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(72) Inventor: **Priest, Eric**
Churchl. Way, Nelson, Lancashire BB9 6RT (GB)

(74) Representative: **Robinson, Ian Michael**
Appleyard Lees,
15 Clare Road
Halifax HX1 2HY (GB)

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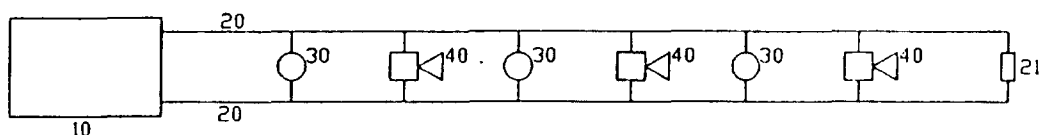
(71) Applicant: **PROTEC FIRE DETECTION PLC**
Nelson, Lancashire BB9 6RT (GB)

(54) Alarm apparatus

(57) An alarm apparatus using a single pair of signal wires (20) coupled to detector units (30) and alarm output units (40). Voltage on the signal wires (20) is re-

versed to indicate an alarm condition and periodically dipped to a third voltage level to decouple the alarm output units (40) enabling the detector units (30) to be monitored in the alarm state.

FIG.1



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Description

[0001] The present invention relates in general to an alarm apparatus such as a fire alarm.

[0002] An alarm system typically comprises detector units for detecting an alarm condition, e.g. heat or smoke; and alarm output units for producing an audible and/or visual alarm signal, e.g. bells, sirens, or flashing lights. The detector units and alarm output units are usually distributed around a building or other site protected by the alarm system, and coupled by signal wires to a control panel. It is desired to minimise wiring between the control panel and the detector and alarm output units. Ideally, it is desired to use a single pair of signal wires to form a zone circuit, with both detector units and alarm output units being coupled to the same pair of signal wires. Such an arrangement would minimise cabling costs and aid discrete installation because the or each zone circuit connected to the control panel would require only a single run of signal wires.

[0003] Typically, the control panel monitors the current drawn on the signal wires, and determines an alarm condition when the current increases in response to an increased current draw by a detector unit detecting a predetermined condition. However, a problem arises in that in the alarm condition the alarm outputs, coupled to the same signal wires, draw current to operate, and it is no longer possible to monitor the detector units.

[0004] It is an aim of at least preferred embodiments of the present invention to provide an alarm system which enables detector units to be monitored even when the system is in an alarm condition.

[0005] According to the present invention there is provided an alarm apparatus comprising: a control panel for monitoring a set of signal wires to determine a standby state and an alarm state; one or more detector units coupled to the signal wires for triggering the alarm state in response to a predetermined detection event; one or more alarm output units coupled to the signal wires for operatively responding to the alarm state; and decoupling means for decoupling the alarm output units from the signal wires in the alarm state such that the control panel operatively monitors the detector units.

[0006] Preferably, the detector units draw current from the signal wires above a preset limit when a predetermined condition such as heat, smoke, etc. is detected. Conveniently, the detector units comprise switch means for creating a lower resistance path between the signal wires when a predetermined condition is detected.

[0007] Preferably, the control panel comprises current monitor means for monitoring current drawn on the signal wires, the current monitoring means preferably comparing the monitored current against predetermined limits and determining an alarm condition when the monitored current is within a predetermined window. Ideally, an end of line monitor, such as an end of line resistor, is provided at an end of the signal wires remote from the

remote control panel, and the current monitoring means determines a normal operating condition when a first low level of current is drawn corresponding to the end of line resistor.

[0008] Preferably, the control panel comprises power supply means for supplying power at a predetermined voltage to the signal wires. Preferably, the voltage supply means supplies a first voltage of a first polarity in the standby state. Preferably, the voltage supply means supplies a second voltage, ideally of a second polarity, in the alarm state, the voltage supply means preferably being responsive to the current monitor means.

