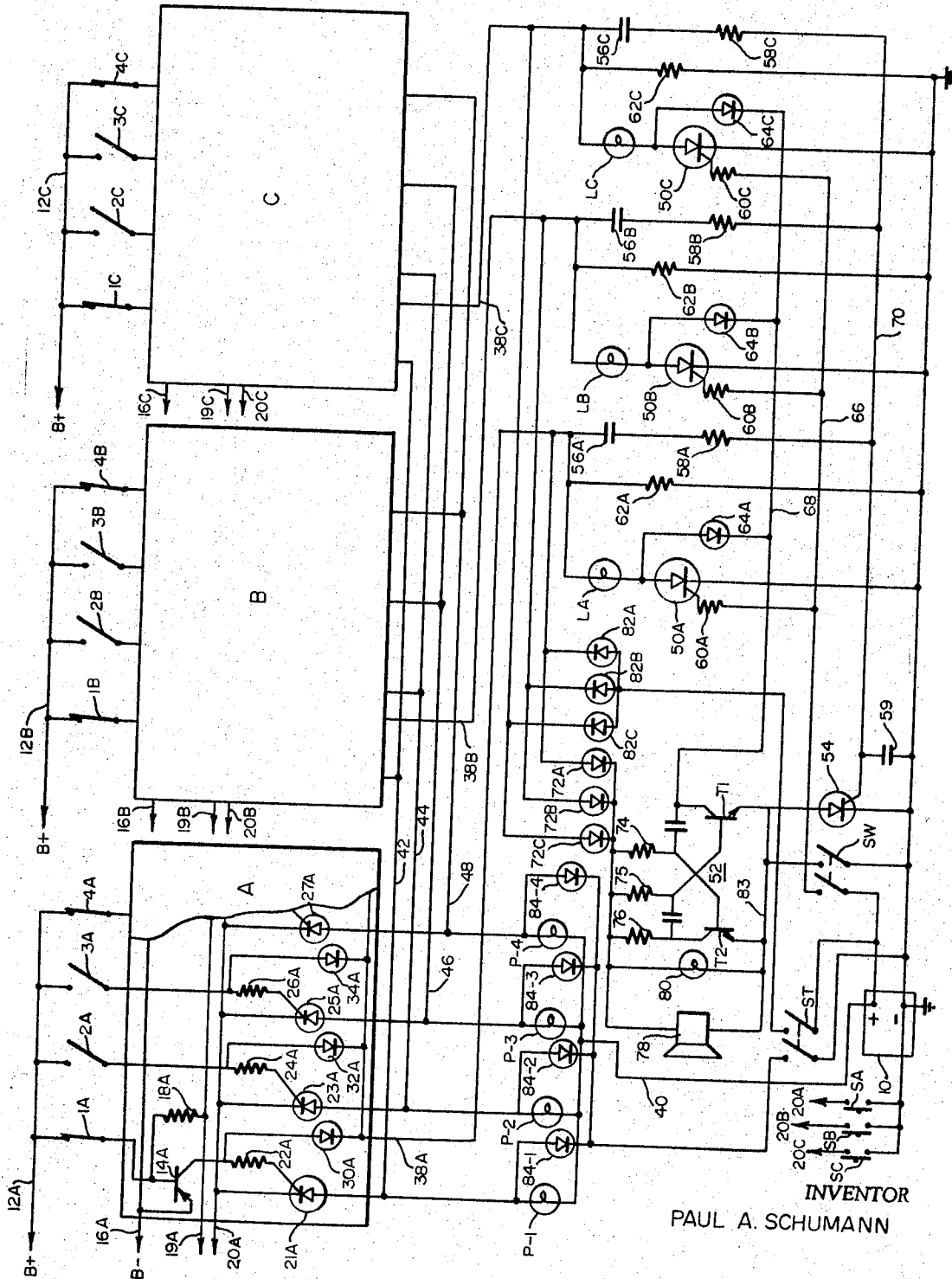


May 27, 1969

P. A. SCHUMANN
CONSTANT SURVEILLANCE ALARM SYSTEM FOR
A PLURALITY OF REMOTE LOCATIONS
Filed Aug. 11, 1966

3,447,145



INVENTOR
PAUL A. SCHUMANN

BY *Anthony A. O'Brien*

ATTORNEY

1

3,447,145

CONSTANT SURVEILLANCE ALARM SYSTEM FOR A PLURALITY OF REMOTE LOCATIONS

Paul A. Schumann, Richmond, Va., assignor to Robertshaw Controls Company, Richmond, Va., a corporation of Delaware

Filed Aug. 11, 1966, Ser. No. 571,766

Int. Cl. G08b 25/00

U.S. Cl. 340—213.1

11 Claims

This invention relates generally to surveillance alarm systems and more particularly to a solid state system for monitoring a plurality of remotely located alarm condition sensing means which are generally placed at various remote locations and in which signals therefrom are transmitted to a centrally located control station.

It is an object of the present invention to arrange a constant surveillance alarm system in novel circuitry employing a minimum number of indicating lights and a minimum number of conductors for connecting these lights with the alarm contacts.

It is another object of the present invention to provide a solid state constant surveillance alarm system which will reduce the comparative size of the equipment and further reduce the number of required components.

Still another object of the present invention is to provide a constant surveillance alarm system which utilizes the characteristics of semi-conductor devices such as controlled rectifiers for reducing size and increasing reliability.

The present invention has a further object in that a constant surveillance system for monitoring a plurality of remotely located points at a central control station utilizes silicon controlled rectifiers as active elements.

