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FLIP-FLOP ALARM SYSTEM WITH LAMP TEST CIRCUIT

Filed June 18, 1965

3 Sheets-Sheet 1

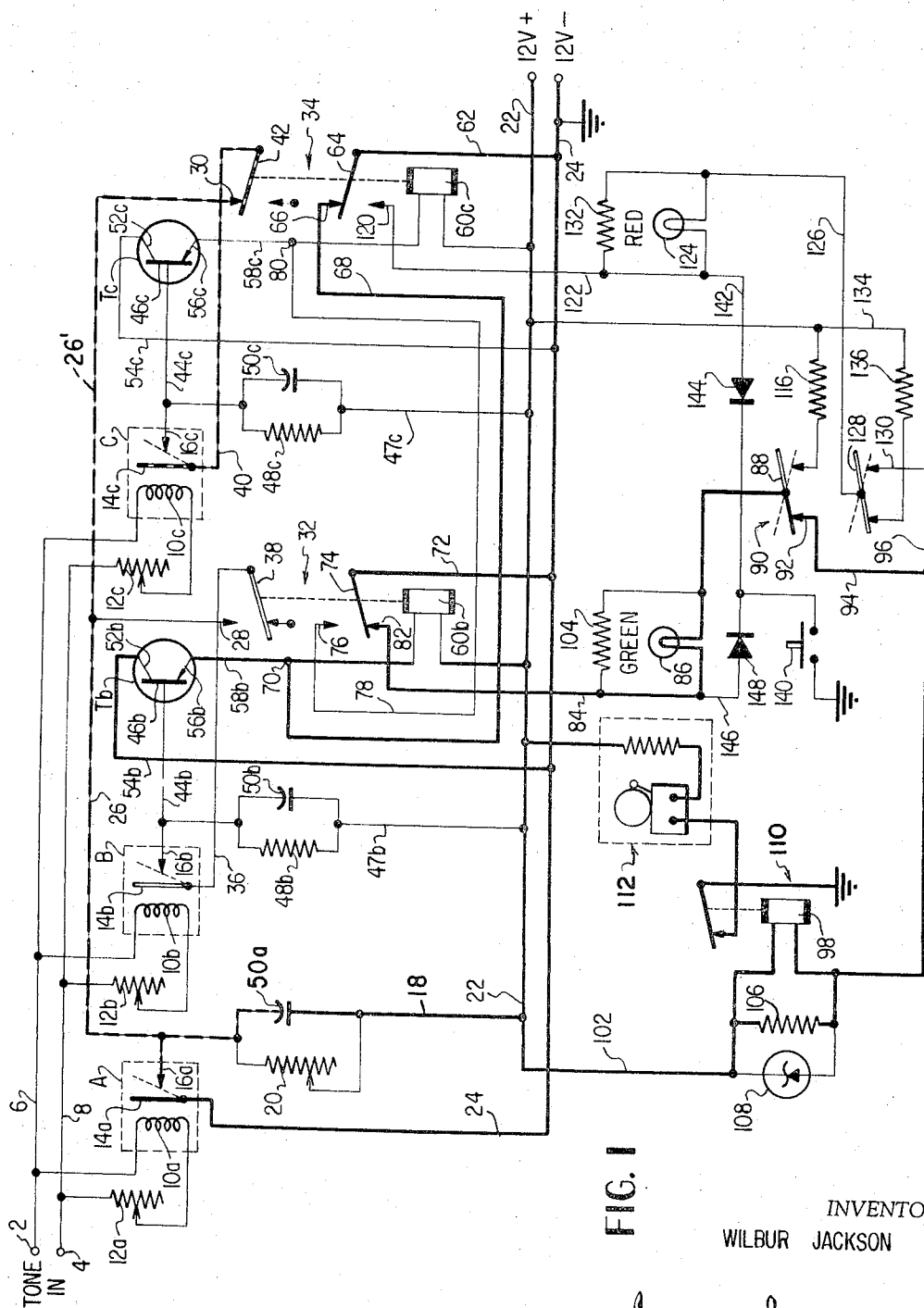


FIG. 1

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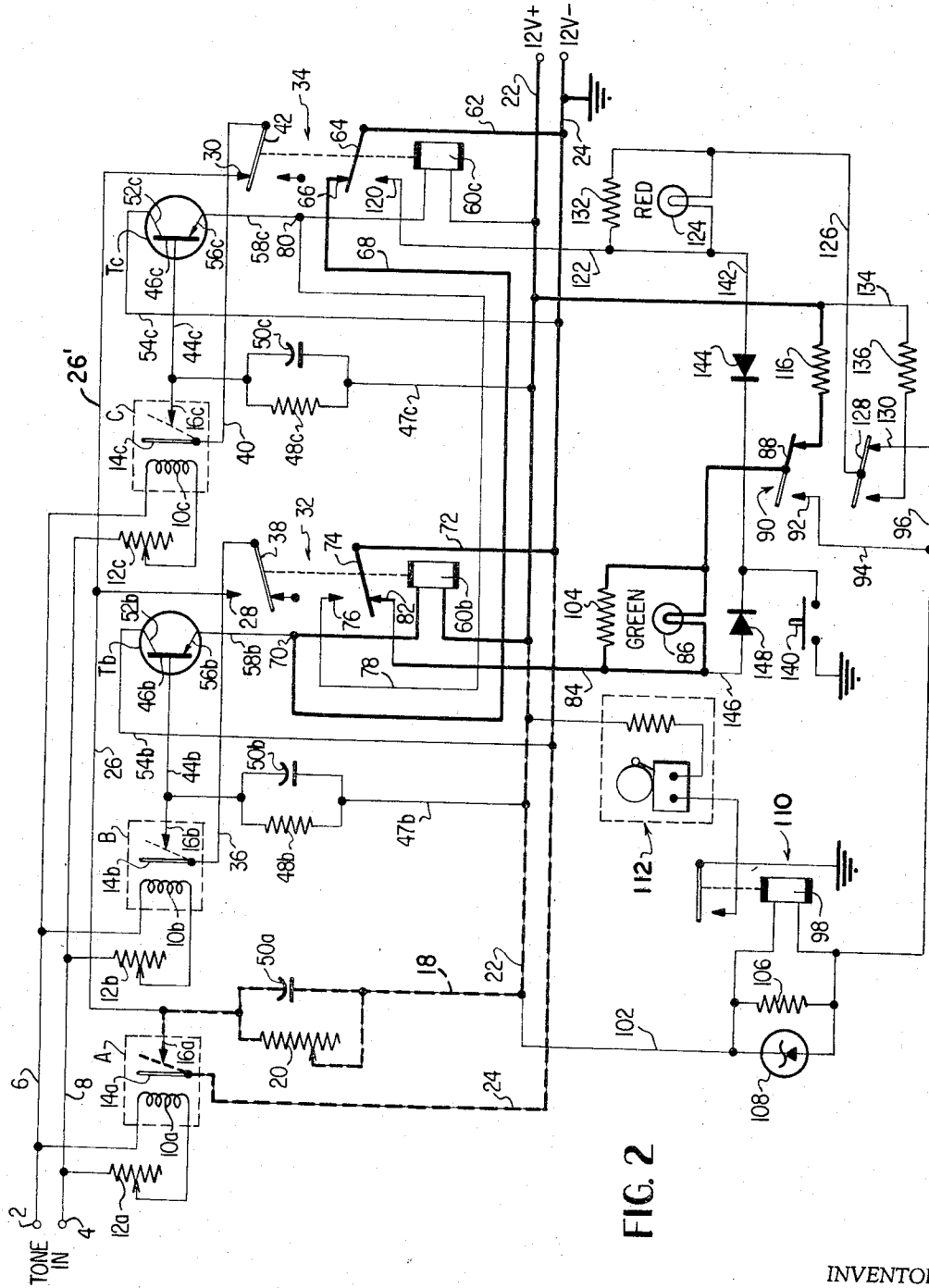


