Oct. 13, 1970 F. E. SELLINGER ET AL 3,534,350

ELECTRICAL PROTECTION SYSTEM

Filed Nov. 21, 1967 3 Sheets-Sheet 1

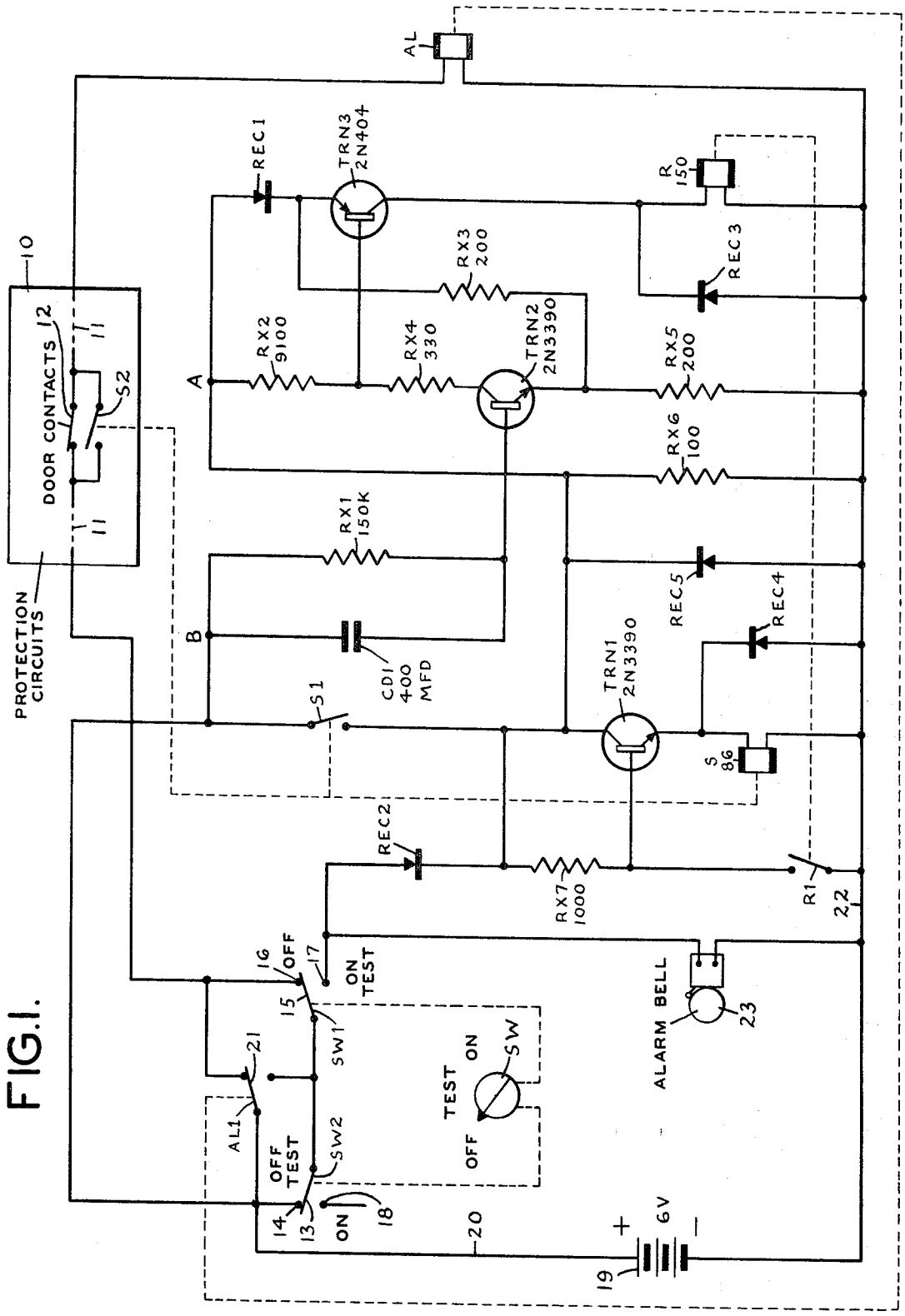

FIG. 1.

