Jan. 8, 1957 R. C. DICKINSON ET AL 2,777,035

AIR-TYPE CIRCUIT INTERRUPTER

Original Filed Feb. 23, 1949 2 Sheets-Sheet 1

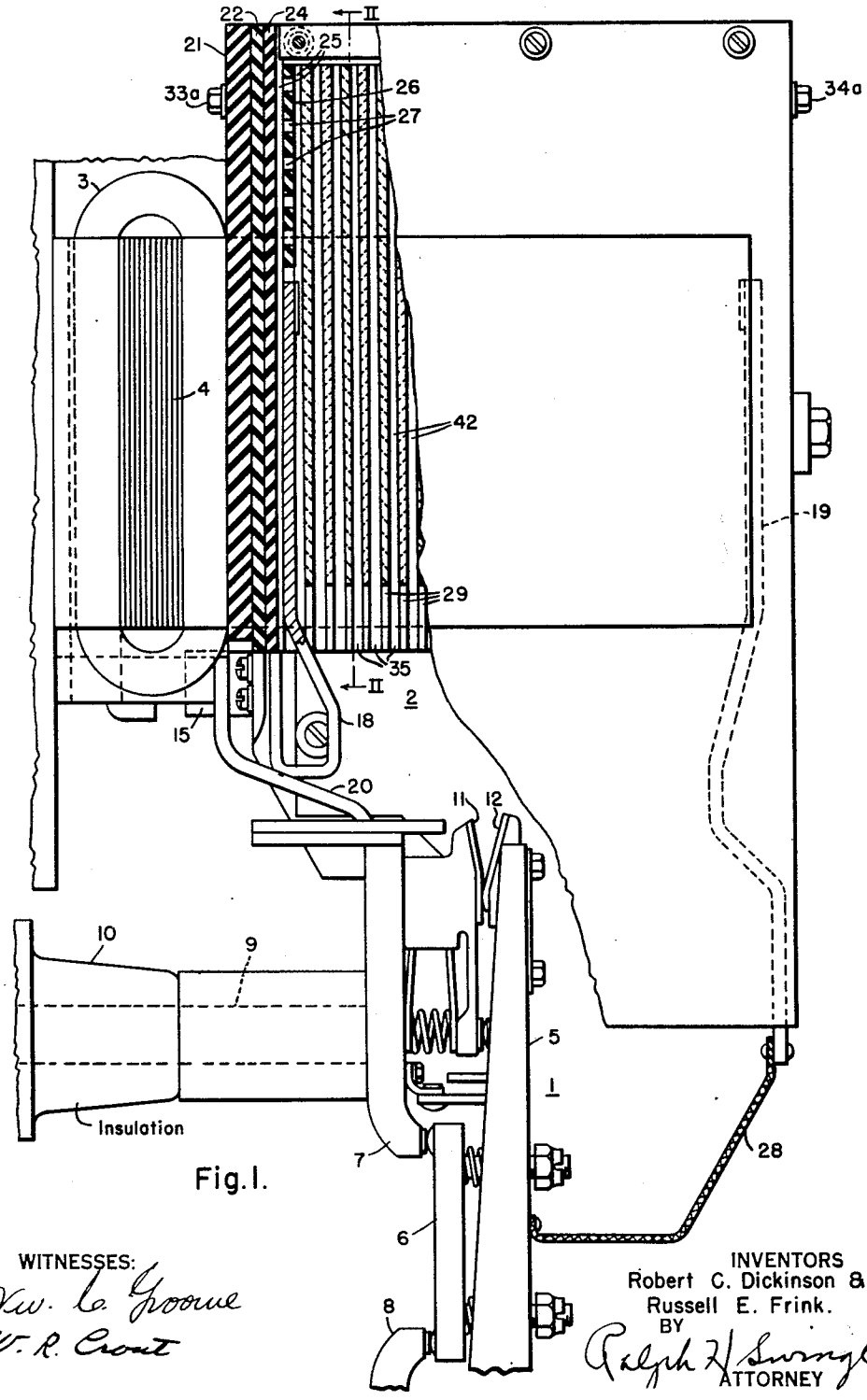

Fig. 1.