[0009] Preferably, the alarm output units are arranged to operate only in the alarm state, preferably by distinguishing between the first voltage and the second voltage. Where the second and first voltage are of opposite polarity, each alarm output unit preferably comprises polarity detecting means, such as a diode.

[0010] Preferably, the decoupling means comprises charge storage means for storing charge to enable the alarm output units to draw current from the charge storage means. Preferably, the alarm output units are switchable to draw current from either the signal wires or the charge storage means. Ideally, the alarm output units temporarily draw current from the charge storage means in response to a predetermined condition on the signal wires. Therefore operation of the alarm outputs is not interrupted. In the preferred embodiment, one the charge storage means is associated with each the alarm output unit, the charge storage means being a capacitor.

[0011] Preferably, the voltage supply means is arranged to periodically switch between the second voltage and a third voltage suitably of the same polarity as the second voltage. Suitably, the third voltage is lower in magnitude than the second voltage. Conveniently, the charge storage means is arranged to supply current to the alarm output units when the voltage supply means supplies the third voltage to the signal wires. When the third voltage is supplied, the alarm output units are effectively decoupled from the signal wires, and therefore any current drawn will be due to other elements, including the detector unit and the end of line resistor. In this way, the current monitoring means of the control panel assesses the current drawn and determines whether the detector units have detected a new detection event.

[0012] Advantageously, the alarm apparatus described above allows the detector units to be monitored even when in an alarm state. Also, where plural sets of signal wires are coupled to the control panel, the control panel preferably sets the alarm state on all such zones when a detection event occurs on any one zone and the alarm apparatus is able to monitor each zone for a new detection event.

[0013] According to a second aspect of the present invention there is provided a method comprising the steps of: entering a standby state and monitoring current drawn by one or more detector units coupled to a set of signal wires; entering an alarm state when the current

is within a predetermined window; in the alarm state, operating one or more alarm output units coupled to the signal wires thereby drawing current from the signal wires; temporarily decoupling the alarm output units from the signal wires using charge storage means to supply current to the alarm output units; in the alarm state and during the temporary decoupling, monitoring current drawn on the signal wires to thereby determine current drawn by the detector units.

[0014] Preferably, the method comprises the steps of: in the standby state, supplying a first voltage to the signal wires at a first polarity; in the alarm state, supplying a second voltage of opposite polarity to the first voltage, each alarm output unit having a polarity detector for distinguishing between the first and second voltages.

[0015] Preferably, the method comprises the step of: temporarily changing the second voltage to a third voltage, suitably of equal polarity and lower value to the second voltage, to thereby temporarily decouple the alarm output units.

[0016] According to a further aspect of the present invention there is provided a method comprising the steps of: entering a standby state and supplying a first voltage; entering an alarm state following a detection event, and supplying a second voltage; periodically reducing the second voltage to a third voltage to thereby detect another detection event.

[0017] According to a further aspect of the present invention there is provided an alarm output circuit for use with a set of signal wires, the alarm output circuit comprising: a polarity sensor for distinguishing a standby state when a first voltage is present on the signal wires, and an alarm state when a second voltage of opposite polarity is present on the signal wires; an alarm output unit for outputting an audible or visual alarm signal in the alarm condition; charge storage means for temporarily supplying current to the alarm output unit such that the alarm output unit is decoupled from the signal wires.

[0018] Preferably, the polarity sensor is a diode coupled in series between the alarm output unit and the signal wires, and the charge storage means is a capacitor coupled in parallel with the alarm output unit across the signal wires. In operation, when the second voltage is temporarily reduced to a third voltage, the capacitor supplies current to maintain output from the alarm output unit, and the diode isolates the capacitor and alarm output unit from the signal wire.

