

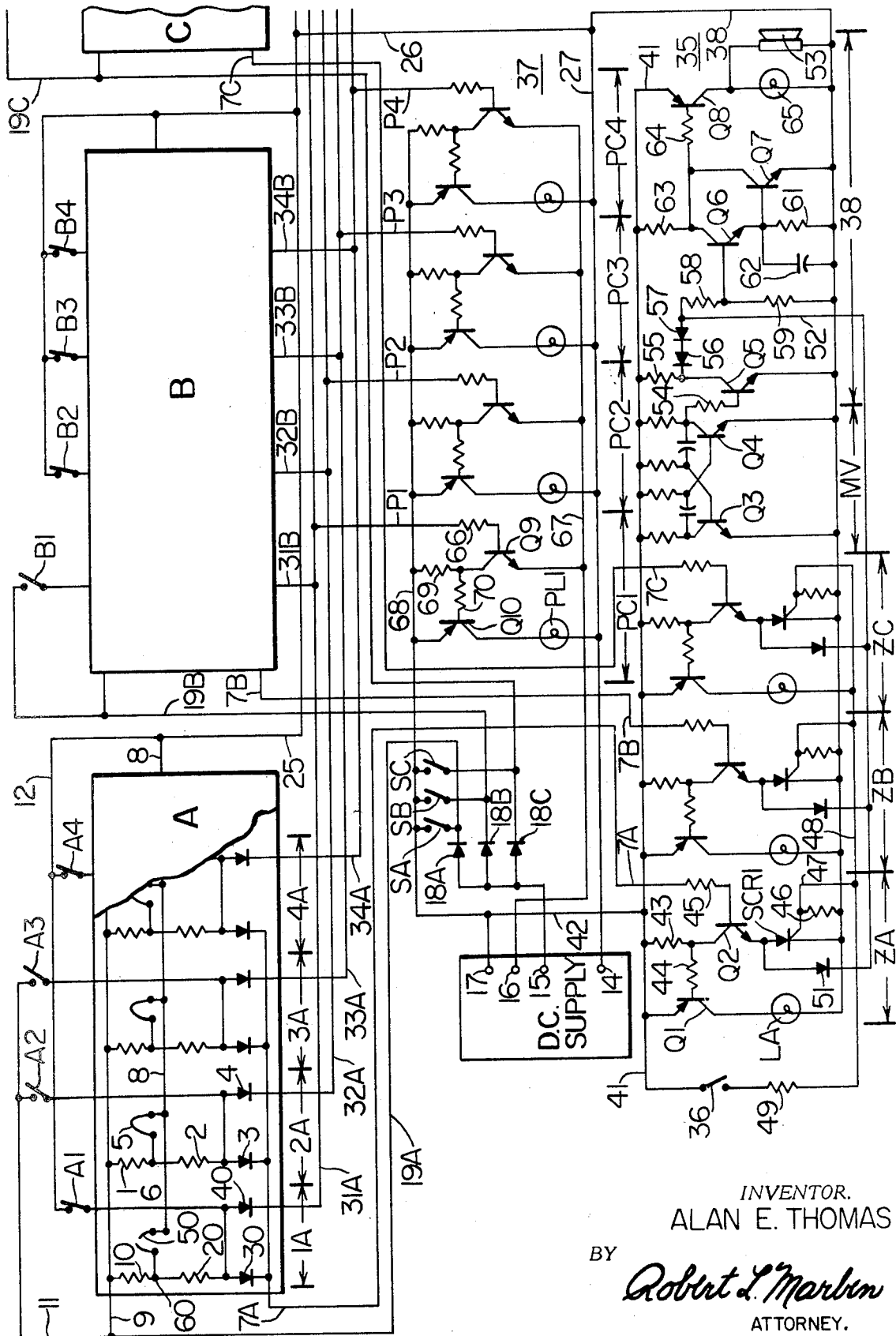
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CONSTANT SURVEILLANCE ALARM SYSTEM

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CONSTANT SURVEILLANCE ALARM SYSTEM
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ABSTRACT OF THE DISCLOSURE

Electrical circuitry uses only semiconductor devices for monitoring the condition of a plurality of alarm points at each of a number of zone stations. The monitoring is done at a central station. The circuitry at the central station includes alarm point and zone station identifying circuits providing a visual indication of the zone and alarm point in alarm. An audible alarm circuit is also included which is energized via the zone identification circuits to provide an audible alarm indicative of an alarm point moving to its alarm position. The operation of the audible alarm circuit via an energized zone identifying circuit can be terminated allowing audible alarm circuit to be subsequently energized via another zone identifying circuit in response to an alarm point in another zone moving to the alarm position.

This invention relates generally to constant surveillance alarm systems and particularly to an improved system using only semiconductor devices as active elements for monitoring a plurality of remotely located alarm points at a central station.

Previously known alarm systems have used a large number of gated semiconductor switching devices such as silicon controlled rectifiers which are turned on by a momentary gate signal applied to such devices and remain on after the gate signal is removed. Available systems using devices of this type have not been widely accepted since the gated semiconductor switching devices as connected in such systems have been known to operate in response to transients thus giving erroneous alarm indications. Further, systems using a large number of gated semiconductor switches require special care when laying out the physical location of the components in order to avoid gating signals from being erroneously applied via an inductive or capacitive coupling.

