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FAULT-INDICATING MEANS FOR SIGNAL SYSTEMS

Original Filed June 4, 1934

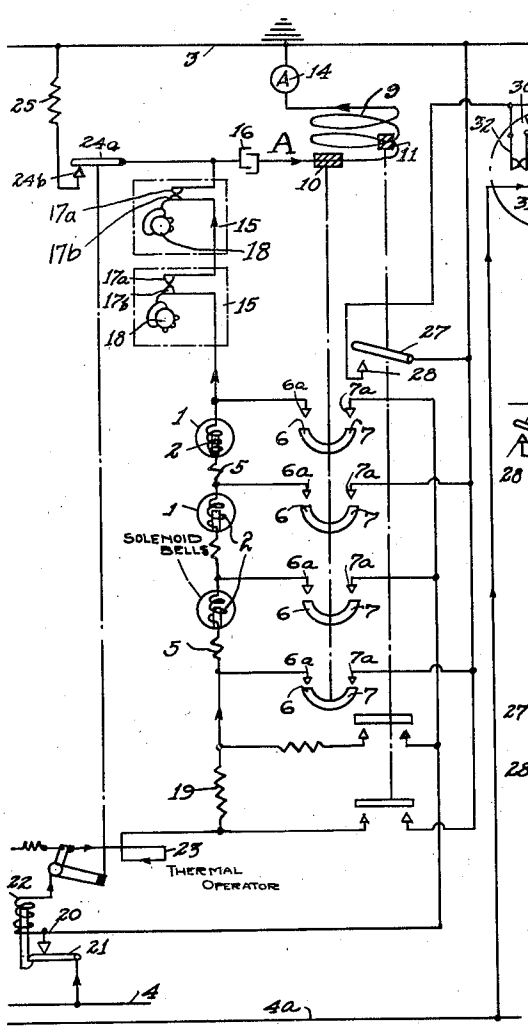


Fig. 1.

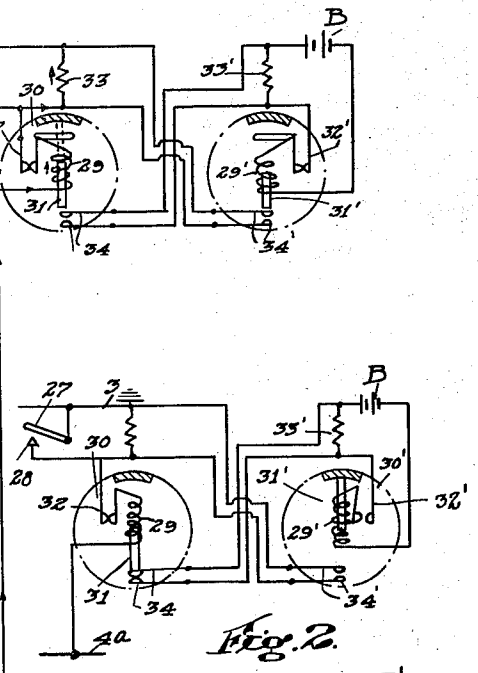


Fig. 2.

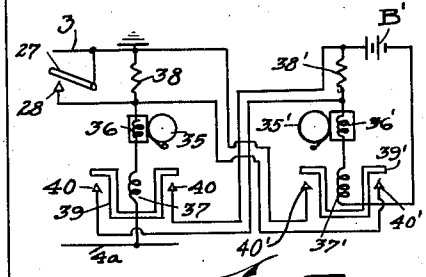


Fig. 3.

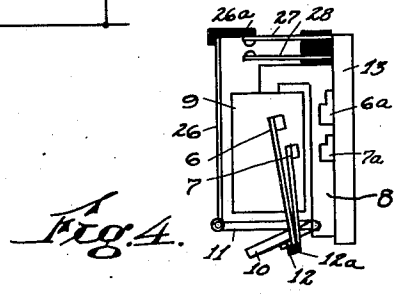


Fig. 4.

