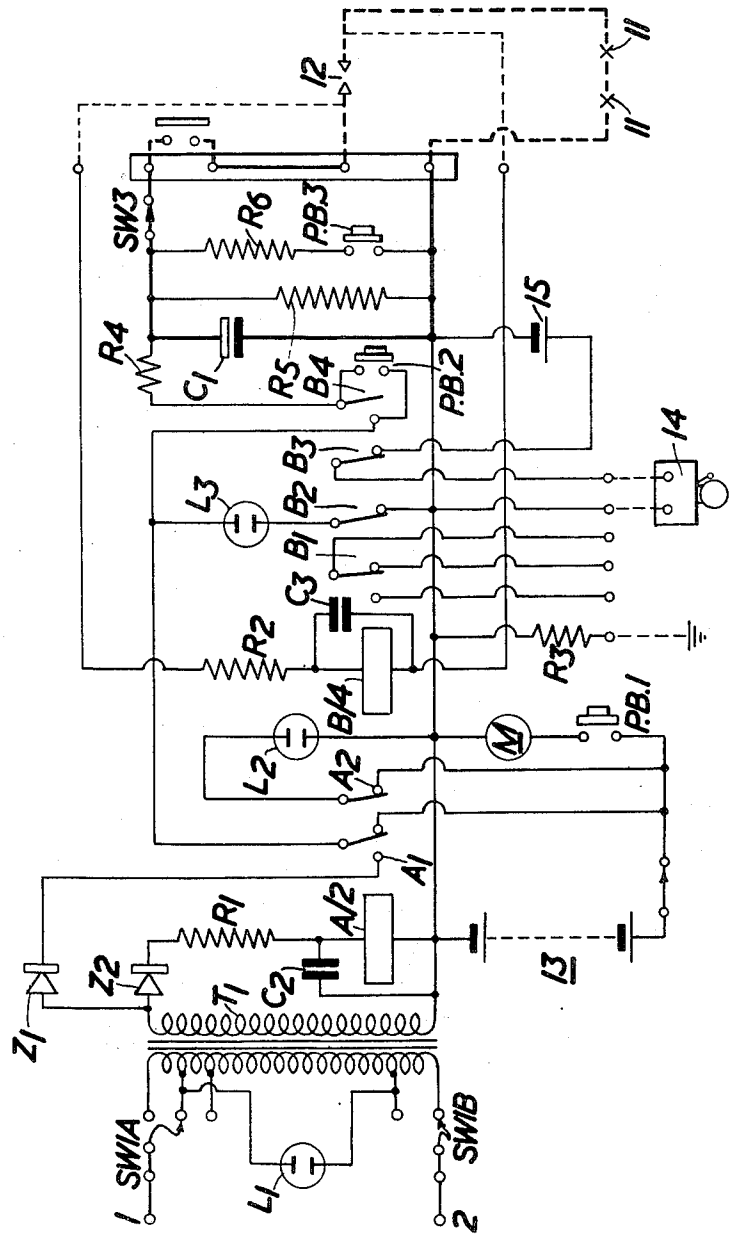
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ELECTRICAL POWER SUPPLY APPARATUS

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ELECTRICAL POWER SUPPLY APPARATUS

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11 Claims. (Cl. 340—213)

This invention relates to electric supply apparatus and monitoring and controlling means therefor.

The invention is particularly, but not exclusively, concerned with electric power supply apparatus adapted to provide current for firing an explosive charge or detonator used for effecting operation of means for relieving and/or suppressing an explosion or for suppressing a fire.

According to the present invention there is provided electric power supply apparatus adapted to supply current of a predetermined value to a circuit upon closure of a pair of contacts, wherein a relay energising winding is connected across said contacts so that current flows through said circuit which is sufficient to energise said relay but is less than said predetermined value, said relay being deenergised upon closure of said contacts or upon interruption or sufficient reduction of the supply current, said de-energisation effecting a desired indication.

Thus, an indication will be given if the circuit to be supplied becomes open circuit or if for any reason the current through the circuit is interrupted or falls below the value necessary for maintaining the relay energised.

The invention also provides electrical power supply apparatus adapted to be connected to current utilisation means and normally open contacts, comprising a current source, said normally-open contacts being adapted upon closure to ensure the supply of a predetermined current from said source to said utilisation means, and an electric relay whose state of energisation is controlled by the value of current fed to said utilisation means, a predetermined state of energisation of said relay effecting a desired operation.

