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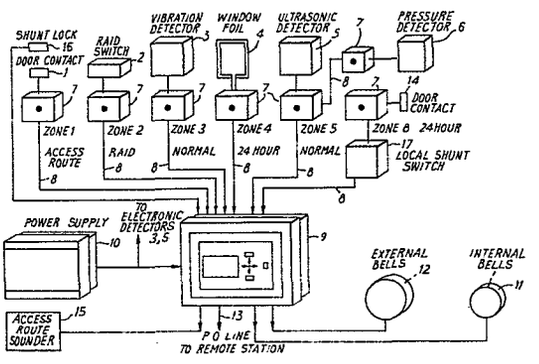
(54) Alarm system and a sensor module therefor.

(57) An alarm system is capable of monitoring a plurality of zones (1-8). The system comprises a sensor module (7) in each zone, connected to an alarm sensor (1-6) and by a respective signalling path (8) to a central controller (9). Alarm indications produced by the alarm sensor can be stored in the module and an indication of the type of alarm indication can be signalled to the controller. The controller is able to act on the module to set or unset settable alarm sensors, and also to produce a visual indication in the zone of the module being an indication of the ability of a module to respond to alarm indications.

The sensor modules can also be connected in series and can monitor more than one alarm sensor.



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INTRUDER ALARM SYSTEM AND A SENSOR MODULE THEREFOR

The present invention relates to an alarm system.

A previously proposed alarm system is described in an article "Microprocessor-Based Alarm Reporting and Display System" by J.B. Morgan of Vindicator Corporation, Santa Clara, California, (Proceedings of 1978 Carnaham Conference on Crime Countermeasures). The described system comprises up to 2000 alarm sensors connected, in groups, to up to 250 transponders. The transponders are connected to a common multiplex data bus and are sequentially addressed by a central controller.

The described system is a digital system, is expensive, and more suitable for large installations having hundreds of transponders rather than for smaller installations with say tens of transponders at most.

It is an object of the present invention to provide an alarm system suitable for smaller installations.

According to one aspect of the invention, there is provided an alarm system capable of monitoring a plurality of zones, the system comprising a respective sensor module (7) in each zone, each module being connected to, and arranged to monitor, at least one associated alarm sensor (1-6) in its respective zone, the system also comprising a central controller (9) and being characterised in that each sensor module (7) is connected to the central controller (9) by a respective two-way signalling path (8), and is capable, on the one hand of storing an alarm indication produced by its associated alarm sensor or sensors and, on the other hand, of signalling said indication to the

central controller (9) via said respective signalling path (8); the module (7) also including means, selectively actuable by the central controller (9) via said respective signalling path (8), to visually indicate in each zone, whether the module (7) in that zone remains capable of responding to an alarm indication.

According to another aspect of the invention, there is provided a sensor module (7) suitable for use in an alarm system characterised by the module (7) including store means (43) capable of storing an alarm indication produced by a connected alarm sensor (1-6) and also including display means (73), selectively actuable by a central controller (9), to display whether said store means continues being capable of responding to an alarm indication.

The sensor module may further comprise means selectively actuable by the central controller to set and unset settable alarm sensors. The sensor module may yet further comprise means capable of identifying an alarm indication distinctive of differing alarm sensors, and signalling said alarm indication to the central controller.

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made by way of example, to the accompanying drawings in which:

Figure 1 is a schematic block diagram of an alarm system incorporating zone modules in accordance with the invention;

Figure 2 is a schematic diagram showing the connection of several zone modules in series;

Figure 3 is a schematic diagram showing an alarm detection loop and a raid circuit connected to a zone module;

Figure 4 is a schematic block diagram of a zone module; and

Figures 5A and B are detailed circuit diagrams of the zone module of Figure 4.

Figures 6A and B are detailed circuit diagrams of a zone module allowing connection to either a raid circuit or an alarm detection circuit.

General Description - Figure 1

Referring to Figure 1, the shown intruder alarm system can

monitor eight zones of for example a building. This may be utilized particularly for an intruder alarm system but is not restricted thereto, for example fire sensors may be utilized. In each zone there is at least one detector, 1...6 connected to a zone module 7. In the example shown, zone 5 has two zone modules 7 and two detectors 5 and 6 and monitoring of zone 6 and 7 is not shown for reasons of clarity. The zone modules 7 are connected by respective four core cables 8 to a central controller 9. A power supply 10 supplies power to the central controller and to active or electronic detectors such as detectors 3 and 5 which require a power supply.

The central controller 9 receives indications from the detectors 1 to 6 via the zone modules 7, of whether or not any of the detectors have sensed an intrusion in any of the zones, and also sends signals to the zone modules to achieve various functions which will be described hereinafter. The controller sequentially scans the zones and only thereby can identify which zone is indicating an intrusion.

In the system of Figure 1 the zones shown are dedicated to different alarm functions as follows for example:

Zone 1 is dedicated to an access route in which the operation of a door contact 1 is monitored,

Zone 2 includes a raid switch 2,

Zones 3 to 8 include: a vibration detector 3; a window foil 4; an ultrasonic detector 5 and a pressure detector 6 both in zone 5; and a door contact 14 in zone 8. However, the zones do not need to be dedicated to particular types of alarm, and are more usually dedicated to a particular geographical area.

The controller, together with the zone modules, can also be arranged to detect whether the detector giving an alarm in any one zone is a raid detector or not from the nature of the signal it receives from a zone module as will be described hereinafter.

Zones 1 and 8 can include either or both a shunt lock 16, which enables an authorised person to pass through the access zone without generating an alarm and a local shunt switch 17 which enables a localised area to be switched off.

General Description - Figure 2

In a zone such as zone 5 where there are two or more zone modules, they are connected in series as shown in Figure 2. The continuity of the four cores of successive portions of the cable 8 is maintained by wires within each zone module so that removal of any one module breaks the continuity. The actual circuits of the zone modules are connected in parallel with the continuous cable portions 8. The controller is able to detect breakage of continuity due to removal of a zone module and signal an alarm condition in response thereto.

Although Figure 1 shows only one detector per zone module 7, more than one detector may be connected to each module 7 as shown for example in Figure 3, which will be described in more detail hereinafter.

General Description - Figure 3

Referring to Figure 3, each zone module 7 has: an input/output arrangement 71 having two ports for connection to a detection loop 30, and two power supply ports for powering an active detector; an arrangement 72 having two ports for connection to a raid loop 37; and an LED display 73 positioned to be visible to an observer. The module accepts inputs from three types of alarm contact at the input/output arrangement 71 for the detection loop. They are:

1) A normally open ordinary threshold alarm contact;
2) A normally closed ordinary threshold alarm contact; and
3) An anti-tamper or other 24 hour alarm contact.

