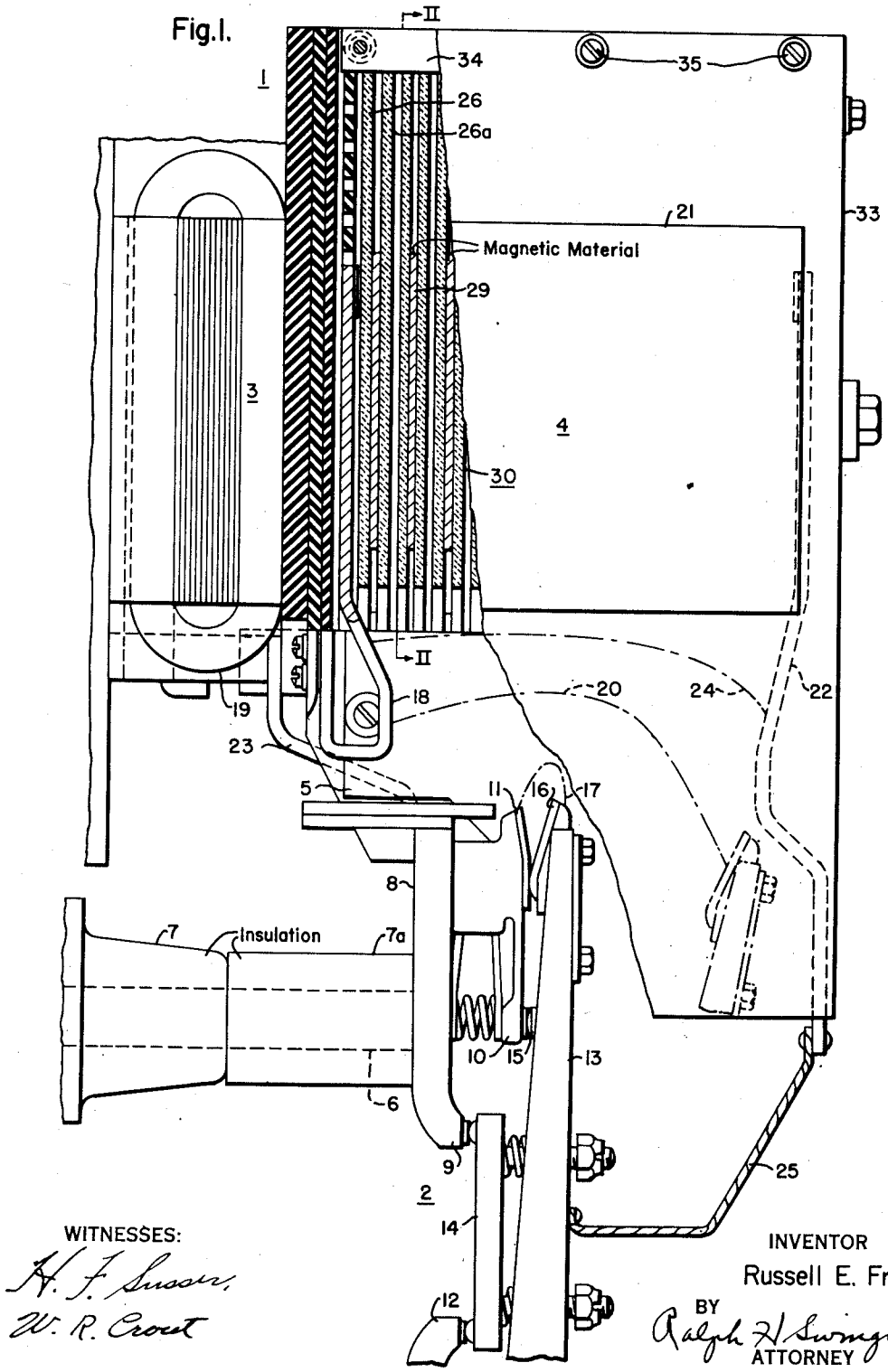
Feb. 5, 1952 R. E. FRINK 2,584,570

CIRCUIT INTERRUPTER

Filed Feb. 7, 1950 2 SHEETS—SHEET 1

Fig. 1.