In addition, previously known alarm systems have required the use of at least one active semiconductor device in the field circuitry associated with each alarm point to permit the use of either normally open or normally closed alarm contacts. Such arrangements are unduly complicated and have been known to give erroneous indications when several points were in alarm.

It is an object of the present invention to provide a novel circuit for use with each alarm point which can readily be used with either normally open or normally closed alarm contacts.

Another object of the present invention is to provide a novel circuit for use with either normally open or normally closed alarm contacts that uses only resistors and diodes thus eliminating all the expense and troubles associated with alarm point circuitry using such devices as relays, transistors and gated semiconductor switching devices.

Another object of the present invention is to provide central station circuitry which uses transistors and a minimum number of gated semiconductor switching devices to eliminate the expense and troublesome operation associated with central station circuitry using devices such as re-

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lays or a large number of gated semiconductor switching devices.

Still another object is to connect the few gated semiconductor switching devices used in such a manner that the gate electrode for such devices can only receive a gate signal when a manually operated switch is operated thus preventing any triggering of the devices by transients in the circuits or leakage current, etc.

A further object is to provide a system which does not require a high capacity D.C. supply.

Other objects and advantages of the invention presented herein 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 diagram of an alarm system embodying the present invention.

Considering the drawing, reference characters A, B and C identify circuitry for field monitoring stations or surveillance zones A, B and C, each having one or more monitoring or alarm points A1, A2, A3, A4 and B1, B2, B3, etc., which can be in the form of either a normally open or normally closed pair of electrical contacts. In the drawing the various alarm points are shown in their normal position. At the time of manufacture of the zone circuitry it is not known which alarm point contacts will be of the normally closed type and which will be of the normally open type. The circuitry for each alarm point, it should be noted uses only two resistors and two diodes making it very reliable and easily manufactured. In addition, the circuitry for each alarm point when manufactured can be identical thus simplifying assembly of the zone circuitry package. Only a simple modifications is required during field installation of the zone surveillance circuitry to provide the proper circuitry for either normally open or normally closed alarm points.

The circuitry for each alarm point in zone A is identified as 1A, 2A, 3A, 4A. Like circuitry is provided for additional surveillance zones B, C, etc. The circuitry 2A for alarm point A2 will be described in detail. The circuitry 2A includes two series connected resistors 1 and 2 connected in series with a zone output diode 3. The anode of diode 3 is connected to resistor 2 and to the anode of a second diode 4 providing an alarm point output. A conducting loop 5 made readily available to the installer is connected at one end to the connection 6 common to the series connected resistors 1 and 2. The circuitry provided for the other alarm points is the same prior to making the field installation. The corresponding elements in the 1A circuitry for alarm point A1 are identified by using the same numerals as were used for the 2A circuitry for alarm point A with a zero added to the numeral.

The circuitry for each alarm point in a zone is interconnected by the use of common lines. Thus, a common line 7A interconnects the cathodes of all diodes in zone A corresponding to diode 3. The end of loop 5 opposite the connection 6 is connected to a common line 8 which makes a similar connection to the loops in circuitry 1A, 3A and 4A corresponding to loop 5 of circuitry 2A. Similarly, a common line 9 is connected to the end of resistor 1 opposite connection 6 and to the resistors in circuitry 1A, 3A and 4A corresponding to resistor 1.

As mentioned earlier, the monitoring or alarm contacts for each of the surveillance zones are of two types, i.e., normally open or normally closed contacts. In either case, one of the alarm point contacts is connected to the anodes of the diodes in its alarm point circuitry. Thus, for example, one of the contacts for alarm point A2 is connected to the anode of diodes 3 and 4. In the case of the normally open alarm points in a zone the other contact of the alarm points is connected to a common line, which for zone A is line 11. Line 11 connects with the common

line 9. In the case of the normally closed alarm points in a zone, the other side of the alarm points are also connected to a common line, which for zone A is line 12. Line 12 connects with the common line 8. The normally closed alarm points also require a slight modification to be made in the zone circuitry for such points. The loop 5 connection must be severed. Thus, loop 5 of alarm point circuitry 1A for the normally closed contacts A1 is shown as being open. In practice this is accomplished by merely snipping the loop, which as has been mentioned, is made readily available to the installer.

The loop in alarm point circuitry 4A is also severed since point A4 is a normally closed alarm point making the 4A circuitry and 1A circuitry the same. Similarly, the 2A and 3A circuitry is identical since they each serve normally open alarm points.

It should be recognized that the loop 5 could be made to plug into position in the circuitry when needed in the case of normally open point and removed when the circuit is connected to a normally closed point or may be a simple switch that is opened or closed to accommodate the particular alarm point connected to the circuitry.

The circuitry for the various zones are located at a point remote from a central station. The central station contains circuitry connected to the various zones capable of automatically determining when an alarm point has its contacts in the alarm position and which point is in an alarm condition. The central station circuitry includes a multilevel D.C. supply 13. Thus, terminal 14 is the ground connection and terminals 15, 16 and 17 provide successively larger D.C. voltage levels.

