

May 16, 1933.

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1,909,212

SELECTIVE CONTROL CIRCUIT FOR ALARM SYSTEMS

Filed March 11, 1930

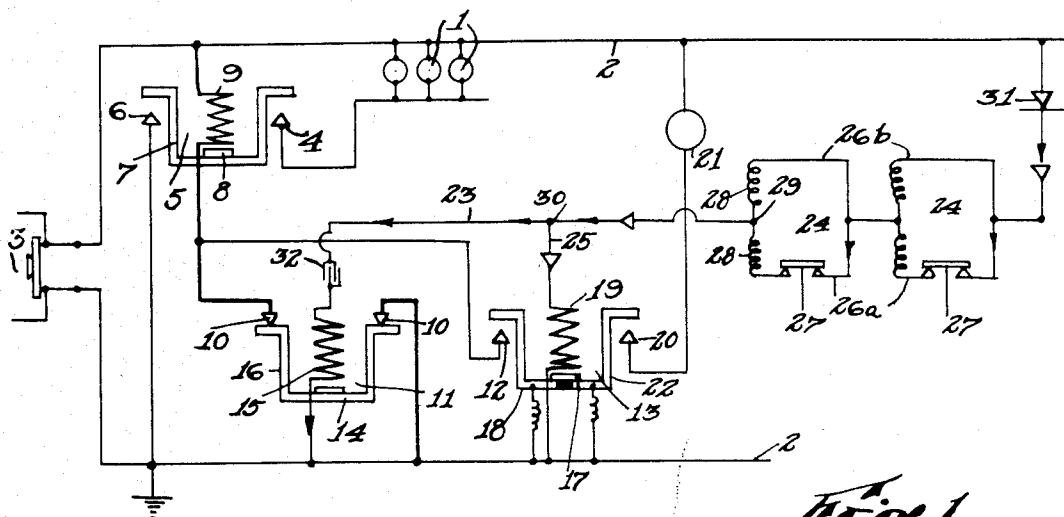


Fig. 1.

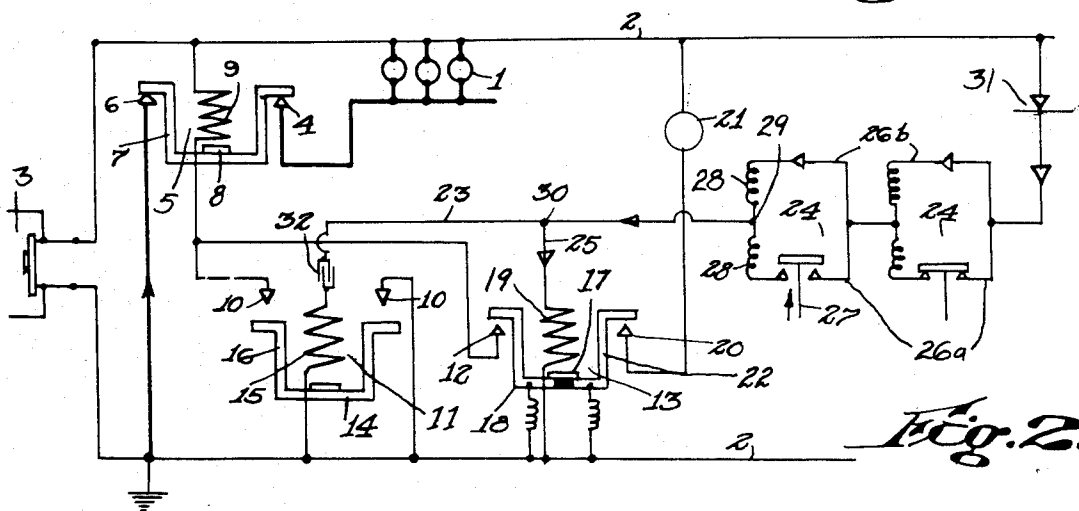


Fig. 2.

