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Rain/Water Level Alarm

This simple device (Fig. 1.1) may be used as a rain alarm, to indicate that it's time to rush out and bring in the washing, but it may also be used in other domestic situations, e.g. to give an audio indication that the bath water has reached the right level, or to give an alarm when

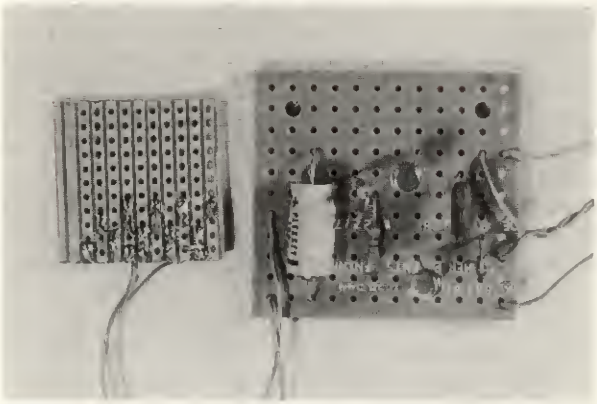

Figure 1.1

The rain/water level alarm

water gets into premises that are prone to flooding. Units of this type also have uses outside the home environment, e.g. in yachting, where there are obvious uses. In fact circuits of this type are extremely useful and versatile despite their simplicity.

The circuit

The operation relies on the fact that, although pure water is an insulator, water which contains even quite small amounts of dissolved impurities

will conduct sufficiently well for the current to be easily detected by an electronic circuit and a simple sensor. In practice, any water which the unit is likely to be used to detect will contain significant amounts of dissolved impurities, and even rainwater, which might be expected to be almost pure water, can be readily detected by this circuit.

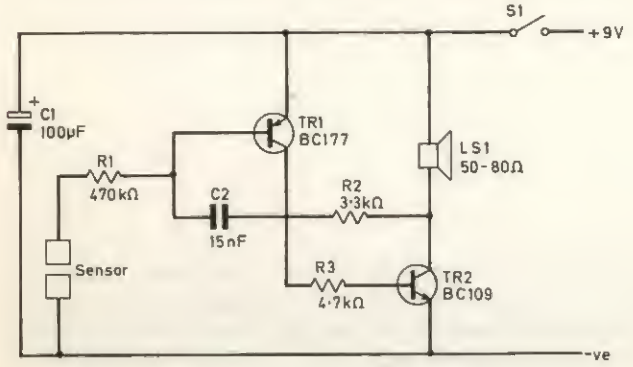

Figure 1.2
The circuit of the alarm

The circuit diagram of the rain/water level alarm is provided in Fig. 1.2. Basically the unit is just a simple audio oscillator with the output fed to a loudspeaker. However, bias resistor R1 is not connected direct to the negative supply rail as it would normally be, but is connected via a simple sensor. The sensor simply consists of two pieces of metal which are mounted close to each other, but not in direct contact. Therefore, under quiescent conditions TR1 receives no base bias current and is cut off. TR2 receives only leakage currents via TR1 and R3 into its base circuit, and as these are only minute TR2 is also cut off. This gives the circuit a standby current consumption which is negligible, and this makes it suitable for battery operation even if it will need to be used for very long periods.

When the two pieces of metal forming the sensor are bridged by water, a small bias current will flow into TR1 base, and TR1 will switch on. TR2 will then be switched on by the base current it receives from TR1, and a negative going pulse will be fed to TR1 base from the collector of TR2 by way of R2 and C2. This causes TR1 to conduct more heavily which in turn results in TR2 conducting more readily and supplying a stronger negative signal via C2 and R2. This regenerative action continues until TR2 is saturated, and can no longer supply a negative going signal to TR1 base.

In the absence of a further signal from TR2, TR1 will start to conduct less heavily and will reduce the base current to TR2. This

causes TR2 to start to turn off, and the positive-going signal at TR2 collector is fed to TR1 base by R2 and C2. This causes TR1 to conduct still less heavily, and a regenerative action occurs once again with TR2 becoming cut off as a result.