WITNESSES:

H. F. Susan

W. R. Crout

INVENTOR

Russell E. Frink.

BY

Ralph H. Swingle

ATTORNEY

Feb. 5, 1952 R. E. FRINK 2,584,570

CIRCUIT INTERRUPTER

Filed Feb. 7, 1950 2 SHEETS—SHEET 2

Fig.2.

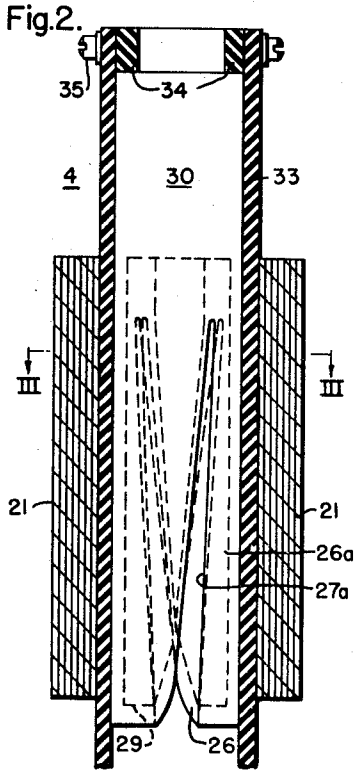
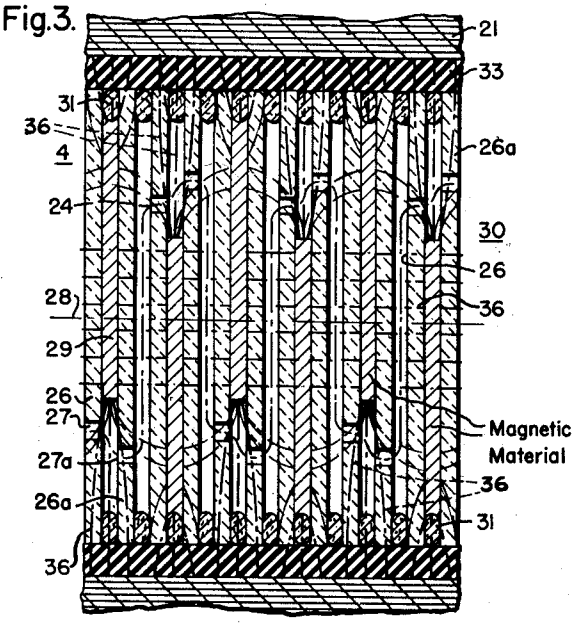


Fig.3.



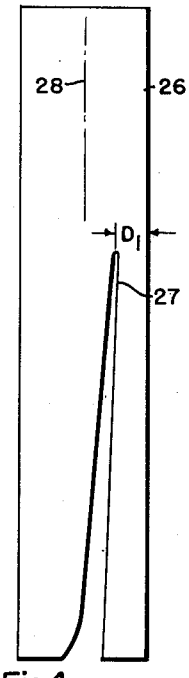


Fig.4.

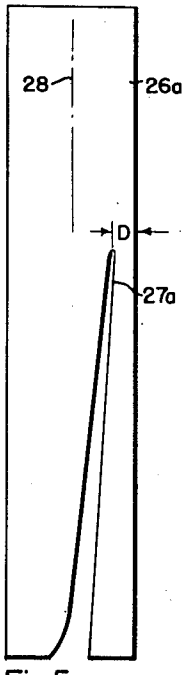


Fig.5.

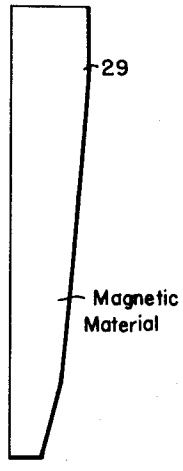


Fig.6.

