

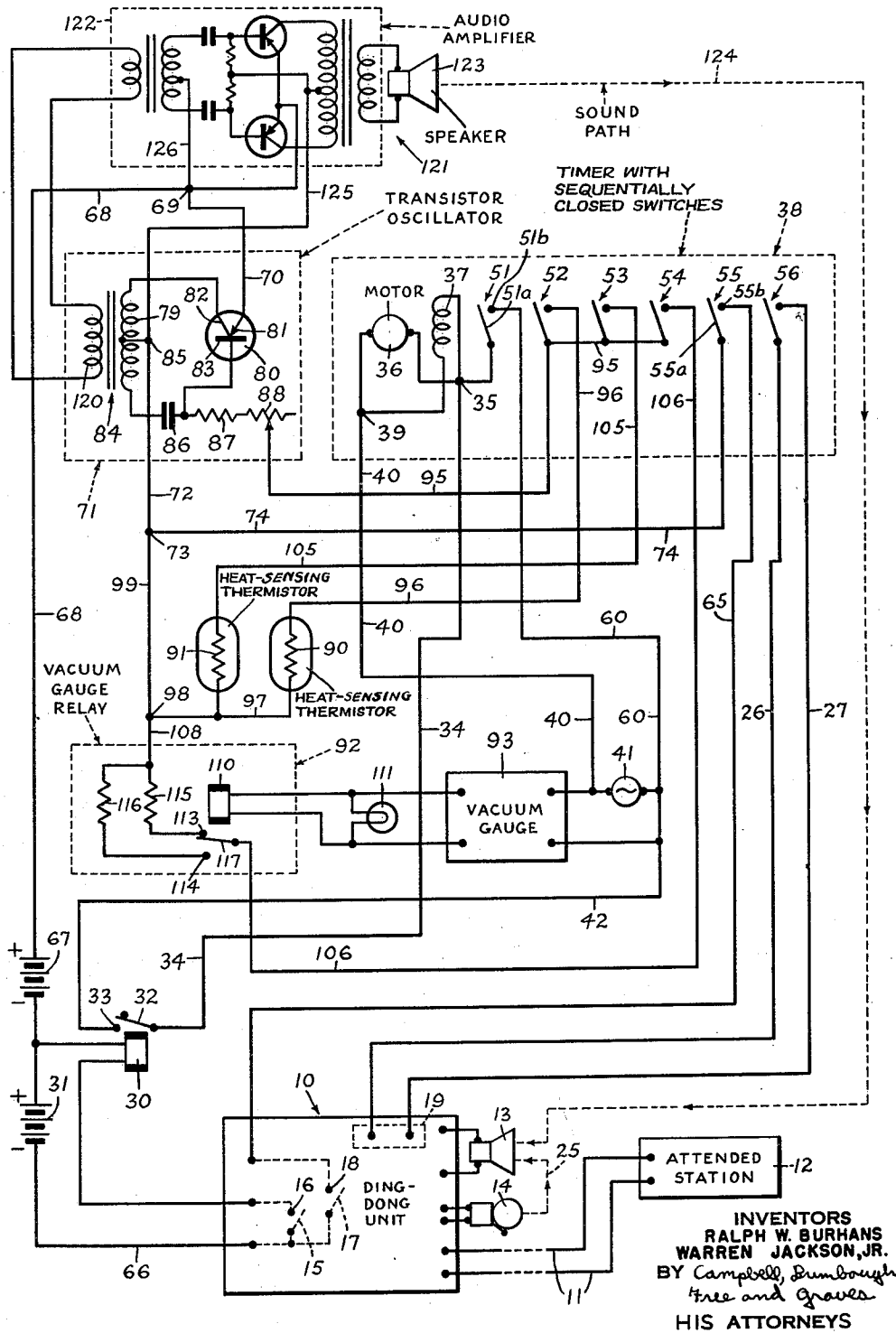
April 17, 1962

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3,029,642

TRANSISTOR THERMISTOR TELEMETERING DEVICE

Filed Dec. 22, 1954



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TRANSISTOR THERMISTOR TELEMETERING DEVICE

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Filed Dec. 22, 1954, Ser. No. 477,076
13 Claims. (Cl. 73-362)

This invention relates generally to telemetering apparatus and more particularly to apparatus of this character employing transistors.