ELECTRICAL PROTECTION SYSTEM

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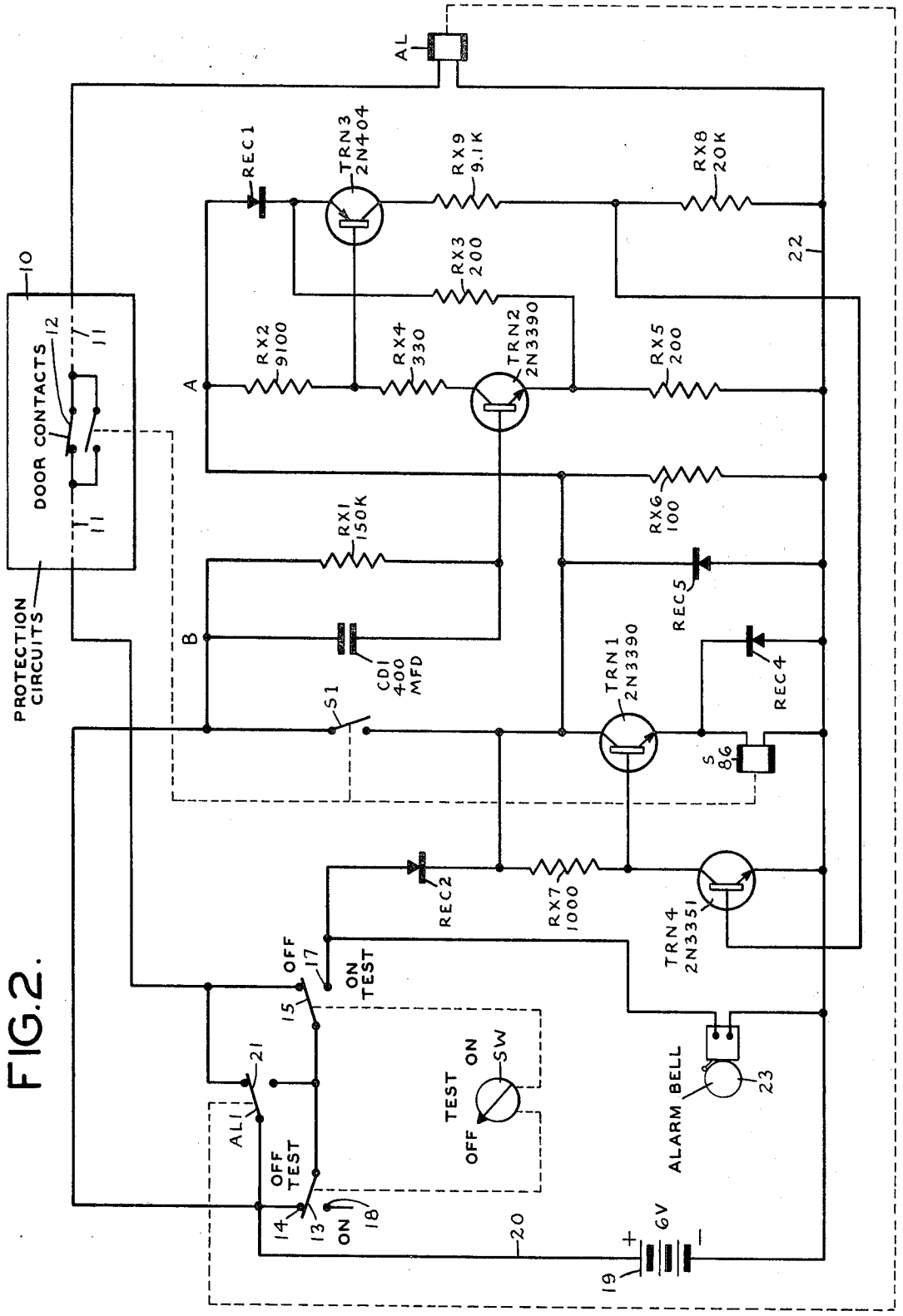

FIG.2.

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ELECTRICAL PROTECTION SYSTEM