FIG. 2

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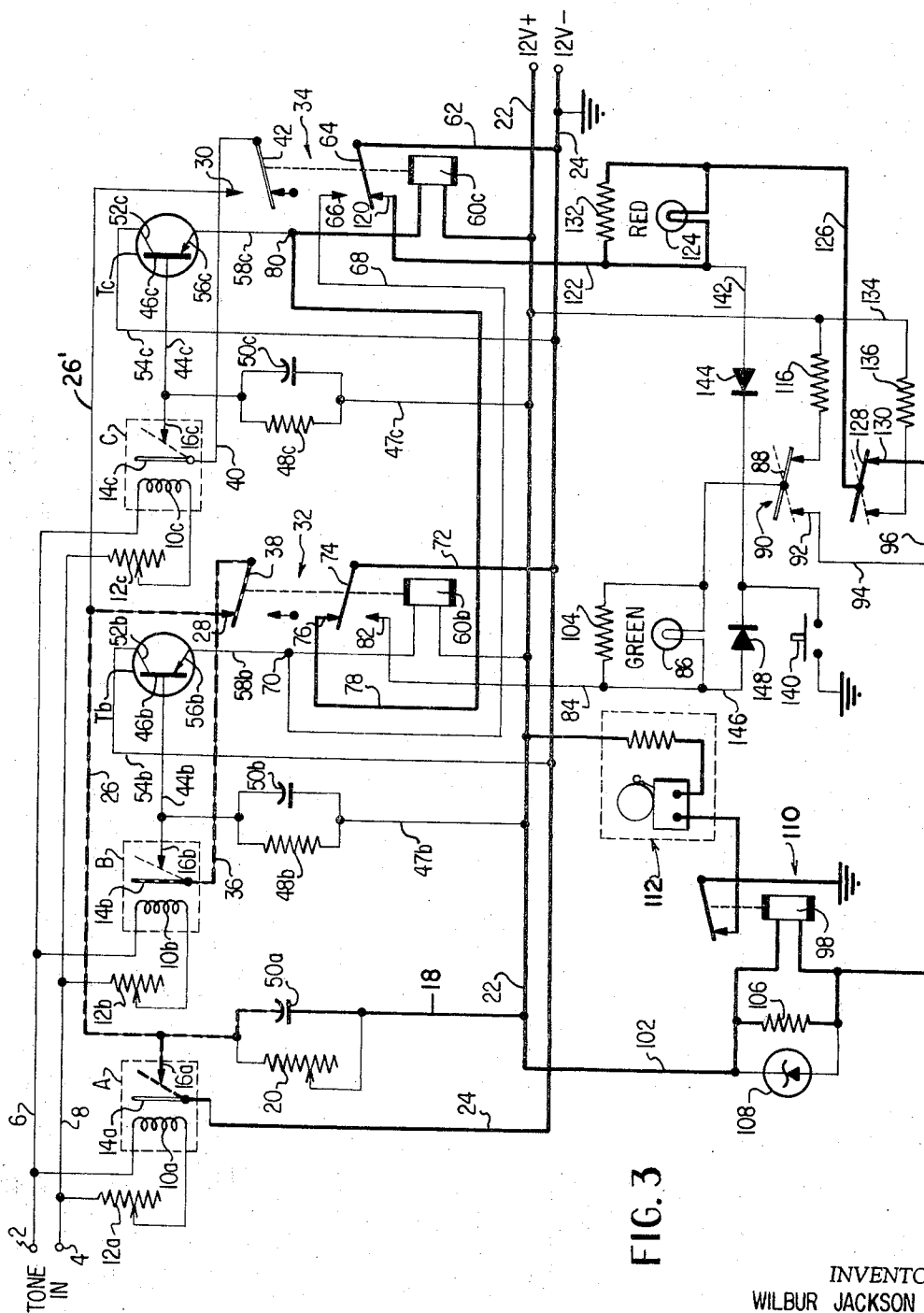


FIG. 3

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FLIP-FLOP ALARM SYSTEM WITH LAMP TEST CIRCUIT

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ABSTRACT OF THE DISCLOSURE

This device is for monitoring conditions at a remote station which transmits an identifying tone signal followed by one of two subsequent tone signals characteristic of conditions to be monitored. A first resonant relay responds to the identifying tone signal, and one or the other of two other resonant relays responds to one or the other of the subsequent tone signals. Ordinarily, one of the subsequent tone signals characterizes a normal condition at the remote station and the other subsequent tone signals characterizes an abnormal condition. An alarm circuit remains unresponsive to relay response to normal condition tone signals, but is actuated by relay response to an abnormal condition tone signal. Once actuated, the alarm circuit requires a forced reset to de-activate it.