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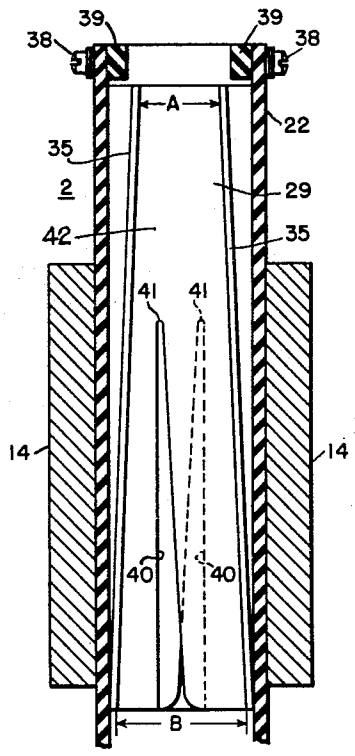

Fig. 2.

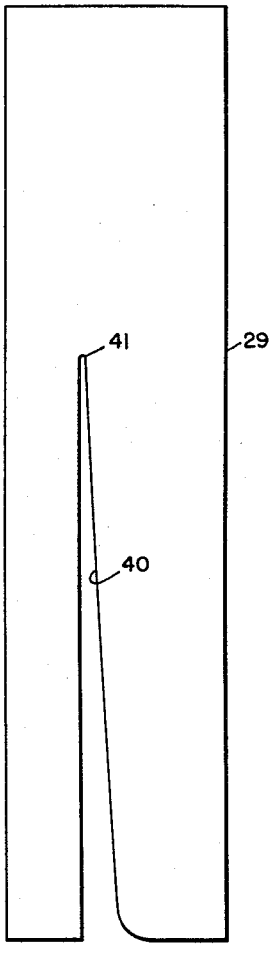

Fig. 3.

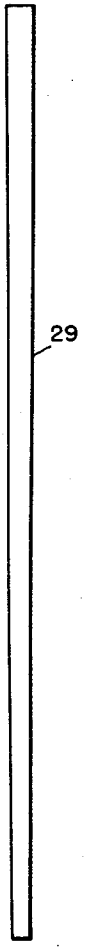

Fig. 4.

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AIR-TYPE CIRCUIT INTERRUPTER

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Original application February 23, 1949, Serial No. 77,794, now Patent No. 2,687,461, dated August 24, 1954. Divided and this application March 30, 1954, Serial No. 419,753

12 Claims. (Cl. 200—144)

This invention relates to improvements in circuit interrupters, and more particularly to arc-extinguishing structures for circuit interrupters of the air break type.

This application is a division of our application filed February 23, 1949, Serial No. 77,794, now United States Patent 2,687,461, issued August 24, 1954, and assigned to the assignee of the instant application.

In United States Patent 2,442,199, issued May 25, 1948 to Robert C. Dickinson and Russell E. Frink, and which was assigned to the assignee of the instant application, there is shown and described an arc-extinguishing structure for circuit interrupters of the air break type in which arc extinction is accomplished by the lateral movement of an established arc toward the closed ends of a series of tapered slots formed in spaced plates of insulating material. Lateral movement of the arc is obtained by a magnetic field produced by a magnetic blowout coil and magnetic field poles. This magnetic field is also relied upon to produce a blast of unionized gas through the arc while the arc is held substantially immovable against the closed ends of the slots in the plates of insulating material.

It is a general object of the present invention to improve the plate construction in an air break type of circuit interrupter of the type disclosed in the aforesaid patent so as to increase the velocity of the arc gases as they pass upwardly between the spaced ceramic plates of the arc chute structure.

A more specific object is to provide an improved spacing arrangement of the spaced plates of a circuit interrupter of the foregoing type.