Examples of such contacts are shown in Figure 3. Within the detection loop 30 an active detector powered from the power supply ports of the input/output arrangement 71 has two normally closed contacts 32 and 33, whilst the loop 30 also includes passive normally closed contacts 34 and 36 and a passive normally open contact 35. Referring to Figure 1 for examples of the contacts, the active detector having contacts 32, 33 may comprise an ultrasonic detector such as 5, the normally closed contacts 34 and 36 may comprise a window foil such as 4, and the normally open contact 35 may be a pressure detector such as 6.

Referring to Figure 3, a raid loop 37 comprises a series of two normally closed contacts 38 and 39 equivalent to raid switch 2 of Figure 1 for example.

As disclosed hereinabove, the nature of the signal received by the controller from a zone module can identify the type of detector giving the alarm. To enable one module to maintain this facility with only one alarm loop connection, it is necessary to incorporate a booster circuit which is operational only if the alarm sensor connected is a raid loop. The functioning of this particular module will become clear hereinafter.

Set and Unset contacts

Alarm contacts can be either:

1) selectively set and unset; or
2) permanently set.

Referring to Figure 3, diodes D33 and D36 shunt normally closed contacts 33 and 36 whilst diode D35 is in series with normally open contact 35. Such contacts 33, 35 and 36 are settable and unsettable by choosing the direction of current flow around the loop 30. The unshunted switches 32 and 34 from anti-tamper switches for their respective sensors. If the current flow in loop 30 is in the direction of conduction of the diodes D33 and D36 (and counter to that of diode D35) the contacts 33, 35 and 36 are inoperative and thus unset. Otherwise they are set when the current flows in the opposite direction.

Contacts such as 32, 34 and the raid contacts 38, 39 are insensitive to the direction of current flow and so are permanently set.

Zone Module Signals

The zone module 7 accepts three signals from the controller 9. They are:

1) A reset signal to reset a bistable latch circuit in the zone module;
2) A set/unset signal; and
3) A display signal for selectively causing the LED display 73 of the zone module to display the state of the latch

circuit.

The zone module indicates to the controller:

1) the operation of an alarm contact;

2) whether the contact is in the detection loop or the raid loop;

3) normal operation (no alarm contacts operated);

and the zone module is able to:

4) store in the bistable latch circuit the operation of an alarm contact even if the contact is immediately reset;

5) display the state of the latch circuit using the LED display 73 in response to the display signal of the controller;

6) reset the latch in response to the reset signal of the controller; and

7) set and unset alarm contacts in response to the set/unset signal of the controller.

Signal Lines

Referring to Figure 2, the controller is connected to a zone module 7 (or a series of modules 7) via a four core cable 8. The four cores are designated:

(i) alarm line

(ii) control line

(iii) common ground (OV) and

(iv) power line (+12V).

Alarm Line

The alarm line from the controller is terminated by an end of line resistor EOL having in the example a resistance of 6K8 connecting the alarm line to the common ground. The alarm line connects within the controller 9 to a +12V supply via a 1K resistor, and to a set of comparators 20.

The comparators, in effect, sense the total resistance in series with the 1K resistor, by comparing the voltage V_A on the alarm line with reference voltages.

In order to indicate a raid alarm a zone module effectively connects both a 1K resistor and a 4K7 resistor in parallel with the EOL resistor, and other alarms are indicated by connecting a

4K7 resistor in parallel with the EOL resistor.

If the alarm line is broken, or the ground line is broken or a zone module is removed, open-circuit is sensed.

Thus the voltage VA varies as a proportion of the +12V as follows:-

Condition	VA as Proportion of +12V
Normal	0.8 - 0.9
Open circuit	0.9 - 1.0
Raid alarm	0.3 - 0.5
Other alarm	0.5 - 0.8
Short circuit	0 - 0.3

The controller can reset a latch circuit of a zone module by reducing the +12V source voltage of the alarm line to 0 volts for a period of between 200ms and 1 second as will be apparent hereinafter.

Control Line

The controller can also send signals to the zone module(s) 7 via the control line, which as will be apparent hereinafter have an effect as follows:-

0 - 2V = Set

3 - 5V = Unset

6 - 15V = Enable display

If the control line goes open circuit or short circuit to ground the zone module acts as if it has received the Set signal.

Power Line

If the power line is broken or shorted, a current monitor in the zone module becomes inoperative and signals an alarm.

Zone Module - Fig.4

The control line is connected to a Set-Unset detector 40 which controls a voltage reversal circuit 41 to cause current to flow in the alarm detection loop (e.g.loop 30 of Fig.3) in a direction defined by the voltage on the control line, to set or unset the alarm contacts in the loop.

A current monitor 42 monitors the current flowing in the detection loop 30 by monitoring the current flowing from the +12V line to the reversal circuit 41. Referring to Figure 3,

in normal operation the current is limited by an end of line resistor EOL (6K8) and the internal resistances of the voltage reversal circuit 41 and the monitor 42. Thus, in the normal operation a current of value within a preset range (or window) flows. If the loop 30 indicates an alarm the current flow in the loop is either zero (open circuit loop) or a high value due to short circuiting of the end of line resistor, and in either case the monitor 42 causes a latch circuit 43 to operate and connect a 4K7 resistor from the alarm line to the ground line. As discussed hereinbefore, this change of alarm line resistance is sensed by the central controller to indicate an alarm condition.

A raid input detector 44 is connected to for example the raid loop 37 of Figure 3. If a normally closed contact 38 or 39 is opened due to an intrusion, a 1K resistor is connected from the alarm line to the ground line by the detector 44. Furthermore the latch circuit 43 is also operated by the detector 44 to connect the 4K7 resistor to the ground line. The controller senses the resultant alarm line resistance as a raid condition.

The zone module 7 further comprises the LED73 which is driven by an LED drive 45. The drive is controlled by the latch 43 and by a display mode detector 46, which is responsive to the control line voltage, via an AND gate 47.

If the controller emits the enable display voltage and at the same time an alarm condition is indicated by the latch 43, the LED will emit light.

The zone module also comprises a normally closed anti-tamper switch 48 which is in series with the detection loop to cause an alarm if for example, the housing (not shown) of the zone module is removed.