[0019] According to another aspect of the present invention there is provided a control panel for an alarm system, comprising: monitor means for monitoring current drawn on a set of signal wires coupled to detector units and alarm output units, the current monitor for determining an alarm condition when the monitored current is within a predetermined window; voltage supply means for supplying a first voltage across the signal wires in a normal condition, and a second voltage in the alarm state, the voltage supply means for periodically reducing the second voltage to a third voltage.

[0020] Preferably, the second and third voltages are of opposite polarity to the first voltage. Conveniently, the first and second voltages have a magnitude of around 27 volts, and the third voltage has a magnitude of around 13 volts. Preferably, the dip period when the second voltage is reduced to the third voltage is of the order of 5 to 500 μ S, preferably 150 to 250 μ S and ideally 200 μ S.

[0021] Preferably, the detector units are each provided with a bridge circuit to operate at either polarity of the first and second voltages.

[0022] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 is a schematic diagram of a preferred alarm apparatus;

Figure 2 is a schematic diagram of a preferred alarm output unit;

Figures 3 and 4 are voltage timing diagrams referring to the circuit of Figure 2; and

Figure 5 is a schematic diagram of part of the preferred control panel.

[0023] The preferred embodiment of the present invention will be described with particular reference to the example of a fire alarm apparatus with detector units for responding to a detection event such as heat, smoke, a manual alarm push, or other suitable events. However, the preferred alarm apparatus can be implemented to perform a variety of different detection functions.

[0024] Referring to figure 1, the alarm apparatus comprises a control panel 10 coupled to a set, in this case a pair, of signal wires 20 forming a zone circuit. The control panel 10 is coupleable to other, similar, zone circuits (not shown).

[0025] Each zone circuit is provided with an end of line monitoring device, in this case an end of line resistor 21, such that the control panel 10 can confirm that a complete circuit is achieved. The signal wires 20 are installed within a site to be protected by the alarm apparatus, such as a building, and may be up to, for example, 1000 metres in length. Therefore, it is desired to minimise the amount of wiring required to form each zone circuit.

[0026] The signal wires 20 of each zone circuit are coupled to one or more detector units 30 placed at suitable locations within the building. As an example, a smoke detector is typically located on a ceiling of a room and it is desired that cabling should be visually unobtrusive. One or more alarm output units 40 are provided, also coupled between the signal wires 20 to thereby minimise cabling requirements. The alarm output units 40 may take any suitable form, ideally for providing a

human audible or visible alarm. A combined alarm output and detector unit may be provided having one or more detector elements and one or more audio or visual output elements.

[0027] Referring to figure 2, each alarm output unit 40 is provided with a load device 41 for generating an audio or visual output, the load device being coupled across the signal wires 20 in parallel with a capacitor C1 and in series with a diode D1.

[0028] The operation of the alarm apparatus shown in figures 1 and 2 will now be described in more detail with reference to the voltage timing diagrams of figures 3 and 4.

[0029] Referring firstly to figure 3, in a normal standby state, the control panel 10 supplies a first voltage V1 to the signal wires 20 of each zone circuit, in this example a positive voltage. Correct operation of the standby state is monitored with reference to the current flow through the end of line resistor 21 and any quiescent current drawn by detectors 30 and alarm outputs 40. When a detection event occurs, one of the detectors 30 triggers to provide a lower resistance path between the signal wires 20 and thereby significantly increase the current drawn to a predetermined higher level. The current monitor in the control panel 10 determines the current drawn, suitably by determining the voltage across a sense resistor.

[0030] When the control panel recognises that a detector has triggered, following a detection event, an appropriate response is determined. This response may include, for example, providing operator feedback at a central control station, summoning emergency services, and other features which need not be described here in detail. Where it is desired to alert human occupants of a building or other site, alarm output units 40 are activated. In the circuit of figure 1, all the alarm output units 40 coupled in the zone circuit of signal wires 20 are activated in a single action. However, it is important that the zone may still be monitored in order to, for example, determine whether a second detection event has occurred triggering another of the detectors. Also, the control panel 10 may determine a global alarm condition wherein the alarm output units 40 on some or even all zone circuits coupled to the control panel 10 are activated. In this global alarm state, it is important that detector units 30 coupled to each zone can still be monitored, ie. to determine whether a new detection event has occurred within that zone.