A more specific object is to improve the interrupting capacity of a circuit interrupter of the foregoing type without increasing the expense thereof either in regard to assembling operations or in the cost of constructional materials.

Another object is to provide an improved plate configuration to restrict the exhaust passages between the plates at the exhaust end of the arc chute.

Still a further object of our invention is to provide wedge-shaped, spaced plates in a circuit interrupter of the air-break type, utilizing either parallel spacer strips or tapered spacer strips.

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

Figure 1 is a side elevational view, partially in vertical section, of an air break type of circuit interrupter embodying our invention and shown in the closed circuit position;

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

Fig. 3 is an enlarged plan view of one of the arc-extinguishing plates forming the arc-extinguishing structure; and

Fig. 4 shows a side elevational view of the wedge-shaped plate of Fig. 3.

Referring to the drawings, and more particularly to Fig. 1 thereof, the reference numeral 1 generally designates suitable contact structure which, when separated to the open circuit position, establishes an arc which is moved upwardly itno an arc chute, generally designated by the reference numeral 2 as a result of the transverse magnetic field set up by the blowout coil 3 and associated magnet structure 4. A rotatable contact arm 5 carries a conducting bridge 6 which, in the closed circuit position, as shown in Fig. 1, interconnects stationary main contacts 7, 8.

A contact stud 9 carries the current from the stationary main contact 7, through an insulating bushing 10 to the external circuit. The contact stud for the stationary main contact 8 is not shown, but it may be identical to the contact stud 9.

Consequently, in the closed circuit position of the interrupter, as shown in Fig. 1, the electrical circuit comprises the contact stud 9, stationary main contact 7, conducting bridge 6, stationary main contact 8, to the contact stud therefor, not shown, to the external circuit.

During the opening operation of the interrupter, the contact arm 5 is rotated in a clockwise direction about a pivot pin, not shown, but which is in electrical contact with the stationary main contact 8, to draw an arc between the arcing contacts 11, 12 after the separation of conducting bridge 6 from the main contacts 7, 8.

When the arcing contacts 11, 12 separate, the arc formed therebetween will expand upwardly because of the loop circuit so that one terminal thereof will be transferred to the arc terminal member 18, and the other arc terminal will be transferred to the other arc terminal member 19.

When this occurs, the blowout coil 3 will be put into series circuit and the transverse magnetic field set up thereby between the field pole members 14 (Fig. 2) will move the established arc upwardly along the arc terminal members 18, 19 into the arc chute 2. The electrical circuit now comprises contact stud 9, conductor 20, blowout coil 3, contact clip 15, arc terminal member 18, the arc itself, arc terminal member 19, flexible shunt 28, contact arm 5 to the other contact stud, not shown.

The arc chute 2 comprises an insulating rectangularly-shaped housing member 22 positioned adjacent to an insulating plate 21, the latter serving as a base for the blowout coil 3. Within the housing 22 is placed a plate 24 composed of an insulating material. Two insulating spacer strips 25 space a plate 26, composed of an insulating material, away from the plate 24. The plate 26 may have a plurality of apertures 27 formed therein which facilitate the venting of arc gases therethrough, particularly when high currents are to be interrupted. Two more insulating spacer strips 25 space the plate 26 from a plurality of plates 29, forming a unitary plate assembly. The plates 29 are composed preferably of a refractory insulating material, such as a zircon porcelain, which does not give off gas when contacting an arc. The plates 29 have a construction more clearly shown in Figs. 3 and 4 and are separated by pairs of asbestos rope 35.

Above the arc terminal member 19 is a second insulating plate 26, which is spaced by spacer strips 25 from the right-hand plate 29 of the plate assembly. Two additional spacer strips 25 space the right-hand plate 26 from a refractory plate, not shown, which is, in turn, separated from the right-hand end of the housing 22 by a plurality of strips of fish paper. Bolts 33*a* secure the several strips 25, plate 26 and the housing 22 to the plate 21. Bolts 34*a* secure the right-hand plate 26 and its spacer strips 25 and fish paper strips to the housing 22.