The invention further provides electrical power supply apparatus adapted to be connected to current utilisation means and to normally-open contacts, comprising a storage capacitor adapted to be connected in series with said utilisation means and said contacts, and an electromagnetic relay adapted to be connected across said contacts, the resistance of said relay circuit being such that said relay is energised when said contacts are open.

Preferably the resistance of the energising circuit connected across said contacts is such that even if the relay winding is short circuited the current through the circuit will still be less than said predetermined value.

The current supply circuit may include contacts in series therewith which are only closed on energisation of said relay, said contacts being paralleled by a switch whereby energisation of said relay can only be effected by closure of the switch, whereupon said contacts complete a holding circuit for the relay.

In the case of apparatus for use in conjunction with fire or explosion suppression, the circuit may be the firing circuit of the explosive charge or detonator, and the pair of contacts may be those of means for detecting a fire or incipient explosion.

One form of power supply apparatus according to the invention will now be described, by way of example only,

this apparatus being suitable for use, for example, with the plant protection equipment described in the specification of my co-pending Patent Application No. 429,360 filed May 12, 1954. The apparatus will be described by reference to the accompanying circuit diagram, in which external wiring is shown in broken lines.

The function of this power supply apparatus is to maintain charged a capacitor C1 of large capacity, for example 200 μf., which is connected across the igniting wire or wires of one or more electrically fired detonators 11 and in series with the contacts 12 of a detector of the kind referred to in the aforesaid specification. When the detector contacts 12 are closed on detection of a fire or incipient explosion, the capacitor C1 will be discharged through the firing circuit of the detonator or detonators 11 ignition of which will initiate the desired relief or suppression.

This apparatus is designed for operation normally from a 50 cycle alternating current supply connected between terminals 1 and 2 and is arranged to change over automatically to battery operation in the event of interruption of the mains current input. To this end the apparatus comprises a mains transformer T1 having an indicator lamp L1 connected across the input winding to indicate when the mains supply is available, and the secondary winding is connected via a rectifier Z1 to the firing capacitor C1 via various contacts which will be referred to hereafter.

Also connected across the input winding is an energising circuit for a relay A/2 comprising a rectifier Z2 and resistor R1 in series with the relay winding, the latter being shunted by a smoothing capacitor C2.

The relay A/2 is designed to effect the automatic changeover to battery operation and subsequent restoration to mains operation when the mains current is again available. For this purpose the moving portion of a contact pair A1 is connected to the firing capacitor C1 and its associated fixed front contact is connected to the rectifier Z1 so that this circuit will be interrupted if the changeover relay A/2 is not energised. The associated fixed back contact is connected to one terminal of a high-tension battery 13 the other terminal of which is connected via the earth line to one electrode of the firing capacitor C1 whereby, if the mains input is interrupted and the changeover relay A/2 de-energised, the high-tension battery 13 will automatically be connected across the capacitor C1. A second set of contacts A2 of the changeover relay A/2 is connected in series with an indicator lamp L2 across the high-tension battery 13 so that when the relay A/2 is de-energised and the battery 13 is connected across the capacitor C1 the indicator lamp L2 will be lit to show that the circuit is operating from the battery, the mains indicator lamp L1 being extinguished as a result of the interruption of the mains current. When mains power is restored relay A/2 is re-energised and the battery thereby disconnected.

Also connected across the high-tension battery 13 is a voltmeter M in series with a push-button "check battery" switch PB1, whereby the state of the batteries can be checked on the voltmeter by pressing the button.

A second relay B/4 is connected in series with a resistor R2 across the detector contacts 12 and is thereby connected in series with the detonators 11 across the charging supply for the capacitor C1. The prime function of this second relay B/4 is to operate alarm indicators on firing of the detonators 11, and also to monitor the correct functioning of the firing circuit. Because of the connection of the relay winding in series with the detonators 11 the small energising current for the relay B/4 is drawn continuously through the detonators 11 and in the event of a detonator igniting wire or any of the wiring thereto becoming open circuited, the relay B/4 is de-energised.

The relay B/4 is similarly de-energised if the capacitor C1 develops a short-circuit or loses its charge. The resistor R2 is of such a value as to ensure that if the relay winding becomes short-circuited the increased current through the detonators 11 is insufficient to result in firing of the detonators.

