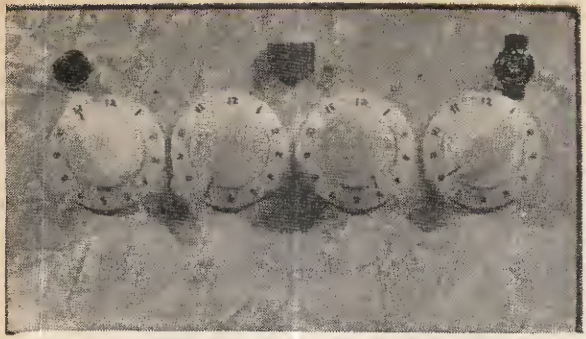


ELECTRO-COMBINATION LOCK

By P. L. TILSON

THE MAIN disadvantages with an ordinary mechanical combination lock are firstly that the lock must be on the safe or strongbox itself, and is thus easily visible, and can be blown off; secondly, an expert can find the combination.

The electrical lock described in this article can be mounted any reasonable distance from the safe, has no tumblers, and so cannot be "stethoscoped". If the wrong combination is selected, even by only one number, an alarm bell rings, and continues to ring until cancelled by the owner of the safe or somebody else knowing the combination. This lock costs far less to make than it would cost to buy a commercial lock of the combination type.

The lock on the safe is, in fact, a solenoid operated bolt. These are readily available in two types; 250 volt a.c. operated, and 12 volt d.c. operated. For the circuit in question, the latter type was chosen. The a.c. type would have meant an additional relay, and therefore a higher cost.

COMBINATION

The correct combination for the circuit shown in Fig. 1 is **11, 7, 5, 8.** When S1–4 are set to these positions and S5 pressed, current flows from the power supply through these set switches, through the bolt solenoid, the normally closed contacts of S6, and back to the power supply unit. Other combinations can be arranged by wiring the wafer switches in a different sequence, or renumbering the switch positions.

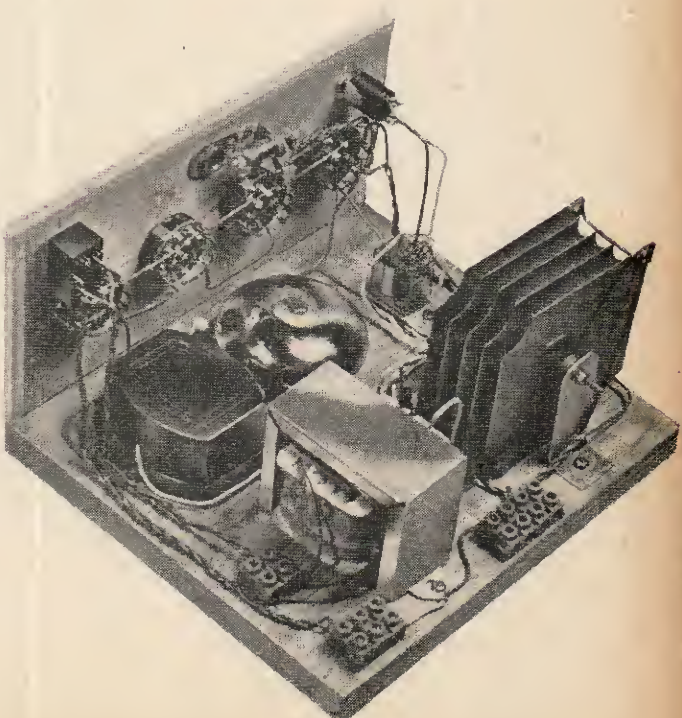
If the wrong combination is set the current flows through the wafer switches, but on finding the one which is incorrectly set, it follows a path through the relay coil, and returns to the power supply unit through S5 (closed) and S6. The relay is operated; contacts RLA1 and RLA2 close. Contacts RLA1 holds the relay on even if S5 is switched off. Contacts RLA2 supply current to the alarm bell, which will continue to ring until S6 is opened and disconnects the supply to the relay coil. To reset the circuit in readiness for a subsequent alarm, S6 should be closed again.

