Jan. 5, 1932. J. SLEPIAN 1,840,292

ELECTRICAL CONTACTOR

Filed June 29, 1928

Fig. 1.

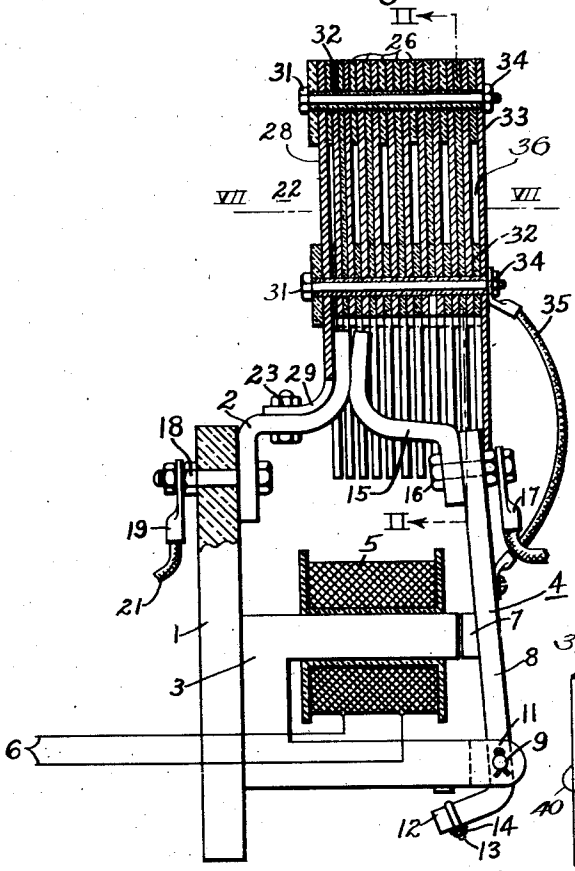


Fig. 2.

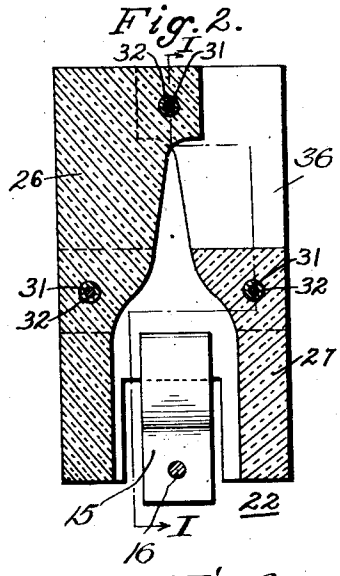


Fig. 6.

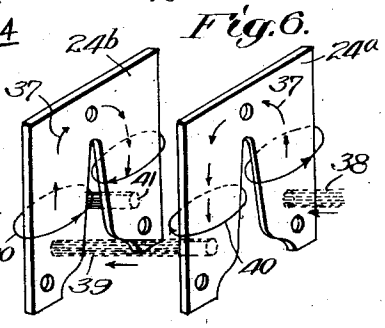


Fig. 3.

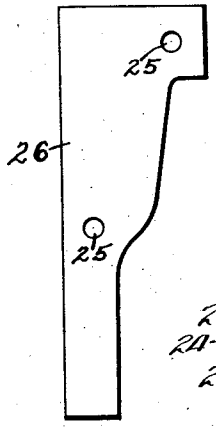


Fig. 4.

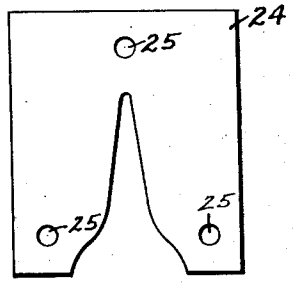


Fig. 5.