Once the latch circuit has been actuated to indicate an alarm it is deactuated by the central controller 9 reducing the +12V source voltage on the alarm line to zero for 200ms to 1 second, the latch circuit being powered from the alarm line via connection 49.

The zone module thus allows the following five modes of operation to be achieved for a zone module of one zone, assuming one zone module per zone.

a) Unset

All normal settable/unsettable alarm contacts associated with the module are inhibited, although anti-tamper, raid, and other 24 hour contacts still operate. This mode is the normal day time mode. No display of the alarm condition is required at the zone module.

b) Set

All contacts associated with the module are enabled and can cause the latch 43 and the controller to indicate an alarm condition. No display of the alarm condition is required at the zone module to avoid warning an intruder that an alarm has been set off.

Search

In this mode, the display of the zone module is enabled by the controller and if an alarm contact is actuated so that the associated latch circuit 43 indicates the alarm condition, the associated display 73 locally indicates the alarm. All settable/unsettable alarm contacts in other zones are unset by the controller to inhibit them. Thus the zone module of the actuated alarm displays the alarm, but other alarms in other zones are inhibited by the controller so as to allow a search for the alarm source to be made without setting off the other alarms. This mode also allows easy checking for faulty alarms.

Test

In this mode, the controller is caused to continuously cycle through the set, display and reset modes if an alarm contact is deliberately operated to test it. The zone module provides local indication of the operation of the contact but no alarms are signalled by the controller.

Reset

The latch circuits 43 can be reset by removing the power supply to the alarm line.

Zone Module - Details - Figs. 5A and B

Referring to Figure 5A, the set/unset detector 40 comprises a transistor 40 the base of which is connected to the control line via a potential divider R1, R2 to receive the set/unset signal from the controller 9. In the set condition, the transistor is non conductive, and in the unset condition it is conductive.

The voltage reversal circuit 41 comprises six CMOS inverting amplifiers (eg a4069 circuit) in a single IC package having a common power line 50. The amplifers are connected as shown to produce a direction of current flow in the detection loop 30 defined by the set/unset detector 40.

The current monitor 42 monitors the current flowing in the power line 50 to the reversal circuit 41. In the normal condition of the detection loop, the current flowing in the power line is limited by resistors R3, R4 of the monitor 42, by resistors R7 and R8 at the outputs of the reversal circuit and by the 6K8 end of line resistor of the detection loop.

In this situation, transistor T2 of the monitor 42 is non-conductive and transistor T1 is conductive.

If the monitored current departs from the normal value due to an alarm, in response to which it becomes zero or very large, transistor T1 becomes non-conductive.

Thus the voltage at point A of Figure 5A is +12V indicating normal operation or OV indicating an alarm in the detection loop 30.

The raid input detector 40 which is connected to the raid loop 37 comprises a transistor T3 the base of which is connected to a potential divider R11, R12, R13 between the +12V line and the ground line as shown. In normal operation the raid loop shorts out resistors R12, R13 so that transistor T3 is non-conductive and the voltage at point B is +12V derived from the alarm line via the 1K resistor. In an alarm condition the raid loop is open-circuit, transistor T3 is conductive and the voltage at point B is zero volts and the 1K resistor is effectively in parallel with the 6K8 end of line resistor EOL (see Fig.4 or Fig.2) to signal a raid alarm to the controller 9.

Referring to Figure 5B, the latch circuit 43 comprises four NAND gates in a common IC package having a common power line 49 (eg a4093 circuit). The power is derived from the alarm line via a smoothing and clamping circuit comprising a resistor R14, a Zener diode D2 and a capacitor C1.

The gates are connected as shown to form a bistable latch circuit. Resistor R15 and capacitopr C2 in one of the feed back connections of the bistable define a minimum time required for an alarm condition to actuate the bistable.

If the voltage at point A or B goes zero for more than the minimum time, the bistable is set so that the 4K7 resistor is connected from the alarm line to ground via the low impedance output of one of the gates, to signa1 an alarm condition to the controller 9.

In the case of a raid alarm both the 1K and the 4K7 alarm resistors are connected between the alarm line and ground. For other alarms only the 4K7 resistor is so connected.

The display mode detector comprises a transistor T4, the base of which is connected to a potential divider R16, R17, R18 between the control line and ground.

A diode 47 is connected between the potential divider and the bistable to act as the AND gate 47.

If the bistable circuit does not indicate an alarm, but the controller emits the display enable signal on the control line, the diode 47 conducts, the conduction path extending to ground through the low impedance output of the gate to which it is connected and thus transistor T4 is non-conductive. If the bistable circuit indicates an alarm, diode 47 is non conductive and the transistor T4 is conductive, and LED 73 is then enabled.

As the bistable is powered from the alarm line, it can be reset by reducing the alarm line source voltage to OV.

If it is desired to only have one alarm loop connection on the module, as disclosed hereinabove a booster circuit operational for raid loop connections must be incorporated.

Referring to figures 6A and B, which in so far as possible retain symbols common to figures 5A and B, a raid or detection loop 37 or 30 is connected to the voltage reversal circuit 41.

If an alarm is detected then as before the voltage at point A will drop to zero volts, which will be sensed by latch circuit 43 to connect the 4K7 resistor from the alarm line to ground via the low impedance output of one of the latch circuit gates, to signal an alarm condition to the controller.

In the case when a raid loop 37 is connected to voltage reversal circuit 41, a further 1K resistor needs to be connected across the alarm line to ground to indicate a raid alarm. To facilitate this, a raid switch RS is linked to a point C connected to diode 47, which point increases in voltage when an alarm condition is registered. By connecting raid switch RS to resistor 12 of a booster circuit 44 and having raid switch RS operational, an alarm condition appearing at point C will cause transistor T3 in circuit 44 to conduct, connecting thereby the required 1K resistor across the alarm line to ground.

Therefore by this means, when a raid loop is connected to a module, operation of the raid switch RS will allow a signal identifying a raid alarm to be passed to the controller. However, if a detection circuit is connected to the module, de-activation of raid switch RS will ensure a signal identifying a detection alarm is passed to the controller.

What we claim is:

1. An alarm system capable of monitoring a plurality of zones, the system comprising a respective sensor module (7) in each zone, each module being connected to, and arranged to monitor, at least one associated alarm sensor (1-6) in its respective zone, the system also comprising a central controller (9) and being characterised in that each sensor module (7) is connected to the central controller (9) by a respective two-way signalling path (8), and is capable, on the one hand of storing an alarm indication produced by its associated alarm sensor or sensors and, on the other hand, of signalling said indication to the central controller (9) via said respective signalling path (8); the module (7) also including means, selectively actuable by the central controller (9) via said respective signalling path (8), to visually indicate in each zone, whether the module (7) in that zone remains capable of responding to an alarm indication.