[0031] Referring to figure 3, the voltage supplied by the control panel 10 to the signal wires 20 is switched following a detection event from the first voltage V1 to a second voltage V2. Conveniently, the first and second voltages are of equal magnitude such as around 27.6 volts, and of opposite polarity. The voltage trace of figure 3 represents the voltage at a circuit point 51 of figure 2. As shown in figure 2, when the first voltage V1 is supplied, the diode D1 prevents the alarm output 41 operating. However, when the voltage is reversed in the

alarm state to the second voltage V2, diode D1 conducts and the alarm output 41 operates.

[0032] As shown in figure 3, the second voltage V2 is periodically dipped to a third voltage V3 which is conveniently half the magnitude of the second voltage V2, ie. about 13.8 volts. The voltage is dipped preferably for a relatively short period, such as of the order of 200 μ S.

[0033] During the dip period, the capacitor C1 maintains the voltage at the circuit point 52 shown in figure 2 at or near the second voltage (-27 volts), whilst the voltage at the circuit point 51 of figure 2 drops to the value of the third voltage (-13.8 volts). Therefore, diode D1 is reverse biased and isolates the capacitor C1 and the alarm output unit 41 from the signal wires 40. The dip period is determined such that the capacitor C1 stores sufficient charge to supply current to the alarm output 41 during the dip period and maintain operation of the alarm output.

[0034] As shown in figure 4, the voltage at the circuit point 52 will of course fall as the capacitor C1 discharges, but since the difference between the second voltage V2 and the third voltage V3 is relatively large, the capacitor does not discharge sufficiently for the diode D1 to switch over, ie. does not discharge to around -13.2 volts within a dip period of around 200 μ S.

[0035] Figure 5 shows relevant portions of the control panel 10 coupled to the signal wires 20 of one of the zone circuits. Conveniently, a power supply is arranged to provide 0 volt, 13.6 volt and 27.6 volt lines, which are selectively coupled to the signal wires 20 through changeover switches 11, 12 and 13. In the standby mode, the 0V and 27V lines are coupled to the signal wires 20 through voltage reversal switches 11, 12. In this position, current drawn on the zone circuit is sensed by a first current detection unit 14. Suitably, the first current detection unit 14 determines a normal operating state when the current drawn by the signal wires 20 is within a first predetermined window, and an alarm state when the current is in a second predetermined window which conveniently is of greater magnitude of the first window. The current detection circuit 14 suitably determines an open circuit fault and a short circuit fault when the current drawn is below or respectively above predetermined minimum and maximum limits.

[0036] When the sensed current is within the second predetermined window indicating that a detection device has triggered following a detection event, the current detection circuit 14 provides a suitable output to a control logic circuit (not shown). In response to the alarm condition, voltage reversal switches 11 and 12 are changed over to supply the second voltage of reverse polarity by in effect swapping the 27 volt and 0 volt lines.

[0037] In the alarm condition the 27 volt line is periodically switched to a 13 volt supply by a voltage dip switch 13 under control of, for example, the control logic circuit. When the supply voltage is dipped to the third voltage, i.e. about 13 volts, a second current detection circuit 15 is used to determine the current drawn on the

signal wires 20. In this way the status of the detector units 30 in the zone may be determined even though the alarm outputs 40 operate on the same signal wires.

