Aug. 12, 1952 H. V. NYE 2,606,982

ARC CHUTE DEFINING TWO ALTERNATE ARC PATHS

Filed June 11, 1949 2 SHEETS—SHEET 1

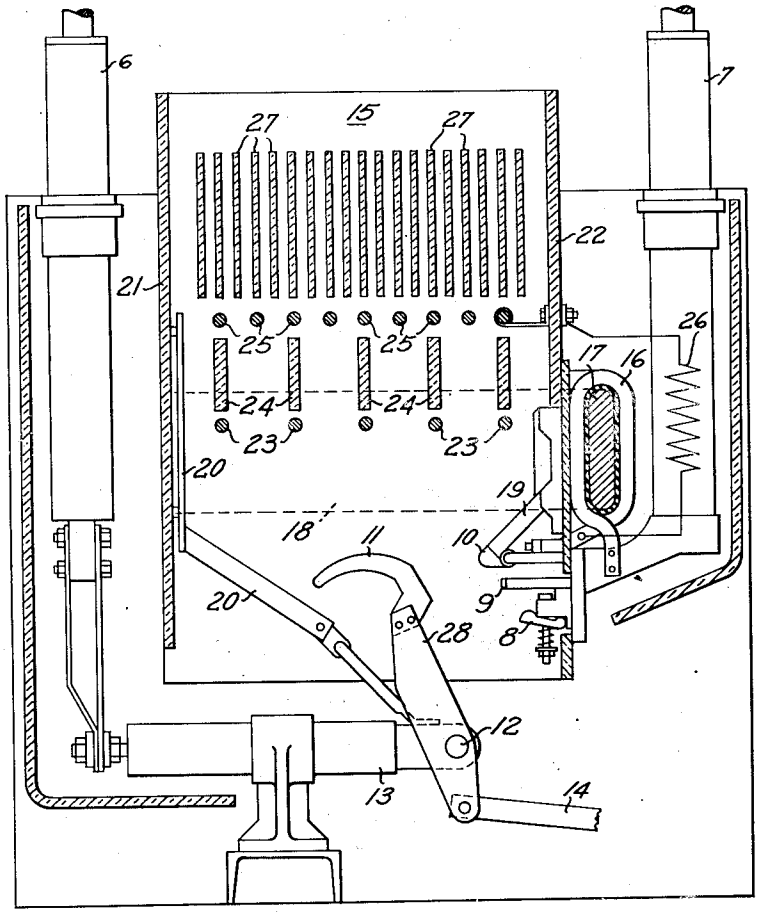



Fig. 1

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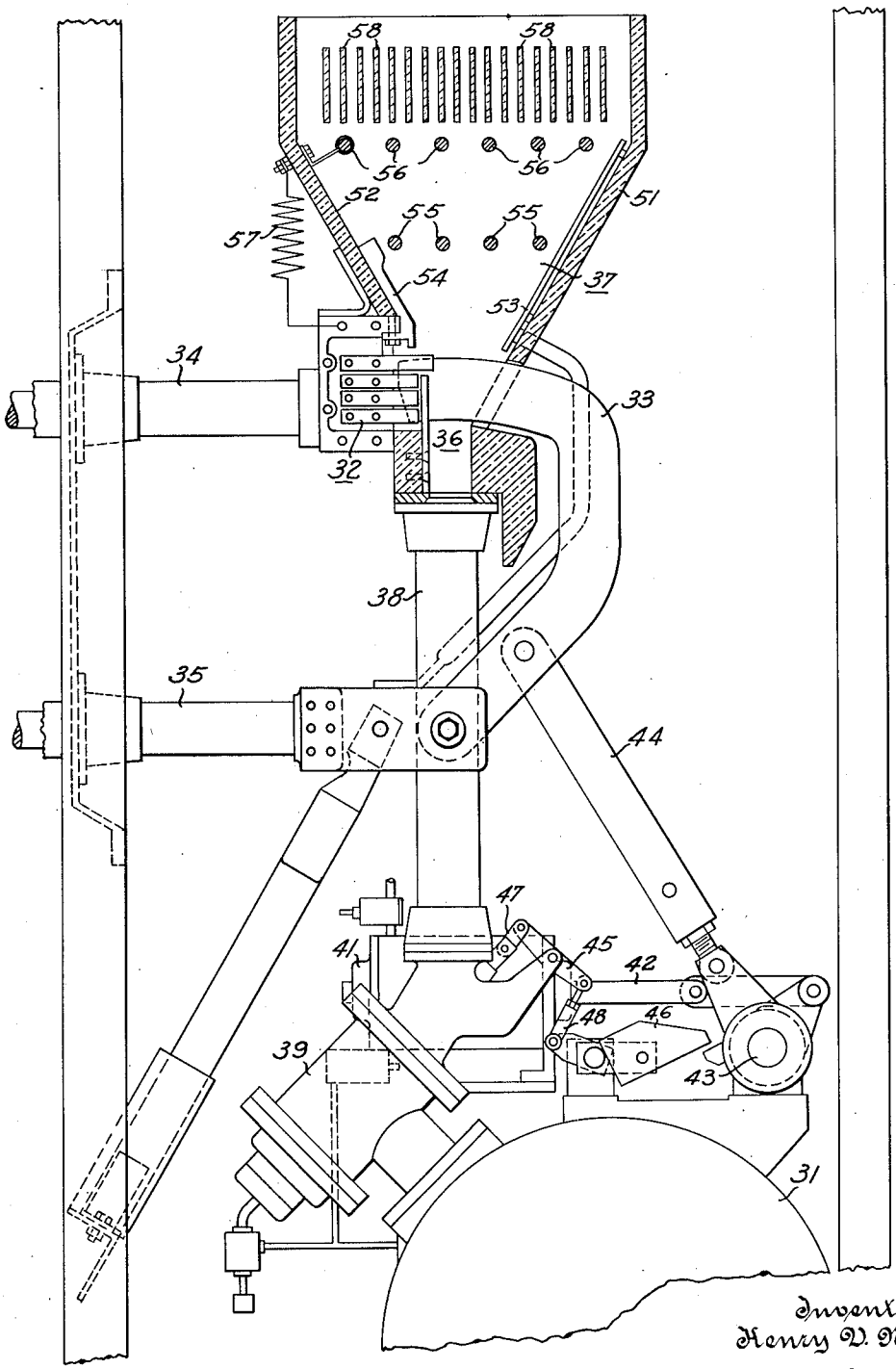



Fig. 2

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Patented Aug. 12, 1952 2,606,982

# UNITED STATES PATENT OFFICE

2,606,982

## ARC CHUTE DEFINING TWO ALTERNATE ARC PATHS

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Application June 11, 1949, Serial No. 98,527

9 Claims. (Cl. 200—144)

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This invention relates to circuit interrupting devices and more particularly to arc extinguishing means for use in connection therewith.

In the construction and operation of circuit interrupters, it is frequently necessary to provide means for extinguishing quickly the arc which is drawn between separable arcing contacts. This arc is usually blown by blowout means, such as a magnetic blowout coil or an air blast, into an arc chute which is arranged to quench the arc by lengthening it, cooling it, or a combination of both.

Arc chutes having spaced insulating plates to lengthen the arc or squeeze the arc into narrow slots are well known. Arc chutes which consist of spaced metallic plates or their equivalent which break the arc into a number of small arc segments in series and move the arc rapidly across cooling surfaces, are also well known. It has also been proposed to use spaced metal pins or bars for the purpose of cooling and quenching the arc. The spacing and arrangement of the arc quenching elements, however, have not been entirely satisfactory with the result that arc interruption has not been reasonably consistent except for arc chutes having a large aggregate mass of cooling material.

