June 5, 1951 K. LERSTRUP 2,555,799

ELECTRIC SWITCH

Filed Feb. 5, 1947 2 Sheets-Sheet 1

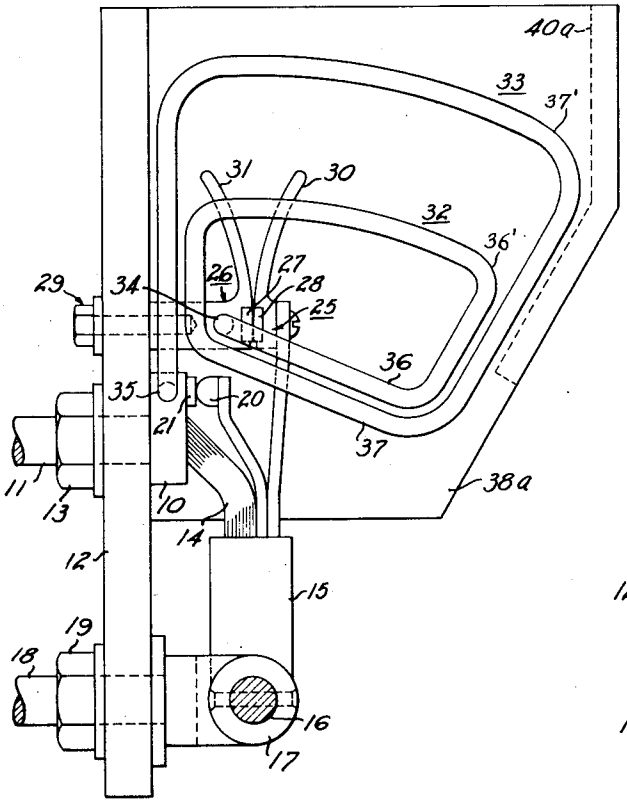


Fig. 1

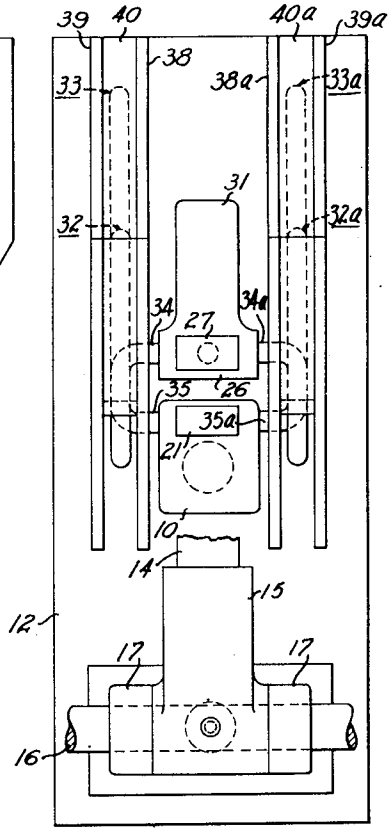


Fig. 2

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ELECTRIC SWITCH

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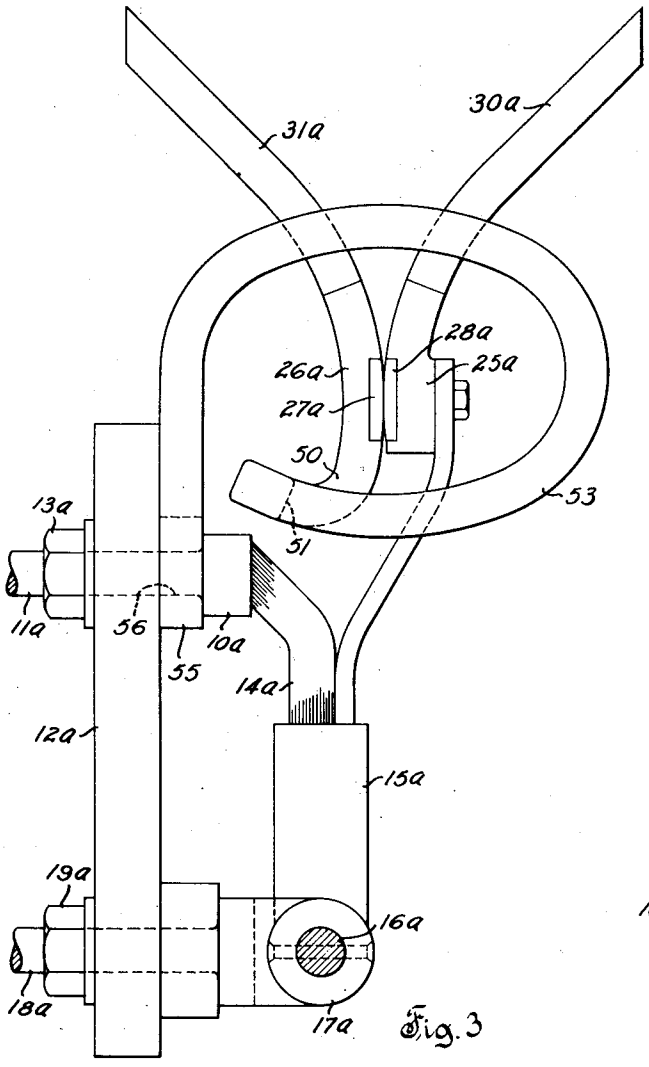


