INTRUDER ALARM FOR SMALL CRAFT

THIS article describes the construction of a simple low cost alarm that will prove effective as a deterrent to vandals or marauders visiting your yacht or motor-boat.

Although primarily designed to prevent unlawful entrance through boat doors and hatches, it may also be employed as a burglar alarm for cars or as a domestic sentinel. Current consumption on standby is exceedingly low, in the order of microamps and the choice of a silicon transistor in the first stage insures against fortuitous switching of the relay through thermal influences.

CIRCUIT DESCRIPTION

The circuit diagram for the alarm system is given in Fig. 1. In essence the circuit consists of an *npn* emitter follower TR1, the load of which is a 500 ohm 600 type relay RLA, followed by an astable pulse generator (TR2, TR3) switching an alarm at a selected frequency.

In the standby condition the transistor TR1 is held off by the loop of closed microswitches which are fitted to hatches and doors. It was found in practice that the relay would not trip even for a loop resistance of 50 kilohms, so it can be seen that high contact resistance, effected by alternative choice of contact plate switching through poor connection, should not reduce the efficiency of this alarm.

ACTIVATION OF ALARM

If the loop line is broken through forced entrance, the small quiescent current through R1 is diverted to the base of TR1 which switches on, so energising relay RLA. The normally open contacts RLA1 close. This has the initial effect of providing a latching potential to the relay by way of R2 thus ensuring that any attempt to cut off the alarm by closing doors or hatches and so completing the loop is frustrated since the relay armature is held in effect by its own contacts.

Any attempts by the marauder to rip out the loop wires are equally ineffectual with this latching action.

ASTABLE MULTIVIBRATOR

The closed relay contact RLA1 also completes the circuit for the complementary astable multivibrator circuit composed of TR2 and TR3. Most readers are probably familiar with the conventional multivibrator, easily recognised by its crossed pair of feedback capacitors. The circuit employed in this boat alarm produces a similar output pulse, but it is very different in its operation.

In the standby condition the electrolytic capacitors C1 and C2 are discharged, but with the closing of RLA1, C1 charges through the point contact diode D1 and RLB coil with a time constant appropriate to this series train. Simultaneously C2 charges by way of RLB coil, VR1, and R3—with a relatively larger time constant.

Since the charging of C2 is exponential from zero, a negative potential will appear at the base of the *npn* silicon transistor TR2, proportional to the values of R3 and the frequency control potentiometer VR1. This negative bias holds off TR2 and consequently TR3, since no collector current is being passed to the base of this transistor. With the charging of C2 the negative hold-off bias is removed and TR2 is switched into conduction with consequent bottoming of TR3.

This means that most of the supply volts now appears across RLB so closing the normally open contacts of RLB1. At this point the diode D1 is reverse biased and does not allow the rapid discharge of C1 through TR3. This capacitor now acts as a temporary supply to maintain the complementary pair in conduction. With the discharge of C1 and C2 by way of the base-emitter junction of TR2, D1, and VR1, the circuit reverts to its original state, with relay contacts opening prior to the next cycle of charging events.

MARK-SPACE RATIO

Whilst the consumption of the operating unit is a nominal 20mA, the current taken by the alarm audio transducer will be very much greater. A degree of power conservation can be achieved by adjusting VR1 for the smallest mark-to-space ratio.

This setting will of course, be a compromise between an urgent alarm repetition rate, if this is required, and the available capacity of the batteries employed.

If a bank of high power zinc-carbon dry cells, such as Ever Ready HP1's are used with a car horn, the mark-space potentiometer setting should be at its lowest—although it must be stated that these cells would be more suited to a large underdome bell as an alarm.

COMPONENTS . . .

Resistors
R1 100kΩ
R2 330Ω
R3 270kΩ
All 10%, ½ watt carbon

Capacitors
C1 100μF elect. 15V
C2 8μF elect. 15V

Potentiometer
VR1 10kΩ horizontal preset

Transistors
TR1 2N2926 (Yellow)
TR2 2N2926 (Yellow)
TR3 OC71

Diodes
D1, D2 OA81 (2 off)