Lines 9 and 11 of zone A are connected to receive a D.C. voltage from D.C. supply 13. Thus, lines 9 and 11 are electrically connected to terminal 15 of supply 13 via line 19A and a diode 18A to provide the zone circuitry with the lowest D.C. voltage level available from the supply 13. This voltage level is similarly applied to zones B and C via diode 18B and line 19B for zone B and diode 18C and line 19C for zone C. The zone A circuitry is electrically connected to the ground terminal 14 of supply 13 via connecting lines 25, 26 and 27. Line 25 is connected to lines 8 and 12 of zone A. The lines of zone B and zone C (not shown) corresponding to lines 8 and 12 of zone A are also connected to ground. Line 7A provides an electrical path back to the central station and is considered the zone output line for zone A. Thus, any voltage appearing at the cathode of the zone output diode 3 or at any of the diodes in zone A corresponding to diode 3 will be connected to the central station circuitry. It should be noted that no voltage appears at the cathode of any of the zone output diodes until a normally open or normally closed alarm point is in its alarm position. Thus, consider alarm point circuitry 1A which is connected to the normally closed contacts or alarm point A1. With the circuitry as shown the anode of diode 30 is connected to ground via the normally closed contacts, and line 12, 25, 26 and 27. This ground connection is removed when the normally closed contacts A1 are in the alarm position, i.e., open, causing the voltage applied at line 9 to appear at the cathode of diode 30 via resistors 10 and 20 and thence to the central station circuitry via zone output line 7A. In the case of a normally open point reference is made to alarm point circuitry 2A in which the loop 5 connects point 6 to ground via lines 8, 25, 26 and 27, causing diode 3 to be at ground potential. Upon movement of the normally open contacts A2 to the alarm or closed position, the voltage at line 9 is applied via line 11 and contacts A2 to the anode of diode 3 and thence to the central station circuitry via line 7A. Resistor 2 prevents the voltage applied to the anode of diode 3 from being connected directly to ground via the loop 5. The zone output lines for zones B and C corresponding to line 7A of zone A are lines 7B and 7C, respectively.

Point output lines for each of the alarm points of zone A, zone B, etc., are needed for use in identifying the particular point that is in an alarm condition. The output line for point A1 is line 31A connected to the cathode of point output diode 40. The output lines for points A2, A3, and A4 are lines 32A, 33A, and 34A, respectively, connected to the cathodes of point output diodes of circuits 2A, 3A and 4A corresponding to diode 40 of circuit 2A. Zone B has alarm points B1, B2, B3 and B4 corresponding to alarm points A1, A2, A3 and A4 with point output lines 31B, 32B, 33B and 34B, respectively. Similar alarm points and point output lines are provided for zone C and any other additional zones included in a system.

The number of lines extending from the central station to the various zones is minimized since the corresponding point output lines of the various zones are connected together and then connected to the central station via a single point output line. Thus, output lines 31A, 31B, etc., are connected together and thence to the central station circuitry via the line P1. Similarly, output lines 32A, 32B, etc., are connected together and to the central circuitry via the lines P2. Lines P3 and P4 are similarly connected to lines 33A, 33B, etc., and 34A, 34B, etc., respectively.

The point output diode for each point circuitry will present whatever electrical potential exists at the zone output diode. Thus, referring to point circuitry 2A it is seen that the anode of point output diode 4 is connected to the anode of diode 3. Thus, as in the case for diode 3, diode 4 is at ground potential until the normally open point A2 closes causing the potential on line 19A to be applied to diode 4 with resistor 2 connected between the potential of line 19A and ground. Similarly, the anode of point output of diode for a normally closed alarm point is at ground potential until alarm point opens. In this connection reference is made to point circuitry 1A which is connected to a normally closed alarm point. As has already been described early in connection with diode 30 of circuitry 1A, diode 30 is at ground potential until point A1 opens to apply the potential of line 19A to the anode of diode 30 via resistors 10 and 20. Since the anodes of diodes 30 and 40 are connected together diode 40 is also at ground potential when the point A1 is closed and at the potential of line 19A via resistors 10 and 20 when point A1 opens.

The zone output and point output diodes 3 and 4, respectively, of circuitry 2A and the corresponding diodes in other point circuitry provide a necessary blocking or isolating function for the circuitry. Thus, assume point B2 is in alarm placing a potential on point output line 32B. If diode 4, which connects with line 32B via line 32A, were not present the voltage on line 32B would be applied to zone output line 7A of zone A via diode 3 and similarly to zone output line 7C of zone C, etc., thus indicating to the central station circuitry that all zones had at least one point in alarm. The point output diodes, i.e., those diodes corresponding to diode 4, prevent this from happening. Similarly, if the zone output diodes, i.e., those diodes corresponding to diode 3, were not present a voltage appearing on a zone output line such as line 7A due to operation of an alarm point would be applied to all other alarm point output lines indicating that all points in a zone were in alarm.