This invention relates to an alarm system responsive to encoded signals of predetermined sequence characteristics and, more particularly, to a flip-flop relay and alarm system requiring manual reset in order to shut off the alarm.

The primary object of this invention is to provide an alarm system for monitoring of operating conditions at one of a plurality of remote stations so as to sound an alarm upon deviation of a condition at the remote station from a predetermined norm. By way of example, let it be assumed that the remote station incorporates a power-consuming device, and it is desired to know, at a central station, the "on" and "off" conditions of the remote station's power supply. Let it further be assumed that a multi-tone transmitter at the remote station periodically transmits first an identifying tone, i.e., a "be" of predetermined frequency, and then either a "ba" of lower tone representing a "power on" condition, or a "bo" of still lower tone representing a "power off" condition. The object of this invention is to provide, for use as a central station, an alarm system which will turn on an indicator lamp and sound an audible signal, hereinafter termed a "bell," upon deviation of the received tones from a first tone sequence to a second tone sequence and which, in order for the operator to shut off the bell, requires him to preset and precondition the control circuit so that it becomes responsive only to the second tone sequence.

Another object of the invention is to provide a bell relay and plural signal lamp test circuit by means of which all the signal lamps and the bell relay may be simultaneously tested without appreciable dimming of the lamps. Assuming, for example, that the supply circuit is 12 volts, each signal lamp and an associated resistor thereacross has a total voltage drop of 6 volts, and assuming further that a bell alarm relay winding and an associated resistor thereacross has a total voltage drop of 6 volts, and the lamps are in series parallel with the bell relay. So long as only one lamp is being tested, sufficient current will normally flow through the bell relay winding so that its illumination will be normal. However, if both lamps are to be tested simultaneously with the bell relay, insufficient current would normally flow through the bell relay to provide for pull-in of the bell relay and full illumination of both lamps, and the operator could not judge whether there is any fault and, if so, where. The object now is to provide, in such a

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circuit, a zener diode in parallel with the bell relay, and hence in series with both lamp circuits, the zener diode having a "knee" at about 6 volts. Thus, if only one lamp is tested, the current flowing through the relay winding and its associated resistor is sufficient for pull-in of the relay and illumination of the lamp; and if both lamps are tested simultaneously, the needed additional current will bypass the relay winding via the zener diode, and both lamps and the relay winding will be fully energized.

These and other objects will be apparent from the following specification and drawings, in which:

FIG. 1 is a circuit diagram of the alarm circuit in first condition wherein it will be assumed that a "power on" code tone sequence has just been received and the operator has not yet reversed the reset switch;

FIG. 2 shows the circuit in the same condition as FIG. 1 with the exception that the operator has reversed the reset switch, thereby extinguishing the bell, it being assumed that the "power-on" tone sequence is continuing; and,

FIG. 3 shows the circuit in the condition resultant when a "power-off" tone sequence is received.

Referring now to the drawings, which are similar diagrams heavy-lined to show the same circuit in three typical conditions, it will be assumed that there are fed into a signal input terminals 2 and 4 sequences of tone code signals denoting the condition of a device, presumably at a remote station, to be monitored. If, in this example, the "on-off" condition of a power supply at the remote station is being monitored, the remote transmitter would transmit a tone code signal "be-ba" or "be-bo." The frequency of the "be" would identify the particular device, i.e., the power supply, from which the report originates. The "ba" frequency denotes an "on" condition, and the "bo" denotes an "off" condition.

Signal input terminals 2 and 4 are respectively connected to conductors 6 and 8, across which are respectively connected, in series, the windings and potentiometers 10a and 12a, 10b and 12b, and 19a and 12c of three resonant relays A, B and C. The reed 14 of a resonant relay A is tuned to resonate only in response to the particular "be" tone signal identifying the monitored device, reed 14b of resonant relay B being tuned to resonate only in response to the "ba" tone signal identifying one condition (in this example "on") of the monitored device, and reed 14c of resonant relay C being tuned to resonate only in response to the "bo" tone signal identifying another condition (such as "off") of the monitored device.

