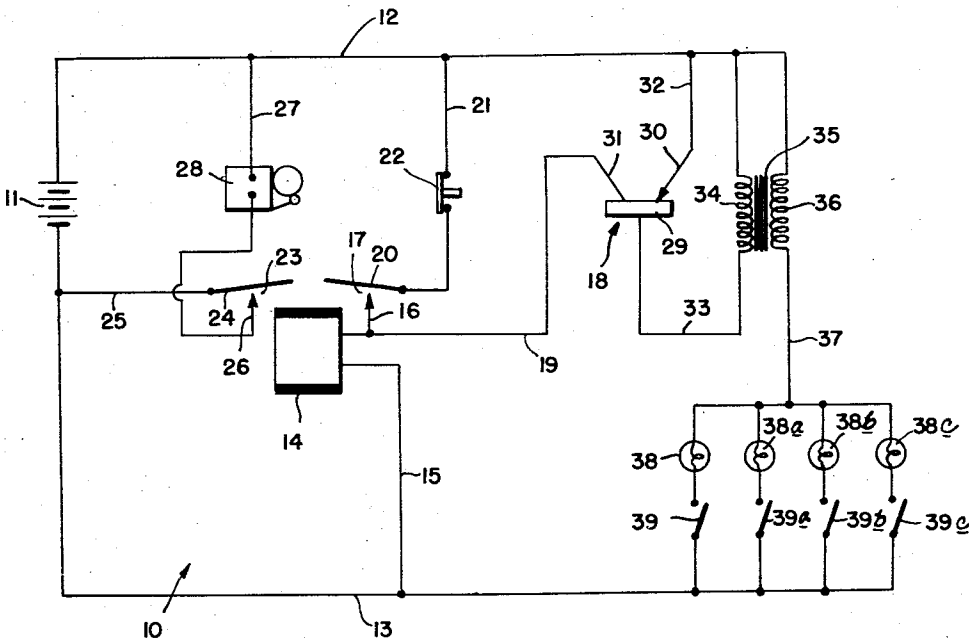


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FAULT ANNUNCIATOR
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FAULT ANNUNCIATOR

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2 Claims. (Cl. 340-213)

This invention relates to an annunciator system, and more particularly to a fault annunciator that provides one or more indications of the occurrence of an abnormal condition at any or all of a plurality of stations.

There are many instances where it is desirable to alert personnel of a change from a normal to an abnormal operating condition of machinery, other equipment, control systems, etc. This is particularly true where automatic equipment is used, for one of the advantages of automation is that of minimizing personnel. Since automatic equipment functions for the most part without attention, a minimum number of workmen can take care of many machines. This creates a special problem, however, for the absence of personnel in constant attendance to each piece of equipment requires that some means be employed to make known the occurrence of malfunctioning or other abnormal conditions.

As a consequence, annunciator or alarm systems have been developed for use with automatic equipment, and such systems are operative to provide visual and audible indications whenever abnormal conditions are present in the equipment. Known annunciator systems have been, for the most part, custom-made to accommodate particular conditions in given installations and have been complex and quite expensive. There exists then a need for a fault annunciator system that is simple in design and relatively inexpensive, and that can be made to accommodate a large variety of different equipment installations. It is, accordingly, a general object of this invention to provide a new and improved annunciator system which is simple to construct and install, which requires a minimum of maintenance, which comprises components that are economical and of small size, and in which the amount of necessary wiring is minimized.

Another object of the invention is that of providing an annunciator system which employs a minimum of moving parts, and in which the remote components of the system need not be sealed or otherwise protected against the effects of dust, contamination, corrosive atmospheres, etc.

Still another object of the invention is that of providing an annunciator system in which there are no relays nor other components, with the exception of a fault switch, at the detecting stations.

A further object of the present invention is to provide an improved annunciator system in which a single silenceable indication device is operative in response to the occurrence of an abnormal condition at any one of a number of detecting stations and which, subsequent to providing an indication of such abnormality at any one station, may be placed in readiness to indicate an abnormality at another station even though the first faulty condition still persists.

Yet a further object is to provide a fault annunciator that employs a D.C. current pulse to supply a threshold current of greater magnitude for energizing a utilization device which controls an audible signal.

Additional objects and advantages of the invention will become apparent as the specification develops.

In accordance with the present invention, a unidirectional current conductive switch in the form of a transistor is made operative in response to the closing of a

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trouble or fault sensing switch which may be located at a detecting station, and in turn provides a current flow sufficient to energize a utilization device which may comprise a relay and controls the initiation of an audible signal. The transistor is made operative by the D.C. current pulse that appears when the trouble sensing switch is closed, and amplifies such pulse to a threshold value sufficient to energize the relay. Termination of the D.C. pulse will not again energize the relay because of the unidirectional current flow characteristics of the transistor.

