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[54] ALARM CIRCUIT

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[58] **Field of Search**.....340/227, 228, 236, 237, 420; 317/154, 155, 124

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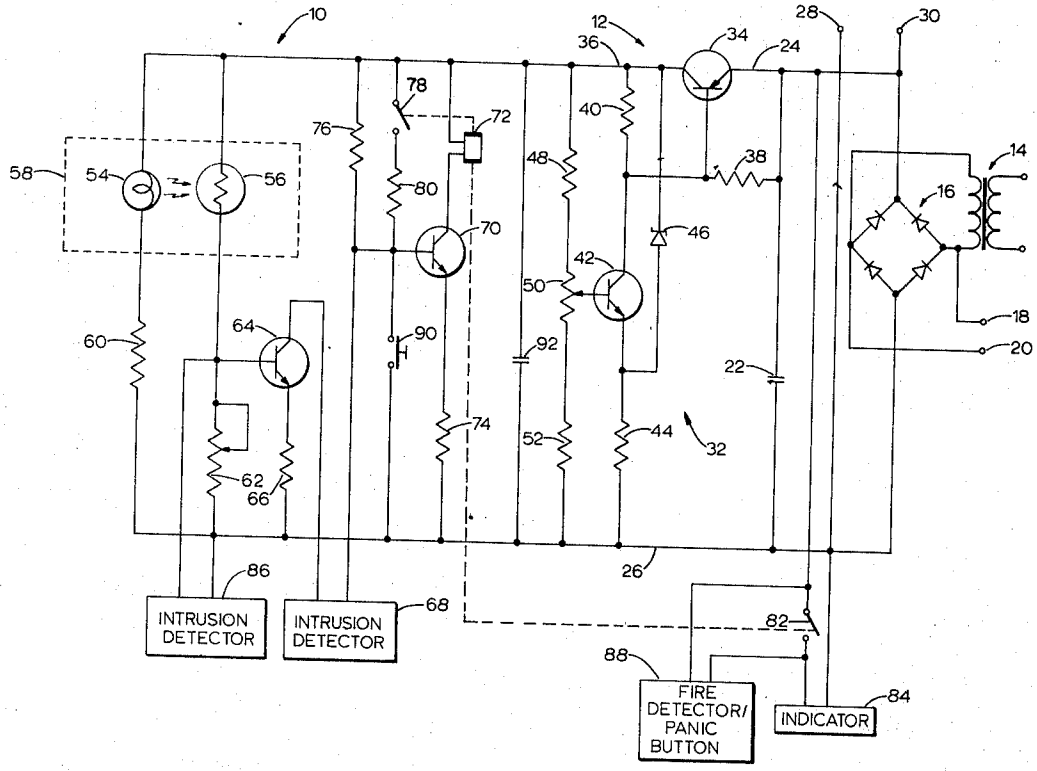
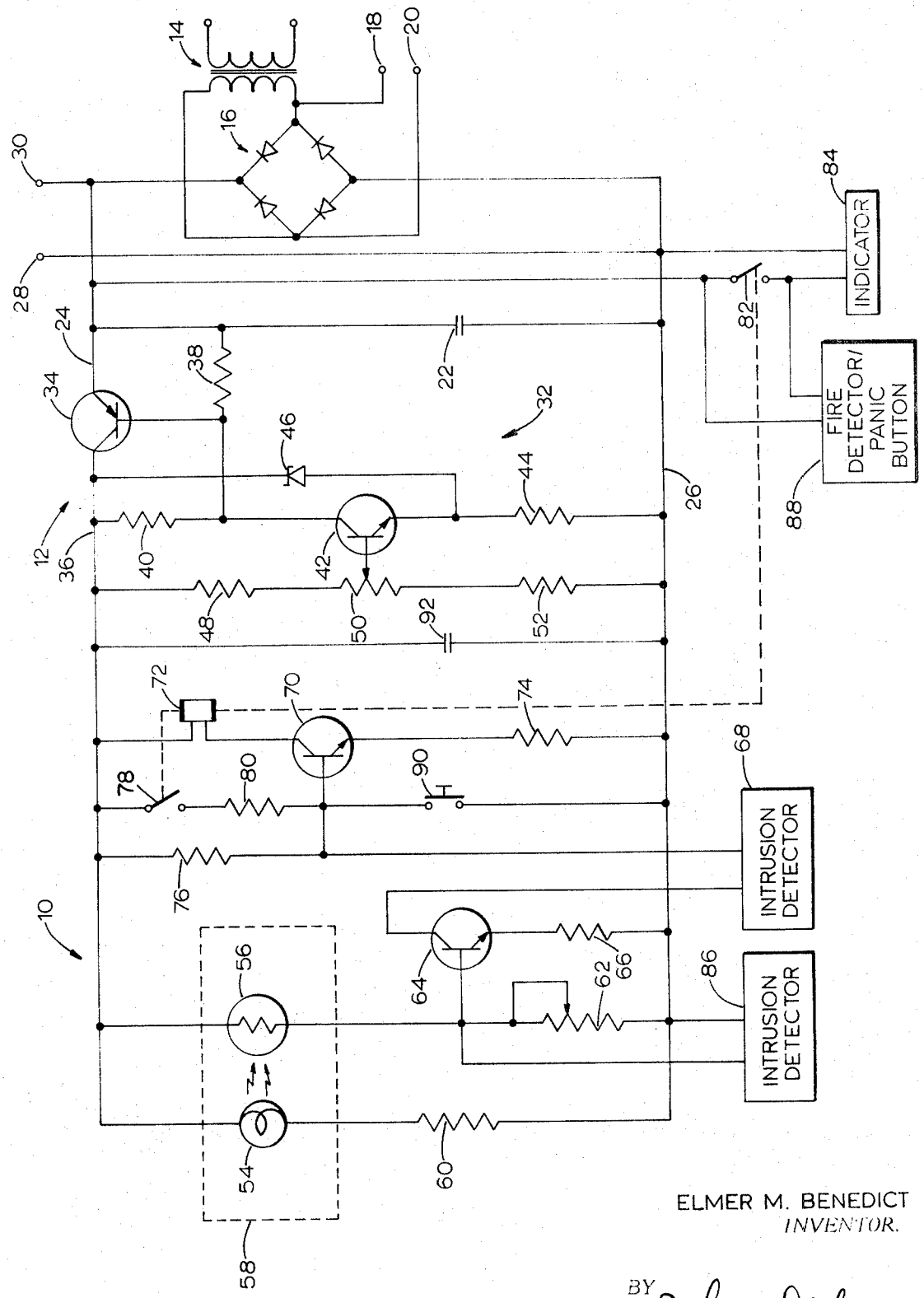
[57] **ABSTRACT**

