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[56]

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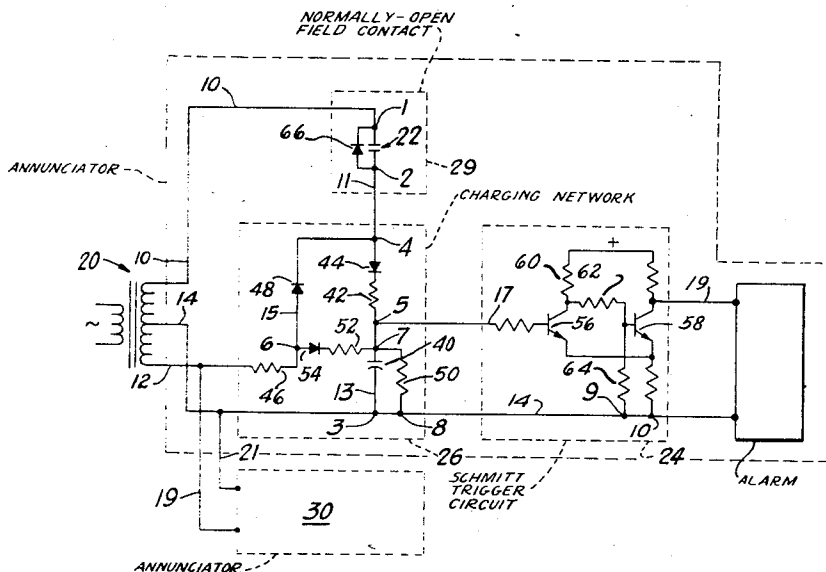
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[54] **SELF-MONITORING FIELD-CONTACTS FOR
 AUTOMATIC ALARM SYSTEMS**
 4 Claims, 2 Drawing Figs.

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 320/1
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 213.1

ABSTRACT: A self-monitoring field-contact circuit for providing an alarm in automatic alarm or annunciator systems should the wires to the field-contacts become broken or shorted. A unipolarity operated switching circuit between the field-contact to be monitored and an alarm indicator unit is triggered by a capacitor charging circuit in response to either (a) the closing of a normally open field-contact because of a malfunction of the monitored equipment, or (b) the breakage (opening) or shorting out of the field-contact wires.