The contact 16a of resonant relay A is connected, on the one hand, via conductor 18 and capacitor 50a to the positive bus 22 of a 12 volt power supply circuit, whereas the reed 14a is connected to the negative, or ground, bus 24 of the power supply circuit. Hence, when reed 14a vibrates against contact 16a, capacitor 50a charges. A potentiometer 20 is connected across capacitor 50a in order to bleed off the charge between the "be's" which are periodically received at regular intervals. The negative side of capacitor 50a is also respectively connected via conductors 26, 26' to the contacts 28 and 30 of two four-pole double-throw relays 32 and 34. The reed 14b of resonant relay B is connected by a lead 36 to the arm 38 which sometimes cooperates with contact 28 of relay 32, and the reed 14c of resonant relay C is connected via lead 40 to arm 42 which sometimes cooperates with contact 30 or relay 34.

A lead 44b connects the base 46b of a transistor Tb to the contact 16b of resonant relay, and a circuit 47b which includes resistor 48b connects base 46b to ground, normally biasing the transistor to cut-off. A similar circuit 47c including resistor 48b also normally biases transistor

Tc to cut-off. However, connected across resistors 48b and 48c are capacitors 50b and 50c, respectively, which when charged, bias the bases of their associated transistors to cause emitter-collector conduction. The collectors of transistors Tb and Tc are respectively connected via leads 54b and 54c to negative bus 24, and their emitters 56b and 56c are connected via lead 58b and winding 60b of relay 32 or lead 58c and winding 60c of relay 34 to positive bus 22. Thus, if transistor Tb conducts, relay 32 pulls in as shown in FIG. 1, and if Tc conducts, then relay 34 pulls in as shown in FIG. 3.

A holding circuit for relay 32 is established in the "out" condition of relay 34 (FIGS. 1 and 2) from ground bus 24 via lead 62 arm 64 and contact 66 of relay 34, via conductor 68 to connection 70 to lead 58b and thence via winding 60b of relay 32 back to the positive bus 22. Likewise, a holding circuit for relay 34 is established in the "out" condition of relay 32 (FIG. 3) from ground bus 24 by lead 72, arm 74 and contact 76 of relay 32, conductor 78 and connection 80 to lead 58c and thence via winding 60c of relay 34 back to positive bus 22. Obviously, only one relay can be held on at any given time.

Referring to the circuit in the FIG. 3 condition, let it be assumed that there has previously been a "power off" signal which has created the FIG. 3 condition, the reversing switch 90 detailed below has been moved by the operator to the FIG. 1 condition, and then a "be-ba" (power on) signal has been received. The "be" tone signal causes reed 14a of resonant relay A to vibrate, thereby engaging contact 16a so as to periodically connect the negative side of capacitor 50a to ground bus 24 and charge capacitor 50a upon receipt of the "ba" tone, reed 14b of resonant relay 14b vibrates against contact 16b of resonant relay B, thereby placing the negative bias of capacitor 50 on base 46 of transistor Tb and also charging up capacitor 50b. Transistor Tb is biased "on", and the "on" biasing charge on capacitor 50b remains long enough for relay 32 to pull in. Relay 34 then being "out," the holding circuit for relay 32 is established.

An indicator lamp and alarm circuit denoting the receipt of the exemplified "power on" tone sequence is established (FIG. 1) from ground bus 24, lead 72, arm 74 and contact 82 of relay 32 and thence via conductor 84, 6 volt signal lamp 86 arm 88 of reversing switch arm 90, contact 92 branch 94 and conductor 96 through the winding 98 of a bell relay 100, and thence via lead 102 back to positive bus 22. 10K resistors 104 and 106 are connected across lamp 86 and relay winding 106. Also paralleling relay winding 98 and resistor 106 is a zener diode 108 having a knee at about 6 volts, for purposes described hereinafter. Thus, when the "be-ba" signal actuates the circuit to the FIG. 1 condition, indicator lamp 86 goes "on", the circuit 110 for bell 112 is closed, and the operator must flip reversing switch 90 to its FIG. 2 condition in order to silence bell 100. However, in so doing, an energizing circuit for lamp 86 is maintained via arm 88 of reversing switch 90, contact 114, resistor 116 and lead 118 back to positive bus 22.

