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ELECTRIC CIRCUIT FOR DIRECT CURRENT ELECTROMAGNETIC CONTACTORS

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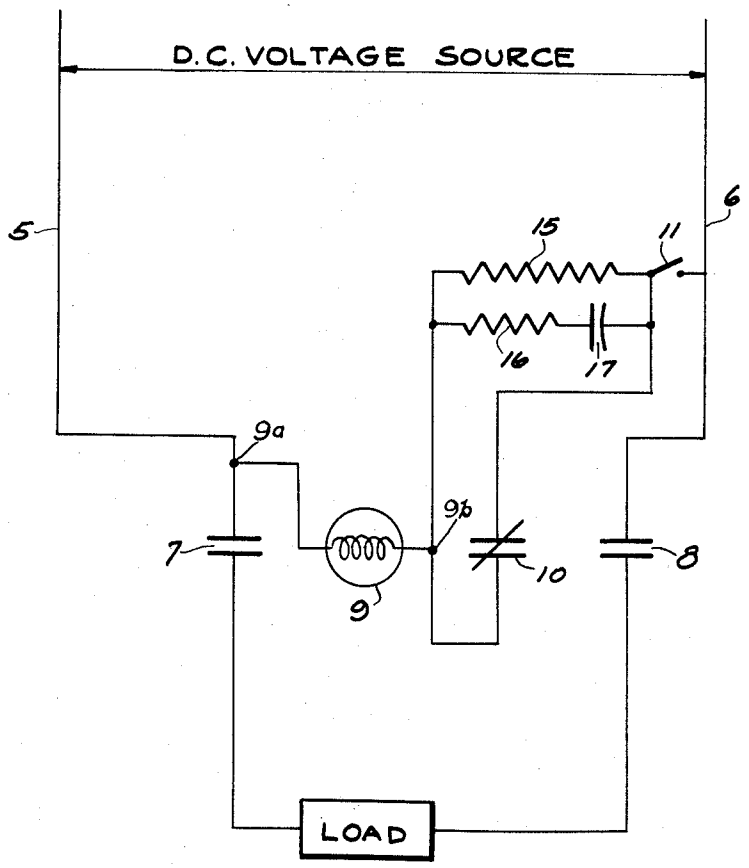

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ELECTRIC CIRCUIT FOR DIRECT CURRENT ELECTROMAGNETIC CONTACTORS

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This invention relates to improvements in electric protective circuits for direct current electromagnetic contactors.

When an electromagnetic contactor included in a D.C. circuit is being opened, means should be provided to by-pass the current or at least a large proportion thereof for a sufficient time to permit full opening of the contactor with a minimum amount of destructive arcing. The time required can be relatively short but the means must be both sensitive and rugged if the circuit is subjected to shock and vibration such as occur in naval vessels. Various mechanical or electrical, or combined mechanical and electrical, means have been tried for use where constant vibration is present and shocks of high magnitude are to be expected, but such means have not heretofore been found acceptable.

A primary object of the invention is to provide a novel arrangement of electrically operable means for inserting a protective resistor of proper value in circuit with an electromagnetic coil without adversely affecting closing of contacts controlling the flow of direct current, and which means will be sufficiently rugged to withstand a high degree of shock and/or vibration.

Another object of the invention is to insure complete opening and to reduce arcing between contacts in a D.C. circuit when such contacts are being opened, and particularly when the contacts or contactors are subject to shock and vibrations.

Another object is to provide a control circuit for a direct current contactor wherein current will first flow through the normally closed interlock contacts to energize the closing coil for initiating closing of the normally open main contacts, and upon opening of said interlock contacts at least a major portion of the current flow will be transferred to a capacitor branch circuit, whereupon said current flow will remain at a high enough value for a long enough time to maintain a sufficient degree of coil energization for complete closing of the main contacts; even though the interlock contacts have been previously opened, as aforementioned.

Another object is to provide such a circuit arrangement wherein the current flow in the capacitor branch circuit will be automatically discontinued and current will flow only throughout the protective resistor in series with the contactor operating coil; pending subsequent complete disconnection of said coil, thus protecting said coil against excessive current.

Another object is to provide such a circuit wherein, upon removal of the applied voltage, the main contacts of the contactor will open and the capacitor will discharge through its current limiting resistor and the normally closed interlock contacts, and the capacitor will remain uncharged until another closing operation of the contactor is initiated.

Other objects and advantages of my invention will become apparent from the following description of the particular embodiment thereof herein illustrated.

The single figure of the drawing diagrammatically

illustrates a circuit for the operating coil of a contactor controlling flow of direct current, and means for automatically placing a protective resistance in circuit when the contactor is being closed, while providing a sufficient degree of energization of the operating coil to effect complete closing operation of the contactor.