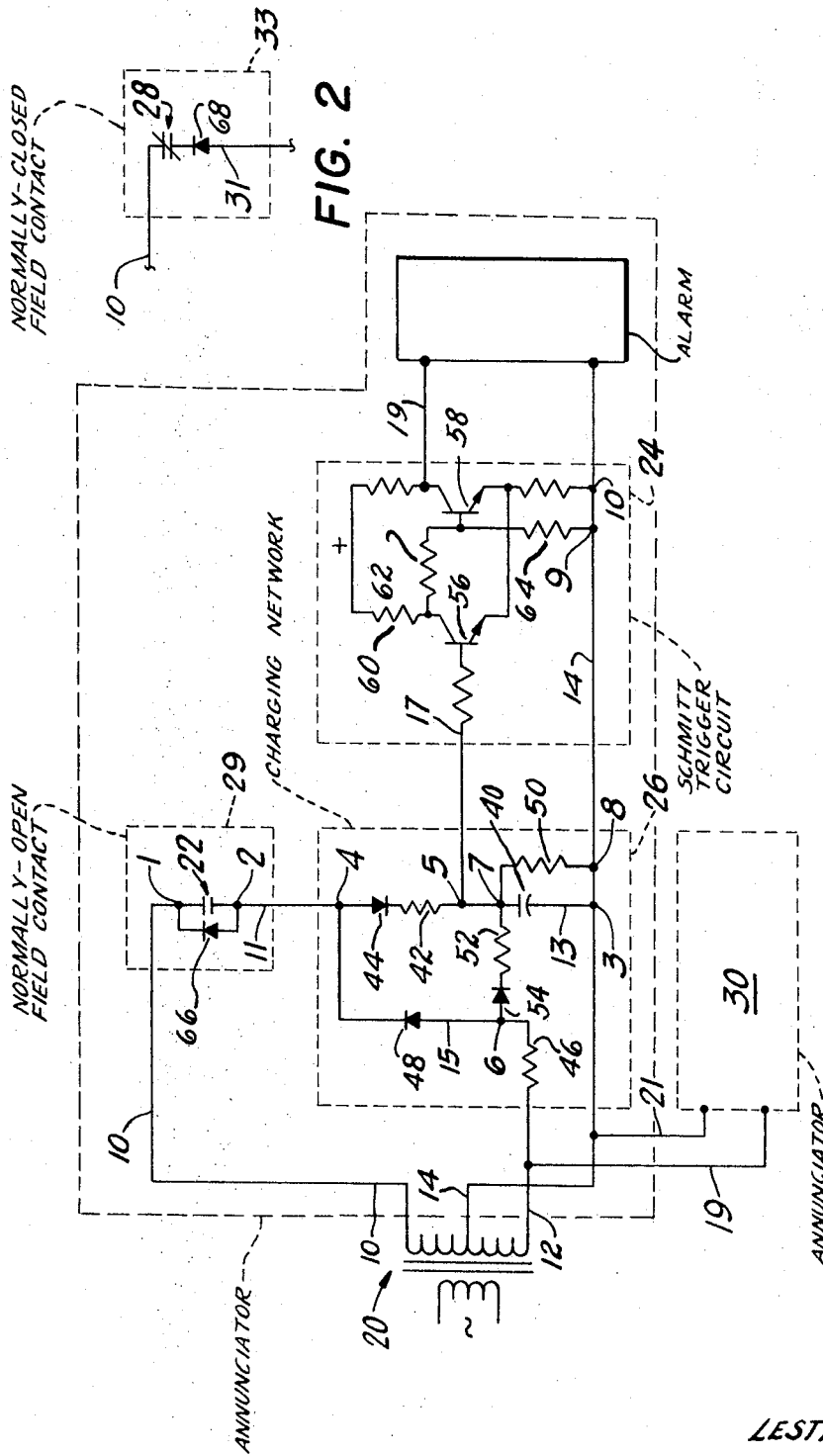


FIG. 1

FIG. 2

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SELF-MONITORING FIELD-CONTACTS FOR AUTOMATIC ALARM SYSTEMS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to electrical communications and more particularly to alarms or annunciators automatically responsive to a condition.

2. Description of the Prior Art

Automatically responsive alarm or annunciator systems are used to provide a visual and/or audible indication of a malfunction in equipment being monitored. These systems can also be used to provide automatic shutdown of the monitored equipment if desired. An example of such an annunciator system is shown and described in copending application Ser. No. 430,577 entitled "Improved Annunciator System" filed Feb. 5, 1965 by Merle E. Martin now U.S. Pat. No. 3,480,938.

These annunciator systems work well to monitor equipment so long as the annunciator system itself is in good working order. A problem associated with such systems is that the wires from the field-contacts to the alarm point sometimes become broken or shorted out. In this event, even though the field-contact may be closed (or opened, as the case may be) by a malfunction, no alarm will be indicated. The monitored equipment can be extensively damaged before the malfunction is detected by the annunciator.

Accordingly, an object of this invention is to provide an alarm in the event that the field-contact wires become broken or shorted.

SUMMARY OF THE INVENTION

These and other objects and novel features are accomplished by providing a capacitor charging circuit for triggering a conventional unipolarity current operated switching circuit, of which the latter circuit provides a signal to operate a visual and/or audible alarm. The capacitor charging circuit is charged by either (a) operation of field-contacts resulting from a malfunction or (b) the breakage or shorting out of the field-contact wires. The charging circuit includes a capacitor for triggering the switching circuit at the voltage level required for its operation. The charging circuit also includes a diode in parallel with a normally open field-contact (or in series with a normally closed field-contact) to block the polarity of current which would trigger the switching circuit but pass current of opposite polarity. Other diodes and resistors are used to direct only positive-polarity current (assuming the switching circuit is triggered by positive polarity voltage) to the capacitor in the event of wire breakage or shorting.

The above and further objects and novel features of the invention will appear more fully from the following detailed description when the same is read in connection with the accompanying drawing. It is to be expressly understood, however, that the drawing is not intended as a definition of the invention but is for the purpose of illustration only.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing wherein like parts are marked alike:

FIG. 1 is a schematic diagram illustrating an embodiment of the present invention in connection with an annunciator circuit wherein a normally open field-contact arrangement is used; and

FIG. 2 is a schematic diagram illustrating a circuit for adapting the invention illustrated in FIG. 1 for use with a normally closed field-contact arrangement.