An illustrative embodiment of the invention is shown in the accompanying drawing, in which the single figure thereof is a schematic circuit diagram of an annunciator system incorporating the present invention.

The fault annunciator, which is designated in its entirety with the numeral 10, operates on a direct current power source which is exemplified in the drawing by a battery denoted with the numeral 11. For convenience, the positive and negative lines leading from the power source 11 are designated, respectively, with the numerals 12 and 13. Preferably, the power source 11 has an output of from 18 to 24 volts, but it will be apparent that the value may be varied in accordance with the requirements of the circuit components selected for use therewith.

Connected across the source 11 is a utilization device such as a relay 14, one side of the energizing coil thereof being connected to the negative line 13 through a lead 15. The opposite side of the energizing coil is connected directly to the fixed contact 16 of the relay switch 17, and also to a transistor or unidirectional impedance device 18 through lead 19. The switch 17 defines a self-holding circuit for the relay 14, and the movable blade or contact 20 thereof is connected to the positive line 12 through lead 21 which has a normally closed acknowledgment switch 22 interposed therein. It will be apparent that the relay 14 when once energized to close the switch 17 thereof, remains energized until the acknowledgment switch 22 is opened—assuming that at the time the switch 22 is opened, the circuit through lead 19 is interrupted. The switch 22 will be located at a convenient position, and ordinarily will be manually operable.

A second relay switch 23 is also provided, and the normally open movable contact 24 thereof is connected through lead 25 to the negative side of the power source 11. The fixed contact 26 of relay switch 23 is connected to the positive side of the power source through a lead 27 which has a signal device 28 interposed therein. The device 28 provides an audible signal alarm and may be a bell, as shown. When the relay 14 is energized, the switch 23 thereof will be closed and the audible signal device 28 actuated, and this actuated state of the signal device will be maintained for as long as the relay is energized.

The transistor 18 has a base 29, an emitter 30 and collector 31, and defines a uni-directional current conductive switch. The collector 31 is connected to lead 19 and is, consequently, in series with the energizing coil of the relay 14. The emitter 30 is connected directly to the positive side of the power source 11 through lead 32, and it is apparent then that the transistor is in shunt connection with the self-holding circuit of the relay. The base 29 of the transistor is connected through lead 33 to one side of the secondary winding 34 of a transformer 35. The other side of the winding 34 is connected to the positive side of the power source 11. The primary winding 36 of the transformer has one side thereof connected to the positive terminal of the power source, and the

other side thereof connected through lead 37 to one side of a plurality of signal devices 38, 38a, 38b and 38c arranged in parallel with each other. The signal devices 38 are intended to provide visual indications and may be in the form of lights, as shown.

Connected in series with the respective lights are fault sensing switches 39, 39a, 39b and 39c, and each of these switches is in turn connected to the negative side of the power source 11 through line 13. The fault sensing switches may be of any suitable type, such as pressure switches, level controls, temperature controls, etc.; and are responsive to a change in condition at a detecting station. Ordinarily, these switches are normally open, and will be closed in response to the occurrence of an abnormal operating condition in a policed machine as the same is reflected at the detecting station. It will be appreciated that each of the sensing switches defines a separate detection circuit; and thus, in the illustration, four separate detection circuits are shown. A lesser or greater number of detection arrangements may be employed, depending upon the particular requirements of any given installation.

Normally, the circuit will be in the condition shown in the drawing, and such condition will be maintained until a fault or change from normal occurs in a piece of equipment or system, etc. policed by the circuit. In this normal condition, no current is flowing through the primary winding 36 of the transformer for all of the fault sensing switches 39 are open. The transistor 18 is biased at or near cut-off, and as a consequence the relay 14 is deenergized and the switches 17 and 23 thereof are in their normally open state. Therefore, the visual signal devices 38 and the audible signal device 28 are at rest.

If one of the fault sensing switches, 39c for example, is closed by a change from normality at a detecting station, current will flow through the primary winding 36 of the transformer and through the light 38c, thereby providing a visual indication of such variation in condition. The initiation of a D.C. current flow through the primary winding 36 will induce a current flow in the secondary winding 34 of the transformer, whereupon such transient current will make the transistor 18 conductive. The amplification characteristics of the transistor will thereby establish a current flow through the energizing coil of the relay 14 of sufficient magnitude to energize the relay, whereupon the switches 17 and 23 will be closed. Thereafter, the relay remains in its energized state because of the self-holding circuit defined through the switch 17 thereof. As a result, an audible signal device 28 is actuated through the relay switch 23. Since the flow of current through the primary winding 36 of the transformer is of constant value (that is, it is a D.C. current), the flow of current in the secondary winding 34 will discontinue almost immediately.

