BUILD A CRYPTO LOCK

ELECTRONIC SECURITY: SMALL IN SIZE AND BURGLAR PROOF

This unusual electronically activated lock is the simplest—yet one of the most difficult to "break"—circuits examined by the Editors in the past few months. Its simplicity is deceptive and we urge anyone having a use for such a device to peruse this article carefully.

THERE ARE almost as many varieties of electronic combination locks as there are combinations to operate them. Most are complex pieces of solid-state wizardry—often employing dozens of costly components in elaborate circuits to provide burglar-proof "one-chance-in-1,774,385" combinations.

By contrast, the "Cryptolock" is a simple device, that is inexpensive, easy to build, and small enough to give you electronic lock protection on such things as medicine cabinets, power tool chests, gun racks, desks, and even strong boxes. Or you can use it to safeguard the doors of your home and garage as safely as the best mechanical lock.

The Cryptolock's three-digit combination is deceptive. Numerical grouping, two timing circuits and a penalty feature make "cracking" it a difficult task. Yet, when one knows the combination, it can be opened in less than two seconds. The Cryptolock can be powered by batteries or by a low-voltage dc power supply. Thus it is suitable for both fixed and portable installations.

On the "key" panel for the Cryptolock are six miniature, momentary-contact, push-button switches—each identified by number. The switches are connected to the electronic circuit, which is housed in a small, molded-plastic box mounted inside the area to be protected.

The combination of the unit shown in Fig. 1 is 1/5-4. This means that, to open the lock, switches 1 and 5 must be pressed simultaneously, followed immediately by the pressing of switch 4. Most people find that it is quite easy to press the two initial switches at the same time with their index and middle fingers. Since these two switches are wired in series, they must be closed at the same time for a fraction of a second in order to enter the first part of the combination. Then when the 4 switch is pressed, the solenoid on the lock is energized.

That seems pretty simple, but there is a catch. After the first two numbers are pressed, you have only about one and one-half seconds to press the third. After that time,

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thing happens when the third number is pressed. It is then necessary to start over with the first two numbers. This two-digit/one-digit combination is enough to confuse most would-be "safe-crackers" who expect to try no end of one-number-at-a-time combinations. That's not the end of the thief's problems, however. If, at any time after he has chanced to press 1 and 5 simultaneously, he chances to press 2, 3, or 6, the lock is automatically deactivated for about 25 seconds. Until the circuit comes to life again, even the correct combination won't open it. What's more, if 2, 3, or 6 is pressed again during this period, the waiting time is extended to the full 25 seconds. The fact that there is no way to tell when he has deactivated the circuit by pressing the wrong number is enough to discourage even the most persistent burglar.

Of course, the combination of the Cryptolock can be changed to any two-digit/one-digit code in a matter of minutes with a soldering iron. It can also be made more complicated by adding four or more switches in parallel with the penalty switches (2, 3, and 6). The combination—while sufficiently complex to foil most attempts to open it illegally—is still simple enough for a child to remember and use.

Construction. Using the circuit shown in Fig. 1, the prototype was built in a 2⅛" × 3¼" × 1⅛" molded plastic box. This makes the unit as small as possible for use in a limited space. However, a larger enclosure can be used. The circuit can be located some distance away from the key panel and the solenoid latching mechanism.