DESCRIPTION OF THE PREFERRED CONSTRUCTION

Referring now to FIG. 1 of the drawings, a conventional alternating current powered transformer 20 supplies AC current through line 10 to point 1 of field-contact 22. AC current is supplied from line 12 through a charging network 26 to input point 5 of a conventional switching circuit 24 (shown within

the dotted lines). Switching circuit 24 is illustrated herein as being a Schmitt trigger although it can be an SCR (silicon controlled rectifier) or any other type of switch operable at a selected voltage level of one polarity (positive herein).

Switching circuit 24 is connected at points 9 and 10 to power return line 14 which is center-tapped into the secondary of transformer 20 in a conventional manner.

The charging network 26 (shown within the dotted lines) includes a capacitor 40 connected, through resistor 42 and diode 44, by line 11 to point 2 of field-contact 22 and connected by line 13 to point 3 of power return line 14. Line 12 is connected to point 4 of line 11 and includes resistor 46 in series with a diode 48.

A voltage divider network for charging capacitor 40, when the capacitor is charged along the line 11 voltage path, is provided by resistor 42 and a resistor R4 in parallel with capacitor 40.

Another voltage divider network for charging capacitor 40, when the capacitor is charged along the line 15 voltage path, is provided by resistor 52 in series with the capacitor 40 and resistor 50 in parallel with the capacitor. Diode 54 and resistor 52 are not essential for effective operation of the circuit but they do provide closer control of the charging rate of capacitor 40 by forming a parallel path with diode 48, diode 44 and resistor 42.

Connected between point 5 and power return line 14 is a conventional Schmitt trigger circuit which provides a signal to power return line 14 when it is triggered by capacitor 40 when the capacitor reaches the operating voltage level of the trigger circuit. Briefly, the Schmitt trigger 24 is a regenerative bistable circuit whose state depends on the amplitude of the input voltage. Assuming that transistor 56 is nonconducting, the base of transistor 58 is biased by the voltage divider consisting of resistors 60, 62, and 64. The emitters of transistors 56 and 58 are of equal voltage due to the forward bias voltage required by transistor 58. When the input voltage reaches the operating level, transistor 56 begins to conduct and regeneratively turns off transistor 58. Transistor Q2 will again conduct when the input voltage is lowered. The input voltage is supplied by the charging of capacitor 40 when either contacts 22 close in response to a malfunction or if the power lines to the field-contact 22 become broken or shorted.

Also connected between power supply line 12 and power return line 14 by way of lines 19 and 21 is an annunciator alarm circuit 30. Preferably the annunciator is of the type described in copending application Ser. No. 430,577; however, any of the conventional annunciator alarm systems which cause a light to glow, a horn to sound, a bell to ring or any other conventional alarm indication can, of course, be used.

OPERATION

In the normal operation of a known annunciator, the annunciator is connected between the power and return lines as, for example, annunciator 30 is connected by lines 19 and 21 across power lines 12 and 14. Upon a malfunctioning of the equipment being monitored, normally open contacts 22 will close, and annunciator 30 will be activated to indicate that malfunctioning has occurred. So long as the lines to the field-contacts are in proper working order, annunciator 30 monitors the operation of the equipment being monitored. However, should the lines to the field-contacts become broken or shorted due to vibration, accident, and the like, the equipment monitored by contacts 22 and annunciator 30 may malfunction and yet annunciator 30 would not indicate the malfunction. This could result in extensive damage to the monitored equipment.