In practice, the present invention contemplates monitoring one or more zones which are remotely located from a central station with each zone having a plurality of monitoring or alarm points including alarm contact means which are responsive to an alarm condition for providing an electrical signal in accordance therewith. Semiconductor switch means in the form of a semiconductor controlled rectifier, hereinafter referred to as an SCR, is coupled to each alarm point and is adapted to be triggered into conductivity when a signal is received from its respective alarm point and a supply voltage is simultaneously supplied thereto by means of a "zone switch" coupled to a source of power supply potential. Each alarm point of a zone, moreover, is commonly coupled to a zone alarm circuit including a zone alarm light located at the central control station for providing an indication that an alarm condition has occurred in a particular zone. Commonly coupled to each of the zone alarm circuits is another SCR and a gated oscillator circuit controlled by such SCR to provide a blinking condition to the particular zone alarm light which is responding to an alarm condition. Also an audible alarm and a visual indication is provided which will indicate that an alarm condition has occurred generally. Still another SCR is respectively coupled to each zone alarm circuit providing a steady state alarm indication when an "alarm acknowledgment" switch is manually closed. Upon actuation of the particular zone switch, an alarm point light will indicate the respective alarm point in a particular zone due to the triggering of the SCR coupled thereto. An additional feature is provided whereby a test circuit is included for selectively energizing all of the indicating alarm lights for ascertaining the operability thereof.

Other objects and advantages of the invention will become apparent from a study of the following description considered in conjunction with the accompanying drawing wherein the single figure is a schematic electrical

2

diagram of an alarm system embodying the present invention.

In describing the operation of the system, it is assumed that initially all of the alarm contacts are in their illustrated condition, that all of the semiconductor elements are non-conductive, and that all of the alarm indicating lights are deenergized.