The plates 29 and the spacer strips 35 are cemented together in a preliminary process to form a unitary plate

assembly which may be bodily placed into the rectangular housing 22. Insulating holding strips 39 are secured by bolts 38 to the opposed inner sides of the housing 22 to prevent the unitary assembly of plates 29 from being forced upwardly out of the housing 22 by the pressure of gas formed during the interrupting operation.

Referring to Fig. 3, which more clearly shows the configuration of each insulating plate 29, it will be observed that each plate 29 has an inwardly extending slot or notch 40 which constricts in lateral dimension in a direction toward the top of the plate 29. Referring to Fig. 2 it will be observed that the assembling of the plates 29 is such that the upper closed ends of the slots 40 are alternately staggered throughout the arc chute 2 so that when the arc is forced upwardly into the several slots 40 it will assume a zig-zag configuration at the upper closed ends 41 of the slots 40 prior to its being extinguished.

The opening operation of the interrupter will now be explained. Upon the clockwise rotation of the contact arm 5, an arc is drawn between the arcing contacts 11, 12 which quickly transfers, because of the loop circuit, to the arc terminal members 18, 19 to thereby connect into series circuit the blowout coil 3. The magnetic field set up by the blowout coil 3 between the field pole members 14 sets up a transverse magnetic field through the arc chute 2, to thereby force the established arc upwardly along the arc terminal members 18, 19 until it comes into contact with the closed ends 41 of the slots or notches 40 provided in the several plates 29. The magnetic field gives an upward component of velocity to the electrons which bombard gas particles and impart to them an upward velocity. This magnetically produced gas blast carries ionized gases upwardly to the closed ends 41 of the slots 40 where extinction is caused by the magnetically produced upward gas blast, the exhaust gases passing upwardly between the plates 29 and out of the arc chute 2.

In prior constructions of air break circuit interrupters of this type, such as set forth in the aforesaid patent, it has been the practice to position the spacers 35 or sections of asbestos rope parallel to each other at the opposed outer-side edges of each plate 29. The spacers 35 constitute a side wall means between adjacent plates 29. We have discovered, however, that considerable interrupting improvement is obtained by placing the spacers or sections of asbestos rope 35 so that a tapered constricted exhaust gas passage 42 is provided between each set of adjacent plates 29, as shown more clearly in Fig. 2. In other words, the lateral space "A" separating the spacers 35 at the upper end of the plate 29 is smaller than the lateral space "B" separating the spacers 35 at the lower end of the plate 29, as shown more clearly in Fig. 2.

Thus by drawing the spacers 35 in at the exhaust end of the interrupting assembly so as to gradually restrict or choke each exhaust passage 42, a considerable increase in interrupting ability has been achieved. The actual reason for this is not known with certainty at present, but the following theory may apply. It is to be clearly understood, however, that we are not limited or bound by our present theory of the operation, because regardless of any theory proposed, there is a distinct improvement in interrupting ability achieved. We feel, however, that a possible explanation may reside in the fact that when the arc is at the upper closed ends 41 of the slots 40, it is at a very high temperature, and as the gases are travelling upwardly through the arc, they pass upwardly to the exhaust end of the arc chute, in which passage they are cooled by the surfaces of the plates 29 and contract in volume.

The reduction of the cross-section of the gas path as the gases become progressively cooler maintains the flow at high velocity and increases the turbulence and consequently the back pressure maintaining a higher pressure in the interrupting space, and also giving a more uniform motion of the arc in the slot. Even though this proposed theory may be incorrect, nevertheless the fact remains that a substantial improvement is maintained by the construction set forth in our invention without increase in size, and only a slight increase in assembly labor.

