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REVERSE PHASE RELAY FOR USE IN CONNECTION WITH POLYPHASE ALTERNATING CURRENT CIRCUITS.

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Fig. 2.

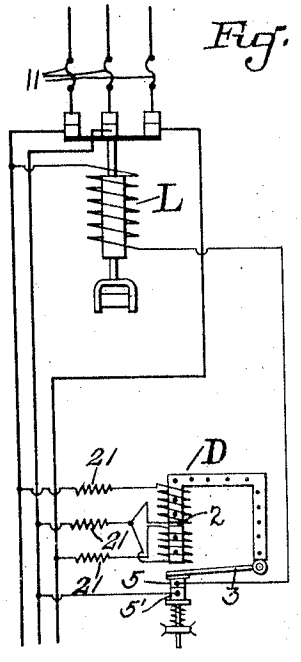


Fig. 1.

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REVERSE-PHASE RELAY FOR USE IN CONNECTION WITH POLYPHASE ALTERNATING-CURRENT CIRCUITS.

1,339,192. Specification of Letters Patent. Patented May 4, 1920.

Application filed December 30, 1915. Serial No. 69,355.

To all whom it may concern:

Be it known that I, ERNEST L. GALE, Sr., a citizen of the United States, residing in Yonkers, in the county of Westchester and State of New York, have invented a new and useful Improvement in Reverse-Phase Relays for Use in Connection with Polyphase Alternating-Current Circuits, of which the following is a specification.

My invention relates to protective means for translating devices used in connection with poly-phase alternating current circuits, and has for one of its objects the provision of a simple and practical means operable automatically to open-circuit or cause an interruption of the poly-phase circuit upon any of the following events; one phase dead as may be occasioned by a fuse blowing in the supply line, or by a disordered switch such as a motor reversing switch for elevators, in which the contacts may be burned out, worn or otherwise in such a condition as to not connect the translating device with the source of current supply, or in the event of a reverse or interchange of a phase or phases of the poly-phase supply circuit.

Another object of the invention is to provide a single device operable under any of the conditions stated above, and to provide in conjunction therewith a visual means whereby the operation of the said device as caused by a phase reversal may readily be distinguished from an operation thereof as caused by a fuse blowing or a disordered switch, and further to provide a ready means for establishing a proper phase relation when the visual means are indicative of an existing phase reversal.

In the accompanying drawings, Figure 1 illustrates diagrammatically one form of my invention as applied to a two phase alternating current system, together with a translating device and certain other controlling apparatus therefor; Fig. 2 illustrates a modified arrangement of my invention, it being applied to a three phase alternating current system.

Referring to Fig. 1, M indicates a multiphase motor, which may be connected to the apparatus to be operated in any desired manner. A series of slip rings on the motor shaft connect the motor circuits to a starting device A, which in this case is manually operated, but which may be replaced by any automatic starting device if desired.

An electromagnetic switch L may be in the form of a main line or potential switch, it together with electro-magnetic motor reversing switches, R, R′, being adapted to control the current supply to the motor M, from a multi-phase alternating current source, Fig. 1, illustrating more particularly a two phase four wire system, the leads designated *a*, *a′*, constituting one phase, and *b*, *b′*, a second phase.

The parts thus far described are well known in both function and structure, and are thus described only in general.

Coming now to the elements which constitute more essentially the subject matter of the present invention, it comprises a relay magnet D, consisting in its more essential details of a laminated core 1, which is preferably constructed with a magnetic air gap 2. A magnet armature 3 is pivoted at 4, it controlling contacts 5, 5′, the contact 5, being movable with the armature, and the contact 5′ being fixed. The relay is provided with two independent windings 6, 6′ which may be either in superimposed relation, that is one over the other, as illustrated in Fig. 1, or end to end as illustrated in Fig. 2. In case of the relay, D, it may be made in the manner disclosed in the patent to Rice, No. 1,025,590, May 5, 1912, for instance, in which an inductance is added to one coil and a resistance to another coil, thereby obtaining a phase displacement of substantially 180° in coils fed from a two-phase supply having a 90° phase difference.

The potential switch L, is adapted normally to be closed by hand, and thereafter maintained in closed position by its associated electromagnet. The contacts 5, 5′, controlled by the relay magnet are normally closed by the armature of the relay when in unattracted position, these contacts establishing a self-holding circuit for the winding of the switch L.

The supply leads *a*, *a′*, constitute one phase of the supply circuit, the lead *a′* being connected through the switch L directly to the motor terminal 8′, and the lead *a* being connected through the switch L, auxiliary switches 12, 12′ controlled by the reversing

switches, and thence to the motor terminal 8. The leads b, b', constitute another phase, they being connected through the switch L, a rectifier switch N (by means of which proper phase relation may be established in the event of a reverse or interchange of a phase or phases of the supply mains a, a', b, b') and thence by way of the motor reversing switches R, R', to the motor leads 9, 9'. The electro-magnetic reversing switches R, R' effect the operation of the motor in reverse directions in a well understood manner, by interchanging the supply leads b, b' with the motor leads 9, 9'.

The terminals of the relay windings 6, 6' are connected across different phases so that their magnetizing effects on the armature oppose each other, when the phases of the supply circuit are properly interrelated. The armature of the relay will, under these conditions remain in unattracted position and in this manner maintain the potential switch L in closed position.

Should now for any reason the phases or leads of the main line supply circuit become reversed or interchanged, the windings of the relay will, in this event act cumulatively in their magnetizing effect, causing the relay to attract its armature and in so doing separate the contacts 5, 5', which open the self holding circuit of the potential switch, causing the latter automatically to open and in this manner disconnect the translating device from the source of current supply.