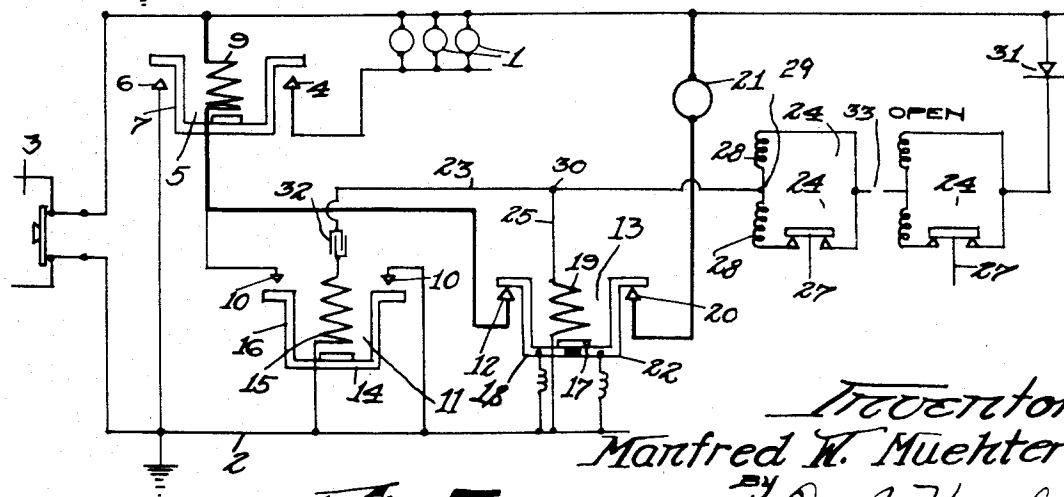


Fig. 3.

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UNITED STATES PATENT OFFICE

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SELECTIVE CONTROL CIRCUIT FOR ALARM SYSTEMS

Application filed March 11, 1930. Serial No. 434,841.

The present invention relates to a control circuit for alarm systems particularly of the closed circuit fire alarm type in which the alarm bells are adapted to be rung either continuously, or in accordance with a code, upon the interruption of the normally closed circuit through any one of a number of alarm station boxes.

In addition to the alarm bells employed in a system of the above described type, the system usually also provides a so-called trouble bell or other indicating device which is adapted to be sounded, or energized, when there is any trouble in the system such as would be caused by an open wire, or ground. The purpose of such a trouble signal is to indicate to the person responsible for the care of the installation that there is an open wire, or ground, somewhere on the system so that the trouble will be remedied at the earliest opportunity.

While such trouble indicating devices have been heretofore employed for fire alarm systems, prior installations of the closed circuit type have operated in such a manner that upon the occurrence of trouble, the signal alarm devices would be sounded simultaneously with the energization of the trouble indicator, in other words, sound a false alarm. Obviously, such premature operation of the alarm signals is undesirable under any conditions, particularly in a fire alarm installation for a school where the sounding of a false alarm might well lead to confusion. Furthermore, fire alarm systems of the closed circuit type have also been open to the objection that the trouble indicating device is energized upon the sounding of the alarm signals, which in some cases may be undesirable.

According to the present invention, the above described objectionable characteristics are completely eliminated by providing a selective control circuit in which the energization of the trouble indicator is rendered independent of the energization of the alarm circuit, so that only the trouble indicator will be energized upon the occurrence of an open circuit, or ground, on the system. Furthermore, my improved control circuit

is so arranged that the trouble indicator will not be energized upon sounding the alarm signals in the customary manner by breaking the circuit at one of the box stations. The above and other advantageous features of the invention will hereinafter more fully appear with reference to the accompanying drawing in which—

Fig. 1 is a diagrammatic view illustrating a fire alarm system embodying my invention in its normal inoperative position.

Fig. 2 is a diagrammatic view illustrating the sounding of the alarm bells upon operating a box station in the usual manner.

Fig. 3 is a diagrammatic view illustrating the energization of the trouble indicator upon the occurrence of an open wire, or ground, on the system.