[0038] According to a further preferred embodiment of the present invention, the first and/or second current detection circuits 14, 15 distinguish between the various types of detector 30 coupled to the signal wires 20. Typically, a detection device such as detector unit 30 draws a current of around 40mA to indicate that a detection event has occurred. Where a plurality of detectors are provided, each detector is configured to draw a predetermined level of current. For example, the first detector draws current in the region of 20mA, the second in the region of 40mA, and the third in the region of 60mA. The current detection circuits 14, 15 comprise means for determining the current level drawn by the active detector unit from the signal wires 20 and comparing this against corresponding predetermined windows. In this way, the detector unit 30 responsible for triggering the detection event is determined. The current level determining means suitably comprises a plurality of comparators forming in effect an analogue to digital converter. In the preferred embodiment, the current detection circuits 14, 15 distinguish between 3, 4 or 5 predetermined current levels. The current levels are associated with individual detectors, or are associated with each type of detector such as a smoke detector, a heat detector, and a manual call point.

[0039] An alarm apparatus has been described which allows for simple and cost effective installation with minimal wiring, with detectors and alarm outputs coupled to the same signal wires, and which enables the detectors to be monitored even in an alarm state. The apparatus uses simple components in each alarm output unit, namely a diode and a capacitor, and a voltage switching power supply in the control panel.

[0040] The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0041] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0042] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0043] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features

disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. An alarm apparatus comprising:

a control panel (10) for monitoring a set of signal wires (20) to determine a standby state and an alarm state;

one or more detector units (30) coupled to the signal wires for triggering the alarm state in response to a predetermined detection event;

one or more alarm output units (40) coupled to the signal wires (20) for operatively responding to the alarm state; and

decoupling means (C1, D1) for decoupling the alarm output unit (40) from the signal wires (20) in the alarm state such that the control panel (10) operatively monitors the detector unit (30).

2. An alarm apparatus as claimed in claim 1, wherein the control panel monitors current drawn on the signal wires (20), and the detector unit (30) indicates a detection event by changing the current drawn on the signal wires (20).

3. An alarm apparatus as claimed in claim 1 or 2, further comprising an end of line resistor (21) coupled to the signal wires (20) remote from the control panel (10) for determining a normal operating current in a standby state.

4. An alarm apparatus as claimed in any of claims 1 to 3, wherein the decoupling means comprises charge storage means (C1) for supplying current to the alarm output unit (41); and

wherein the alarm output unit (41) is arranged to temporarily draw current from the charge storage means in response to a predetermined condition on the signal wires (20).

5. An alarm apparatus as claimed in claim 4, wherein the predetermined condition is a predetermined change in the voltage level on the signal wires (20).

6. A method of operating an alarm apparatus, comprising the steps of:

entering a standby state and monitoring current drawn by one or more detector units (30) coupled to a set of signal wires (20);

entering an alarm state when the current is within a predetermined alarm window;

in the alarm state operating one or more alarm output units (40) coupled to the signal wires (20) thereby drawing current from the signal wires; 5

temporarily decoupling the alarm output units from the signal wires (20) using charge storage means (C1); and 10

in the alarm state and during the temporary decoupling, monitoring current drawn on the signal wires to thereby determine current drawn by the or each detector unit (30). 15

7. A method as claimed in claim 6, comprising the steps of:

in the standby state, supplying a first voltage to the signal wires (20) at a first polarity; 20

in the alarm state, supplying a second voltage to the signal wires (20) of opposite polarity to the first voltage; 25

wherein each alarm output unit (40) comprises a polarity detector (D1) for distinguishing between the first and second voltages to determine the standby state and the alarm state. 30

8. A method as claimed in claim 7, comprising the step of:

temporarily changing the second voltage to a third voltage to thereby temporarily decouple the alarm output unit (40). 35

9. An alarm output circuit coupleable to signal wires of a alarm apparatus, the alarm output circuit comprising: 40

a polarity sensor (D1) for distinguishing between a standby state when a first voltage is present on the signal wires (20), and an alarm state when a second voltage of opposite polarity is present on the signal wires (20); 45

an alarm output unit (41) for outputting a human detectable alarm signal in response to the alarm state; 50

charge storage means (C1) for temporarily supplying current to the output unit (41) such that the output unit (41) is decoupled from the signal wires (20). 55

10. A control panel for an alarm system, comprising:

monitor means (10) for monitoring current drawn on a set of signal wires (20) coupled to detector units (30) and alarm output units (40), the current monitor means for determining an alarm condition when the monitored current is within a predetermined alarm window;

voltage supply means (10) for supplying a first voltage across the signal wires (20) in a standby state, and a second voltage in the alarm state, the voltage supply means for periodically reducing the second voltage to a third voltage.

