

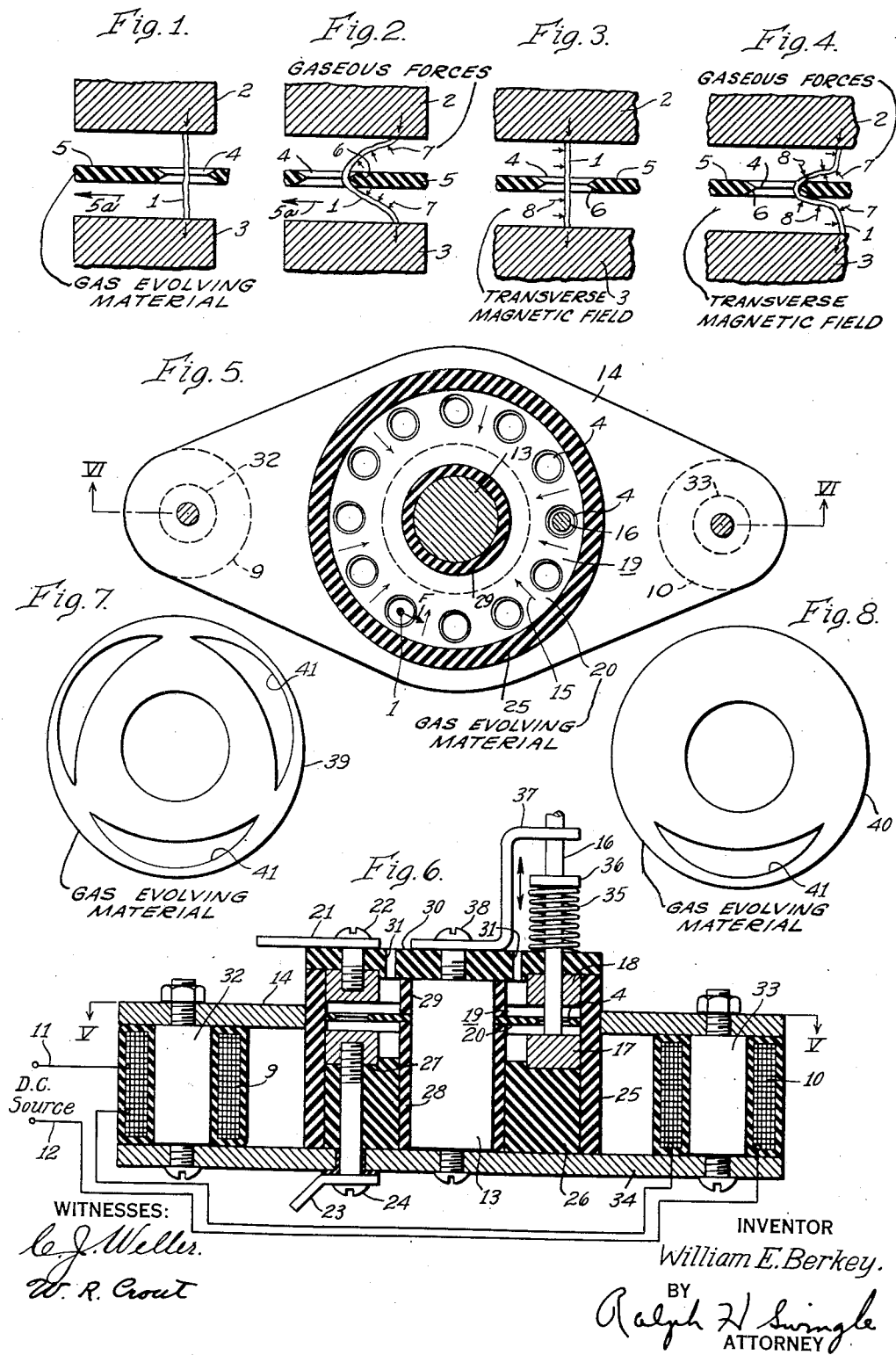
June 22, 1948.

W. E. BERKEY
CIRCUIT INTERRUPTER

2,443,650

Filed Sept. 27, 1944

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 9.