Considering the drawing, reference characters A, B and C generally identify circuitry for separate surveillance zones A, B and C each having one or more monitoring or alarm contacts A1, A2, A3, A4 and B1, B2, etc., being in the form of either a normally open or a normally closed pair of contacts. One side of all contacts are commonly connected to the positive terminal of a D.C. power supply 10 by means of a respective power buss 12A, 12B and 12C. The opposite terminal of the normally closed contact 1A is coupled to the base of transistor 14A while the opposite contacts of the normally open alarm contacts 2A, 3A and 4A are coupled to the gate electrode of a respective SCR and a semiconductor diode. In greater detail, considering zone A, the alarm contacts 1A are coupled to the base of transistor 14A which in turn has its emitter coupled to buss 16A that is adapted to be connected to the positive terminal of the D.C. power supply 10. The base of transistor 14A additionally has a resistor 18A coupled to a point of reference potential by means of a ground buss 19A which is returned to the negative terminal of the power supply 10. The collector of transistor 14A is coupled to the gate of SCR 21A by means of resistor 22A and the anode of semiconductor diode 30A. The normally open alarm contacts 2A are coupled to the gate of SCR 23A by means of resistor 24A. Likewise, field alarm contacts 3A and 4A are coupled to the respective SCRs 25A and 27A by means of resistors 26A and 28A (not shown). Also coupled to the field alarm contacts 2A through 4A are the respective anodes of semiconductor diodes, 32A, 34A and 36A (not shown). The cathodes of the diodes 30A, 32A, 34A and 36A are commonly connected to an output line 38A which in turn is connected to the zone alarm light LA.

The cathodes of SCR's 21A, 23A, 25A and 27A are commonly connected to buss 20A which is adapted to be coupled to the negative terminal of the D.C. power supply 10 through a zone switch SA (zone A). The anode of the SCR's 21A, 23A, 25A and 27A are connected in series to respective alarm point lights P1, P2, P3 and P4, which are commonly returned to the positive terminal of the D.C. power supply 10 by means of the line 40.

The circuitry with respect to zones B and C is chosen for sake of example to be substantially identical with the circuitry shown with respect to zone A. Thus, the output line 38B is connected to the zone alarm light LB and the output line 38C is connected to the zone alarm light LC. It should also be noted that the corresponding SCR's 21B and 21C (not shown), have their anodes commonly connected to the indicator light P1 by means of the circuit lead 42. Likewise, the SCR's 23B and 23C are commonly coupled to the indicator light P2 by means of the circuit lead 44. Circuit leads 46 and 48 commonly connect SCR's 25B and 25C, and 27B and 27C, respectively.

The indicator lights P1 through P4 will then present an indication of a particular alarm point within a zone whereas the zone alarm lights LA, LB and LC give an indication of the particular zone. Seven indicator lights then are adapted to provide twelve indicators for twelve alarm points.

Zone alarm circuitry is also associated with the zone alarm lights LA, LB, and LC. Each zone alarm light LA, LB and LC is connected in series to silicon controlled rectifiers 50A, 50B and 50C, respectively. Also associated with the aforesaid zone alarm lights is a gated free-run-

ning multivibrator circuit 52 and another silicon controlled rectifier 54. Considering the zone alarm light circuitry for LA in greater detail, a resistance capacitor combination comprising capacitor 56A and 58A are coupled in series between the output line 38A and the anode of SCR 54. The zone alarm light LA is connected in series to the anode of SCR 50A while its cathode is returned to ground which is commonly connected with the cathode of SCR 54. The gate electrode of SCR 50A is coupled to the one set of two sets of normally open contacts of an "alarm acknowledge" switch SW through the resistor 60A. A resistor 62A is coupled from the common connection of capacitor 56A and the light LA to ground. A semiconductor diode is coupled from the common connection of the light LA and the anode of SCR 50A to the collector of transistor T1 of the multivibrator circuit 52.

The circuitry with respect to zone alarm lights LB and LC is similar with respect to that described to zone light LA. However, it should be noted that the resistors 60A, 60B and 60C are commonly connected to the said one set of contacts of the "alarm acknowledge" switch SW by means of circuit lead 66. The diodes 64A, 64B and 64C have their cathodes commonly connected to the collector of transistor T1 by means of circuit lead 68. Also, the resistors 58A, 58B and 58C are commonly connected to the gate of SCR 54 by means of circuit lead 70. A capacitor 59 is coupled between the gate of SCR and ground.