Filed Nov. 21, 1967 3 Sheets-Sheet 3

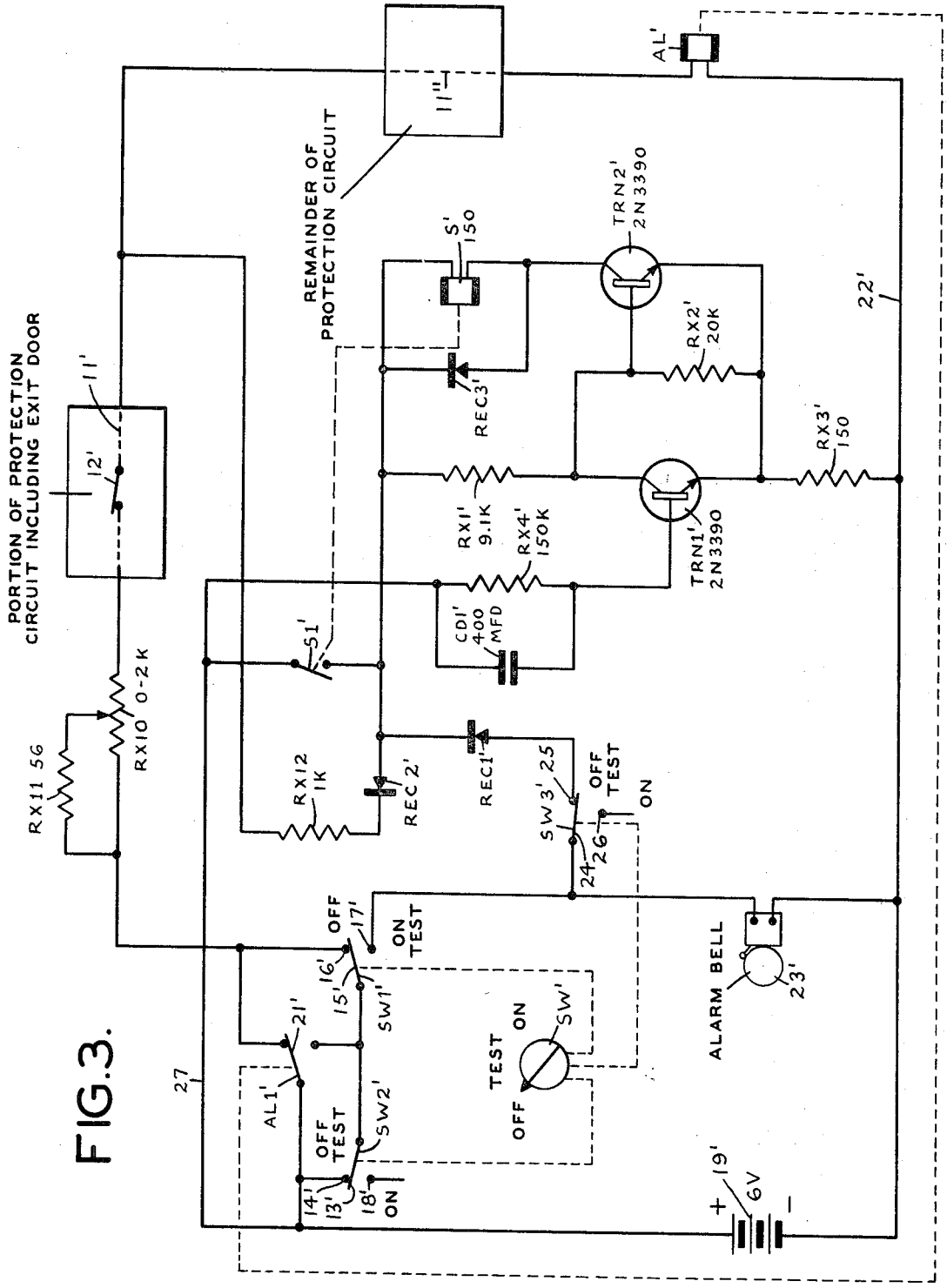

FIG. 3.

United States Patent Office 3,534,350 Patented Oct. 13, 1970

3,534,350

ELECTRICAL PROTECTION SYSTEM

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Int. Cl. G08b 13/08, 29/00
U.S. Cl. 340—214 8 Claims

ABSTRACT OF THE DISCLOSURE

An electrical protection system with an automatic exit control which provides a time delay period in which a person setting up the system can leave the premises without initiating an alarm signal. A three position control switch is arranged in an "off" position to charge a capacitor and in a "test" position to test the system alarm bell and to energize a relay which in turn commences the discharge of the capacitor through a discharge circuit selected to provide a desired time constant. Immediately after the test of the bell the control switch is moved to an "on" position. After a time delay dependent on the capacitor discharge time constant, a transistor circuit is energized to release the relay and recharge the capacitor. During the interval that the relay is energized the protection contacts on an exit door are shunted or otherwise rendered ineffective to transmit an alarm.

BACKGROUND

Electrical protection systems for the protection of mercantile establishments, factories and other types of buildings are generally provided with a local alarm bell or are connected to a police or guard headquarters or to a central station. In the former case, ringing of a bell in or adjacent to the protected premises signals an alarm. In the latter case, an alarm condition is signalled to a central station or other location where guards or police are on duty so that they can investigate promptly the cause of the alarm.

During business hours, generally during the day and/or early evening, the protection afforded the premises is entirely or largely disconnected. At the close of business hours, doors and windows are closed and inside protection devices, e.g., traps and photoelectric devices are connected. The last person to leave the premises is required to test the electrical integrity of the protection system and then, if the test is satisfactory, such person must leave the premises. Since the exit door is normally protected by door contacts, opening the door to leave the premises would signal an alarm, either locally or at the central station or police headquarters, if means were not provided to suppress such an alarm.