Basically, the central station circuitry includes the D.C. supply 13, which already has been mentioned, plus circuitry shown to the left of 35 which is effective to provide an audible alarm in response to a voltage signal being received over any one of the zone alarm lines 19A, 19B and 19C and is effective to provide a flashing light to indicate which zone is the source of the voltage or alarm signal. The circuitry also provides a means to terminate the audible alarm by momentary operation of an alarm acknowledgment switch 36. The circuitry is also arranged to cause the operation of the zone indicating light to change from a flashing light source to a

steady light source when the alarm acknowledgment switch 36 is operated.

Circuitry is also provided at the central station for interrogating the remote zone circuitry to determine which alarm point in the zone is in alarm position. This includes an alarm point indicating or interrogating switch for each zone plus a separate point indicating circuit for each alarm point circuitry in the zone circuitry. The alarm point indicating switches for zones A, B and C are switches SA, SB and SC, respectively. This circuitry is shown to the left of 37 with the point indicating circuits identified as circuits PC1, PC2, PC3 and PC4 which are connected to the remote point circuitry in the various zones via lines P1, P2, P3 and P4, respectively. Thus, if zone A has been indicated by circuitry 35 as being an alarm, operation of alarm point indicating switch SA is effective when operated to apply an operating signal to the zone A point circuitry. The operating signal is routed via the point output diode for the point which is in alarm to the point indicating circuit connected to the point output diode. Thus, if point A2 were in its alarm position, i.e., closed, the operation of alarm point indicating switch SA applies an operating signal obtained from the D.C. supply 13 to point indicating circuit PC2 via point output diode 4 and lines 32A and P2.

Consideration will now be given to the details of the central station circuitry 35 followed by a detailed description of its operation in the system. Details of the central station circuitry 37 will then be discussed followed by a detailed description of its operation in the system.

The circuitry to the left of 37 includes a zone indicating circuit for each of the remote zone circuits which are identified as ZA, ZB and ZC. Included also is a free-running multivibrator circuit, MV, connected to circuitry 38 and to the zone indicating circuits. Circuitry 38 includes an output circuit for the multivibrator plus an amplifier circuit for the audible signalling device.

Since the zone indicating circuits ZA, ZB and ZC are identical only one need be described in detail. Zone indicating circuit ZA will be described. It includes two transistors Q1, Q2, which are PNP and NPN transistors, respectively. An incandescent lamp LA is connected between a common line or connector 39 and the collector of transistor Q1. Line 39 is connected to ground terminal 14 of D.C. supply 13 via line 27. The emitter of transistor Q1 is connected to a common line or connector 41 which is connected to terminal 17 of D.C. supply 13 via line 42. The voltage between terminal 17 and ground terminal 14 is the largest available from supply 13. The collector of transistor Q2 is connected to line 41 via a resistor 43 and to the base of transistor Q1 via a resistor 44. The base of transistor Q2 is connected to zone output line or connector 7A of zone A via a resistor 45. A silicon controlled rectifier SCR1 is connected between the emitter of transistor Q2 and ground connecting line 39 with the anode of SCR1 connected to the emitter. A resistor 46 is connected between the gate electrode of SCR1 and the ground connecting line 39. The gate electrode of SCR1 is also connected via a connecting line 47 to common line 48 which is connected to resistor 49. The other end of resistor 48 is connected to line 41 via an alarm acknowledgment switch 36 to provide an electrical path from terminal 17 of supply 13 to the gate of SCR1 upon actuation of switch 36. The anode of SCR1 is also connected to the cathode of a diode 51. Diode 51 and the diodes in circuits ZB and ZC corresponding to diode 51 have their cathodes connected to a common line or connector 42 which connects with the circuitry 38.

The free running multivibrator MV is of standard construction and therefore need not be described in detail. It includes two NPN transistors Q3 and Q4 which alternately conduct as is the normal operation for a free running multivibrator. Thus, when Q3 is conducting Q4 is not conducting and vice versa. The rate at which this takes place is determined by the RC time constant built

into the circuitry. The output of the multivibrator is substantially a square wave signal.

An output circuit is connected to the multivibrator circuit MV and serves to control the operation of the zone indicating circuits ZA, ZB and ZC in accordance with the operation of the multivibrator. The output circuit connected to the multivibrator MV also cooperates with the output of the zone indicating circuits ZA, ZB and ZC to provide a pulsating or square wave input signal to an amplifier for an audible alarm device 53 when one of the zone indicating circuits is receiving an alarm signal from its associated zone circuit. This output circuit includes the NPN transistor Q5 which has its emitter connected to the ground connecting line 39, its base connected to the collector of transistor Q4 of the multivibrator MV via a resistor 54 and its collector connected to the common line 41 via a resistor 55. Two series connected diodes 56 and 57 connect line 52 from the zone indicating circuit ZA, ZB and ZC to the collector of transistor Q5. The cathode of diode 56 is connected to the collector of transistor Q5. The anode of diode 57 is connected to line 52 and to resistor 58 of two series connected resistors 58 and 59. Resistor 59 is connected to ground connecting line 39.

The amplifier for the audible alarm device 53 includes the three transistors Q6, Q7 and Q8. Transistor Q6 has its emitter connected to the base of transistor Q7 and to ground connecting line 39 via a resistor 61. A capacitor 62 is connected in parallel with resistor 61 and serves to smooth out the pulsating or square wave signal so that the amplifier output will provide a signal to the audible alarm device 53 to cause it to provide a steady sound output. Intermittent operation of the audible alarm device 53 can be achieved by removing the capacitor 62 from the circuit. The collector electrodes of transistors Q6 and Q7 are connected together and to line 41 via a resistor 63. The collector electrodes of transistors Q6 and Q7 are also connected to the base of transistor Q8 via a resistor 64. The emitter of transistor Q8 is connected to line 41. The collector of transistor Q8 is connected to the ground connecting line 39 via the audible alarm device 53 and also to line 39 via an incandescent lamp 65. The lamp 65 is added to give a visual indication in addition to the audible signal provided by device 53.

Operation of the circuitry described up to this point is as follows. The multivibrator is the only portion which is constantly in operation. The D.C. voltage presented between terminals 17 and 14 of the supply 13 is applied to the circuitry 35. Transistor Q2 of zone indicating circuitry ZA and the corresponding transistors in circuitry ZB and ZC are not operating since there is no voltage present at the base of the transistors. Since transistor Q2 is not conducting transistor Q1 is also off since its emitter and base are at the same potential. A small amount of leakage current is present, however, which flows to ground via resistors 58 and 59 and transistor Q5 of the multivibrator when it is conducting to cause a small voltage to be present at the base of transistor Q6. This voltage is not great enough, however, to cause the transistor Q6 to conduct so the audible alarm device remains inoperative.

The condition just described for the circuitry 35 continues so long as there are no alarm or monitoring points operated in the zone circuitry A, B or C. One of the functions of the zone circuitry is to connect a voltage to the appropriate zone indicating circuit upon operation of any of the alarm contacts or points connected as a part of the zone circuitry. For example, in the case of the zone A circuitry such a voltage is applied to the base resistor 45 of transistor Q2 of zone indicating circuitry ZA via line 7A. Lines 7B and 7C are the interconnecting lines for zones B and C, respectively, and their respective zone indicating circuits ZB and ZC. While lines 19A, 19B and 19C with respective diodes 18A, 18B and 18C connect the output terminal 15 of D.C.

supply 13 to zones A, B and C, respectively, no voltage is presented at lines 7A, 7B and 7C so long as the alarm points or switches are in their normal operating positions. Thus, in the case of a normally closed point, such as A1, the voltage between terminal 15 and ground terminal 14 of supply 13 appears across diode 18A, resistors 10 and 20 and switch contacts A1. Switch A1 has one side connected to the anode of diode 30 and the other side connected to ground terminal 14 via lines 12, 25, 26 and 27. Line 7A is connected to switch A1 via diode 30 and is therefore at ground potential. If alarm point A1 goes into alarm, i.e., switch A1 opens, ground connection for 7A is removed placing line 7A at the potential of terminal 15. Line 7A thus applies a positive voltage to the base of transistor Q2 of zone indicating circuitry ZA when a normally closed alarm point opens. In the case of the other type of alarm point, i.e., a normally open switch, such as point A2, the voltage between terminals 15 and 14 appears across diode 18A and resistor 1. The end of resistor 1 opposite diode 18A is connected to ground via loop or jumper 5 and lines 8, 25, 26 and 27. Switch A2 has one side connected to terminal 15 of supply 13 via lines 11, 19A and diode 18A. The other side of switch A2 is connected to the anode of diode 3. The anode of diode 3 is connected to ground via resistor 2 so line 7A connected to the cathode of diode 3 is at ground potential. If alarm point A2 goes into alarm, i.e., switch A2 closes, line 7A then is at the potential of terminal 15 since closure of switch A2 connects the anode of diode 3 to terminal 15 via lines 11 and 19 and diode 18A. Since line 7A is connected to the base of transistor Q2 of zone indicating circuitry ZA via resistor 45, the base of transistor Q2 has a positive potential applied to it.

It is thus seen that operation of an alarm point switch from its normally closed or normally open position is effective via its associated point circuitry in the zone circuitry to apply a positive voltage to the zone indicating circuitry connected to the zone in which the operated alarm point is located. Thus, operation of any one of the alarm points A1, A2, A3, A4 of zone A will cause a positive voltage to be applied to the zone indicating circuitry ZA via zone output line 7A connecting the zone A with the central station circuitry. Similarly, operation of any alarm point for zone B and zone C will apply a positive voltage to zone indicating circuit ZB and ZC, respectively, via their respective connecting lines 7B and 7C.

All of the zone indicating circuits are the same. The operation of circuit ZA will be described to illustrate the operation of the zone indicating circuitry. Prior to the application of a positive voltage to the base of transistor Q2, its base is connected to ground via the zone A circuitry and its collector is at the highest potential available from D.C. supply 13. Transistor Q2 is therefore not conducting except for a small leakage current. Upon operation of an alarm point in zone A the base is connected via the zone A circuitry and zone output line 7A to the potential at terminal 15 of supply 13 causing transistor Q2 to conduct. The silicon controlled rectifier SCR1 is not conducting so all the emitter current from transistor Q2 flows via diode 51 and thence to ground via resistors 58 and 59 and to ground via diodes 56 and 57 during the conductive periods of transistor Q5. Transistor Q5 is controlled by the voltage of the collector of transistor Q4 of multivibrator MV and therefore conducts when Q4 is not conducting. It is apparent that transistor Q5 when conducting effectively shorts out resistors 58 and 59 causing the emitter current of transistor Q2 to increase. The current of transistor Q2 thus varies in accordance with the frequency of operation of the multivibrator circuit MV. It should be noted that transistor Q5 could be eliminated along with resistors 54 and 55 and connect diode 56 directly to collector of transistor Q4. The transistor Q5 is only used to eliminate any possible loading effect on the multivibrator circuit MV that might

occur if a large number of zone indicating circuits are used in a system and all were to be turned on at the same time due to an alarm in each associated zone.

Transistor Q1 does not conduct when Q2 is not conducting since the base of transistor Q1 is then at the same potential as its emitter. However, when transistor Q2 conducts current flows through resistor 43 causing voltage drop. The voltage at the base of transistor Q1 is reduced by the amount of the voltage drop across resistor 43 since it is connected via resistor 44 to resistor 43. Transistor Q1 thus conducts when transistor Q2 conducts. The collector current of transistor Q1 which flows through zone indicating lamp LA therefore varies in accordance with the frequency of the multivibrator to provide a flashing indication that an alarm point switch in zone A is in its alarm position.

The intermittent increase flow of current through resistors 58 and 59 from transistor Q2 applies a bias voltage to the base of transistor Q6 causing it to conduct during each period of increased current flow. The emitter current of transistor Q6 flows through resistor 61 and causes capacitor 62 to charge to maintain an operating bias voltage for transistor Q7 causing it to conduct. The collectors of transistors Q6 and Q7 are connected to resistor 63 to increase the voltage drop across resistor 63 and thus decrease the voltage at the base of transistor Q8 so it can provide needed current flow for the incandescent lamp 65 and audible alarm device 53 plus one or more additional alarm devices that may be connected at some point remote from the central station. It should be noted that the audible alarm device 53 will provide a substantial constant sound level when the circuitry as described above is placed in operation by an alarm point switch being operated to its alarm position. The audible alarm device 53 can be made to be energized in accordance with the frequency of the multivibrator MV by removing the capacitor 62 from the circuit. The lamp 65 is not an essential element, but is included as a part of the system to provide a visual alarm indication should an operator wish to disconnect the audible alarm 53.

Upon energization of the audible alarm device 53 due to an alarm condition occurring at one of the alarm points provision has been made for the operator to terminate the operation of the audible alarm device and still have the zone indicating lamp in the energized zone indicating circuit remain energized. This is accomplished by momentary operation of the alarm acknowledgment switch 36. The zone indicating circuit ZA has been described as being energized. Operation of switch 36 is effective to cause current to flow through resistor 46 to develop a voltage across resistor 46 sufficient to turn on silicon controlled rectifier SCR1 via its gate electrode which is connected to the resistor 46. The silicon controlled rectifier SCR1 will be turned on since it has a voltage present at its anode due to conduction of transistor Q2. Thus, though switch 36 also causes current to flow through the resistor in the other zone indicating circuits ZB and ZC corresponding to resistor 46, the silicon controlled rectifiers in the circuits ZB and ZC will not be turned on since the anodes of such silicon controlled rectifiers do not have an operating voltage applied to them. In this connection it should be noted that the diodes in circuits ZB and ZC corresponding to diode 51 prevent the operating voltage present at the anode of SCR1 from being applied to the anodes of the silicon controlled rectifiers in circuits ZB and ZC. Diode 51 also functions as a blocking or isolating diode in circuit ZA should any of the other zone indicating circuits be energized.

It should be noted that only transistor Q2 in the zone indicating circuit need conduct to initiate operation of the audible alarm device 53. Thus, if the zone indicating lamp LA were burned out, an audible alarm would still be produced in the event an alarm point moved to the alarm position.

The circuitry described up to this point functions to

alert an operator at the central station when an alarm point is in the alarm position and provides an indication, via the lamp LA in zone indicating circuit ZA and corresponding lamps in circuits ZB and ZC, for the zone in which the alarm condition exists. In order that correction of the alarm condition can be expedited or the importance of the alarm condition be evaluated it is necessary to determine which alarm point in the identified zone is in the alarm position. This is accomplished by the point identification circuitry PC1, PC2, PC3 and PC4.

The point identification circuitry is made up of circuit portions PC1, PC2, PC3 and PC4 which are alike except that each one is connected to a particular alarm point circuit in each zone. Thus, circuit portion PC1 is connected to the alarm point A1 of zone A, B1 of zone B, etc. Similarly circuit portion PC2 is connected to the alarm point A2 of zone A, B2 in zone B, etc.

The description which follows is for circuit portion PC1, but is also applicable to the other circuit portions. Circuit portions PC1 includes a two stage amplifier. The first stage includes the NPN transistor Q9 which has its base connected via a resistor 66 to line P1 which connects with the point output lines 31A, 31B, etc., of alarm points A1, B1, etc., respectively. A common line 67 connects with all of the point identification circuit portions PC1, PC2, PC3 and PC4. It connects the emitter of transistor Q9 and the emitters of the other transistors corresponding to transistor Q9 to terminal 16 of supply 13. Terminal 16 provides a D.C. voltage which is intermediate the voltage level of terminal 17 and terminal 15. A common line 68 also connects with all of the point identification circuit portions. It connects the terminal 17 of supply 13 with one end of a resistor 69 in portion PC1 and with the corresponding resistors in the other portions. The other end of resistor 69 is connected to the collector of transistor Q9 and to resistor 70 connected to the base of the PNP transistor Q10 of the second amplifier stage. The emitter of transistor Q10 is connected to the common line 68. The collector of transistor Q10 is connected to the ground connecting line 27 via an incandescent lamp PL1 which when energized provides a visual indication to the operator of the system.

As has been explained previously, the operation of an alarm point switch in zone A to its alarm position is effective to connect the voltage supplied to line 19A to the zone output diode for the alarm point circuitry and thence to the zone output line 7A. The point output diode for each alarm point circuitry is connected to the zone output diode of the alarm point circuitry and therefore provides the voltage applied to the zone circuitry to the point output diode upon operation of the alarm point of the alarm point circuitry. Thus, in the case of alarm point A1 point output diode 40 is connected to zone output diode 30 and will therefore supply the voltage on line 19A to the point output line 31A upon alarm point A1 being operated to its alarm position, i.e., open position. Similarly, the output diode 4 of alarm point circuitry 2A provides the point output line 32A with the voltage supplied to zone A via line 19A when the alarm point switch A2 moves to its alarm position, i.e., closed position.

For purposes of explaining the operation of the point identification circuitry assume alarm point A1 is in the alarm position. The alarm condition is established as being in zone A by the energization of lamp LA in the zone identification circuitry as has already been explained. Line 19A is effectively connected to the base resistor 66 of transistor Q9 via the point output diode 40, point output line 31A and line P1. Line 19A connects with terminal 15 via diode 18A so the lowest voltage available from supply 13 is being applied to the base of transistor Q9. The emitter has a greater voltage applied to it via line 67 connected to terminal 16 of supply 13 so transistor Q9 does not conduct. While an electrical path has been established from the voltage supply 13 to the base of transistor Q9 by operation of the alarm point it is necessary

to have a means for applying a voltage to the base of transistor Q9 which is greater than the voltage on the emitter to cause transistor Q9 to conduct. The switch SA is connected between the line 19A on the cathode side of diode 18A and to the 68. Line 68 is connected to terminal 17 which provides the highest possible voltage from supply 13 to line 19A and therefore the base of transistor Q9 is connected to this high voltage upon operation of the alarm point interrogating switch SA for zone A. Similar switches SB and SC are connected between line 68 and respectively to lines 18B and 18C to provide the interrogation function in the case of an alarm condition existing in zone B or C. Operation of transistor Q9 causes the voltage at the base of transistor Q10 to be reduced by the voltage drop across resistor 69 due to the collector current of transistor Q9 so transistor Q10 conducts to energize lamp PL1 and thus identify alarm point A1 as the alarm point that is in alarm. If more than one alarm point in zone A had given rise to the operation of the zone alarm circuitry for zone A, the point identification circuitry for such alarm point or points would also be energized by operation of the alarm point interrogating switch SA.

It should be noted that at least two stages of amplification are used for each zone indicating circuit and each point indicating circuit. As has already been pointed out, this is advantageous in the case of the zone indicating circuitry since the second stage containing the zone indicating lamp can be defective without interfering with the operation of the first stage which functions to initiate operation of the audible alarm device circuitry. Two stages of amplification are also advantageous since the first stage in each of these circuits receives its driving current via the remotely located zone circuitry. Such driving current will, of course, be much smaller than that required if a single stage of amplification were used. The zone circuitry draws a certain amount of current even when there are no points in alarm. In order to keep this quiescent current at a suitable level and thus minimize the capacity of the D.C. supply 13, it is desirable to use resistors 1 and 2 having a value on the order of 22,000 and 18,000 ohms, respectively. The driving current available from the alarm point circuitry using such resistance values is great enough if two stages of amplification are used. The use of high resistances in the point circuitry to reduce the quiescent current provides another advantage. The high resistance permits the line impedance connecting the central station circuitry and the field stations and interconnecting the field stations to be as high as 1000 ohms without adding any significant amount to the field station resistance and therefore providing an acceptable level of driving current.

Inasmuch as the present invention is subject to a variety of modifications and changes in details, it is intended that all matters contained in the above description or shown on the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A constant surveillance alarm system for electrically monitoring at a central station a plurality of remote zone stations, each connected to a plurality of alarm points comprising in combination:

- a D.C. voltage supply at the central station having first and second output points and a ground reference point, said supply providing the greatest voltage between said first point and said ground reference;
- an input for each zone station;
- an output for each zone station;
- a plurality of diodes, one for each zone station;
- means connecting the anodes of said plurality of diodes to said second output point and each cathode of said plurality of diodes to said input point of a different one of said plurality of zone stations;
- at least one alarm point circuit at each of said zone stations connected to said input point for the zone and having a zone output diode connected to said

zone output point, an alarm point output diode, and means, including an alarm point having a normal position and an alarm position, operable to couple a voltage applied to said input point for the zone station to said zone output diode and said alarm point output diode in response to said alarm point being in said alarm position;

a free-running multivibrator at the central station;

a plurality of zone indicating circuits at the central station, each having an indicator means and each connected to said output point of a different one of said zone stations to supply an initiating signal to the connected zone indicating circuit in response to movement of an alarm point in the connected zone station to the alarm position;

means coupling said plurality of zone indicating circuits to said free-running multivibrator causing an operating zone indicating circuit to conduct in accordance with the frequency of operation of said free-running multivibrator;

a plurality of alarm point indicating circuits at the central station, each connected to one of said alarm point output diodes in each of said zone stations, each having an indicator means, each of said alarm point indicating circuits requiring a D.C. voltage signal from said first output point of said D.C. voltage supply to be applied via one of said alarm point output diodes to place the alarm point indicating circuits with its indicator means in operation;

means selectively connecting said first output point of said D.C. voltage supply to the cathodes of said plurality of diodes connected to the input point of a different one of said plurality of zone stations, operation of said last-mentioned means thereby connecting said first output point to a selected one of said zone stations to apply the voltage of said first output point of said D.C. voltage supply to one of said alarm point indicating circuits via one of said alarm output diodes when said selected one of said zone stations has an alarm point in the alarm position causing said one of said alarm point indicating circuits to operate.

2. A constant surveillance alarm system as claimed in claim 1 further including

an audible alarm circuit at the central station having an input connected to said means coupling said plurality of zone indicating circuits to said free-running multivibrator to provide said audible alarm circuit with an energizing signal in response to operation of one of said zone indicating circuits.

3. A constant surveillance alarm system as claimed in claim 1 wherein said means coupling said plurality of zone indicating circuits to said free-running multivibrator includes

a resistive load connected between said plurality of zone indicating circuits and said ground reference and a circuit connected in parallel with said resistive load including a transistor connected to conduct in response to said free-running multivibrator output.

4. A constant surveillance alarm system as claimed in claim 1 wherein said means selectively connecting said first output point of said D.C. voltage supply to the cathodes of said plurality of diodes includes

a plurality of individually operable switches, one for each of said plurality of diodes, each of said switches having one side connected to said first output point and having the other side connected to the cathode of a different one of said plurality of diodes.

5. A constant surveillance alarm system as claimed in claim 1 wherein each of said plurality of zone indicating circuits includes

a gated electronic semiconductor device connected in parallel with said means coupling said plurality of zone indicating circuits to said free-running multivibrator, said device having a gate electrode connected to said D.C. voltage supply via a normally open switch, said switch when closed causes said gated electronic semiconductor device to conduct to effectively by-pass said means coupling said plurality of zone indicating circuits to said free-running multivibrator.

6. A constant surveillance alarm system as claimed in claim 5 wherein said gated electronic semiconductor device is a silicon controlled rectifier.

7. A constant surveillance alarm system as claimed in claim 1 wherein each of said plurality of zone indicating circuits includes

a first transistor controlled by said output point of the zone station to which the zone indicating circuit is connected, and a second transistor connected to said indicator means and said first transistor, said second transistor conducting when said first transistor is conducting.

8. A constant surveillance alarm system as claimed in claim 7 wherein each of said plurality of zone indicating circuits includes

a diode connected between an electrode of said first transistor and said means coupling said plurality of zone indicating circuits to said free-running multivibrator;

said last-mentioned means having an end opposite said last-mentioned diode connected to said ground reference;

each of said plurality of zone indicating circuits further including a gated electronic semiconductor device connected between said electrode of said first transistor and said ground reference said device having a gate electrode connected to said D.C. voltage supply via a normally open switch, said switch when closed causes said gated electronic semiconductor device to conduct to effectively by-pass said means coupling said plurality of zone indicating circuits to said free-running multivibrator.

9. A constant surveillance alarm system as claimed in claim 1 wherein said means in said alarm point circuit includes a resistive load, at least a portion of said resistive load connected between said input point and said ground reference with the connection to said ground reference being completed by said alarm point when said alarm point has a normal position that is closed, said alarm point, when having a normal position that is open, being connected across said resistive load, and said zone output diode and said alarm point output diode having their anodes connected to the end of said resistive load opposite the end connected to said input point.

10. A constant surveillance alarm system as claimed in claim 1 wherein each of said alarm point indicating circuits includes a two-stage transistorized amplifier with said indicator means connected in the second stage, the first stage of said two-stage transistorized amplifier being connected to one of said alarm point output diodes in each of said zone stations.

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