Feb. 19, 1935. H. L. RAWLINS 1,991,909

OIL CIRCUIT BREAKER

Original Filed Dec. 3, 1929 3 Sheets-Sheet 1

Fig. 1.

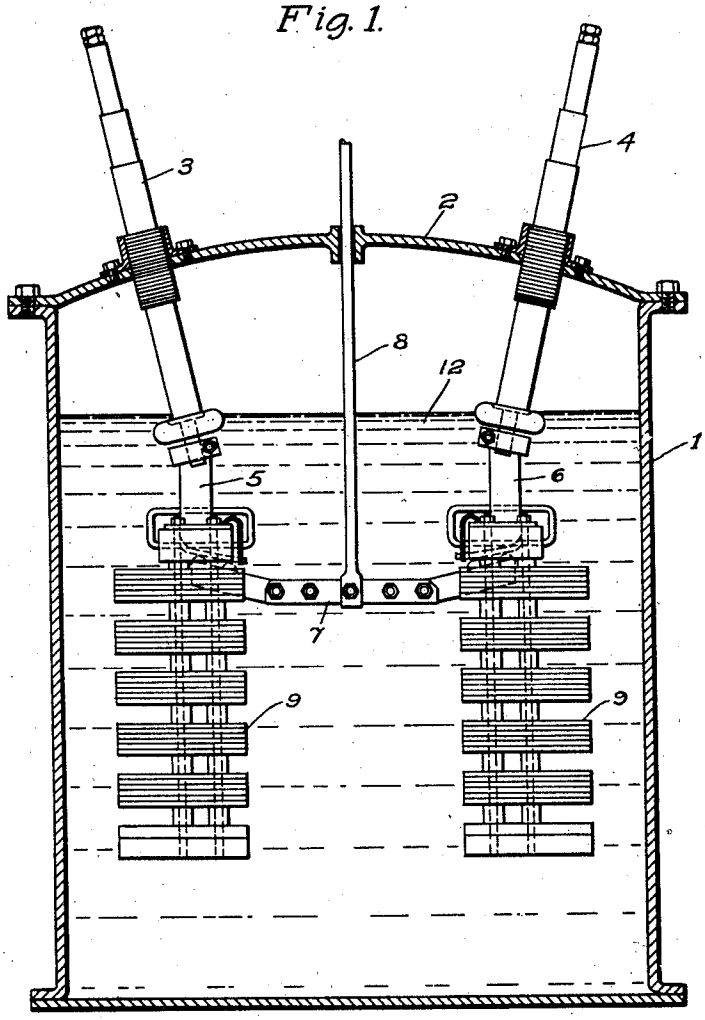
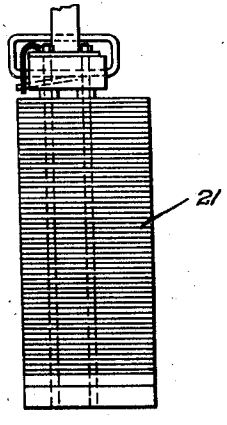


Fig. 2.



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OIL CIRCUIT BREAKER

Original Filed Dec. 3, 1929 3 Sheets-Sheet 2

Fig. 3.

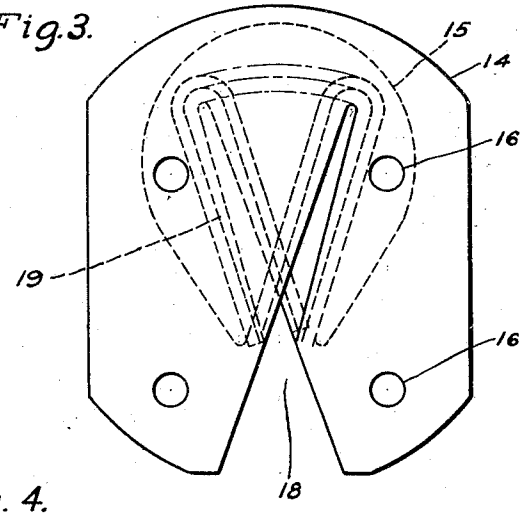
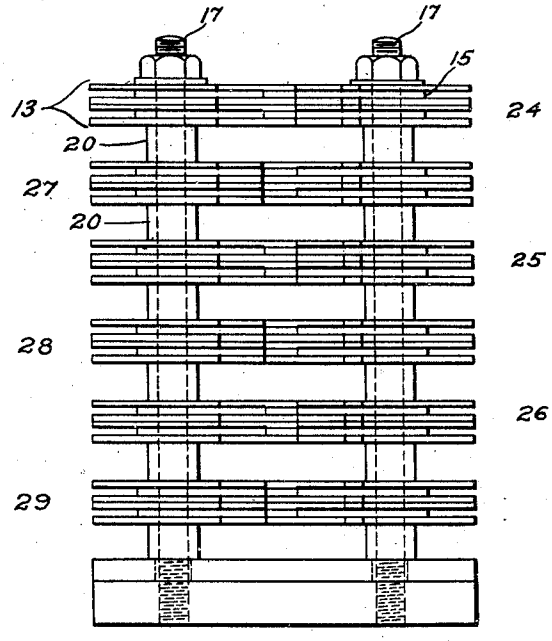


Fig. 4.