Figs. 3 and 4 show more particularly the wedge-shaped plate 29. This plate 29 is wedge-shaped, as shown, and when employed in a stack with parallel spacers 35 will constrict the exhaust passages 42 between each pair of adjacent plates. Thus, the constricted exhaust passage 42 may be formed either by wedge-shaped plates alone, with parallel spacers 35, or by wedge-shaped plates 29 with tapered spacers 35, as shown in Fig. 2.

The foregoing description of our invention indicates how we have increased the voltage interrupting ability of plate type circuit interrupters of the type set forth in the aforesaid patent by employing wedge-shaped plates 29, as shown in Figs. 3 and 4. Either parallel spacers 35, or tapered spacers 35, as shown in Fig. 2, may be employed with the wedge-shaped plates 29. We have set forth what we believe to be the best theoretical explanation for the phenomena involved but do not limit ourselves as to the correctness of said explanation. By only a small or negligible increase of assembly cost, we have improved the operation of plate type circuit interrupters of the foregoing type without increasing their overall dimensions by merely reducing the cross-section of the space between the plates 29 at the exhaust ends of the plates.

Although we 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.

We claim as our invention:

1. A circuit interrupter of the airbreak type including an arc chute comprising a plurality of spaced wedge-shaped plates of insulating material, the thickness of each plate increasing in a direction toward the exhaust end of the arc chute, the plates being so disposed that the median plane of each plate is parallel to the median plane of every other plate, means for establishing an arc and moving it against the plates, and the exhaust passages between the plates decreasing in cross-sectional area at the exhaust end of the arc chute.

2. A circuit interrupter of the airbreak type including an arc chute comprising a plurality of spaced slotted wedge-shaped plates of insulating material, the thickness of each plate increasing in a direction toward the exhaust end of the arc chute, the plates being so disposed that the median plane of each plate is parallel to the median plane of every other plate, means for establishing an arc and moving it into the slots and against the plates, and the exhaust passages between the plates decreasing in cross-sectional area at the exhaust end of the arc chute.

3. A circuit interrupter of the airbreak type including an arc chute comprising a stack of spaced slightly wedge-shaped plate portions, means for establishing an arc, the established arc moving against the slightly wedge-shaped plate portions to effect the extinction thereof, spacing means positioning the slightly wedge-shaped plate portions a relatively short distance apart which is comparable to the thickness of the plate portions, and the exhaust passages between the slightly wedge-shaped plate portions defined by the slightly wedge-shaped plate portions and by the spacing means becoming smaller toward the exhaust end of the arc chute.

4. A circuit interrupter of the airbreak type including an arc chute comprising a stack of spaced wedge-shaped slotted plate portions, means for establishing an arc, the established arc moving against the wedge-shaped slotted plate portions to effect the extinction thereof, spacing means positioning the wedge-shaped slotted plate portions a relatively short distance apart which is comparable to the thickness of the plate portion, and the exhaust passages between the wedge-shaped slotted plate portions

defined by the wedge-shaped slotted plate portions and by the spacing means becoming smaller toward the exhaust end of the arc chute.

5. A circuit interrupter of the airbreak type including an arc chute comprising a plurality of spaced wedge-shaped plates of insulating material, each wedge-shaped plate having a closed-end slot extending inwardly from one end thereof, a pair of spacer strips separating adjacent wedge-shaped plates a relatively short distance apart, means for establishing an arc and moving it through the slots provided by the several wedge-shaped plates, and the lateral distance between each pair of spacer strips diminishing toward the exhaust end of the arc chute.

6. A circuit interrupter of the airbreak type including an arc chute comprising a plurality of spaced insulating wedge-shaped plate portions, spacing means extending along each side edge of the wedge-shaped plate portions separating adjacent wedge-shaped plate portions a relatively short distance apart, means for establishing an arc and moving it substantially transversely against the insulating wedge-shaped plate portions to effect the extinction thereof, and the lateral distance between the spacing means along one side edge of the wedge-shaped plate portions and the spacing means along the opposite side edge of the wedge-shaped plate portions progressively diminishing toward the exhaust end of the arc chute.