A variety of devices and circuits have been used to suppress transmission of an alarm signal for a period of time after the protection has been turned on in order to permit exit from the premises without transmission of an alarm signal. The most widely used device has involved a timer switch set by the person setting up the protection after the test of the system integrity is complete. Such devices work well, but are subject to disadvantages. For example, use of a timer represents a separate operation which may be forgotten and which in such case will result in a spurious alarm when the person leaves the

premises. The danger of this occurring is greatest when the test mechanism and the timing mechanism are at different locations, which is usually the case.

The principal object of the invention has been the provision of a novel and improved automatic exit control for an electrical protection system.

Another object of the invention has been the provision of a novel and improved electronic circuit for affording an automatic exit control.

Other and further objects, features and advantages of the invention will appear more fully from the following description of the invention.

SUMMARY OF THE INVENTION

The invention is concerned with an automatic exit control for an electrical protection system having a plurality of protection devices connected in a protection circuit, one of the devices being exit contacts operatively associated with an exit door for operating upon opening of the door. The exit control comprises a three position switch having "off," "test" and "on" positions and being adapted to be moved sequentially from one to another of the positions. An alarm signalling means, e.g., a bell, has dual operating circuits arranged to connect the signalling means to a source of potential to operate the signalling means when the switch is in its "test" position and also when both the switch is in its "on" position and one of the protection devices is operated to open the protection circuit. A capacitor is arranged to be maintained fully charged when the switch is in its "off" position, the capacitor having a discharge circuit with a selected time constant. When the switch is moved to its "test" position a current responsive means is operated to commence means is maintained operated when the switch is moved from its "test" to its "on" position, which is done as soon the discharge of the capacitor. The current responsive as the bell sounds. When the capacitor discharges to a predetermined proportion of its full charge, the conductive condition of a transistor is changed, which in turn results in return of the current responsive means to its unoperated condition. During the interval that the current responsive means is operated, operation of the signalling means in response to operation of the exit door contacts is prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in greater detail with reference to the appended drawings in which:

FIG. 1 is a schematic diagram illustrating one embodiment of the invention;

FIG. 2 is a schematic diagram illustrating a modification of the circuit of FIG. 1; and

FIG. 3 is a schematic diagram illustrating another embodiment of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings and more particularly to FIG. 1, the protection circuits for the protected premises are indicated diagrammatically by the box **10** and the dashed line **11**. The dashed line **11** is intended to indicate any desired number of protection devices connected in series. Typically these might include door contacts, window foil, traps and frequently more sophisticated protection devices, as is well known in the art. Among the devices included in the series circuit **11** is a set of door

contacts 12 which protect the exit door and which open when the exit door is opened. The contacts 12 are bridged by a set of normally open relay contacts S2 of a relay S.

For the purposes of description, the "normal" condition of the circuits and switches in the various figures is to be taken as the "off" or "day" condition, i.e., the minimum protection condition in which some or all of the protection devices are not effective. In their "off" condition a control switch SW formed by a ganged pair of switches SW1 and SW2 is set as shown in FIG. 1 with armature 13 made with "off-test" contact 14 of switch SW2 and armature 15 made with "off" contact 16 of switch SW1. When the ganged switches are moved to the "test" position, armature 13 remains made with contact 14 while armature 15 leaves contact 16 and makes with "on-test" contact 17 of switch SW1. When the ganged switches are moved to the "on," i.e., maximum protection or "night" condition position, armature 13 leaves contact 14 and makes with blank "on" contact 18 of switch SW2 while armature 15 remains made with contact 17.

Positive potential from a suitable source, e.g., the 6 volt battery 19, is supplied through a conductor 20 to contact 14 of switch SW2, to armature 21 of alarm relay contacts AL1 of alarm relay AL and to circuit point B. The negative terminal of battery 19 is connected to a negative conductor 22.

Relay AL is normally energized through its contacts AL1, the circuit extending from the positive terminal of battery 19 through conductor 11 (including door contacts contact AL1, protection circuit 11 (including dor contacts 12) the coil of alarm relay AL and conductor 22 to the negative terminal of battery 19. When power is first turned on (or when contacts 12 are closed after having been opened) relay AL will be energized through the alternate circuit shown including armature 14 and "off" contact 13 of the ganged switch SW2 and armature 15 and "off" contact 16 of ganged switch SW1.

