

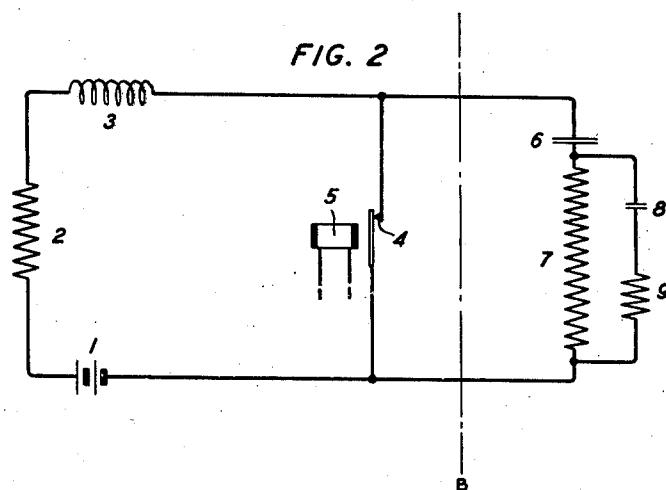
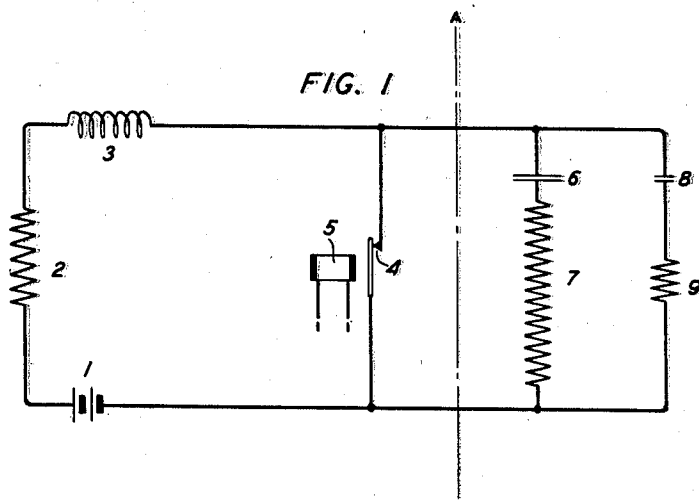
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ELECTRIC CURRENT INTERRUPTER

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ELECTRIC CURRENT INTERRUPTER

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This invention relates to electrical systems and more particularly to electric current interrupters to be used in connection with such systems.

An object of the invention is to suppress the sparking at a contact when it breaks an electric circuit.

A further object is to suppress electric current oscillations within a system when the current is interrupted by the opening of a contact.

10 An additional object is to decrease the electromagnetic radiation from the system.

Before describing the present invention, it is well to review briefly the nature of the system to which the device may be applied.

15 If a circuit containing a source of electric current, an inductance and capacity is broken by the opening of a contact, the effect of the inductance is to build up the electromotive force across the increasing contact gap. If the rate of increase of electromotive force is high, it may become so great before the contacts have become very widely separated that a series of sparks will occur at the gap. The usual breakdown voltage of a short gap is approximately 300 volts and the inductance may build up the voltage to several times this amount. In order to prevent this sparking, it has been the practice to connect a condenser in series with a resistance in shunt with the contact, the capacity and resistance being of certain desired values. When the contact is opened, the inductance will discharge its energy through the resistance into the condenser and the voltage across the contacts will never reach the breakdown value. Sparking at the contacts will thus be prevented. The resistance in series with the condenser retards its discharge when the contacts are subsequently closed thereby preventing an excessive discharge current which would weld the contacts together.

40 It has been found that while this capacity and resistance shunt may effectively prevent sparking at the contacts, there are certain secondary oscillations set up in the circuit which are objectionable. These secondary oscillations frequently cause annoyance in telegraph and telephone circuits and also cause interference with radio reception.

A feature of the present invention, therefore, whereby these secondary oscillations are suppressed resides in effectively short-circuiting this primary shunt for high frequency oscillations by adding in a shunt circuit a second condenser of smaller capacity. This second condenser in series with a small resistance may be added in shunt with the primary spark suppressor or in shunt

with the resistance of the primary spark suppressor.

The invention will be understood from the following description together with the accompanying figures of the drawing in which two embodiments of the invention are illustrated. Fig. 1 shows an operating circuit including a contact shunted by primary and secondary spark suppressors. Fig. 2 differs from Fig. 1 in that the secondary spark suppressor shunts only the resistance element of the primary spark suppressor.

In either figure the circuit to the left of the broken line AB is an operating circuit consisting of a source of electric current 1 here shown as a battery, resistance 2, inductance 3, and contacts 4 adapted to be opened upon the energization of electromagnet 5 and to close upon the deenergization of the electromagnet. The circuit is understood to have in addition a certain distributed capacity due to the effects of the earth and of other conductors in proximity to it.

Fig. 1 shows to the right of the broken line AB a primary spark suppressor consisting of a condenser 6 of suitable capacity in series with a resistance 7 of suitable value as a shunt around the contacts 4 of the operating circuit. Around this primary spark suppressor is shunted a secondary spark suppressor consisting of a relatively smaller condenser 8 in series with a relatively smaller resistance 9.

Fig. 2 shows to the right a broken line AB the primary spark suppressor consisting of the condenser 6 and the resistance 7 and the secondary spark suppressor consisting of the condenser 8 and resistance 9, but in this case the secondary spark suppressor is shunted around only the resistance of the primary shunt.