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FAULT-INDICATING MEANS FOR SIGNAL SYSTEMS

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Original application June 4, 1934, Serial No. 728,812. Divided and this application April 15, 1936, Serial No. 74,567

8 Claims. (Cl. 177—311)

The present application is a division of my original application, Serial No. 728,812, filed jointly with Frank Scherma, June 4, 1934, for an Alarm signal system, since issued as Patent No. 2,149,200, on February 28, 1939, and relates particularly to improved means for indicating the occurrence of a fault, power failure or any abnormal circuit condition which might occur in a system of the character contemplated by the aforesaid original application, or in any other supervised electrical system.

According to the invention of the present application, there is provided an arrangement, whereby the means for indicating trouble in a supervised electrical system is also supervised, with provision being made for additional supervision of the auxiliary trouble indicating means. As a result, any fault in either the supervised system or in the doubly supervised trouble indicating means, is immediately called to attention. The above and other advantageous features of the invention will hereinafter more fully appear from the following description with reference to the accompanying drawing, in which:

Fig. 1 is a schematic view illustrating a signal system, to which there has been applied double or cross supervision of the trouble-indicating means.

Fig. 2 is a fragmentary view illustrating functioning of the trouble-indicating means.

Fig. 3 is a fragmentary view illustrating a modification in the manner of obtaining double supervision.

Fig. 4 is a view of side elevation of a master controller for the system.

Like reference characters refer to like parts in the different figures.

The invention is shown in Fig. 1, for purposes of illustration, as being embodied in an alarm signal system in which signals 1, indicated as being of the single-stroke solenoid and plunger type, are shown as each providing an operating winding 2. The windings 2 of the signals 1 are adapted to be connected in sections across the supply mains 3 and 4, with balancing resistors 5 therebetween, by means of a number of pairs of relatively movable contacts 6 and 6*a*, 7 and 7*a*, with such contacts forming part of a master controller generally indicated by the reference character A.

Referring to Fig. 4, the master controller A comprises a U-shaped magnetic core 8, one leg of which is surrounded by an energizing winding 9, while the lower end of the other core leg supports a main armature 10 and an auxiliary armature 11 movable independently of the main armature. The main armature 10 carries a bar 12 on which are mounted, in pairs, a number of contacts 6 and 7 corresponding to the movable contacts of the several sets of contacts shown in Fig. 1 for controlling energization of the signal windings 2. These contact arms 6 and 7 are insulated from the bar 12 at 12*a* and cooperate with stationary contacts 6*a* and 7*a* mounted on an insulating base 13 carrying the master controller A. Therefore, closure of the main armature 10, in response to energization of the winding 9, is adapted to simultaneously energize the signal windings 2 in sections according to the connection of the several stationary contacts 6*a* to the signal windings 2 and the connection of the other contacts 7*a* to the supply mains 3 and 4.

Referring again to Fig. 1, the winding 9 of the master controller A is shown as having one terminal permanently connected to the supply main 3 through an ammeter 14, while the other terminal thereof is connected in series with a number of alarm sending stations 15, 15 disposed at various locations throughout the system from where it is desired to send an alarm. The stations 15 are also in circuit with the several signal windings 2, with a condenser 16 interposed between the stations 15 and the winding 9 when the supply mains 3 and 4 are energized from an alternating current source. Each sending station 15 provides a pair of relatively movable contacts 17*a* and 17*b*, normally closed, so long as the station is in a non-operating condition and, for purposes of illustration, each station 15 is shown as comprising a contact-actuating member 18 in the form of a cam wheel, normally stationary. The function of the cam wheel 18, when rotated, is to open and close the contacts 17*a* and 17*b* to successively interrupt and re-establish the circuit through the stations 15.