The disclosed embodiment of the invention is a circuit which is responsive to one of a number of abnormal conditions for activating an alarm. The circuit includes a highly regulated power supply formed of a transistor connected in series between an unregulated voltage supply and the detector portion of the circuit. A feedback circuit, which senses voltage fluctuations, controls the level of conduction of the transistor, thereby controlling the voltage drop thereacross to provide a regulated output voltage. A smoke detector is formed of a light and a photocell mounted in a smoke chamber, the interior of which is shielded from ambient light. Any increase in the resistor of the photocell caused by the presence of smoke activates, through an amplifier circuit, a latching relay, which in turn activates an alarm. The amplifier circuit is also responsive to either the closing of normally open contacts or the opening of normally closed contacts to actuate the relay. Additional detectors and controls are connected in parallel with the relay contacts which energize the alarm.

1 Claim, 1 Drawing Figure





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ALARM CIRCUIT

This invention relates generally to a detector circuit for indicating the occurrence of an abnormal condition and more particularly to a circuit which is responsive to the occurrence of one or more of a number of abnormal conditions for actuating an indicating device, such as an alarm.

The present invention has particular application in residences as a safety system for providing an indication of an abnormal condition, such as an unauthorized intrusion or the presence of a fire. However, the circuit disclosed herein may be employed in any installation for detecting an abnormal condition.