The capacities of condensers 6 and 8 and the values of resistances 7 and 9 will depend upon the specific electrical conditions of the circuit used such as the electromotive force of source 1 and the values of resistance 2, inductance 3, and the distributed capacity of the circuit, and upon the physical conditions of the contacts 4 such as the size of the contacts and the composition of the contact material. The values of capacity and resistance can be determined by experiment for any specific set of circuit conditions.

Operation

With contacts 4 closed an electric current originating at source 1 flows around the operating circuit through resistance 2, inductance 3 and contacts 4 and back to source 1. If electromagnet 5 is now energized contacts 4 are broken.

Inductance 3, however, tends to maintain a current in the circuit. Since contacts 4 have opened this current flows through resistance 7 and charges condenser 6 and to a small extent through resistance 9 charging condenser 8. This prevents the electromotive force across the air gap at contacts 4 from building up to the breakdown value of the air gap. In addition to this there are certain high frequency oscillations generated in the circuit upon the opening of contacts 4. These oscillations, which may have a frequency of millions of cycles per second are not effectively short-circuited by the primary shunt due to the relatively large value of resistance 7. However, the secondary shunt as shown in either Fig. 1 or Fig. 2 offers comparatively little impedance to these high frequency oscillations since resistance 9 is comparatively small. Therefore these high frequency oscillations are effectively short-circuited by the secondary shunt and therefore are suppressed.

If electromagnet 5 now becomes deenergized contacts 4 close. In the arrangement shown in Fig. 1 condensers 6 and 8 will discharge through resistances 7 and 9 respectively and contacts 4. The energy which has been stored up in the condensers will be dissipated in the resistances which will prevent the current through the contacts 4 from reaching a value large enough to weld them together. In the arrangement shown in Fig. 2 condenser 8 will have discharged through resistances 7 and 9 while the contacts were open provided they remained open for a sufficient time. In this case condenser 6 will discharge through resistance 7 and contacts 4 when the contacts are closed. If contacts 4 were opened only momentarily, however, condenser 8 may not have fully discharged. In this case resistance 9 will prevent a sudden surge of current from condenser 8 when the contacts close.

Any high frequency oscillations generated during closing of the contacts will be effectively short-circuited by the secondary shunt.

It should be observed that neither shunt alone can accomplish both the function of preventing sparking at the contacts upon opening and of suppressing high frequency oscillations. The condenser needed to prevent sparking at the contacts is of such capacity that the resistance in series with it must be comparatively large in order to prevent welding at the contacts upon closing. The large resistance, however, prevents the effective short-circuiting of the high frequency oscillations. An added small capacity in series with a small resistance while not being large enough to absorb the primary surge of current upon opening of the contacts will provide an effective short-circuit to the high frequency oscillations.

In a specific case a main spark suppressor having capacity 6 equal to 0.1 microfarad and resistance 7 equal to 65 ohms connected around a pair of contacts reduced interference in an adjacent radio receiving set 70 decibels below the value observed when the shunt was not connected. When a secondary spark suppressor having capacity 8 equal to 0.01 microfarad and resistance 9 equal to 10 ohms was connected in shunt with the main spark suppressor as shown in Fig. 1 a further reduction in the interference was observed of 40 decibels.

Although the resistance and inductance of the

operating circuit are shown in the drawing in specific positions in the circuit it is understood that they may be distributed throughout the circuit or localized at a number of places depending upon the particular circuit conditions. It is also understood that other modifications may be made in the circuit arrangements, and therefore I do not desire to be limited to the exact arrangements as shown and described but I aim to cover broadly all such changes and modifications as come within the spirit and scope of the appended claims.

What is claimed is:

1. In an electrical system, a pair of contacts adapted to be opened and closed, a condenser in series with a resistance connected as a shunt around said contacts and a second condenser of relatively less capacity in series with relatively less resistance connected directly in parallel with said first condenser and resistance.

2. In an electrical system, in combination, a pair of contacts adapted to be opened and closed, a condenser in series with a resistance connected in direct shunt around said contacts and a condenser of relatively less capacity in series with relatively less resistance connected in direct shunt around said contacts.

3. In an electrical system, a circuit interrupter, a condenser in series with a resistance connected as a direct shunt across said interrupter, and a second condenser of relatively less capacity in series with relatively less resistance connected directly in parallel with said first condenser and resistance.

4. In an electrical system, breaking contacts, a spark suppressor comprising a condenser in series with a resistance directly shunting said contacts, and means to effectively short circuit said spark suppressor for high frequency oscillations comprising a second condenser of relatively less capacity in series with relatively less resistance connected directly in parallel with said spark suppressor.

5. In an electrical system, a pair of contacts adapted to be opened and closed, means to limit arcing at said contacts comprising a condenser and a resistance in series connected as a direct shunt across said contacts, and means to limit high frequency oscillations in said system comprising a second condenser of relatively less capacity than said first condenser in series with a second resistance of relatively less value than said first resistance connected directly in parallel with said first condenser and resistance.

6. In an electrical system, contacts adapted to be opened and closed, a condenser in series with a resistance connected as a direct shunt across said contacts, and a second condenser of relatively less capacity in series with relatively less resistance connected as a direct shunt across at least the resistance of the said first shunt.

7. In an electrical system, breaking contacts, a spark suppressor comprising a condenser in series with a resistance connected as a direct shunt across said contacts, and means to effectively short circuit said resistance for high frequency oscillations comprising a condenser of less capacity than said first condenser in series with a resistance less in value than said first resistance connected in direct shunt with at least the resistance of said spark suppressor.

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