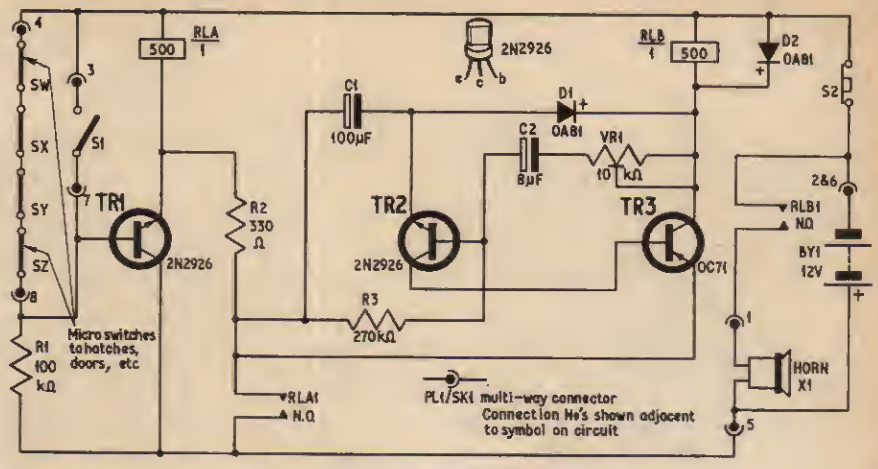


Fig. 1. Circuit diagram of the boat alarm

Switches
S1 Bulgin s.p.s.t. key operated rotary snap switch (Home Radio)
S2 Push-to-break-single pole miniature push button switch (Radiospares)
SW-SZ Alarm switches—miniature button or lever type (Bulgin) (Quantity as required)

Relays
RLA 9V 500Ω coil, 1 make light duty contacts 600 Type (Keyswitch)
RLB 9V 500Ω coil, 1 make heavy duty contacts 600 Type (Keyswitch)

Connectors
PL1, SK1 8-way standard multi-pole connector (plug, socket, cover shell and retainer, Radiospares)

Miscellaneous
BY1 12V battery (see text)
X1 Car horn (see text)
Diecast Box (S.T.C.) $8\frac{3}{4}$in × $5\frac{3}{4}$in × $2\frac{5}{32}$in (Electroniques)
Miniature p.v.c. wire 7/40 (Radiospares)

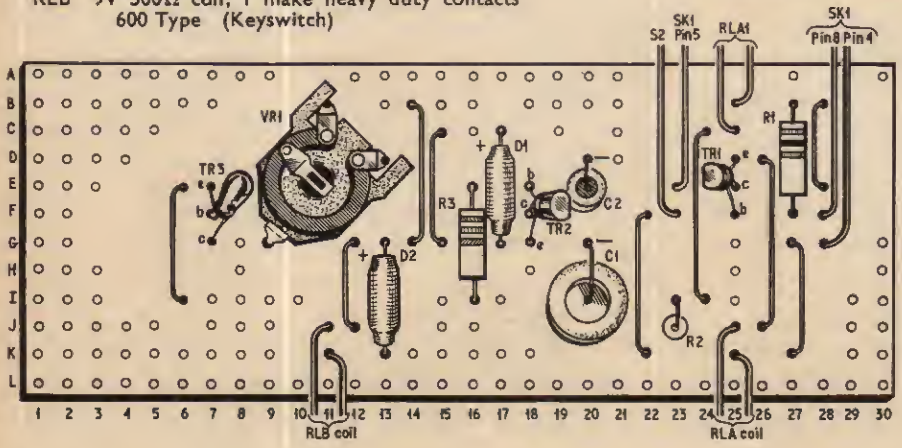
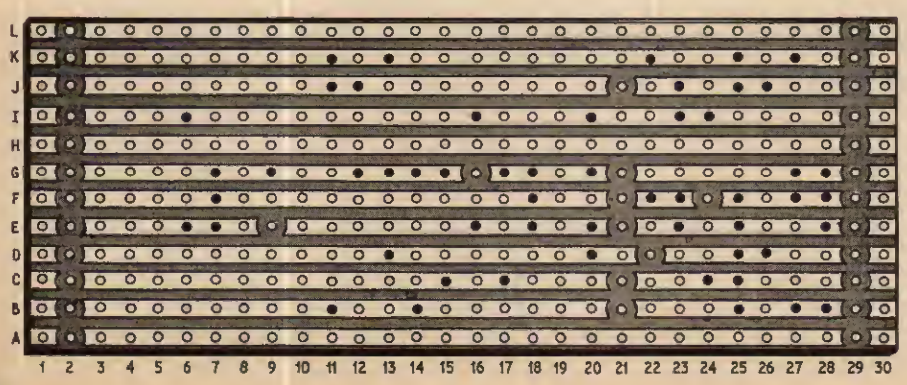