Since many different types of sending stations are employed in fire alarm systems, it is unnecessary to further describe the structural details of each station 15, other than to say that, normally, the position of the cam wheel 18 is such as to maintain the station contacts 17*a* and 17*b* closed while the station is in its non-operating condition. Then, upon actuation of the station for the purpose of sending an alarm, rotation of the cam wheel 18 momentarily separates the contacts 17*a* and 17*b*, whereupon engagement of the contacts is re-established, in accordance with the arrangement of the cam projections on the wheel 18. In other words, operation of a sending station 15 results in alternately breaking and

re-making the circuit through the station contacts 17a and 17b, and obviously the cam wheel 18 can be driven through suitable operating mechanism, not shown, so as to send a number of signal impulses through the system for operating the signal windings 2 in accordance with a code, all as fully described in my aforesaid original application, Serial No. 728,812, now issued as Patent No. 2,149,200

With the parts of the system in the condition shown in Fig. 1, that is, the normal condition in which the system is prepared to send signals, a continuous circuit is maintained from the lower terminal of the winding 9 through the closed contacts 17a and 17b of the several stations 15 in series, and from thence to the other supply main 4 through the windings 2 of the signals 1, also in series. Beyond the windings 2, the circuit to the supply main 4 also includes a resistor 19, and the normally closed contacts 20 and 21 of a time delay cut-out device comprising an operating winding 22 in circuit with one of the contacts 20. In passing to the winding 22 the current also traverses the thermal element 23 of an automatic interruptor.

The circuit interruptor of which the thermal element 23 forms a part, comprises a pair of normally closed contacts 24a and 24b, which are connected in circuit with a resistor 25 between the main 3 and the lower terminal of winding 9, so as to constitute a shunt around the controller winding of less resistance than the winding 9. The existence of this shunt circuit permits the flow of only a small supervisory current through the winding 9 of the master controller A, as indicated by the small arrows in Fig. 1, which current also traverses the stations 15, the signal windings 2, thermal element 23 and cut-out winding 22. As a result, the winding 9 of the master controller is not energized sufficiently to pull up the main armature 10, so that the several pairs of contacts 6 and 6a and 7, 7a which control the energization of the signal windings 2 remain in an open condition.

The strength of the supervisory current flowing through the winding 9 of the master controller A is sufficient, however, to hold up the auxiliary armature 11, as shown in Fig. 4. The free end of the auxiliary armature 11 carries a rod 26 extending upwardly in front of the winding 9, and with the armature held up by the supervisory current, an insulating plate 26a at the upper end of the rod is held just clear of a resilient contact 27 that is normally spaced from a second stationary contact 28. The contact 27 is connected to the supply main 3, while the other contact 28 leads to one terminal of the winding 29 of a trouble signal 30.

The trouble signal 30 is illustrated as being of the solenoid bell type, wherein the winding 29 surrounds a magnetic plunger 31. One terminal of the winding 29 is connected to the supply main 4a, while the other terminal thereof is connected in parallel, through interruptor contacts 32, to the contact 28 and one terminal of a resistor 33. The other terminal of resistor 33 is connected to main 3 and the resistor 33 serves to reduce current passing through the winding 29 to a very low value, as indicated by the small arrows. With the small supervisory current flowing through the winding 29, the plunger 31 is maintained in a position in which its upper end is partly within the winding 29, and this is the position which the plunger normally occupies in the supervised condition of the circuit.

The contacts 27 and 28 under the control of the auxiliary armature 11 are connected across the terminals of the resistor 33, and as long as these contacts are held separated by the raised armature 11, only the supervisory current flows through the trouble signal winding 29. However, upon dropping of the armature 11, as upon the occurrence of an open circuit or ground in the signal system, closure of the contacts 27 and 28 will establish a direct connection of one terminal of winding 29 to the main 3, with consequent full energization of this winding. This results in the plunger 31 being drawn upwardly into the winding 29, as indicated in dotted lines, to strike the resonant member of the signal a single blow. As the plunger moves to its extreme striking position, it operates one movable interruptor contact member 32 to momentarily break the flow of current through winding 29, whereupon the plunger 31 drops back part way and is immediately drawn upwardly to give another stroke due to reenergization of the winding circuit upon reclosure of the contacts 32. In other words, so long as the contacts 27 and 28 remain closed, the trouble signal 30 will sound intermittently to give indication of the existence of some abnormal condition in the signal system.