One set of alarm relay contacts B2 is connected in series with an indicator lamp L3 connected across the charging supply of the capacitor C1 to give a visual alarm whenever one of the conditions leading to de-energisation of the alarm relay B/4 exists. To give an aural alarm a further set of contacts B3 is connected in series with an alarm bell 14 (or other aural indicator), which is energised from a completely independent battery supply 15.

A set of changeover contacts B1 may be used for effecting any desired operation which is required concurrent with firing of the detonators, for example, switching-off apparatus in the plant in which the fire or incipient explosion has occurred.

The charging circuit of the firing capacitor also includes a further set of contacts B4 controlled by the alarm relay B/4, these contacts completing a holding circuit for the relay B/4 when it is energised. The contacts B4 are paralleled by a push-button "reset" switch PB2 which is operated on initial switching-on of the apparatus and must be re-operated whenever the relay B/4 has become de-energised. The provision of the reset switch PB2 ensures that after the detector contacts 12 have been closed and the detonators 11 fired, with the eventual result that the detector contacts open once more due to the fire or explosion having been suppressed or relieved, voltage will not be applied across the detonator terminals until the reset button PB2 has been operated. Relay B/4 is shunted by a capacitor C3 which smooths out any inductive surge occurring an operation of the relay.

The firing capacitor C1 is also paralleled by a test discharge circuit comprising a resistor R6 in series with a push-button "test" switch PB3 which is pressed for test purposes to discharge the capacitor thereby de-energising the alarm relay B/4 and operating the alarms. If the "reset" button PB2 is now pressed, the alarms will cease to operate when the capacitor C1 is again fully charged and ready to fire the detonators 11 in the event of closure of the detector contacts 12.

Switch SW1 switches off the mains supply at SW1A and simultaneously isolates the battery at SW1B. The electrical circuit is earthed through a high value resistor R3 to prevent build-up of a static charge. Safety switches may be provided for the circuit connecting the capacitor C1 across the detonators 11, and one such safeguard takes the form of a key-operated switch SW3 which is so arranged that withdrawal of the key interrupts the circuit to the detonators. Thus, a person going to the detonator location may take the key with him to ensure that voltage is not applied inadvertently to the detonators whilst he is in their vicinity. Other safety switches may take the form of interlocks 16 for various parts of the apparatus, for example on inspection doors, to ensure that the system is rendered inoperative on opening of any such door.

What I claim is:

1. Electrical power supply apparatus comprising a step-down transformer, said transformer having an input winding connected to mains input terminals and an output winding, current rectifying means, a storage capacitor, said current rectifying means and said capacitor being connected electrically in series with said output winding, a pair of utilisation terminals electrically connected respectively to opposite electrodes of said storage capacitor, an electromagnetic relay having an energising winding, said relay having a pair of electrical contacts which are held in the open position when said relay is energised, an electrically operated alarm, said alarm having an electrical operating circuit which is completed upon closure of said electrical contacts, and a further pair of terminals between which the energising winding of said relay is connected, whereby when a further pair of normally-open contacts is connected electrically in series with a utilisation circuit between said pair of utilisation terminals, each of said further pair of terminals can be connected to one of said further pair of normally-open contacts respectively for energising said relay from said storage capacitor through said utilisation circuit when said normally-open contacts are open.

2. Electrical power supply apparatus comprising a step-down mains supply transformer, said transformer having a mains input winding and an output winding, current rectifying means, a capacitor, said capacitor being connected electrically in series with said rectifying means and said output winding, a pair of normally-open contacts, a current utilisation circuit, said normally-open contacts being connected electrically in series with said current utilisation circuit and said capacitor, whereby upon closure of said contacts current is fed from said capacitor to said utilisation circuit, an electromagnetic relay, said relay being electrically connected across said normally-open contacts, said relay having a pair of relay contacts which are open when said relay is energised, and an electrically energised alarm device, said device having an energising circuit electrically connected in series with said pair of relay contacts and said capacitor terminals.