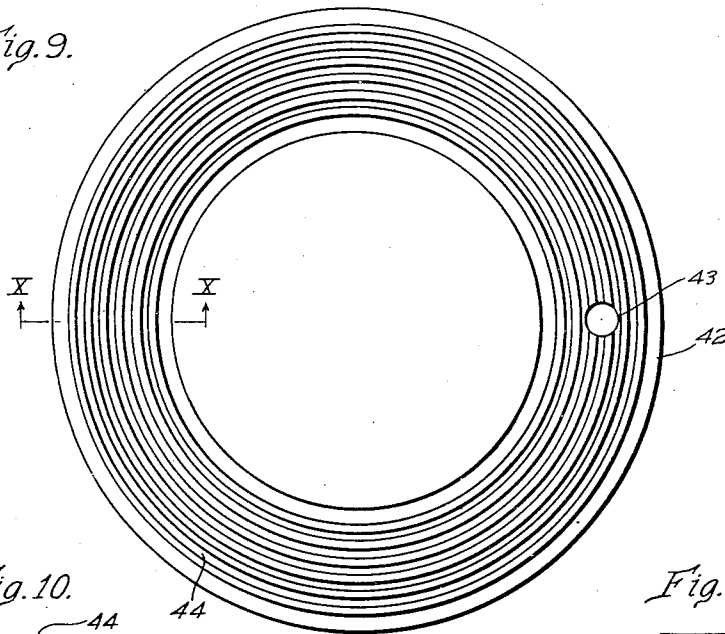


Fig. 10.

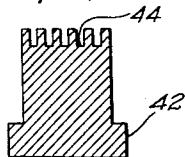


Fig. 11.

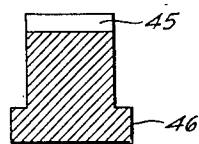
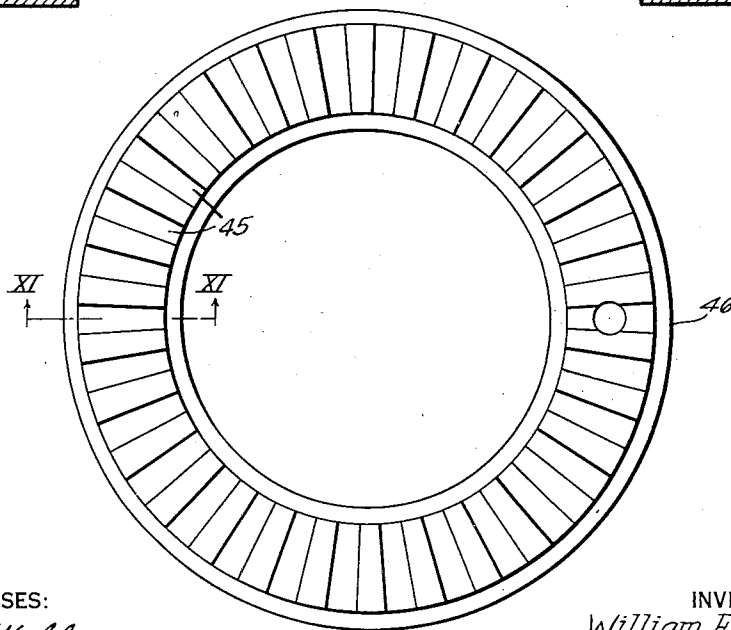


Fig. 12.



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CIRCUIT INTERRUPTER

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1

This invention relates to circuit interrupters, in general, and, more particularly, to arc extinguishing structures therefor.

A general object is to provide an improved circuit interrupter in which an arc is established and rotated. Preferably during the rotation thereof the arc is forced against baffle means disposed directly in the path of the rotating arc.

Another object is to provide an improved circuit interrupter of the rotating arc type in which the contact structure has an improved construction.

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

Figures 1-4 theoretically illustrate the principles involved in my invention;

Fig. 5 is a sectional view taken along the line V-V of Fig. 6;

Fig. 6 is a vertical sectional view taken substantially along the line VI-VI of Fig. 5, the parts being shown in the closed circuit position;

Figs. 7 and 8 illustrate modified types of baffle plate constructions;

Fig. 9 is an enlarged plan view of a modified type of contact construction;

Fig. 10 is a sectional view taken along the line X-X of Fig. 9;

Fig. 11 is a sectional view taken along the line XI-XI of Fig. 12; and

Fig. 12 is another modified type of contact construction.