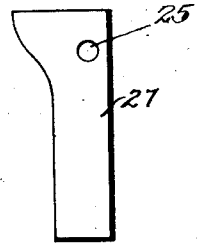
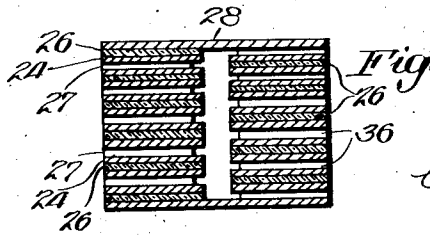


Fig. 7.



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Patented Jan. 5, 1932 1,840,292

UNITED STATES PATENT OFFICE

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ELECTRICAL CONTACTOR

Application filed June 29, 1928. Serial No. 289,237.

My invention relates to electrical contactors and particularly to arc extinguishing devices therefor.

One object of my invention is to provide an electrical circuit interrupter that shall be capable of interrupting circuits of large capacity in air without the necessity of resorting to the employment of oil or other media for quenching the arc at the contacts thereof.

While, however, my invention is applicable to the interruption of circuits of large interrupting capacities, it may also be applied with advantage for interrupting circuits of low capacity.

As a particular feature of my invention here described, the arc, consequent upon opening of the circuit, is drawn into the arc extinguishing means by the magnetic quality of the material employed in constructing the said means and is rapidly moved thereby within the means to deionize and to cause it to be quickly extinguished.

The rapid movement of the arc within the extinguishing means prevents the burning and vaporization of metal which would otherwise occur if the arc terminals stood still for any appreciable proportion of the duration of the arc. Metal vapors continuing to burn after the arc proper is extinguished are a frequent cause of restriking or reignition of the arc, and these are prevented by my invention.

In the particular embodiment here shown, the deionizing means comprises plates of magnetic metal which provide the electrodes for the terminals of the short arcs into which the main arc is broken, and also provides in itself the means for causing these short arcs to move rapidly over the electrode plates.

With these and other objects in mind the invention comprising the novel structure, combination and arrangement of parts will be herein fully pointed out in the following description taken in conjunction with the drawings, in which

Figure 1 is a side view, partly in section along line I—I of Fig. 2, and partly in elevation, of a particular embodiment of my invention;

Fig. 2 is a sectional view on the line indicated by II—II in Fig. 1,

Figs. 3, 4 and 5 are views in elevation of a component element in the assembly shown in Fig. 2.

Fig. 6 is a schematic diagram illustrating how the magnetic field is set up to move the arc; and

Fig. 7 is a sectional view on the line VII—VII of Fig. 1.

My invention comprises, in general, the insulating base member 1 upon which is mounted a stationary contact member 2 and a magnetic core member 3 which supports a movable contact 4. The foregoing elements may be of any type well known in the art to be suitable, their precise structure not being claimed herein.

The core member 3 of the contactor 4 has a potential coil 5 that may be energized from any source through leads 6, and is arranged to attract an armature 7 that is attached to an arm 8. The latter is pivoted at 9 to a projection 11 of the core member 3. The movable member 8 has a projection 12 on its extreme end in which an adjusting screw 13, with a lock nut 14, is screwed. The screw 13 may be regulated to vary the amount of movement in the movable member 8. A movable contact tip 15 is mounted on the movable member 8 at its upper end by a bolt 16 which is also the means for clamping a terminal 17 to the movable contact member 8 to complete an electrical circuit thereto. The contact member 2 is fastened to the insulating panel 1 by a bolt 18 which is also the means for clamping a terminal 19 thereto, thus connecting member 2 with an electrical circuit through conductor 21.

The contactor 2 is the means for supporting the arc extinguishing device 22 which is secured to it by the bolt 23. The arc extinguishing device 22 comprises alternating layers of iron plates and insulating material, and its structure will now be described in detail.

Referring to Fig. 4, the iron plate 24 there shown contains a central V-shaped groove similar to that described in the Baker et al. application, Serial No. 187,647, filed Apr. 29, 1927, and assigned to the Westinghouse Elec-

tric and Manufacturing Company. The plate 24 contains holes 25 that are employed in the assembly of the device 22 as explained hereinafter.