3. Electrical power supply apparatus comprising a source of direct current, a capacitor, said capacitor being connected electrically across said source, a pair of normally-open contacts, a current utilisation circuit, said capacitor being connected electrically in series with said normally-open contacts and said current untlisation circuit, an electromagnetic relay, said relay having a high resistance energising circuit, said energising circuit being connected electrically in series with sad normally-open contacts, whereby closure of sad normally-open contacts short circuits said relay energising circuit, a further pair of contacts controlled by said relay so that said contacts are closed when said relay is de-energised, a further source of electric current, and an electrically energised alarm device, said alarm device being connected electrically in series with said further source of electric current and said further pair of contacts whereby de-energising of said relay as a result of closure of said normally-open contacts closes said further pair of contacts and energises said alarm device.

4. Apparatus according to claim 3, in which said energising circuit includes a resistor, the resistive value of said resistor being appreciably greater than the resistive value of said current utilisation circuit.

5. Apparatus according to claim 3, in which said normally-open contacts are controlled by means for detecting fires and explosions.

6. Electrical power supply apparatus comprising a direct current supply source, a capacitor, an electromagnetic relay, said relay having a pair of relay contacts which are closed when said relay is energised, a manually operable switch, said switch being electrically connected in parallel with said contacts, said supply source being electrically connected in series with said relay contacts and said capacitor, a pair of normally-open contacts, a current-utilisation circuit, said capacitor being electrically connected in series with said normally-open contacts and said utilisation circuit, a resistor, said resistor having a resistive value appreciably greater than the resistive value of said current utilisation circuit, said relay being electrically connected in series with said resistor across said normally-open contacts, whereby closure of said normally open contacts short circuits said relay, said relay having a further pair of relay contacts which are separated when said relay is energised, an electrically-energised warning device, and a further electrical supply

source, said warning device being electrically connected in series with said further pair of relay contacts and said further supply source whereby de-energisation of said relay completes an energising circuit for said warning device.

7. Apparatus according to claim 6, in which said normally open contacts constitute part of a fire and explosion detector, said contacts being closed when a fire or explosion is detected.

8. Apparatus according to claim 6, in which said current-utilisation circuit consists of the electrical firing circuit of an explosive charge.

9. In electrical power supply apparatus adapted to be connected to current operated means and to a pair of normally-open contacts, operation of said current operated means being effected by the passage of current of a predetermined value, a storage capacitor adapted to be connected electrically in series with said current operated means and said contacts, an electromagnetic relay, said relay having an energising circuit adapted to be connected electrically across said contacts whereby with said normally-open contacts in the open condition relay energising current flows from said storage capacitor through said utilisation means to energise said relay, said energising circuit having a substantial resistive value whereby said relay energising current is less than said predetermined value, said relay having a pair of electrical contacts which are opened when said relay is energised, and an electrically energised alarm having an alarm energising circuit which includes said pair of electrical contacts whereby said alarm is operated upon de-energisation of said relay, closure of said normally-open contacts short circuiting said energising circuit whereby the current through said utilisation means exceeds said predetermined value and also said relay is de-energised and the alarm operated.

10. Electrical power supply apparatus for an automatically operated fire and explosion suppressant distributing system comprising a direct current supply source, a capacitor, an electromagnetic relay, said relay having a pair of relay contacts which are closed when said relay is energised, a manually operable switch, said switch being electrically connected in parallel with said contacts, said supply source being electrically connected in series with said relay contacts and said capacitor, whereby closure of said manually operable switch completes an energising circuit for said relay which is thereafter maintained in the energised condition by closure of said pair of relay contacts, a pair of normally-open contacts adapted to be closed upon detection of a fire or explosion, an electrically fired detonator, said detonator having an igniting wire, said capacitor being electrically connected in series with said normally-open contacts and said igniting wire whereby closure of said normally-open contacts discharges said capacitor through said igniting wire to fire said detonator, a resistor, said resistor having a resistive value appreciably greater than the resistive value of said igniting wire, said relay being electrically connected in series with said resistor across said normally-open contacts, said relay also having a further pair of relay contacts which are separated when said relay is energised, an electrically-energised fire and explosion warning device, and a further electrical supply source, said warning device being electrically connected in series with said further pair of relay contacts and said further supply source.

11. Electrical power supply apparatus according to claim 10, further comprising a further manually operable testing switch and a further resistor, said testing switch and said further resistor being electrically connected in series across said capacitor whereby closure of said testing switch discharges said capacitor and short circuits said relay thereby energising said warning device.

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