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Original Filed Dec. 3, 1929 3 Sheets-Sheet 3

Fig. 5.

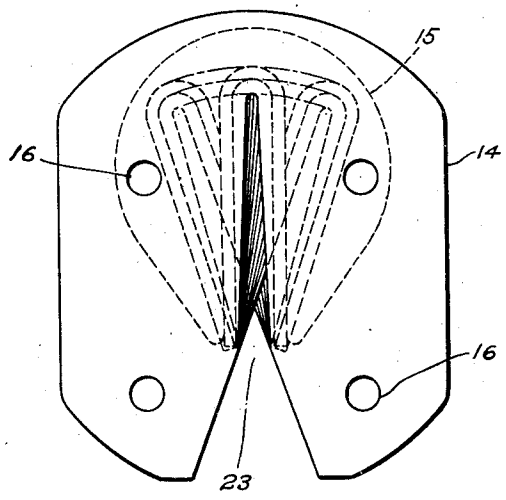
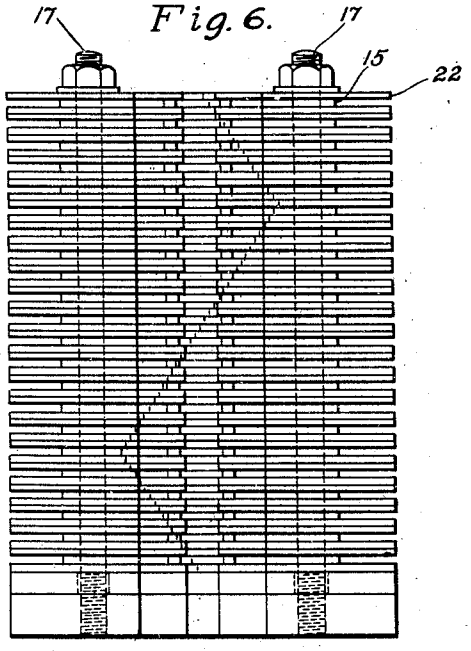


Fig. 6.



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UNITED STATES PATENT OFFICE

1,991,909

OIL CIRCUIT BREAKER

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Application December 3, 1929, Serial No. 411,269
Renewed July 14, 1932

28 Claims. (Cl. 200—150)

My invention relates to circuit interrupters, and particularly to arc lengthening and extinguishing devices therefor.

In Baker et al., Patent No. 1,899,605, issued February 28, 1933, and assigned to the assignee of the present invention, an arc extinguishing device is disclosed comprising a plurality of insulating and magnetic plates that contain alined slots for registering with an arc path that is established between separated contact members. In such an arrangement, the arc so established is moved into the slots where it is deionized and extinguished, because of the distortion of the surrounding field in the presence of the magnetic plates.

Supplementing this structure, the present application has for its object, a more effective arrangement and location of the said slots in the plates to provide an increasing length to the arc moving therein and without effecting the outside dimensions of the slotted structure.

It is another object of my invention, to provide a plurality of insulating plates with slots that are so alternately arranged that they register with each other only at the point wherein the arc is first established.

It is a further object of my invention to provide a plurality of slotted insulating plates adjacent an arc path that shall have the slots so offset angularly from a common path that the arc is caused to be lengthened as it is moved into said slots.

For a more complete understanding of the nature and object of my invention, reference should be had to the following detailed description taken in conjunction with the accompanying drawings, in which

Figure 1 is a sectional view in elevation of a circular interrupter embodying my invention.

Fig. 2 is a view in elevation of a somewhat different embodiment of my arc extinguishing structure shown in Fig. 1.

Fig. 3 is an enlarged view of the arc extinguishing and lengthening structure illustrated in Fig. 1.

Fig. 4 is a view in elevation of the structure shown in Fig. 3.

Fig. 5 is an enlarged plan view of my arc extinguishing structure shown in Fig. 2.

Fig. 6 is a view in elevation of the structure shown in Fig. 5.

