon used in buoyant devices such, for example, as life jackets or floatation vests.

To aid in recovering personnel thrown overboard while wearing a floatation vest, it is the practice to attach a Homing Beacon to life jackets and floatation vests so as to transmit a signal receivable by search party interrogators combing the water. The Homing Beacon is a simple transmitter operating on a small battery source of power. Obviously it is desirable to disable the transmitter while the Homing Signals are not needed to enhance the life of the battery.

A problem in using conventional switches for connecting and disconnecting the source of power at appropriate times becomes evident when it is realized that it is absolutely necessary that the switch be closed when a person wearing a life jacket or floatation vest is immersed in the water; yet it is equally desirable that the switch be opened under all other conditions including when such life preservers are in storage or thrown in any position, for example, onto a bunk bed. In other words, the switch must be operative under water and inoperative when out of water. Although elaborately designed electronic and mechanical switches have been designed to operate under the conditions mentioned above, they have not been found to be suitable for use in connection with floatation vests because of the size, cost, weight, and lack of simplicity of operation necessary to assure continued and fool-proof operation over a long period of time without the need for frequent inspection.

The general purpose of this invention is to provide a simple, inexpensive, light-weight automatic AND Gate Switch capable of controlling a Homing Beacon transmitter power source in a light-weight floatation vest worn by personnel on water vessels, the power source of which must be inactivated at all times other than when the vest is submerged in a fluid so as to preserve the power source. This is accomplished in accordance with the invention by forming an AND Gate Circuit from a pair of serially connected switch means which are so configured as to be normally open in any position until submerged in a fluid, under which condition the switches will be closed while the Gate circuit is in a substantially vertical position. In one embodiment of the invention, one of the switching means is a mercury switch and the other is a fluid operable float switch. In another embodiment of the invention, the AND Gate Circuit is defined by two fluid operable float means in series with each other.

An object of this invention is the provision of a switch for use in controlling the power source to a Homing Beacon transmitter.

Another object of this invention is a provision of a fluid operable AND Gate Switch for controlling the power supply to a transmitter located in a light-weight floatation vest.

Still another object of the present invention is a provision of an AND Gate Switch for use in connection

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with the controlling of a power supply to a transmitter, the switch being operable to activate the power supply upon its submergence in a fluid, the power supply being inactivated at all other times.

Yet another object of this invention is the provision of an AND Gate Circuit having two switching means connected in series with each other, both of the switching means being closed when the Gate Switch is immersed in a fluid, in a vertical-upright position.

With these and other objects in view, as hereinafter more fully appear, in which will be more particularly pointed out in the appended claims, reference is now made to the following description taken in connection with the accompanying drawings in which:

FIG. 1 is an electrical circuit diagram of the AND Gate Circuit in connection with the Homing Beacon transmitter.

FIGS. 2A, 2B and 2C show, respectively, a side view of one embodiment of the AND Gate Switch in a non-immersed vertical position, an immersed vertical position, and a non-immersed inverted position.

FIG. 3 shows another embodiment of the basic AND Gate Switch using a second fluid operable float switch in place of the mercury switch shown in the previous embodiment.

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1, a simple electrical circuit diagram representative of the Homing Beacon transmitter circuit. Resistor 11, connected to terminals 2 and 4, represents the effective resistance of the Beacon transmitter. The transmitter is supplied by a battery 12 (which may be a mercury battery of the V5675 RCA type) and is shown connected in series with the load resistor 11 at terminal 4. So as to conserve the battery 12, an AND Gate Switch 25, defined by serially connected switches 5 and 10, is connected in series with battery 12 and terminal 2 to complete the circuit to terminal 4. As obvious, both switches 5 and 10 must be closed in order for battery 12 to operatively energize the transmitter represented by resistance 11.

