

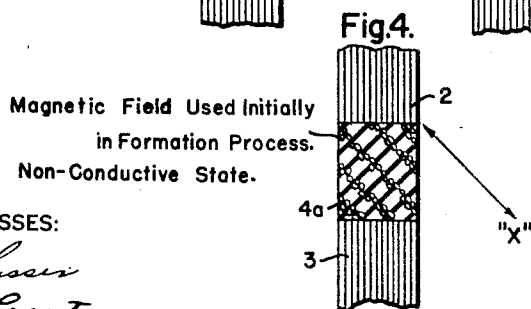
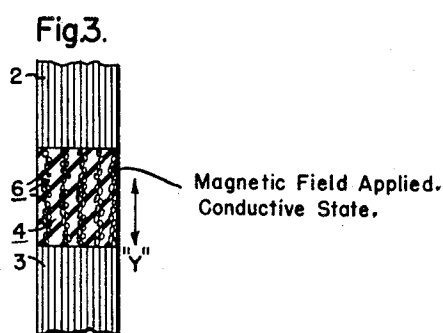
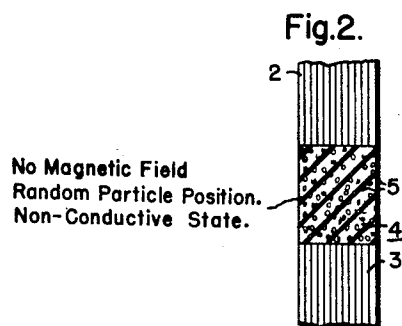
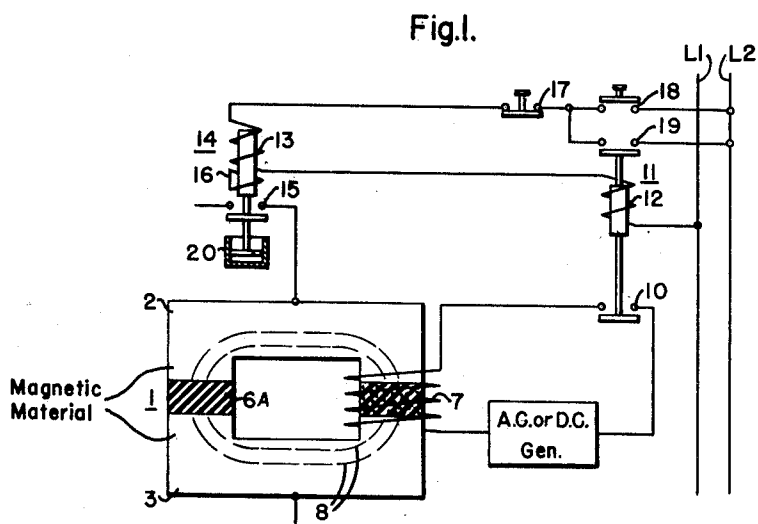
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CIRCUIT INTERRUPTER

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WITNESSES:

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CIRCUIT INTERRUPTER

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My invention relates to circuit interrupters in general, and, more particularly, to interrupting elements therefor.

A general object of my invention is to provide an improved circuit interrupter which will more effectively interrupt the circuit therethrough than has been attained heretofore.

A more specific object is to provide an improved circuit interrupter of the type having a pair of electrodes between which is interposed an elastomeric matrix in which is embedded a plurality of magnetizable conductive particles, the conductance of which is responsive to an impressed magnetic field.

Further objects and advantages will readily become apparent upon a reading of the following specification, taken in conjunction with the accompanying drawing, in which:

Figure 1 somewhat diagrammatically illustrates an improved circuit interrupter embodying my invention and shown in the open circuit position:

Fig. 2 is an enlarged view showing somewhat schematically the condition of the elastomeric matrix with the magnetizable particles initially disposed at random throughout the matrix, when no magnetic field is applied.

Fig. 3 is a view similar to that of Fig. 2 but indicating the condition arising when a magnetic field is applied to the elastomeric matrix in the directions "Y,Y," as viewed in the drawing; and

Fig. 4 is a view similar to Fig. 1, that is with no impressed magnetic field, but with the magnetizable particles disposed in chains having an initial orientation due to utilizing a magnetic field in either direction "X" during the time of initial formation of the material.

Referring to the drawing, and more particularly to Figure 1 thereof, the reference numeral 1 designates a laminated soft iron frame, the two halves of which also act as electrodes 2, 3. Between the electrodes 2, 3 is an elastic mass 4 in which are embedded a plurality of magnetizable conductive particles 5 (Fig. 2). The elastic mass 4 is preferably an elastomeric matrix or a "rubber-like" material. Also a block of insulating material 6A is provided to insulate the two line terminals 2, 3. However, material 6 may be another mass the same as 4, so the two would be in parallel.