Fig. 2. The Veroboard sub-assembly

(a) top view, showing arrangement of components



(b) underside view, showing breaks in conductor strips, and soldered connections

Items used in the boat alarm system

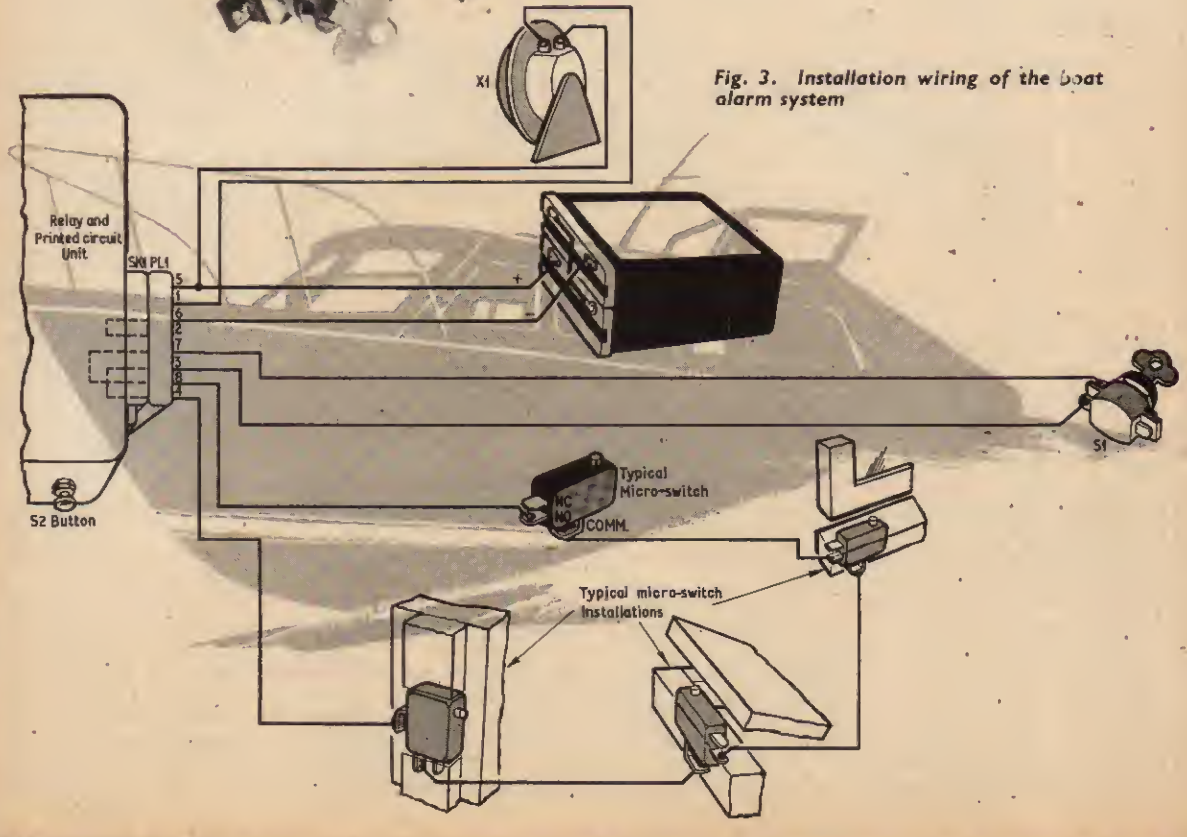


Fig. 3. Installation wiring of the boat alarm system

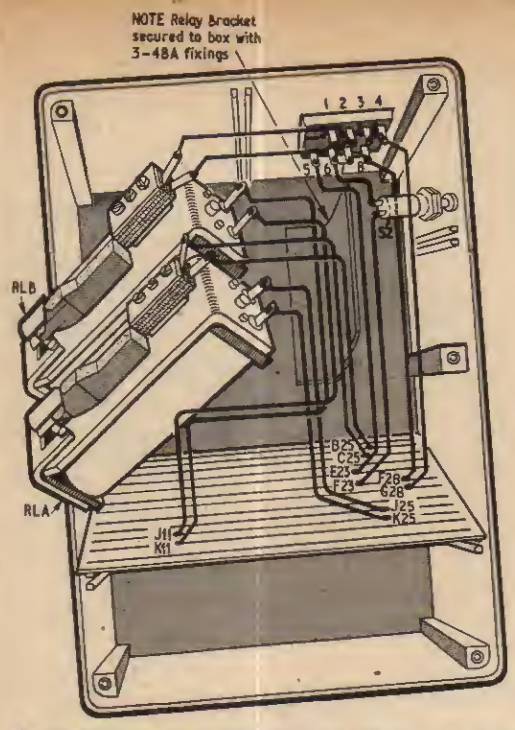


Fig. 4. Interior view of the main unit. Relays and circuit board have been moved from their normal positions to clarify the wiring details

Obviously secondary type batteries, i.e. lead acid or nickel cadmium will provide a much larger capacity, and may be preferred. Of the latter kind, the DEAC 5M6 is suitable (two will be required).