FIG. 2 illustrates the condition in the circuit after the operator has silenced bell 112. Lamp 86 stays "on" so long as a "be-ba" tone signal sequence, or no signal at all, prevails. However, upon receipt of a "be-bo" tone signal sequence, reed 14a of resonant relay A resonates with the "be" tone signal, capacitor 50a charges, reed 14c of resonant relay C resonates with the "bo" tone signal, thereby charging capacitor 50c and imposing the negative bias on base 46c of transistor Tb. When transistor Tb goes "on", relay 34 pulls in, thereby breaking the holding circuit for relay 32 and the latter then establishes the holding circuit for relay 34 and breaks the energizing circuit for signal lamp 86.

When relay 34 pulls in a signal lamp and bell relay energizing circuit is established from ground bus 24 through lead 62, arm 64, contact 120, conductor 122, lamp 124, lead 126, arm 128 and contact 13 of reversing

switch 90, conductor 94 and back to positive bus 22 via bell relay winding 98 and its parallel resistor 106 and conductor 102. Bell 112 must be silenced by flipping reversing switch back to its FIG. 1 position, whereupon an alternate energizing circuit for lamp 124 is maintained via arm 128 and contact 138 of reversing switch 90 and back to positive bus 22 via resistor 136 and leads 134, 118. Lamp 132, which also is rated at 6 volts, also has a 10K resistor across it to maintain circuit continuity in event its filament burns out.

Reverting now to the FIG. 2 condition, let it be assumed that the operator desires to test both lamps 86 and 124 and bell relay 100 simultaneously. Lamp 86 is already energized via the held arm 74 and contact 82 of relay 32. By closing test switch 140, an additional energizing circuit for both bell relay 100 and lamp 124 is established from positive bus 22 via conductor 102, bell relay winding 98 and its parallel resistor 106, conductor 96, contact 130 and arm 128 of reversing switch 90, lead 126, through lamp 124 and its parallel resistor 132 and thence via conductor 142 and rectifier 144 through switch 140 to ground. If the conditions of relays 32, 34 are reversing switch 90 were reversed and from the FIG. 2 condition lamp 124 were on, the test circuit for lamp 86 would run from branch 94 through contact 94 and arm 88 of reversing switch 90, through lamp 86 and its parallel resistor 104 and thence through conductor 146, rectifier 148 and test switch 140 to ground. Assuming a voltage drop of approximately 6 volts across both lamps and their associated resistors, which would then be in series with bell relay winding 98 and its resistor 106, insufficient current would normally blow through winding 98 and resistor for full illumination of both lamps and for pull-in of relay 100, and the voltage drop across relay winding 98 and its resistor would normally rise to about 9 volts. However, when the voltage drop across winding 98 and resistor 106 exceeds 6 volts, then zener diode 108 conducts and establishes a partial shunt around winding 98 and resistor 106, thereby supplying ample current at full 6 volts to lamps 86 and 124.

The invention is not limited to the details of the circuit disclosed and described hereinbefore, but is intended to cover all substitutions, modifications and equivalents within the scope of the following claims.

I claim:

1. A multi-tone decoding and signalling device comprising, a tone signal input circuit, first, second and third resonant relays each having a control winding connected across said tone signal input circuit and each having power input and output connections and each resonant relay being responsive only to first, second and third tone signals of respectively different frequencies, a power supply circuit including two conductors of opposite polarity, a first capacitor and charging circuit therefor connected to said power supply circuit and the power output connection of the first resonant relay for charging said first capacitor upon energization of the control winding of the first resonant relay by a first tone signal, first and second switching transistors each having control elements respectively connected to the power output connections of said second and third resonant relays, first and second relay means including control windings respectively associated with said first and second transistors and having certain contact and armature pairs which are normally closed when their windings are de-energized and certain other contact pairs which are closed when their windings are energized, a pair of power circuits across said power input conductors and running respectively through controlled elements of said first and second transistors and the control windings of the first and second relay means respectively associated therewith, said first and second relay means each including a first normally open contact and armature pair for establishing a transistor on-switching circuit from said first capacitor to the power input connections of said second and third resonant relays respectively when

