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SUPERVISED ELECTRIC ALARM SYSTEM

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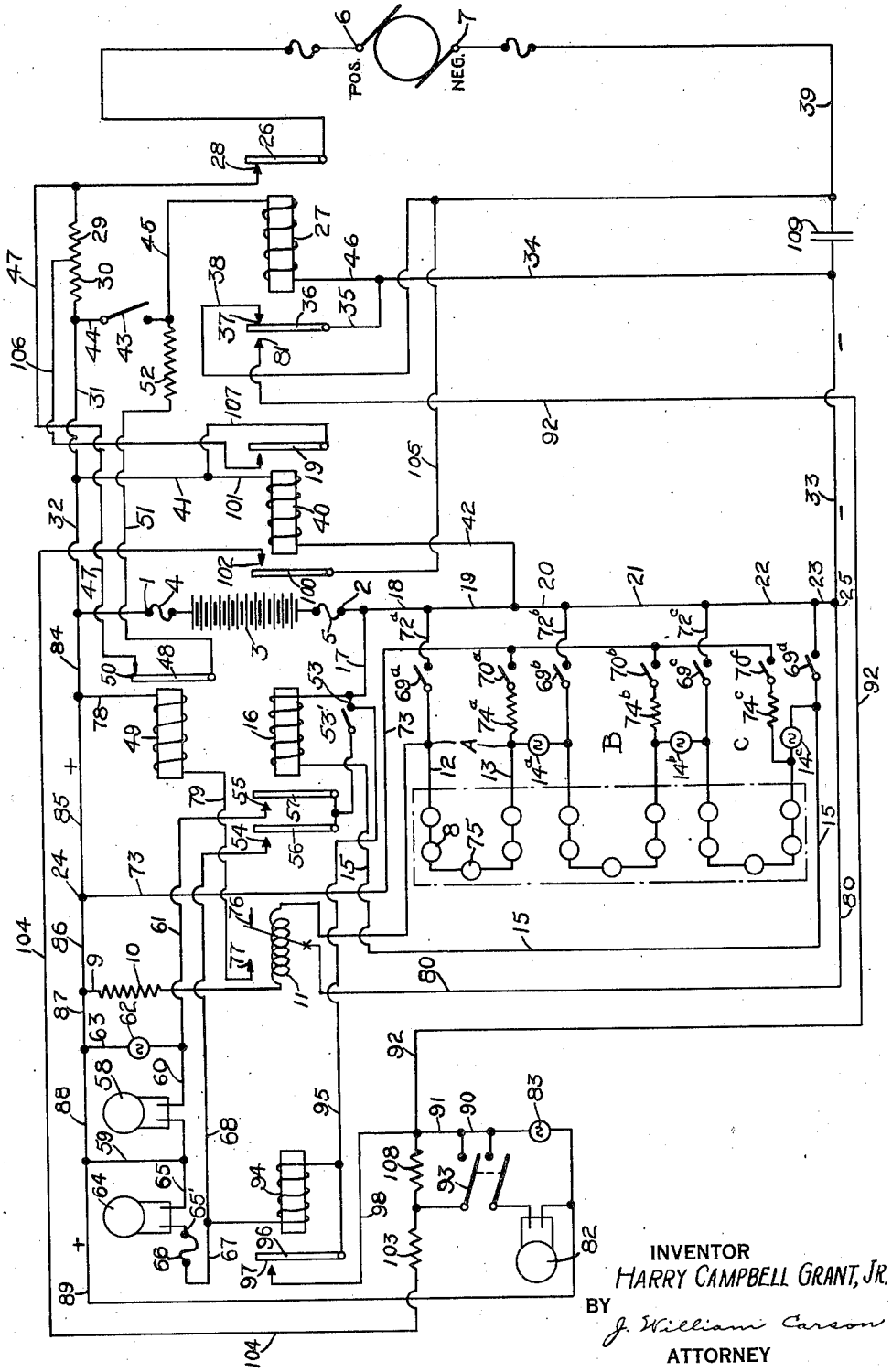

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SUPERVISED ELECTRIC ALARM SYSTEM

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2 Claims. (Cl. 177—355)

This invention relates to alarm systems, for fire, for burglary, and so forth, of the type in which a plurality of external circuits, each containing one or more normally closed circuit opening devices, are connected in series with a no-load relay and a source of electric potential, whereby the opening of the circuit at any point, due to a fire condition or burglary, is indicated at a central alarm station.

