A combination lock controlled by an electronic circuit that responds to actuation of selected ones of a bank of switches in predetermined order and is inhibited in response to actuation of any other one of the switches. The circuit includes an array of SCR's connected in series, each triggerable by actuation of a selected one of the switches. A solenoid is energized in response to firing of the last SCR in the array to open the lock. When used in an automobile to deter theft, the solenoid is preferably connected to control a valve in the fuel line, and includes a self-holding contact so that, once energized it remains energized until the ignition switch is turned off.

2 Claims, 1 Drawing Figure
ELECTRICAL COMBINATION LOCK AND
VEHICLE THEFT PREVENTION SYSTEM

BRIEF DESCRIPTION

This invention relates to a novel, electrically con-
trolled lock of the kind that responds to actuation of
selected ones of a bank of switches and is inhibited in
response to actuation of any switch other than the
selected ones.

The invention was prompted by the demand for a
lock for automobiles to deter theft, but it is believed it
will be found advantageous in many other utilizations.
It provides a simple and reliable combination arrange-
ment, practically pick-proof, which can be readily
adapted for use in almost any security system.

Briefly, the circuit of the invention includes a bank of
momentary contact switches, typically ten in number,
and an array of triggerable avalanche devices such as
SCR's connected in series with each other and with the
device to be controlled. Selected ones of the switches
are connected to trigger the avalanche devices, thereby
to energize the device to be controlled in response to
firing of the last avalanche device in the series. All of
the switches other than the selected ones are connected
to trigger an inhibiting arrangement which cuts off the
avalanche device and holds them disabled until the
circuit is deenergized.

When used as an automobile safety lock, the device
to be controlled is preferably a normally closed sole-
noid valve in the fuel line of the vehicle, and most of
the circuit components are mounted, along with the
valve, in a sturdy, weatherproof box beneath the floor
of the vehicle.

DETAILED DESCRIPTION

The presently preferred embodiment of the inven-
tion will now be described in connection with the ac-
companying drawing, wherein the single FIGURE is a
schematic diagram of a circuit according to the inven-
tion.

The circuit shown is arranged to control the opera-
tion of a solenoid valve 10 in the fuel line 11 of an au-
tomobile. All of the components of the circuit included
within the dashed rectangle 12 are preferably mounted
in a weatherproof housing secured beneath the floor of
the automobile, where it is relatively inconspicuous and
inaccessible. Other devices such as, for example, the
starter relay may be electrically ganged with the sole-
noid valve 10 if desired, but it is believed that control of
the fuel line alone provides adequate protection against
theft and that the additional cost of supplementing it
with starter, ignition, hood locks, or other controls is
not ordinarily justifiable.

The circuit includes an array of ten momentary con-
tact switches S-1 through S-0, inclusive, which may be
mounted on the instrument panel or steering column of
the vehicle. The circuit as shown is arranged to ener-
gize the valve 10, opening it, in response to the actua-
tion, in order, of three of the switches, S-8, S-2, and
S-5, representing the code combination 825. Activation
of any other of the switches inhibits the circuit until the
ignition switch 14 is opened.

The circuit is connected across the vehicle's battery
through the ignition switch 14, and includes three
SCR's 20, 21 and 22 connected in series with each other
for energizing the valve 10, and a fourth SCR 24
for inhibiting the circuit.

The switches S-1 to S-0 are connected to trigger the
SCR's 20, 21, 22, and 24. The switches representing
the predetermined code are connected respectively to
trigger the enabling SCR's 20, 21, and 23. All of the
other switches are connected to the gate electrode of
the inhibit SCR 24. The cathode of the first SCR 20
is connected through a normally closed contact of a
relay 26, which is energized in response to firing of the
inhibit SCR 24. When the relay 26 is energized, the
ground connection for all of the enabling SCR's 20, 21,
and 22 is broken, and the enabling SCR's are held cut.

