

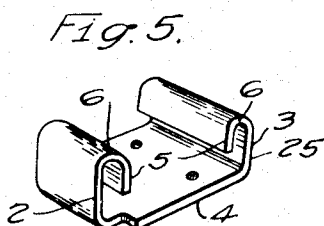
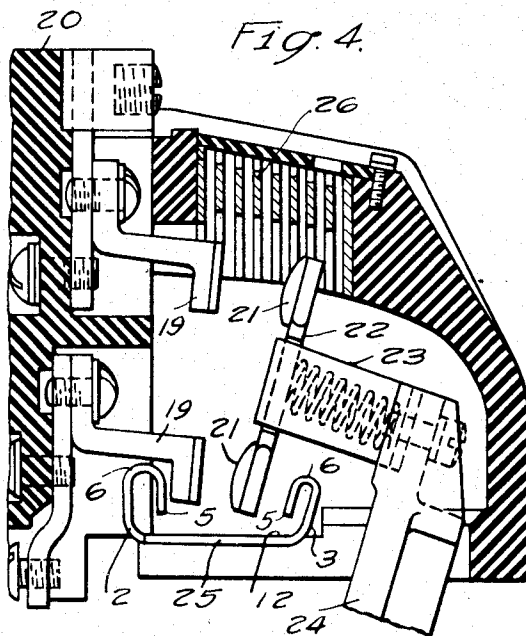
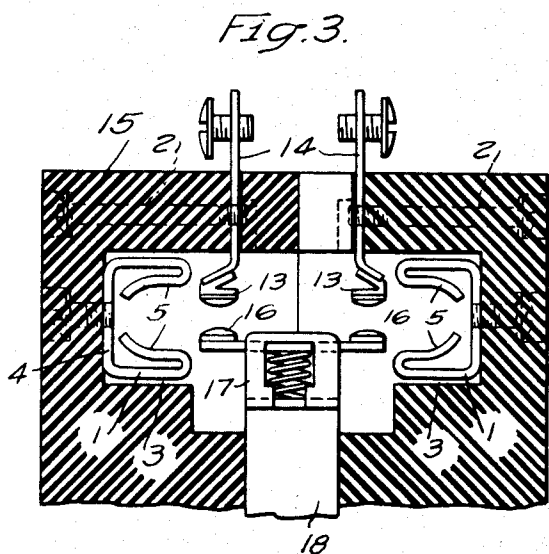
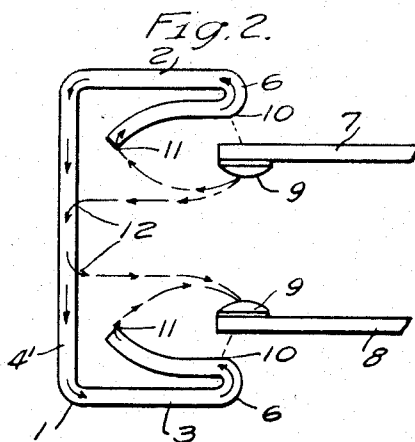
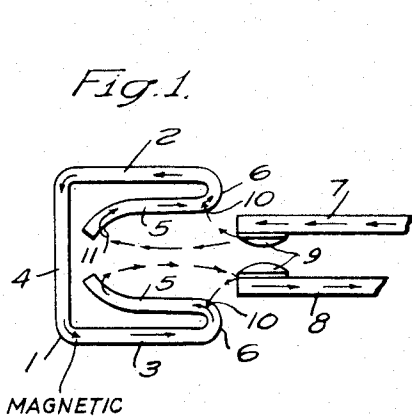
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2,356,039

ARC LIMITING DEVICE

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2,356,039

ARC LIMITING DEVICE

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5 Claims. (Cl. 200—147)

This invention relates to an arc limiting device and, more particularly, to an arc quenching structure for separating an arc, drawn between two contact members, into two separate parts and for confining such arc or arcs to a limited area adjacent the contact members.