Referring to the drawings and, more particularly, to Figs. 1 and 2 thereof, it will be noted that an arc 1 is established by means not shown between the cooperable contacts 2, 3, the arc extending through a hole 4 provided in a baffle plate 5 composed of a suitable gas evolving material such as horn fiber or boric acid. The baffle plate 5 is moved toward the left as indicated by the arrow 5a by suitable means not shown so that the edge 6 of the hole 4 engages the arc 1 causing the latter to assume a bowed shape as shown in Fig. 2. The arc 1 causes gases to be evolved from the plate 5 which react upon the arc forcing it in the direction of the arrows 7 of Fig. 2. These forces caused by the gas evolving from the plate 5 do not necessarily have a direction which is perpendicular to the axial length of the arc but may have a random direction as they act against the arc 1.

Thus the constructions shown in Figs. 1 and 2 illustrate the forces acting upon the arc which result from physically moving the baffle plate 5

2

composed of a suitable gas evolving material laterally so that one edge of the hole 4 engages the arc 1.

The construction shown in Figs. 3 and 4 illustrate an arrangement whereby the arc 1 is moved between the cooperable contacts 2, 3 by means of a transverse magnetic field passing perpendicularly into the plane of the paper. Consequently, the arc moves in a direction that is not only perpendicular to its length but also in a direction which is perpendicular to the magnetic field. The forces exerted by the magnetic field on the arc 1 are designated by the arrows 8 and are always in a direction perpendicularly to the axial length of the arc 1 and uniformly distributed along its length. As the arc 1 is moved toward the right by the action of the magnetic field, the baffle plate 5 in this instance remaining stationary, the arc 1 will again engage the edge 6 of the plate 5, which is composed of a suitable gas evolving material.

The arc 1 again assumes a bowed shape as shown in Fig. 4 but it will be observed that in this instance the arrows 8 still react upon the arc 1 in a direction perpendicularly to its axial length and tend to intimately force the arc 1 against the baffle plate 5 to cause a greater evolution of gas than was the case in Fig. 2. This results because of the uniform distribution of forces along the length of the arc. The arrows 7 again indicate the forces exerted by the gas evolved from the plate 5 as a result of the intimate engagement of the arc 1 thereon.

Consequently, from the examination of Figs. 1-4, it will be observed that the construction shown in Fig. 4 is far superior to the construction shown in Fig. 2 where only the baffle plate 5 is physically moved. In other words by utilizing a magnetic field the engagement between the arc 1 and the plate 5 is more effective and there correspondingly results a greater evolution of gas from the baffle plate 5. The greater evolution of gas consequently more readily effects the extinction of the arc 1.

The use of a direct-current field results in an additional advantage. The reaction forces with a direct-current magnetic field to move the arc remain finite and larger in magnitude as compared with an A.-C. magnetic field as the arc current approaches zero. If an alternating-current magnetic field is used then the reaction forces on the arc decrease faster as the current approaches zero because both the field and current are decreasing.

Figs. 5 and 6 show an embodiment of my in-

vention in which the principles set forth during the discussion of Figs. 3 and 4 are applied. Referring more particularly to Fig. 6, it will be observed that I have provided two serially related field coils 9, 10 which are energized preferably from a suitable current source as indicated by the terminal connections 11, 12. Although a direct-current source is preferable, it is not absolutely necessary and an alternating-current source may be employed. By utilizing a direct-current source for energizing the field coils 9, 10, the radial magnetic field which is thus set up between the magnetic core 13 and the pole plate 14 and indicated by the arrows 15 of Fig. 5 does not diminish in strength as a function of time.

Consequently, upon the upward movement of the movable bridging contact 16 from the ring-shaped contact 17 an arc 1 (Fig. 5) is established and rotated around the ring-shaped contacts 17, 18.