In the prior art, one common form of telemetering apparatus employs a system of relays, bells and buzzers to generate a signal indicative of an undesired change in a physical condition monitored by the apparatus. Apparatus of this sort, however, requires a large number of parts, is complex in organization, is bulky, and has a maintenance schedule requiring undesirably frequent visits. Other types of prior art telemetering apparatus performing the same function utilize electronic circuits containing vacuum tubes. The last-named type of apparatus is also disadvantageous for monitoring a condition at a remote location, since the vacuum tubes cause a heavy current drain on the battery source of power usually used to energize the apparatus. Moreover, this current drain is aggravated by the characteristically long warm-up time required for vacuum tubes to become fully operative. Hence, frequent replacement of the battery is necessary. Note also that, since allowance must be made for a warm-up period before each transmission of a data signal, the warm-up period not only represents a current drain on the battery during an interval in which the apparatus is performing no useful function, but in addition unduly extends the time necessary for a transmission.

It is an object of this invention to provide telemetering apparatus free of the above-noted disadvantages of the prior art.

A further object of this invention is to provide telemetering apparatus characterized by one or more of the advantages of simplicity, compactness, inexpensiveness, reliability, minimization of battery current drain, and elimination of the necessity for a warm-up period.

Another object of the invention is to provide telemetering apparatus of the above-noted character suitable for monitoring a plurality of physical conditions at a remote location.

Yet another object of the invention is to provide telemetering apparatus of the above-noted character adapted to transmit signals telephonically.

These and other objects are realized in accordance with the invention by providing an apparatus to be used at an unattended station and taking the form of a transistor oscillator circuit and a means for sensing a change in the condition to be monitored. The transistor oscillator circuit is of a nature to provide for transmission of oscillatory signals to an attended station at a frequency determined by an impedance characteristic of the circuit. The value of this impedance characteristic is changed by the sensing means in response to a change in the monitored condition. Accordingly, the oscillatory signal indicates the said change by a change in frequency value.

As a feature in accordance with the invention, timing means may be provided to perform one or more of the functions of limiting the transmission period of the signal, limiting energization of certain of the telemetering apparatus circuits to those times when signal transmission is desired, and coupling, in turn, a plurality of condition sensing units with the oscillator circuit when a plurality of physical conditions are to be monitored.

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As another feature in accordance with the invention, there may be provided couplings of electrical or other nature for the telemetering apparatus such that the same, in response to a telephonic signal received at the unattended station from the attended station, is adapted to establish a telephonic transmission, back to the attended station, of the data signal for the monitored condition.

The invention may be better understood from the following detailed description of a representative embodiment thereof taken in conjunction with the accompanying drawing of the embodiment and wherein the electric circuits and other components of the embodiment are shown partly in schematic diagram and partly in block diagram. While the invention is described herein in connection with an application thereof for monitoring conditions in a mass spectrometer, it will be understood that the invention is of general application in the monitoring of one or more physical conditions.

Referring to the drawing, the numeral 10 designates a commercially available device known as an "unattended station circuit" or more popularly as a "ding-dong circuit." The ding-dong unit 10 (which is at the unattended station) has an assigned telephone number. The unit 10 is connected through the telephone distribution network 11 with an attended station 12 when a subscriber at this latter station requests the number of the unattended station.

The ding-dong unit itself is not a part of the present invention. Hence, only a brief description of its more important components will be given. These consist of a microphone 13, a bell 14, a momentary start circuit shown as a movable contact 15 closable with a fixed contact 16, a continuous start circuit shown as a movable contact 17 closable with a fixed contact 18, and a stop circuit 19.