2. A system according to Claim 1, wherein said sensor module (7) is also capable, on the one hand, of storing an alarm indication produced by said at least one associated alarm sensor (1-6) and, on the other hand, signalling to the central controller (9) an alarm indication distinctive of the alarm indication produced by said at least one associated alarm sensor (1-6).

3. A system according to Claims 1 or 2, wherein an alarm zone includes at least two series linked sensor modules (7).

4. A system according to any one of Claims 1, 2 or 3, wherein the sensor module (7) includes means, selectively actuable by said central controller (9), to set and unset settable alarm sensors (1-6).

5. A sensor module (7) suitable for use in an alarm system according to any preceding claim characterised by the module (7) including store means (43) capable of storing an alarm indication produced by a connected alarm sensor (1-6) and also including display means (73), selectively actuable by a central controller (9), to display whether said store means continues being capable of responding to an alarm indication.

6. A sensor module (7) according to Claim 5, wherein there is included response means being capable of identifying alarm indications distinctive of differing alarm sensors and signalling said identification to a central controller (9).

7. A sensor according to Claim 6, wherein there is further included means, selectively actuable by a central controller, to set and unset suitable alarm sensors (1-6).

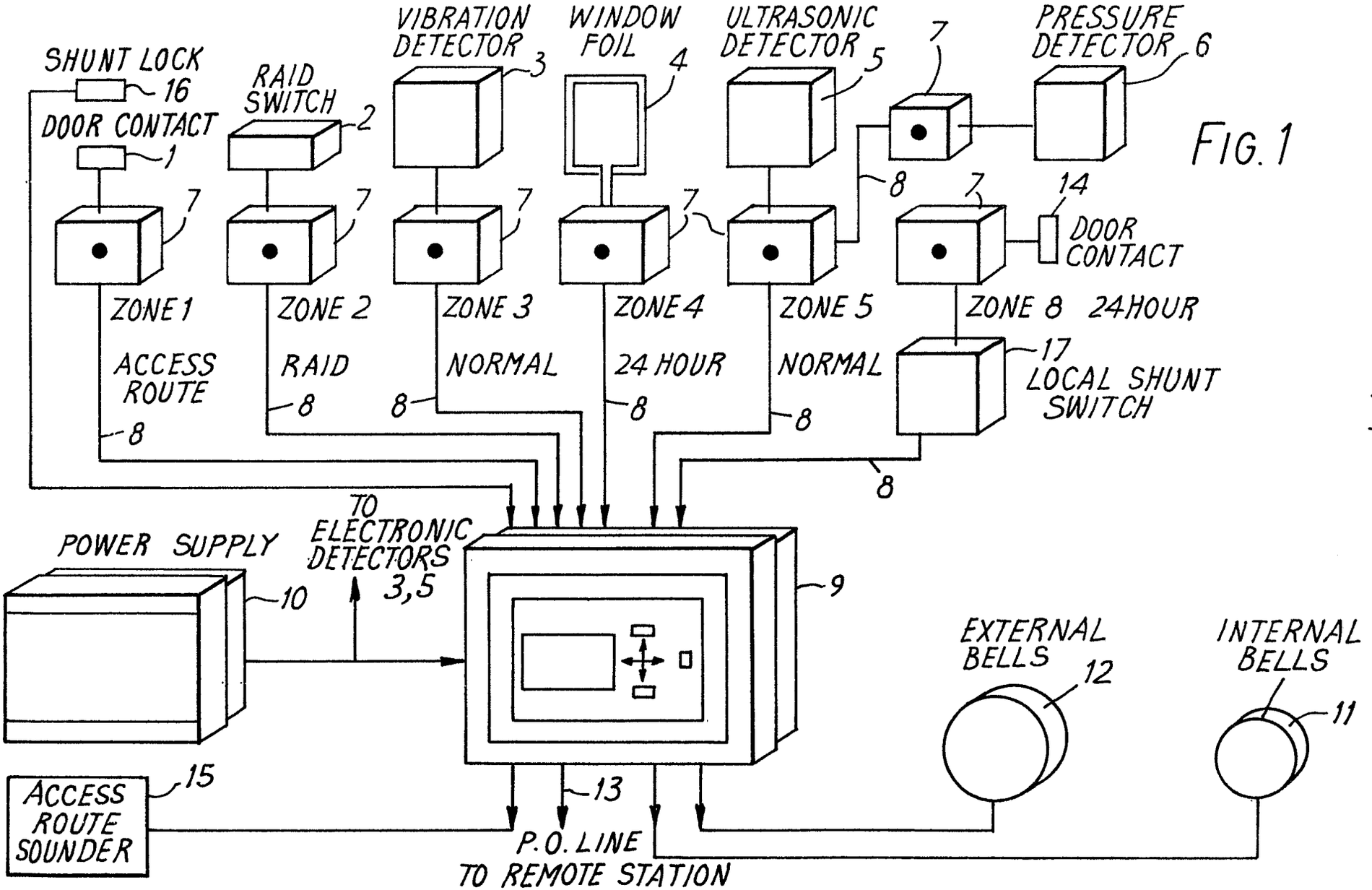

FIG. 1

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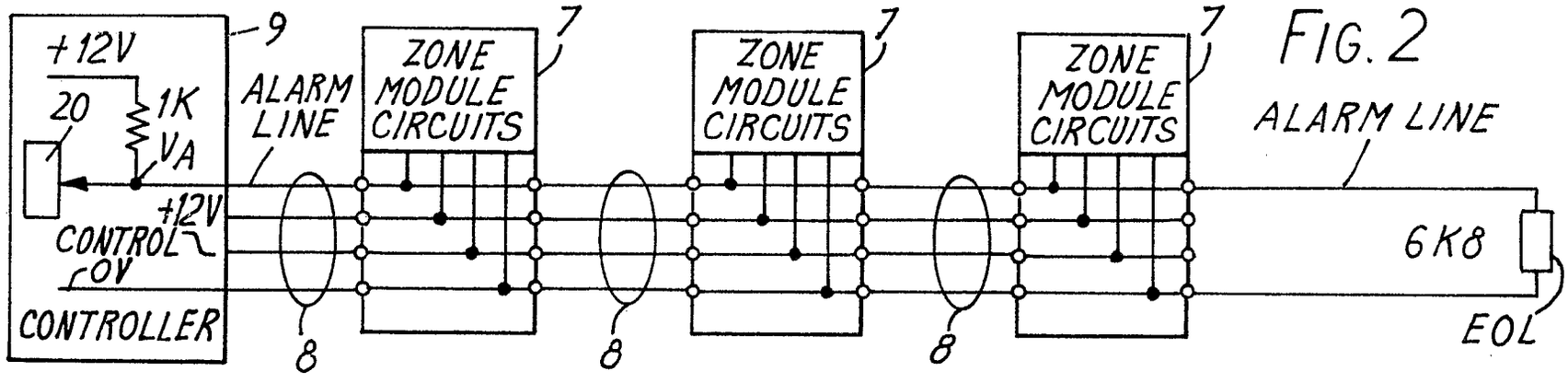

