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SIGNALLING APPARATUS INCLUDING REMOTE BATTERY RECHARGING SYSTEM

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FIG. 1

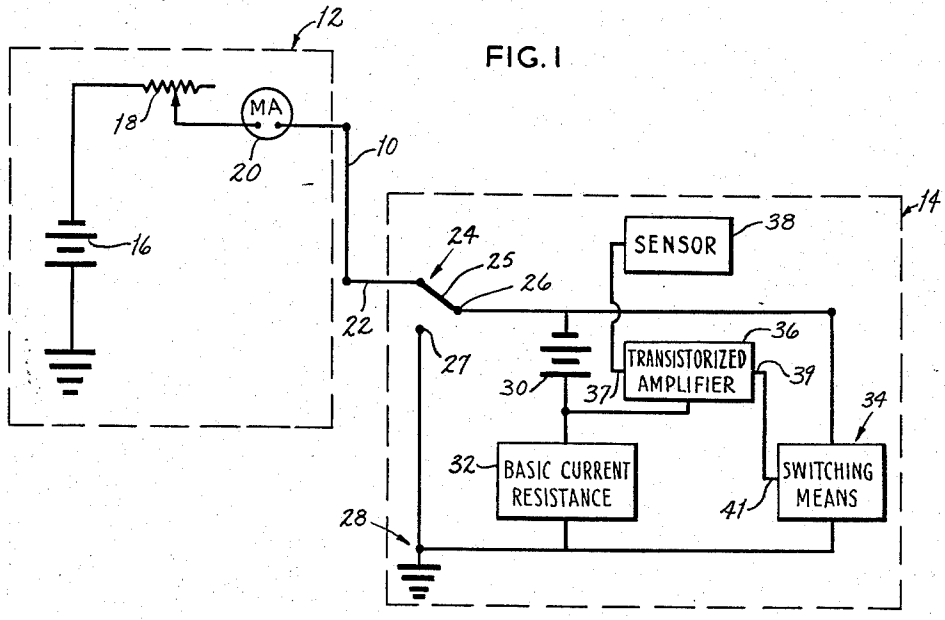
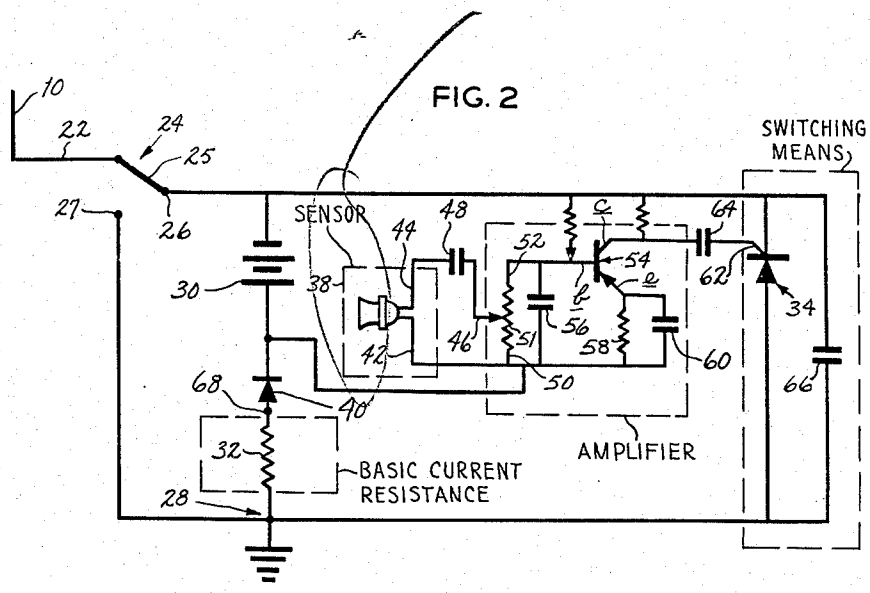


FIG. 2



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SIGNALLING APPARATUS INCLUDING REMOTE BATTERY RECHARGING SYSTEM

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5 Claims. (Cl. 340—261)

This application is a continuation-in-part of application Serial No. 216,489, filed August 13, 1962, now Patent Number 3,149,320, for "Signalling Apparatus Including Remote Battery Recharging system."

