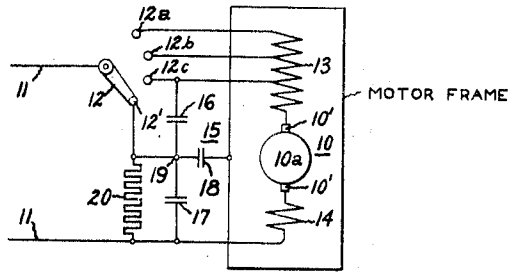
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ELECTRIC PROTECTIVE APPARATUS

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ELECTRIC PROTECTIVE APPARATUS

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4 Claims. (Cl. 171—97)

My invention relates to an electric protective apparatus for circuit interrupters and more particularly where such circuit interrupters are used in connection with motors of the commutator type.

Wherever electric switches are employed, the question of suppressing and extinguishing arcs accompanying the operation of the switches arises. The interruption of alternating-current circuits is readily accomplished because the arc or discharge occurring upon the separation of the switch contacts tends to extinguish itself automatically when the alternating current passes through the zero point of the current wave. However, in a direct-current circuit, a different situation obtains for there is no tendency for the arc to extinguish itself since the current never goes through zero and, therefore, the interrupting ability of a given switch when used in connection with such direct-current circuits is generally very much less than when used in alternating-current circuits.

Many of the modern appliances are provided with universal motors to operate either from a direct-current or alternating-current source. In apparatus of this type, it has been necessary to incorporate an expensive switch of the high-speed break type so that the circuit may be interrupted properly in the event that the apparatus is operated from a direct-current source, whereas, if it were only to be operated from an alternating-current source, a much cheaper switch of the slow-break type could be utilized. It would be desirable, therefore, to have a switching device for interrupting direct-current circuits which would cost approximately the same as one for interrupting alternating-current circuits while still having the same interrupting capacity.

Arrangements utilizing arc quenching capacitors have been proposed whereby the cheaper slow-break type of switches could be used effectively to interrupt direct-current circuits. My invention relates to such an arrangement as is disclosed and claimed in copending joint application Serial No. 321,048, filed February 27, 1940, on behalf of C. G. Suits and A. M. Gurewitsch and assigned to the same assignee as the present invention.

Many of the so-called universal appliances which may be used on either an alternating-current or a direct-current source and, therefore, include commutator motors, must be provided with filters of some sort for the suppression of radio interference and these filters usually comprise condenser combinations. In accordance with my invention, I utilize these condensers not only to eliminate high-frequency currents which cause radio interference but also to aid in extinguishing the arcs which accompany the operation of associated electric switches whereby a slow-break electric switch may be used whether the appliance is energized from a source of direct or a source of alternating current.

It is an object of my invention, therefore, to provide a new and improved electric protective device for suppressing arcs in electric switches used in connection with commutator motors so as to adapt switches to interrupt more severe arcs than can be extinguished by mere separation of the contacts and wherein this same apparatus cooperates to minimize the radio influence of said motors.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention, reference may be had to the accompanying drawing the single figure of which is a schematic diagram of a circuit embodying my invention.

My invention is applicable to any load circuit of the type which produces high-frequency currents having a radio influence which may be energized either from a source of direct or alternating current. Accordingly, I have illustrated my invention as applied to a multispeed commutator motor 10 preferably of the type adapted to operate on either alternating current or direct current from source 11 which may be either an alternating-current or direct-current source. The motor 10 may be controlled by means of a suitable switch 12 which I have illustrated in the drawing as of the multiposition type whereby the speed of electric motor 10 may be varied. The details of the construction of this switch form no part of the present invention and it has been deemed unnecessary to illustrate in detail its specific structure. As will be described in greater detail hereinafter, switch 12 is preferably of the slow-break type since such switches from an economy standpoint are more desirable.

Commutator motor 10 is provided with series field windings 13 and 14 which should be distributed more or less symmetrically on the yoke of the motor since it has been found that this type of distribution aids in suppressing radio interference with a minimum of filter expense. With only one field coil connected to one terminal

of the armature 10a of electric motor 10, a certain amount of radio interference is produced which cannot be eliminated unless an excessive amount of filter capacitance is used. In order to control the speed of motor 10, field winding 13 is provided with a plurality of taps which are connected to contacts 12a, 12b, and 12c, of switch 12. Switch 12 controls the energization of motor field 13 so that, when the switch is in the position 12a, the motor will operate on maximum field and thereby operate at minimum speed; when in its position 12b, the motor will operate on reduced field and, therefore, will operate at increased speed; and when in its position 12c the motor will be operating on minimum field strength and, therefore, at its maximum speed. In other words, three speeds are provided, known as "low," "medium," and "high" speeds.

Since motor 10 has been illustrated as of the commutator type, it is provided with arcing contacts, namely, the brushes 10' which produce high frequency components of current and voltage giving rise to radio interference. In order to minimize the radio influence of motor 10, I provide a filter 15 including condensers or capacitors 16, 17, and 18 which provide substantially a short-circuit path for the high-frequency currents produced by motor 10 so that practically none of these currents are reflected in the circuit between motor 10 and source 11. Capacitors 16 and 17 connected across the motor terminals provide a very low impedance for the balanced high-frequency currents which might cause radio interference and, in order to eliminate the effect of any unbalanced high-frequency currents, the midpoint 19 between capacitors 16 and 17 is connected to the motor frame, schematically shown, through a low-impedance path including capacitor 18. The capacitance of condenser 18 is preferably somewhat smaller for best results than that of condensers 16 and 17. By means of filter 15, therefore, a low-impedance path has been provided for these high-frequency currents so that they are eliminated from the electric circuit interconnecting motor 10 with the source of power 11.