A semiconductor diode 72A is coupled from the zone output line 38A to the multivibrator circuit 52 at the common connection of resistors 74, 75 and 76. Semiconductor diode 72B is connected between the zone output lead 38B to the multivibrator circuit 52 and diode 72C is connected from the multivibrator circuit 52 to the zone output lead 38C. The anode of SCR 54 is connected to the common connection between the emitters of transistors T1 and T2. It should be pointed out that the other set of contacts of the "alarm acknowledge" switch SW, which is also shown in a normally open position, is coupled across SCR 54.

An audible alarm device 78 is coupled across the multivibrator circuit 52 such that one side thereof is common to the emitters of transistor T1 and T2 while the other side is common to the diodes 72A, 72B and 72C. A visual alarm 80 is also coupled directly across the audible alarm 78 for being indicative of an alarm condition generally as is the audible alarm.

A test circuit for the above described circuitry includes a double pole normally open switch ST and seven semiconductor devices, i.e., diodes 82A, 82B and 82C, and diodes 84-1, 84-2, 84-3 and 84-4. One set of contacts of the switch ST when closed connects the negative terminal of the power supply 10 to the diodes 84-1 through 84-4. The cathodes of these diodes are commonly connected to the aforementioned section of the switch ST while the anodes thereof are respectively connected to the alarm point lights P1 through P4 respectively. By closing the switch ST, all four lights P1 through P4 will be lit since the opposite side of the lights are returned to the positive terminal of the power supply 10. The other set of switch contacts of the switch ST is connected on one side to the positive terminal of the power supply 10 with the outer side being commonly connected to the zone output line 38A which is common to the capacitor 56A and the resistor 62A and the zone alarm light LA. Similarly, the cathode of diode 82B is connected to the zone output line 38B and the cathode of diode 82C is connected to the zone output line 38C.

The operation and further description of the embodiment shown on the drawing will be accomplished by describing the operation of the circuit when an alarm condition occurs at a selected point in a zone. Assuming alarm point 2 of zone A identified as the normally open alarm contacts 2A has closed indicating an alarm condition, the positive side of the power supply 10 is applied to the

anode of the diode 32A as well as the gate of SCR 23A by means of the buss 12A. SCR 23A however, will not be triggered inasmuch as the ground return circuit coupling the cathode to the negative terminal of the power supply A is open-circuited due to the normally open condition of the zone switch SA. Diode 32A, on the other hand, becomes conductive and the positive voltage on buss 12A is impressed on the zone output line 38A. The appearance of a positive potential at the zone output line 38A renders diode 72A conductive applying a positive potential to the anode of SCR 54 which may be called the "alarm SCR," via the audible alarm 78 and the light 80 connected in parallel. At the same time, a transient current signal is established by the closure of the alarm point contacts 2A and is fed to the gate of the alarm SCR 54 by means of the triggering circuit including the capacitor 56A and the resistor 58A. The transient signal thus applied to the gate of SCR 54 triggers it into conduction placing line 83 at ground potential completing the circuit necessary for operating the audible alarm 78, the indicator lamp 80, and also the free-running multivibrator circuit 52.

It should be noted that the collector load impedance for transistors T1 is any one or all of the zone alarm lights LA, LB and LC, which is commonly connected to the collector thereof by means of respective diode 64. In other words, when a positive voltage appears on any zone output line, such as line 38A, zone alarm light LA becomes the load impedance for the transistor T1 inasmuch as blocking diode 64A is properly poled to conduct. The normal operation of the free-running multivibrator circuit, such as shown in circuit 52 is such that one transistor T1 or T2 will conduct while the other transistor is turned off. The first transistor will then be turned off when the other transistor is turned on. The zone alarm indicating light, in the specific example LA, which forms a part of the multivibrator circuit is energized each time transistor T1 is turned on during operation of the multivibrator. The frequency of the operation of the multivibrator 52 is low enough so the on and off operation of the transistor T1 can be detected by the eye as the alarm indicating of an alarm condition occurring in zone A. Not only is there a blinking indication that an alarm has occurred in zone A but the audible alarm 78 gives an audible indication that an alarm condition exists generally as well as visual indication thereof as provided by the lamp 80.