Previous systems of the type described have been objectionable because of the need for an alarm relay for each of the several external circuits. Another objection to previous systems has been incomplete supervision against various kinds of trouble which may be encountered under conditions of actual service.

It is therefore the primary object of the present invention to provide a fire alarm system of the type referred to which will meet the public demand for a simple and efficient system, and which at the same time is fully supervised against any troubles which may develop.

The present invention is generally similar to that shown and described in my copending application of the United States, Serial No. 572,783, filed October 23, 1931; but differs therefrom in the provision of simpler means for locating the external circuit or circuits from which a fire signal has been relayed to the central fire alarm station, it being unnecessary to search for the circuit in alarm by operation of various switches as provided for in my earlier application.

It is therefore another object of the present invention to provide a closed circuit fire alarm system in which simpler means is provided to locate the external circuit or circuits from which a fire signal has been relayed to the central fire alarm station, without having additional contact relays for each of the external circuits and without any searching operation being necessary.

It is also an object of this invention to provide a system which can be electrically energized either by a main source of electrical potential, or by a secondary source of electrical potential normally under charge from the main source, the system likewise being capable of energization simultaneously by both of the sources of potential.

It is also an object of this invention to indicate failure of the main source of electrical energy.

It is a further object to indicate failure of the secondary source of electrical energy.

It is a still further object to completely supervise the external circuits against grounds and to provide means to remove the grounds so as to avoid dangerous conditions which would otherwise occur.

A still further object is to provide means to detect short-circuits occurring in any one of the external circuits.

Further objects, not specifically enumerated above, will be apparent as the invention is described in greater detail in connection with the accompanying drawing, in which the single figure is a diagrammatical representation of an alarm system constructed and arranged in accordance with the invention.

In the system shown the reference numerals 1 and 2 represent the positive and negative terminals of a secondary source of electrical potential in the form of a battery 3, which is protected by fuses 4 and 5 and which is normally under charge, in a manner hereinafter to be described, from a main source of electrical energy, the positive and negative terminals of which are shown at 6 and 7.

At A there are shown the terminals of a so-called "external" circuit containing normally closed circuit opening thermostats 8. B and C indicate the terminals of additional external circuits, all of which are connected in series in the following manner; current flowing from the positive line through the wire 9, the ground current limiting resistance 10, the ground detecting galvanometer relay 11, one side, 12, of the external circuit A, the other side, 13, of the external circuit A, circuit lamp 14^a, through the external circuit B, circuit lamp 14^b, through the external circuit C, circuit lamp 14^c, wire 15, the fire alarm relay 16 and the wires 17, 18, 19, 20, 21, 22 and 23 to the negative line. The electrical characteristics of the various elements in the series circuit are so chosen that the current normally flowing in the circuit is of a value insufficient to illuminate the circuit lamps, the current however being of a sufficient value to energize the fire alarm relay 16 and serving as a supervisory current for the various elements in said series circuit, the relay 16 being a circuit supervising relay as well as a firm alarm relay.

The circuit just described and the battery 3 are connected in parallel with the main supply terminals 6 and 7, the latter normally supplying the energizing current for said circuit and the charging current for the battery, the positive and negative junction points being at 24 and 25.

The path of the charging current for the battery is from the main supply terminal 6 through the armature 26 of the main supply supervising relay 27, the contact 28, the charging resistances

29 and 30, the wires 31 and 32, through the battery, the wires 18, 19, 20, 21, 22, 23, 33, 34 and 35, the armature 36 the contact 37, and the wires 38 and 39 to the main supply terminal 7.

At 40 is shown the battery supervising relay which is connected to the positive terminal of the battery by wires 32 and 41, and to the negative terminal of the battery by the wires 42, 19 and 18.