Referring to the drawing by reference numerals, 5 and 6 represent leads from and to a suitable source of direct current through main contacts 7 and 8, when closed, to a load as indicated. The main contacts 7 and 8 are normally open and are closed by coil 9 when the coil is properly energized. One terminal 9^a of the coil 9 is connected directly with lead 5 and the other terminal 9^b of the coil is connected with lead 6 through interlock contacts 10 and a manually operated switch 11. When the main contacts 7 and 8 are open the interlock contacts 10 are closed but the coil 9 is connected in circuit only upon closure of said switch 11. Energization of coil 9 results in closing of the main contacts 7 and 8; with consequent opening of the interlock contacts 10.

A first branch circuit includes a resistor 15 connecting switch 11 with a terminal of the coil 9 and such circuit is in parallel with the interlock contacts 10. While the interlock contacts 10 remain closed, current for energizing coil 9 flows through contacts 10; and resistance 15 has no substantial effect upon the degree of energization of coil 9. A second branch circuit, in parallel with contacts 10 and the resistor 15, includes a resistor 16 and a capacitor 17 connected in series with each other and in series with one terminal of coil 9, as shown. Thus it will be apparent that only resistances and a capacitance are required in the circuit arrangement herein disclosed; and various known forms of each of such electrical units are so rugged as to be unaffected by constant vibration and/or shocks of any magnitude; which are not direct impacts upon such units themselves.

In operation, with direct current voltage applied to the leads 5 and 6, upon closure of switch 11, the current flows through the interlock contacts 10 and through the coil 9 which is energized so that it begins to close main contacts 7 and 8 and to open said interlock contacts 10. As the contacts 10 open, current will also flow through the resistor 16 and the capacitor 17 at a sufficiently high value and for a sufficient length of time to keep the coil 9 energized for fully closing, and maintaining closed, the main contacts 7 and 8. After a relatively short time, however, the capacitor 17 becomes fully charged and the flow through the capacitor 17 and its resistor 16 dies out. Thereafter the only circuit available for flow of current through coil 9 is through the resistor 15 in series with the coil. Thus the coil 9 cannot be subjected to excessive current, as the voltage is divided between the resistor 15 and the coil 9. When switch 11 is thereafter opened, to discontinue the supply of D.C. voltage, the coil 9 is deenergized and the contacts 7 and 8 reopen and interlock contacts 10 are reclosed. The capacitor 17 then discharges through the interlock contacts 10 and through the resistor 16, so that the second branch circuit is again ready for recharging, etc., as aforedescribed.

It will be understood that the size of the various parts will be determined by the maximum current to be handled. However, it has been found that a 25 mf. capacitor and a 50 ohm resistor are adequate for coil circuits of contactors controlling direct current up to 100 amperes. The present construction has performed satisfactorily when tested under shock vibration conditions simulating those occurring in naval vessels.

The present invention essentially provides branch circuits in parallel with the interlock contacts of a D.C. contactor, in which one branch is provided with a resistor limiting the voltage in such branch and the current supplied to the contactor closing coil. The other branch

circuit includes only a capacitor in series with a resistor to provide an alternate path for flow of direct current at a sufficiently high value for a sufficient length of time to insure closure of the normally open main contacts, and for maintaining the same closed. Upon deenergization of the main leads 5 and 6, as by opening switch 11, the main contacts 7 and 8 are automatically opened and interlock contacts 10 reclose. Hence, the capacitor 17 discharges through its resistor 16 and through the interlock contacts 10, and the entire circuit is ready for another cycle of operations.

I claim:

1. In an electrical circuit for controlling an electroresponsive device having an operating coil connectable across a direct current power source and normally open contacts responsive to energization of said coil, in combination, a protective resistor in series with said coil, normally closed contacts in parallel with said resistor for shunting the latter when said coil is deenergized, and means in circuit with said coil and responsive to opening of said normally closed contacts to cause a momentary surge of current from said source to flow in said coil to insure complete closure of said normally open contacts.

2. The combination according to claim 1, wherein said means comprises a capacitor connected in series with said coil and effective when so connected with said coil to a power source to cause charging current for said capacitor to be drawn through said operating coil.

3. The invention defined in claim 2, together with means in circuit with said capacitor for effecting rapid discharge of said capacitor upon deenergization of said coil, and including said normally closed contacts connected in series with said coil.

4. The invention defined in claim 3, together with a resistor in series with said capacitor and said normally closed contacts to limit the discharge through said normally closed contacts to a predetermined rate.

5. In an electrical circuit for controlling a direct current device including an electromagnetic coil, a switch for energizing and deenergizing said coil, normally open main contacts and normally closed interlock contacts responsive to energization of said coil, and a protective resistor electrically inserted in series with said coil upon opening of said interlock contact, the improvement comprising a capacitor connected in series with said coil and in parallel with said interlock contacts to be effective upon opening of the latter to suppress arcing thereat, and to nullify the current reducing effect of the resistor connected in series with said coil to insure closure of said normally open contacts.

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