WITNESSES:

H. F. Susser.

W. R. Crout

INVENTOR

Russell E. Frink.

BY

Ralph H Swingle

ATTORNEY

Patented Feb. 5, 1952

2,584,570

UNITED STATES PATENT OFFICE

2,584,570

CIRCUIT INTERRUPTER

Russell E. Frink, Pittsburgh, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application February 7, 1950, Serial No. 142,875

2 Claims. (Cl. 200—147)

1

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

A general object of my invention is to provide an improved arc extinguishing structure of the spaced plate type in which the magnetic field is intensified to thereby effect more rapid movement and faster extinction of the established arc.

Another object is to provide an improved spaced plate type of arc extinguishing structure of the type having a plurality of spaced plates with offset slots extending therein, in which the offset distance between the closed ends of diverging offset slots may be increased by a novel intensification of the magnetic field.

A further object is to provide pairs of cooperating offset slotted plates in which the offset distance of one plate of a pair of plates is greater than the offset distance of the other of the pair of plates. Preferably the pairs of plates are so disposed so that the offset slots are disposed first to one side of the centerline of the arc chute and then to the other side of the centerline of the arc chute.

A further object is to provide an improved spaced plate type of arc extinguishing structure, of the type set forth in the immediately preceding paragraph, in which plates of magnetic material are embedded between said pairs of plates to intensify the magnetic field, and thereby propel the arc more rapidly upwardly within the slots.

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

Figure 1 is a side elevational view, partially in vertical section, of a circuit interrupter embodying my invention and shown in the closed-circuit position;

Fig. 2 is a vertical sectional view taken along the line II—II of Fig. 1 looking in the direction of the arrows;

Fig. 3 is an enlarged plan view in section taken along the line III—III of Fig. 2, looking in the direction of the arrows; and

Figs. 4–6 are side views of plate details used in assembling the improved arc chute.

Referring to the drawings, and more particularly to Fig. 1 thereof, the reference numeral 1 indicates generally a circuit interrupter which, in general, comprises contact structure 2, a blow-out assembly 3 and an arc chute 4. The contact structure 2 separates to establish an arc which is moved upwardly by the blow-out assembly 3 into the spaced plate arc chute 4 where interruption is rapidly achieved.

2

The contact structure 2 comprises a terminal stud 6 surrounded by insulating bushings 7, 7a and supporting a stationary main contact plate 8. The contact plate 8 forms a main stationary contact 9, and in addition supports a relatively stationary secondary contact 10 and a relatively stationary arcing contact 11.

The other terminal stud for the interrupter 1 is not shown, but supports a second stationary main contact 12, and in addition pivotally supports a main moving contact arm 13 which, being pivotally mounted, is adaptable to swing, during the opening operation, in a clockwise direction about its pivot point to first cause separation between a conducting bridge 14 and the stationary main contacts 9, 12. Subsequently the continued clockwise opening rotative motion of the moving contact arm 13 causes separation between the secondary arcing contacts 10, 15, which separation is subsequently followed by separation between the arcing contacts 11, 16. Suitable biasing springs and stops are provided to give the desired sequence in the contact separation.

Because of the loop circuit formed by the two terminal studs and the main contact arm 13, and because of venting out of the arc chute at the point 5, the arc 17, which is initially established between the arcing contacts 11, 16, bows upwardly to contact the arc horn 18, and thereby insert into series circuit the blowout coil 19 of the blowout assembly 3. The position of the arc at this point is designated by the reference character 20. The energization of the blowout coil 19 sets up a transverse magnetic field between the pole plates 21 to further move the arc 20 upwardly into the arc chute 4. Subsequently the right-hand end of the arc 20 transfers to the right-hand arc horn 22, and at this time the electrical circuit through the interrupter includes terminal stud 6, contact plate 8, connector 23, blowout coil 19, arc horn 18, the arc 24, the right-hand arc horn 22, flexible conductor 25, and through the main contact arm 13 to the lower terminal stud of the interrupter 1, not shown.