When a subscriber at attended station 12 wishes to obtain information from the unattended station, he calls in the regular way the number assigned to the ding-dong unit 10. The incoming telephonic signal received by the ding-dong unit is in the form of ringing current which activates the unit so that one short ringing interval is heard. Following the ring, the ding-dong unit operates the bell 14, whose tone is fed by air path 25 into microphone 13. The resulting "ding-dong" bell tone is heard at the attended station for about a five-second interval. At the end of this interval, the bell stops, and momentary and continuous start circuits are actuated to close contacts 15, 16 and contacts 17, 18.

The contacts of the momentary start circuit open after a short delay, but the contacts of the continuous start circuit remain closed so long as the ding-dong unit 10 is telephonically connected with the attended station 12. If the subscriber at station 12 "hangs up," the contacts of the continuous start circuit are opened shortly thereafter to shut down the ding-dong unit 10 as a whole. Alternatively, the unit may be shut down by a signal originating at the unattended station in the form of a coupling together of a pair of external leads 26, 27 for the stop circuit 19. When so shut down, the ding-dong unit 10 is then ready to respond to another incoming call.

While the ding-dong unit 10 is "on," the microphone 13 thereof will pick up sonic signals for telephonic transmission thereof back to the attended station 12. Accordingly, the ding-dong unit is adapted to provide a telephonic connection with the attended station 12 of a sonic signal generated by a telemetering apparatus.

Considering the relation between the ding-dong unit 10 and the present invention, the momentary actuation to closure of contacts 15, 16 completes a circuit to energize a relay winding 30 from a battery source 31.

Winding 30, when energized, closes a movable contact 32 with a fixed contact 33 to complete a circuit through the following elements: contact 32, lead 34, junction 35, the parallel connection of a timing motor 36 and a clutch coil 37 in a timing means 38, junction 39, lead 40, alternating current power source 41, lead 42, and the fixed contact 33. When the mentioned circuit is so completed, the local power source 41 (which may be a 110 volt A.C. source) will energize both the timing motor 36 and the clutch coil 37.

The timing means 38 may be a timer of a type described in bulletin 130C published in March 1951 by the "Eagle Signal Corporation" of Moline, Illinois. In this timer, the clutch coil 37, when energized, links a plurality of normally open switches 51—56 to the rotation of timing motor 36. Responsive to this rotation, each of the switches will close during the timing cycle for a fixed period thereof. The timer is such that it is possible to select, at will, the time of initiation and the duration of the closure period for any particular switch. If, at any time, the clutch coil 37 becomes de-energized, the linkage between the switches and timing motor 36 is broken. Any closed switch then springs open to thus restore the whole timer to starting condition.

The closure period for switch 51 is selected to last from the beginning to the end of the timing cycle. Hence, as soon as coil 37 is energized, the movable contact 51a of switch 51 closes with fixed contact 51b thereof to complete a self-holding circuit for the timer through the following elements: movable contact 51a, junction 35, coil 37 and motor 36 in parallel, junction 39, lead 40, A.C. power source 41, lead 60, and fixed contact 51b. With this self-holding circuit, motor 36 and coil 37 stay energized despite opening of contacts 32, 33 at the end of momentary actuation of contacts 15, 16.

The switch 51 at the end of a timing cycle will open to interrupt the holding circuit. Upon occurrence of this event, any closed ones of switches 51—56 will open. Thus, timing means 38 is self-resetting at the end of a cycle. Moreover, upon interruption of the holding circuit, the motor 36 and coil 37 will be de-energized and cannot be re-energized until relay winding 30 is again actuated by ding-dong unit 10. Thus, the timing means 38 is also characterized by a single cycle feature in the sense that it is incapable of recycling to give more than one timing cycle for any given telephone call made to the ding-dong unit 10.

