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(56) Documents cited

GB A 2113025	GB 1432453	GB 1321863
GB A 2060370	GB 1418011	GB 1314255
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GB 1482140	GB 1371251	

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Selected US specifications from IPC sub-classes B63B B63C B64D F42C G01F G01N G01R H03K

(54) Condition responsive switching circuit

(57) Electrodes S1, S2 for sensing a conductive liquid and/or an inductive field are coupled to an amplifier 1, 3 which controls a switching transistor 5. The amplifier 1, 3 is sensitive enough to be responsive not only to sea water but also to de-ionised tap water or reservoir water. The device may be attached to a life jacket so that transistor 5 turns on a light or radio beacon 9 when water connects electrodes S1, S2. Alternatively, the electrodes S1, S2 may act as aerials responsive to an inductive field developed by a human or an animal or by an active power circuit, the device being used as a trigger in alarm systems, for example. Amplifier transistor 3 may directly drive an additional low power load such as a lamp 11. A damping capacitor (19), (Fig. 2), may be included to prevent the device responding to an inductive field.

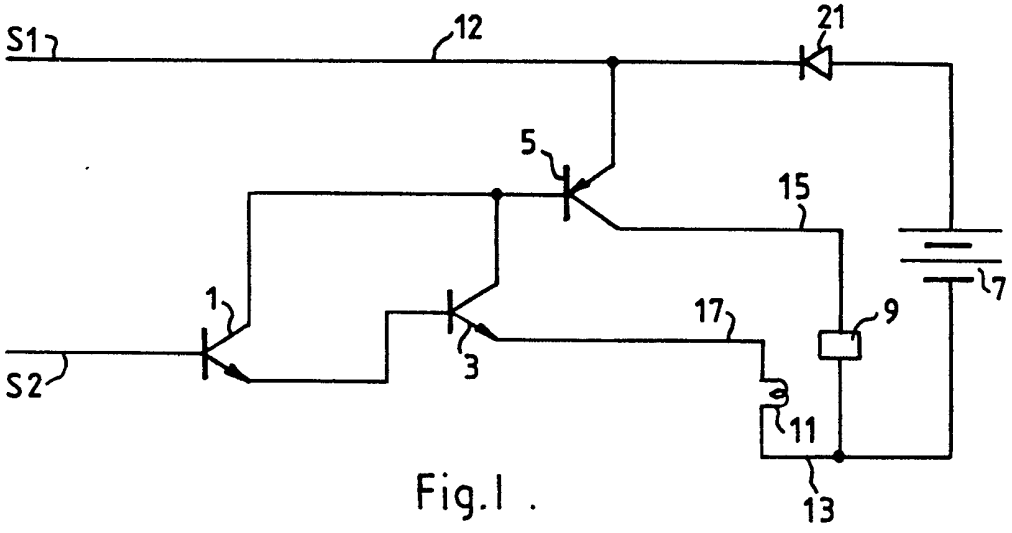

Fig.1 .