The components were mounted on perf-

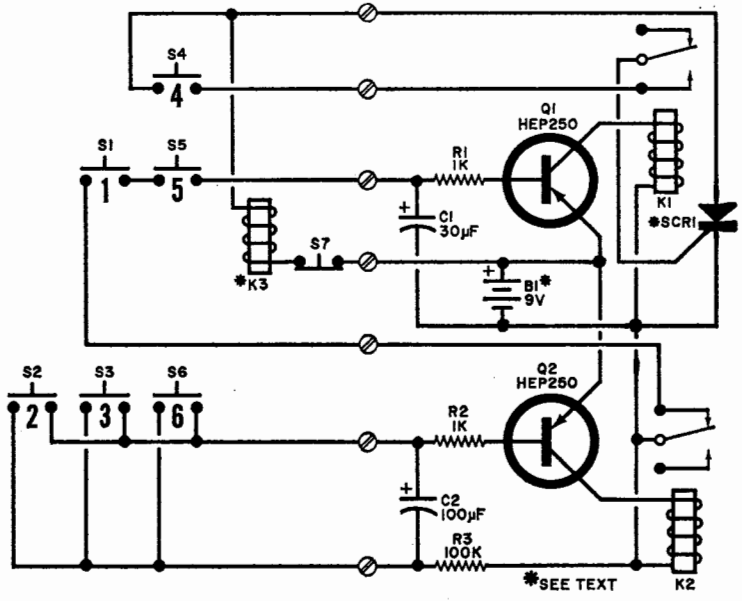
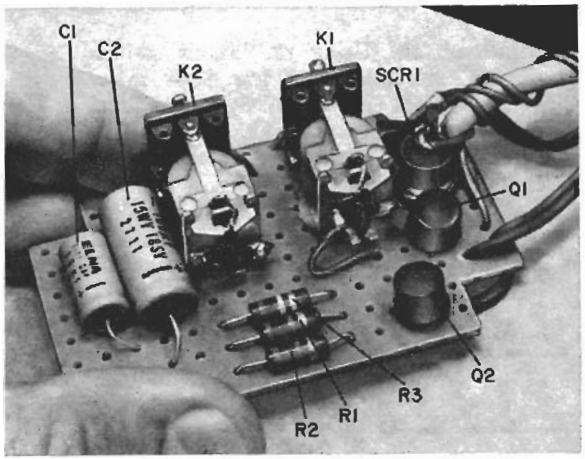


Fig. 1. If desired, circuit can be extended by adding more switches in parallel with S2, S3, and S6; in series with S1 and S5; or in series with S4. To change combinations, rearrange the switch positions on door or plate.

PARTS LIST

B1—9-volt dc source
C1—30-μF, 15-volt electrolytic capacitor
C2—100-μF, 15-volt electrolytic capacitor
K1,K2—5000-ohm miniature dc relay (Lafayette Little Jewel 99E60915 or similar)
K3—6-to-9-volt dc solenoid or relay (see text)
Q1,Q2—SK3004 or HEP250 transistor
R1,R2—1000-ohm, ½-watt resistor
R3—100,000-ohm, ½-watt resistor
SCR1—Silicon controlled rectifier (GE-X1 or similar, see text)
S1-S7—Spst normally open miniature push-button switch (Switchcraft 961 or similar)
Misc.—Test lamp (6-to-9-volt), perf board, plastic case, power relay (optional), interconnecting multi-lead cable.

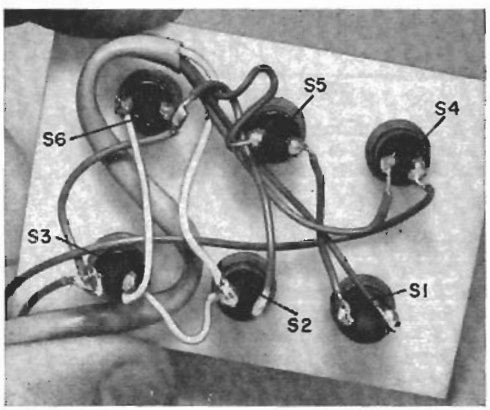
board. Parts placement is not critical, as long as each component is isolated from the others and free movement of the relay armature is assured. Point-to-point wiring is acceptable if leads are kept short and neat. Use a needle-nose pliers or a clip-type heat sink to protect *Q1* and *Q2* when soldering. The *SCR* is bolted to the perf board by its threaded



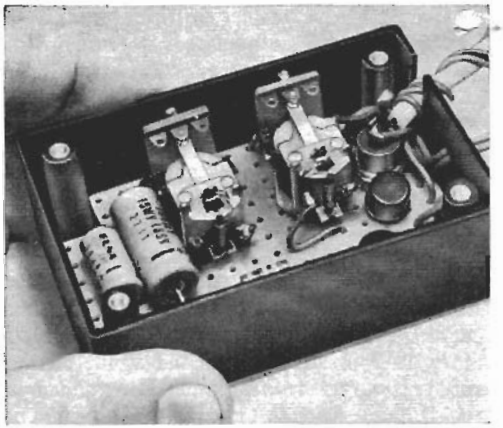
If you build the lock on perf board, you can follow layouts used by the author on prototype model.

anode. Bolt or cement the two miniature relays to the perf board. They should be mounted so that they are upright and relatively level. Their performance will be affected if they are mounted on their sides or inverted.