With ganged switches SW1–SW2 in their "off" positions, the positive potential supplied to circuit point B charges a capacitor CD1 through the base-emitter circuit of an otherwise non-conductive transistor TRN2 and a resistor RX5. It will be observed that typical values for capacitor CD1, resistor RX5 and the other circuit elements are set forth in the drawings. This has been done only by way of illustration and their values are not to be taken as limiting the scope of the invention. Typical transistor types are indicated on the drawings. The rectifiers may all be diodes of the IN2070 type.

An alarm bell 23 is connected between contact 17 and negative conductor 22. A series circuit formed by a rectifier REC2, a resistor RX7 and normally open contacts R1 of a relay R is connected in parallel with bell 23.

Circuit point B is arranged to be connected to the junction of resistor RX7 and rectifier REC2 and to the collector of a transistor TRN1 through normally open contacts S1 of relay S. The base of transistor TRN1 is connected to the junction of resistor RX7 and contacts R1, while the emitter thereof is connected to one side of the coil of relay S. A rectifier REC4 shunts the coil of relay S to suppress voltage surges on operation of relay S. A rectifier REC5 is connected between the collector of transistor TRN1 and the negative conductor 22 to protect the transistor from voltage surges.

When relay S becomes energized, as will hereinafter be described, positive potential is supplied to a circuit point A through normally open contacts S1. Between point A and negative conductor 22 there are two series circuits. One is formed by resistors RX2 and RX4, the collector-emitter circuit of transistor TRN2 and a resistor RX5. The other is formed by a rectifier REC1, the emitter-collector circuit of a transistor TRN3 and the coil of relay R. The coil of relay R is shunted by a rectifier REC3 which serves to suppress voltage surges upon operation of relay R.

The junction of resistors RX2 and RX4 is connected to the base of transistor TRN3. The emitter of transistor TRN2 is coupled tothe emitter of transistor TRN3 through a resistor RX3. Transistors TRN1, TRN2 and TRN3 are normally non-conducting, except for the charging current flowing through the base-emitter junction of transistor TRN2 as described above.

When control switch SW is moved from the "off" to the "test" position thereof, ganged switch SW2 does not transfer but switch SW1 does, applying positive potential to contact 17. This positive potential on contact 17 operates bell 23 so that the person operating the switch (for convenience to be called the proprietor) knows that the bell is operating properly.

The positive potential on contact 17 also causes current to flow through rectifier REC2, resistor RX7, the base-emitter circuit of transistor TRN1 and the coil of relay S, thus energizing transistor TRN1. With transistor TRN1 energized, relay S becomes energized, closing contacts S1 and S2 thereof.

Contacts S2 shunt the exit door contact 12, thus permitting the proprietor to leave the premises without causing an alarm signal when the open condition of the exit door causes contacts 12 to be open.

Closing contacts S1 locks relay S in its energized condition by supplying positive potential directly to the collector of transistor TRN1. Closing of contact S1 also supplies positive potential directly to circuit point A. Hence when control switch SW is operated to its "on" position in which armature 14 makes with blank contact 18 and thus removes positive potential from armature 15, transistor TRN1 remains conductive, relay S remains energized and circuit point A remains at a positive potential. Rectifier REC2 is poled to prevent positive potential being applied to bell 23 through contact S1.

Operation of switch SW to its "on" position also silences bell 23 by removing its operating potential at armature 14. Under these conditions bell 23 will only operate when an open occurs in protection circuit 11 causing alarm relay AL to drop out and transferring its armature 21 to back contact AL1 so as to provide positive potential to bell 23 through armature 15 and contact 17 of switch SW1. Such an open will be representative either of circuit trouble or an alarm and hence will require investigation. As is well known in the art, when the system is connected to a central station, alarm bell 23 will normally be disabled during the "on" or "night" condition and the alarm signal occurring when relay AL drops out will be transmitted silently to the central station through alarm relay contacts and a signalling circuit not shown in the drawings.

As soon as switch SW is moved to the "test" position and armature 15 makes with contact 17, capacitor CD1 will start to discharge through resistor RX1. The discharge of capacitor CD1 can best be understood by considering the voltages at the various pertinent points in the circuit. When the circuit is in its normal "off" condition, capacitor CD1 is charged to about 5.5 volts, the remaining 0.5 volt of the supply appearing across the resistance of the base-emitter junction of transistor TRN2. When switch SW is moved to the "test" position, thus supplying 6 volts positive potential to point A, a path is established to negative conductor 22 through rectifier REC1, resistor RX3 and resistor RX5. There will be about a 0.5 volt drop across rectifier REC1, so that the voltage drop across resistor RX3 will be about 2.75 volts and the voltage drop across resistor RX5 similarly will be about 2.75 volts.