Now another important feature of my invention is, to automatically disconnect or interrupt the source of current supply between the motor and the supply source, in the event of one phase being dead, as may be occasioned for example, by a worn or burned contact on the reversing switches. In order to meet this contingency, I connect the winding 6' through the main reversing switch contacts 10, 10', etc., and in this manner make the winding 6' dependent for its current supply on the reversing switch contacts. Thus it will be seen that a disordered reversing switch causes one of the phases to become dead and likewise one of the relay windings, the remaining or live relay winding now operating the relay armature, to separate the contacts and cause the switch L to open and thereby disconnect the translating device from the source of power supply.

Now right here it will be pointed out, that since the motor leads 9, 9', become interchanged with the supply leads b, b', by the operation of one or the other of the reversing switches R, R' to reverse the direction of rotation of the motor, it becomes necessary to prevent an interchange of the leads for the winding 6', so as not to disrupt the normal or opposing relation existing between it and the winding 6. In order to maintain this opposed relation under the circumstances set forth, I connect one of the leads through reversing switch auxiliary contacts 7, 7' so as to be common to the supply lead b, the other lead of the relay winding being connected through the reversing switch auxiliary contacts 13, 13', so as to be common to the supply lead b'. With this arrangement the relation between the leads of the relay winding 6' relatively with the supply leads b, b', is maintained the same, upon the interchange of the motor leads 9, 9' relatively with the supply leads b, b'.

Another factor to be considered which causes a phase to be dead, is in the case of a fuse or fuses blowing on the line, the fuses in the present instance being indicated by the reference numeral 11. In this event one of the relay windings is caused to be dead, and the remaining or live winding will effect an operation of the relay armature to separate the contacts 5, 5' and in this manner automatically effect an opening of the switch L.

It will be noted here, that for any of two conditions, that is, such as a blown fuse, or a disordered reversing switch, the relay is caused to operate by the action of only one of its windings, the other winding in such an event being dead. In the event of a reverse or interchange of a phase or phases of the supply circuit, an operation of the relay magnet is effected by the cumulative action of the two windings, both of which in this event will of course receive a current supply. Now in order to distinguish an operation of the relay magnet as caused by a reverse or interchange of a phase or phases of the supply circuit, from that due to the other two causes, I provide a means in the form of a number of lamps designated 14, 15, the lamp 14 being connected directly across the leads a, a' of one phase, and the lamp 15 having an initial circuit established by auxiliary contacts 16 controlled by the relay magnet, when the latter operates, this initial circuit including a self-holding winding 17 which controls contacts 18, and the auxiliary contacts 7 or 7' dependent on which of the two reversing switches is closed. Now it will be noted that the operation of the relay effects an opening of the switch L, thus cutting off the current supply to the reversing switch contacts 7, 7' and the relay windings, and in order now to maintain a supply of current to the lamp 15, and also the winding 17, a circuit is provided therefor directly across the mains b, b', this circuit including the self holding winding 17, contacts 18 controlled thereby, and also the contacts 19 and 20 or 20'. The contact 19 is carried by, but insulated from one of the knife blades of

the switch A, it being adapted to contact with a fixed contact 20 when in one closed position, and with the contact 20′ when in the other closed position.

Thus it will be seen that with the arrangement as provided herein, both of the lamps 14 and 15 will glow simultaneously only in the event of a reversal or interchange of a phase or phases of the supply leads, such an indication, signaling the proper time to throw the rectifier switch from one position to another, to establish a proper phase relation on the supply line.

The circuit for the winding 17 is opened as are the contacts 18, by the change over operation of the switch A, the said circuit being opened by the disengagement of the contact 19, from either of the contacts 20 or 20′, dependent on the position of the switch A before the change over is made.

Referring now more particularly to Fig. 2 it will be mentioned that there may be connected in series with each of the relay windings, an ohmic resistance 21 for the purpose of reducing the current consumption of the windings. It will be understood that the employment of these ohmic resistances is optional, their use being in no way essential to the operativeness of the relay.

It has been found by actual tests, that an alternating current magnet consisting of a single laminated core provided with a suitable air gap, and two independent windings, operates in conjunction with a three phase alternating current system as illustrated in Fig. 2, with as equally good success as when used in conjunction with a two phase alternating current system, and in both cases either with or without an ohmic resistance in series with each relay winding.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In apparatus of the class described, the combination with a motor, a source of alternating current supply, motor reversing switches, means dependent for current supply on the reversing switches and responsive to a phase reversal on the line automatically to disconnect the motor from the source of supply, and means arranged to designate an existing phase reversal on the line as distinguished from a disordered reversing switch.

2. In apparatus of the class described, the combination with a motor, a source of alternating current supply, motor reversing switches, means controlled by the reversing switches and responsive to a phase reversal on the supply line automatically to disconnect the motor from the source of supply, means arranged to designate an existing phase reversal on the line as distinguished from a disordered reversing switch, and means to establish a proper phase relation on the line in the event of existing phase reversal thereon.

3. In apparatus of the class described, the combination with a motor, a source of alternating current supply, a reversing switch for the motor, means operable by a phase reversal on the line or by a disordered reversing switch, and means for signaling the operation of the latter means when caused by a phase reversal on the line, and as distinguished from a disordered reversing switch.

4. In apparatus of the class described, the combination with a motor, a source of alternating current supply, a reversing switch for the motor, means operated by a phase reversal on the line or by a disordered reversing switch, and means for distinguishing visually between an operation of the latter named means as caused by a phase reversal on the line, and an operation thereof as caused by a disordered reversing switch.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

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Witnesses:
E. H. Steele,
George D. Rose.