My invention comprises in general, a casing 1 having a cover 2 thereon that supports conducting bushings 3 and 4, in a manner well known in the art. The bushings 3 and 4 are the means of support for the contact members 5 and 6 respectively that are conductively joined by a movable bridging member 7.

A lift rod 8 supports the bridging member 7 and extends through the cover 2 where it is actuated by a mechanism (not shown), to operate the bridging member 7 to open and to closed positions. Arc lengthening and extinguishing devices 9 are supported on the conducting members 5 and 6 respectively and are immersed in a quenching liquid 12, that is contained within the casing 1.

Figures 3 and 4 disclose enlarged views of the arc lengthening and extinguishing structure 9, that comprises a plurality of groups of slotted plates that are spaced some distance apart and which will be referred to hereinafter as the "open-stack" construction.

A unit assembly 13 comprises a plurality of insulating plates 14 between which magnetic plates 15 are positioned and provided with mounting holes 16 for assembling the units 13 on insulating rods 17. Slots 18 are cut in each of the insulating and magnetic plates 14 and 15, the slots in the magnetic plates 15 being somewhat larger to enable an insulating member 19 to be employed to insulate the arc from the magnetic plate. Insulating spacers 20 are employed on the rods 17 to space the units 13 to form the open-stack construction.

The slots 18 are disposed at an angle in each of the plates and are alined in each set of the unit assemblies 13. When the unit assemblies 13 are mounted on the rods 17 the slots of each adjacent assembly are oppositely disposed, as shown in Fig. 3 the purpose of which will be hereinafter explained.

A somewhat different embodiment of the arc lengthening and extinguishing structure 9 is illustrated in Figures 5 and 6. The plates, as shown in Fig. 6, are built up into a solid stack 21 the assembly being known as the "solid-stack" construction. Insulating plates 22 are provided with slots 23 that are offset angularly from each other a small amount. The magnetic plates 15 are alternately positioned throughout the stack in a similar arrangement to that for the structure shown in Figs. 3 and 4. The plates 22 and 15 are assembled on the insulating rods 17, in such manner that the slots are continuously displaced angularly first to the right and then to the left of the center slot. In this arrangement, the path for the arc, in the remote end of the slot, is in the shape of an S-curve, and the arc is lengthened as it is moved toward the closed end of the slots.

The offset relation of the slots 23 forms recesses into which the quenching fluid will be trapped and supplied to the arc core as it moves thereacross in a manner similar to that explained in the above-noted patent. Channels or recesses similar to those described in the above-noted patent are provided in the unit assembly 13 of Figures 3 and 4 to trap oil and to retain it adjacent the arc path.

The operation of my arc lengthening and extinguishing device will now be described. As the bridging member 7 is moved to open position and an arc is established in the mouth of the slots 18 and 23, it is moved into the slots by the distortion of the field about the arc in the presence of the iron plates 15. As the arc moves into the slots 18 of Figs. 3 and 4, the portions associated with the unit assemblies 13, that are designated as 24, 25 and 26, will move to the right, while the portion of the arc in the unit assemblies designated as 27, 28 and 29 will move to the left causing the arc to be elongated during its movement toward the closed end of the slots.

In a similar manner the arc in the slots 22, of Figs. 5 and 6 will be offset to the right and left as it is moved toward the closed end of the slots and thereby increased in length during the said movement.

In either arrangement, an arc established at the mouth of the slots 18 and 23 is considerably increased in length as it is moved into the slots because of the offset arrangement of the opposite ends thereof.

The magnetic forces between the various portions of an arc distorted into a zig-zag path are such as to tend to force it against the faces of the flat plates shown herein and hence tend to assist in bringing about extinction of the arc.

The extinguishment of the arc brought about by the contraction of the arc core and the deionization of the arc path when the current cycle reaches zero, occurs in the same manner as that in the above-noted application, the present arrangement providing for the additional extinguishing characteristic, that of lengthening the arc path, an arrangement that is desirable on circuit interrupters having increased speed of contact separation.

It will thus be seen that I have provided a plurality of slots in insulating and magnetic plate constituting an arc extinguishing structure, that causes the arc to be elongated as it is moving within the slots. My invention is further novel in that, the lengthening of the arc, takes place within a unit structure without it being necessary to increase the outside dimensions thereof.

While I have described and illustrated a particular embodiment of my invention, it is to be understood, by those skilled in the art, that many changes, additions, substitutions and omissions may be made therein without departing from the spirit and scope of my invention as set forth in the accompanying claims.

I claim as my invention:

1. The combination with means for causing an arc, of a plurality of plates each having a narrow slot therein adjacent the arc path, and means comprising the staggered relation of said slots for causing the arc to elongate as it moves thereinto.