This invention pertains to remote station alarm and signalling apparatus used in conjunction with a central alarm station of the type which monitors the direct current transmitted via separate signalling wires to the remote stations. Abnormal signals which are sensed at the remote stations result in changes in these direct currents and monitoring thereof provides an indication of such conditions to personnel located at the central alarm station.

In the copending application Serial No. 216,489, filed August 13, 1962, and referred to hereinabove, the remote station circuitry disclosed is arranged so that the signalling wire connecting the central station to this circuitry provided not only the current which indicates the abnormal conditions, but also provides recharging current for a remote station battery. Such disclosed station circuitry provides three parallel circuits which branch from a common input terminal and converged to a common reference potential. Because the battery at the remote station and a resistor, used to establish a basic current rate in the signalling wire, were in separate parallel circuits, an open circuit condition in the resistor circuit resulted in the current being diverted entirely through the battery circuit.

Accurate, sensitive monitoring apparatus at the central station will readily detect such an open circuit condition by sensing a change in the current. However, it is highly desirable to be able to detect such an open circuit as an absolute "go or no go" condition, rather than depend on the detection of a variation in the current. To this end, the open circuit should produce a complete cessation of current, and be readily monitored.

It is an object of the present invention to provide a remote station alarm circuit wherein open circuit conditions in a basic or normally conducting circuit may be detected with absolute certainty by conventionally employed monitoring apparatus provided at a central station.

Another object is to so utilize at a remote station a silicon-controlled rectifier and a sensor means as to put into effective use on the occurrence of an abnormal condition at the remote station, a battery thereat which is kept charged by the normal flow of current over the signalling wire.

In the present invention this purpose (as well as others apparent therein) are achieved generally by providing an improved remote observation station circuitry having an input terminal connected to a signalling wire which couples the remote station to a central signal station. A direct current source at the central station transmits a monitored current over a signalling wire to the input terminal. Branching from the input terminal are two circuits which converge to a common reference potential terminal. One of these circuits includes a rechargeable remote station battery connected in series with an electrical element which provides a selected resistance to establish a predetermined basic current in the circuit. The battery supplies electrical power to electrical components; for example, amplifiers, local alarms, etc. at the remote station and is rechargeable by current supplied by the signalling wire. The electrical element establishes a basic current in the signalling wire. It is this basic current by which the normally-persisting condition at the remote station is identified. Because the selected resistor is in series with the rechargeable battery, current flow in the signalling wire ceases whenever there is an open circuit at any point between the input terminal and the reference terminal in the resistance circuit.

The other circuit which, on the occurrence of the condition to be detected, serves as a current-shunting circuit, is maintained normally non-conducting by a switch provided therein. A sensor is electrically coupled to this switch to render this circuit conducting when an abnormal condition is detected by the sensor.

The utilization of the invention will become apparent to those skilled in the art from the disclosure made in the following description of a preferred embodiment of the invention as illustrated in the accompanying drawing, in which:

FIG. 1 is a block diagram representation of the alarm signalling circuitry showing the basic functional elements thereof; and

FIG. 2 is a detailed schematic diagram of the electrical components utilized in the remote observation station, the dashed lines representing the block diagram elements of FIG. 1.

Referring now to the drawing, wherein like reference characters designate like or corresponding parts throughout the several phases, there is shown in FIG. 1 a single signalling wire **10**, such as a leased telephone wire, which interconnects a central or observation station, generally designated **12**, with a remote station, generally designated **14**. A direct current power source **16** which is located at the observation station **12** or at some other convenient point in the circuit, has its positive terminal connected to ground and its negative terminal connected to a line-limiting resistor **18**. It should be understood that a plurality of remote stations **14** may be connected to and operated from a single central station **12** by a plurality of the interconnecting signalling wires **10**.

