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ELECTRIC ALARM SYSTEM

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FIG. 3.

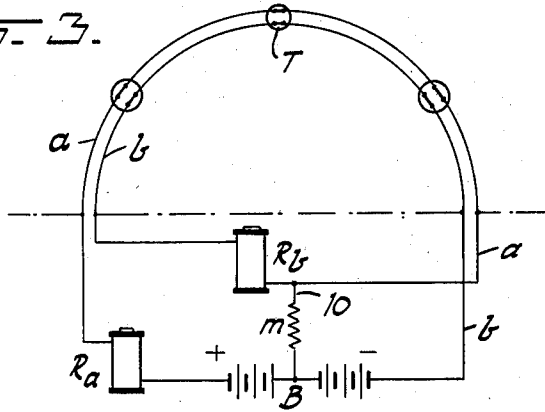


FIG. 4.

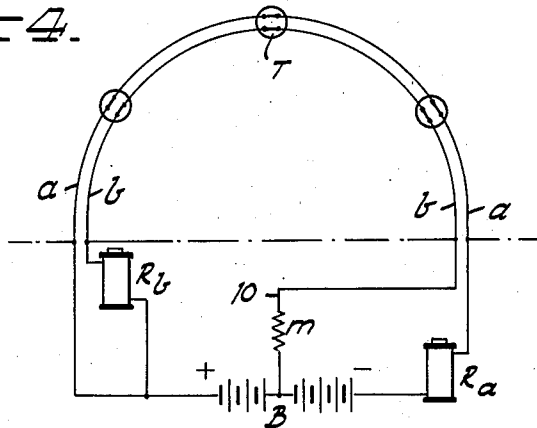
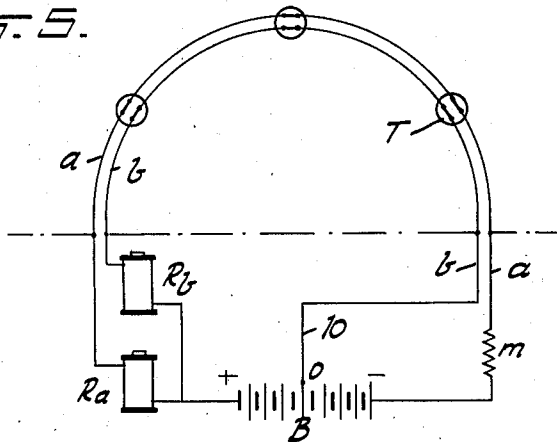


FIG. 5.



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ELECTRIC ALARM SYSTEM

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11 Claims. (Cl. 177-311)

This invention relates to automatic electric systems for giving the alarm in cases of fire or other danger.

The chief object of this invention is to increase the certainty of operation of such systems and to cause the system to operate the alarm even under unfavourable conditions.

Another object of this invention is to render it possible for the system to operate properly, even if a part or parts of the source of electric current are out of operation.

Another object of this invention is to increase the safety against false alarm.

Other objects will be evident from the following specification and claims.

Several embodiments of the invention are illustrated in the annexed drawings, which show connection diagrams of various systems according to the invention.

Referring now to Fig. 1 of the drawings, *a* and *b* indicate two conductors or wires of a section or control circuit, extending through the localities to be protected. Into the wires double current breakers or thermocontacts (fusible contacts) *F* are inserted and arranged at convenient places at said localities. The *b*-wire or branch has one end connected to the plus pole of the battery *B* via the winding of a section relay *R_b*, while the other end of said wire is directly connected with the middle or zero point of the battery. To the same middle point also the *a*-wire is connected through the winding of a section relay *R_a*, while the other end of the *a*-wire is connected with the minus pole of the battery via a small protective resistance *m*.

Both relays *R_a*, *R_b* are normally supplied with current and are excited, holding their armatures attracted.

In Fig. 1,—as well as in the other figures,—one single section or loop is shown, but other sections may be provided which would preferably be connected with the battery *B* in quite similar manner. The number of sections is arbitrary. The sections may have three or more wires each. In addition to the devices shown also indicating members, switches and the like should be provided, for instance, as shown in U. S. Patent No. 2,059,510. Such members do not form any part of this invention and are well-known in the art. For this reason they are not shown in the present drawings.