FIG. 2A shows a cutaway side view of the AND Gate Switch 25 in a non-immersed, substantially vertical position. Insulator block 16 serves as the body of Gate Circuit 25 with switch 10 being defined by a tapered cylindrical chamber containing an electrically conductive floatable ball 3 freely movable therein. The cylindrical chamber is tapered by a smaller diameter at the bottom and has a reduced neck section 26 terminating at port 20, the cross-sectional dimensions of the chamber being such as to enable floatable ball 3 to freely move towards either end of the chamber even when the insulator block 16 is not at an exact vertical angle. A pair of electrically conductive contacts means 15a, 15b are secured to the sidewalls of neck section 26 and are connected respectively to conductors 27 and 28. A second switch 5 is formed by an enclosed cylindrical chamber 34 of substantially uniform cross-section with rounded ends and having a portion of it filled with mercury 6 which in the position illustrated, is in contact with a pair of electrical contacts 17a, 17b that are secured to the lower sidewalls of chamber 34 and are connected respectively to conductors 29 and 27. From the foregoing description and FIG. 2A, it is obvious that the AND circuit 25 will remain open at switch 10 and closed at switch 5 as long as a block 16 remains in a substantially vertical, non-immersed position. If the block 16 is immersed in a fluid, the fluid would first enter through opening 14 and cause floatable ball 3 to move towards and engage contacts 15a-15b, thereby completing the circuit between terminals 2 and 4. Contacts 15a-15b are preferably arcuate so as to provide a better receiving means for ball 3 and

hence makes better electrical contact therewith. FIG. 2B illustrates this closed circuit arrangement, which occurs when the AND Gate Switch 25 is in an immersed vertical position. The aforescribed switch unit 25 is designed for being secured, in any suitable manner, to a life jacket or floatation vest and is located thereon so as to be submerged in water and in a substantially upright position as illustrated in FIGS. 2A and 2B when the wearer of such life preservers is in the water in a substantially upright position. Of course it is to be understood that the amount of mercury 6 in chamber 34 will be sufficient to enable contact between terminals 17a and 17b for allowance of a certain amount of tilt from a vertical position and yet be insufficient to make contact with terminals 17a and 17b when the unit 25 is sufficiently tilted out of water to cause ball 3 to roll into engagement with terminals 15a and 15b. The amount of mercury 6 is selectively determinable depending upon the diameter of chamber 34, the cross-sectional and longitudinal dimensions of chamber 32, the degree of taper of chamber 32, and the size of ball 3, as may be desired for any given design parameters.

FIG. 2C illustrates what occurs when the unit 25 is in an inverted, non-immersed condition such as may happen when the life preserver is in stowage. In this condition, the mercury reservoir 6 is not shorting contacts 17a and 17b and switch 10 is now closed since gravity has caused floatable conductor ball 3 to engage terminals 15a and 15b. From the foregoing descriptions of FIGS. 2A, 2B and 2C, it is apparent that when unit 25 is out of the water at least one of switches 5 and 10 will be open and when unit 25 is submerged in water both switches will be closed when in a substantially upright position as exemplified in FIG. 2B.

FIG. 3 shows a cross-sectional view of a second embodiment of the basic invention using a solid steel ball 18 in connection with arcuate contacts 19a and 19b to form switch 5, instead of the mercury type switch shown in FIG. 2A. Electrically, the switch will function identically to the mercury-floatable ball switch. The switch is shown in its vertical immersed position having both switches 5 and 10 closed so it could provide a closed series circuit between terminals 2 and 4. Since conductor ball 3 is hollow, it will float upon being immersed, while solid ball 18 will remain at its lowermost position even if fluid enters either inlet 21 or 22 because its density is greater than the fluid in which it is immersed. Chamber 33 is identical to chamber 32 but is inverted relative thereto. The purpose of having them identical is for ease of fabrication and to enable access through either ports 21 and 22 for repair purposes, especially with respect to terminals 19a and 19b located in neck section 36. Of course it is to be understood that ports 21 and 22 may be selectively closed without affecting the operation of unit 25.

Thus, the present invention is an operatively simple and trouble free AND Gate requiring minimal maintenance throughout its long life of operation. The simplicity of the switch provides a greater safety factor since, in fact, the need for the switch to operate under fluid submerged conditions is unlikely and at most occurs at very infrequent periods of time. Thus, a person wearing the vest can be assured that even if the vest has not been used for months in an immersed condition, it will operate satisfactorily should any on-water disaster or mishap occur to the wearer. Finally, the need for light weight miniaturized equipment has become mandatory by recent advancements made in the light-weight life jacket themselves. Obviously cost is an important consideration since such life preservers are used in quantities of hundreds of thousands by men aboard ships, not to mention the likelihood of use such preservers in connection with Homing Beacon equipment used on commercial and military aircraft flying over water. The simplicity of electrical and mechanical design of the instant device permits the economical production and safe use of such switches for use

in connection with life preservers, although its use is not limited thereto. The switch may be used in connection with any other devices and for any other purposes too numerous to list.