Any number of switches may be connected up as in Fig. 1, with a corresponding increase or decrease in the number of possible combinations. A simple formula can be used to calculate the number of combinations:

$$c = x^n - 1$$

where c is the number of possible combinations, x is the number of positions on the switches, and n the number of switches. Thus with the circuit shown in Fig. 1, 20,735 different combinations are possible! With one more switch, the number is increased to 248,831! It should be noted that all the switch contacts *except* those of the actual combination, should be connected together and taken to one end of the relay coil. If this is not done, the alarm system cannot operate.

There is no reason why the unit should not be built for 6 volt operation if this is more convenient. In this case, a relay suitable for 6 volt operation should be used (type MH2 185 ohms). Likewise the transformer, solenoid, rectifier, bell, and pilot lamp should also be 6 volt types.



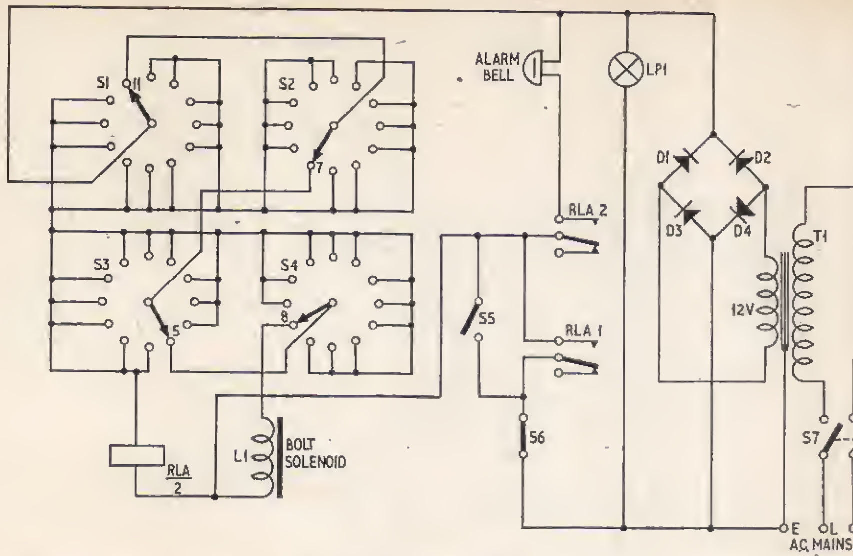


Fig. 1. Circuit diagram of the combination switching system designed for a 12 volt d.c. power supply. The solenoid L1 and switch S6 are shown here but are installed in the safe remote from the main unit

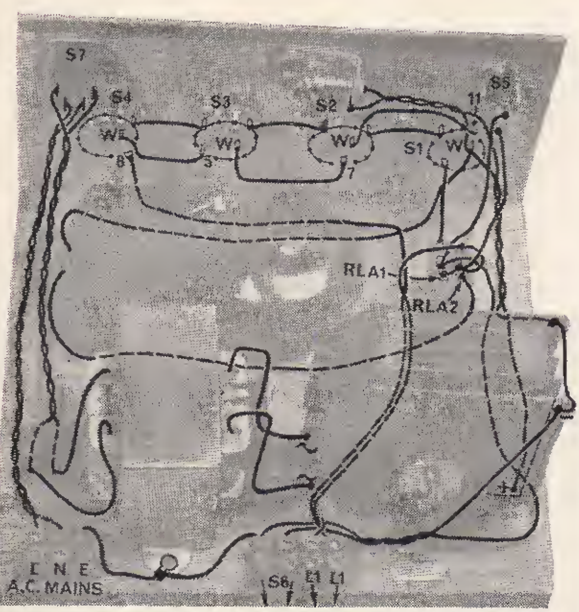


Fig. 2. This photograph of the main switching and power unit has been treated to show the layout and wiring of components

COMPONENTS . . .