The system described operates as follows:

When the *a*-wire is broken, the current normally flowing through the relay *R_a* is cut off and for this reason this relay is de-energized, falls

off and indicates the break in well-known manner. In similar manner, the relay *R_b* is de-energized, when the *b*-wire is broken, and indicates the fault. If both wires are broken simultaneously, the two relays *R_a*, *R_b* are de-energized at the same time, one or more relays and a fire alarm relay are energized in well-known manner, see for instance, U. S. Patent No. 2,059,510.

In case of a short-circuit between the wires *a*, *b*, the relay *R_a* is evidently short-circuited, independently of the position of the fault within the section, because the resistance of the wires always is very low in relation to the resistance of the winding of the relay. The relay *R_a* thus short-circuited is de-energized, falls off and indicates the fault, but the relay *R_b* has still its full normal current and remains excited, thus preventing false alarm. As shown in Fig. 1, the middle point of the battery may be permanently grounded. In this case, if a point of the *a*-wire is grounded, the relay *R_a* is short-circuited in similar manner and de-energized. If a point of the *b*-wire is connected with the earth, nothing happens, such ground-connection being of no importance and having no influence upon the operation of the system.

To attain an equal discharge of the two halves of the battery, the resistance of the relay *R_b* is, preferably, equal to the sum of the resistances of the protector member *m* and of the relay *R_a*. If the windings of the relays have the same resistance, an equal discharge may be attained by connecting the conductor *10* to another inner point of the battery than the middle point. The protective resistance *m*, for which other current-limiting means may be substituted, may also be arranged in the conductor *10* or between the central battery connection of the *b*-wire and the conductor *10*.

It is evident that the wires *a*, *b* of the section or sections are connected with more than two taps of the battery in such manner that at a contact between the wires a potential is carried from one wire to the other at the point of contact, while simultaneously at least one relay of a section remains energized. It is also evident that this result is attained without the use of balance or compensation resistances connected in series between the wires. In the systems heretofore known such energy-consuming resistances are necessary which are short-circuited or cut off in case of contact between the wires.

Consequently, in the systems embodying the present invention, false alarm is avoided in case of contact between the wires, and simultaneously

a reliable indication of the contact is attained without the use of high, energy-consuming resistances, which reduce the sensitivity of the relays and consequently decrease the safety of operation.

The invention may be said to be based upon the following principles:

(1) A short-circuit or contact between the wires *a*, *b* shall bring about a change of the electric state of the section, thus rendering it possible to effect an indication of the contact.

(2) This change of the electric state must not render all wires of the same section currentless, because otherwise all section relays will be de-energized and cause false alarm.

(3) At the point of contact a potential or voltage shall be carried over from one wire to the other, to effect said change of the electric state.

(4) This carrying over of a potential is effected by connecting the wires of the section to separate parts of the same battery or to different batteries connected in series, that is, by connecting the wires to at least three taps having different voltages. Simultaneously, in case of contact, no energy-consuming resistances will be short-circuited or cut off. In other words: In the ordinary operation of the system no balance or compensation resistances are included in the wires. Such resistances consume considerable quantities of energy and consequently reduce the sensitivity of the relays, because the energy remaining for the actuation of the relays is reduced by such consumption.

When three taps from the battery are used all wires or conductors of the same section have, preferably, one end connected with one and the same tap of the battery, or with adjacent taps, that is, taps having substantially the same voltage. The other ends of the wires are unsymmetrically connected with other taps each having a substantially different voltage, in such manner that in case of contact between the wires of the same section at least one relay of the section will still have substantially its normal current and hold its armature attracted in an unchanged position. Simultaneously at least one other relay of the section will be subjected to such a great change of its current that its armature changes its position of attraction.