FIG.1

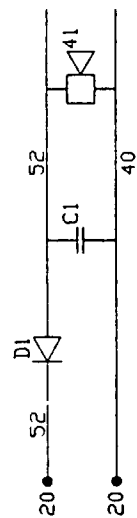
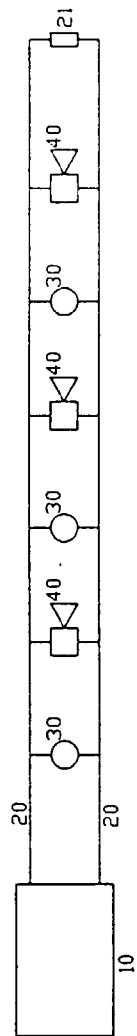
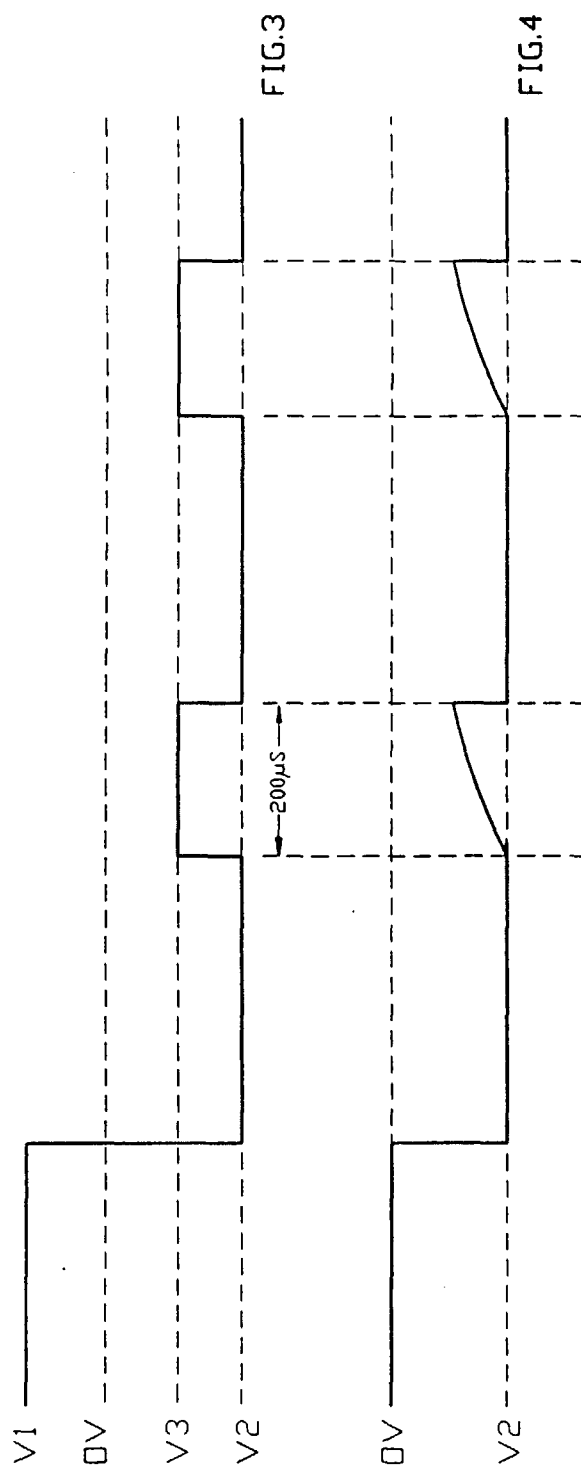
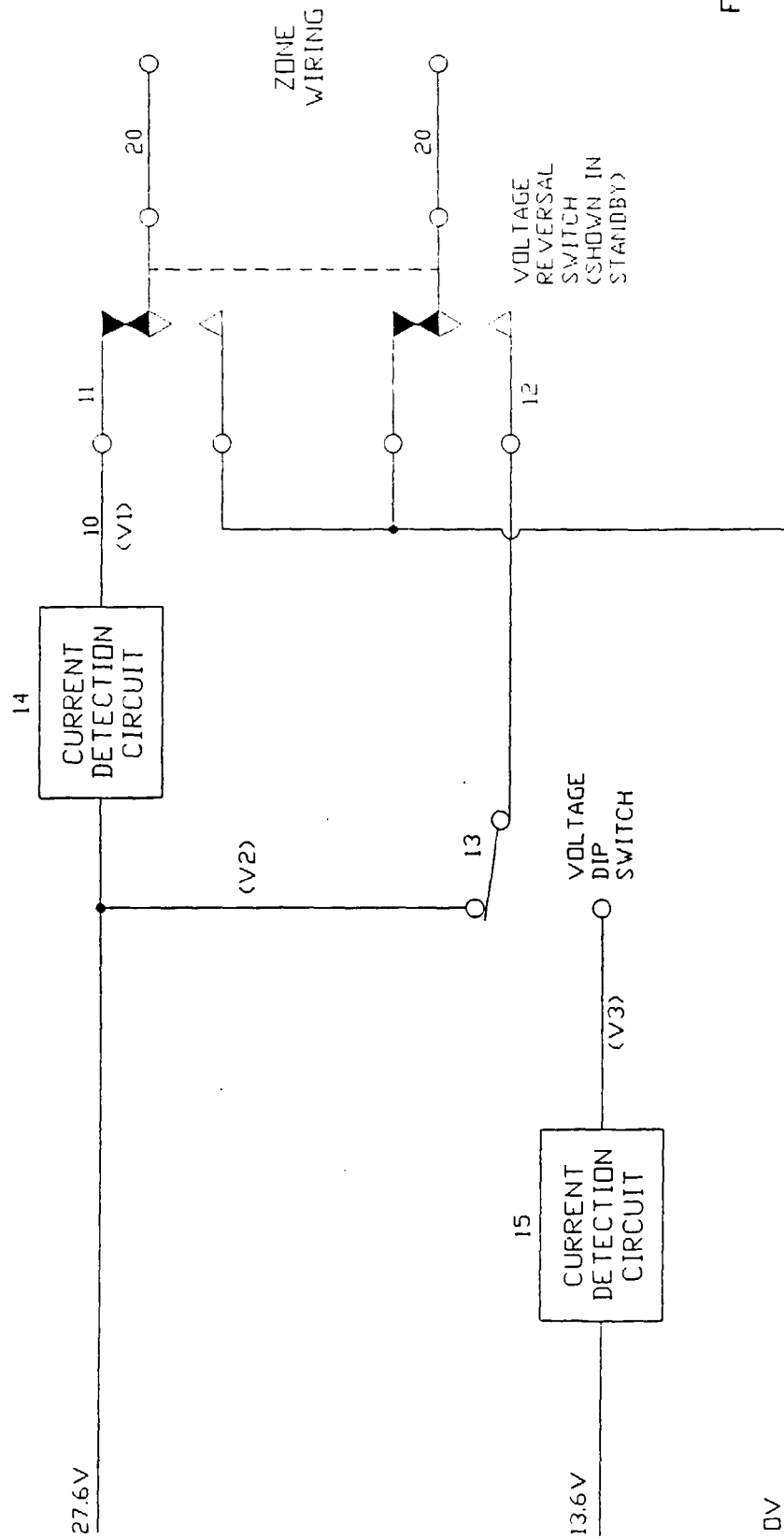