Referring to Fig. 2, it will be observed that with no magnetic field applied a non-conductive condition exists between the terminals 2, 3 with the magnetizable particles 5 distributed at random throughout the matrix 4. The particles 5 may constitute any suitable magnetizable conductive

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particles such as finely divided iron, nickel, magnetite and the like. The particles 5 are initially dispersed through the mass 4 in a random position. However, in some instances, it may be desirable to align the particles into chains, said chains extending in the directions "X," indicated in Fig. 4, by applying a magnetic field during the initial formation of the matrix, so that all of the chains will be aligned in substantially the same direction along the flux lines of the magnetic field during the initial formation process. Thus, in the absence of a magnetic field, a non-conductive condition is present as indicated in Figs. 2 and 4, in which no current flow takes place between the pair of electrodes 2, 3. However, upon the application of a magnetic field, say in the directions "Y," as indicated in Fig. 3, the particles 5 of Fig. 2 or the conductive chains 5 of Fig. 4 are slightly stressed out of their initial position so that they assume a pattern as shown in Fig. 3, in which the particles 5 form conductive chains 5 extending between the line terminals 2, 3 in the directions "Y." Immediately upon removal of the magnetic field of Fig. 3, the particles 5 return to their original position as indicated in Fig. 2, or the chains 5 return to their position of Fig. 4, this condition arising by virtue of the "rubber-like" or elastic condition of the elastomeric matrix 4.

With the principles of my invention thoroughly in mind as a result of an analysis of Figs. 2, 3 and 4, returning again to Fig. 1 it will be noted that I have provided a magnetic field coil 7 energized by a suitable A.-C. or D.-C. source.

If the random particle material 4 of Fig. 2 is used in Fig. 1, I preferably employ an axially directed magnetic field as indicated in Fig. 1. Although the field may be A.-C. or D.-C., I prefer to use D.-C., since better results are achieved.

If the material 4A of Fig. 4 is employed in Fig. 1, that is with the chains 5 initially aligned in the directions "X" by application of a magnetic field in the initial formation process of the material 4A, then I prefer to use an externally impressed magnetic field that is substantially in the direction of a straight line extending between the line terminals 2, 3. Here again, however, the field may be A.-C. or D.-C., but preferably I use a D.-C. field.

The front contacts 10 of a contactor 11 are provided to control the energization of the winding 7. The circuit for energizing the coil 12 for closing the contactor 11 extends from the control line L1 through the coil 12 to the coil 13 of a disconnect switch 14, which when opened interrupts the passage of any residual current

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through the interrupter following removal of the magnetic field. The disconnect switch 14 has a pair of front contacts 15 and a closed turn 16, the latter insuring a slow opening of the contacts 15 during the opening operation of the interrupter, until after such a time at which the magnetic field has been removed and the particles 5 will have assumed the position shown in Fig. 2 or 4. This will insure breaking the circuit within the mass 4 and not at the contacts 15.

An opening button 17 is provided in circuit with the windings 12, 13 and a closing button 18 is by-passed by front contacts 19 of the contactor 11.

The operation of the interrupter of my invention will now be explained. Initially the conditions are as shown in Fig. 1 with the disconnect switch 14 open and with the winding 7 deenergized. The particles assume the condition shown in Fig. 2 or Fig. 4 and no current passes through the interrupter. To send current through the interrupter, one closes the closing button 18 by any suitable means. This energizes the coils 12, 13 across the control lines L1, L2. The disconnect switch 14 closes after the contactor 11 by virtue of the operation of the one-way acting dashpot 20. This prevents application of line voltage to the interrupter until the particles 5 or chains 6 have assumed their conducting positions. Otherwise sparking might occur within the material 4 if voltage were applied to the mass 4 at the same time as the field was applied.

The closing of the contactor 11 closes the front contacts 19 energizing the winding 7, and also closes the front contacts 19 by-passing the closing button 18, so that the latter may be momentarily operated.

The energization of the winding 7 through the closing of the front contacts 19 of the contactor 11 sets up a magnetic field as indicated by the flux lines 8 to thereby stress the elastomeric matrix 4 and cause the chains 6 embedded therein to be stressed out of their original condition as in Fig. 4, or the particles 5 from a completely random position as in Fig. 2. This leads to the conductive condition indicated in Fig. 3 where the particles 5 align to form the conductive chains 6 extending between the electrodes 2, 3.

When the physical alignment as idealized in Fig. 3 occurs, the circuit interrupter is closed by virtue of the closing of the delayed acting disconnect switch and current passes there-through. To open the circuit through the interrupter, the opening button 17 is pressed to deenergize the windings 12, 13. The contactor 11, when deenergized, opens, breaking the circuit through the winding 7 to remove the magnetic field 8 and to thereby cause the particles 5 to be forced back into their original position as indicated in Fig. 2 where a non-conductive state exists. Because of the closed turn 16, the disconnect switch 14 is slow in opening so that the non-conductive condition of Fig. 2 is sure to be in existence before opening of the disconnect contacts 15. The opening of the disconnect contacts 15 insures the interruption of any residual current passing through the interrupter following removal of the magnetic field.