FIG. 2

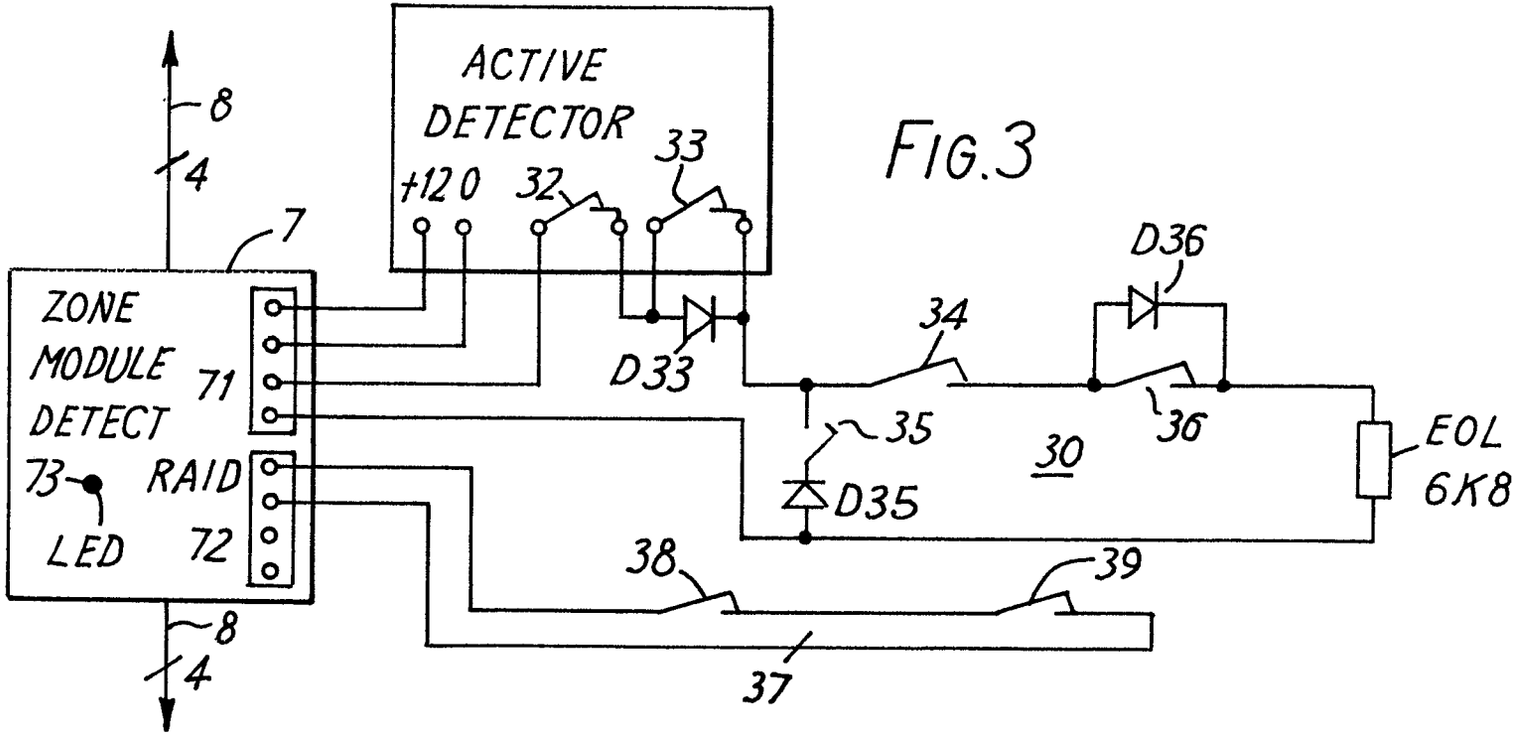

FIG. 3

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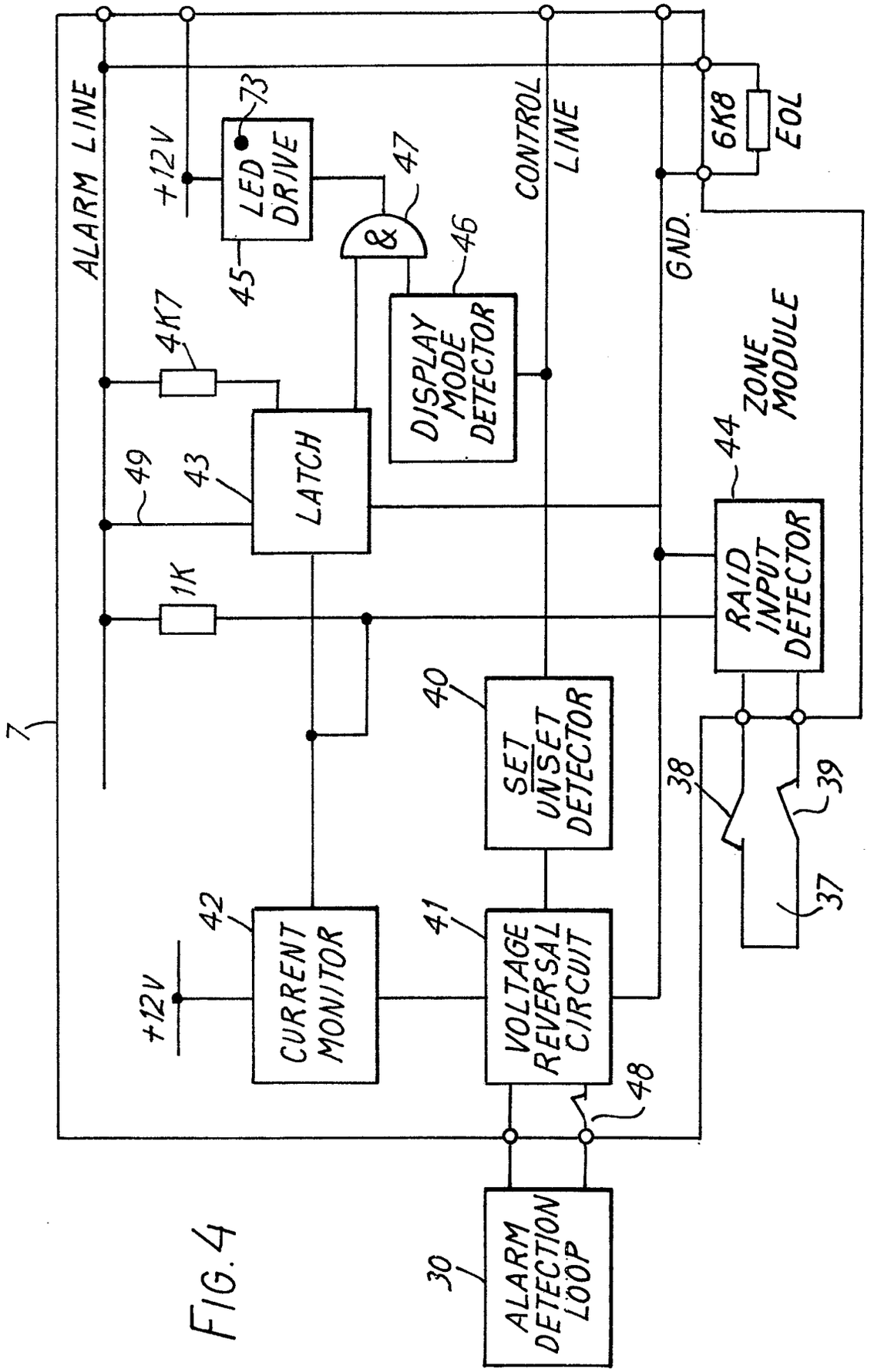