In accordance with this invention small protective resistances, or other means for limiting the current may be used, for preventing a short-circuiting of the battery in case of contact between the wires of the section. But such protective resistance is here evidently subjected at most to a part of the voltage of the battery, and, in contrast to the compensating or balancing resistances heretofore used, such protective resistance has not the purpose of preventing false alarm in case of contact between the wires of a section. For these reasons, the protective resistance may be small and consequently the losses of energy therein are low. Thus, the remaining energy at disposal for actuating the relays is not substantially reduced and the relays will operate more safely. Consequently, the safety of operation is increased, without any reduction of the selectivity of the system.

The protective resistance may, for instance, be $\frac{1}{10}$ or $\frac{1}{100}$ of the resistance of the section relay inserted into the same wire.

In the embodiment shown in Fig. 2 the *a*-wire, from the relay *R_a*, is placed first along that part of the *b*-wire, which is next to the relay *R_b*. The battery *B* consists of two portions connected

in series and having different voltages. That is, the conductor *10* is connected to another point than the middle point of the battery. In other respects, this embodiment is similar to that shown in Fig. 1 and operates in an analogous manner.

Fig. 3 shows that the protective resistance *m* may be placed in the conductor *10* leading to the central tap of the battery. The source of current *B* consists of two distinct batteries, connected in series. In other respects, this embodiment is analogous with those illustrated in Figs. 1 and 2 and operates similarly.

In the system illustrated in Fig. 4 the *a*-wire is connected between the two outer poles of the battery, that is between the plus pole and the minus pole, and this wire has its section relay *R_a* at the minus pole. The *b*-wire is connected with the plus pole via the section relay *R_b*, while the other end of said wire is connected with an inner point of the battery via the conductor *10*, into which the protective resistance *m* is inserted. In this case each of the section relays is placed next to an outer pole.

If one or two wires are broken, this system operates in the same manner as that shown in Fig. 1. In case of contact between the wires *a*, *b*, the relay *R_a* still remains in connection with the plus pole of the battery and retains its full normal current, if the resistance *m* is substantially higher than the resistance of the wire *a* itself. This is true in all ordinary systems, because the resistance of the wires *a*, *b* is generally very low. In spite of the condition just mentioned the resistance *m* may have a very small resistance compared with those of the relays and will consequently consume very little energy.

Thus, in spite of a contact between the wires *a*, *b*, the relay *R_a* remains unaltered in an energized state and holds its relay attracted. But the relay *R_b* is short-circuited by that part of the *a*-wire which is between the plus pole and the point of contact. Thus, *R_b* is de-energized, lights its signal lamp and indicates the fault while *R_a* remains energized and prevents false alarm.

It is evident that the resistor *m* may be inserted at that end of the *a*-wire or *b*-wire which is next to the plus pole.

In the system shown in Fig. 5 the two section relays *R_a* and *R_b* are next to one and the same pole. In the embodiment shown that pole is the plus pole. The resistor *m* is in the *a*-wire next to the minus pole, but may also be placed in the conductor *10*, that is, in the *b*-wire.

In case of breaks in one or two wires this system operates just as the systems shown in Figs. 1-4. In case of contact between the wires *a*, *b* in Fig. 5, the relay *R_a* will receive voltage only from that part of the battery *B* which is between the plus pole and the inner point to which the conductor *10* is connected. As a result of the voltage thus reduced on the relay *R_a* said relay is entirely or partially de-energized and falls off entirely or by one stop, because the resistance of the *b*-wire is small in relation to that of the resistor *m*. In order for the relay *R_a* to fall off stepwise, it must evidently be a two or multiple step relay, see United States Patent No. 2,059,510.

The relay *R_b* still has its normal voltage and remains in its normal energized position, preventing false alarm.

From the facts given above it is evident that in the embodiment shown, that is, double-wire sections connected to three different points of the battery, one end of both wires *a*, *b* is connected to

a common point of the source of current B or to points of that source having substantially the same voltage, while the opposite ends of the wires are connected with different points of the source, that is with points having substantially different voltages. The system is not symmetrical. In this way the result is attained that at direct contact or leakage between the wires one relay remains substantially unchanged, that is, retains its full normal current and holds its armature in the normal attracted position, while the other relay is subjected to a substantial change of voltage, that is, an increase or decrease, in such manner that its armature changes its position of attraction. In other words its armature falls off or is moved to another position. Thus, the fault is indicated and simultaneously false alarm is prevented. The same is obviously true for sections having three or more wires.