Considering the voltage drops between point B and negative conductor 22, there are 5.5 volts across capacitor CD1 and 2.75 volts across resistor RX5, giving a total of 8.25 volts. Since the supply is only six volts, capacitor CD1 must discharge to obtain circuit equilibrium.

Capacitor CD1 has two possible discharge paths. The first is through resistor RX1. The second is through con-

tacts S1, rectifier REC1, resistor RX3 and the base-emitter junction of transistor TRN2. Since the back resistance of the base-emitter junction of transistor TRN2 is much higher than the 150K ohm resistance of resistor RX1, very little current flows through the second path. Hence the discharge time constant is determined essentially by the capacitance of capacitor CD1 and the resistance of resistor RX1. For the example shown, the time constant is one minute.

The charge on capacitor CD1 applies a back bias to the base-emitter junction of transistor TRN2 which prevents base current from flowing until the charge has fallen off sufficiently for the back bias to be overcome by the forward bias produced by the voltage drop across resistor RX5. Thus when the charge on capacitor CD1 is reduced to 2.75 volts, transistor TRN2 will no longer be back biased and will become conductive. Current flowing through the collector-emitter circuit of transistor TRN2 will bias transistor TRN3 to conduction and the latter will conduct. Transistor TRN3 was held non-conductive until conduction of transistor TRN2 by the back bias applied to the emitter of transistor TRN3 through rectifier REC1.

When transistor TRN3 becomes conductive, current flowing through its emitter-collector circuit energizes relay R, resulting in closing of normally open contacts R1.

Closing of contacts R1 connects the base of transistor TRN1 to negative conductor 22, causing transistor TRN1 to become non-conductive. With transistor TRN1 non-conductive, relay S drops out and opens contacts S1 and S2 thereof.

Opening of contacts S2 removes the shunt path around door contact 12, restoring protection to the exit door. The exit door contact will have been shunted for a time dependent on the discharge time constant of capacitor CD1, e.g., one minute, which affords sufficient time for the proprietor to leave the premises and close the exit door behind himself.

Opening of contacts S1 removes the by-pass around capacitor CD1, allowing the latter to recharge, which will occur promptly through the base emitter junction of transistor TRN2. The opening of contacts S1 also removes the collector voltage from transistors TRN2 and TRN3 via the point A causing them both to become non-conductive. Non-conduction of transistor TRN3 allows relay R to become deenergized. Deenergization of relay R opens contacts R1, leaving the system in its steady state protection "on" condition.

FIG. 2 illustrates a slight modification of the circuit of FIG. 1 in which the function of relay R is performed by an additional transistor. Like reference characters in FIGS. 1 and 2 denote the same elements.

In FIG. 2 the coil of relay R and rectifier REC3 are replaced by series connected resistors RX8 and RX9. Normally open contacts R1 are replaced by the collector-emitter circuit of a transistor TRN4. The base of transistor TRN4 is connected to the junction of resistors RX8 and RX9.

Transistor TRN4 is normally non-conductive until forward biased by the voltage drop across resistor RX8 resulting from the current flow in the emitter-collector circuit of transistor TRN3 when the latter becomes conductive. When transistor TRN4 becomes saturated by reason of base current received from the emitter-collector circuit of transistor TRN3, the base of transistor TRN1 will be brought to a potential essentially equal to that of conductor 22. Transistor TRN1 hence becomes (non-conductive (as occurred in FIG. 1 when contacts R1 closed), dropping out relay S.

With relay S dropped out, capacitor CD1 starts to charge and the opening of contacts S1 renders transistors TRN2 and TRN3 non-conductive, as described in connection with FIG. 1. When transistor TRN3 becomes non-conductive, transistor TRN4 in turn will become non-conductive.

Referring now to FIG. 3, there is shown a modified

circuit embodying the invention. Elements in FIG. 3 which correspond generally to those of FIG. 1 are given like—but primed—reference characters. In FIG. 3 the three position control switch SW' has an additional armature 24, "off-test" contact 25 and blank "on" contact 26 forming an additional ganged switch SW3'.

The circuit of FIG. 3 is shown in its normal "off" condition with control switch SW' "off." Current flows from the positive terminal of battery 19' through alarm relay front contact AL1', a potentiometer resistor combination RX10–RX11, a first portion 11' of the protection circuit, a second portion 11'' of the protection circuit, the coil of alarm relay AL' and negative return conductor 22' to the negative terminal of battery 19'. The first portion 11' of the protection circuit includes the exit door contacts 12'.