In the copending joint application mentioned above is described an arrangement wherein a large increase in the interrupting capacity of a switch is obtained if a condenser charged to a polarity opposite to that of the potential across the switch contacts when the circuit is interrupted is suddenly applied across said switch contacts after a predetermined separation thereof. The results of tests set forth in this joint application further show that, for a given arc-quenching condenser and a given applied voltage, there is an optimum contact separation which should exist at the instant the reversely or oppositely charged condenser is connected across the switch contacts in order to obtain maximum interrupting ability.

In accordance with my invention, condenser 16 of the filter 15 for minimizing the radio influence of motor 10 is arranged so as to be charged to a potential opposing the potential across the contacts of switch 12 and to be connected across the contacts of switch 12 after a predetermined separation thereof for arc-quenching purposes whereby switch 12 may be of the slow-break type and, therefore, considerably cheaper than would ordinarily be suitable when source 11 is a direct-current source of potential. Switch 12 is illustrated as being provided with an additional contact 12' located at a predetermined distance, as set forth in the above-mentioned joint application, from contact 12c which distance is dependent upon the size of condenser 16 and the potential of the source 11. Condenser 16 may be charged to a predetermined potential, which opposes the potential across the contacts of switch 12 upon interruption of the circuit, through condenser 17 which provides a high-impedance charging path. However, as illustrated in the drawing, I may also provide a resistor 20 having a high impedance connected in series with condenser 16 across source 11 when switch 12 is closed to energize motor 10. It will be understood by those skilled in the art that, when switch 12 is associated with contact 12c, condenser 16 will be reversely charged to substantially one half the potential of source 11. An appreciable charging time is, of course, required for condenser 16 but, in practical cases, the values of capacitance and resistance of condenser 16 and resistor 20, respectively, are such that this charging time is negligibly small in comparison to the period determined by the frequency of operation of the switch.

The operation of my electric protective apparatus will be obvious to those skilled in the art. Filter 15 will substantially suppress the high-frequency currents generated by commutator motor 10, thereby minimizing the radio influence thereof. At the same time, condenser 16 of this filter is arranged to be reversely charged relative to the potential across switch 12 upon interruption of the circuit so as rapidly to quench the associated arc drawn, when suddenly applied across the switch contacts after a predetermined separation thereof, thereby greatly increasing the interrupting capacity of switch 12. By this arrangement, a current zero is effectively obtained even though motor 10 is energized from a source of direct current.

I have, therefore, provided a simple and very compact circuit-interrupting device for a commutator motor which may be energized either from a direct-current or an alternating-current source wherein the radio influence of the commutator motor is minimized by the same apparatus which increases the interrupting capacity of the circuit-interrupting device thereby serving in a dual function.

It should be understood that my invention is not limited to the specific details and arrangement thereof herein illustrated and I intend in the appended claims to cover all such changes and modifications as fall within the spirit and scope of my invention.

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

1. In combination, a source of electrical energy, a load circuit of the type which produces high-frequency currents having a radio influence, a switch including a plurality of contacts for connecting and disconnecting said source and said load circuit, a filter for minimizing the radio influence of said load circuit, said filter including a condenser, and means for shunting said condenser across said switch contacts during said disconnecting operation in order to increase the current-interrupting ability of said switch.

2. In combination, a source of electrical energy, a load circuit of the type which produces high-frequency currents having a radio influence, a switch including a plurality of contacts for connecting and disconnecting said source and said load circuit, a filter for minimizing the radio influence of said load circuit, said filter includ-

ing a condenser arranged to be charged to a potential having a polarity opposite to the polarity of the potential across said switch contacts when disconnecting said source and said load circuit, and means for shunting said reversely charged condenser across said switch contacts during said disconnecting operation after said contacts have been separated to a predetermined distance to increase the current-interrupting ability of said switch.

3. In combination, a source of electrical energy, a commutator motor, a switch including a plurality of contacts for connecting and disconnecting said source and said motor, a filter for minimizing the radio influence of said motor, said filter including a condenser arranged to be charged to a potential having a polarity opposite to the polarity of the potential across said switch contacts when disconnecting said motor from said source, and means for shunting said reversely charged condenser across said switch contacts during said disconnecting operation to increase the current-interrupting ability of said switch.

4. In combination, a source of direct current, a multispeed motor of the type which produces high-frequency currents having a radio influence, a switch for connecting and disconnecting said motor and said source and controlling the seed of said motor including a plurality of contacts, a filter for minimizing the radio influence of said motor, said filter including a condenser arranged to be charged to a potential having a polarity opposite to the polarity of the potential across said switch contacts when disconnecting said motor from said source, and means for shunting said reversely charged condenser across said switch contacts during said disconnecting operation after said contacts have been separated to a predetermined distance whereby the current-interrupting ability of said switch is greatly increased.

LEONARD W. COOK.