FIG. 4

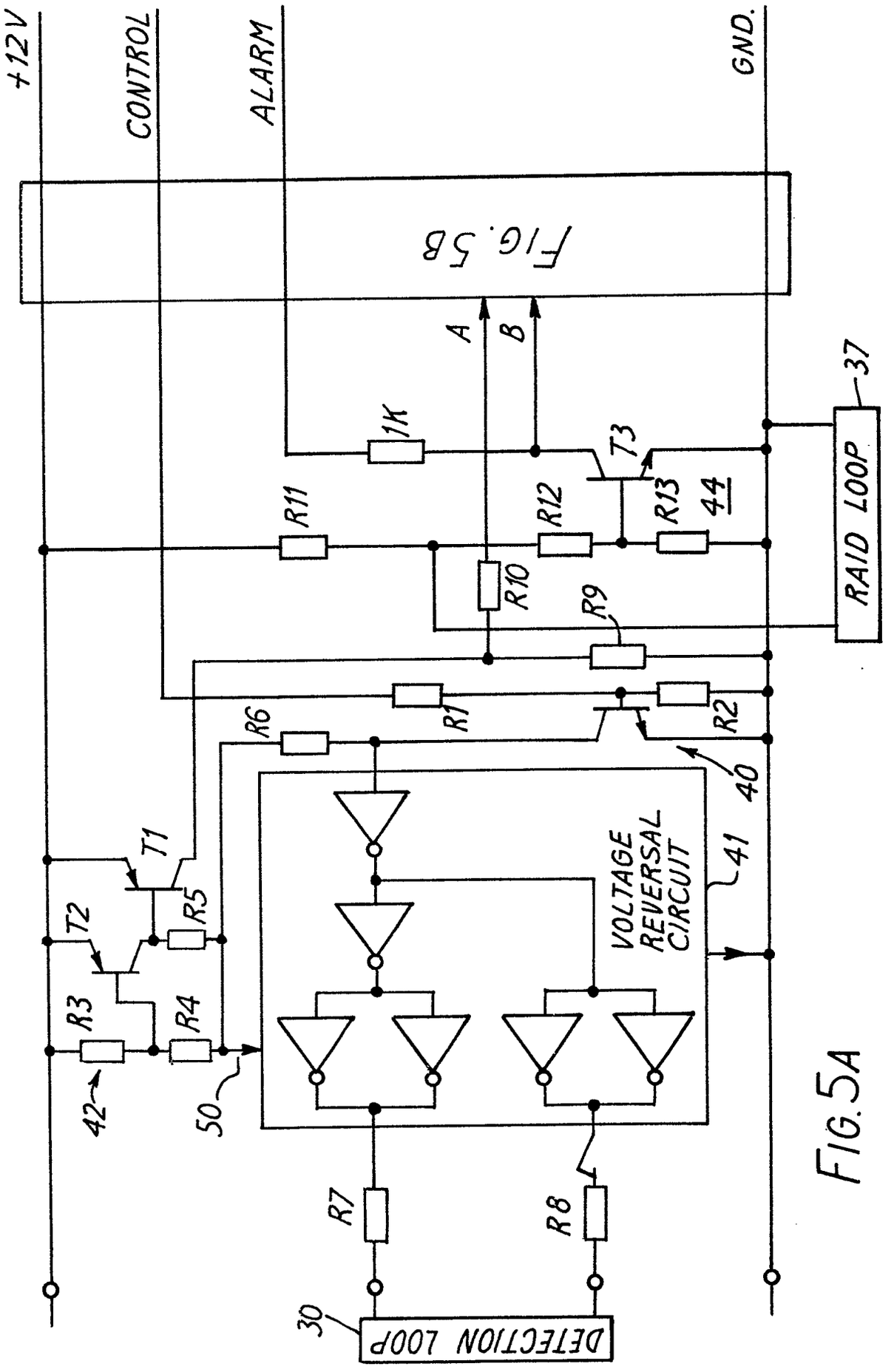
+12V
CONTROL
ALARM
GND.
Fig. 5B
A
B
1K
T3
R11
R12
R13
44
R10
R9
37
RAID LOOP
R1
R2
R6
40
T1
T2
R5
R3
R4
42
50
VOLTAGE REVERSAL CIRCUIT
41
R7
R8
30
DETECTION LOOP