The timing capacitor CD1' is normally maintained charged by connection to the battery positive terminal through a conductor 27, the charging circuit being completed through the base-emitter junction of transistor TRN1', a resistor RX3' and return conductor 22'.

When the three armature control switch SW' is moved from its "off" position to its "test" position, only armature 15' moves. Current thus flows through contacts SW2', SW1', SW3', rectifier REC1', and series connected resistors RX1', RX2', and RX3' to return conductor 22'. Current also flows through alarm bell 23', causing the latter to operate. A current having no significance will also flow through rectifier REC2', resistor RX12, portion 11'' of the protection circuit and the coil of the alarm relay AL' to the negative conductor 22'.

Current flowing through resistor RX1', RX2' and RX3' bias transistor TRN2' to conduction. The collector-emitter circuit current of transistor TRN2' flows through the coil of relay S', causing the latter to become energized and closing normally open contacts S1'.

Closing of contacts S1' locks up relay S' by connecting the coil of relay S' to conductor 27. Closing of contact S1' also shunts the portion 11' of the protection circuit which includes exit door contact 12', the circuit extending from conductor 27 through contacts S1', rectifier REC2' and resistor RX12 to the junction of portions 11' and 11'' of the protection circuit. Hence opening of exit door contacts 12' will not cause alarm relay AL' to drop out.

The movement of switch SW' to the "test" position causes capacitor CD1' to start discharging through parallel resistor RX4' in the same manner as described in connection with FIG. 1.

When bell 23' sounds, indicating that it is in working order, control switch SW' is moved to its "on" position, causing transfer of armature 14' of switch SW2' to blank contact 18' and transfer of armature 24 of switch SW3' to blank contact 26. Armature 15' of switch SW1' remains on contact 17'.

As capacitor CD1' discharges, the difference between its voltage and the supply voltage appears as a bias at the base of transistor TRN1'. When this forward bias is sufficient to overcome the back bias caused by the voltage drop across resistor RX3', the transistor TRN1' will become conductive. The voltage across resistor RX3' occurs as a result of current flow through the circuit RX1', RX2' and RX3'. The time required for the charge of capacitor CD1' to decrease sufficiently to permit transistor TRN1' to conduct depends on the discharge time constant of CD1'–RX4'.

When transistor TRN1' becomes conductive, the collector-emitter circuit thereof shunts the base supply for transistor TRN2', rendering the latter non-conductive. When transistor TRN2' becomes non-conductive, relay S' drops out, resulting in the opening of front contacts S1' thereof. With contacts S1' open, capacitor CD1' recharges through the base-emitter circuit of transistor TRN1'. The opening of contacts S1' removes the collector voltage from transistor TRN1' which becomes non-conductive and the system remains in its "on" condition.

The period of time during which relay S' is energized, which depends on the discharge time constant of capacitor CD1', determines the length of time that exit door contacts 12' are ineffective to transmit an alarm. This time, which is preferably about one minute, affords sufficient time for the proprietor to leave the premises by the exit door and to close the door behind him. More than one set of exit protection contacts may be included in protection circuit portion 11' if the proprietor desires a choice of exit doors.

As in the case of FIG. 1, the proprietor is required only to actuate the control switch to the "test" position and then, when the bell has rung, to the "on" position. The exit delay interval is automatically metered by a simple and reliable electronic circuit.

While the invention has been described in connection with specific embodiments thereof and in a specific use, various modifications thereof will occur to those skilled in the art without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. In an electric protection system having a plurality of electrical protection devices for protecting premises having a means of egress protected by one of said devices which is actuated upon opening of said means of egress, an automatic exit control comprising:

(a) three position switch means having an "off" position, a "test" position and an "on" position and being adapted to be moved sequentially from one to another of said positions;

(b) a source of operating potential;

(c) alarm signalling means having a first operating circuit arranged operatively to connect said signalling means to said source when said switch means is in said "test" position thereof and a second operating circuit operatively coupled to said devices and arranged, upon operation of any of said devices, and with said switch means in said "on" position thereof, to connect said signalling means to said source;

(d) a capacitor having a charging circuit coupled to said source to maintain said capacitor fully charged when said switch means is in said "off" position thereof;

(e) a discharge circuit for said capacitor, said discharge circuit having a selected time constant;

(f) current responsive means arranged to be operated when said switch means is in said "test" position thereof and being operatively coupled to said capacitor charging circuit to permit said capacitor to discharge through said discharge circuit while said current responsive means is operated;

(g) means to maintain said current responsive means operated when said switch means is moved to said "on" position thereof;

(h) a transistor circuit operatively coupled to said capacitor and arranged to have the conductive condition thereof changed when the charge on said capacitor decreases to a predetermined proportion of said full charge;

(i) means responsive to said change in the conductive condition of said transistor circuit to return said current responsive means to its unoperated condition; and

(j) means operatively coupled to said current responsive means and to said one of said devices to suppress operation of said signalling means in response to opening of said egress means during the time interval that said current responsive means is operated.