When a system in accordance with the present invention has been installed and is to be made ready for use, the reset switch 43 is closed, whereupon current flows from the positive terminal of the battery through the wires 32, 31 and 44, the reset switch 43, the wire 45, the main supply supervising relay 27, and the wires 46, 34, 33, 23, 22, 21, 20, 19 and 18 to the negative terminal of the battery. This results in energization of the main supply supervising relay 27, causing closing of the contacts 28 and 37. Upon intentional reopening of the reset switch 43, which is therefore preferably of the push-button type, the main supply supervising relay 27 will be found to be connected across the main supply terminals 6 and 7 through the armature 26, the contact 28, the wire 47, the armature 48 of the ground detecting auxiliary relay 49, the contact 50, the wire 51, the resistance 52, the wires 45, 46 and 35, the armature 36, the contact 37, and the wires 38 and 39, thus holding the relay 27 energized.

By reason of the herein-referred to flow of current through the external circuits from the junction point 24 to the junction point 25, the fire alarm relay 16 is normally energized, but as soon as a fire occurs in a space protected by an external circuit, as for example in the space indicated by the thermostat 8 on the external circuit A, the circuit between the junction points 24 and 25 is broken by the opening of the thermostat, whereby the fire alarm relay 16 is de-energized. This results in the closing of the contacts 54 and 55 by the armatures 56 and 57, whereupon fire alarm signals are rendered in the following manner. The reference numeral 58 represents the fire alarm gong which is normally located at the central fire alarm station. This gong is sounded by reason of current flowing from the positive line through the wires 59, 60 and 61, the contact 55, the armature 57, and the wires 53 and 17 to the negative line, the switch 53' being a normally closed switch which will be referred to hereinafter. At the same time the fire alarm lamp 62, normally located at the central fire alarm station, is illuminated by current flowing from the positive line through the wires 63 and 61, the contact 55, the armature 57, and the wires 53 and 17 to the negative line.

In certain types of installations, for example on board ships, it is advisable to signal the presence of fire to the engine room or some other location than the central fire alarm station, which is normally in the wheelhouse or chart room of the ship. For this purpose there is provided a second fire alarm gong 64, which becomes energized by current flowing from the positive line through the wires 59 and 65, the fuse 66, the wires 67 and 68, the contact 54, the armature 56, and the wires 53 and 17 to the negative line.

As soon as the presence of fire is made known by any one or more of the means provided, the fire-watch attendant immediately proceeds to the central fire alarm station, at which point he will find on the operating panel normally open switches 69^a, 69^b, 69^c, 70^a, 70^b, 70^c and 71, all of which he is to immediately proceed to close.

If no fire has occurred in any of the spaces protected by the external circuit A, so that no thermostat has operated on this circuit, no indication will be given by the circuit lamp 14^a, as both sides of the circuit lamp will be found to be connected to the negative line; the one side through the wires 23, 22, 21, 20, 19 and 72^a, the switch 69^a and the external circuit A; and the other side through the wires 23, 22, 21 and 72^b and the switch 69^b. If, however, fire has occurred in one of the spaces protected by the external circuit A, so that one of the thermostats 8 on the external circuit A has operated to open the circuit, the first referred to connection of the one side of the circuit lamp 14^a to the negative line through the external circuit A itself would not be completed, because of the open circuit caused by the operated thermostat 8. The circuit lamp 14^a is then illuminated by reason of the last mentioned connection of the lamp to the negative line and by reason of its connection to the positive line through the wire 73, the switch 70^a and the resistance 74^a, thus indicating that a thermostat has been operated on the external circuit A. The resistance 74^a is a current consuming resistance which has its principal use when both sides of the circuit lamp 14^a are connected to negative in the manner already described.

Similar indications are given in connection with the external circuits B and C, as the corresponding switches, lamps and current consuming resistances being indicated by similar reference numerals.