7. A circuit interrupter of the airbreak type including an arc chute comprising a plurality of spaced slotted insulating wedge-shaped plate portions, spacing means extending along each side edge of the wedge-shaped plate portions separating adjacent wedge-shaped plate portions a relatively short distance apart, means for establishing an arc and moving it substantially transversely against the wedge-shaped plate portions and into the slots thereof to effect the extinction thereof, and the lateral distance between the spacing means along one side edge of the slotted wedge-shaped plate portions and the spacing means along the opposite side edge of the slotted wedge-shaped plate portions progressively diminishing towards the exhaust end of the arc chute.

8. A circuit interrupter of the airbreak type including an arc chute comprising a plurality of spaced insulating wedge-shaped plate portions, side wall means extending along the opposite sides of the arc chute and spacing the wedge-shaped plate portions a relatively short distance apart, means for establishing an arc and moving it substantially transversely against the insulating wedge-shaped plate portions to effect the extinction thereof, and the lateral distance between the side wall means along one side of the arc chute and the side wall means along the opposite side of the arc chute progressively diminishing toward the exhaust end of the arc chute.

9. A circuit interrupter of the airbreak type including an arc chute comprising a plurality of spaced insulating wedge-shaped plate portions having closed end slots therein, side wall means extending along the opposite sides of the arc chute and spacing the wedge-shaped plate portions a relatively short distance apart, means for establishing an arc and moving it substantially transversely against the insulating wedge-shaped plate portions and into the slots thereof to effect the extinction of the arc, and the lateral distance between the side wall means along one side of the arc chute and the side wall means along the opposite side of the arc chute progressively diminishing toward the exhaust end of the arc chute.

10. A circuit interrupter of the airbreak type including an arc chute comprising a stack of spaced insulating wedge-shaped plate portions, spacing means positioning the wedge-shaped plate portions a relatively short distance apart to define separate exhaust passages therebetween, the median plane of each wedge-shaped plate portion being parallel to the median plane of every other wedge-shaped plate portion so that the end wedge-shaped plate portions of the stack are parallel to each other thereby obtaining adequate flash-over distance at the exhaust end of the arc chute, means for establishing an arc, means for moving the established arc substantially transversely against the wedge-shaped plate portions to effect the extinction thereof, and the cross-sectional area of the exhaust passages through the wedge-shaped plate portions defined by the spacing means and by the wedge-shaped plate portions becoming progressively smaller toward the exhaust end of the arc chute.

11. A circuit interrupter of the airbreak type including an arc chute comprising a stack of spaced insulating wedge-shaped plate portions having closed end slots therein, spacing means positioning the wedge-shaped plate portions a relatively short distance apart to define separate exhaust passages therebetween, the median plane of each wedge-shaped plate portion being parallel to the median plane of every other wedge-shaped plate portion so that the end wedge-shaped plate portions of the stack are parallel to each other thereby obtaining adequate flash-over distance at the exhaust end of the arc chute, means for establishing an arc, means for moving the established arc into the slots of the wedge-shaped plate portions substantially transversely against the wedge-shaped plate portions to effect the extinction thereof, and the cross-sectional area of the exhaust passages through the wedge-shaped plate portions defined by the spacing means and by the wedge-shaped plate portions becoming progressively smaller toward the exhaust end of the arc chute.

12. A circuit interrupter of the airbreak type including an arc chute comprising a plurality of spaced wedge-shaped plates of insulating material, a pair of spacer strips separating adjacent wedge-shaped plates a relatively short distance apart, means for establishing an arc and moving it substantially transversely against the wedge-shaped plates to effect the extinction thereof, and the lateral distance between each pair of spacer strips diminishing toward the exhaust end of the arc chute.

References Cited in the file of this patent

FOREIGN PATENTS

127,629	Switzerland	Sept. 1, 1928
383,127	Great Britain	Nov. 10, 1932