Upon any interruption of the power supply to the mains 3 and 4a, or upon the occurrence of any break in the circuit of winding 29, the flow of supervisory current through the winding stops, thereby completely deenergizing the winding and permitting the plunger 31 to drop back to the position shown in Fig. 2, in which only a very small portion of the upper end of the plunger is disposed within the winding 29. With the plunger 31 in this position, its lower end presses together a pair of contacts 34 which are normally separated when the plunger 31 is partly raised, due to the flow of supervisory current. The contacts 34 are connected across the terminals of a resistor 33' that is in circuit with the winding 29' of an auxiliary trouble signal 30' that is adapted to be energized from an auxiliary source of power, such as a battery B. With the resistance 33' in circuit with the winding 29', the flow of current therethrough is reduced to such a value that a plunger 31' within the winding 29' is held in a slightly raised position, just out of engagement with normally open contacts 34' connected across the terminals of resistor 33.

Upon closure of the contacts 34, due to the dropping of the plunger 31 to its lowest position, as shown in Fig. 2, the resistor 33' is shunted out and sufficient current then passes through the winding 29' to cause the plunger 31' to strike the resonant member of the signal 30' a single blow. An interruptor including contacts 32' is also in the circuit of the winding 29', so that the plunger 31' is adapted to give recurrent strokes as long as the winding 29' is energized with full current. Therefore, the auxiliary signal 30' is adapted to be operated upon any interruption of the power source supplying the mains 3 and 4a, or upon any break in the circuit of winding 29. The resonant members of the signals 30 and 30', respectively, can have different tones, or different rates of striking, so that the person responsible for the maintenance of the alarm system will know the general nature of the trouble which is indicated by operation of either signal.

Upon failure of the auxiliary power source B, or occurrence of a break in the circuit of winding 29', the supervisory current through winding 29' will be interrupted and the plunger 31' will drop

to its lowermost position to close contacts **34'** and shunt out resistor **33**. This will cause operation of the trouble signal **30** to indicate failure of the auxiliary power source B, or a fault in the signal **30'**, and since the signals are preferably mounted adjacent to each other, the condition of the contacts **34** and **34'** can be readily ascertained to localize the particular source of trouble.

Referring now to Fig. 3, there is shown a modification in the manner of providing double or cross supervision of both trouble signals and the auxiliary source of supply. In this modified arrangement, one trouble signal is indicated at **35**, with its winding **36** having one terminal thereof connected to the supply main **4***a* in series with the winding **37** of a relay. The other terminal of the winding **36** is connected to the supply main **3** through a resistor **38** which reduces the current passing through the windings **36** and **37** to a very low value, which while not sufficient to operate the signal **35**, is sufficient to cause the winding **37** to hold a bridging member **39** out of engagement with a pair of spaced contacts **40**.

The contacts **27** and **28** under the control of the auxiliary armature **11** are connected across the terminals of the resistor **38**, and as long as these contacts are held separated by the raised armature **11**, only the supervisory current flows through the trouble signal winding **36** in series with the relay winding **37**. However, upon dropping of the armature **11**, as upon the occurrence of an open circuit or ground in the signal system, closure of the contacts **27** and **28** will establish a direct connection of one terminal of winding **36** to the main **3**, with consequent full energization of the winding **36** to operate the trouble signal **35** and give indication of the existence of some abnormal condition in the signal system.

Upon interruption of the power supply to the mains **3** and **4***a*, or the occurrence of a break in the circuit of winding **36**, the flow of supervisory current through the windings **36** and **37** is interrupted, thereby completely de-energizing the winding **37** and permitting its bridging member **39** to drop and establish a circuit between the contacts **40**. The contacts **40** are connected across the terminals of a resistor **38'** that is in circuit with the winding **36'** of an auxiliary trouble signal **35'**, adapted to be energized from an auxiliary source of power B'. The winding **36'** is in series with the winding **37'** of a relay and with the resistor **38'** in the circuit, the flow of supervisory current is just enough to hold a bridging member **39'** under the control of winding **37'** out of engagement with a pair of spaced contacts **40'**. Upon bridging of contacts **40**, it is evident that the resistor **38'** will be shunted out, whereupon sufficient current passes through the auxiliary trouble signal winding **36'** to energize the same. Therefore, the auxiliary signal **35'** is adapted to be operated upon any interruption of the power source supplying the mains **3** and **4***a*, or upon a break in the circuit of winding **36**.