If no fire has occurred in any of the spaces protected by the external circuit B, so that no thermostat has operated on this circuit, no indication will be given by the circuit lamp 14^b, as both sides of the circuit lamp will be found to be connected to the negative line; the one side through the wires 23, 22, 21 and 72^b, the switch 69^b and the external circuit B; and the other side through the wires 23, 22 and 72^c and the switch 69^c. If, however, fire has occurred in one of the spaces protected by the external circuit B, so that one of the thermostats 8 on the external circuit B has operated to open the circuit, the first referred to connection of the one side of the circuit lamp 14^b to the negative line through the external circuit B itself would not be completed, because of the open circuit caused by the operated thermostat 8. The circuit lamp 14^b is then illuminated by reason of the last mentioned connection of the lamp to the negative line and by reason of its connection to the positive line through the wire 73, the switch 70^b and the resistance 74^b, thus indicating that a thermostat has been operated on the external circuit B. The resistance 74^b is a current consuming resistance which has its principal use when both sides of the circuit lamp 14 are connected to negative in the manner already described.

If no fire has occurred in any of the spaces protected by the external circuit C, so that no thermostat has operated on this circuit, no indication will be given by the circuit lamp 14^c, as both sides of the circuit lamp will be found to be connected to the negative line; the one side through the wires 23, 22 and 72^c, the switch 69^c and the external circuit C; and the other side through the wire 23 and the switch 69^d. If, however, fire has occurred in one of the spaces protected by the external circuit C, so that one of the thermostats 8 on the external circuit C has operated to open the circuit, the

first referred to connection of the one side of the circuit lamp 14c to the negative line through the external circuit C itself would not be completed, because of the open circuit caused by the operated thermostat 8. The circuit lamp 14c is then illuminated by reason of the last mentioned connection of the lamp to the negative line and by reason of its connection to the positive line through the wire 73, the switch 70c and the resistance 74c, thus indicating that a thermostat has been operated on the external circuit C. The resistance 74c is a current consuming resistance which has its principal use when both sides of the circuit lamp 14c are connected to negative in the manner already described.

It will, of course, be understood that the occurrence of a wire break in any of the external circuits will turn in fire alarm signals, but the existence of a wire break will not become apparent until after an unsuccessful search for the presence of fire on the circuit indicated, the same condition holding whenever a circuit lamp burns out, or whenever any other element in the supervised alarm circuit fails.

Testing of any one of the external circuits can be accomplished by opening the test switches provided in the various circuits. For the external circuit A the test switch is shown at 75. Although the test switches can be employed to test simply the operability of the central station fire alarm apparatus, the primary object of the test switches is to locate short-circuits of the external circuit leads which would prevent operation of the central station fire alarm apparatus by thermostats more remote from the central station than the existing short-circuit. Accordingly a test switch is placed at the most remote point of each of the external circuits; and failure of the central station fire alarm apparatus to function upon opening of a test switch is an indication of a short-circuit in the particular external circuit tested. It should be noted that short-circuits of the external circuit leads can not be detected automatically but only by manual test, as the external circuits have no current limiting resistances and therefore a short-circuit has the same resistance as the normal line circuit.

It has already been mentioned that the external circuits are protected against the accurrence of grounds, and the relay 11 has already been referred to as the ground detecting galvanometer relay, while the relay 49 has been referred to as the ground detecting auxiliary relay.

In order to protect the circuit lamps 14a, 14b and 14c against blowing out by the high current which usually flows upon the occurrence of a ground, it being noted that the circuit lamps are in series with and between the external circuits A, B and C, so that the ground current may flow through one or more of the circuit lamps, a high resistance 10 is employed to limit the ground current, this resistance serving to protect at the same time the more or less sensitive galvanometer relay 11.

It is customary in ship installations to have the ship's electrical circuits ground clear but this condition rarely exists. At times the ship's negative may be grounded and shortly after this the ground may be changed from negative to positive. The relative position of the ground on a ship's generator and various points of the circuit in accordance with the present invention will cause different indications to be given at the central control station.

In order to clarify the discussions which follow, let it be assumed, by way of example, that a snip has a 220 volt supply and that the battery 3 of the present invention is a 40 volt battery.

Let it also be noted that the normal direction of flow of current through the ground detecting galvanometer relay 11 is from the positive line to the negative line, i. e. from the junction point 24 to the junction point 25; it being further noted that the side of the relay 11 connected to the external circuit A is at a voltage lower than the positive line voltage.