Fig. 3

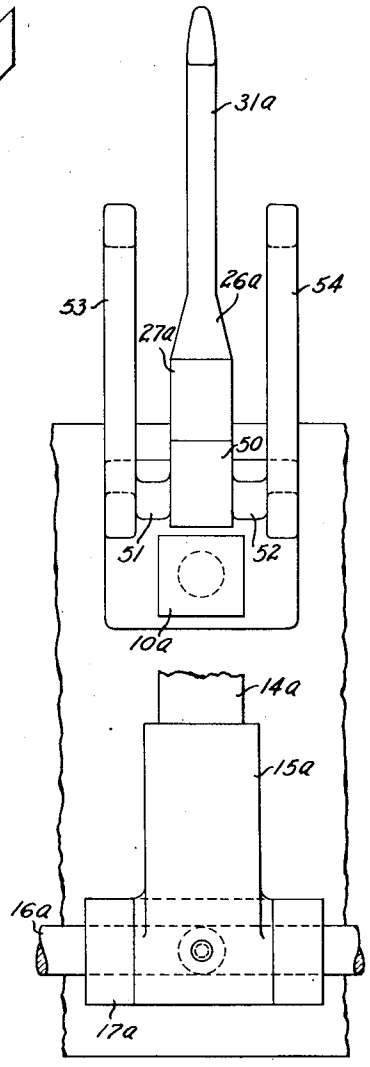


Fig. 4

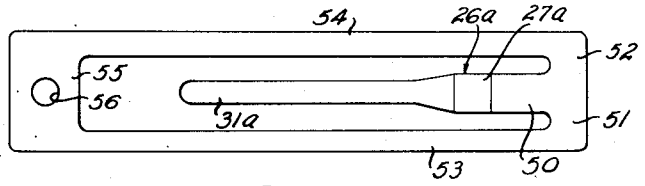


Fig. 5

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Patented June 5, 1951

2,555,799

UNITED STATES PATENT OFFICE

2,555,799

ELECTRIC SWITCH

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Application February 5, 1947, Serial No. 726,588

2 Claims. (Cl. 200—147)

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This invention relates to electric switches or circuit breakers and more particularly to the control of arcs formed by the opening of electric switches or circuit breakers. The principal object of the invention is the provision of new and improved electric switches or circuit breakers and new and improved control of electric arcs.

The invention involves the control of an electric arc by means adapted to provide a magnetic field and a more specific object is the provision of new and improved means for providing the magnetic field and more particularly to provide a strong, concentrated field while having a minimum of self-inductance in the field providing means.

Another object of the invention is the provision of new and improved means providing a most desirable distribution of magnetic field over the entire travel of the electric arc.

Other objects will appear as the description of the invention proceeds.

The novel features of the invention and how the objects are attained will appear from this specification and the accompanying drawings showing several embodiments of the invention and forming a part of this application, and all these novel features are intended to be pointed out in the claims.

In the drawings:

Fig. 1 is a side elevation of a circuit breaker or switch embodying the invention, certain insulating walls having been removed to better show the parts behind the walls;

Fig. 2 is a front elevation partly fragmentary, of the circuit breaker shown in Fig. 1;

Fig. 3 is a side elevation of another circuit breaker or switch embodying the invention;

Fig. 4 is a front elevation of the circuit breaker shown in Fig. 3; and

Fig. 5 is a plan view, on a reduced scale, of a plane development of a detail of the circuit breaker of Figs. 3 and 4.

Referring first to Figs. 1 and 2, the circuit breaker here shown has a stationary main contact 10 carried by a stud 11 serving as an electrical terminal extending through an insulating support 12 and held thereon as by a nut 13. A movable main contact 14 is engageable with the stationary main contact 10 and is carried by an arm 15 carried by a rotatable shaft 16 which may be mounted in bearing means 17. This bearing means 17 may be carried by a stud 18 serving as an electrical terminal extending through the support 12 and held thereon by a nut 19. The shaft 16 may be used to rotate the

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contact 14, for example, clockwise to open position. It will be understood that construction described is schematic and any desired suitable construction may be used.

The arm 15 also carries, as by a suitable flexible arm, an auxiliary contact 20 engageable with a stationary auxiliary contact 21 here shown as mounted on the main contact 10.