2. The combination with means for drawing an arc, a plurality of plates each having a narrow slot therein adjacent the path of said arc, means for moving the arc into said slots and means for lengthening the arc during said movement.

3. The combination with means for drawing an arc in a quenching fluid which supplies a deionizing gas when acted upon by the arc, a plurality of slotted plates adjacent the path of said arc, means for moving the arc into said slots and means for lengthening the arc during said movement.

4. The combination with means for drawing an arc in a quenching fluid which supplies a deionizing gas when acted upon by the arc, a plurality of plates adjacent the path of said arc, means for trapping said fluid in said plates, means for moving the arc into said trapped fluid, said plates having staggered slots for lengthening the arc during said movement.

5. In combination with a plurality of slotted plates for extinguishing an electrical arc, said plates having their slots aligned at one end and disposed in offset relation at the other end to form a continuous tortuous arc path and means for moving the arc in said slots.

6. The combination with a circuit interrupter, of a group of plates having alined slots, means for assembling a plurality of said groups of plates in spaced relation and having the slots of each group oppositely disposed from that of an adjacent group and alined along a common axis.

7. The combination with a circuit interrupter, of a plurality of plates associated therewith having slots therein that are relatively angularly disposed and positioned to intersect along a common line and means for establishing an arc at the said line of intersection of the slots.

8. The combination with a circuit interrupter, of means positioned adjacent the arc path thereof for confining the arc and increasing the arc length as it is moved thereinto and means for moving the arc into the said means, comprising a plurality of slotted plates of magnetic material having their slots disposed in staggered relation.

9. In a circuit interrupter, a plurality of plates of insulating material arranged contiguously in a stack, a slot in each of said plates of insulating material, said slots having corresponding portions thereof out of alignment and forming a continuous passage through the stack, and means for causing the arc to play through said slots.

10. In a circuit interrupter, a plurality of plates of insulating material arranged contiguously in a stack, a slot in each of said plates of insulating material, said slots being angularly disposed to each other and having one end of each of said slots aligned throughout the stack, and means for drawing the arc adjacent the aligned ends of said slots.

11. In a circuit interrupter, a plurality of plates of magnetic material, each of said plates having a slot extending from one edge toward the central portion thereof, said plates being arranged in a stack with the open ends of said slots aligned and with the other ends of said slots in staggered relation, and means for drawing the arc adjacent said aligned open ends of the slots.

12. In a circuit interrupter, a plurality of plates of magnetic material, each of said plates having a slot extending from one edge toward the central portion thereof, said plates being arranged in a stack with the open ends of said slots aligned and with the other ends of said slots in staggered relation, means for drawing the arc adjacent said aligned open ends of the slots, and means of insulating material for preventing the arc com-

ing in contact with said plates of magnetic material.

13. In a circuit interrupter, means of insulating material having a slot therein, one portion of said slot providing a straight passage through said means of insulating material and another portion of said slot providing a zig-zag path through said means of insulating material, means for drawing the arc adjacent the straight portion of said slot and means for moving the arc into the zig-zag portion of said slot.

14. In a circuit interrupter, means of insulating material having a slot therein, one portion of said slot providing a straight passage through said means of insulating material and another portion of said slot providing a zig-zag path through said means of insulating material, means for drawing the arc adjacent the straight portion of said slot, and a plurality of plates of magnetic material having slots extending from one edge toward the central portions thereof for moving the arc into the zig-zag portion of said slot in said means of insulating material.

15. In a circuit interrupter, means of insulating material having a narrow groove extending along the length thereof, said groove being closed on each side and at one end and being opened at its other end for at least part of its length to the outside of said means of insulating material, said groove providing a straight passage through said means of insulating material adjacent its open end and a zig-zag path through said means of insulating material adjacent its closed end, and means for drawing an arc adjacent the opened end of said groove, and means for moving the arc toward the closed end of said groove.

16. In a circuit interrupter, means of insulating material having a narrow groove extending along the length thereof, said groove being closed on each side and at one end and being opened at its other end for at least part of its length to the outside of said means of insulating material, said groove providing a straight passage through said means of insulating material adjacent its open end and a zig-zag path through said means of insulating material adjacent its closed end, and means for drawing an arc adjacent the opened end of said groove, and a plurality of plates of magnetic material for moving the arc toward the closed end of said groove, each of said plates of magnetic material having a slot extending from one edge toward the central portion thereof, and each of said plates being disposed with said groove in said means of insulating material within said slot in the plate.