Disposed between the ring-shaped contacts 17, 18 are baffle means of gas evolving material generally designated by the reference numeral 19 and disposed directly in the path of the rotating arc 1 which is initially drawn through a hole 4 of the baffle means 19. In this instance the baffle means 19 comprises a $\frac{1}{8}$ inch thick fiber plate having $\frac{1}{4}$ inch diameter holes 4 provided therein adjacent its periphery as more clearly shown in Fig. 5.

It will be observed that in the closed circuit position, as shown in Fig. 6, the movable bridging contact 16 extends through one of the holes 4 provided in the insulating plate 20 of annular configuration and composed of gas evolving material.

The terminal connections to the interrupter as shown more clearly in Fig. 6 comprise a terminal strip 21 connected by a screw 22 to the upper ring-shaped contact 18. The other terminal of the interrupter comprises a terminal strip 23 electrically connected by a screw 24 to the lower ring-shaped contact 17. The current passing between the contacts 18, 17 may be either direct current or alternating current. If alternating current is employed, and the field coils 9, 10 are energized from an alternating-current source, preferably the field coils would be serially connected with the contacts 17, 18 to an alternating-current source.

The contact structure may be secured in place by an insulating sleeve 25 which surrounds an annularly shaped block of insulating material 26, the latter having an annular groove 27 into which is fixed the lower ring-shaped contact 17. The annular plate 20 is held in position by two insulating sleeves 28, 29 which surround the core 13. An insulating cap 30 may be provided having apertures 31 formed therein to permit an escape of the gases formed during the rotation of the arc 1. The field coils 9, 10 surround cores 32, 33 respectively formed of suitable magnetic material, such as iron, which extend between the pole plates 14, 34. If desired the contact structure may be biased toward the open circuit position by means of a compression spring 35 interposed between the cap 30 and a flange 36 integrally formed with the movable bridging contact 16. A bracket 37 secured by a screw 38 to the cap 30 may be employed to guide the movement of the bridging contact 16. Suitable actuating means not shown may be employed to effect longitudinal movement of the bridging contact 16.

The arc 1 may jump from hole to hole as it rotates around the ring-shaped contacts 18, 17 each time striking an edge 6 of the holes 4 as shown in Fig. 4 to cause a considerable evolution of gas. The extent of rotation depends upon the force F (Fig. 5) which acts on the rotating arc 1, and the force F in turn depends upon the magnitude of the current being interrupted and the radial magnetic field strength.

Actually the arc 1 may circle the ring-shaped contacts 18, 17, several times, jumping from hole to hole during the rotation thereof.

In place of the gas evolving fiber plate 20, insulating plates 39 or 40 as shown in Figs. 7 and 8 may be employed.

The fiber plate 39 in Fig. 7 has provided therein three arcuately-shaped slots 41 and the fiber plate 40 has a single arcuately-shaped slot 41.

Preferably, each of the ring-shaped contacts

18, 17 has either a construction as shown in Fig. 9 or a construction as shown in Fig. 12. The modified construction shown in Fig. 9 comprises a ring-shaped contact 42 having a hole 43 provided therein through which the bridging contact 16 extends. The contact 42 has a plurality of concentrically disposed annular grooves 44 provided therein. The depth of the grooves 44 was $\frac{1}{8}$ inch and the width of the grooves 44 was $\frac{1}{2}$ inch, as illustrated in the cross section of Fig.

10. Such a construction gave excellent results. Another contact construction which gave very good results is that shown in Figs. 11 and 12 wherein a plurality of radially disposed grooves 45 were provided in the modified contact construction 46. The depth of the radial grooves 45 was $\frac{1}{8}$ inch and the spacing between adjacently disposed grooves 45 was substantially $\frac{1}{4}$ inch.

The above two contact constructions facilitate arc rotation inasmuch as the arc rotates by jumping from point to point in its rotative movement. A portion of the arc length near the terminal end of the arc bows down in the direction of arc travel, and the above two constructions take advantage of this phenomena by facilitating the jumping of the arc from a previous point of arc termination to a point adjacent to which the bowed portion of the arc neared the contact. This jumping phenomena continues during arc rotation.