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

Referring first to Fig. 1, the system is shown with a simplified circuit in order to facilitate an understanding of the invention, it being readily apparent that additions and modifications may be made to the apparatus shown, without departing from the invention. As an illustrative embodiment of the invention, the system is shown as comprising a series of gongs 1, 1 which are distributed at various points, one end of the gong circuit being connected to one of two supply mains 2 which are adapted to be energized from a suitable source of alternating current energy, not shown, through a switch 3. The other end of the circuit through the gongs 1 is connected to a stationary contact 4 forming part of a relay device, generally designated by the reference character 5. The gong relay 5 provides a second stationary contact 6 connected to the other supply main 2 and a circuit is adapted to be established between the stationary contacts 4 and 6 by means of a bridging member 7 carried by the movable armature 8 of the relay 5. As shown in Fig. 1, the armature 8 is held attracted by an energized winding 9, so as to maintain the bridging member 7 out of engagement with the contacts 4 and 6, thus maintaining the

circuit through the gongs 1 in an open condition.

One terminal of the winding 9 of the gong relay 5 is connected to one supply main 2, while the other terminal thereof is connected in parallel circuit relation with a stationary contact 10 of a relay 11 and a second stationary contact 19 of a relay 13. The relay 11 provides a second contact 10 spaced from the first one, and when the armature 14 of the relay 11 is attracted by the energized winding 15, the armature 14 maintains a bridging member 16 in engagement with the spaced contacts 10. Therefore, so long as the winding 15 remains energized, the circuit of the winding 9 of the gong relay 5 is maintained so as to hold up the armature 8 and keep the gongs 1 silent.

The relay 13 provides an armature 17 carrying a contact arm 18 that is adapted to be maintained out of engagement with the stationary contact 19 when the winding 19 of the relay 13 is energized, as shown in Fig. 1. The arm 18 is connected to one supply main 2, so that it is evident that should the winding 19 be deenergized, a holding circuit for the winding 9 of the gong relay 5 will be established through the stationary contact 19 and movable contact arm 18 of the relay 13 when the armature 17 drops back.

The relay 13 provides a second stationary contact 20 connected to one terminal of a trouble signal 21, shown as a bell, the other terminal of which is permanently connected to one supply main 2. The stationary contact 20 of the relay is adapted to be engaged by a movable contact arm 22 carried by the armature 17, the arm 22 being connected to the other main 2. Consequently, should the winding 19 of the relay 13 be deenergized to permit the armature 17 to drop, the trouble bell 21 would be sounded by being connected across the mains 2.

One terminal of the winding 15 of the relay 11 is connected to one main 2, while the other terminal thereof is connected in series with a condenser 23 to a line conductor 24 leading to a series of box stations indicated by the reference characters 24. One terminal of the winding 19 of the relay 13 is likewise connected to one main 2, while the other terminal thereof is connected by a conductor 25 to the line 23 and stations 24 in parallel with the conductor 23, and the manner in which the flow of current through the conductors 23 and 25 is selectively controlled in accordance with my invention will now be described.

The box stations 24 are connected in series circuit relation to one main 2, and since the stations 24 are identical, only one need be described in detail. Each box station 24 provides parallel conductors 26a and 26b and the conductor 26c contains a switch

27 of a type customarily employed in fire alarm stations. Normally, the switch 27 is closed to permit the flow of current through the conductor 26a, but should the station 24 be operated for the purpose of sounding an alarm, as by breaking a glass, the switch 27 will be opened. The parallel conductor 26b is continuous and the two conductors 26a and 26b are connected to the respective ends of an inductance coil 28. The middle of the coil 28 provides a tap at 29, and this tap is connected over the line 23 to the junction 30 leading to the relay windings 15 and 19, respectively. With the switch 27 of each station 24 closed, which is the normal condition of affairs, it is obvious that current will flow in opposite directions in the opposed branches of each inductance coil 28, and since the tap 29 leading from the coil 28 is at the middle point thereof, the two portions of the coil 28 will balance each other and permit alternating current to flow equally through the conductors 26a and 26b, the resulting impedance of coil 28 being very small.