Within the ding-dong unit, the closure of the contacts 15, 16 of the momentary start circuit is accompanied by closure of the contacts 17, 18 of the continuous start circuit. These last-named contacts remain closed until the ding-dong unit is shut down by operation of the stop circuit 19. Shortly after closure of contacts 17, 18, the timing motor 36 closes together the movable contact 55a and fixed contact 55b of the switch 55, assigned a closure period lasting from the beginning to the end of the timer cycle. With this closure of switch 55, a circuit is completed through the following elements: fixed contact 55b, lead 65, contact 18, contact 17, lead 66, battery 31, another battery 67, lead 68, junction 69, lead 70, transistor oscillator circuit 71, lead 72, junction 73, lead 74, and movable contact 55a of timing switch 55. When the mentioned circuit is so completed, the battery sources 31 and 67 furnish power to the transistor oscillator circuit 71.

Considering oscillator circuit 71, while the same may be any one of various transistor oscillators, preferably it is of the form to be described. In oscillator 71, a transistor 80 having emitter, collector, and base electrodes 81, 82, 83 is connected so that battery current flows through transistor 80 from emitter electrode 81 to collector electrode 82. Inductance means, in the form of the center tapped, primary winding 79 of an audio-transformer 84, is coupled at one end with collector electrode 82 so that the center tap 85 of the winding is coupled with lead 72. Thus, the upper half of primary winding 79 is coupled

with the emitter electrode 81 and the collector electrode 82 in the path for the battery current.

To provide the A.C. signal feedback factor necessary for oscillation, the lower half of primary winding 79 is coupled to the base electrode 83 by capacitance means in the form of a capacitor 86 having, say, a 0.05 mfd. value. To complete the conditions necessary for oscillation, the base electrode 83 is coupled with a resistance path permitting a fraction of the current traversing emitter electrode 81 to return through the base electrode 83 to the negative end of battery 31. The serially connected, fixed resistor 87 (of, say, 10K value) and variable resistor 88 (variable, say, from 0—250K) form components of this resistance path to be further described in greater detail.

With the described connections, the oscillator circuit 71, when energized, produces oscillatory signals at a frequency determined by an impedance characteristic of the circuit. This characteristic is, say, the RC value of the resistance path and the capacitor 86. By changing the value of this impedance characteristic the frequency of the oscillatory signal is correspondingly changed. Preferably, the change in frequency is effected by changing the resistance value of the resistance path. Also, preferably, the circuit parameters are selected to give signal frequencies within a particular range. This range includes frequencies of "audible" value in the sense that sonic signals at these frequencies can be heard by the human ear.

The oscillatory signals are changed in frequency by sensing means which may take the form of a single sensing unit for monitoring a single physical condition. The sensing means in the presently described embodiment, includes three sensing units. Of these sensing units, two are in the form of the temperature sensitive resistors 90, 91 for monitoring the presence of liquid nitrogen in cold traps (not shown) of the mentioned mass spectrometer. The third is in the form of a relay 92 for monitoring the vacuum gauge 93 of the mass spectrometer.

The several sensing units 90, 91, 92 are coupled in turn into the resistance path of the transistor oscillator 71 by the closure through timer motor 36 of the switches 52, 53, 54. Taking up these switches in the order in which they close, when switch 52 closes, it completes the resistance path from base electrode 83 to battery 31 through the following elements: fixed resistor 87, variable resistor 88, lead 95, switch 52, lead 96, temperature sensitive resistor 90, lead 97, junction 98, lead 99, junction 73, and from thence back to battery 31 by the route given for the power circuit of oscillator 71. The effect of closure of switch 52 is thus to route the resistance path for oscillator circuit 71 through temperature sensitive resistor 90. As a first result the circuit 71 will start to oscillate. As a second result, the frequency of oscillation of the circuit is determined by the effective resistance of resistor 90.

