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CIRCUIT ARRANGEMENT FOR THE BLOCKING OF CIRCUITS IN INTERLOCKING PLANTS OPERATING WITH ELECTRIC LOCKINGS

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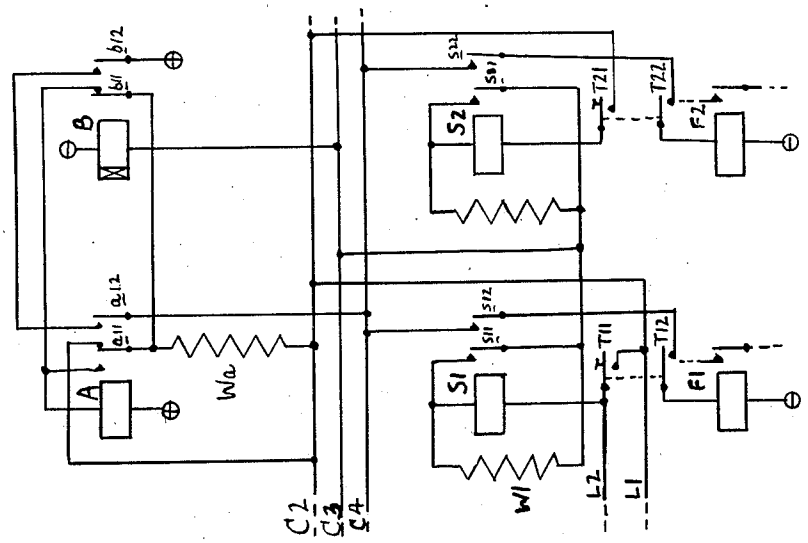


FIG. 2

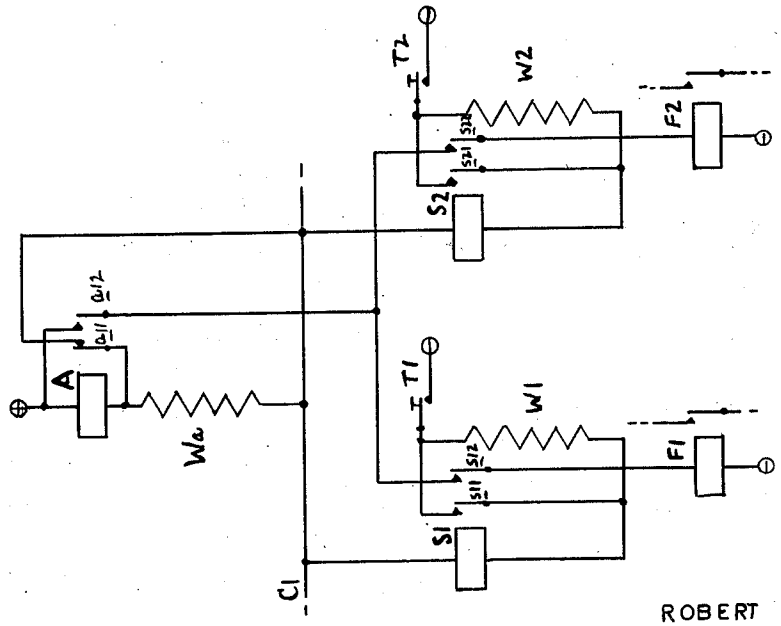


FIG. 1

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CIRCUIT ARRANGEMENT FOR THE BLOCKING OF CIRCUITS IN INTERLOCKING PLANTS OPERATING WITH ELECTRIC LOCKINGS

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2 Claims. (Cl. 317—136)

Traffic control machines with electric interlocking necessitate a preventive arrangement for eliminating a simultaneous action of several switching operations. So, for instance, certain routes should not be lined up simultaneously, or signals should not be made to display a "clear" aspect at the same time. Under certain conditions the simultaneous throwing of a number of switches must be prevented. When all these operations are, as usually, controlled by relays, rest contacts of all other relays in conflicting circuits are connected into the circuits of these control relays so that each relay disconnects all other relays when responding. This system, however, requires a large number of contacts and the entire circuitry becomes badly arranged and is liable to faults due to the complication of the system.

As an improvement, the present invention provides for feeding circuits of switching relays, simultaneous response of which shall be prevented, over the coils of a common blocking relay which reverses the circuits by its response so that no further switching relay can be energized. When the reverse results in the interconnection of a resistor into the common link of the circuit, there is only one contact of the blocking relay required for this function.