Referring more particularly to Figs. 2–6, which collectively illustrate the construction of my improved arc chute, it will be apparent that the arc chute 4 comprises pairs of refractory, non-gas evolving, insulating plates 26, 26a which have offset closed slots 27, 27a, as more clearly shown in Figs. 4 and 5. It will be observed that the distance D, which is the distance between the closed end of the offset slot 27a and the right-hand side of the plate 26a, as viewed in Fig. 5,

is less than the distance D_1, which is the distance between the closed end of the offset slot **27** of the plate **26** and the right-hand side of said plate **26**, as shown in Fig. 4.

The arc chute **4** is built up of pairs of the plates, **26**, **26***a*, with the offset slots first to one side of the centerline **28** of the arc chute **4**, and then to the other side of the centerline **28** of the arc chute **4**, as shown more clearly in Fig. 3.

Disposed between the two plates **26**, **26***a* of each pair of plates is a magnetic filler plate **29**, more clearly shown in Fig. 6. As indicated in Figs. 3 and 6 the magnetic filler plate **29** appears to be a single plate of magnetic material. However, in practice, it would be desirable to have the magnetic filler plate **29** composed of laminations cemented together to reduce losses.

The arc chute **4**, comprises a sub-assembly **30** including the pairs of plates **26**, **26***a*, together with the magnetic filler plates **29** cemented together with asbestos rope **31** as a spacing means. In other words, the asbestos rope **31** is coated with cement and placed between the several plates, as shown in Fig. 3, the resulting sub-assembly **30** being placed under pressure and baked. Following baking, the sub-assembly **30** is a unitary structure which may be bodily placed within the arc chute housing or jacket **33**, and maintained in position by the use of insulating holding strips **34** which are bolted by bolts **35** to the insides of the upper side of the housing **33**. The holding strips **34** prevent the gas pressure created during the interruption process from blowing the sub-assembly **30** upwardly out of the housing **33**.

The arc **24** is forced upwardly by the transverse magnetic field, extending between the pole plates **21**, within the offset slots **27**, **27***a* to the position shown in Fig. 3. It will be observed that the magnetic plates **29** cause the flux lines of the magnetic field to become distorted as indicated by the reference character **36**, as viewed in Fig. 3, so that throughout the length of the arc **24** it is acted upon by the magnetic field.

It is, of course, well known by those skilled in the art that the force which causes upward movement of the arc **24** is proportional to the current passing through the arc **24** and to the component of the magnetic field which is at right angles to the arc. Since only the component of the arc at right angles to the magnetic field is appreciably affected by the magnetic field, this limits the amount of offset between the diverging ends of the slots. Consequently without the use of the magnetic plates **29**, the magnetic field would be substantially parallel to portions of the arc **24** extending between the offset slots **27**, **27***a*, and hence would have no driving effect upon these portions of the arc **24**. The result is that there is a limiting ratio of offset distance to plate thickness plus plate spacing. In other words, the parallel portions of the arc would not rise as rapidly as the curved portions of the arc curving around the closed ends of the slots, and the curved portions of the arc would hence restrike back to the parallel portions.

However, by distorting the magnetic field by the use of the magnetic filler plates **29**, the magnetic field makes a substantial angle to the direction of the arc even though the arc is extensively folded upon itself by the use of highly offset slotted plates. Furthermore, there is a beneficial effect in arc interruption derived from the magnetically induced gas blast present when the direction of arc and the field are other than parallel, which is not present over the length of

arc parallel to the field. This effect is described in AIEE Technical Paper 46–55 by R. C. Dickinson and R. E. Frink, pages 220–223, volume 65 Transactions for the AIEE 1946 as follows: ". . . it [magnetic de-ionization] consists of moving the arc toward the closed tops of slots in insulating arc resisting plates. At this position, the presence of a strong magnetic field imparts to the electrons an upward velocity. They in turn bombard gas particles and produce an actual blast of gas perpendicular to the arc, which action requires the arc continually to ionize fresh gas in considerable quantities. When current zero is reached, this action continues in a sufficient degree effectively to de-ionize the plurality of short lengths of arc near the edges of the slots."