Temperature sensitive resistance 90 is of such type (well known in the art) that, when cooled to low temperature in the presence of liquid nitrogen, the resistor 90 has a value of several megohms. With this megohm value in the resistance path, an oscillation is produced at a frequency which in audible terms corresponds to a very low tone as, say, 20—60 cps. This low frequency oscillation indicates the continuing presence, as is desired, of liquid nitrogen in the cold trap monitored by the resistor. On the other hand, if no liquid nitrogen is present, the value of resistor 90 decreases to several thousand ohms with the result that circuit 71 oscillates at a relatively high frequency in audible terms as, say, at 1000 cps. This high frequency value for the oscillatory signal indicates a failure in the action of the monitored cold trap.

Under the action of timing motor 36, the closure period of switch 52 is completed by the opening of the switch to decouple resistor 90 from oscillator circuit 71. A short time thereafter, the motor 36 closes switch 53 for a period during which the resistance path for return current from

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base electrode 83 to battery 31 is completed through the following elements; fixed resistor 87, variable resistor 88, lead 95, switch 53, lead 105, temperature sensitive resistor 91, lead 97, and then back to battery 31 in the same manner as previously described for resistor 90. Resistor 91, when so coupled with oscillator 71, controls the frequency of the signal thereof in a manner alike to the controlling action of resistor 90. Thus, circuit 71 produces low and high audible frequency signals in respective correspondence with the presence and absence of liquid nitrogen in the cold trap monitored by resistor 91.

The timing motor 36 at the end of the closure period of switch 53 opens this switch to decouple resistor 91 from oscillator circuit 71. A short time thereafter, motor 36 closes switch 54 to complete the mentioned resistance path for circuit 71 through the heretofore-mentioned elements up to lead 95, thence through switch 54, lead 106, relay 92, lead 108, junction 98, and from thence back to battery 31 by the route heretofore described. The closure of switch thus inserts the relay 92 into the resistance path for the third monitoring period.

Relay 92 includes a winding 110 connected across the warning light 111 for the vacuum gauge 93 of the mass spectrometer. The relay 92 also comprises a pair of fixed contacts 113, 114, the resistors 115 (of, say, 2M value) and 116 (of, say, 2K value) connected, commonly, with the lead 108 and, respectively, with fixed contacts 113, 114. The relay is completed by a movable contact 117 adapted to close with either of the fixed contacts 113, 114.

When the mass spectrometer vacuum system is operating properly, the relay winding 110 will be energized by the voltage across warning light 111. Winding 110, when so energized, maintains movable contact 117 in closure with fixed contact 113 to maintain the megohm value resistor 115 in the resistance path for oscillator circuit 71. Under these conditions, the circuit 71 oscillates to produce the signal of normal low audible frequency. If, however, the mentioned vacuum system breaks down, the warning light 110 goes out, the winding 110 becomes deenergized, and the movable contact 117 opens with fixed contact 113 and closes with fixed contact 114. By this shift in the movable contact, the low kilohm value resistor 116 is substituted for the megohm value resistor 115 in the resistance path. Hence, in case of vacuum breakdown, the oscillator circuit 71 produces its warning signal of high audible frequency.

For conversion of the oscillator signal into a form conveniently transmissible through the ding-dong unit 10, the secondary winding 120 of audio transformer 84 is coupled with the input of an electrosonic transducer means 121. This transducer means may take the form of an audio amplifier 122 operated by transistors, and a speaker 123 electrically coupled with the amplifier 122 and sonically coupled by the air path 124 with the microphone 13 of ding-dong unit 10. Conveniently, the amplifier may be served by leads 125, 126 with power from the same circuit which energizes transistor oscillator 71. Hence, the transistor amplifier will be energized during, and only during, the time interval in which transistor oscillator 71 is energized.