Fig. 3 represents a member 26 of insulating material adapted to cover a part of the surface of the iron plates 24 when the latter are assembled to form the chamber 22. The contour along the side of this insulating member is similar to that of half of the V-shaped slot in the iron plate shown in Fig. 4. Holes 25, adapted to aline with holes 25 in the latter, are provided in the insulating material 26.

Fig. 5 is a view of the other member 27 of insulating material that is employed together with the insulating members 26 to space the iron plates 24 apart. It will be seen that the shape of members 26 and 27 is such that part of the surface of the plates 24 is left uncovered. The gap 36 in the insulating layer between plates 24 forms a path in which an arc may run. In alternate layers the insulating members 26 and 27 are reversed in position so that the gaps 36 do not aline. In this way there are conduction currents in the plates completing the circuit between the successive arc sections, and these currents in the plates produce magnetic fields which cause the arc sections to move outwardly.

In assembling the arc extinguishing device 22, I provide a backing plate 28 of magnetic material that contains a bent portion 29 along its lower edge. The latter is employed to mount the entire member upon the contact member 2 as explained above. Bolts 31 are provided having insulating sleeves 32 for insulating the bolts 31 from the iron plates 24. Upon the bolts 31, a pair of insulating members 26 and 27 are placed in position against the surface of the backing plate 28 and covering substantially one half of the surface thereof. Next an iron plate 24 is placed on top of the insulating members 26 and 27; then another set of insulating members 26 and 27 are placed upon the iron plate 24, but in reversed position; that is to say, if the member 26 is placed on the right-hand side of the first layer of plates assembled, in the position shown in Fig. 2, it will be placed on the left-hand side in the second layer. Thus the covered and uncovered portion of the plates 24 alternate in successive layers, the purpose of which will be made clear hereinafter. The structure is built up from the insulating members 26 and 27 and the iron plates 24 until a sufficient number have been provided to properly extinguish the arc drawn at the contact members 2 and 15. The last plate 33 is an iron member similar to the other members 24. The entire assemblage of plates is clamped into a unitary structure by tightening the clamping nuts 34.

A shunt 35 is provided connecting the plate 33 to the movable member. This connection connects the plates 28 and 33 into terminals for the arc when it is moved thereon after leaving the contact members 2 and 15.

When an arc is established between the contact members when they are separated, the field thereabout produces a magnetic flux in the iron plate 24 that impels the arc upward into the V-shaped groove formed by the alined notches in plates 24 and causes it to break up into a series of short arcs operating in the spaces 36 formed between those parts of the surfaces of the main plates 24 not covered by the insulating members 26 and 27. Since the arc spaces 36 are disposed alternately on opposite sides of the V-shaped slot, as shown in Fig. 7, the arcs playing on each side of each plate 24 will be on opposite legs of the plate and the current will flow through the plate between the ends of the arcs. This is illustrated schematically in Fig. 6, which shows two plates 24 taken from the middle of the extinguishing device 22. In this figure, the plates 24*a* and 24*b* are spaced apart and the insulating sheets 26 and 27 are omitted to make the diagram clearer. Assuming the current to flow in such a direction that the arc current flows into the front of plate 24*a*, the direction of current flow will then be that indicated by arrows 37. With the arc 38 playing on the right-hand leg of plate 24*a*, the current will then flow up the right-hand leg and down the left-hand leg of plate 24*a* to the base of arc 39, which plays between the plates, and the direction of the current flowing in plate 24*b* will be up in the left-hand leg and down in the right-hand leg to the base of the arc 41 flowing to the next plate. Thus, it is seen that the current flows in opposite directions in adjacent plates.