FIG.2





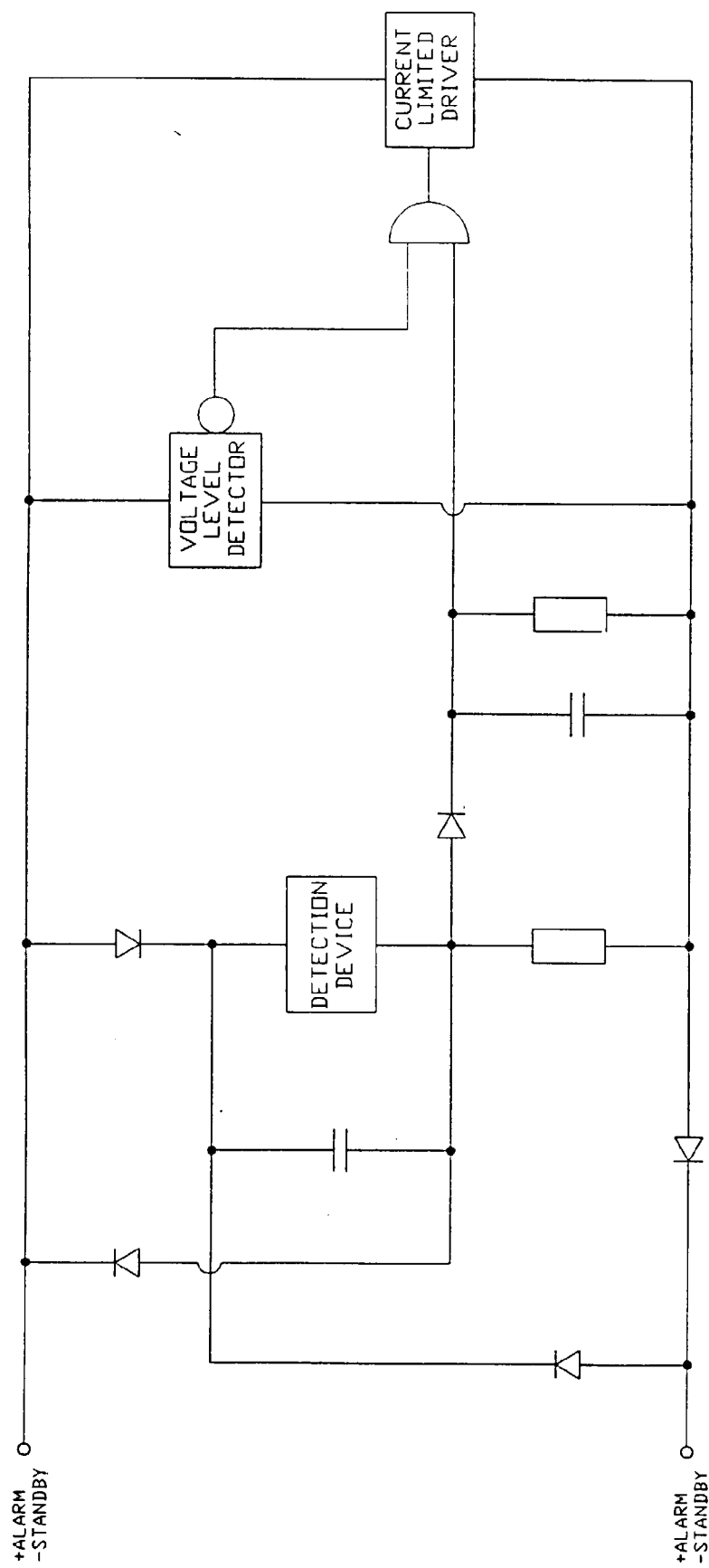


FIG.6