At the central observation station **12**, a monitoring instrument **20**, for example, a milliamp meter or like current measuring instrument, is inserted in the line between the line-limiting resistor **18** and the signalling wire **10**. When the circuit between the central station **12** and a remote station **14** is completed, the monitoring instrument **20** provides a visual indication of the current which is being supplied from the direct current power source **16** to the remote station **14**. The term "monitoring instrument" is intended to include all devices which measure current flow and provide a "read-out" of the information conveyed by observing the change in the current flow, or which otherwise provide observable response to gross changes in current flow.

At the remote station **14** the signalling wire **10** is connected by conductor **22** to a switch, generally designated **24**. A contact arm **25** of the switch is movable between two poles **26** and **27**, pole **27** being that which is contacted by the switch arm **25** during the day and pole **26** serving as an input terminal which is contacted by the switch arm **25** during the night or other such periods when the remote station **14** is unattended.

A reference potential terminal, generally designated **28**, is provided at the remote station **14** to complete the circuit between the central station **12** and the remote station **14**. The day pole **27** of the switch **24** is directly connected to this reference terminal **28**, which may conveniently be a ground terminal, as shown in FIG. 1.

With the contact arm of switch **24** in the "night" position as shown in FIG. 1, the current supplied to input terminal **26** has two circuit paths leading to the ground

potential terminal 28, one path normally conducting and the other normally nonconducting. The normally conducting path includes a rechargeable remote station battery 30 and an electrical element 32 characterized in having a selected resistance. It should be understood that this path may also include additional condition sensing apparatus which operates on the current flowing from the central station. The remote station battery 30 is of the type which accepts a recharging current at a substantially constant rate; for example, as nickel-cadmium battery. As described in my U.S. Patent No. 3,149,320. It has its negative terminal connected to the input terminal 26 and its positive terminal connected to the electrical resistive element 32. The normally nonconducting path includes a switching means, generally designated 34, which under normally persisting conditions is open. Current is supplied to the input terminal 26 from the reference terminal 28, and through the series circuit of the remote station battery 30 and the electrical element 32. This current flow, in addition to providing an indication of the normally-persisting condition at the remote station, charges the remote station battery 30 and obviates supplemental remote station charging apparatus which is subject to power failures and tampering. The electrical element 32 is selected such that its resistance determines a basic current which, under normally-persisting conditions, flows in the signalling wire 10.

A transistorized amplifier 36 is connected across the remote station battery 30, so that the battery 30 serves as a source of B–power for the amplifier 36. The input terminal 37 of the amplifier 36 is connected to a sensor 38, and its output terminal 39 is connected to a control terminal 41 of the switching means 34.

Under normally-persisting conditions, the switching means 34 is biased so that it is nonconducting. In this condition all of the current appearing at the input terminal 26 will flow through the series circuit, which includes the battery 30 and electrical resistive element 32, to ground. However, when an abnormal condition exists in the remote station 14—for example, when a burglar creates sounds at the station—the sensor 38 will detect this condition and produce an electrical signal which is fed to the transistorized amplifier 36. This signal is then amplified and fed to the normally nonconducting switching means 34 to overcome the bias thereon and render the parallel circuit of the switching means 34 conductive. This effects a shunting of current to the parallel circuit which includes the switching means 34, resulting in an increased flow of current through the signalling wire 10. Such increase in current flow is identifiable as indicating an abnormal condition; and is so detected by the monitoring instrument 20 at the central station 12.

Referring now to FIG. 2, there is shown the detailed circuit elements which are utilized at the remote station to provide the necessary detection of abnormal conditions by a reading of increased current flow, and to render a positive indication of open-circuits in the basic current path by a cessation of current flow. The remote station battery 30 has its negative terminal connected to the remote station input terminal 26 and its positive terminal connected to the cathode of a conventional diode 40. The anode of the diode 40 is connected to one terminal of a selected resistor 32, while the other terminal of the resistor is connected to ground. The sensor 38 is preferably a microphone capable of picking up sounds generated by burglars in warehouse, safety deposit and fur vaults, or the like. One terminal 42 of the microphone is connected to the positive terminal of the battery 30. The other terminal 44 of the microphone is coupled to a sliding arm 46 of a potentiometer by means of a coupling capacitor 48. A terminal 50 of the potentiometer 51 is connected to the positive terminal of the battery 30, and its other terminal 52 is connected to the base electrode *b* of transistor 54. A bypass condenser 56 is connected across the terminals 50 and 52 of the potentiometer 51. The emitter *e* of the transistor 54 is connected to a bias resistor 58 and a bypass condenser 60, which is connected in parallel with resistor 58 between the positive terminal of battery 30 and the emitter *e*. The collector of transistor 54 is coupled to the control electrode 62 of the silicon-controlled rectifier 34 by means of a coupling capacitor 64. The cathode of the silicon-controlled rectifier 34 is connected to the input terminal 26, and the anode is connected to the reference potential terminal 28. A bypass condenser 66 is connected across the anode and cathode terminals of the rectifier 34.