The magnet flux set up by these currents in the two plates will then be in the same direction between the plates, as indicated by arrows 40. This flux, which is from left to right between the plates, will, therefore, act on the arc 39 to move it in a downward direction. It should also be noted that the direction of the flux acting on arcs 38 and 41 is also such as to move them downwardly. The path of the arc will, therefore, be upwardly in the V-shaped groove from the contacts 2 and 15 to a point near the tip of the groove where it is transferred to the plates. The arc is then split up into a series of short arcs which are moved downwardly between the plates until they are extinguished. This arrangement of the arc sections and the consequent currents in the plates produces magnetic fields which impel the arcs between the plates 24 to travel across the surfaces thereof in such a rapid manner that they do not remain long enough at any one spot on the plates to melt or vaporize the material thereof, until the arc is extinguished.

It should be noted that the V-shaped groove shown in Figs. 2 and 4 of the arc extinguish-

ing device 22 will of itself tend to extinguish the arc without having the arc drawn within the space between the iron plates 24. Such a method of arc extinction being described in my Patent No. 1,784,760 issued December 9, 1930, and in the above said copending application of Baker et al. The principles governing the design of the deionizing structure above described as to member thickness and spacing of plates, and contour of the V-shaped notch therein, are substantially those given in my copending applications above cited and reference is made thereto for such information.

It will be seen that my invention may be employed on low capacity circuits, as well as on circuits of very much higher capacity that have heretofore employed circuit interrupters in which arcs were extinguished in oil or other media.

By means of my invention, therefore, the arc incident to opening of the contactor is moved into a deionizing structure where its movement along the surface of the plates from its place of initial formation takes place so rapidly that no appreciable burning of the contact members occurs until the arc is extinguished. In consequence, where the prior art has found oil switches necessary, air-brake contactors may be designed according to the principles of my invention for many conditions of service, with a resulting decrease of cost and a greater ease of installation and elimination of fire hazard. Even on services where air-brakes have previously been used, the contactors may be made with lighter parts and are of increased durability.

Many modifications of the precise embodiment of my invention here described will, in fact, be evident to those skilled in the art from the mere attempt to adapt the problems here disclosed to circuits of particular voltage or current ratings.

These principles are, in fact, of broad applicability to many types of apparatus other than arc interrupting apparatus, and to many types of arc interrupters besides contactors. I desire, therefore, that the language of the appended claims shall be construed broadly to cover all modifications and arrangements within the spirit of my invention.

I claim as my invention:

1. Deionizing means comprising a plurality of magnetizable conducting sheets spaced from each other by insulating material so arranged as to compel the successive short arcs, into which the initial arc is broken, to be out of alignment.

2. In combination with a pair of separable contact members of a circuit interrupter, operating means therefor, and deionizing means for splitting the arc drawn by said contact members into a plurality of arcs, said deionizing means including member of conducting material, and insulation so disposed as to keep said plurality of arcs from all being in alignment.

3. In combination with a circuit interrupter having separable contact members, means for operating the said members, arc extinguishing means adjacent the contact members comprising layers of magnetic material in perpendicular relation to the arc and insulating material between the said layers covering substantially half of the surfaces of said magnetic material and disposed thereon so as to prevent consecutive short arcs formed thereon from being in alignment.

4. In combination with a circuit interrupter having separable contact members, means for operating the said members, a series of sheets of conducting material having V-shaped grooves cut in the side thereof adjacent the said contacts and insulating material covering substantially half of the surfaces of said magnetic sheets and disposed therebetween with the covered portions of alternate sheets alined to form a series of staggered arc paths between said sheets of magnetic material.

5. In an arc rupturing device, in combination, separable contact members, operating means for said contact members, deionizing means comprising sheets of magnetic material positioned transversely to the path between said contact members and having substantially one-half of each layer covered alternately by insulating material disposed therebetween with the covered halves of alternate sheets alined.

6. Circuit interrupter means comprising a pair of separable contact members, operating means therefor, and means for causing the initial arc to be broken into a plurality of arcs between layers of spaced conducting material in such a way that successive arcs are not in alignment.