The arm 15 further carries, as by a suitable flexible arm, an arcing contact 25 engageable with a stationary arcing contact 26. The contacts 25, 26 may be made of copper or other suitable metal, and at the point of contact, the contacts 26, 25 may be provided with insets 27, 28 of a metal having more desirable contact properties than those of the bodies of the contacts 25, 26. The stationary contact 26 may be mounted and held on the support 12 in any suitable way as by a screw 29. Desirably, the arcing contacts 25, 26 include arc horns or runners 30, 31 respectively, extending upwardly and flaring away from each other. The contacts 14, 20, 25 and runner 30 are broken away in Fig. 2 to more clearly show the other parts.

Means is provided for causing movement of the arc drawn between the contacts 25, 26, transverse to the general extent of the arc, this means being here shown as a pair of planar coils disposed in generally coaxial and parallel relation at opposite sides of the contacts 25, 26. Referring to the coil which is shown in Fig. 1, this coil in this instance comprises two turns 32, 33. The turn 32 has an end 34 carried by and electrically connected to the contact 26, and as viewed in Fig. 1 runs counterclockwise from the end 34 360° to the beginning of the turn 33, the turn 33 continuing counterclockwise 360° to an end 35 which is carried by and electrically connected to the main stationary contact 10. It will be noted that the lower parts or first conductor portions 36, 37 of the turns 32, 33 are relatively closely spaced and slant downward in approximately the direction of travel of the contact 25 in opening and are somewhat below that direction. The upper parts or second conductor portions 36', 37' are relatively widely spaced and are bent downward in approximately the direction in which the contact 25 travels when opening. However, the portions 36', 37' are above the path of contact travel. The paired portions 36, 37 define relatively closely spaced parallel curves at one section of the periphery of each of the coils, and the paired portions 36', 37' define relatively widely spaced parallel curves at another section of the periphery of each of the

coils. It will be further noted that the turn 32 covers a smaller area than the turn 33. The arc runners 30, 31 are preferably of such length that they extend upwardly beyond the upper part of the turn 32, but not beyond turn 33.

The turns 32, 33 are disposed just outside of an arc chute wall 38 of insulating material (see Fig. 2) which protects the entire area of the inside of the turns 32, 33. Another wall may be used to cover the outside of the turns 32, 33, and a spacer 40 may be provided between the outer margins of the walls 38, 39. The walls 38, 39 may be suitably supported by the support 12. In Fig. 1 the parts 38, 39 and 40 have been omitted to show the turns 32, 33 and the switch structure in full lines.

Disposed at the other side of the contacts 25, 26 is a two turn coil having turns 32*a* and 33*a* which are preferably identical with the turns 32, 33. The turn 32*a* has an end 34*a* carried by and electrically connected to the contact 26, and the turn 33*a* has an end 35*a* carried by and electrically connected to the contact 10. Accordingly, it will be evident that the turns 32, 33 are in parallel with the turns 32*a*, 33*a*, and when current flows through the pairs of turns they cooperate to provide a magnetic field transverse to the arc drawn between the contacts 25, 26, the field being stronger within the turns 32, 32*a* than in the space outwardly of the upper portions of the turns 32, 32*a* and within the upper portions of the turns 33, 33*a*.

The turns 32*a*, 33*a* may be protected by walls 38*a*, 39*a* and a spacer 40*a* as hereinbefore described regarding the corresponding parts 38, 39, 40. Arc barriers of any known type (not shown) may be disposed between the walls 38, 38*a*.

The operation of the embodiment of Figs. 1 and 2 is as follows. When the circuit breaker is opened, the main contacts 14, 10 open first, then the auxiliary contacts 20, 21. While the contacts 25, 26 are still in engagement current flows from the stud 11 to the ends 35, 35*a* of the turns 33, 33*a* thence through the turns 33, 33*a* in parallel, thence through the turns 32, 32*a* in parallel, to the ends 34, 34*a* and the contact 26 to the contact 25 to the stud 18. By reason of the construction and arrangement of the coils they have very little self-induction and the current will rise rapidly in them. Furthermore a maximum of the magnetic flux produced is effective to cause movement of the incipient arc and cause it to move upwardly. Also the flux provided is concentrated and powerful. When the contacts 25, 26 open, the arc drawn between them is in series with the described parallel connected turns and will be powerfully impelled upwardly by the magnetic field hereinbefore referred to which provides a most desirable field distribution over approximately the entire arc travel from incipience to the place of extinguishment where the arc has been sufficiently lengthened and attenuated and cooled. It is evident that somewhere in the neighborhood of the upper edge of turn 33 the impelling magnetic field will be zero. The arc barriers or other cooling structures therefore must be constructed to retain the arc within the boundaries of turn 33 until the arc is successfully extinguished.