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

1. An AND Gate Switch unit for operation in an immersible fluid comprising:
 - a mass of electrically non-conductive material forming the body of said unit,
 - first and second gravity operable switches carried by said body and electrically connected in series relationship, and
 - means included in said second switch responsively operable to fluid pressure to maintain said second switch in closed circuit condition when said unit is immersed in fluid in a predetermined position, said switches being oriented on said body in such manner that gravity will retain at least one of said switches in an open condition for any position of said unit when not immersed in a fluid.
2. The unit defined in claim 1 wherein said fluid pressure responsive means includes:
 - a longitudinal chamber, and
 - a floatable conductive ball longitudinally movable within said chamber, said chamber having ports at each end to permit entry of fluid therewithin when placed in a fluid medium.
3. The unit defined in claim 2 further including:
 - a pair of electrically conductive terminal means located at the top end of said chamber when aligned vertically in said predetermined position, said terminal means being adapted to conductively engage said floatable conductive ball when positioned at said one end.
4. The unit defined in claim 1 wherein said first switch includes:
 - an enclosed longitudinal chamber,
 - a pair of electrical contact means located near the end of said enclosed chamber which is at the bottom thereof when said unit is in said predetermined position, and
 - a reservoir of mercury filling said enclosed chamber to a point above the location of said contact means but being of such an amount as to interrupt contact with at least one of said pair of contact means when said unit is tilted a predetermined degree from said predetermined position.
5. The unit defined in claim 3, wherein:
 - said chamber is tapered with the large end thereof being at the top when said unit is in said predetermined position.
6. The device as defined in claim 2 wherein said first switch includes:
 - a longitudinal chamber positioned alongside the chamber of said second switch with their longitudinal axes substantially in parallel,
 - a non-floatable electrically conductive ball movably retained within the chamber of said first switch, and
 - a pair of electrical terminals in one end of each of said chambers but in opposing ends thereof.
7. The unit as defined in claim 4 wherein said fluid pressure responsive means includes:
 - a longitudinal chamber, and a floatable conductive ball longitudinally movable within said chamber, said chamber having ports at each end to permit entry of fluid therewithin when placed in a fluid medium.
8. The unit as defined in claim 3 wherein said first switch includes:
 - an enclosed longitudinal chamber,

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a pair of electrical contact means located near the end of said enclosed chamber which is at the bottom thereof when said unit is in said predetermined position, and

a reservoir of mercury filling said enclosed chamber to a point above the location of said contact means but being of such an amount as to interrupt contact with at least one of said pair of contact means when said unit is tilted a predetermined degree from said predetermined position.

9. A dual switch unit for providing a closed series circuit between two connector terminals on said unit when said unit is immersed in a fluid in a predetermined position comprising:

a mass of electrically non-conductive material forming the body of said unit,

first and second longitudinal chambers formed in said body with their longitudinal axes being substantially parallel and in a substantially vertical position when in said predetermined position,

fluid port means in said mass in communication with said second chamber to permit entry therewithin of fluid when said unit is immersed in a fluid medium, first and second conductive terminals located in said second chamber near the end thereof which is at the top when in said predetermined position,

circuit means connecting said first terminal to one of said connector terminals,

first and second conductive contacts located in said first chamber near the end thereof which is at the bottom when in said predetermined position, circuit means connecting said first contact to the other of said connector terminals,

an electrical conductor connecting said second terminal to said second contact,

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gravity responsive conductive means movably retained within said first chamber in electrical engagement with said first and second contacts when in said predetermined position and operable to interrupt engagement with at least one of said first and second contacts when the position of said unit deviates a predetermined degree from said predetermined position, and

buoyant conductive means movably retained within said second chamber and held by gravity at the end thereof which is at the bottom when in said predetermined position but operable in response to fluid entering said port means to conductively engage said first and second conductive terminals when said unit is in said predetermined position.

10. The unit defined in claim 9 wherein:

said first chamber is an enclosed chamber, and said gravity responsive means consists of mercury filling a predetermined portion of said first chamber.

11. The unit defined in claim 9 wherein said gravity responsive means is a non-buoyant mass.

References Cited

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30 DAVID SMITH, JR., *Assistant Examiner*.

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