VETO SWITCH

The key operated rotary snap switch S1 is in shunt with the alarm loop and is intended to be installed outside the cabin or other protected enclosure. When S1 is closed the alarm is inoperative and hatches and doors can be opened with impunity.

When the cabin is vacated and the door locked prior to departing from the vessel, the keyswitch is turned and the key pocketed, leaving the system set up. It follows of course, that the siting of this switch should be such as to make it as inconspicuous as possible.

RESET SWITCH

If an intruder does set off the alarm the deactivation procedure on return would be to close the veto switch S1 with the key, and then press the push-to-break switch S2 which will de-energise relay RL1, so breaking the alarm contacts RLA1. Releasing this switch immediately sets the system to standby again.

CONSTRUCTIONAL DETAILS

A suitable housing for the electronic assembly is an S.T.C. diecast box slotted to take the Veroboard sub-assembly (see diagrams and photograph).

Since this box is made of an aluminium alloy it is essential to paint this with a waterproof metal primer (as used on boats) to prevent corrosion. This should be done after the unit is sealed so that the paint applied forms a barrier to corrosive influences. Technical data sheets on the choice of primers and paints applicable may be obtained by writing for relevant data sheets to British Paints Ltd., Little Ship Division, Northumberland House, 303–306 High Holborn, London, W.C.1.

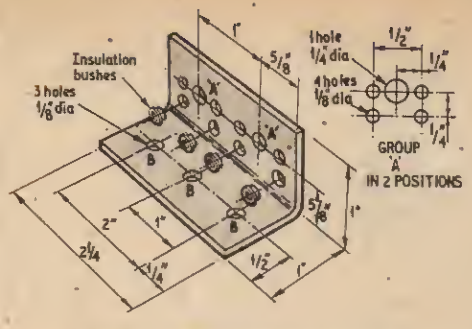


Fig. 5. Relay mounting bracket

In the relay sub-assembly, drilling of all holes in the mounting bracket should be done using the template shown as a guide. Since the circuit consists entirely of switching elements there is nothing particularly critical in the construction.

The unit should be given a functional check prior to boxing and particular care should be taken in making the breaks in the copper strip of the Veroboard at the extremes of the board, as one is sometimes inclined to do this extremely fast with a spot fact cutter and leave pieces of swarf to short adjacent strips.

LOOP CIRCUIT SWITCHES

It is recommended that linear action microswitches be used in the loop circuit as "break-in" detectors. Either the button or lever type microswitches may be used as both types can be suitably recessed for doors and hatches.

Perhaps a more economic system would be the employment of stainless steel shims arranged to operate as contact plates. Wiring to these plates would be by way of eyelet tags, the assembly being both electrically and mechanically joined by brads driven through eyelet tags and shims to the wood backing. As this was not tried in the prototype system it can only be a suggested possible alternative.

Connection to all microswitch detectors should be by miniature p.v.c. 7/40 wire. Although not as inconspicuous as thin enamelled wire, there is less likelihood of abrasion producing false alarms through short circuits if the loop wires are spliced in the run.

Since any attempt to cut wires will trigger the alarm, concealment of these wires by channelling is not really important. Any burglar who is *au fait* with alarm systems would be deterred if he was made aware of some protective guard against his intended pillaging; after all, many motorists display stickers on their windows to the effect that X's proprietary alarm system is installed —which is a daunting first line deterrent.

ACOUSTIC TRANSDUCER

The audible alarm device suggested is a v.h.f. car horn. However, since the contacts of relay RLB are heavy duty, other types of alarm may be fitted, such as a strident bell—this applies particularly if the system is adopted for home or business protection.

For the larger vessel with its own power supplies, existing hooters, marine horns, or loud hailers can be connected in the external switch circuit.

If the system is used for car protection, horn and headlights can be arranged in series with the RLB contacts. This will necessitate the use of an extra pair of contacts at the multi-pole connector PL1, SK1 for load sharing, as these contacts are only rated at 5 amps. ★