The need has long existed for a home alarm device which is not only reliable, but inexpensive to the point of being attractive to all income groups. The normally available alarm circuits which are relatively inexpensive suffer from one major problem which makes them undesirable; namely, such known devices are not sufficiently reliable to provide adequate protection. The unreliability of such known devices vary considerably with changes in environmental conditions. If such devices are employed, for example, to detect the occurrence of a fire by detecting the presence of smoke in the surrounding atmosphere, the environmental conditions at one time may cause triggering of the device at a relatively low level of smoke in the surrounding atmosphere and at another time at a relatively high content of smoke in the surrounding atmosphere. Consequently, such devices may be triggered, for example, by the presence of cigarette smoke in the atmosphere under certain environmental conditions. This relatively low sensitivity of such devices is, of course, not desirable.

The lack of a high degree of sensitivity in such prior known devices is due primarily to inadequate regulation of supply voltage to the device. If the power supply voltage is maintained constant under all types of environmental conditions, the sensitivity of the detection circuit will be greater.

If a detector circuit is employed for detecting the occurrence of an unauthorized intrusion onto a premises, it is usually necessary to employ relatively long lead lengths between the detector unit and the various stations at which an intrusion may occur. The resistance and stray capacitance of such long leads can change the operating conditions of the detector circuit if such leads are connected to relatively low impedance points in the circuit. Such a change in the operating conditions of the detector circuit reduce its sensitivity and reliability. Since the lead length from a particular sensing unit to the detector circuit varies considerably from one installation to another, a detector circuit which has a relatively low input impedance must be designed specifically for each installation.

Accordingly, it is an object of the present invention to provide a circuit for detecting the presence of an abnormal condition or an unauthorized intrusion which is relatively inexpensive and has a high degree of sensitivity and reliability.

A feature of the present invention resides in the provision of a highly regulated power supply for the detector circuit, which power supply is relatively simple and inexpensive, but high effective for maintaining the supply voltage constant.

Another feature of the present invention resides in the provision of a high impedance circuit which forms the input to the detector circuit for various intrusion sensors.

These and other objects, features and advantages of the present invention will be more fully realized and understood from the following detailed description when taken in conjunction with the accompanying drawing, wherein the single FIGURE is a schematic diagram of the preferred embodiment of the present invention.

With reference to the drawing in detail, there is shown a detector circuit, generally designated with the reference numeral **10**, and a power supply, generally designated with the reference numeral **12**, which provides a highly regulated supply of voltage to the detector circuit **10**. A transformer **14** is connected between a source of alternating current voltage and a full wave bridge rectifier circuit **16**. The input to the transformer **14** may be 110 volts AC or 220 volts AC line voltage which is reduced by the action of the transformer to **12** volts AC. A pair of input terminals **18** and **20** are also connected to the rectifier circuit **16** to permit operation of the device by means of a 12 volt AC auxillary voltage source. A capacitor **22** is connected in parallel with the full wave rectifier circuit **16** and together therewith provides unregulated partially filtered DC voltage across lines **24** and **26**. A pair of input terminals **28** and **30** are provided for connecting a 12 volt DC auxillary voltage source for operation of the circuit. Accordingly, the circuit can be operated from either a normal line voltage supply or from either a 12 volt DC or 12 volt AC auxillary voltage supply. Circuit arrangements which are well known in the art may be employed for connecting one of the auxillary supplies to the circuit if the line voltage should fail for various reasons.

The unregulated voltage appearing across the lines **24** and **26** is supplied to a regulation circuit generally indicated with the reference number **32**, which provides a regulated voltage to the detector circuit **10**. The regulation circuit **32** includes a PNP transistor **34** having its emitter and collector electrodes connected in series between the line **24** and a line **36**. The voltage developed across the lines **26** and **36** constitutes the regulated voltage employed by the detector circuit **10**. A resistor **38** is connected between the positive voltage on the line **24** and the base of the transistor **34**, and a resistor **40** is connected between the positive voltage on the line **36** and the base of the transistor **34**. The base of the transistor **34** is also connected to the collector of a transistor **42** having its emitter connected through a resistor **44** to the line **26**. It can be readily appreciated that the biasing voltage on the base of the transistor **34** is established by the voltage divider action of the resistors **38** and **40** and the conduction level of the transistor **42**.