The components chosen for *SCR1*, *K3* and the power source must be properly related. Start with the selection of solenoid *K3*.



In finished version, the six pushbuttons would be mounted directly on the door being protected.



To protect the relays, in the prototype, the unit was mounted in a conventional plastic enclosure.

There are many low-current dc solenoids on the market, so select a 6- or 9-volt type that is spring-loaded to remain locked unless the coil is energized. Then choose an SCR that can carry the coil current and a power source that can handle this load. As another option, a 6-to-9-volt relay (with contacts rated to carry the load) can be used instead of *K3* if you wish to activate some form of alarm. With dc applied to the SCR, once it is fired, it will remain on unless the supply

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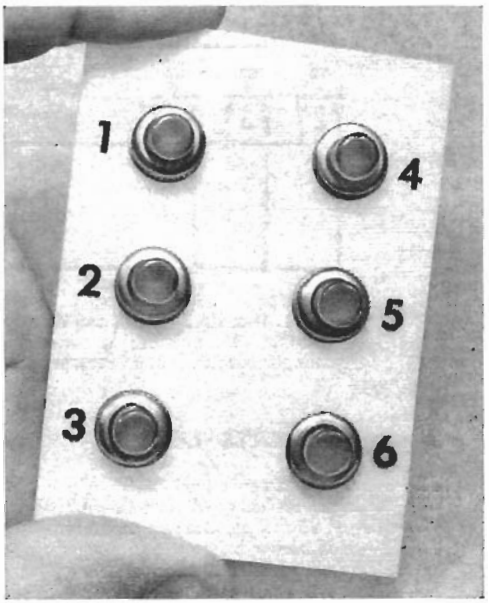

The six pushbuttons can be marked in any fashion with numbers, letters, symbols, or left just plain.

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is interrupted. This is the purpose of the normally closed pushbutton *S7*. When *S7* is depressed, the SCR is cut off.

Checkout. When all components have been secured in place and wired in accordance with Fig. 1, substitute a 6-to-9-volt lamp for *K3*. Depress pushbutton switches 1 and 5 and note that relay *K1* closes. If it does not, recheck all wiring, including the connections to the pushbuttons on the key panel. It's easy to wire them incorrectly since you are working from behind and they are in reverse order. Once assured that the wiring is correct, press 1 and 5 again, followed quickly by 4. The test lamp should light, indicating that SCR has been triggered and the lock is open. If not, use needle-nose pliers to bend the metal tab (carefully) to which the armature spring of *K1* is attached. Bend it upward to decrease the tension on the spring. Try the combination again. An additional adjustment of *K1*'s spring may be necessary. Switch *S7* is used to de-activate the system.

Now press 2, 3, or 6 on the key panel. Relay *K2* should close and remain closed for 20 to 30 seconds. During this time, it is impossible to activate *K1*. If *K2* doesn't close, repeat the adjustment procedure specified for *K1*. Generally speaking, you won't have to adjust *K2* because it closes with much more force than *K1*. There are a number of types of miniature, 5000-ohm dc relays on the market and their response times vary considerably so be prepared to switch relays if necessary. Once *K1* and *K2* are adjusted, no further adjustments should be necessary. Just be sure they remain in an upright position while the Cryptolock is being activated.

In the typical home or garage installation, it's a good idea to provide a key switch backup to the electronic locking system. Simply wire a spst key switch so that it bypasses the electronic lock and (when closed with a mechanical key) applies power directly to the solenoid latch to open the door. The key switch can be located some distance from the electronic key panel and concealed. This will enable you to open the door in the event the key panel is damaged as a result of an attempted burglary. Also remember to keep pushbutton *S7* within the protected area. —30—