When an alarm condition occurs, the "alarm acknowledge" switch SW is momentarily closed by the operator which places a short across the SCR 54 rendering it non-conductive and simultaneously places the positive terminal of the power supply 10 on line 66, which in turn applies positive voltage to the gates of the SCRs 50A, 50B and 50C through their respective gate resistors 60A, 60B and 60C. Since in the example under consideration only zone output line 38A has a positive voltage thereon, SCR 50A will be triggered into conduction causing the zone alarm light LA to be continuously energized due to the fact that the return path to ground is provided through the SCR which now exhibits a very low impedance to ground.

Once the particular zone in which an alarm has been indicated is established, in the instant example zone A, it becomes desirable to determine which alarm point is presenting an alarm condition. This is effected by means of the "zone switches" SA, SB and SC in combination with the SCR circuitry arrangement for each zone. The switch SA is used for determining the point at which an alarm has occurred in zone A, the switch SB is used for determining the point at which an alarm occurs in zone B, and switch SC is used for determining the point at which an alarm has occurred in zone C. Assuming that an alarm condition has occurred at alarm contacts 2A, closing "zone switch" SA will provide a ground return over line 20A for the SCRs 21A, 23A, 25A and 27A. Each of these SCRs has positive voltage applied to their respective anodes through their respective indicator lights P1 through P4. Since the

5

contacts 2A are now closed, a positive potential will be applied to the gate of transistor 23A rendering it conductive, thereby closing the circuit through light P2 causing it to light and thereby providing an indication of an alarm condition at alarm point 2A. SCR's 21A, 25A and 27A will remain non-conductive as well as all of the SCR's in zones B and C.

A separate alarm circuit for each zone is supplied in order that the "alarm" SCR 54 can be triggered by an alarm condition from any zone and after being acknowledged can be triggered by an alarm condition occurring in a different zone. Also, when the second alarm is acknowledged, SCR 54 can be triggered by an alarm condition occurring in still another zone, etc.

After an alarm condition is corrected, it is necessary that the capacitor in the zone alarm circuit, i.e., capacitors 56A, 56B and 57C, associated with the zone having an alarm condition be discharged. This is necessary in order to again place the circuit in condition for receiving an alarm signal from the respective zone. The subject capacitor in the triggering circuit is discharged by means of the respective resistor 62A, 62B or 62C connected from the capacitor to ground.

When it is desirable to utilize normally closed alarm contacts in the system such as, at alarm point 1A, an additional circuit element is needed for each set of normally closed contacts. This element takes the form of transistor 14A coupled between the alarm point contacts 1A and the blocking diode 30A. The normally closed contacts 1A operate to hold the transistor 14A in an off or non-conductive condition. When the contacts 1A open, however, transistor 14A is rendered conductive and since the emitter-to-collector resistance is negligible when operated in the switching mode, positive voltage appears on zone output line 38A from buss 16A via transistor 14A and blocking diode 30A. In all other respects, the operation as hereinbefore described is the same.

As indicated previously, a test circuit for the preferred embodiment includes the "test" switch ST in combination with the diodes 84-1 through 84-4 and diodes 82A through 82C. The test circuit when operated by means of closing the switch ST, applies the positive voltage of the power supply 10 to each of the alarm indicating lamps LA, LB and LC by means of diodes 82A, 82B and 82C, respectively, as well as to the audible alarm 78, lamp 80 and the multivibrator circuit 52 by means of the diodes 72A, 72B and 72C. The "alarm" SCR 54 is triggered by the transient produced by closing the switch ST causing the multivibrator 52, the alarm indicating lamps and the audible alarm 78 to operate. In addition, the circuitry applied a ground connection to all of the alarm point lights P1 through P4 by means of the diodes 84-1 through 84-4 providing an indication as to whether or not they are operating properly. The diodes mentioned with respect to the test circuitry moreover are used to keep the signal which may be presented during normal use of the system from passing to other points in the circuit where it might cause an erroneous indication.