Transformer
T1 A.C. mains primary, 12V 3A secondary

Solenoid
L1 Solenoid operated bolt, 12 volt (Service Trading Co., 47/49 High Street, Kingston on Thames)

Relay
RLA 12 volts 700 ohms (Keyswitch Relays Ltd., type MH2)

Rectifier
12V 3A metal bridge rectifier

Switches
S1, S2, S3, S4 1-pole 12-way single wafer types
S5 Push on, release off single pole push button
S6 On/off toggle switch

Lamp
LP1 Indicator lamp with 12V bulb

Miscellaneous
P.V.C. insulated wire, four core cable, plywood, nuts and bolts

A practical wiring diagram of the control unit and the power supply unit is shown in Fig. 2. The panel indicator lamp may be omitted if desired.

Needless to say, all connections in the unit should be soldered, and a miniature electrical iron is preferable for this operation. Cored solder containing a *non-corrosive* flux (such as Ersin Multicore) should be used for this purpose. Four-core cable is used for connecting the solenoid and S6 to the control unit, as this happened to be handy, but remember, the flex used must be capable of carrying sufficient current to operate the solenoid. Ordinary 5 amp lighting flex is admirably suited to this purpose.

THE SAFE BOLT

It is not proposed to give constructional details of the safe itself as this depends on the individual requirements of the constructor. The author's safe was a box 1 foot square and let six inches into the wall. The surface of the box was panelled to match the surrounding wood.

The solenoid is fixed to the door of the safe with a single clamp and screwed down firmly. The position of the end of the iron core of the solenoid is marked on the safe wall, and a hole of suitable diameter is drilled to take the core. As may be seen in Fig. 3, the end of the core is chamfered, as is the wall of the safe, to enable the door to be closed without withdrawing the bolt. Fig. 4 illustrates the crude, but effective method of returning the bolt. Any form of coil spring is suitable here, provided that it is not so strong that the solenoid cannot withdraw the bolt. The wires from the coil may be stapled to the door and walls of the safe, and led out of the back.

The only other part which is housed in the safe itself is the alarm bell "cancellation" switch S6. This prevents anybody from cancelling the alarm before attempting to open the safe.

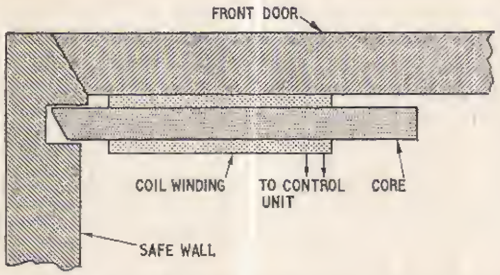


Fig. 3. Sectional plan view of the solenoid bolt mounted inside the safe on the door. Note the chamfered bolt to facilitate easy closure

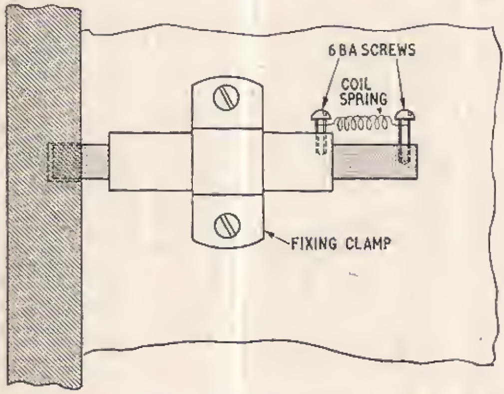


Fig. 4. Interior view of the solenoid bolt mounted on the door with a clamp. The coil spring allows the bolt to remain in the "locked" position until operated by the combination circuit

TESTING

To test the unit, the safe door should at first be left open. Set the combination switches to the correct combination code, and press S5 intermittently. The bolt should move smoothly backwards and forwards. If it does move, but only slightly, try adjusting the tension of the return spring. If the bolt does not appear to move at all, check the wiring to the bolt, and make sure that S6 is closed. If all is well, set the switches to the "wrong" combination and press S5 again. The alarm bell should ring, and continue ringing even when S5 is released. If it stops ringing when S5 is released check the wiring around the RLA1 contacts of the relay, and of the combination switches themselves. ★