The coils of the switching relay and of the blocking relay are suitably so designed that the switching relay responds first when being operated and then the blocking relay, while upon a simultaneous connection of several switching relays, the blocking relay responds first and thus prevents the response of the switching relays.

When a circuit is established and is also to be guarded against ground connections and stray currents, the individual circuits of the switching relays are fed at both ends via a blocking relay each, as a further example of this invention, whereby each of these blocking relays actuates the blocking function upon response. For supervising the action of the blocking relays, contacts of these relays are incorporated in the circuits controlled by the switching relays.

A better understanding of the invention may be had from the description of specific examples thereof made in connection with the copending drawing, in which;

Figure 1 is a schematic circuit diagram of an embodiment of the invention using a single blocking relay and

Figure 2 is a modified circuit arrangement in accordance with the invention utilizing two blocking relays to provide additional controls.

Turning first to Fig. 1, two parallel operated circuits are shown, one of which includes an auxiliary relay S1 and a utilization relay F1, the other one of which is provided with similar relays S2, F2. A blocking relay A is connected in common to these parallel circuits. It should be understood that more than two such parallel circuits may be provided but only two are illustrated for the purpose of simplicity. Furthermore, it is to be understood that these utilization relays are the ones which control signals or switches related to conflicting routes so that only one such circuit may be established at any

one time. Two separate switches T1, T2 are shown in the energizing leads for switch relays S1, S2 respectively. As illustrated, these switch contacts T1, T2 show the lines open at this time.

Closure of switch T1, for example, completes a circuit from the source of positive voltage through the winding of relay A, back contact *a*11, common lead C1, winding of auxiliary relay S1, resistor W1, contacts T1 to ground, causing relay S1 to be energized and to operate. Relay A is a marginal relay requiring greater current than can be drawn through the single lead and resistor W1 in order to operate. Operation of relay S1 closes a circuit through the shunting lead around resistor W1 at contact *s*11 shorting out this resistor thereby passing sufficient current to operate relay A. Operation of relay S1 also closes contacts *s*12 in the circuit of relay F1 but this relay still does not operate since its complete circuit is still open at *a*12, when relay A operates however, contact *a*12 completes a circuit for relay F1 from positive potential source, contact *a*12, contact *s*12, winding of relay F1 to ground. This relay then controls signalling equipment or operates switches to give a clearance for a particular track circuit. At the same time relay A serves to operate contact *a*11 to open its direct energizing path but alternative energization for relay A is maintained from positive through the winding of relay A, resistor W*a*, winding of S1, contact *s*11, contact T1 to ground. Resistor W*a* is of such a resistance value that it reduces the current passing through the relay windings A and S1, but will not pass sufficient current to operate any further switch relays but will maintain them energized once operated, since the maintaining current is considerably less than that required to actuate the relay.

If contact T2 had been closed instead of T1 then relays S2 and F2 would have been operated through the precisely similar circuit for this relay including common conductor C1, including the relay contacts *s*21 and *s*22.

Relay A, while marginal in operation, is designed to be quicker operating than relay S1 or S2. Should contacts T1 and T2 be simultaneously closed then relay A will operate before either of relays S1 or S2 operate, since sufficient current will pass through the parallel connected resistances W1 and W2 and the windings S1, S2 to energize relay A. Upon operation of relay A, contacts *a*11 will open thereby removing the short circuit from resistor W*a* so that relays S1 and S2 will now receive insufficient current to operate them since their operating paths may now be traced from positive, winding of relay A, resistance W*a*, winding of relay S1, resistance W1 and the parallel path from conductor C1 through the winding of relay S2 through resistance W2. Thus there is provided a safety interlock which prevents simultaneous display of signals through the operation of both circuits, since if neither of the relays S1 or S2 can operate, the control relays F1 or F2 cannot operate since their operating paths include a set of the contacts on the S1 or S2 relays, namely *s*12 or *s*22. This arrangement provides a circuit which effectively locks out all other S relays after the operation of any one of them.