GB 2 190 254 A

The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

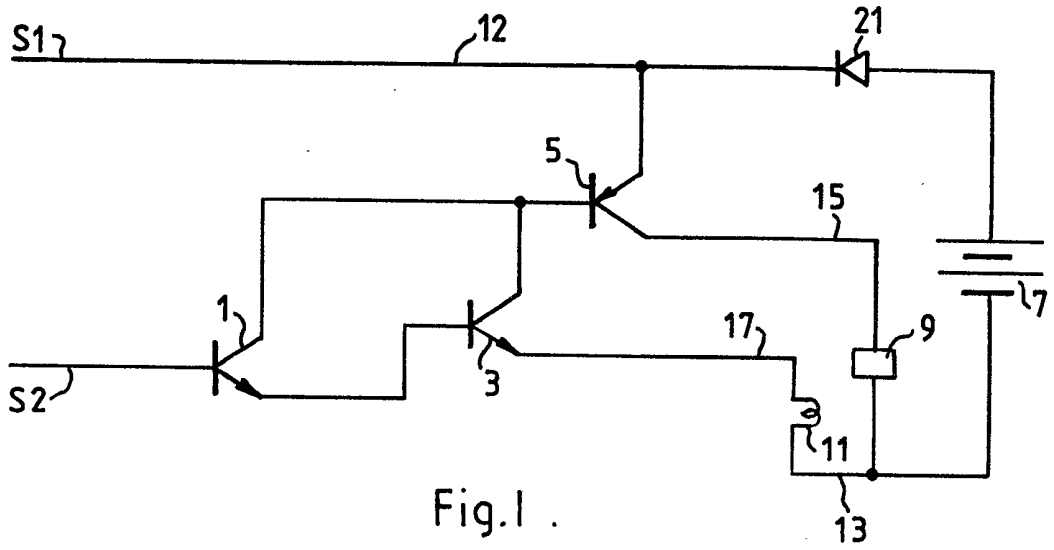

Fig.1 .

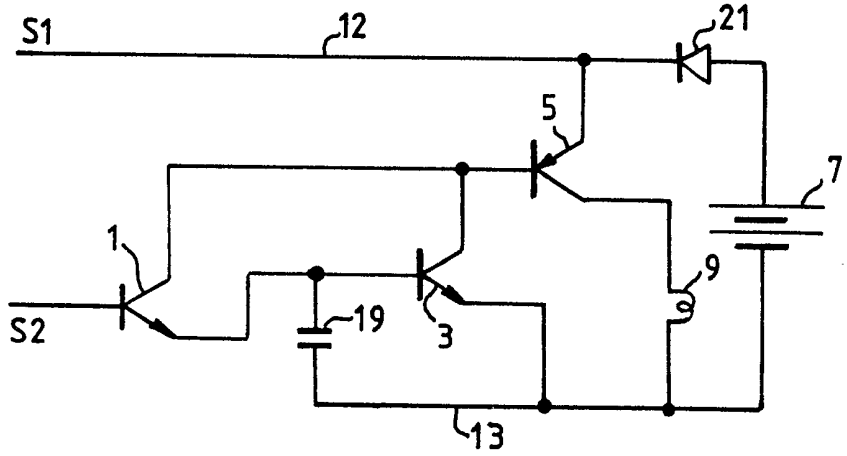

Fig. 2.

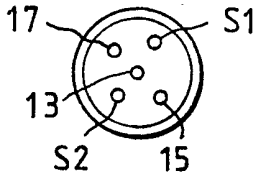

Fig.3A.

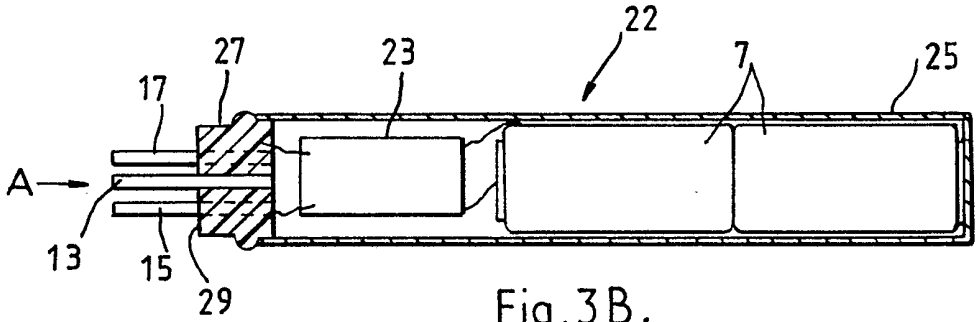

Fig.3B.

SPECIFICATION

A control unit

This invention relates to a control device.

According to the invention in a first aspect there is provided a control device comprising sensing means for sensing the presence of a conductive liquid and/or an inductive field and producing an amplified switching signal when the liquid or field is sensed and switching means responsive to the amplified switching signal for connecting a power source to a load.