If, therefore, any one of the wires of any of the external circuits becomes grounded while at the same time the positive side of the main power supply is normally grounded, the voltage on the side of the ground detecting galvanometer relay 11 will become greater than the positive line voltage, so that the direction of current flow through the galvanometer relay 11 will reverse, causing closing of the galvanometer contact at 77. Closing of the contact at 77 then energizes the ground detecting auxiliary relay 49, current flowing through the relay 49 from the positive line through the wires 78 and 79, the galvanometer relay contact 77, the needle of the galvanometer relay and the wire 80 to the negative line. Energization of the ground detecting auxiliary relay 49 causes the contact 50 to open. The opening of the contact 50 directly interrupts the already described energizing circuit of the main supply supervising relay 27, whereupon the latter is de-energized, opening the contact at 37 and closing the contact at 81. This action results in the sounding of the trouble gong 82 and the illumination of the trouble lamp 83, by reason of current flowing from the positive terminal of the battery through the wires 84, 85, 86, 87, 88 and 89, then in parallel through the trouble gong 82 and the trouble lamp 83, then through the wires 90, 91 and 92, the contact 81, the armature 36, and the wires 35, 34, 33, 22, 21, 20, 19 and 18 to the negative terminal of the battery. The sounding of the trouble gong 82 can be stopped by opening the normally closed switch 93, but the trouble lamp will remain illuminated until the trouble has been repaired.

If, on the other hand, any one of the wires of one of the external circuits should become grounded while at the same time the negative side of the main power supply is normally grounded, the fire alarm relay 16 will be short-circuited and will release its armature, turning in the already described fire alarm signals. As a negative ground is not as serious as a positive ground, at least in the system of the present invention wherein no dangerous ground currents will flow on a negative ground, no provision need be made to remove the ground automatically, as it can be removed when located.

Although it is one of the purposes of the main supply supervising relay 27 to indicate the failure of the main supply, whereby the relay would be de-energized and the trouble signals given in the manner already explained, the most important function of the relay 27 in the present arrangement is to break the circuit between the fire alarm system and the main supply on both sides on the occurrence of a positive ground, thus removing the ground and allowing the battery to re-energize the fire alarm relay 16, so that dangerous currents often flowing for ground conditions will be interrupted. For this reason the relay 27 is not arranged to pick up on the main supply voltage directly, but, if de-energized, is required to be

reset manually by the reset switch 43, as otherwise, upon deenergization of the relay 27 due to a ground with consequent breaking of the ground circuit, the relay 27 would be re-energized and thus bring back the ground, with the result that the relay would buzz rapidly and burn off either of the contact 28 or 37, depending on the relative location of the grounded points.

The relay 27 has also a third function, which is best mentioned at this time, in that the breaking of the circuit between the fire alarm system and the main supply upon failure of the main supply prevents the battery from discharging back into the main supply lines, the battery now serving as the main and only source of energy.

In view of the fact that the auxiliary fire alarm gong 64 is normally located at some distance from the central fire alarm station, defects can easily occur in the external leads to the auxiliary fire alarm gong, and this gong is accordingly supervised by means of the auxiliary gong supervising relay 94, current flowing from the positive line through the wire 59, the external gong lead 65, the auxiliary fire alarm gong 64, the fuse 66, the wire 67, the auxiliary gong supervising relay 94, and the wires 95, 53 and 17 to the negative line.

If now the main supply is normally grounded on the negative side, and if a ground occurs in the external gong lead 65', the auxiliary gong supervising relay 94 will be short-circuited and consequently de-energized, whereby the armature 96 will close the contact 97, and the trouble gong and trouble lamp will be operated by reason of current flowing from the positive line through the trouble gong and trouble lamp in parallel, the wires 90, 91 and 98, the contact 97, the armature 96, and the wires 95, 53 and 17 to the negative line. At the same time the auxiliary gong 64 will sound due to the cutting out of the high resistance of the supervising relay 94. If, however, a ground occurs in the external gong lead 65, such ground will constitute a direct short-circuit across the battery 3 and one of the fuses 4 and 5 will blow out, whereupon the battery supervising relay 40 will be energized and will give the trouble signal in a manner hereinafter to be described.