The possibility of the annunciator not indicating a malfunction of the system is remedied in accordance with this invention. Referring back to FIG. 1, alternating current is supplied to normally open field-contact 22 from transformer 20. Diode 66 blocks the polarity of current which would trigger

switching circuit 24 through charging circuit 26, but will pass the opposite polarity. When the field contact 22 closes, as from a malfunction, capacitor 40 will be charged through diode 44 and resistor 42 when the cycle of alternating current in line 10 is positive with respect to line 14. When capacitor 40 charges to the trigger voltage level of switching circuit 24, the latter will activate the alarm 30. When the cycle of alternating current in line 12 is positive with respect to line 14, positive voltage is applied to resistor 46. Line 10 is then negative with respect to both line 12 and line 14. Current will flow from line 12 through resistor 46, diode 48, and diode 66 to line 10. The current flow will hold line 15 negative with respect to line 14. This will produce no switching action in switch 24, but if line 10 or line 11 should be broken (opened), the current flow from line 12 to line 10 would cease and line 15 would then become positive with respect to line 14 when line 12 is positive with respect to line 14. Capacitor 40 will then charge to the trigger voltage level through diode 54 and resistor 50 and through diode 44 and resistor 42, thereby triggering switching circuit 24 for activating alarm 30. If line 10 and line 11 should short together, capacitor 40 will charge to trigger voltage level through diode 44 and resistor 42 since diode 48 blocks current from flowing through diode 54 and resistor 50.

During normal operation, when there are no fault signals generated by closing of contacts 22 or opening or shorting of the power supply lines to contacts 22, then capacitor 40 will discharge through resistor 50 before the operating level of switch 24 is reached.

The invention will work equally well with normally closed field-contacts. In the embodiment illustrated in FIG. 2, diode 68 (corresponding to diode 66 of FIG. 1) is placed in series with a normally closed field-contact 28 connected to line 10 between the field-contact and line 31. Line 31 corresponds to line 11 of the previously described charging circuit.

In operation, diode 68 will block current through field-contact 28 when line 10 is positive with respect to line 12 and line 14, but current will flow when line 10 is negative with respect to line 12 thereby holding line 15 negative with respect to line 14. When the field-contact 28 opens, as from a malfunction, capacitor 40 will charge to a positive voltage through diode 54 and resistor R3. When capacitor 40 reaches the trigger voltage of switching circuit 24, the latter will activate the alarm 30. Should line 10 and line 31 short together, capacitor 40 will charge, when line 10 is positive, through diode 44 and resistor R1 and subsequently trigger switching circuit 24.

SUMMARY

The foregoing describes a switching circuit that triggers on a positive current. For negative operation, the diodes would be installed in the reverse direction. In each case the principle of operation would remain the same.

Thus, it can be seen that the charging circuit can be used to monitor either normally open or normally closed field-contacts. It will trigger any switching circuit triggered by unipolarity voltage, whether positive or negative. In the event of a break or short in the wires leading to or from the field-

contacts, the switching circuit will activate the annunciator alarm. Accordingly, the circuit provides an advantageous safety feature to prevent damage to monitored equipment due to defective wiring to the field-contacts.

Having thus described the invention in its best embodiment and mode of operation, that which is desired to be claimed by Letters Patent is:

I claim:

1. A field-contact circuit for providing an alarm indication of a malfunction in an annunciator system, comprising:
 - a first current path connecting a first current source through a field-contact and a charging network means to an alarm means in said annunciator system;
 - a second current path connecting a second current source through said charging network means to said alarm means;
 - said charging network means connected to said first and second current paths and being selectively responsive to:
 - said field-contact operating in response to a fault in equipment monitored by said annunciator system, and to a defect in said first current path,
 - said charging network means including a capacitance chargeable to an operating voltage level from current in said first current path during operation of said field-contact and chargeable from current in said second current path in response to a defect in said first current path;
 - a trigger circuit means connected between said field-contact and said alarm means operative in response to said operating voltage level of said capacitance for operating said alarm means;
 - first current-blocking means connected in parallel with said field-contact for blocking current of one polarity tending to flow through said first current path and for passing current of the opposite polarity through said first current path;
 - second current-blocking means connected in said second current path for blocking current of one polarity tending to flow through said second current path and for passing current of the opposite polarity through said second current path; and
 - a first resistance in said first current path and a second resistance in said second current path forming a voltage divider with a third resistance connected in both said first and second current paths across said capacitance for charging said capacitance to said operating voltage level, whereby operation of said field-contact charges said capacitance to said operating voltage level for operating said trigger circuit means.
2. The charging circuit of claim 1 wherein said trigger circuit means is a Schmitt trigger.
3. The charging circuit of claim 1 wherein said field-contact is normally open.
4. The charging circuit of claim 1 wherein said field-contact is normally closed and said first current-blocking means is in series with said normally closed field-contact in said first current path.