7. Circuit interrupter means comprising a pair of separable contact members, operating means therefor and magnetic means comprising sheets of iron, portions of which are spaced apart by layers of insulating material so disposed that the arcs between said sheets are in staggered relation.

8. In an arc rupturing device, in combination, separable contact members, means for separating said contact members and sheets of magnetic material spaced apart by insulating members that cover substantially one-half the surfaces of said sheets and disposed with alternate layers alined to form a folded arc path having sides of magnetic material.

9. In combination with a circuit interrupter having a pair of separable contact members, means for operating the contact members, and deionizing means for an arc located adjacent the contact members and comprising a plurality of spaced conducting sheets that are partially covered with insulating material to provide arc paths of such

form that a magnetic field is set up to rapidly move the arcs between the conducting sheets.

10. In an arc rupturing device, in combination, means for drawing an arc, operating means therefor, magnetic means adjacent said arc drawing means including a plurality of magnetic sheets spaced transverse to the arc path, means for transferring an arc to the spaces between said sheets and means for causing the current paths to the arc sections through said sheets to be transverse to the said arc path.

11. An arc quenching device including a conducting plate, said plate being positioned in the arc path so that the arc plays on each side of said plate, and means for causing the arc on each side of said plate to play on a different section of said plate.

12. An arc quenching device including a conducting plate, said plate having a slot therein, and means causing the arc to play on each side of said plate on opposite sides of said slot.

13. An arc quenching device including a conducting plate, said plate being positioned in the arc path so that the arc plays on each side of said plate, and means for causing the arc current to flow in said plate so that the magnetic field set up by the current in said plate moves the arc on the plate.

14. An arc quenching device including a conducting plate, said plate having a slot therein, and means causing the arc to play on each side of said plate on opposite sides of said slot so that the arc current flows in the plate around said slot and sets up a magnetic field for moving the arc on the plate.

15. An arc quenching device including a conducting plate of magnetic material, said plate being positioned in the arc path so that the arc plays on each side of said plate, and means for causing the arc on each side of said plate to play on a different section of said plate.

16. An arc quenching device including a conducting plate of magnetic material, said plate having a slot therein, and means causing the arc to play on each side of said plate on opposite sides of said slot.

17. An arc quenching device including a conducting plate, said plate being positioned in the arc path so that the arc plays on each side of said plate, and means for causing the arc current to flow in said plate in such a direction that the magnetic field due to said current acts to move the arc on each side of said plate in substantially the same direction.

18. In an arc quenching device, a plurality of metal plates between which the arc is split up into a plurality of arcs, and means for causing some of said arcs to be moved between one portion of said plates and the other of said arcs to be moved between another portion of said plates.

19. An arc quenching device comprising a plurality of sheets of conducting material, and a plurality of sheets of insulating material interposed between said conducting sheets, said insulating sheets being so arranged as to have arc spaces between said conducting sheets, said arc spaces being staggered through said plurality of conducting sheets.

20. An arc quenching device comprising a plurality of sheets of conducting material having a slot therein, insulating members between said plates along one side of said slots, and open spaces between the plates on the other side of said slots, said open spaces and insulating members being disposed alternately on opposite sides of said slots.

21. An arc quenching device comprising a stack of spaced metallic plates having slots therein, and arc barriers disposed alternately between said plates on opposite sides of said slots.

22. An arc quenching device comprising a stack of spaced metallic plates having slots therein, and means for closing each of said spaces along one side of said slots, said closed spaces being disposed alternately on opposite sides of said slots.

23. In a circuit interrupter, means for drawing an arc, means for quenching said arc comprising a stack of metallic plates having slots therein and arc barriers disposed alternately between said plates on opposite sides of said slots, and the end plates of said stack being electrically connected in the circuit to be interrupted.

In testimony whereof, I have hereunto subscribed my name this 23rd day of June, 1928.

JOSEPH SLEPIAN.