2. In an electric protection system having a plurality of protection devices connected in a series protection circuit, one of said devices being exit contacts operatively assoiated with an exit door for operation upon opening of said door, an automatic exit control comprising:

(a) three position switch means having an "off" position, a "test" position and an "on" position and being adapted to be moved sequentially from one to another of said positions;

(b) a source of operating potential;

(c) alarm signalling means having dual operating circuits arranged to connect said signalling means to said source to operate said signalling means when said switch means is in said "test" position and when both said switch means is in said "on" position and one of said devices is operated to open said protection circuit;

(d) a capacitor having a charging circuit coupled to said source to maintain said capacitor fully charged when said switch means is in said "off" position thereof, said capacitor having a discharge circuit with a selected time constant;

(e) a relay having an energizing circuit arranged to be connected to said source when said switch means is moved from said "off" to said "test" position thereof and having a locking circuit for maintaining said relay energized when said switch means is moved from said "test" position to said "on" position;

(f) means coupled to said switch means and operative upon movement of said switch means to said "test" position thereof to cause said capacitor to discharge through said discharge circuit;

(g) a first transistor coupled to said capacitor and arranged to become conductive when said charge on said capacitor decreases to a predetermined proportion of said full charge;

(h) means responsive to conduction of said first transistor to deenergize said relay; and

(i) means operatively coupled to said relay and to said exit contacts to suppress an alarm upon operation of said exit contacts during the interval that said relay is energized.

3. In an electric protection system as set forth in claim 2, an automatic exit control in which said energizing circuit for said relay includes a second transistor which is operatively coupled to said source to become conductive when said switch means is moved to said "test" position thereof.

4. In an electric protection system as set forth in claim 2, an automatic exit control in which there are provided a third transistor and a second relay arranged to be energized when said third transistor is conductive, said third transistor being operatively coupled to said first transistor to follow the energized condition thereof, said second relay having contacts forming a part of said means responsive to conduction of said first transistor and arranged to deenergize said second transistor and said first relay when said second relay becomes energized.

5. In an electric protection system as set forth in claim 2, an automatic exit control in which there are provided third and fourth transistors, said third transistor being operatively coupled to said first and fourth transistors to follow the energized condition of said first transistor and, when energized, to energize said fourth transistor, said fourth transistor being operatively coupled to said second transistor to render the latter non-conductive when said fourth transistor is conductive.

6. In an electric protection system as set forth in claim 3, an automatic exit control in which said means responsive to conduction of said first transistor to deenergize said relay includes said second transistor, said second transistor, being operatively coupled to said first transistor so as to become deenergized when said first transistor becomes conductive.

7. In an electric protection circuit as set forth in claim 6, an automatic exit control in which said relay has a single set of contacts, said single set of relay contacts serving as the operative element of said locking circuit, of said means to cause said capacitor to discharge and of said means to suppress an alarm.

8. In an electric protection circuit as set forth in claim

2, an automatic exit control in which said time constant is selected so that said first transistor becomes conductive approximately one minute after said switch means is moved from said "off" position to said "test" position thereof.

References Cited

UNITED STATES PATENTS

2,449,168	9/1948	Kertz	340—276
2,944,252	7/1960	Muehter	340—214 X
2,983,912	5/1961	Ghers	340—276
3,103,003	9/1963	Roberts	340—214 X
3,452,345	6/1969	Kinsey	340—276 X

THOMAS B. HABECKER, Primary Examiner

P. PALAN, Assistant Examiner

U.S. Cl. X.R.

340—276; 274

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,534,350 Dated October 13, 1970

Inventor(s) Sellinger et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 2, lines 34-36, should read -- the discharge of the capacitor. The current responsive means is maintained operated when the switch is moved from its "test" to its "on" position, which is done as soon --

col. 3, line 30, after "conductor" insert -- 20, armature 21 and front --;

line 30, delete "11 (including door contacts";

line 31, "dor" should read -- door --

col. 4, line 3, "tothe" should read -- to the --;

col. 5, line 66, "(non-conduc-" should read -- non-conduc- --;

col. 7, line 73, "assoiated" should read -- associated --;

col. 10, line 1, "Ghers" should read -- Ghersi --.

Col. 8, line 44, "2" should read -- 3 --; line 54, "2" should read -- 3 --.

Signed and sealed this 26th day of January 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents