

[54] ANNUNCIATOR SYSTEM

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- [51] Int. Cl. G08b 29/00
- [58] Field of Search 340/409, 213, 420, 253 R; 317/39, 8; 307/127, 151

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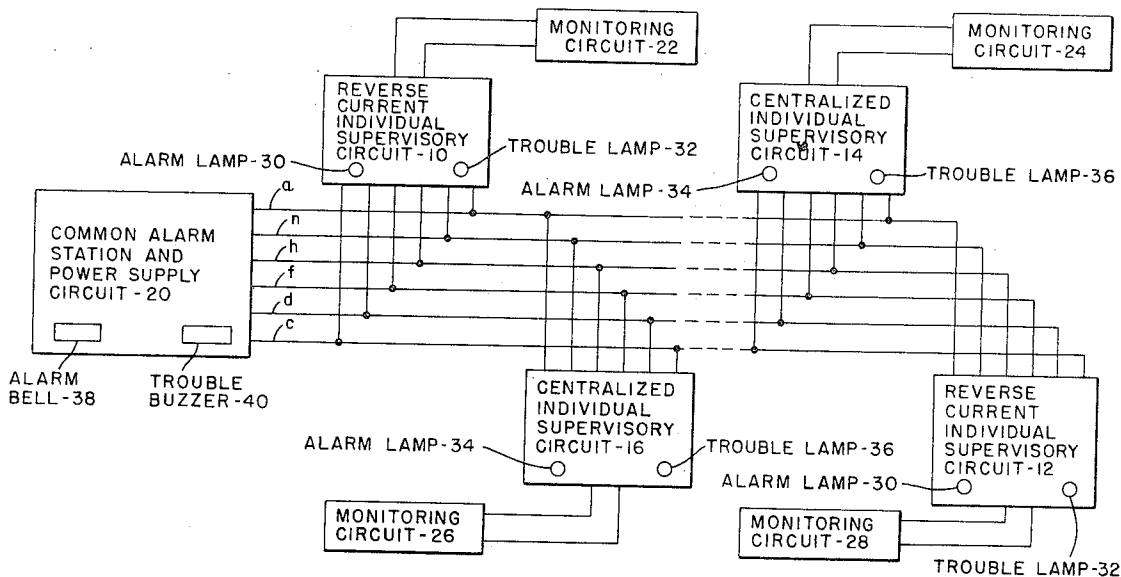
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[57] ABSTRACT

There is provided an annunciator system for indicating that an alarm condition exists at any of a plurality of remote station monitoring circuits having a like plurality of supervisory circuits, each associated with one of the monitoring circuits, and a central station common circuit which is coupled to each of the supervisory circuits. An alarm signal, indicative of an alarm condition at the remote station, is detected by an associated supervisory circuit, which in turn actuates an alarm indicator in the supervisory circuit and in the central station common circuit. A disruption in the circuit connection between one of the remote station monitoring circuits and the associated supervisory circuit is detected by the associated supervisory circuits, which in turn actuates a trouble indicator in the supervisory circuit and in the central station common circuit. The supervisory circuits are compatible with both remote station monitoring circuits which provide an alarm signal by increasing the magnitude of a current flowing in the monitoring circuit, and remote monitoring circuits which provide an alarm signal by changing the direction of a current flowing in the monitoring circuit.

24 Claims, 4 Drawing Figures



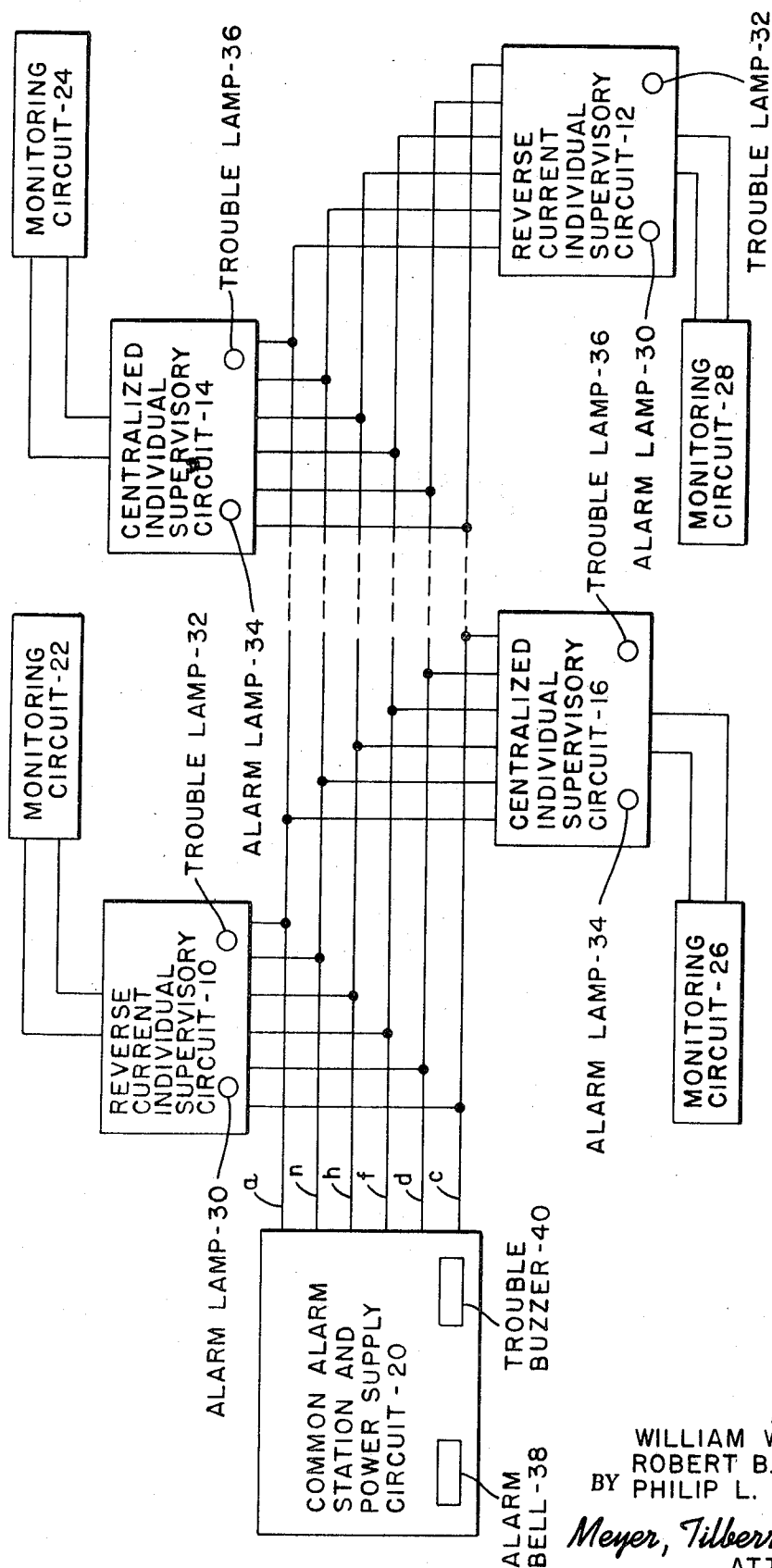


FIG. 1

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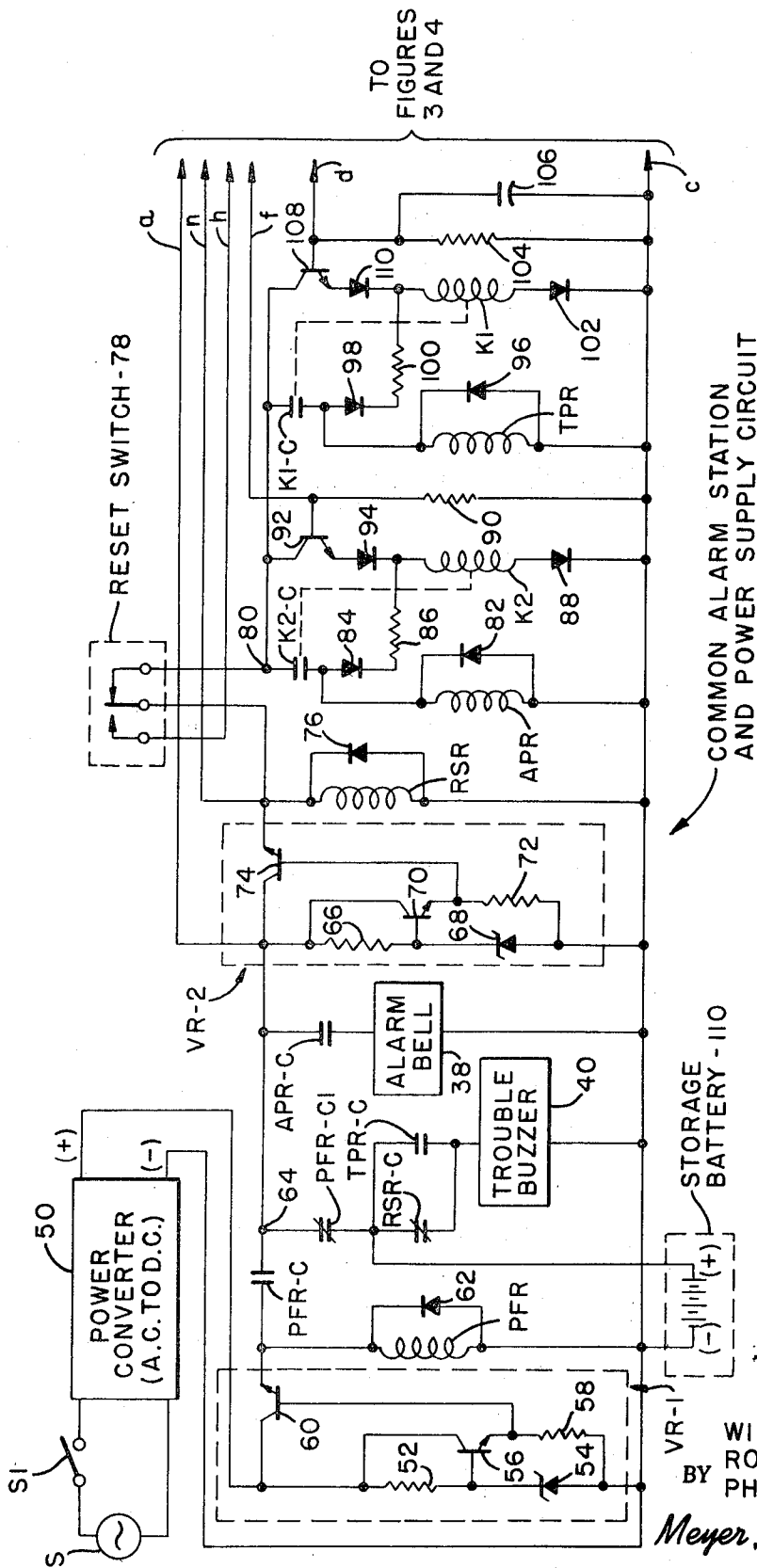
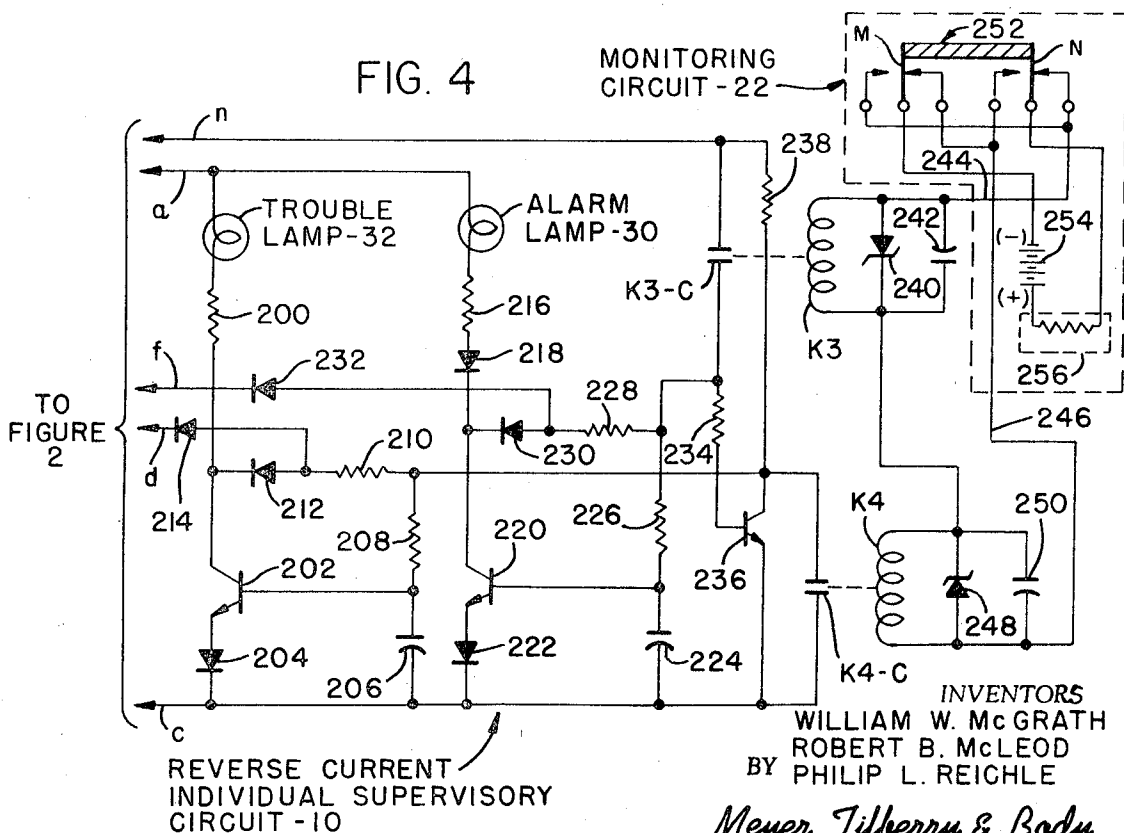
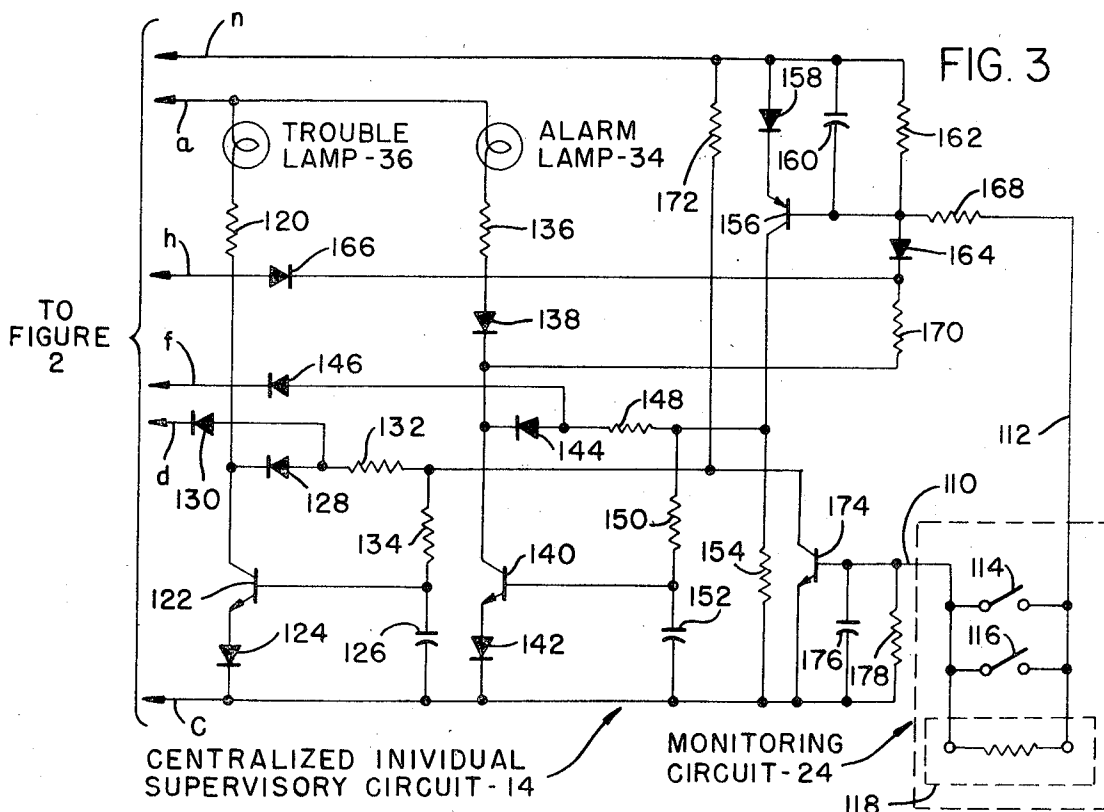


FIG. 2

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ANNUNCIATOR SYSTEM

This invention pertains to the art of annunciator systems, and more particularly, to an improved annunciator system which provides indications in response to either an alarm condition at a monitoring station or a trouble condition of the annunciator system.

The invention is particularly applicable to fire alarm systems and will be described with particular reference thereto although it will be appreciated that the invention has broader applications such as in monitoring the condition of a device or environment at a remotely located station and providing visual and/or audible indications in accordance therewith at a centrally located station. It is intended that this annunciator system can also be used to monitor for intruders wherever valuable assets of any kind are stored so that an operator at a central station will be alerted by the visual and/or audible indication in order to initiate corrective measures.

A known annunciator system is described and illustrated in U.S. Pat. No. 3,430,231, issued Feb. 25, 1969, and assigned to Foster E. Weld. Generally, annunciator systems of the type to which this invention pertains have included electromechanical relays which are actuated in response to the conditions being monitored. Alarm and trouble indicators are energized in these annunciator systems corresponding to an increase or decrease respectively in a predetermined current flowing in a remote station monitoring circuit. A more sophisticated approach to the annunciator concept that will evolve, and which has been incorporated in this invention, is the incorporation of solid state circuitry into an annunciator system in order to perform the desired functions in an improved manner.

One of the principle problems of an annunciator system incorporating solid state circuitry is that the system is inherently susceptible to internal and external interference caused by the sensitivity of the system. An increase in sensitivity of the system, however, is a desirable feature because it improves the efficiency and responsiveness of the system.

The present invention integrates a number of solid state components with conventional components in an annunciator system which provides increased monitoring sensitivity and reliability while reducing susceptibility to false alarms and interference.

The present invention contemplates a new and improved annunciator system which overcomes all of the above problems and others, and provides an integration of circuitry which is compatible with both the normal type of remote station monitors and the reverse current type of monitors which may be used interchangeably or in combination in the system, and which may subsequently be expanded to include additional remote station monitors.

In accordance with the present invention there is provided an annunciator system comprised of a first remote station monitoring circuit including means for changing the magnitude of a supervisory current flowing therein from a predetermined value in response to an alarm condition to thereby transmit an alarm signal indicative of an alarm condition at the first remote station; a second remote station monitoring circuit including means for changing the direction of a supervisory current flowing therein from a determined direction in response to an alarm condition to thereby transmit an alarm signal indicative of an alarm condition at a second remote station; a first and second supervisory circuit each respectively electrically connected to an associated one of the monitoring circuits wherein each supervisory circuit includes alarm indicating means and first circuit means for energizing the alarm indicating means in response to an alarm signal, and trouble indicating means and second circuit means for energizing the trouble indicating means in response to a disruption in the electrical connection between a supervisory circuit and its associated monitoring circuit; and, a central station common circuit including common alarm indicating means and third circuit including common alarm indicating means and third circuit means for energizing the common alarm indicating means when the supervisory alarm of either of the supervisory circuits becomes energized.

In accordance with a further aspect of the present invention, the central station includes common trouble indicating means and fourth circuit means for energizing the common trouble indicating means when the supervisory trouble indicating means of either of the supervisory circuits becomes energized.

In accordance with a still further aspect of the present invention, each supervisory circuit includes a timing means for preventing energization of the supervisory alarm indicating means in the supervisory circuit for a predetermined period of time after an alarm signal is transmitted by an associated monitoring circuit.

In accordance with another aspect of the present invention there is provided an annunciator system comprised of a remote station monitoring circuit including means for reversing the direction of a supervisory current flowing therein from a predetermined direction in response to an alarm condition to thereby transmit an alarm signal indicative of an alarm condition at the remote station; and, a supervisory circuit electrically connected to the monitoring circuit and including alarm indicating means and first circuit means for energizing the alarm indicating means in response to an alarm signal, and a trouble indicating means and second circuit means for energizing the trouble indicating means in response to a disruption in the electrical connection between the supervisory circuit and the monitoring circuit.

In accordance with a further aspect of the present invention the annunciator system includes a central station common circuit having common alarm indicating means and third circuit means for energizing the common alarm indicating means when the supervisory alarm of the supervisory circuit becomes energized.

In accordance with another aspect of the present invention, there is provided in an annunciator system a remote monitoring circuit comprising actuatable circuit means having a normal first condition and a second condition and adapted to be connected to a voltage supply source; first and second bistable circuit means each having a first condition and a second condition; the first bistable circuit means being coupled to the actuatable circuit means in such a manner so that when the actuatable circuit means is actuated from the normal first condition to its second condition, the bistable circuit means is actuated from its first condition to its second condition; the second bistable circuit means being connected to the actuatable circuit means in such a manner that the second bistable circuit means is actuated from its first condition to its second condition in response to a disruption in the electrical connection between the actuatable circuit means and the second bistable circuit means.

In accordance with another aspect of the present invention, there is provided in an annunciator system a central station common circuit adapted to be coupled to a plurality of remote station monitoring circuits and comprising common alarm indicating means and first circuit means for energizing the common alarm indicating means upon receipt of an alarm signal from any of the plurality of remote station monitoring circuits; the first circuit means for, upon actuation in response to the receipt of an alarm signal, energizing the common alarm indicating means; and, circuit means for maintaining the common alarm indicating means in an energized condition after the removal of an alarm signal from the central station common circuit.

In accordance with another aspect of the present invention there is provided in an annunciator system a supervisory circuit adapted to be connected to a remote station monitoring circuit and comprising trouble indicating means and first circuit means for energizing the trouble indicating means in response to a trouble signal; alarm indicating means and second circuit means for energizing the alarm indicating means in response to the receipt of an alarm signal from a remote station monitoring circuit; and, first timing means for preventing the first circuit means from energizing the alarm indicating means for a predetermined period of time after the receipt of an alarm signal from the remote station monitoring circuit.

In accordance with another aspect of the present invention, there is provided an annunciator system comprising a remote station monitoring circuit including means for changing the magnitude of a supervisory current flowing therein from a preselected value in response to an alarm condition at the remote station monitoring circuit; a supervisory circuit electrically connected to the remote station monitoring circuit and including: trouble indicating means and first circuit means for energizing the trouble indicating means in response to a disruption in the electrical connection between the supervisory circuit and the remote station monitoring circuit; alarm indicating means and second circuit means for energizing the alarm indicating means in response to the receipt of an alarm signal from the remote station monitoring circuit; and, first timing means in response to the receipt of an alarm signal from the remote station monitoring circuit; and, first timing means for preventing the first circuit means from energizing the alarm indicating means for a predetermined period of time after the receipt of an alarm signal from the remote station monitoring circuit.

In accordance with a further aspect of the present invention the annunciator system includes a central station common circuit coupled to the remote station monitoring circuit and comprising common alarm indicating means and first circuit means for energizing the common alarm indicating means upon receipt of an alarm signal from the remote station monitoring circuit; the first circuit means includes a latching circuit means having: circuit means for, upon actuation in response to the receipt of an alarm signal, energizing the common alarm indicating means; and, circuit means for maintaining the common alarm indicating means in an energized condition after the removal of an alarm signal from the central station common circuit.

The principle object of the present invention is to provide an annunciator system which is compatible with both conventional remote station monitoring circuits and reverse current remote station monitoring circuits.

Another object of the invention is to provide an improved annunciator system using solid state components in combination with conventional components in order to improve the sensitivity of remote station monitoring.

A further object of the present invention is to provide an annunciator system which is not susceptible to internal or external interference and which thus provides increased reliability of operation.

A still further object of the present invention is to provide an annunciator utilizing a time delay between detection of trouble or alarm conditions and energization of the trouble or alarm indicators.

The invention may take physical form in certain parts and arrangements of parts, a preferred embodiment of which will be described in detail in the specification and illustrated in the accompanying drawings which form a part hereof and wherein:

FIG. 1 is a block diagram illustrating an annunciator system incorporating centralized individual annunciator circuits and reverse current individual annunciator circuits in accordance with the preferred embodiment of the present invention;

FIG. 2 is a schematic diagram illustrating a common alarm station employed with the annunciator system as illustrated in FIG. 1;

FIG. 3 is a schematic diagram illustrating a centralized individual annunciator circuit employed in the annunciator system as shown in FIG. 1; and,

FIG. 4 is a schematic diagram of a reverse current individual annunciator circuit employed with the annunciator system shown in FIG. 1.

Reference is now made to FIG. 1 which illustrates in block diagram form, a preferred embodiment of the annunciator system constructed in accordance with the present invention. More particularly, the annunciator system includes a plurality of reverse current individual supervisory circuits 10, 12 and a plurality of centralized individual supervisory circuits 14, 16 being connected to a common station and power supply circuit

20. In addition, each of the supervisory circuits 10, 12, 14 and 16 are respectively coupled to one of a plurality of monitoring circuits 22, 24, 26 and 28. Thus, common alarm station and power supply circuit 20 is connected through six conductors, to wit, conductors A, C, D, F, H and N, to each of the supervisory circuits 10, 12, 14 and 16. As is readily apparent from FIG. 1, common alarm station 20 is compatible with a plurality of supervisory circuits 10 through 16, and in addition, is compatible with both reverse current individual supervisory circuits 10, 12 and centralized individual supervisory circuits 14, 16.

Each reverse current individual circuit 10, 12 includes an alarm lamp 30 for providing an indication of an alarm signal, and a trouble lamp 32 for providing an indication of a malfunction within the individual supervisory circuit 10, 12 or monitoring circuit 22, 28. Similarly, each centralized individual supervisory circuit 14, 16 includes an alarm lamp 34 and a trouble lamp 36. It is contemplated, that alarm lamp 30, 34 and trouble lamps 32, 36 could be replaced by or could be utilized with a bell or buzzer to provide an audible indication of an alarm or trouble condition. Also, common alarm station 20, which is preferably located at a central station, includes an alarm bell 38 for providing an indication of an alarm condition at any of the individual supervisory circuits 10 and 16. In addition, trouble buzzer 40 also provides an indication of a trouble condition, such as loss of power, within common alarm station and power supply circuit

COMMON ALARM STATION AND POWER SUPPLY CIRCUIT

Reference is now made to FIG. 2 which illustrates in more detail the preferred circuit of common alarm station and power supply circuit 20. As illustrated, this circuit generally includes an alternating-current voltage supply source S such as a 115 volt alternating-current supply line, which is coupled through a power converter 50, a pair of voltage regulator circuits VR-1 and VR-2, and suitable alarm and trouble circuitry to the common output conductors A, C, D, F, H and N. More particularly, voltage supply source S is connected through a normally open switch S-1 to power converter 50 to thereby provide a full-wave rectified signal, which is in turn applied to voltage regulator circuit VR-1. Voltage regulator circuit VR-1 includes a resistor 52 connected in series with a Zener diode 54, poled as shown in FIG. 2, being connected across the output terminals of power converter 50. The junction point between resistor 52 and Zener diode 54 is connected to the base of an NPN transistor 56 having its collector connected to the positive polarity terminal of power converter 50 and its emitter connected through a resistor 58 to the negative polarity terminal of converter 50. Also, the emitter of transistor 56 is connected directly to the base of an NPN transistor 60 having its collector connected to the positive polarity terminal of power converter 50 and its emitter connected through the coil of power failure PFR to the negative terminal of converter 50.

Power failure relay PFR includes a relay diode 62, poled as shown in FIG. 2, connected across the opposite terminals of the coil to reduce transient voltage spikes when power failure relay PFR is deenergized. Also, power failure relay PFR includes a pair of normally open contacts PFR-C connected to the emitter of transistor 60 and to one terminal 64 of a pair of normally closed relay contacts PFR-C1 of power failure relay PFR. The other terminal of relay contact PFR-C1 is connected through a pair of normally open relay contacts RSR-C of regulator supervisory relay RSR and trouble buzzer 40 to the negative polarity terminal of power converter 50. In addition, the other terminal of relay contacts PFR-C1 is connected through a pair of normally open relay contacts TPR-C of a trouble power relay TPR to trouble buzzer 40.

Terminal 64 of relay contacts PFR-C1 is also connected through a pair of normally closed relay contacts APR-C of a alarm power relay APR and the alarm bell 38 to the negative polarity terminal of converter 50. Voltage regulator circuit

VR-2 includes a resistor 66 connected in series with a Zener diode 68, poled as shown in FIG. 2, between terminal 64 and the negative polarity terminal of power converter 50. The junction point between resistor 66 and Zener diode 68 is connected directly to the base of an NPN-transistor 70 having its collector connected to terminal 64 and its emitter connected through a resistor 72 to the negative polarity terminal of converter 50. Also, the emitter of transistor 70 is connected to the base of a transistor 74 having its collector connected to terminal 64 and its emitter connected through the relay coil of regulator supervisory relay RSR to the negative polarity terminal of power converter 50. Also, a diode 76 poled as shown in opposite terminals of the relay coil of regulator supervisory relay RSR.

The collector and emitter of transistor 74 are also coupled to conductors A and N, respectively, of common alarm station 20. In addition, the emitter of transistor 74 is connected through the normally closed portion of a single-poled double-throw reset switch 78 to a terminal 80 of a pair of normally open relay contacts K2-C of common alarm relay K2. The other terminal of reset switch 78, i.e., the normally open terminal is connected to conductor H of alarm station 20.

The other terminal of normally open relay contacts K2-C is connected through the coil of alarm power relay APR to the negative polarity terminal of power converter 50. A diode 82, poled as shown in FIG. 2, is connected across the relay coil of alarm power relay APR to prevent excessive transient spikes upon deenergization of alarm relay APR. The other terminal of normally open relay contacts K2-c is also connected to the anode of a diode 84 having its cathode connected through a resistor 86 to one terminal of the coil of common alarm relay K-2. The other terminal of this coil is connected through a diode 88, poled as shown in FIG. 2, to the negative polarity terminal of power converter 50. A resistor 90 is connected between the negative polarity terminal of converter 50 and the base of an NPN transistor 92 having its collector connected directly to terminal 80 and its emitter connected through a diode 94, poled as shown in FIG. 2, to the junction point between resistor 86 and the coil of common alarm relay K2. The base of transistor 92 is also coupled to conductor F of alarm station 20.

Terminal 80 of normally open relay contacts K2-C of common alarm relay K2 is connected through a pair of normally open relay contacts K1-C of a common trouble relay K1 to one terminal of the coil of trouble power relay TPR. The other terminal of this coil is connected directly to the negative polarity terminal of converter 50, and is also connected through a diode 96, poled as shown in FIG. 2 to the junction point between relay contacts K1-C and the coil of trouble power relay TPR. This junction point is also connected to the anode of a diode 98 having its cathode connected through a resistor 100 to one terminal of the coil of common trouble relay K1. The other terminal of this relay coil is connected through a diode 102, poled as shown in FIG. 2, to the negative polarity terminal of power converter 50. A parallel-connected resistor 104 and capacitor 106 are connected between the negative polarity terminal of converter 50 and the base of an NPN transistor 108 having its collector connected directly to terminal 80 and its emitter connected through a diode 110, poled as shown in FIG. 2, to the junction point between resistor 100 and the coil of common trouble relay K1. Further, the base of transistor 108 is also coupled directly to conductor D of alarm station 20.

The positive polarity terminal of an emergency storage battery 110 is connected to the junction point between relay contacts PFR-C1 and relay contacts PSR-C, and the negative polarity terminal of battery 110 is connected in common with the negative polarity terminal of power converter 50 to conductor C of alarm station 20.

CENTRALIZED INDIVIDUAL ANNUNCIATOR CIRCUIT

Reference is now made to FIG. 3 which illustrates in more detail centralized individual supervisory circuit 14 and the associated monitoring circuit 24. Individual supervisory circuit 14 generally includes circuitry for energizing trouble lamp 36 whenever the current consumed by monitoring circuit 24 decreases to a predetermined level, such as an open circuit within monitoring circuit 24 or a break occurs in one of the supervisory lines 110, 112. Individual supervisory circuit 14 also includes circuitry for energizing alarm lamp 34 whenever the current flowing through monitoring circuit 24 increases to a predetermined value, such as upon closure of either of a pair of normally open alarm switches 114 and 116. When alarm switches 114 and 116 close, they shunt an end of line resistor 118 to increase the current through monitoring circuit 24 to the predetermine value needed for an alarm condition.

In the preferred embodiment, centralized individual supervisory circuit 14 is comprised of trouble lamp 36 having one terminal thereof connected to conductor A of alarm station 20 and the other terminal connected through a resistor 120 to the collector of an NPN transistor 122. The emitter of this transistor is connected through a diode 124 to conductor C of alarm station 20, and the base of this transistor is connected through a capacitor 126 to conductor C. The collector of transistor 122 is also connected through a diode 128, poled as shown in FIG. 3, to the anode of a diode 130 having its cathode connected directly to conductor D of alarm station 20. The junction point between diode 128 and diode 130 is connected through a pair of series-connected resistors 132 and 134 to the base of transistor 122.

One terminal of alarm lamp 34 is connected to the conductor A of alarm station 20, and the other terminal is connected through a resistor 136 to the anode of a diode 138. The cathode of diode 138 is connected to the collector of an NPN transistor 140 having its emitter connected through a diode 142, poled as shown in FIG. 4, to conductor C of alarm station 20. The collector of transistor 140 is coupled through a pair of isolating diodes 144, and 146, both poled as shown in FIG. 3, to conductor F of alarm station 20. The junction point between diodes 144 and 146 is connected through a pair of series-connected resistors 148 and 150 to the base of transistor 140. Also connected to the base of transistor 140 is one terminal of a capacitor 152 having the other terminal thereof connected directly to conductor C of alarm station 20.

The junction point between resistors 148 and 150 is connected through a resistor 154 to conductor C, and to the collector of a PNP transistor 156. The emitter of transistor 156 is connected through a diode 158, poled as shown in FIG. 4, to conductor N of alarm station 20, and the base of this transistor is connected through a circuit comprised of a parallel-connected capacitor 160 and resistor 162 to conductor N. Also, the base of transistor 156 is connected through a pair of series-connected diodes 164 and 166, both poled as shown in FIGS. 3, to conductor H of alarm station 20. In addition, the base of transistor 156 is connected through a resistor 168 to supervisory line 112. The junction exit between series-connected diodes 164 and 166 is connected through a resistor 170 to the cathode of a diode 138.

Conductor N of alarm station 20 is connected through a resistor 172 to the junction point between resistors 132 and 134, and to the collector of an NPN transistor 174. The emitter of transistor 174 is connected directly to conductor C of alarm station 20, and the base of this transistor is connected through the parallel-connected capacitor 176 and resistor 178 to conductor C. Also, the base of transistor 174 is connected to supervisory line 110.

In the preferred embodiment monitoring circuit 24 includes normally open alarm switches 114 and 116, and end of line resistor 118, each being connected across supervisory lines 110 and 112. It is contemplated that various types of alarm switches, such as manually or automatically actuated switches,

could be employed with monitoring circuit 24. Single-pole, single-throw alarm switches 114 and 116 have been illustrated for purposes of simplifying the examination.

Centralized individual annunciator circuit 16 and monitoring circuit 26 preferably take the form of circuits similar to centralized individual supervisory circuit 14 and monitoring circuit 24, respectively.

REVERSE CURRENT INDIVIDUAL ANNUNCIATOR CIRCUIT

Reference is now made to FIG. 4 which generally illustrates reverse current individual supervisory circuit 10 and monitoring circuit 22. Reverse current individual supervisory circuit 12 and monitoring circuit 28 preferably take the form of circuits similar to reverse current supervisory circuit 10 and monitoring circuit 22, respectively, therefore, only the later circuits will be described in detail. More particularly, reverse current individual supervisory circuit 10 includes a trouble lamp 32 having one terminal connected to conductor A of alarm station 20 and the other terminal thereof connected through a resistor 200 to the collector of an NPN transistor 202. The emitter of this transistor is connected through a diode 204 to conductor C of alarm station 20, and the base of this transistor is connected through a capacitor 206 to conductor C. Also, the base of this transistor is connected through a pair of series-connected through a capacitor 206 to conductor C. Also, the base of this transistor is connected through a pair of series-connected resistors 208 and 210 to the anode of a diode 212 having its cathode connected to the collector of transistor 202. The junction point between resistor 210 and diode 212 is connected through a diode 214, poled as shown in FIG. 3, to conductor D of alarm station 20.

Also connected to conductor A of alarm station 20 is one terminal of alarm lamp 30 having the other terminal thereof connected through a resistor 216 to the anode of a diode 218. The cathode of diode 218 is connected to the collector of an NPN transistor 220 having its emitter connected through a diode 222, poled as shown in FIG. 4, to conductor C of alarm station 20. The base of transistor 220 is connected through a capacitor 224 to conductor C of alarm station 20, and the base of this transistor is also connected through a pair of series-connected resistors 226 and 228 to the anode of a diode 230. The cathode of diode 230 is connected to the collector of transistor 220. In addition, the junction point between resistor 228 and diode 230 is connected through a diode 232, poled as shown in FIG. 4, to conductor F of alarm station 20.

The junction point between series-connected resistors 226 and 228 is connected through the normally open contacts K3-C of alarm relay K3 to conductor N of alarm station 20. Also, this junction point is connected through a resistor 234 to the base of an NPN transistor 236 having its emitter connected directly to conductor C of alarm station 20 and its collector connected through a pair of normally open relay contacts K4-C of trouble relay K4 to conductor C. The collector of transistor 236 is also connected directly to the junction between series-connected resistors 208 and 210, and is connected through a resistor 238 to conductor N of alarm station 20.

Connected across the coil of alarm relay K3 is a Zener diode 240, poled as shown in FIG. 4. Also connected across the coil of alarm relay K3 is a capacitor 242. One terminal of capacitor 242 provides one line 244 of a pair of supervisory lines 244 and 246, and the other terminal of capacitor 242 is connected to one terminal of the coil of trouble relay K4. The other terminal of relay coil K4 is connected directly to supervisory line 246. Also, parallel-connected Zener diode 248, poled as shown in FIG. 4, and capacitor 250 are connected across the coil of trouble relay K4.

Monitoring circuit 22 generally includes a double-pole, double-throw alarm switch 252, a direct-current voltage supply source or battery 254, and a current limiting resistor element 256. More particularly, alarm switch 252 includes a

pair of single-pole double-throw section M and N wherein the movable contacts of both sections are connected in common. The movable contact of section M of alarm switch 252 is connected to the negative-polarity terminal of battery 254, and the movable contact of section N is connected through resistor 256 to the positive-polarity terminal of battery 254.

The normally open portion of section M of alarm switch 252 is connected in common with the normally open portion of section M of alarm switch 252 and the normally open portion of section N are connected in common to supervisory line 256. As previously discussed with respect to alarm switches 114 and 116, alarm switch 252 is illustrated as a simple mechanical switch for purposes of simplification; however, it is contemplated that various manual and automatically controlled alarm switches could be employed.

OPERATION OF ANNUNCIATOR SYSTEM

With reference to FIG. 1, it may be readily seen that a plurality of reverse current individual supervisory circuits 10, 12 and a plurality of centralized individual supervisory circuits 14, 16 may be employed with a single common alarm station and power supply circuit 20. In addition the reverse current individual supervisory circuits 10, 12 are completely compatible with centralized individual supervisory circuits 14, 16. Thus, upon actuation of any of the monitoring circuits 22 through 28, by actuation of alarm switches 114, 116, 252 or upon a trouble condition within the monitoring circuit, an indication of the condition is presented at the individual supervisory circuit 10, 12, 14 or 16. The trouble or alarm indication developed at any of the individual supervisory circuits 10 through 16 is applied to the common alarm station 20 to provide a common indication thereof.

Upon closure of normally open S-1, power converter 50 is connected across the 115 volt voltage supply source S, and a full-wave, direct-current signal is applied to voltage regulator circuit VR-1. This voltage signal is applied across series-connected resistor 52 and diode 54 so that the voltage appearing across resistor 58 is approximately equal to the voltage appearing across linear diode 54. The voltage developed across resistor 58 is in turn applied through the base to emitter portion of transistor 60 so that the voltage developed at the emitter of transistor 60 with respect to the negative polarity terminal of power converter 50 is approximately equal to the voltage drop across linear diode 54. In the preferred embodiment, this voltage is equal to approximately 22 volts. Voltage regulator circuit VR-2 operates in a manner similar to that of voltage regulator circuit VR-1, except the voltage drop across linear diode 68 is preferably equal to approximately 16 volts.

Upon application of the signal developed by power converter 50 to the coil of power failure relay PFR, relay contact PFR-C closes thereby coupling the power converter 50 directly to conductor A of alarm station 20. If, however, there is a power failure or a failure within power converter 50, power failure relay PFR will become deenergized thereby opening contact PFR-C so as to remove power converter 50 from conductor C of alarm station 20. Also, upon energization of power failure relay PFR, relay contacts PFR-C1 open thereby disconnecting the positive polarity terminal of battery 110 to conductor A of alarm station 20.

Regulator supervisory relay RSR is energized upon closure of switch S-1 thereby causing normally closed contacts RSR-C to remain open during normal operation. In the event of a failure within the power supply circuit 20, regulator supervisory relay RSR will become deenergized to apply battery 110 across trouble buzzer 40 thereby providing an indication of trouble within power supply circuit 20. With reference to FIGS. 2 and 3 it is readily apparent that the direct-current signal applied to conductor N causes a current to flow through resistors 162, 168, supervisory line 112, end of line resistor 118, supervisory line 110, and the parallel-connected resistor 178 and the base-emitter junction of transistor 174. This current is of a value such that transistor 174 is forward biased into

conduction. With transistor 156 in a nonconductive condition, transistor 140 remains nonconductive thereby preventing the energization of alarm light 34. In addition, with transistor 156 in a nonconductive state, the signal applied to conductor F is equal to approximately ground potential.

With transistor 174 in a conductive condition, transistor 122 remains in a nonconductive condition thereby preventing the energization of trouble lamp 36. In addition, with transistor 174 in a conductive condition, the signal applied to conductor D of alarm station 20 is equal to approximately ground potential.

If either of the supervisory lines 110 or 112 is open, transistor 174 changes from a forward biased condition to a reverse biased condition, thereby causing the signal applied to conductor D of alarm station 20 to change from a signal equal to approximately ground potential to a positive polarity signal. This positive polarity signal causes transistor 108 to become forward biased thereby energizing common trouble relay K1 which in turn, causes relay contacts K1-C to close. Upon closure of relay contacts K1-C, trouble power relay TPR becomes energized thereby closing relay contacts TPR-C, which in turn energize trouble buzzer 40. Also, when transistor 174 becomes reverse biased, a positive polarity signal is applied across capacitor 126 which will then commence to charge through resistors 172 and 134. When the voltage developed across capacitor 126 attains a predetermined level, transistor 122 will become forward biased to energize trouble lamp 36 thereby providing an indication of trouble at the individual annunciator circuit 14. In addition, as transistor 122 becomes forward biased, the positive-polarity signal is removed from conductor D of alarm station 20. Thus, whenever supervisory lines 112 or 110 are broke, alarm broken, 40 in common alarm station 20 is energized and, after a short period of time, i.e., the time required for capacitor 126 to charge to a predetermined level, trouble lamp 36 is energized to provide an indication of trouble at individual supervisory circuit 14.

An alarm signal is developed whenever alarm switches 114 or 116 are closed, to shunt end of line resistor 118. Thus, when this condition occurs, transistor 156 becomes forward biased thereby causing a positive-polarity signal to be applied to conductor F of alarm station 20. This positive-polarity signal in turn forward biases transistor 92 thereby energizing common alarm relay K2. Upon energization of common alarm relay K2, relay contacts K2-C close to thereby energize alarm power relay APR. When alarm power relay APR is energized, relay contacts APR-C close to thereby energize alarm bell 38. Thus, upon actuation of normally-open alarm switches 114 or 116, alarm bell 38 in alarm station 20 is immediately energized. In addition, when transistor 156 becomes forward biased, a positive polarity signal is applied across capacitor 152 thereby causing this capacitor to commence charging through diode 158, transistor 156, and resistor 150. When voltage developed across capacitor 152 reaches a predetermined level, transistor 140 becomes forward biased to thereby energize alarm lamp 34. Also, when transistor 140 becomes forward biased, the positive polarity signal applied to conductor F of alarm station 20 is removed.

With reference to FIG. 2 it may be noted that when a positive polarity signal is applied to conductor D of alarm station 20, capacitor 106 commences charging through resistors 172 and 132 until the level of the voltage stored by capacitor 106 causes transistor 108 to become forward biased. This circuit performs a function similar to the circuit including capacitor 206 to thereby provide a slight delay in forward biasing transistor 108. As transistor 108 becomes forward biased, the circuitry including relay contacts K1-C, diode 98 and resistor 100 causes relay K1 to remain energized even after the positive-polarity signal applied to conductor D is removed. Thus, upon applying a positive-polarity signal to conductor D, trouble buzzer 40 is energized and remains energized until the normally closed contacts of reset switch 78 are opened. Similarly, once a positive-polarity signal is applied to conductor F,

transistor 92 is forward biased into conduction, the circuitry including relay contact K2-C, diode 84, and resistor 86 causes relay K2 to remain energized until the normally closed contacts of reset switch 78 are opened. Thus, alarm bell 38, once energized, remains energized until reset switch 78 is opened.

The operation of the reverse current individual supervisory circuit 10 is similar to that of centralized individual annunciator circuit 14; however, with reference to FIGS. 3 and 4 it may be seen that transistors 156 and 174 are replaced with normally open relay contacts K3-C and K4-C. In normal operation, a current flows from a positive polarity terminals of battery 254 through resistive device 256, section N of switch 252, Zener diode 240, Zener diode 248, section M of alarm switch 252 and back to the negative polarity terminal of battery 254. Thus current causes alarm relay K3 to be normally de-energized and the voltage developed across Zener diode 248 causes trouble relay K4 to become energized. With trouble relay K4 energized, contacts K4-C are closed thereby causing the signal applied to conductor D of alarm station 20 to be equal to approximately ground potential. If either supervisory line 244 or 246 is broken, trouble relay K4 becomes de-energized thereby causing relay contacts K4-C to open, which in turn causes a positive-polarity signal to be applied to conductor D of alarm station 20. With these signals developed at conductor D, the operation of alarm station circuitry 20 will be similar to that previously described.

If alarm switch 252 is actuated, the current through the coils of alarm relay K3 and trouble relay K4 is reversed thereby causing trouble relay K4 to become deenergized and alarm relay K3 to become energized. With alarm relay K3 energized, relay contact K3-C will close thereby applying a positive-polarity signal to conductor F of alarm station 20. This positive-polarity signal, as discussed previously, will cause alarm bell 38 to become energized.

Although the invention has been shown in connection with a preferred embodiment, it will be readily apparent to those skilled in the art that various changes in form and arrangement of parts may be made to suit requirements without departing from the spirit and scope of the invention as defined by the appended claims.

Having thus described our invention, we claim:

1. An annunciator system comprising:

a first remote station monitoring circuit including means for changing the magnitude of a supervisory current flowing therein from a preselected value in response to an alarm condition to thereby transmit an alarm signal indicative of an alarm condition at the first remote station;

a second remote station monitoring circuit including means for changing the direction of a supervisory current flowing therein from a predetermined direction in response to an alarm condition to thereby transmit an alarm signal indicative of an alarm condition at the second remote station;

a first and second supervisory circuit each respectively electrically connected to an associated one of said monitoring circuits, each said supervisory circuit including alarm indicating means and first circuit means for energizing said alarm indicating means in response to a said alarm signal, and trouble indicating means and second circuit means for energizing said trouble indicating means in response to a disruption in said electrical connection between said supervisory circuit and its said associated monitoring circuit; and,

a central station common circuit including common alarm indicating means, and third circuit means for energizing said common alarm indicating means when the supervisory alarm indicating means of either of said supervisory circuits becomes energized

2. An annunciator system as set forth in claim 1, wherein the electrical connection between a said supervisory circuit and its associated monitoring circuit includes a supervisory current circuit, said current circuit is adapted to be connected to a source of voltage so that a said supervisory current of a given value normally flow in said current circuit.

3. An annunciator system as set forth in claim 2, wherein said central station includes common trouble indicating means and fourth circuit means for energizing said common trouble indicating means when the supervisory trouble indicating means of either of said supervisory circuits becomes energized.

4. An annunciator system as set forth in claim 2, wherein said first monitoring circuit includes means for increasing the magnitude of a said supervisory current in response to an alarm condition.

5. An annunciator system as set forth in claim 4, wherein said supervisory circuit associated with said first monitoring circuit includes a first timing means for preventing said first circuit means from energizing said supervisory alarm indicating means for a predetermined period of time after an alarm signal is transmitted by said first monitoring circuit.

6. An annunciator system as set forth in claim 5, wherein said supervisory circuit associated with said second monitoring circuit includes a second timing means for preventing said second circuit means from energizing said supervisory trouble indicating means for a predetermined period of time after a disruption occurs in the electrical connection between said first monitoring circuit and its associated supervisory circuit.

7. An annunciator system as set forth in claim 6, wherein said first timing means includes a capacitive means, and actuatable electronic control means having a first and a second condition, said capacitive means being coupled to said actuatable electronic control means in such a manner that when a voltage developed across said capacitive means in response to an alarm signal attains a predetermined value said actuatable electronic control means is actuated from said first condition to said second condition to thereby energize said supervisory alarm indicating means.

8. An annunciator system as set forth in claim 1, wherein said third circuit means comprises a latching circuit means including:

circuit means for, upon actuation in response to the change in magnitude of the supervisory current flowing in the first remote station monitoring circuit from a said predetermined value, energizing said common alarm indicating means; and,

circuit means for maintaining said common alarm indicating means in an energized condition after the supervisory current returns to a said predetermined value.

9. An annunciator system comprising:

at least one remote station monitoring circuit including power means at the station to provide a supervisory current flowing therein, and means at the station for reversing the direction of a supervisory current flowing therein from a predetermined direction in response to an alarm condition to thereby transmit an alarm signal indicative of an alarm condition at the remote station;

at least one supervisory circuit electrically connected to an associated monitoring circuit, each said supervisory circuit including alarm indicating means and first circuit means in response to a said alarm signal from at least one said remote station, and trouble indicating means and second circuit means for energizing said trouble indicating means in response to a disruption in the said electrical connection between any said supervisory circuit and at least one said remote station monitoring circuit.

10. An annunciator system as set forth in claim 9, including a central station common circuit having common alarm indicating means, and third circuit means for energizing said common alarm indicating means when the supervisory alarm indicating means of said supervisory circuit becomes energized.

11. An annunciator system as set forth in claim 10, wherein the electrical connection between a said supervisory circuit and said remote station monitoring circuit includes a supervisory current circuit, said current circuit is adapted to be connected to a source of voltage so that a supervisory current of a given value normally flows in said current circuit.

12. An annunciator system as set forth in claim 11, wherein said central station includes common trouble indicating means and fourth circuit means for energizing said common trouble indicating means when the supervisory trouble indicating means of said supervisory circuit becomes energized.

13. An annunciator as set forth in claim 12, wherein said supervisory circuit includes a first timing means for preventing said first circuit means from energizing said supervisory alarm indicating means for a predetermined period of time after an alarm signal is transmitted by said remote monitoring circuit.

14. An annunciator system as set forth in claim 13, wherein said supervisory circuit includes a second timing means for preventing said second circuit means from energizing said supervisory trouble indicating means for a predetermined period of time after a disruption occurs in the electrical connection between said remote monitoring circuit and said supervisory circuit.

15. An annunciator system as set forth in claim 14, wherein said first timing means includes a capacitive means, and actuatable electronic control means having a first and a second condition, said capacitive means being coupled to said actuatable electronic control means so that when a voltage developed across said capacitive means in response to an alarm signal attains a predetermined value, said actuatable electronic control means is actuated from said first condition to said second condition to thereby energize said supervisory alarm indicating means.

16. An annunciator system as set forth in claim 10, wherein said third circuit means comprises a latching circuit means including:

circuit means for, upon actuation in response to the energization of said supervisory alarm indicating means, energizing said common alarm indicating means; and, circuit means for maintaining said common alarm indicating means in an energized condition after the supervisory alarm indicating means becomes deenergized.

17. An annunciator system comprising:

a first remote station monitoring circuit including means for changing the magnitude of a supervisory current flowing therein from a preselected value in response to an alarm condition to thereby transmit an alarm signal indicative of an alarm condition at the first remote station;

a second remote station monitoring circuit including means for changing the direction of a supervisory current flowing therein from a predetermined direction in response to an alarm condition to thereby transmit an alarm signal indicative of an alarm condition at the second remote station;

a first and second supervisory circuit each respectively electrically connected to an associated one of said monitoring circuits; said supervisory circuits each having detecting means for respectively providing a first output signal upon receipt of a said alarm signal transmitted by said first remote station monitoring circuit and providing a second output signal upon receipt of a said alarm signal transmitted by said second remote station monitoring circuit.

18. An annunciator system as set forth in claim 17, wherein said first and second supervisory circuits each include alarm indicating means and first circuit means for energizing said alarm indicating means in response to a said alarm signal, and trouble means and second circuit means for energizing said trouble indicating means in response to a disruption in said electrical connection between the associated supervisory circuit and its said associated monitoring circuit.

19. In an annunciator system a remote station monitoring circuit comprising:

a DC voltage supply source at the station;

actuatable circuit means having a normal first condition and a second condition and connected to the voltage supply source;

first and second bistable circuit means each having a first condition and a second condition; said first bistable cir-

cuit means being diode coupled to said actuatable circuit means in such a manner so that when said actuatable circuit means is actuated from said normal first condition to its said second condition said bistable circuit means is actuated from its said first condition to its said second condition; said second bistable circuit means being diode connected to said actuatable circuit means in such a manner that said second bistable circuit means is actuated from its said first condition to its said second condition in response to a disruption in said electrical connection between said actuatable circuit means and said second bistable circuit means.

20. In an annunciator system a supervisory circuit adapted to be connected to a remote station monitoring circuit and comprising:

trouble indicating means and first circuit means for energizing said trouble indicating means in response to a trouble signal;

alarm indicating means and second circuit means for energizing said alarm indicating means in response to the receipt of an alarm signal from a said remote station monitoring circuit; and,

first timing means for preventing said first circuit means from energizing said alarm indicating means for a predetermined period of time after the receipt of a said alarm signal from a said remote station monitoring circuit.

21. In an annunciator system as set forth in claim 20, wherein said first timing means includes a capacitive means, and actuatable electronic control means having a first and second condition, said capacitive means being coupled to said actuatable electronic control means in such a manner so that when a voltage developed across said capacitive means in response to an alarm signal attains a predetermined value said actuatable electronic control means is actuated from said first condition to said second condition to thereby energize said alarm indicating means.

22. An annunciator system comprising:

a remote station monitoring circuit including means for changing the magnitude of a supervisory current flowing

therein from a preselected value in response to an alarm condition at the remote station;

a supervisory circuit electrically connected to said remote station monitoring circuit and including:

trouble indicating means and first circuit means for energizing said trouble indicating means in response to the disruption of said electrical connection between said supervisory circuit and said remote station monitoring circuit;

alarm indicating means and second circuit means for energizing said alarm indicating means in response to the receipt of an alarm signal from a said remote station monitoring circuit; and,

first timing means for preventing said first circuit means from energizing said alarm indicating means for a predetermined period of time after the receipt of a said alarm signal from a said remote station monitoring circuit.

23. An annunciator system as set forth in claim 22 including a central station common circuit coupled to said supervisory circuit and comprising:

common alarm indicating means;

first circuit means for energizing said common alarm indicating means in response to the energization of said alarm indicating means in said supervisory circuit; and,

second circuit means for maintaining said common alarm indicating means in an energized condition after said alarm indicating means in said supervisory circuit becomes deenergized.

24. An annunciator system as set forth in claim 23 including a plurality of supervisory circuits wherein said first circuit means includes a latching circuit means having:

circuit means for, upon actuation in response to the receipt of a said alarm signal from any supervisory circuit, energizing said common alarm indicating means; and, circuit means for maintaining said common alarm indicating means in an energized condition after the removal of a said alarm signal from said central station common circuit.

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