One of the principal objects of this invention is to provide an arc quenching structure adjacent a pair of separable contact members which will function up to certain current values to divide an arc drawn between the contact members into two parts and extinguish such divided arcs, and above certain current values will function to confine and limit the length of the arc streams to an area adjacent the contacts.

According to the invention, a circuit interrupting mechanism having a pair of separable contact members between which an arc may be drawn is provided with a substantially U-shaped metallic structure so arranged with respect to the contact members that each of its arms or limbs will provide an arc horn to which an arc may strike from one of the contact members.

More specifically, the U-shaped structure of the character referred has ends of its limbs extending inwardly and doubled back to provide substantially U-shaped loops to which an arc may strike, the U-shaped loops operating to produce a magnetic field for moving and confining the arc in a space between the arms of the U-shaped member.

Other objects, features and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawing in which:

Figure 1 is an end elevational view of a structure constructed in accordance with the principles of this invention and showing its arrangement with respect to a pair of separable contact members;

Fig. 2 is a view similar to Fig. 1 illustrating a modified form of the structure;

Fig. 3 is a sectional view of a circuit interrupting device showing the application of the arc separating device of this invention to a double break contact structure;

Fig. 4 is a sectional view of a circuit interrupting device showing the preferred embodiment of this invention; and

Fig. 5 is a perspective view of the U-shaped arc separating device shown in Fig. 4.

Referring to Figs. 1 and 2 of the drawing the numeral 1 designates a U-shaped metal member formed of magnetic material and having parallel arms or limbs 2 and 3 spaced apart and connect-

ed together by a base portion 4. The ends 5 of the limbs 2 and 3 are doubled back and project inwardly toward the base portion 4 to provide substantially U-shaped loops 6 at the end of each of the arms 2 and 3. Relatively movable conducting members 7 and 8 are provided with contact members 9 positioned adjacent and substantially in the space between the U-shaped loop 6 at the ends of the limbs 2 and 3.

Upon relative movement of the conducting members 7 and 8 to separate the contact members 9, an arc will be drawn between the contact members 9. Since the flow of current in the conducting members 7 and 8 and in the arc between the contact members 9 will provide a current loop having its strongest magnetic field at the center of the current loop which is between the conducting members 7 and 8, the arc between the contact members 9 will move outwardly toward the U-shaped member 1. As such arc lengthens the current will follow the path of least resistance and an arc will strike from each of the conducting members 7 and 8 or contact members 9 to each end of the limbs 2 and 3 substantially at the points 10. In this manner the arc originally drawn between the contacts 9 is divided into two separate portions thereby doubling the number of arcs between the contact members 9 for a purpose to be described. At this time the current will flow as designated by the arrows from conducting member 7 through one of the divided arc portions to the point 10 on the limb 2 and thence through the U-shaped member 1 to the point 10 on the other limb 3 and the other of the divided arc portions to the conducting member 8.

Due to the shape of the U-shaped loop 6, the direction in which the current is flowing is reversed and a current loop is formed which will have its strongest magnetic field at the point 10. Such field will function to move the end of the arc remote from the contact member 9 at the point 10 downwardly along the surface of the inwardly extending sections 5 of the limbs 2 and 3. If the end of the arcs remote from the contact members 9 move to a point 11 on the inwardly extending sections 5, the resistance of the two separate arc portions will increase due to arc lengthening and the current will follow the path of least resistance causing such arcs to either rejoin or strike immediately to the points 10 if they have not already been extinguished in a manner to be described. In the event that the arcs have not been extinguished, it will be noted that it makes little difference whether they

are considered as rejoining across the contact members 9 or as striking directly to the points 10 since they will always strike to the points 10 upon joiander across the contact members 9 as explained above.