17. In a circuit interrupter, a body of liquid which evolves gas when acted upon by an arc, means for drawing an arc in said liquid, a plurality of plates of insulating material positioned along the arc path, said plates having a straight passage therethrough where the arc is initially drawn and having a zig-zag passage therethrough and means for moving the arc into said zig-zag passage.

18. In a circuit interrupter, a stack of contiguous plates of insulating material having a passage therethrough, means movable for drawing an arc in said passage, the opposite side walls of said passage at one portion thereof defining an undulatory space therebetween for the arc.

19. In a circuit interrupter, means of insulating material having a passage therethrough, said passage providing a straight path through said means of insulating material, a contact member movable along said straight path, and said passage having opposite side walls at one portion thereof defining an undulatory space therebetween with the major portion of the width of said space at alternate portions along the passage positioned on opposite sides of the center line of said straight path for the contact member.

20. In a circuit interrupter, means of insulating material having a passage therethrough, means including a contact member movable through said passage for initially breaking the circuit through said circuit interrupter and drawing an arc in said passage, said passage having opposite side walls defining an undulatory space therebetween for the arc with the major portion of the width of said space at alternate portions along the passage positioned on opposite sides of the center line of the path of movement of the contact member, means along said passage for giving off gas when acted on by the arc, and venting means permitting flow of said gas out of at least the portion of said passage where the arc is first drawn as soon as said contact member has begun to move.

21. In a circuit interrupter, a body of arc extinguishing liquid which forms gas when acted upon by the arc, an arc extinguishing chamber immersed in said liquid, said chamber including means of insulating material having a passage therethrough with means for initially causing the arc therein, venting means extending from said passage laterally through the side wall of said chamber whereby fluid may flow laterally through the arc directly into the liquid outside of said chamber, and means for elongating the arc initially drawn.

22. In a circuit interrupter, a body of arc extinguishing liquid which forms gas when acted upon by the arc, an arc extinguishing chamber immersed in said liquid, said chamber including a plurality of plates of insulating material having slots therein extending from the central portion of the plates to the outer edge thereof, said chamber having a passage therethrough with means for causing the arc therein, and said slots forming venting means permitting a flow of fluid through the arc and laterally through the side wall of the chamber to the liquid outside thereof, and means for causing at least a portion of the arc to take an elongated zig-zag shape.

23. In a circuit interrupter, a body of liquid which evolves gas when acted upon by an arc, means for drawing an arc in said liquid, a plurality of plates of insulating material positioned along the arc path said plates having an opening therethrough means for moving the arc laterally in one direction in said opening through the plates and means for elongating the arc by moving portions thereof laterally in another direction.

24. In a circuit interrupter a body of liquid which evolves gas when acted upon by an arc, a movable contact for drawing an arc in said liquid, a plurality of contiguous plates of insulating material forming a solid stack positioned along the arc path and immersed in said body of liquid, said stack of plates having a passage therethrough providing a straight path in which the contact moves and draws the arc and providing a zig-zag path in which the arc may play and means for causing portions of the arc to move to play in said zig-zag path.

25. In a circuit interrupter, a body of arc extinguishing liquid which forms gas when acted upon by an arc, means of insulating material

forming a solid body immersed in said liquid and having a passage therethrough, said passage providing a straight path through said means of insulating material, a contact member movable along said straight path, and said passage having opposite side walls at one portion thereof defining an undulatory space therebetween with the major portion of the width of said space at alternate portions along the passage positioned on opposite sides of the center line of said straight path for the contact member.

26. In a circuit interrupter, a body of arc extinguishing liquid, a plurality of contiguous plates of insulating material forming a solid stack immersed in said liquid, said stack of plates having a passage providing a straight path therethrough, a pair of separable contacts for drawing an arc, one of said contacts being positioned beyond one end of the stack of plates and the other contact being movable through the whole length of the stack along the straight path therethrough and out the other end thereof, and said passage having continuous opposite side walls formed entirely by the edges of said contiguous plates of insulating material, said opposite side walls defining an undulatory space therebetween with the major portion of the width of said space at alternate portions along the passage positioned on opposite sides of the center line of said straight path for the movable contact member.

27. The combination with means for drawing an arc, a plurality of plates each having a narrow slot therein adjacent the path of said arc, means for moving the arc into said slots and means for moving portions of the arc laterally of the direction in which the arc moves in moving into the slots for lengthening the arc during said movement.

28. The combination with means for drawing an arc in a quenching fluid which supplies a deionizing gas when acted upon by the arc, a plurality of slotted plates adjacent the path of said arc, means for moving the arc into said slots and means for moving portions of the arc in a plane generally perpendicular to the plane of movement of the arc in moving into the slots for lengthening the arc during said movement.

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