Under normal operating conditions; that is, at night without "attack sounds" being generated, current flows from the reference potential terminal 28 through the electrical element 32, the diode 40, the battery 30, the switch 24, the signalling wire 10, the monitoring instrument 20, the line-limiting resistor 18, the central station battery 16 and back to ground. The basic current rate which is established under this condition is primarily determined by the resistor 32, assuming that the other resistive parameters in this basic circuit are negligible in comparison thereto.

"Attack sounds" such as those created by a burglar, are sensed by the microphone 38 and transformed into an electrical signal which is supplied to the potentiometer 51 by means of the coupling capacitor 48 and the sliding arm 46. The arm of the potentiometer may be varied to provide the amplification gain required at the specific remote station. From the potentiometer, the signal is applied to the base elcetrode *b* of the transistor 54. There the signal is amplified and supplied from the collector electrode *c* to the control electrode 62 of the silicon-controlled rectifier 34 by means of the coupling capacitor 64. The signal impressed upon the control electrode 62 overcomes the bias on the rectifier 34 and permits it to conduct. In this condition, the current will flow from the reference potential terminal 28 through the rectifier 34 to the input terminal 26. From the input terminal 26, the current then flows through the switch 24, the signalling wire 10, the monitoring instrument 20, the line-limiting resistor 18 and a central station battery 16 to ground. Because the resistor 32 is shunted by the current, its magnitude will be significantly greater. The detection of this greater current will indicate that the abormal condition is present at the remote station. Since the positive terminal of the battery 30 is connected to the cathode of the diode 40, current from the battery 30 will be isolated from the normally nonconducting circuit path which includes the silicon-controlled rectifier 34.

Oftentimes in the application of the signalling apparatus hereinabove described, it is customary to break the circuit at the terminal 68, between the diode 40 and resistor 32, to insert therein additional remote station detection apparatus. For example, the basic current which normally passes through the battery 30, diode 40 and resistor 32, can be directed through window foil strips or other condition-sensing circuit elements, whereby to provide a multiplicity of condition sensors at the remote station. By providing a series circuit at the remote station battery 30, including such additional condition-sensing elements and the resistor 32, an open circuit which might develop therein can be detected at the central station with certainty. An open circuit in this basic normally conducting current path, occurring concurrently with the open circuit of the normally nonconducting circuit path, prevents even minute current flow in the signalling wire 10. There being no current flow in the signalling wire 10, the monitoring instrument 20 at the central station will read zero, thereby indicating a definite open circuit at the remote station.

Obviously many modifications and variations of the present invention are visible in light of the above teachings. For example, instead of the remote station battery 30 supplying power to an amplifier as described in the

illustrative embodiment (or in addition to this function), it may be utilized to power local alarm apparatus, such as gongs, bells, or the like. Furthermore, several stages of amplification may be used where required. Conversely, where the "attack sounds" are likely to be of sufficient magnitude, the amplifier may be omitted entirely and the output signals of the microphone applied directly to the rectifier **34** to vary the bias thereof. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

I claim:

1. For use with a central observation station from which monitored current is transmitted from a direct current source and over a signalling wire to a remote station having an electrically powered component,

the improved remote station circuitry, comprising

an input terminal for connection to the signalling wire,

a reference potential terminal,

first and second circuits branching from said input terminal and converging to said reference potential terminal,

said first circuit comprising

a rechargeable remote station battery for supplying electrical power to such electrical component at the remote station and rechargeable by current supplied thereto by the signalling wire said battery having terminals connectable to such electrically powered component, unidirectional current conducting means in said first circuit in series with said remote station battery, to isolate the flow of the current of said remote station battery from said second circuit and

an electrical element in series with said rechargeable battery,

said element being characterized by having resistance of a value selected to establish a predetermined basic current in the first series circuit and the signalling wire, by which a normally-persistent condition at the remote station is identifiable at the observation station,

said second circuit comprising

switching means for maintaining said second circuit normally nonconducting, and

sensor means electrically coupled to said switching means for rendering said second circuit conducting when an abnormal condition is detected at the remote station, thereby to increase the current flow in the signalling wire.

2. The improved remote station circuitry of claim **1**, wherein

the battery is of a type which accepts a recharging current at a substantially constant rate.

3. The improved remote station circuitry of claim **2**, wherein

said switching means is a silicon-controlled rectifier having a control electrode,

said sensor means is a microphone electrically coupled to said control electrode,

whereby abnormal sounds occurring at the remote station are converted into electrical signals which bias the silicon-controlled rectifier to its conducting state.

4. For use with a central observation station from which monitored current is transmitted from a direct current source and over a signalling wire to a remote station, the improved remote station circuitry comprising

an input terminal for connection to the signalling wire,

a reference potential terminal,

first and second circuits branching from said input terminal and converging to said reference potential terminal,

said first circuit comprising

a recharageable remote station battery having terminals for supplying electrical power at such remote station and rechargeable by current supplied thereto by the signalling wire,

undirectional current conducting means connected in said first circuit in series with said remote station battery, to isolate the flow of the current of said remote station battery from said second circuit, and

an electrical element is series with said rechargeable battery and having a resistance of a value selected to establish a predetermined basic current in said first series circuit and the signalling wire, by which a normally-persistent condition at the remote station is identifiable at the observation station,

said second circuit comprising

a silicon-controlled rectifier for maintaining said second circuit normally non-conducting, said silicon-rectifier having two of its electrodes connected to said reference potential terminal and said input terminal, respectively, and further having a control electrode, and

amplifier means connected across the terminals of said remote station battery and supplied power thereby, said amplifier means having an input terminal and an output terminal, said output terminal being connected to said control electrode of said silicon-controlled rectifier,

a microphone connected to said input terminal of said amplifier means,

whereby an abnormal conditioned sensed by said microphone at said remote station biases said silicon-controlled rectifier to its conducting state.

5. An improved direct current alarm system of the type having

a principal source of direct current,

monitoring apparatus at an observation station, connected to said principal source and including means to sense an alteration in the current flow therefrom,

circuitry at a station which is remote from the principal current source,

a signalling wire connecting the principal current source, the observation station apparatus, and the remote station apparatus,

said remote station apparatus being characterized by having

an input terminal for connection to the signalling wire,

a reference potential terminal,

first and second circuits branching from said input terminal and converging to said reference potential,

said first circuit comprising

a rechargeable battery of the type which accepts a charging current at a substantially constant rate, said battery having one of its terminals connected to said input terminal, unidirectional current conducting means connected to the other terminal of said remote station battery, to isolate the flow of the current of said remote station battery from said second circuit,

a selected resistor having one of its terminals connected to said unidirectional current conducting means, the other terminal of said resistor being connected to said reference potential terminal, and

a transistorized amplifier connected across said battery for receiving electrical power therefrom, said amplifier further having an input terminal and an output terminal,

said second circuit comprising

a silicon-controlled rectifier having a cathode electrode, an anode electrode, and a control electrode, said anode electrode being connected to said reference potential terminal, said cathode electrode being connected to said input terminal, and said control electrode being connected to the output terminal of said amplifier,

together with a microphone having an output terminal electrically connected to the input terminal of said amplifier,

whereby signals sensed by said microphone are amplified and switch the silicon-controlled rectifier to a current-conducting condition.

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NEIL C. READ, *Primary Examiner.*