If the fault sensing switch 39c is opened by a correction in the operation condition of the equipment to which it is responsive, the audible signal 28 will continue to be actuated until the acknowledgment switch 22 is opened to break the self-holding circuit of the relay. On the other hand, the usual situation is for the fault switch 39c to remain closed, and the audible alarm 28 is deactuated by depressing the acknowledgment switch 22; and when the faulty condition in the equipment associated with the switch 39c is corrected, it will be opened and the light 38c deenergized. In the meantime, however, should a condition of abnormality be detected by another of the sensing switches, 39b for example, it will close, the light 38b will be energized, and a current flow of greater magnitude will be initiated through the secondary winding 36 of the transformer because of the parallelism of the resistances defined by the two energized lights 38b and 38c. This increase in current through the primary winding will establish a transient current flow through the secondary winding 34 of the transformer, whereupon the transistor will conduct and the relay 14 will again be

energized to actuate the audible alarm 28. The acknowledgment switch 22 may again be opened to deenergize the relay and terminate the audible alarm, and the circuit is again in condition for both visually and audibly indicating a subsequent abnormality at another detecting station.

The relay 14 will not be energized when the switches 39b and 39c are opened, for the resultant flux change in the transformer 35 will attempt to cause a current flow in the opposite direction—that is, from the emitter 30 to the base 29 in the transistor; and the current flow in this direction cannot be accommodated thereby because of the uni-directional current flow characteristics thereof. Thus, while an induced voltage in the secondary winding 34 of the transformer resulting from a current pulse through the primary winding thereof will energize the relay 14 when a fault sensing switch is closed, the induced voltage of opposite polarity in the secondary winding will not energize the relay when one of the fault sensing switches is thereafter opened.

While in the foregoing specification an embodiment of the invention has been set forth in considerable detail for purposes of making a complete disclosure, it will be apparent to those skilled in the art that numerous changes may be made in those details without departing from the spirit or principles of the invention.

I claim:

1. In a fault annunciator system of the character described, a direct current power source, a relay having an energizing coil connected across said power source and being equipped with a pair of normally open switch contacts, one of said contacts being connected in series with the energizing coil to define a self holding circuit for said relay, a first signal device connected across said power source in series with the other of said switch contacts so as to be actuated when the relay is energized, a transistor having a collector and emitter connected in series with said energizing coil in shunt relation with said first switch contact, a transformer having a primary winding connected across said power source and a secondary winding connected between the power source and base of said transistor, a plurality of visual signal devices and normally open fault switches, a visual signal device and fault switch being connected in series, all of the visual signal device and fault switch combinations being connected in parallel with each other and in series with said primary winding, any one of said fault switches being adapted to be closed by a change in condition at a detecting station to illuminate its associated visual signal device and induce voltage in said primary and secondary windings to drive said transistor to conductive state to energize said relay, an acknowledgement switch connected in series with said one switch contact and actuable to de-energize said relay and said first signal device, the illuminated visual signal device remaining closed and said other fault switches being actuable to render said transistor conductive and re-energize said first signal device.

2. In a fault annunciator system of the character described, a power source, a relay having an energizing coil connected across said power source and being equipped with a pair of normally open switch contacts, one of said contacts being connected in series with the energizing coil to define a self holding circuit for said relay, a first signal device connected across said power source in series with the other of said switch contacts so as to be actuated when the relay is energized, a unidirectional impedance device connected in circuit with said energizing coil and in shunt relation with said first switch contact, a transformer having a primary winding connected across said power source and a secondary winding connected in circuit with said impedance device, a plurality of visual signal devices and normally open fault switches, a visual signal device and fault switch being connected in series, all of the visual signal device and fault switch combinations being

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connected in parallel with each other and in series with said primary winding, any one of said fault switches being adapted to be closed by a change in condition at a detecting station to illuminate its associated visual signal device and induce voltage in said primary and secondary windings to drive said impedance device to conductive state to energize said relay, an acknowledgement switch connected in series with said one switch contact and actuable to de-energize said relay and said first named signal device, the illuminated visual signal device remaining closed, and said other fault switches being

actuable to render said impedance device conductive and to re-energize said first signal device.

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