said first and second relay windings are de-energized and for breaking said transistor on-switching circuit when said relay windings are energized, means for normally biasing the control elements of said transistors to off switched states, a holding circuit for each relay means winding established through a normally closed contact and armature pair of the other relay means and each being opened upon energization of the other relay means winding, whereby the holding circuits of said relay means operate in flip-flop mode, first and second electrically energizable signal devices, and first and second energizing circuits respectively for the first and second signal devices running from one power conductor through normally open contact and armature pairs on the first and second relay means to the other power conductor.

2. The combination claimed in claim 1, the means for normally biasing the control elements of said transistor to off switched states each including a circuit running from one of said power conductors to the control element of the respective transistor to which the output connection of a resonant relay is connected, a series resistor, in each of the last-named circuits, and a capacitor connected across the resistor.

3. A multi-tone decoding and signalling device comprising, a tone signal input circuit, first, second and third resonant relays each having a control winding connected across said tone signal input circuit and each having power input and output connections and each resonant relay being responsive only to first, second and third tone signals of respectively different frequencies, a power supply circuit including two conductors of opposite polarity, a first capacitor and charging circuit therefor connected to said power supply circuit and the power output connection of the first resonant relay for charging said first capacitor upon energization of the control winding of the first resonant relay by a first tone signal, first and second switching transistors each having control elements respectively connected to the power output connections of said second and third resonant relays, first and second relay means including control windings respectively associated with said first and second transistors and having certain contact and armature pairs which are normally closed when their windings are de-energized and certain other contact pairs which are closed when their windings are energized, a pair of power circuits across said power input conductors and running respectively through controlled elements of said first and second transistors and the control windings of the first and second relay means respectively associated therewith, said first and second relay means each including a first normally open contact and armature pair for establishing a transistor on-switching circuit from said first capacitor to the power input connections of said second and third resonant relays respectively when said first and second relay windings are de-energized and for breaking said transistor on-switching circuit when said relay windings are energized, means for normally biasing the control elements of said transistors to off switched states, a holding circuit for each relay means winding established through a normally closed contact and arma-

ture pair of the other relay means and each being opened upon energization of the other relay means winding, whereby the holding circuits of said relay means operate in flip-flop mode, first and second electrically energizable visual indicator devices, an electrically energizable audible alarm device, ganged first and second reversing switches each having an armature and first and second contacts against which said armatures are simultaneously alternately closable, an energizing circuit for said audible alarm device running from one power conductor to the first contact of the first reversing switch and the second contact of the second reversing switch, an energizing circuit for first visual indicator device running from the other power conductor through a normally open armature and contact pair of the first relay means to the armature of the first reversing switch, and an energizing circuit for the second visual indicator device running from said other power conductor through a normally open contact and armature pair of the second relay means to the armature of the second reversing switch, whereby an operator, in order to break a series connection between the energizing circuit for the audible alarm device and the energizing circuit for one visual indicator device must establish a series connection between the energizing circuit for the audible alarm device and the energizing circuit for the other visual indicator device.

4. The combination claimed in claim 3, and alternate return circuits for said first and second visual indicator devices running from the second contact of the first reversing switch and from the first contact of the second reversing switch to said other conductor of the power supply, whereby one or the other of said visual indicator devices remains energized regardless of whether the energizing circuit for the audible alarm is closed.

5. The combination claimed in claim 3, said audible alarm and visual indicator energizing circuits all including power consuming devices, means including said reversing switches for placing said visual indicator energizing circuits in parallel with one another and in series with the energizing circuit of said audible alarm device, said power supply circuit being for direct current of fixed voltage and a zener diode connected across the power-consuming device in the energizing circuit of the audible alarm device, whereby to bypass current to the power consuming device in the visual indicator device circuits when the voltage drop across the power consuming device in the audible alarm circuit exceeds a predetermined level.

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