If, instead of the main supply line being normally grounded on the negative side, it is normally grounded on the positive side, a ground in the external gong lead 65' will cause the auxiliary gong to sound by reason of the increased voltage to which it will be subjected. On the other hand, if the external gong lead 65 becomes grounded, the increased voltage on the entire system will cause the battery supervising relay 40 to be energized and the trouble signal given in a manner hereinafter to be described. At the same time the abnormally high charging current will cause one of the fuses 4 and 5 to blow, thus protecting the battery against excessive charge.

The external gong leads are not only protected against grounds in the manner already described, but likewise against direct short-circuits of the leads. Such a short-circuit is normally undetected, but as soon as a fire alarm signal is given, the short-circuit of the auxiliary gong leads constitutes a direct short-circuit of the battery, whereupon the fuse 66 or one of the battery fuses 4 and 5 will be blown out, and the battery supervising relay 40 will be energized and the trouble signal given in a manner now about to be described.

While the main supply supervising relay 27 is normally energized, the battery supervising relay 40, which is connected across the terminals of the battery 3, is not energized by the normal battery voltage, but is designed to energize upon a considerable increase in voltage across the relay winding.

It has already been explained that the external circuit between the junction points 24 and 25, and the battery 3, are connected in parallel across the main supply terminals 6 and 7, so that normally the main supply terminals provide the supervisory current flowing through the external circuit and the charging current flowing into the battery. When, however, a fire alarm or trouble alarm is given, the increased current required by the alarm gongs is greater than can be supplied by the main supply. The charging current normally flowing into the battery therefore reverses itself and the battery supplies the excess current required when alarm conditions arise.

If now the battery should fail for any reason, not only will the battery supervising relay 40 be energized and give the trouble signals, but a portion of the charging resistance 29—30 will be cut out of the main supply line, so that the main supply will be capable of supplying the increased current required when alarm conditions arise.

The battery supervising relay 40 is energized upon failure of the battery, both when the system is in its otherwise normal condition and when fire alarm or trouble alarm conditions exist. The manner in which the battery supervising relay is thus energized will be better understood if it is kept in mind that the voltage across the relay winding is normally the same as the voltage across the battery and across the external circuit between the junctions 24 and 25. In the system herein described, the resistance of the external circuit is considerably greater than the internal resistance of the battery, and is also somewhat greater than the value of the charging resistance 29—30. It also happens that in the system described the internal resistance of the battery is less than the value of the charging resistance 29—30. When, therefore, the battery fails for any reason with the substitution of practically infinite resistance in place of the normally small internal resistance of the battery, a considerably increased voltage drop will occur across the external circuit, due to the fact that removal of the battery charging current load will reduce the voltage drop across the charging resistance 29—30, and this increased voltage, occurring likewise across the winding of the relay 40, will cause the relay to pick up its armatures 99 and 100 and close the contacts at 101 and 102. The trouble signals will then be given by reason of current flowing from the positive line through the trouble gong and trouble lamp in parallel, the wire 90, one side of the switch 93, the resistance 103, the wire 104, the contact 102, the armature 100, and the wires 105 and 42 to the main supply terminal 7. Instead, however, of the connection from the main supply terminal 6 being through the charging resistance 29—30, the increased current which the main supply is called upon to supply when the fire or trouble gongs are sounded, requires that part of the charging resistance be by-passed, and it will accordingly be found that the portion 30 of the charging resistance 29—30 is short-circuited by closing of the contact 101, the path of the short-circuit being from one side

of the resistance 30 through the wire 106, the contact 101, the armature 99, and the wires 107, 41 and 31 to the other side of the resistance 30. If now the trouble gong be stopped by opening the switch 93, additional resistance must be drawn into the circuit to protect the trouble lamp 83, and this additional resistance will be found at 108, so that the trouble lamp is energized in a series circuit including the resistances 103 and 108.