What has been shown and described therefore is a solid state constant surveillance alarm system having a number of zones identified as A, B, C, etc. each having a number of monitoring or alarm points in the form of the alarm contacts. The number of zones and the number of monitored points have been selected for the sake of brevity it being understood that any larger suitable number of such zones and/or points may be used. One side of each of the contacts in a given zone is connected via a diode to a common output line for the zone. The output line for a zone is connected to a zone alarm light LA, LB, LC, etc. at a central monitoring station or control center and then to ground. The opposite side of all the contacts in a zone is connected to the positive side of a D.C. power supply. Should one or more of the monitoring points in a zone indicate an alarm condition, the zone indicator or alarm light will be energized. A circuit for each zone for controlling the energization of an audible alarm is also provided and is

6

effected to energize the audible alarm when an alarm condition exists in the zone. The zone alarm indication is by means of a blinking light provided by a gated multivibrator circuit which is rendered operative by means of an "alarm" SCR which is triggered by a transient coupled thereto from the alarm point unless an alarm condition exists. When an alarm is acknowledged by means of an "alarm acknowledge switch," an SCR in circuit combination with the alarm zone light is triggered rendering it energized in a steady state condition. When the zone has been determined, a "zone switch" is closed which permits another SCR to be triggered into conduction energizing an alarm point light, thus giving indication not only of a particular zone but the particular point at which an alarm condition exists.

What is claimed is:

1. A constant surveillance alarm system in which a plurality of remote zones are electrically monitored from a central monitoring station comprising in combination:

a source of supply voltage;

at least one alarm sensing means located in each of said plurality of remote zones and being operable in response to an alarm condition to change operating states and including circuit means for coupling a supply voltage to one side of said alarm sensing means from said source of said supply voltage;

a zone alarm coupled to said at least one alarm sensing means including,

first semiconductor switch means coupled to the other side of said alarm sensing means in each zone and also to said source of supply voltage so as to be rendered conductive upon the occurrence of an alarm condition,

relaxation oscillator circuit means coupled between said other side of said alarm sensing means and said first semiconductor switch means so as to become operable by application of said supply voltage thereto when said first semiconductor switch means becomes conductive,

first alarm indicator means for each zone of said plurality of remote zones coupled between said other side of said alarm sensing means in each zone and said relaxation oscillator circuit forming a portion of the load circuit thereof so as to be intermittently energized upon the occurrence of an alarm condition in the respective zone by operation of the relaxation oscillator circuit,

second semiconductor switch means coupled to each of said first indicator means, and

switch means coupled to said first semiconductor switch means and said second semiconductor switch means which when activated renders said first semiconductor switch means non-conductive and renders said second semiconductor switch means conductive when an alarm condition exists in the respective zone to continuously energize said first alarm indicator means; and

an alarm point circuit for each zone including,

third semiconductor switch means coupled to the other side of said alarm sensing means and being responsive thereto to become conductive when a supply voltage is applied thereto and the respective alarm sensing means changes operating states,

a second alarm indicator means coupled between said source of supply voltage and said third semiconductor switch means becoming energized when said third semiconductor switch means becomes conductive, and

another switch means coupled between said source of supply voltage and said third semiconductor switch means for selectively applying a supply voltage thereto, said third semiconductor switch means becoming conductive thereby when an alarm condition exists at said alarm sensing means whereby said second alarm indicator means is energized.

2. A constant surveillance alarm system as claimed in claim 1 wherein said first, second and third semiconductor switch means are comprised of semiconductor controlled rectifiers.