To impart this upward velocity to the electrons the magnetic field must have a component in quadrature to the direction of current flow.

From the foregoing disclosure it will be apparent that I have provided an improved arc chute in which the magnetic flux is so changed or distorted by the magnetic plates **29** that the arc **24** is always at approximately right angles to the field. The purpose in making the plates **26**, **26***a* with different offsets **27**, **27***a* is to change the direction of the arc **24** as many times as possible which tends to free it of heavier particles carried along in the arc stream. It will be observed that the foregoing structure accomplishes three objectives:

(1) The magnetic field is working on the arc throughout its length so that the limiting ratio of offset to plate thickness plus spacing may be removed, and it is possible to put as much offset in the plates as space will permit;

(2) By keeping the magnetic field at right angles to the arc **24** throughout its length, better deionizing action is obtained; and

(3) The presence of the iron decreases the effective length of the air gap between the pole pieces **21** and makes higher field strengths possible.

It will be apparent from the foregoing description of a preferred embodiment of my invention that I have provided an improved arc chute of the spaced plate type in which by the use of magnetic filler plates **29**, the magnetic field has been distorted to more effectively propel the arc upwardly within the spaced plates so that an increase in offset distance may be employed. Furthermore deionization along the length of the arc has been effectively increased by the additional magnetic driving effect and by the loss of the heavier particles in the arc stream as the latter changes its direction.

Although I have shown and described a specific structure, it is to be clearly understood that the same was 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. A circuit interrupter including means for establishing an arc, an arc chute for extinguishing the arc including a plurality of spaced pairs of insulating plates having closed offset slots provided therein, the closed ends of the offset slots of each pair being disposed to the same side of the centerline of the arc chute, the closed ends of the offset slots of one pair of insulating plates being disposed to the opposite side of the centerline than that of the immediately adjacent pair

of insulating plates, thereby to form a substantially zigzag arc passage transversely of the direction of motion of the arc through the arc chute, blowout means including a pair of pole plates disposed on opposite sides of the centerline of the arc chute, and a plate of magnetic material disposed between each pair of insulating plates sandwiched therebetween and having one side edge thereof extending immediately adjacent the pair of slots provided in such pair of insulating plates, the opposite side of each such magnetic plate extending adjacent to the pole plate on the opposite side of the centerline of the arc chute than that of the closed ends of the offset slots of such pair of insulating plates.

2. A circuit interrupter including means for establishing an arc, an arc chute for extinguishing the arc including a plurality of spaced pairs of insulating plates having closed offset slots provided therein, the closed ends of the offset slots of each pair being disposed to the same side of the centerline of the arc chute, the closed ends of the offset slots of one pair of insulating plates being disposed to the opposite side of the centerline than that of the immediately adjacent pair of insulating plates, thereby to form a substantially zigzag arc passage transversely of the direction of motion of the arc through the arc chute, blowout means including a pair of pole

plates disposed on opposite sides of the centerline of the arc chute, a plate of magnetic material disposed between each pair of insulating plates sandwiched therebetween and having one side edge thereof extending immediately adjacent the pair of slots provided in such pair of insulating plates, the opposite side of each such magnetic plate extending adjacent to the pole plate on the opposite side of the centerline of the arc chute than that of the closed ends of the offset slots of such pair of insulating plates, the amount of offset in the slot of one insulating plate of one pair of insulating plates being different than the amount of offset in the other insulating plate of such pair of insulating plates to thereby cause the arc to change directions as much as possible to facilitate its extinction.

RUSSELL E. FRINK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,840,292	Slepian	Jan. 5, 1932
2,293,487	Bartlett	Aug. 18, 1942
2,306,204	Boehne	Dec. 22, 1942