The section relays R_a , R_b may be placed in one or the other end of the section. Thus, several combinations are possible. In addition, the individual sections of a system may be connected in accordance with the different diagrams of connections shown or in accordance with the various combinations just mentioned. The position of the protective resistor m , for which one or more other current-limiting means, such as fuses, may be substituted, should obviously be chosen with regard to the position of the relays in the sections and wires. It is to be observed that in all embodiments, as shown, one and only one of all ends of the wires is directly connected to one and the same tap of the battery, without any relay or other resistance being inserted in that end of the wire.

The winding R_a , R_b may be united to a single two-step relay, as shown in United States Patent No. 2,059,510. Similarly, multiple-step relays may be used for multiple-wire sections. If the source of current or parts of battery connected in series have the same voltage, a difference of voltage may be attained by inserting one or more resistors.

Finally, it must be mentioned that the systems as shown are less sensitive to battery faults than the systems heretofore known. If, in the systems in accordance with this invention, the battery is partially put out of operation, for instance, due to the melting of a fuse, the system will nevertheless be able to operate by means of the part of the battery which is still intact, so that also in this case alarm will be properly given in case of danger. If, for instance, in Fig. 4 the right-hand part of the battery is put out of operation, the relay R_a will fall off to indicate the fault, but the relay R_b still has its full normal current from the left-hand part of the battery and will give alarm, if and when relay R_b falls off. On the other hand, the relay R_b prevents false alarm in the case just mentioned, that is, if a fuse at the plus pole of the battery is burnt out.

In the systems heretofore known the whole system will be put out of operation in case of a burnt fuse or other faults in the battery and cannot be operated again, until the fault has been removed or a reserve battery has been put in.

The resistor m may be replaced by a fuse of very low resistance. In this case, the section relays are, preferably, slow-acting. If that fuse melts, one of the section relays loses its current and falls off, while the other relay has its normal current and is still connected across a part

of the battery or across the whole battery, depending upon the position of the fuse. In contrast to the systems heretofore known the system in accordance with the present invention is not put out of operation when such fuse is burnt out but may still safely give fire alarm.

When it is said above that in certain cases the resistor m should be relatively great in relation to the resistance of a wire of a section, this applies only to the case that one of the section relays shall retain its full normal current also after short circuiting or leakage, that is contact between the wires. But if a certain reduction of the current is permitted in that relay which after such contact between the wires remains energized to prevent false alarm, the resistance m need only be chosen so high that it limits the short-circuiting current of one half of the battery, to a permissible value. In such case the resistance m may be low in relation to the resistance of a wire.

Reference is made to the copending application of H. T. Nicou, Ser. No. 184,892, for Automatic alarm systems, filed January 13, 1938, in which systems of a generally similar character as the present are claimed.

What we claim is:

1. In an electric alarm system, in combination, a source of current having at least three taps of different voltages, a loop of normally closed protective insulated conductors connected to said taps, a current breaker connected in each of said conductors and responsive to the cause of danger for which alarm is to be operated, and an alarm apparatus electrically connected with said loop to be actuated when all the conductors of said loop are broken, only one single conductor end of a loop being connected with each tap directly, the conductors being connected across different parts of said source.

2. An electric alarm system, comprising, in combination, at least three taps of different voltages from a source of current, a loop of a plurality of protective wires, a current breaker in each of said wires and responsive to the cause of danger for which alarm is to be operated, and an alarm apparatus electrically connected with said loop to be actuated when all the wires of said loop are broken, each wire of said loop having one of its ends connected with one of said taps, while the opposite ends of said wires are connected unsymmetrically with other taps having other voltages.

3. An electric alarm system, comprising, in combination, a source of current having at least three taps of different voltages, a protective loop of multiple wires connected with said taps and extending through the localities to be controlled, circuit breakers connected in said wires and responsive to the cause of danger to be controlled, relays in the wires of said loop, and an alarm apparatus electrically connected with said relays to be actuated when all said relays are at least partially de-energized, the relay in one wire being next to one pole of the source of current, while the other end of said wire is connected with a tap from an inner point of said source of current, and said inner point being also connected with one end of another wire and its relay, while the opposite end of said other wire is connected with the opposite pole of the source of current.