To prevent the arc from restriking across the contact members 9, the base portion 4' connecting the limbs 2 and 3 may be made longer, as shown in Fig. 2, where sufficient space is available. In this showing the steps of drawing an arc between the contact members 9 and striking separate arcs from the conducting members 7 and 8 to the points 10 are the same as described in connection with the showing of Fig. 1. However, in this showing when the ends of the arcs are moved to the points 11 such ends will follow the path of least resistance and strike to the points 12 on the base 4', thereby shunting the limbs 2 and 3 out of the current path. At this time a current loop will be formed by the current arcing from the conducting member 7 to one of the points 12 and flowing through the portion of the base 4' between the points 12 to the return arc from the other of the points 12 to the conducting member 8. The field of this loop will tend to lengthen each of the arcs between the contact members 9 and the points 12. If such arc portions increase in length the resistance thereof will increase and the current in following the path of least resistance will cause arcs to restrike again at the points 10. The structure thus far described may be employed as the sole means of extinguishing an arc as shown in Fig. 3 or may be employed to confine and limit an arc in one portion of a circuit while an arc is drawn and extinguished by other deionizing means in another portion of the circuit as shown in Fig. 4.

Referring to Fig. 3 there is shown a double break contact structure comprising stationary contacts 13 carried by conducting members 14 mounted in an insulating support 15. A pair of movable contact members 16 are mounted on a saddle 17 connected to an operating member 18 mounted for movement in the support 15 back and forth between positions engaging and disengaging the contacts 13 and 16 in a manner well known in the art. A U-shaped deionizing structure 1, such as shown in Figs. 1 and 2, is mounted on the support 15 adjacent each of the pairs of relatively movable and stationary contacts 13 and 16. In this showing the members 1 function to break an arc drawn between the stationary contact 13 and the movable contact 16 into two portions in the same manner as is done to the arc between the contact members 9 of Figs. 1 and 2. In this way the number of arcs between the relatively movable and stationary contacts 13 and 15 is doubled, thereby reducing the voltage across each arc length. This doubling of the number of arcs together with the deionizing effect had by movement of the ends of the arcs over the surfaces 5 will be found effective to extinguish the arcs drawn between the contact members 13 and 16 for current values up to certain limits.

In the event that the voltage of the current being handled exceeds that which is capable of being interrupted by doubling the number of arcs as shown in Fig. 3, it will be necessary to employ other deionizing and extinguishing means as shown in Fig. 4. In this showing a pair of stationary contacts 19 are mounted on an insulating support 20 for engagement with movable contacts 21 carried by a bridging member 22 mounted on a saddle 23 connected to a cross bar 24. The cross bar 24 is preferably mounted for pivotal

movement back and forth between positions engaging and disengaging the contacts 19 and 21. The mounting and operating mechanism for the cross bar 24 forms no part of this invention and has not been shown in the interest of simplicity. The parts of Fig. 4 thus far referred to are shown in the copending application of Delbert Ellis and J. H. Alspach, Serial No. 458,386, filed September 15, 1942, to which reference is made for a more complete description thereof.

A U-shaped member 25 is mounted adjacent the lower pair of contact members 19 and 21. The member 25 functions in the same manner as does the member 1 of Figs. 1 and 2, although differing therefrom in physical appearance. Therefore like numerals have been employed to designate like parts. The member 25 will function to break an arc drawn between the lower set of contacts 19 and 21 into two portions and confine each arc to an area between the limbs 2 and 3. In order to extinguish the arc drawn between the upper set of contacts 19 and 21 and thereby interrupt the flow of current, a plurality of spaced parallel deionizing plates 26 are arranged adjacent such upper contacts. The deionizing metal plates 26 may be of any suitable construction, for instance as shown in Patent No. 1,932,090, issued on October 24, 1933, to Joseph Slepian. In the showing of Fig. 4, the U-shaped member 25 functions to break an arc drawn between the lower set of contact members 19 and 21 into two portions and confine the arc streams to a small area, while the arc drawn between the upper set of contact members 19 and 21 is moved into the deionizing plates 26 where it is broken up, deionized and extinguished. The member 25 in this showing functions to prevent lengthening of the arc between the lower set of contact members 19 and 21 and to prevent such arc from shorting across other parts of the apparatus. In addition the member 25 cooperates with the deionizing plates 26 in interrupting the current since it doubles the number of arcs in series between the lower set of contact members 19 and 21, thereby reducing the voltage across the deionizing plates 26.