During the respective periods in which switches 52, 53 and 54 are closed, the continuous start contacts 17, 18 in ding-dong unit 10 are kept closed to maintain oscillator 71 energized through the power circuit heretofore described. Shortly after timing motor 36 opens switch 54 to decouple relay 92 from the oscillator, the motor 36 closes the switch 56 to thereby shunt together the exterior leads 26, 27 for the stop circuit 19. Stop circuit 19 in response to this shunting action produces the effects of telephonically disconnecting the ding-dong unit from attended station 12, and of opening the continuous start contacts 17, 18.

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The opening of these contacts interrupts the power circuit to oscillator 71 to produce de-energization thereof. Almost immediately thereafter, the timing motor 36, which is still running, causes both the switches 55 and 51 to open, to thus mark the end of the timing cycle. The opening of switch 51 interrupts the circuit from source 41 through motor 36 and clutch coil 37. The described telemetering apparatus is thus restored to its starting condition.

Considering some of the advantages of the described telemetering apparatus, by limiting the energization of oscillator 71 and amplifier 122 to the minimum necessary time duration, the current drain on the battery sources is kept down, even though the subscriber calling the unattended station does not "hang up" his telephone promptly after the data signal from the apparatus has been received by him. Conversely, if the subscriber merely wishes to monitor the condition detected by the first sensing unit, the subscriber, by "hanging up" at the end of the data signal transmission period for this first sensing unit, can immediately deenergize the oscillator 71 through the opening of the continuous start contacts 17, 18. In this manner, a further conservation of the current drain on the batteries can be effected. Note also that the timing means by telephonically disconnecting ding-dong unit 10 (through the closure of switch 56), provides a convenient telephonic signal indicating to the subscriber that full monitoring of the conditions of interest has been completed.

By the use of a transistor in oscillator 71 and of transistors in amplifier 122, the warm-up period required for the telemetering apparatus is reduced substantially to zero. There is consequent conservation of battery current drain and of the time required for transmission of the data signal. The oscillator 71 itself, because of its simplicity of circuit organization, provides a compact, inexpensive and reliable means for obtaining data signals of physical conditions. This reliability of the oscillator, when taken together with the low current drain on the batteries permits a maintenance schedule for the apparatus in which visits need be made no oftener than every six months. Such visits will be primarily for the purpose of replacing the batteries rather than for reconditioning the equipment.

In the event of power failure of the A.C. source 41, occurring before and lasting during a call made to the unattended station, the timing motor 36 will remain unenergized with the result that switch 55 never closes to energize the oscillator 71 from the batteries. Accordingly, the subscriber will hear no audible tone, whatever, and will know from this fact of the power failure of source 41. Thus, the described telemetering apparatus provides for an indication of failure of local power at the unattended station. In the event that the timing means 38 is spring driven or run from the same batteries which energize the oscillator circuit, the same indication of local power failure can be provided by a relay whose contacts are in series with switch 55, the mentioned contacts opening upon the occurrence of a power failure sensed by the relay.

In the event that a power failure occurs in power source 41 during transmission of a data signal, the timing motor 36 stops and the clutch coil 37 becomes deenergized with the consequence that all of switches 51-56 return to open position. The timing means 38 is thereby restored to starting condition, and for the reasons given heretofore, cannot be restarted except by another actuation of the ding-dong unit 10 from attended station 12. Hence, if power from source 41 is resumed during the original call to the ding-dong unit, the timing means will not continue its original timing cycle to give data signals subject to wrong interpretation. On the other hand, when a new call is placed to the ding-dong unit after resumption of power, the timing means will start a new timing cycle, rather than continuing the old timing cycle

to give data signals which are out of order and hence would be misleading.

The above-described embodiment being illustrative only, it will be understood that the present invention comprehends organizations differing in form or detail from the presently described embodiment. For example, in an application which requires the monitoring of only a single physical condition, the timing means may take the form of a simple relaxation oscillator type of time-delay relay which is energized from batteries for the transistor oscillator and amplifier. As before, the time-delay relay places a time limitation on the energization of the transistor circuits. Also, the invention is of application in ways other than with a mass spectrometer. For example, apparatus in accordance with the invention may be used to monitor temperature at a remote spot of a pipeline.