Referring now to Figs. 3 and 4, the circuit breaker here shown comprises a main stationary contact 10*a* and a main movable contact 14*a* engageable therewith. The main contacts 10*a*, 14*a* are here shown as carried and connected as in the case of Fig. 1, similar parts bearing the same reference numeral with the suffix *a*. The circuit breaker of Fig. 3 may also be provided with an auxiliary contact but is here shown as provided with only arcing contacts 25*a*, 26*a* having insets 28*a* and 27*a* respectively. The arcing contact 25*a* is similar to the arcing contact 25 and flexibly supported by the arm 15*a*. The arcing contact 25*a* is provided with an arc runner 30*a*. The arcing contact 26*a* differs from the arcing contact 26 in respects which will be pointed out.

The contacts 14*a*, 25*a* and runner 30*a* are broken away in Fig. 4 to more clearly show the other parts.

The arcing contact 26*a* forms an integral part of an arc runner 31*a* flaring upwardly away from the arc runner 30*a*, and is also integral with a downwardly extending portion 50 integrally united with laterally extending portions 51, 52. The other end of the lateral portion 51 is integral with a portion 53 which extends at right angles to the lateral portions 51 and is bent in the form of a loop as may be seen in Fig. 3. The other end of the lateral portion 52 is integral with a portion 54 which is bent in the form of a loop 54 identical with the loop 53, the loop 54 being in Fig. 1 directly behind the loop 53 and on the opposite side of the contact 26*a*. The ends of the loops 53, 54 remote from the ends at 51, 52 are integral with a transverse portion 55. The transverse portion 55 is here shown as having a hole 56 through which the stud 11*a* is disposed, the contact 10*a* being drawn up against the portion 55 to hold the same in place and make a good electrical connection.

It will be apparent that the loops or turns 53, 54, the contact 26*a* and the arc runner 31*a* may be formed from a single piece of metal and bent to the shape shown in Figs. 3 and 4. Fig. 5 shows a plane development of the single piece of metal, which may be stamped in the form shown, the inset 27*a* being added if desired.

No insulating protecting walls are shown in Figs. 3 and 4 but they are preferably provided for the turns 53, 54 in the same way as described in connection with the protecting walls for the turns 32, 33, and 32*a*, 33*a* of Figs. 1 and 2.

When the main contact 14*a* is opened, current will flow from the stud 11*a* to the transverse portion 55 thence through the turns 53, 54 in parallel, to the contact 26*a* to the contact 25*a* thence to the stud 18*a*. The turns 53, 54 will provide a magnetic field transverse to the arc drawn between the contacts 25*a*, 26*a* and impel it upwardly along the arc runners 30*a*, 31*a* to extinguishment. As in the case of Figs. 1 and 2 the magnetic field providing means, the turns 53, 54, produce a maximum strong field, with low self-inductance.

From the foregoing it will be apparent to those skilled in the art that the illustrated embodiments of the invention provide new and improved electric arc control and new and improved electric switches or circuit breakers and accordingly accomplish the objects of the invention. On the other hand, it will also be obvious to those skilled in the art that the illustrated embodiments of the invention may be variously changed and modified, or features thereof, singly or collectively, embodied in other combinations than those illustrated, without departing from the spirit of the invention, or sacrificing all of the advantages thereof, and that accordingly the

disclosure herein is illustrative only, and the invention is not limited thereto.

It is claimed and desired to secure by Letters Patent:

1. An electric switch for causing the interruption of current comprising: relatively movable contacts including relatively movable arc horns for drawing an arc therebetween; and means for elongating said arc between said arc horns; said means including first and second magnetic field providing planar coils each having a plurality of turns connected in electrical series connection to pass current through all of said turns for any position of said arc relative to said arc horns, said coils being disposed in general coaxial and parallel relation at opposite sides of said contacts, said first and second coils being duplicates of one another and each having first and second conductor portions, said first conductor portions extending in parallel relation and being relatively closely spaced and said second conductor portions extending in parallel relation and being relatively widely spaced, and means for electrically connecting said coils in parallel with each other.

2. An electric switch for causing the interruption of current comprising: relatively movable contacts including relatively movable arc horns for drawing an arc therebetween; and means for elongating said arc between said arc horns, said means including first and second magnetic field

providing planar coils having a plurality of turns connected in electrical series connection to pass current through all of said turns for any position of said arc relative to said arc horns, said coils being disposed in general coaxial and parallel relation at opposite sides of said contacts, said first and second coils being duplicates of one another and each having first and second conductor portions included in said turns, said first conductor portions of said turns defining relatively closely spaced parallel curves at one section of the periphery of each of said coils in a plane thereof and said second conductor portions of said turns defining relatively widely spaced parallel curves at another section of the periphery of each of said coils in a plane thereof, and means for electrically connecting said coils in parallel with each other.

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