However, should the switch 27 of any one of the stations 24 be opened, as upon breaking the glass at the station for the purpose of sounding an alarm, current will flow through one side only of the coil 28, from conductor 26b, thereby unbalancing the circuit through the station to such an extent as to restrict the flow of alternating current through the stations. The coil 28 is so proportioned that when the flow of current through the conductor 26a is interrupted by opening the switch 27, the flow of alternating current through the conductor 26b will be so reduced as to practically deenergize the winding 15 of relay 11 and permit the armature 14 to drop back, as indicated in Fig. 2. This has the effect of deenergizing the winding 9 of the gong relay 5, thereby permitting the armature 8 to drop back, bridge the contacts 4 and 6 and sound the gongs 1 for a fire alarm, as indicated by the heavy circuit lines in Fig. 2.

In the absence of any other influence, the choking action of the coil 28 upon opening the circuit at a box station 24 would also cause the winding 19 of the relay 13 to be deenergized, assuming the winding 13 had the same characteristics as the winding 15. If this were permitted, it is obvious that the dropping back of the armature 17 would cause the switch arm 22 to engage the stationary contact 20 and sound the trouble bell 21. However, as previously pointed out, the present invention contemplates a circuit arrangement, selective in its action, which so functions as to prevent the armature 17 of the relay 13 from dropping back when the armature 15 of relay 11 drops back to cause sounding of the alarm gongs 1.

The principle underlying the selective ac-

tion of a circuit arrangement embodying my invention resides in the simultaneous use of both alternating current and direct current for the purpose of supervising the alarm box circuit. As indicated in the drawings, one possible way of obtaining this effect is by employing in the box circuit a rectifier 31 of the one-way type such as the so-called "cuprous oxide" rectifier which is an unsymmetrical conductor of electrical current, although obviously there are other ways of obtaining the same result. When employing a one-way rectifier 31, as indicated, the resulting supervisory current is direct current with alternating current superimposed thereon having the same frequency as that of the supply mains 2, whereas a two-way rectifier would furnish direct current with alternating current of double frequency. Obviously, it would be possible to obtain the same result by eliminating the rectifier 31 and simultaneously supplying the mains 2 with both direct current and alternating current from suitable sources. In the diagrams, the solid arrowheads indicate the flow of alternating current, while the open arrowheads indicate the flow of direct current.

In order to provide for a selective control with both alternating current and direct current flowing simultaneously, the relays 11 and 13 are adapted to operate only on alternating current and direct current, respectively. Since the winding 15 of the relay 11 is in series with the condenser 32, relay 11 can be operated only by alternating current, and since the winding 19 of relay 13 has a high impedance, alternating current will not energize the relay 13. On the other hand, the winding 19 offers a comparatively low resistance to the flow of direct current, so that the winding 19 will remain energized as long as direct current is flowing in the circuit.

When the alarm gongs 1 are to be sounded by breaking the circuit through a box station at a switch 27, as shown in Fig. 2, it is evident that direct current will continue to flow through the conductor 26b in spite of the fact that the unbalancing of the box circuit by the coil 28 chokes the flow of alternating current to such an extent as to deenergize the winding 15. This result is obtained owing to the fact that the ohmic resistance of the circuit is only increased by twenty-five percent of the resistance of the whole coil 28, this resistance being only a very small percentage in comparison to the ohmic resistance of the complete circuit. Consequently, opening the box switch 27 does not materially effect the flow of direct current through the winding 19 of the relay 13, as indicated by the open arrowheads in Fig. 2. On the other hand, the unbalancing of the coil 28 by opening the switch 27 has a great influence on the

impedance of the whole circuit, since the full inductance of one-half of the coil 28 is suddenly inserted into a circuit which before the opening of a switch 27 was nearly non-inductive in character, owing to the complete balance obtained by alternating current flowing in equal amount through the identical half portions of each coil 28. Therefore, the winding 19 remains energized by the continued flow of unidirectional current therethrough when the gongs 1 are sounded for the alarm, and it is evident that the trouble bell 21 will not be energized. And, assuming that the alarm circuits are functioning properly, as indicated in Fig. 2, it is evident that there will be no indication by the trouble bell 21 upon the normal sounding of an alarm.