Accordingly, the invention is not to be considered as limited save as is consonant with the scope of the following claims.

We claim:

1. Telemetering apparatus for monitoring at least one physical condition at a remote location comprising, a transistor having base, collector and emitter electrodes, inductance means connected with two of said electrodes said electrodes defining a path for flow therebetween through said transistor of current induced by an electrical energy source, capacitance means connecting said inductance means and said third electrode for A.C. signal feedback to the latter, a variable resistance path connected with said third electrode to provide for return therethrough to said source of a fraction of the current flowing from said source through said first-named path, the aforesaid elements forming an oscillator circuit means to develop oscillatory signals at an audible frequency determined by the resistance of said variable resistance path, sensing means responsive to a change in said monitored condition by reacting thereto to change the resistance in said variable resistance path, said resistance change resulting in a frequency change in said oscillatory signals, means terminating a telephone connection from said remote location and responsive to an incoming telephonic signal received therefrom to render said oscillator circuit energized with current from said source to thereby enable said circuit to develop said audible frequency oscillating signal, and means to apply said audible frequency signal through said terminating means to said connection to thereby produce an answer to said incoming signal in the form of an audible tone developed at said remote location.

2. A telemetering circuit as in claim 1 wherein said sensing means is in the form of temperature sensitive resistor means.

3. Telemetering apparatus for monitoring a plurality of physical conditions at a remote location comprising, a transistor having base, collector and emitter electrodes, inductance means connected with two of said electrodes said electrodes defining a path for flow therebetween through said transistor of current induced by an electrical energy source, capacitance means connecting said inductance means and said third electrode for A.C. signal feedback to the latter, a resistance path connected with said third electrode to provide for return therethrough to said source of a fraction of the current flowing from said source through said first-named path, the aforesaid elements forming an oscillator circuit means to develop oscillatory signals at an audible frequency determined by the amount of resistance in said resistance path, a plurality of variable resistance units for sensing, respectively, said plurality of conditions, each sensing unit being responsive to a change in the associated condition by a reaction thereto in the form of a change in the effective resistance of the unit, said resistance change resulting in a frequency change of said oscillating signals, self-resetting timing means for connecting in turn each of said sensing units into said

resistance path, means terminating a telephone connection from said remote location and responsive to an incoming telephonic signal received therefrom to render said oscillator circuit energized with current from said source to thereby enable said circuit to develop said audible frequency oscillating signal, and means to apply said audible frequency signal through said terminating means to said connection to thereby produce an answer to said incoming signal in the form of an audible tone developed at said remote location.

4. A telemetering circuit as in claim 3 wherein said timing means initiates and discontinues energization of said oscillator circuit from said source at respective times representing the beginning and end of a time interval within which said sensing units are successively connected in said resistance path.

5. Telemetering apparatus for monitoring at least one physical condition at an unattended telephone station and for transmitting data on said condition to an attended telephone station, said apparatus comprising, a transistor oscillator circuit means to provide when energized an audible frequency oscillatory signal to be transmitted to said attended station, said signal having a frequency determined by an impedance characteristic of said circuit means, sensing means responsive to a change in said monitored condition by reacting thereto to change said circuit impedance characteristic, self-resetting single cycle timing means to control energization of said transistor oscillator circuit means so as to limit such energization to a time interval of predetermined duration following initiation of operation of said timing means, means at said unattended station terminating a telephone line extension from said attended station and responsive to a telephone signal incoming therefrom to so initiate operation of said timing means, and means to apply said audible frequency signal through said terminating means to said extension to thereby produce an answer to said incoming signal in the form of an audible tone developed at said attended station.

6. Apparatus as in claim 5 further characterized by transistor amplifier means connected with said oscillator circuit to amplify said oscillatory signals, the energization of said transistor amplifier means being controlled by said timing means to be limited to a time interval of the same duration as the energization interval of said oscillator circuit.