According to the invention in a second aspect there is provided a control device comprising first and second cascade connected transistors responsive to an input signal applied to the base of the first transistor to provide an amplified signal, the input signal being indicative of a predetermined sensed condition; and a switching transistor responsive to the amplified signal to provide a switched output.

Preferably the second transistor provides a further switched output.

Preferably the sensed condition is the presence of a conductive liquid between a first sensor terminal connected to the base of the first transistor and a second sensor terminal arranged to be connected to a voltage supply.

Preferably the first and second sensor terminals are arranged to act as aerials so that the device is further responsive to the presence of an inductive field, the presence of said field providing a further sensed condition.

Alternatively the device may include damping means for example a capacitor, to prevent actuation of the device in response to a said inductive field.

In a preferred application, the device is arranged to connect a power supply to a load which may comprise a light source or a radio beacon which is/are switched on when the sensor terminals come into contact with water.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a circuit diagram of an embodiment of the invention;

Figure 2 is a circuit diagram showing a modification to the embodiment of Figure 1;

Figures 3A and 3B show a general view of an embodiment of the invention, with Figure 3B being a sectional view and Figure 3A being taken in the direction of arrow A of Fig. 3B.

With reference to Figure 1, a circuit diagram of an embodiment of the invention is shown.

The device includes a Darlington pair of N.P.N. transistors 1, 3 (e.g. BCIO9). The commonly connected collectors of transistors 1, 3 are connected to the base of a P.N.P. power transistor 5 (e.g. BC327).

Two sensor terminals S1, S2 are connected, respectively, to a positive supply rail 12 (connected to a battery power supply 7) and the base of transistor

A load 9 is connected between the collector of P.N.P. transistor 5 and a negative supply rail 13 connected to the supply 7. A further low-power load illustrated as a lamp 11 may, optionally be provided, connected between the emitter of transistor 3 and the negative rail.

In use, the presence of a conduction path between terminals S1, S2 will cause a current of flow through the base of transistor 1 which will cause the P.N.P. transistor 5 to be switched on by the cascade effect of the Darlington pair 1, 3, thus connecting the battery power supply 7 to the load 9 (and also to the load 11, through the emitter base junction of P.N.P. transistor 5 and transistor 3). Removal of the conduction path causes the device to switch off.

In a preferred application, the sensor terminals S1, S2 are arranged externally of the device and disposed so that if a conductive liquid is disposed between terminals S1, S2, a current will flow acuating the circuit. The presence of the Darlington pair 1, 3 provides the significant advantage that only very small currents are required to actuate the circuit. Thus, the circuit may be actuated not only by relatively good water-based conductors such as sea water but also by water having very small levels of impurities, for example de-ionised tap water or reservoir water.

In a particular application, the device may be arranged to actuate a light or radio beacon 9, and may be attached to a life jacket as a distress device which will switch on automatically when water connects the sensor terminator S1, S2.

Optionally at least one diode 21 (e.g. IN4001) may be provided for reducing the voltage level applied to the loads 9,11.

In a further application, the circuit may be arranged so that the terminals S1, S2 act as aerials, responsive to an inductive field. Due to the sensitivity of the circuit, such inductive field need only be of sufficient strength to develop a very small current for the Darlington pair 1, 3 to switch the transistor 5. Thus the circuit can be arranged to be responsive to the inductive field developed by a human or an animal or the field developed by an active power circuit. In this respect, the device has particular application for e.g. alarm systems as a trigger.

Figure 2 illustrates a modification to the circuit of Figure 1 designed to prevent actuation of the circuit due to inductive field effects, when these are undesirable for a particular application. Similar components are represented by corresponding reference numerals.