3. The invention as defined by claim 1 wherein a plurality of alarm sensing means are located in each of said plurality of remote zones.

4. A constant surveillance alarm system as defined by claim 1 and additionally including an audible alarm circuit coupled between said other side of said alarm sensing means and said first semiconductor switch means, being rendered operative when said first semiconductor switch means becomes conductive to present an audible alarm of an alarm condition existing generally without respect to zone location or a specific alarm point in said zone.

5. The invention as defined by claim 1 wherein said at least one alarm sensing means comprises a pair of alarm contacts responsive to an alarm condition to change from a first operating state to a second operating state.

6. The invention as defined by claim 1 wherein said relaxation oscillator means comprises a multivibrator circuit and including means for being gated into operation by said first semiconductor switch means so as to become operable when said first semiconductor switch means is triggered into conduction when an alarm condition exists.

7. A constant surveillance alarm circuit as defined by claim 1 wherein said first alarm indicator means and said second alarm indicator means comprise indicator lights which are selectively energized in response to an alarm condition existing in a zone and upon actuation of said another switch means indicates a particular point in a specified zone.

8. A constant surveillance alarm system as claimed in claim 1 wherein said at least one alarm sensing means comprises a normally closed set of alarm contacts and transistor means biased in a normally non-conductive condition being coupled between said other side of said alarm sensing means and said zone alarm circuit.

9. The invention as defined by claim 1 wherein said at least one alarm sensing means comprises a set of normally open alarm contacts.

10. A constant surveillance alarm system as defined by claim 1 and additionally including circuit means for determining the operability of said first and second alarm indicator means comprising: a first plurality of semiconductor diodes having one side thereof coupled to one side of said first alarm indicator means; switch means coupling the other side of said first plurality of semiconductor diodes to a terminal of said source of supply voltage; a second plurality of semiconductor diodes having one side thereof coupled to one side of said second alarm indicator means; second switch means coupling the other side of said second plurality of semiconductor diodes to a terminal of said source of supply voltage, and said first and said second switch means when closed providing a

closed electrical circuit for energizing said first and said second alarm indicating means from said source of supply voltage.

11. A constant surveillance alarm system in which a plurality of remote zones are electrically monitored from a central station comprising in combination:

a source of supply voltage;

a plurality of alarm contacts selectively located in each of said plurality of remote zones and being responsive to an alarm condition to change from a first operating state to a second operating state;

circuit means for coupling a supply voltage from said source of supply voltage to one side of all said plurality of alarm contacts;

a zone alarm circuit coupled to the other side of each said plurality of alarm contacts in each of said plurality of remote zones and comprising first controlled rectifier means responsive to an alarm condition in any of said plurality of alarm contact means, a zone alarm light adapted to be energized from said source of supply voltage when said first controlled rectifier means becomes conductive, second controlled rectifier means coupled in series to said zone alarm light for rendering said alarm light continuously energized upon the occurrence of an alarm condition in the respective zone; and

an alarm point indicating circuit coupled to the other side of each said plurality of alarm contacts for indicating a particular point wherein an alarm condition occurs within a specific zone comprising a third controlled rectifier means coupled to each of said plurality of alarm contacts, circuit means energized by means of said respective alarm contacts upon the occurrence of an alarm condition, switch means coupling each of said third controlled rectifier means to said source of supply voltage for rendering said each third controlled rectifier means capable of being energized by said alarm contacts when said switch means are closed, and an alarm light coupled to each said third controlled rectifier means for indicating the point at which an alarm condition occurs in a specific zone.

References Cited

UNITED STATES PATENTS

2,895,125	7/1959	Watts	340—227.1
2,917,731	12/1959	Rodgers	340—213.1
3,381,286	4/1968	Walsh	340—213.1

JOHN W. CALDWELL, *Primary Examiner*.

P. PALAN, *Assistant Examiner*.

U.S. Cl. X.R.

340—214