From the foregoing it will be apparent that the U-shaped member 1 functions as an arc quenching structure which will break an arc drawn between two contact members into two portions. In addition to splitting the arc, the reversal of current flow in the member 1 at the point to which the arc portions strike produces a field for moving the arc rapidly and preventing the formation of ionized gases thereby enabling extinguishment of the arc as the current passes through a zero point in the same manner as is had in other deionizing structures. Although limited as an arc extinguishing device to current values below a certain potential due to the formation of only two arcs, it will be noted that the device 1 also functions to maintain and confine the arc in a limited area while the current is interrupted at another point as in Fig. 4. This latter feature of the device 1 prevents the arc from short circuiting across other parts of the apparatus in a manner which would otherwise interfere with the circuit interrupting action.

Since numerous changes may be made in the above described construction and different embodiments of the invention may be made without departing from the spirit and scope thereof, it is intended that all the matter contained in the foregoing description or shown in the ac-

companying drawing shall be interpreted as illustrative and not in a limiting sense.

We claim as our invention:

1. Circuit interrupting means comprising a pair of separable contact members, operating means for separating said members and drawing an arc therebetween, an arc attracting magnetizable structure arranged in proximity to said members and having a base portion and two spaced limbs at the same side of said base portion, said contact members having a path of separation extending substantially in parallel to said base portion in the spacing direction of said limbs and farther away from said base portion than from the respective ends of said limbs, said path being close to said ends so that the latter attract said arc initially, said limbs being shaped so as to decrease their mutual distance in the direction from said path towards said base portion.

2. Circuit interrupting means comprising a pair of separable contact members, operating means for separating said members and drawing an arc therebetween, a bent continuous metal structure having a base portion and two spaced limbs so as to have approximate U-shape, said limbs being rebent inwardly towards said base portion so as to form a hairpin-curved section at the respective ends remote from said base portion, said sections being at a greater distance from each other at said remote ends than near said base portion, said structure being arranged relative to the path of separation of said contact members so that said path extends substantially in parallel to the spacing direction of said limbs and said limbs extend from said base portion towards said path with said remote ends located near said respective members for attracting said one in order to separate it into two arc portions each extending between either member and the limb next to it.

3. Circuit interrupting means comprising a pair of separable contact members, operating means for separating said members and drawing an arc therebetween, a structure of magnetic metal having a base portion and two spaced limbs so as

to have approximate U-shape, said limbs being bent inwardly towards each other and towards said base portion, said metal structure being arranged relative to the path of separation of said contact members so that said path extends substantially in parallel to the spacing direction of said limbs while said limbs extend from said base portion towards said path with their ends remote from said base portion located near said members respectively in order to attract said arc and separate it into two arc portions substantially only by the electromagnetic coaction of said members and structure.

4. Circuit interrupting means comprising a pair of separable contact members, operating means for separating said members and drawing an arc therebetween, and an arc separating structure comprising a substantially U-shaped conductive body having a base portion and two spaced limbs at the same side of said base portion, said contact members being arranged between said limbs so that the path of separation of said members extends substantially in parallel to the spacing direction of said limbs and is closer to said limbs than to said base portion and in sufficient proximity to said limbs that an arc may strike from each of said contacts to one of said limbs respectively in order to divide the arc into separate portions.

5. An arc separating structure comprising a substantially U-shaped metallic member having a base portion and two spaced limbs extending substantially at right angles to said base portion and having their respective ends turned inwardly and doubled back toward said base portion to provide a substantially U-shaped loop at the end of each limb, and a pair of separable contacts having a direction of separation extending substantially in parallel to said base portion and in parallel to the spacing direction of said limbs and being more remote from said base portion than from said loops so that each of said loops provides an arc horn along which the terminal of an arc may move towards said base portion.

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