Let it now be assumed that there is an open wire in the circuit between the box stations 24, as indicated at 33 in Fig. 3, so that the flow of current is entirely interrupted through the box circuit. When this occurs, both the windings 15 and 19 are simultaneously deenergized so that both armatures 14 and 17 drop back, as indicated in Fig. 3, and obviously, the trouble bell 21 is sounded when the contact arm 22 engages the stationary contact 20. But the signal gongs 1 are not sounded owing to the fact that the contact arm 18 carried by the armature 17 engages the contact 12 to establish a holding circuit for the winding 9 of the gong relay 5, as indicated by the heavy circuit lines in Fig. 3. Therefore, the signal gongs 1 will not be sounded to give a false alarm upon the occurrence of trouble in the system. Obviously the occurrence of a ground will result in the same condition of affairs shown in Fig. 3 for since the windings 15 and 19 are connected to the grounded main 2 the voltage will fall so low as to deenergize the winding 19 and again cause it to both sound the trouble bell 21 and establish a holding circuit for the winding 9 to prevent sounding of the signal gongs 1. In order to insure that the contact arms 18 and 22 will engage the respective contacts 12 and 20 before the contacts 4 and 6 are connected by armature 7, the relay 5 is so designed that its armature 7 has to fall farther than the armature 17 in order to engage the stationary contacts, this relation being indicated in Fig. 1. Consequently when windings 15 and 19 are simultaneously deenergized, winding 9 is reenergized before the armature 7 engages contacts 4 and 6.

I claim:

1. In an electrical control circuit, the combination with a source of alternating current, means for causing the flow of unidirectional current, a circuit controller having a winding responsive to alternating current and a circuit controller having a winding responsive to unidirectional current, of

- means continuously in circuit with the windings of both of said controllers for causing selective operation of said controllers in response to the flow of either alternating or unidirectional current, said selecting means comprising parallel branch circuits having balanced inductances when both of said branch circuits are closed, and including means for opening one of said branch circuits to upset the inductive balance to choke the flow of alternating current and cause deenergization of one of said circuit controllers while sustaining the flow of unidirectional current to maintain the other circuit controller in an energized condition.
2. In an electrical control circuit, the combination with a source of alternating current, means for causing the flow of unidirectional current, a circuit controller having a winding responsive to alternating current and a circuit controller having a winding responsive to unidirectional current, of means continuously in circuit with the windings of both of said controllers for causing selective operation of said controllers in response to the flow of either alternating or unidirectional current, said selecting means comprising parallel branch circuits having balanced inductances when both of said branch circuits are closed, to sustain a flow of alternating current of sufficient strength to maintain the winding of the first-named circuit controller in an energized condition, and including means for opening one of said branch circuits to upset the inductive balance and choke the flow of alternating current through the other branch circuit to such an extent as to cause deenergization of the previously energized winding of said circuit controller.
3. In an electrical control circuit, the combination with a source of alternating current, means for causing the flow of unidirectional current, a circuit controller having a winding responsive to alternating current and a circuit controller having a winding responsive to unidirectional current, of means continuously in circuit with the windings of both of said controllers for causing selective operation of said controllers in response to the flow of either alternating or unidirectional current, said selecting means comprising parallel branch circuits having balanced inductances when both of said branch circuits are closed, to sustain the flow of both alternating and unidirectional current of sufficient strength to maintain the windings of both of said circuit controllers in an energized condition, and including means for opening one of said branch circuits to upset the inductive balance and choke the flow of alternating current in the other branch to such an extent as to cause deenergization of the winding of the first-named circuit controller, while sustaining the flow of unidirectional current to maintain the energization of the winding of the last-named circuit controller.
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