The original regenerative action then commences once again, and the circuit continuously oscillates in this way. Of course, the circuit actually oscillates very rapidly, and several hundred pulses of current are fed to the loudspeaker (which forms the collector load for TR2) each second. A tone of several hundred hertz is therefore emitted from the loudspeaker when the sensor is bridged by water. The unit produces quite a loud sound and has a current consumption of about 50mA when operating the alarm.

The three resistors are needed to protect the transistors against passing excessive base or collector currents, and C1 is merely a supply decoupling capacitor. S1 is the on/off switch.

Construction

All the small components are mounted on a 0.15in matrix stripboard panel which has 11 copper strips by 12 holes. Details of this panel are provided in Fig. 1.3. When a panel of the required size has been cut out

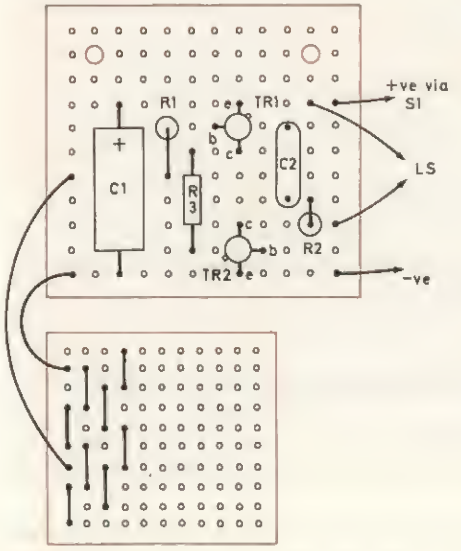

Figure 1.3
The circuit board of the alarm

and the two mounting holes have been drilled, the components can be soldered into circuit. There are no breaks in any of the copper strips.

Mechanically the construction of the unit is quite straightforward except for the mounting of the loudspeaker on the front panel. This requires a cutout of slightly less than the loudspeaker diameter to be made in the front panel, and this can be accomplished using either a fretsaw or a miniature round file. A piece of loudspeaker fret or cloth is then glued in position behind the cutout and the loudspeaker is carefully glued into place over this. A minimal amount of a high quality adhesive such as an epoxy type should be used so that the loudspeaker is firmly mounted, but there is little risk of adhesive getting onto the diaphragm and possibly impeding it. An alternative to the cutout and speaker fret is simply to drill a matrix of small holes in the panel, although it is more difficult to make a good job of this than one might think.

Components list for the rain/water level alarm

Resistors (all miniature ¼W 5%)

R1	470kΩ
R2	3.3kΩ
R3	4.7kΩ

Capacitors

C1	100μF 10V
C2	15nF type C280

Semiconductors

TR1	BC177
TR2	BC109

Switch

S1	S.P.S.T. toggle type

Loudspeaker

LS1	miniature loudspeaker with an impedance in the range 50 to 80Ω

Miscellaneous

Case, and speaker fret or cloth
0.15in matrix stripboard for component panel and 0.1in stripboard for sensor
PP3 battery and connector to suit
Connecting wire, solder, etc.

S1 is also mounted on the front panel, and either a hole for the lead to the sensor must be made in the case, or the leads from the sensor should be terminated in a 3.5mm jack plug, and those from the main circuit should be terminated in a 3.5mm jack socket, the latter being

mounted at any convenient place on the case. When all the wiring has been completed the component panel can be bolted into position.

A sensor for the unit can consist of a piece of 0.1in pitch stripboard (this is preferable to 0.15in matrix board which has a wider strip spacing) with alternate strips bridged by link wires, as shown in Fig. 1.3. For many applications, a short piece of board having two copper strips will be quite adequate, but for a rain alarm the sensor should be as large as possible so that there is a good chance of a raindrop being detected almost immediately raindrops start to fall. Of course, there are many other possible ways of producing a suitable sensor, and there is plenty of scope for using one's initiative here.

Once the alarm has been activated it can be silenced simply by switching the unit off. Before the unit is ready for use again it may be necessary to wipe any moisture from the sensor. Unless the sensor is made from a non-corrosive metal it will be necessary to inspect it periodically to check that it is not badly corroded. If necessary it must be cleaned with metal polish, otherwise it is possible that the alarm will fail to operate.