A Zener diode **46** is connected between the line **36** and the emitter of the transistor **42**. A voltage divider which is formed of a resistor **48**, a potentiometer **50** and a resistor **52** is connected between the lines **26** and **36** and forms a biasing network for the transistor **42**. The base of the transistor **42** is connected to the variable contact arm of the potentiometer **50** which provides a means for adjusting the voltage on the line **36**. Adjustment of the voltage on the line **36** is necessitated by the fact that the operating characteristics of Zener diodes, which would be used as the Zener diode **46**, vary considerably.

The instantaneous voltage developed on the line **36** is dependent upon the conduction level of the transistor **34**, which is in turn controlled by the conduction level of the transistor **42**. The Zener diode **46** supports a fixed value of voltage drop across its terminals, such that the voltage drop across the resistor **44** is equal to the voltage on the line **36** plus the voltage supported by the Zener diode **46**. Accordingly, if the voltage on the line **36** increases by a predetermined amount, the voltage drop across the resistor **44** will increase by the same amount. However, the bias voltage on the base of the transistor **42** will increase only a fractional amount of an increase in the voltage on the line **36**. As a result, if the voltage on the line **36** tends to become greater in value, the conduction level of the NPN transistor **42** will decrease. Such a decrease in the conduction level of the transistor **42** will cause the voltage on the base of the transistor **34** to increase, rendering the transistor **34** less conductive, thereby decreasing the voltage on the line **36** by an amount equal to the subsequent increase of that voltage. As a result, the voltage on the line **36** will be maintained constant regardless of any variation in the voltage developed across the lines **24**, **26**. The transistor **42** and its associated circuitry effectively forms a high gain comparitor circuit between the reference voltage developed across the Zener diode **46** and the voltage established at the base thereof. The action of the transistors **34** and **42** is effectively a feedback gain to compensate for voltage fluctuations which may appear on the line **36**.

The detector circuit **10** includes a light source **54** and a photocell **56** mounted within a smoke chamber which is diagrammatically illustrated by the dotted line outline indicated

with the reference numeral **58**. The smoke chamber **58** is constructed to shield the photocell **56** from any ambient light, but permits the flow of external air therethrough which may contain smoke therein. The light source **54** is connected in series with a resistor **60** across the lines **26, 36** and the photocell **56** is connected in series with a potentiometer **62** across the lines **26, 36**. The junction of the photocell **56** and the resistor **62** is connected to the base of a transistor **64**. The emitter of the transistor **64** is connected through a resistor **66** to the negative potential on the line **26**. The collector of the transistor **64** is connected through the normally closed contacts of an intrusion detector, generally designated with the reference numeral **68**, to the base of a transistor **70**. A relay solenoid coil **72** is connected from the collector of the transistor **70** to the line **26**. A resistor **76** is connected from the line **36** to the base of the transistor **70**. Normally open relay contacts **78**, which are controlled by the relay coil **72**, are connected in series with a resistor **80** across the resistor **76**.

In the quiescent condition of the detector circuit, light emitted from the light source **54** impinges on the photocell **56** and maintains the resistance thereof at a sufficiently low value to maintain the transistor **64** conductive. The conduction of the transistor **64** maintains the bias on the base of the transistor **70** at a level to maintain the transistor **70** nonconductive. When a sufficient amount of the smoke enters the chamber **58** to reduce the amount of light impinging on the photocell **56** and increases the resistance thereof to a predetermined level, the transistor **64** is rendered nonconductive. When the transistor **64** changes from a state of conduction to a state of nonconduction, the voltage on the base of the transistor **70** increases causing it to be rendered conductive. Such conduction of the transistor **70** results in sufficient current flow through the relay coil **72** to close the relay contacts **78**, thereby placing the resistor **80** in circuit to maintain the transistor **70** conductive. This arrangement effectively makes the relay **72** a latching relay.

A second set of relay contacts **82** are connected in series with an indicating device **84**, such as a buzzer, across the lines **24, 26**. When sufficient current is passed through the relay coil **72**, the relay contacts **82** are closed to actuate the indicating device **84**.