It has already been pointed out that grounding of any one of the wires of any of the external circuits while at the same time the negative side of the main supply is normally grounded, results in the turning in of a fire signal. It should also be noted, in the same connection, that a broken wire or a broken circuit lamp will also turn in a fire signal. If therefore, upon the occurrence of a fire signal, manipulation of the switches on the operating panel at the central control station results in the illumination of one of the circuit lamps, it will be known that either a fire has occurred on the circuit indicated or a wire-break has occurred. Failure to locate a fire in any space protected by the circuit will eliminate the possibility of a fire and leave a wire-break to be looked for. On the other hand, if no circuit lamp is illuminated after manipulation of the switches, there is a possibility of a broken circuit lamp or a negative ground. Of course, the circuit lamps may be tested at once, thereby determining whether there has been a circuit lamp broken or a ground.

Reference has already been made to the normally closed switch 53', which will be found to be in the negative connection of the fire alarm signals. This switch is located on the operating panel at the central control station, and may be opened by the fire-watch attendant upon the occurrence of fire so as to silence the fire alarm gongs 58 and 64 and to darken the fire alarm lamp 62, while at the same time a circuit lamp remains illuminated to indicate the occurrence of a fire. This switch is preferably arranged to open automatically upon opening of the door of the control cabinet in which the central station apparatus is usually housed, so that any attempt to close the door without heeding the fire alarm will cause the fire signal to be repeated.

In connection with the resistances 10 and 52, it should be noted that these are current limiting resistances. Also, in connection with the condenser 109, this condenser is employed to prevent arcing at the contact 37 of the main supply supervising relay 27.

It will be understood that circuit lamps have been referred to by way of example only, it being possible to employ annunciator type relays in their place, or any other suitable electro-responsive indicator. Also any polarized type relay may be employed in place of the galvanometer relay referred to.

It will also be understood that the polarities of certain portions at least of the herein described system and circuits can be reversed without affecting either the principle of the invention or the practicability of operation of the system.

From the foregoing description it will be apparent that I have made various improvements in supervised electric alarm systems of the general type referred to, but while the invention has been described with specific reference to the accompanying drawing, it is not to be understood as limited, save as defined in the appended claims.

I claim:

1. In a supervised electric alarm system of the type comprising a plurality of external circuits connected in series with each other and with an electro-responsive device and a source of electric potential, in which each external circuit has at least one circuit opening means in series therewith and in which deenergization of the electro-responsive device effects actuation of an alarm signal, the combination of an electro-responsive indicating means for each external circuit, each arranged adjacent to and in series with its respective external circuit and with the series arrangement of the plurality of external circuits; whereby certain of the electro-responsive indicating means will be in series between successive external circuits, while all of the electro-responsive indicating means will be in series with all of said external circuits and said electro-responsive device; means to connect each external circuit on its side adjacent its associated electro-responsive indicating means with one pole of a source of electric potential through a current limiting means, means to connect each external circuit on its side remote from its associated electro-responsive indicating means with the opposite pole of said source of electric potential, and means to connect each electro-responsive indicating means on its side remote from its point of connection with its associated external circuit with said opposite pole of said source of electric potential; whereby when a circuit opening means on a particular circuit has opened and the aforesaid connecting means have been actuated, the electro-responsive indicating means of said particular circuit will render a desired indication.

2. In a supervised electric alarm system of the type comprising a plurality of external circuits connected in series with each other and with an electro-responsive device and a source of electric potential, in which each external circuit has at least one circuit opening means in series therewith and in which deenergization of the electro-responsive device effects actuation of an alarm signal, the combination of an electro-responsive indicating means for each external circuit, each arranged adjacent to and in series with its respective external circuit and with the series arrangement of the plurality of external circuits; whereby certain of the electro-responsive indicating means will be in series between successive external circuits, while all of the electro-responsive indicating means will be in series with all of said external circuits and said electro-responsive device; means to connect each external circuit on its side adjacent its associated electro-responsive indicating means with one pole of a source of electric potential through a current limiting means, means to connect the opposite pole of said source of electric potential to the points between the electro-responsive indicating means of each external circuit and each succeeding external circuit in the series of external circuits, and means to connect said opposite pole of said source of electric potential to the side of the first external circuit in the series and to the side of the electro-responsive indicating means of the last external circuit in the series most remote from each other electrically; whereby when a circuit opening means on a particular circuit has opened and the aforesaid connecting means have been actuated, the electro-responsive indicating means of said particular circuit will render a desired indication.

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