The solenoid valve 10 is connected in series with the
last enabling SCR 22, and is energized when that SCR
fires. A self holding contact 28 is included in the sole-
noid valve 10 to insure that, once energized, the valve
10 will remain energized and held open so long as the
ignition switch 14 remains closed. This may be impor-
tant at times because closure of one of the non-code
switches will fire the inhibit SCR 24 and cut off the
enabling SCR's 20, 21, and 22 at any time. Thus, if the
self-holding contact 28 is omitted, the fuel supply might
be cut off while the vehicle is in operation if one of the
non-code switches were accidentally or inadvertently
acted. The contact 28 ensures against this.

The enabling SCR's 20, 21, and 22 are connected in
series with each other, and only the first one 20 is
directly grounded. They will, therefore, fire only in
one-two-three sequence. Until the first SCR 20 fires, it
holds the second one 21 cut off, and until the second
one 21 fires, it holds the third one 22 cut off.

Only five wires are needed to connect the bank of
switches S-1 to S-0 and the battery 16 to the housing
12. All of the non-code switches may be commoned
right at their terminals. With such an arrangement,
however, a thief who knows the operation of the cir-
cuit or the circuit could cut the cable leading to the hous-
ing 12, and with the aid of an electrical meter fairly quickly
identify the inhibit and battery leads. It would then be
an easy matter to trigger the enabling SCR's 20, 21,
and 22, and make off with the vehicle.

For maximum security, therefore, eleven leads are
extended to the housing 12, one for the battery 16, and
one for each of the switches S-1 to S-0. Moreover, the
switches are electrically isolated from each other by
diodes 30. With this arrangement, there is no way to
distinguish by testing externally of the housing 12
between the code switches S-2, S-5, and S-8, on the
one hand, and the non-code switches, on the other. To
foil the circuit, the would-be thief must either force
entry into the housing 12, or be lucky enough to chance
upon the predetermined code.

For the same reason, the SCR's 20, 21, 22, and 24
are preferably of the type conforming to U.S. military
specifications Mil-S-19500/168 that are capable of
stable and reliable operation without external connec-
tions between their trigger electrodes and their cathodes.
SCR's commercially designated 2N1770A, for example, are satisfactory for use in the circuit as
shown.

The circuit may be readily adapted for use in connec-
tion with any kind of lock system. Any desired elec-
trically operable device may be used in place of the
solenoid valve 10. Also, in many utilizations, the self-
holding contact 28 will not be needed because it is
often desired to energize the controlled device only
momentarily.
It should also be apparent that the code may include fewer or more than the three digits illustratively described herein. The circuit includes one SCR for each of the code digits, plus the inhibit SCR 24.

The circuit can also be readily modified for use in systems where the positive battery terminal is grounded simply by reversing the polarity of the SCR's and the diodes.

What is claimed is:

1. An electrical combination lock for energizing a device to be controlled comprising:
   a. triggerable avalanche devices equal in number to the number of digits in a predetermined code combination, said avalanche devices being connected in series with each other and with the device to be controlled,
   b. an array of switches greater in number than said avalanche devices,
   c. means for connecting said switches and said avalanche devices to a current source,
   d. selected ones of said switches being arranged to trigger different respective ones of said avalanche devices, whereby said avalanche devices may be fired by actuating said selected switches in a predetermined order,
   e. means for inhibiting said avalanche devices in response to actuation of any of said switches other than said selected ones, and
   f. means for connecting the device to be controlled in series with the one of said avalanche devices triggered by the selected switch that denotes the last digit of the code.

2. A combination lock according to claim 1 including a sturdy housing for the avalanche devices and the device to be controlled, a separate panel spaced from said housing for mounting the switches, and a multi-conductor cable for connecting the switches to the avalanche devices, said cable including a separate conductor for each of said switches, and isolating means in said housing for electrically isolating said separate conductors from each other, whereby electrical testing externally of said housing is ineffective to distinguish between said selected and said other switches.

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