I shall now give three examples of materials which may be used for the matrix 4 or 4A. Suitable elastomeric materials for such use are natural rubber or synthetic elastomers such as polychloroprene, butadiene, styrene copolymers, buta-

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diene-acrylonitrile copolymers, silicone elastomers and the like. A mixture was prepared from 20.8 parts of electrolytic iron particles of an average diameter of 100 microns, 9 parts of a dimethyl silicone fluid of a viscosity of 10,000 centistokes and 0.4 part of butyl perbenzoate. The mixture was molded under a pressure of 500 p. s. i. and a temperature of 150° C. for twenty minutes to produce an elastomeric resistance mass.

Another example was prepared by taking 49.5 parts by weight of electrolytic iron of a fineness of 230-270 mesh, 16.5 parts by weight of dimethyl silicone fluid of a viscosity of 10,000 centistokes and 0.33 part by weight of butyl perbenzoate. This mixture was molded under a pressure of 300-500 p. s. i. and a temperature of 150° C. for twenty minutes to produce an elastomeric resistance mass. A sample of the resultant material interrupted 20 amperes at 83 volts.

Another example was to take 26.6 parts by weight of electrolytic iron of a fineness of 230-270 mesh, 13.3 parts by weight of a dimethyl silicone fluid of a viscosity of 10,000 centistokes and 0.27 part by weight of butyl perbenzoate. The mixture was molded under a pressure of 500 p. s. i. and a temperature of 150° C. for twenty minutes to produce an elastomeric resistance mass.

From the foregoing description of my invention, it will be apparent that I have provided an improved circuit interrupter in which an elastomeric or "rubber-like" matrix is employed in which is embedded a plurality of magnetizable conductive particles 5. The matrix extends between the electrodes 2, 3 and depending upon the existence of a magnetic field forms a conducting or non-conducting state between the electrodes 2, 3. Obviously other control arrangements than that disclosed herein may be employed without departing from the scope of my invention.

Although I have shown and described a specific structure and materials, it is clearly to be understood that the same was only for the purpose of illustration, and that changes and modifications may readily be made therein without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. A circuit interrupter including a pair of fixed electrodes, an elastic mass including finely divided iron particles disposed in chains embedded in an elastomeric matrix with the chains generally aligned in an elastic direction other than that assumed by a straight line extending between the electrodes, means for applying a magnetic field in a direction substantially parallel to the direction assumed by a straight line extending between the electrodes, the impressed magnetic field causing the chains to be stressed out of their original position to a position in which the elastic mass as a whole is rendered conductive, and means for removing the magnetic field to thereby cause said elastic mass to return to its non-conductive state relative to said electrodes.

2. A circuit interrupter including a pair of fixed electrodes, an elastic mass including finely divided magnetizable particles disposed in chains embedded in an elastomeric matrix with the chains generally aligned in a direction other than that assumed by a straight line extending between the electrodes, means for applying a magnetic field in a direction substantially parallel to the direction assumed by a straight line extending between the electrodes, the impressed

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magnetic field causing the chains to be stressed out of their original position to a conductive position, and means for removing the magnetic field to thereby cause said elastic mass to return to its non-conductive state relative to said electrodes.

3. A circuit interrupter including a pair of spaced electrodes, an insulating elastic solid body interposed between said electrodes and having finely divided conducting magnetic particles interspersed therein, the conducting magnetic particles being spaced in substantially non-conductive relation so that the elastic body has a relatively high resistance between the electrodes, means for applying a magnetic field to the elastic body and the particles then being in good-conducting relation with respect to each other to form thereby conducting chains between the electrodes, said elastic solid body being stressed while the magnetic field is applied so that removal of the magnetic field causes, due to the elastic nature of the solid body, a return of the particles to their initially substantially non-conductive relation in which high resistance exists through the finely divided particles between the electrodes.

4. A circuit interrupter including a pair of spaced electrodes, a rubber-like solid insulating substance disposed between said electrodes and forming an elastomeric matrix having finely divided conducting magnetic particles interspersed therein, the finely divided conducting magnetic particles making relatively poor contact so that the interrupter carries no appreciable current from one electrode to the other, means for externally impressing a magnetic field to the solid substance to reorient the finely divided particles against the resiliency of the solid substance, said particles then being positioned in good-conducting relation with adjacent particles and permit-

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ting current flow between the electrodes, and removal of the magnetic field effecting a return of the finely divided particles to their initial non-conducting state due to the elasticity of the rubber-like solid substance.

5. The combination in a circuit interrupter of a pair of spaced electrodes, an elastic insulating solid disposed between the electrodes, finely divided conducting magnetizable particles disposed in chains interspersed within the solid with the chains generally aligned in a direction other than that assumed by a straight line extending between the electrodes, means for applying a magnetic field in a direction substantially parallel to the direction assumed by a straight line extending between the electrodes, the impressed magnetic field causing the chains to be stressed out of their original position to a conductive position between the electrodes, and a removal of the magnetic field causing the chains to reform in their initial condition due to the elasticity of the solid giving rise to a non-conductive state between the electrodes.

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