4. An electric alarm system, comprising a three-tap source of current, a multiple-wire loop extending through the localities to be protected, circuit breakers connected in said wires respon-

sive to the cause of danger for which alarm is to be given, one wire of said loop being connected across the whole source of current, while another wire of said loop is connected with an inner tap of said source of current and with an outer tap of said source of current, and relays at the ends of said wires that are connected with said outer taps.

5. An electric alarm system, comprising, in combination, a source of current having at least three taps of different voltages, a loop of a plurality of protective normally closed wires extending through the localities to be protected, a circuit breaker connected in each of said wires and responsive to the cause of danger for which alarm is to be given, relays connected in the wires of said loop and to different outer pole taps of said source of current, and an alarm apparatus electrically connected with said loop to be actuated when the wires of said loop are broken and the relays of said section are at least partially de-energized, the ends of said wires remote from said relays being connected with said source of current, one with a tap at an intermediate point of said source of current and the other with an outer pole tap thereof, opposite to the tap to which the loop relay in the same wire is connected.

6. An electric alarm system, comprising, in combination, a source of current having at least three taps of different voltages, a multiple-wire protective, normally closed loop connected with said taps and extending through the localities to be controlled, circuit breakers in said wires responsive to the cause of danger to be controlled, relays connected in the wires of said section at the same outer pole of said source of current, an alarm apparatus electrically connected with said relays to be actuated when all of said relays are at least partially de-energized, the ends of said wires most remote from said relays being connected one with an intermediate tap of said source of current and the other with that outer pole of said source of current which is opposite to the pole to which the relay in the same wire is connected.

7. In an electric alarm system, in combination, a source of direct current having at least three taps of different voltages, insulated, protective, normally closed wires connected to said taps to form a loop placed in the locality to be protected, a circuit breaker connected in each of said wires and responsive to the cause of danger for which alarm is to be operated, an alarm apparatus electrically connected with said loop to be actuated when all wires of said loop are broken, only one single wire end of said loop being connected with each tap directly, while the wires of said loop are connected with said taps to lie across different parts of the source of current, and a current-limiting member inserted between one

of said taps and the wire and that is directly connected therewith.

8. In an electric alarm system, in combination, a source of current having three taps of different voltages, a normally closed protective loop of a plurality of wires, relays at one end of each of said wires, and an alarm apparatus operable by said relays, one of said wires being connected across the whole source of current, while another wire is connected across only a part of said source of current.

9. In an electric alarm system, the combination of a source of current having at least three taps of different voltages, a normally closed protective loop of a plurality of wires to be open-circuited by a predetermined condition, in dependence of which alarm is to be raised, said wires being connected to said three taps of said source of current, a relay connected to one end of each of said wires, and an alarm apparatus operable by said relays, one of said wires having its relay-connected end connected with one of the taps of the highest voltage of said source of current, while the ends of said wires which are most remote from said relays are connected with taps of different voltages.

10. In an electric alarm system, the combination of a source of current having at least three taps of different voltages, a normally closed protective loop of a plurality of wires to be open-circuited upon the occurrence of a predetermined condition and in dependence of which alarm is to be raised, relays connected to one end of each of said wires, and an alarm apparatus operable by said relays, each of said wires being connected with two of said taps and across different parts of said source, while to each tap only one single wire end is directly connected without any intermediary relay.

11. In an electric alarm system, in combination, a source of current having three taps of different voltages, a normally closed protective loop comprising a plurality of parallel insulated conductors each having a current breaker therein responsive to the cause of danger for which alarm is to be operated and each having a relay winding inserted into one of its ends, the conductors of said loop being connected with said three taps of different voltages of said current source so that one of said relay windings is connected to that end of a conductor which is connected with the tap of the highest voltage, while a difference of voltage exists between the ends of the said conductors which are most remote from said relay windings, and an alarm apparatus electrically connected with relay contacts controlled by said relay windings to be actuated when all the conductors of said loop are broken.

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