Upon any interruption of supervisory current in the windings **36'** and **37'**, the bridging member **39'** will fall and engage the contacts **40'**. Since these contacts **40'** are connected in parallel with the then open contacts **27** and **28**, their closure will also have the effect of shunting out the resistor **38** to cause full energization of the trouble signal winding **36**. Therefore, any failure of the auxiliary power source B', or any break in the circuit of winding **36'**, will be immediately indicated by operation of the trouble signal **35**. Thus, the arrangement of Fig. 3 provides double or cross supervision of both trouble signals and their circuits, as well as supervision of both power sources.

I claim:

1. In a normally closed electrical system carrying a small supervisory current, a fault-indicating signal, means for energizing said signal to cause its operation in response to any interruption in the flow of said supervisory current in the system, means for maintaining the flow of a small supervisory current through said signal insufficient to cause operation thereof, a second signal for indicating any interruption in the flow of supervisory current through the first signal, means for maintaining the flow of a small supervisory current through the second signal, and means for causing the first signal to operate upon any interruption in the supervisory current through the second signal.

2. In combination with a normally closed electrical system, a fault-indicating signal for said system providing an energizing winding, means for maintaining the flow of a small supervisory current through said winding insufficient to cause operation of said signal, a second signal for indicating any interruption in the flow of supervisory current through the winding of the first signal, means for maintaining the flow of supervisory current through said second signal, and means for increasing the flow of current through the winding of the first signal to cause its operation upon the occurrence of a fault in the system, or upon an interruption of the flow of supervisory current through said second signal.

3. In combination with a normally closed electrical system, a fault-indicating signal for said system providing a solenoid and a magnetic striker, means for maintaining the flow of a small supervisory current through said solenoid just sufficient to hold said striker in a slightly raised position without operating the signal, a second fault-indicating signal, and means for causing operation of said second signal upon dropping of the striker of the first signal, upon any interruption of the supervisory current flowing in said solenoid.

4. In combination with a normally closed electrical system, a fault-indicating signal for said system providing a solenoid and a magnetic striker, means for maintaining the flow of a small supervisory current through said solenoid just sufficient to hold said striker in a slightly raised position without operating the signal, a second fault-indicating signal providing a solenoid and striker similar to the first signal, means for maintaining a flow of supervisory current through the solenoid of the second signal, and means for increasing the flow of current through one solenoid to cause its striker to operate in response to dropping of the striker of the other signal upon interruption in the flow of supervisory current through its solenoid.

5. In combination, an electrical circuit, independent normally closed electrical circuits each including fault-indicating means and means for maintaining a flow of supervisory current through said circuits insufficient to cause operation of said fault-indicating means, and interconnecting means for said circuits, to cause operation of either one of said indicating means in response to an interruption in the flow of supervisory current in the circuit of the other indicating means, and to additionally cause operation of one indicating means in response to the occurrence of a fault in the first-named circuit.

6. In combination, an electrical circuit, independent normally closed electrical circuits each including fault-indicating means and separate sources of electrical energy for maintaining a flow of supervisory current through said first-named circuit as well as through said independent circuits insufficient to cause operation of said fault-indicating means, and interconnecting means for said circuits to cause operation of either one of said indicating means in response to failure of the source supplying the supervisory circuit of the other indicating means, and to additionally cause operation of one indicating means in response to failure of the source supplying said first-named circuit.

7. In combination, an electrical circuit, a first fault-indicating signal, a second fault-indicating signal, means for maintaining a flow of supervisory current through said circuit and both signals, with the value of said supervisory current insufficient to cause operation of either signal, means responsive to interruption of supervisory current through the first signal to operate the second signal, and means responsive to interruption of supervisory current through said circuit or said second signal, to operate the first signal.

8. In combination, an electrical circuit, a first fault-indicating signal, a second fault-indicating signal, means for maintaining a flow of supervisory current through said circuit and both signals, with the value of said supervisory current insufficient to cause operation of either signal, and means including cross connections between said circuit and said signals whereby any interruption of supervisory current through the first signal serves to operate the second signal, and any interruption of supervisory current in said circuit, or through said second signal, serves to operate the first signal.

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