FIG.5A

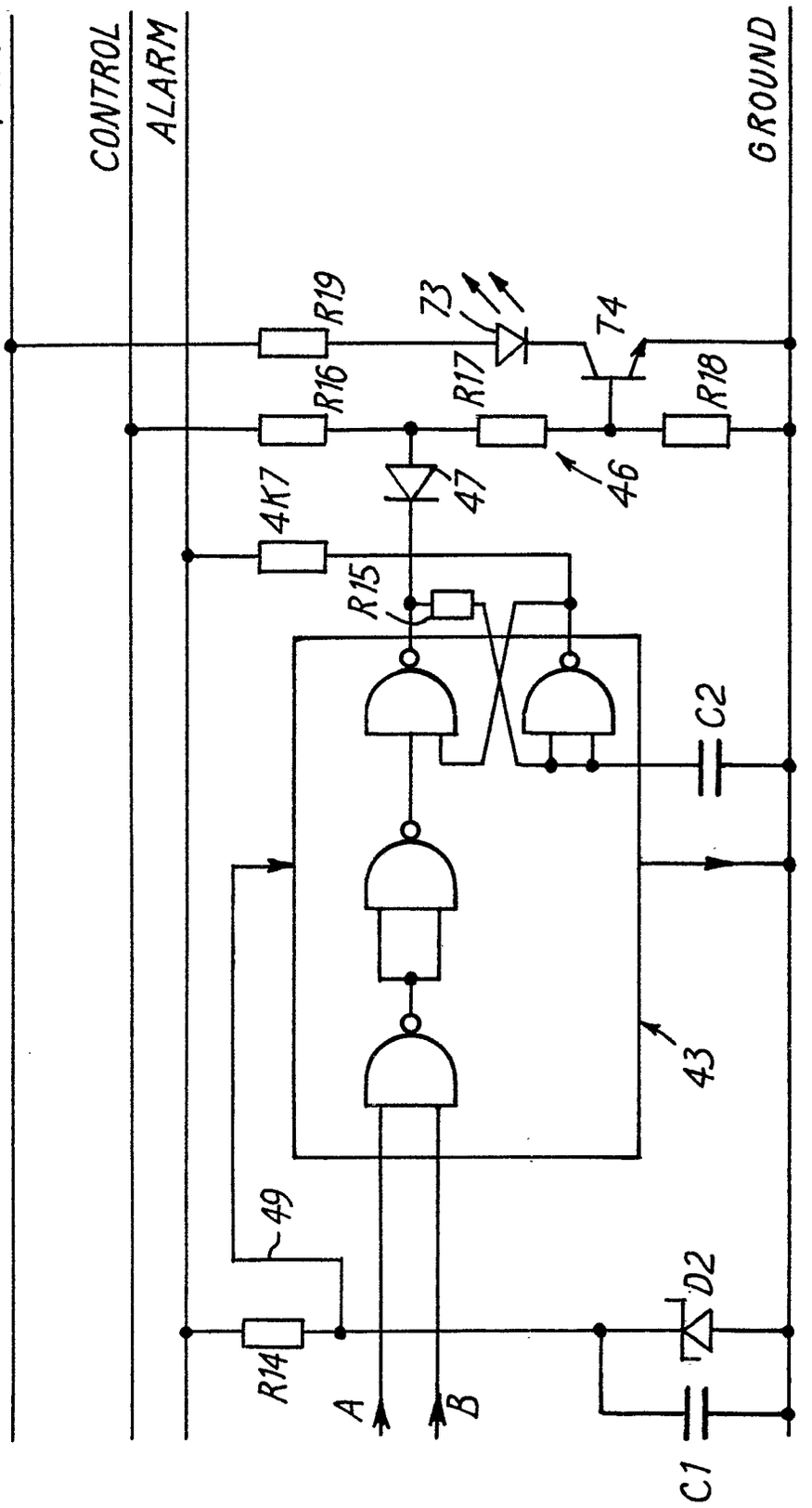
+12 V
CONTROL
ALARM
GROUND
R19
T3
T4
R16
R17
R18
47
46
4K7
R15
C2
43
49
R14
A
B
D2
C1

FIG.5B

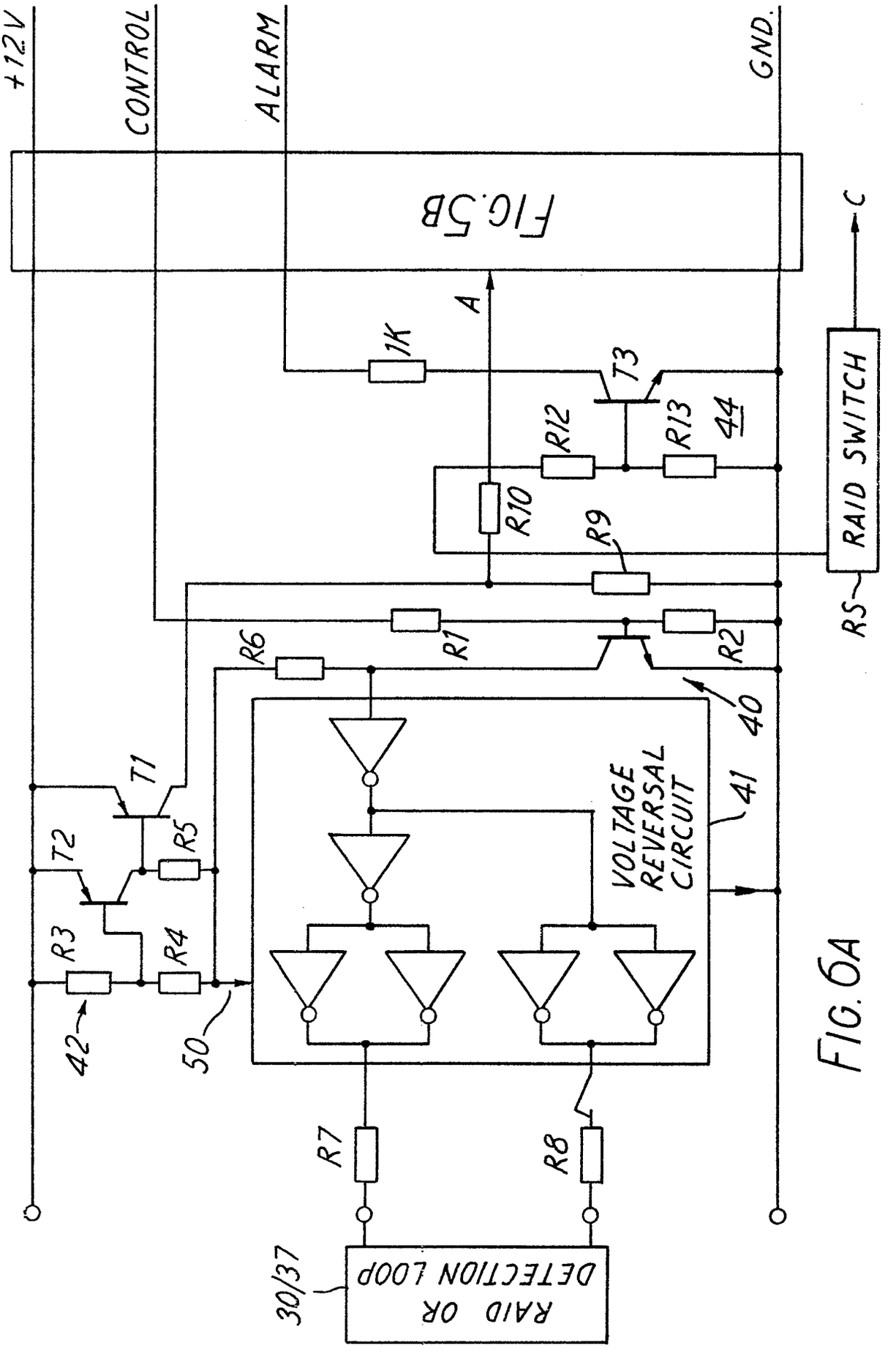
+12V
CONTROL
ALARM
GND.
FIG.5B
A
C
1K
T3
R12
R13
44
R10
R9
RAID SWITCH
RS
R1
R2
R6
40
T1
T2
R5
R3
R4
VOLTAGE REVERSAL CIRCUIT
41
42
50
R7
R8
30/37
RAID OR DETECTION LOOP