Additional inputs are provided for a variety of sensors and actuating devices. The normally open contacts of a intrusion detector, generally indicated with the reference numeral **86** are connected between the base of the transistor **64** and the line **26**. If the normally open contacts of the intrusive detector **86** are closed, the transistor **64** will be rendered nonconductive, thereby forcing the transistor **70** to be rendered conductive to actuate the relay contacts **78** and **82**. If the normally closed contacts of the intrusion detector **68** are open, the transistor **70** will be rendered conductive to actuate the relay contacts **78** and **82**. Since the normally open contacts of the detector **86** and the normally closed contacts of the detector **68** are connected to relatively high impedance points in the circuit, any stray capacitance in the leads to those contacts will not adversely affect the operation of the circuit. As a result, such contacts can be employed with lead lengths up to several hundred feet in length. It has been found in practice that the operation of the detector circuit will not be adversely affected if the resistance of the leads to the contacts is maintained at a value no greater than 100 ohms. In addition, a fire detector or a "panic button" may be connected in parallel with the contacts **82** to actuate the indicating device **84**. Such additional sensors and/or switches are diagrammatically illustrated by the block indicated with the reference numeral **88**.

A switch **90** is connected between the base of the transistor **70** and the line **26** and is effective upon closure thereof to render the transistor **70** nonconductive. The witch **90** is employed to reset the detector circuit after it has been energized from one or more of the sensors connected thereto or from the action of the photocell **56**.

The circuit illustrated in the drawing was constructed and successfully tested with the following values for the various components as shown therein:

R 38	100 ohms
R 40	600 ohms
R 44	470 ohms
R 48	2000 ohms
R 50	1000 ohms
R 52	1000 ohms
R 60	120 ohms
R 62	500 ohms
R 66	300 ohms
R 74	30 ohms
R 76	20,000 ohms
R 80	5000 ohms
C 22	100 microfarads
C 92	50 microfarads

The principles of the invention explained in connection with the specific exemplification thereof will suggest many other applications and modifications of the same. It is accordingly desired that, in construing the breadth of the appended claims they shall not be limited to the specific details shown and described in connection with the exemplification thereof.

The invention claimed is:

1. A detector circuit, comprising: a step down transformer including primary and second windings, a low voltage AC input/output circuit connected across said secondary winding, a bridge rectifier including positive and negative terminals connected across said secondary winding, an unregulated DC input/output circuit connected across said bridge rectifier, a first transistor including emitter, collector and base electrodes, said first transistor emitter electrode connected to said positive terminal of said bridge rectifier, an incandescent light means connected between said first transistor collector electrode and said negative terminal of said bridge rectifier, an impedance means including first and second terminals having an impedance value which is proportional to the light impinging thereon, a means for enclosing said incandescent light means and said impedance means configured to allow the passage of air therethrough and to provide a light impervious shield, said impedance means disposed within said enclosing means for receiving light from said incandescent light means and being spaced apart from said incandescent light means to permit the passage of air therebetween, said impedance means first terminal connected to said first transistor collector electrode, a variable resistance means connected between said impedance means second terminal and said negative terminal of said bridge rectifier, a second transistor including emitter, collector and base electrodes, said second transistor base electrode connected to said impedance means second terminal, a first intrusion detection mean including a normally open set of electrical contacts connected between said second transistor base electrode and said negative terminal of said bridge rectifier, a third transistor including emitter, collector and base electrodes, said third transistor base electrode resistively connected to said first transistor collector electrode, a second intrusion detection means including a normally closed set of electrical contacts connected between said second transistor collector electrode and said third transistor base electrode, a relay including a coil and first and second sets of normally open electrical contacts, said relay coil connected between said third transistor collector electrode and said first transistor collector electrode, said first set of normally open relay contacts connected between said third transistor base electrode and said first transistor collector electrode, a normally open reset switch means connected between said third transistor base electrode and said negative terminal of said bridge rectifier, an indicator means including first and second terminals, said indicator means first terminal connected to said negative terminal of said bridge rectifier, said second set of normally open relay contacts connected between said indicator means second terminal and said positive terminal of said bridge rectifier, a fire detector including a set of normally open electrical contacts connected between said indicator means second terminal and said positive terminal of said bridge rectifier, a resistive voltage divider means including a potentiometer connected between said first transistor collector electrode and

said negative terminal of said bridge rectifier, a fourth transistor including emitter, collector and base electrodes, said fourth transistor base electrode connected to said voltage divider potentiometer, said fourth transistor collector electrode connected to said first transistor base electrode, and a zener diode connected between said fourth transistor emitter electrode and said first transistor collector electrode.

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