Another important consequence of the reaction force F exerted by the magnetic radial field on the arc 1 during the rotation thereof is to produce acceleration of gas and thereby produce an air blast which carries away the arc gases. The field will move the arc terminals as far as the holes in the barrier plate 20 will permit, such motion increasing the arc voltage together with the arc length. As mentioned previously, restriking between successive holes 4 may result, thus causing the arc 1 to jump from hole to hole as it rotates around the contacts 17, 18.

From the foregoing description it will be apparent that I have provided an improved circuit interrupter of the rotating arc type in which the arc is drawn through a hole in suitable baffle structure and rotated, the arc during the rotation thereof striking against the side of the hole to produce a considerable evolution of gas. I have illustrated improved contact constructions and have shown three different types of baffle structures which may be employed.

By utilizing the particular construction disclosed in conjunction with rotative arc movement, contact burning is minimized, turbulence is in-

5

creased, and considerable arc travel is possible with a structure of minimum overall size.

Although I have shown and described specific structures, it is to be clearly understood that the same were merely for the purpose of illustration and that changes and modifications may readily be made therein by those skilled in the art without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In a circuit interrupter, a pair of cooperable ring-shaped contacts, means for establishing an arc between the ring-shaped contacts, means for establishing a radial magnetic field for causing rotation of the arc around the ring-shaped contacts, and at least one of the contacts having a plurality of concentrically disposed annular grooves provided thereon.

2. In a circuit interrupter, a pair of cooperable ring-shaped contacts, means for establishing an arc between the ring-shaped contacts, means for establishing a radial magnetic field for causing rotation of the arc around the ring-shaped contacts, and at least one of the contacts having a plurality of radially disposed grooves provided thereon.

3. In a circuit interrupter, a pair of separated endless ring-shaped contacts immersed in air, an insulating plate disposed between the contacts and having a plurality of spaced holes disposed therein, means for establishing an arc between the separated contacts through one of the holes, means providing a radial magnetic field to cause rotation of the arc around the endless ring-shaped contacts, and said holes in the insulating plate being of substantially uniform size and spaced substantially equidistant about a circular path so that as the arc rotates around the contacts it jumps from hole to hole and extinguishing action at the edges of the holes is immediately brought to bear upon the rotating arc.

4. In a circuit interrupter, a pair of separated endless ring-shaped contacts immersed in air, an insulating plate disposed between the contacts and having a plurality of spaced holes disposed therein, means for establishing an arc between the separated contacts through one of the holes, means providing a radial magnetic field to cause rotation of the arc around the endless ring-shaped contacts, and said holes in the plate being disposed symmetrically about a circular path so that as the arc rotates around the contacts it jumps from hole to hole and extinguishing action at the edges of the holes is immediately brought to bear upon the rotating arc.

6

5. In a circuit interrupter, a pair of separated endless ring-shaped contacts immersed in air, an insulating plate disposed between the contacts and having a plurality of spaced holes disposed therein, means for establishing an arc between the separated contacts through one of the holes, means providing a radial magnetic field to cause rotation of the arc around the endless ring-shaped contacts, the holes in the insulating plate being disposed in a circular path and relatively closely together so that as the arc rotates around the contacts it jumps from hole to hole and there being a plurality of holes in the first half turn around the ring-shaped contacts so that extinguishing action at the edges of the holes is immediately brought to bear upon the rotating arc.

6. In a circuit interrupter, a pair of cooperable ring-shaped contacts, means for establishing an arc between the ring-shaped contacts, means for establishing a radial magnetic field for causing rotation of the arc around the ring-shaped contacts, at least one of the contacts having a plurality of concentrically disposed annular grooves provided thereon, and an insulating plate disposed between the ring-shaped contacts with a plurality of spaced holes therethrough so that the arc jumps from hole to hole as it rotates around the contacts.

7. In a circuit interrupter, a pair of cooperable ring-shaped contacts, means for establishing an arc between the ring-shaped contacts, means for establishing a radial magnetic field for causing rotation of the arc around the ring-shaped contacts, at least one of the contacts having a plurality of radially disposed grooves provided thereon, and an insulating plate disposed between the ring-shaped contacts with a plurality of spaced holes therethrough so that the arc jumps from hole to hole as it rotates around the contacts.

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55