FIG. 6A

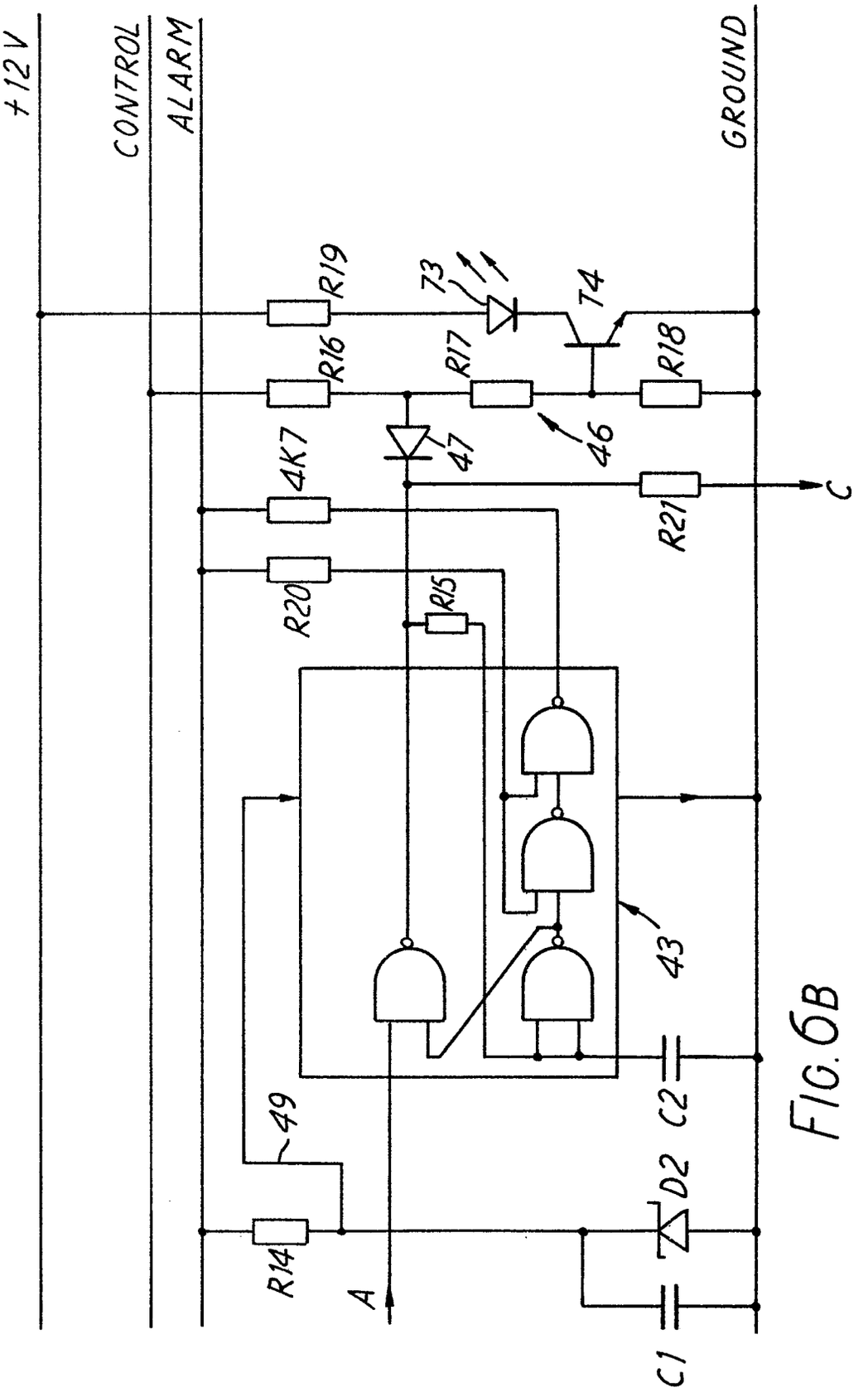
+12 V
CONTROL
ALARM
GROUND
R19
73
74
R16
R17
R18
47
46
4K7
C
R21
R20
R15
43
49
C2
D2
R14
A
C1

FIG. 6B

European Patent Office

EUROPEAN SEARCH REPORT

0063876
Application number

EP 82 30 1785

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Y	FR-A-2 293 018 (SAAB SCANIA) *Page 1, line 1 to page 2, line 30; claims*	1,2,5	G 08 B 25/00 G 08 B 29/00
Y	GB-A-2 022 301 (AMERICAN DISTRICT TELEGRAPH COMPANY) *The whole document*	1,5	
A	DE-A-2 407 267 (FRIEDRICH MERK TELEFONBAU) *Claims*	3-7	
A	FR-A-1 503 894 (ALARME ET TELESURVEILLANCE A.T.S) *Abstract*	3-7	
A	GB-A-1 529 947 (MUNFORD AND WHITE LIMITED)		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	US-A-4 138 674 (HUMPHRIES)		G 08 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	03-08-1982	REEKMANS M.V.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

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