7. Telemetering apparatus for monitoring at least one physical condition at an unattended station telephonically connectible with an attended station, said apparatus comprising, a transistor oscillator circuit means to provide oscillatory signals within the audible frequency range and at a frequency in said range determined by an impedance characteristic of said circuit, sensing means responsive to a change in said monitored condition by reacting thereto to change said circuit impedance characteristic, said last-named change producing an audible change in the frequency of said oscillatory signals, self-resetting single cycle timing means initiated into operation by an incoming signal received by telephone connection at said unattended station from said attended station for controlling the energization of said transistor oscillator circuit so as to limit such energization to a time interval of predetermined duration following said incoming signal, and means providing for transmission of said oscillatory signals from said unattended station over said telephone connection to said attended station.

8. Apparatus as in claim 7 wherein said timing means initiates discontinuance of the telephone connection between said unattended and attended stations after a time interval of predetermined duration following the reception of said incoming signal.

9. Telemetering apparatus for monitoring a plurality of physical conditions at an unattended station telephonically connectible with an attended station, said apparatus comprising, a transistor oscillator circuit means to

provide oscillatory signals within the audible frequency range and at a frequency in said range determined by an impedance characteristic of said circuit, a plurality of variable impedance units for sensing, respectively, said plurality of conditions, each sensing unit being responsive to a change in the associated condition by a reaction thereto in the form of a change in the effective impedance of the unit, self-resetting single cycle timing means initiated into operation by an incoming signal received by a telephone connection at said unattended station from said attended station for connecting in turn the impedance of each of said sensing units into said transistor oscillator circuit, each connection so made producing an audible change in the frequency of said oscillatory signals in response to an impedance change of the connected unit, and means providing for transmission of said oscillatory signals from said unattended station over said telephone connection to said attended station.

10. Apparatus as in claim 9 further characterized by oscillatory circuit control means responsive to a power failure at said unattended station to maintain said oscillator circuit in a condition indicating said power failure.

11. Apparatus as in claim 9 wherein said timing means initiates and discontinues energization of said oscillator circuit from said source at respective times representing the beginning and end of a time interval within which said sensing units are successively connected into said oscillator circuit.

12. Apparatus as in claim 11 further characterized by means rendered operative in response to telephonic disconnection at said attended station prior to the end of said interval to de-energize, forthwith, said transistor oscillator circuit.

13. Telemetering apparatus for monitoring a plurality of physical conditions at an unattended station, said apparatus being adapted for use with an unattended station device telephonically connectible with an attended station and having a transmitting microphone, a telephone circuit opening means, and a start circuit actuated momentarily in response to an incoming signal received by telephone connection from the attended station, said apparatus comprising, a transistor oscillator circuit means to provide oscillatory signals within the audible frequency range and at a frequency in said range determined by a resistance characteristic of the circuit, a plurality of vari-

able resistance units for sensing, respectively, said plurality of conditions, each sensing unit being responsive to a change in the associated condition by a reaction thereto in the form of a change in the effective resistance of the sensing unit, a timing motor adapted to be initially energized by momentary actuation of said start circuit, self-holding means for continuing the energization of said timing motor throughout a timing cycle, first connecting means operated by said timing motor for energizing said transistor oscillator circuit over an interval of said timing cycle, said circuit being otherwise de-energized, a plurality of second connecting means operated successively by said timing motor within said interval to connect in turn the resistance of each of said sensing units into said oscillator circuit, each connection so made producing an audible change in the frequency of said oscillatory signals in response to a change in resistance of the coupled unit, electrosonic transducer means electrically connected with said oscillator circuit and adapted to be sonically coupled with the microphone of said unattended station device for providing transmission of said oscillatory signals through said microphone and said telephone connection to said attended station, and means actuated by said timing motor following operation thereby of the last of said second connection means for initiating operation of the telephone circuit opening means of said unattended station device.

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