In Figure 2, a capacitor 19 is provided between the base of transistor 3 and the negative power supply rail 13. The capacitor is

preferably a silicon disc capacitor and prevents the sensor terminals S1, S2 acting as aerials. The capacitor 19 charges up from the d.c. supply and then forms a "dead-fall" against possible actuation of the device.

The value of the capacitor 19 need only be very small (e.g. .001 micro-farad, 1 kV type) so that the power dissipation of the capacitor 19 is virtually negligible.

Also, in Figure 2, an alternative load arrangement is shown in which a lamp is provided as load 9, with the second switched output, via transistor 3, being connected to ground and not used.

In Figure 3 a practical embodiment of the device of Figures 1 or 2, for use as a water sensor 22 is shown, in which the main components are mounted on a circuit board 23 encapsulated in resin and retained, together with battery cells 7 within a housing 25. The space around the cells and circuit is filled with 916 RTV Silastic. The housing 25 is sealed with a thermoset plug 27 from which three insulation covered pins 13, 15, 17 project. Pin 13 is connected to the negative voltage supply rail with pins 15, 17 being connected, respectively, to the collector of transistor 5 and the emitter of transistor 3, these pins providing the switched outputs. The projecting pins 13, 15, 17 are arranged for connection to a further unit which includes the loads 9, 11. Terminals S1, S2 are also provided through the plug 27 and are arranged flush with surface 29 thereof. In use, the unit including the loads 9, 11 is attached to the sensor 22 so as to spaced from surface 29, which is open to the surroundings. Thus, if the sensor 22 is immersed in water, a connection will be formed between terminals S1, S2 thereby actuating the circuit and providing power to the loads 9, 11.

Whilst the device has been shown connected to a battery source 7 this is not to be construed as limitative and the device may be used connected to a mains supply. In such a use, the device may preferably include a LED indicator. Also, it will be appreciated that with an alternating current source, the capicitor 19 would not provide effective damping against inductive field interference. However, the provision of an alternative damping means would be within the scope of one skilled in the art.

Also, whilst specific applications of the device have been mentioned, these are not to be construed as limitative and the device is applicable for other applications for which the sensing and switching function as disclosed is applicable.

CLAIMS

1. A control device comprising sensing means for sensing the presence of a conductive liquid and/or inductive field, the sensing means including first and second electrodes coupled to a power source, an amplification circuit coupled to one of said electrodes and switching means coupled and responsive to the amplfication circuit, for connecting the power source to a load upon sensing of a said liquid and/or field at said electrodes.

2. A device as claimed in claim 1 wherein the amplification circuit includes a pair of cascade connected transistors.

3. A device as claimed in claim 1 or claim 2 wherein said switching means includes a bipolar transistor.

4. A device as claimed in any one of claims 1 to 3 wherein the amplification circuit is further arranged to connect the power source to a further load having a lower power requirement than the load connectable to the power source via the switching means.

5. A device as claimed in any one of the preceding claims further comprising damping means coupled to the amplification circuit for preventing actuation of the device in response to a said inductive field.

6. A device as claimed in claim 5 wherein the damping means comprises a capacitor connected to said amplification circuit.

7. A control device as claimed in any one of the preceding claims wherein the power source comprises at least one battery cell and the device further comprises a housing containing the cell, amplification circuit and switching means, the first and second electrodes projecting from the housing.

8. In combination, a control device as claimed in any one of the preceding claims and a load connected to the switching means.

9. A combination as claimed in claim 8 wherein the load comprises a light source for a radio becon.

10. A combination as claimed in claim 7 or claim 8 further comprising a further load connected to said amplification circuit.

11. A combination as claimed in any one of claims 8 to 10, wherein the load or loads are retained within a unit separate from the device, the device and unit being electrically connected via connectors projecting from the device.

12. A control device substantially as hereinbefore described with reference figure 1 and figure 3 or figure 2 and figure 3.

13. A combination of a control device and a load or loads substantially as hereinbefore described with reference to figure 1 and figure 3 or figure 2 and figure 3.

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