In Fig. 2 a slightly modified alternative circuit is shown which provides the same protection against simultaneous operation of signals but additionally provides an arrangement to take care of other possible faults which may develop in the system. In the arrangement of Fig. 2, the control switches for the two separate paths are T11 and T12 for the circuit, including common leads C2, C3, relays S1 and F1, and switches T21 and T22 for the alternative circuit including relay S2 and relay F2. In addition, a slow operating relay B is also provided common to the two circuits and suitable contacts *b*11, *b*12 are provided in the common branch circuits for relays

S1, S2 and relays F1, F2 respectively. A normally open bridging circuit is provided across the normally closed contacts *b*11 and a short circuiting connection shunts resistor W*a*. A switch-over contact *a*11 operated by relay A is provided upon operation to close the shunt path around contact *b*11 to open the shunt contact around resistor W*a*. In order to set up the circuit for S1, F1, contacts T11 and T12 are operated to close the circuit. Immediately upon closing these contacts an operating circuit is set up for relay S1 from the positive voltage source, winding of relay A, closed contacts *b*11, the shunt connection around resistor W*a*, common lead C2, line L1, closed contacts T11, line L2, winding relay S1, resistor W1, winding of relay B to ground. Operation of relay S1 closes switch contacts *s*11 short circuiting out resistor W1 so sufficient current will now flow through winding S1 to enable relay A to operate and also closes contacts *s*12 in the circuit of relay F1. Relay F1, however, cannot operate since its energizing circuit is still open at *b*12 and *a*12. The short circuiting of resistor W1 supplies sufficient current to operate relay A, which then operates at contact *a*11 to short circuit out contact *b*11 and to open the circuit around resistor W*a* at the front contact *a*11. Operation of relay A also closes switch contact *a*12 but since the operating circuit for relay F1 is still open at *b*12 it still does not operate. After operation of relays S1 and A, relay B operates due to its slower response, and closes its contact *b*12 so that relay F1 also operates. Simultaneous operation of switches T11, T21, T12 and T22 will serve immediately to operate relay A in the same manner as described in Fig. 1 preventing setting up of either of the circuits.

In addition to the blocking feature against setting up conflicting routes the second common relay B also serves to protect against the establishment of signals due to various faults which may occur in the signalling circuit. Should any ground occur between relay A and the normally open switches T11 and T21 relay A will immediately operate inserting resistor W*a* via its contact *a*11, so that neither relays S1 nor S2 can operate. A stray voltage introduced into line L1 will provide an opposing voltage to the positive voltage of A preventing operation of relay A by effectively short circuiting it. Accordingly, neither F1 nor F2 can operate since contact *a*12 will not close. Any stray voltage introduced into line L2 will operate both relays S1 and B, the operation of contact *b*11 then will cut off relay A so neither relays F1 nor F2 can respond. Should a fault occur interconnecting L1 and L2, relay F1 cannot operate since its circuit is still opened at contact *b*12.

It will thus be apparent that this system provides protection against any type of fault as well as protection against setting up of conflicting routes due to improper operation of the switches.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention, as set forth in the objects thereof and in the accompanying claims.

What is claimed is:

1. An interlocking electrical control system for a plurality of utilization relays comprising a plurality of auxiliary relays corresponding in number to said utilization relays, common blocking relay means, a plurality of impedances, one for each of said auxiliary relays and said blocking relay means, a source of operating potential, a plurality of switch elements, each element adapted to control a different one of said auxiliary relays, each of said auxiliary relays and said blocking relay means having energizing windings and a plurality of contact sets controlled thereby, a plurality of separate series circuits including different ones of said auxiliary relay windings, said impedances and said switch elements, a further series circuit including the energizing winding of said blocking relay means and another of said impedances, said separate series circuits in parallel series relation with said further series circuit across said source, a contact set of each of said auxiliary relays connected in a manner to shunt its associated impedance upon energization of the winding thereof, a contact set of said blocking relay means normally connected in shunt with its associated impedance, a plurality of additional series circuits for operating each of said utilization relays, each including another normally open contact set of a different one of said auxiliary relays, each of said additional series circuits in parallel relation with the other and in series with other normally open contact means of said blocking relay means across said source, the response characteristics of said blocking relay means being such that the current passing through said further series circuit is insufficient to operate said blocking relay means until the impedance in the series circuit connected therewith is shunted by operation of the associated auxiliary relay, and the characteristics of said auxiliary relays being such that the current passing through said further series circuit after operation of said blocking relay means and an auxiliary relay is insufficient to operate a second auxiliary relay.

2. An interlocking electrical control system as claimed in claim 1, wherein said blocking relay means comprises a pair of blocking relays each having a winding connected in said further series circuit, a first one of said blocking relays having a slow response characteristic and having normally closed and normally open contact sets, said second blocking relay having a transfer and normally open contact sets, the normally open contact sets of both said blocking relays connected in series with said additional series circuits, the normally closed contact set of said first blocking relay serially connected between the winding of said second blocking relay and said other impedance, the transfer contact of said second blocking relay connected to shunt said other impedance in its back position and to shunt the normally closed contacts of said first blocking relay in its front position.

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