In accordance with the invention claimed an arc chute is provided adjacent a pair of arcing contacts for receiving the arc at one end thereof and in the majority of cases exhausting the arcing products at the other end thereof. The arc chute employs an arc extinguishing device which provides a first arc path which breaks the arc into a number of small serially connected arc segments. An insulating barrier may be mounted adjacent the first arc path for lengthening and cooling the arc. A second arc path is provided for further elongating and cooling the arc and for placing the arc, after a current zero, in series with a current limiting resistor.

It is, therefore, one object of the present invention to provide a new and improved arc interrupting device.

Another object of the invention is to provide a new and improved arc interrupting device that rapidly extinguishes a high voltage power arc within a comparatively small space.

A further object of the invention is to provide a plurality of arc paths to break the arc into a number of arc segments, extend and cool the arc, and rapidly extinguish the arc within a predetermined period of time.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawings in which:

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Fig. 1 is a diagrammatic view partly in cross section of a magnetic blowout type circuit breaker embodying the present invention; and

Fig. 2 is a diagrammatic view partly in cross section of a fluid blast circuit breaker embodying a variation of the invention illustrated in Fig. 1.

Referring more particularly to the drawings by characters of reference, Fig. 1 illustrates a magnetic blowout type of circuit breaker including as elements thereof a pair of terminal studs 6 and 7 for connecting the circuit breaker to line conductors (not shown). Although in general, circuit breakers of the type considered in Figs. 1 and 2 are provided with a plurality of similar pole structures, one for each phase of a polyphase electric circuit, only one such pole structure is shown in the drawings and the circuit breakers will be described in detail as if they were of the single pole unit type.

The circuit interrupter or breaker in Fig. 1 comprises essentially means for opening the circuit to form the interrupting arc and an arc extinguishing structure. Specifically, the circuit opening means comprises relatively fixed contacts 8 and 9, a fixed arcing contact 10, and a movable arcing contact 11. Arcing contact 11 is mounted on a lever 28 which is pivotally mounted at 12 on an extension 13 of the circuit breaker stud 6 and is operated by means of a reciprocally movable rod 14. The operating rod 14 is suitably connected to an actuating mechanism (not shown) for operating the movable contact between closed and open circuit positions. Fig. 1 illustrates the movable contact 11 in its open circuit position. The arcing contacts are electrically connected to the lower ends of terminal studs 6 and 7. Accordingly, when the breaker is connected in series in a power circuit and the arcing contacts are separated, an arc may form across the gap indicated.

For the purpose of interrupting this power arc, an arc extinguishing structure, such as an arc chute 15 may be mounted so as to receive the power arc which is under the influence of the magnetic blowout means. The arc chute preferably is disposed directly above the arcing contacts, as shown, when the blowout means act upward, but may be mounted in any other suitable location when the blowout means act in other directions. The switch or arcing contacts and the magnetic blowout structure can assume any preferred form and comprise no part of the present invention so that a brief description will

be sufficient. The magnetic blowout means comprises a core 17, poles 18, and a coil 16 which is electrically connected to the terminal stud 7 and to an arc runner 19 so that the arc current (as the arc travels along the runner) flows through the blowout coil in a manner well known in the art.

Normally the current is carried in the closed circuit position of the breaker by the spring biased contact 8. As the movable arcing contact 11 is actuated to open circuit position, current is shunted from fixed contact 8 to fixed contact 9, to fixed arcing contact 10. As the arc is drawn by the movable arcing contact 11, the arc terminal on arcing contact 10 is transferred to arc runner 19 which is usualy an extension arm of the fixed arcing contact 10. As the movable arcing contact 11 reaches its full opening stroke the arc terminal transfers from the movable arcing contact 11 to an arc runner 20 which directs the arc into the arc chute 15. The arcing contact 10 and the arc runner 19 are electrically connected in series with the blowout coil 16 and stud 7. Accordingly, the blowout coil is already energized at the inception of the arc interruption to influence the arc in a well known manner, i. e. to drive it into the arc chute 15 in an ever expanding loop. It will be apparent to one skilled in the art that the blowout field can be utilized in the most efficient manner by disposing the iron pole 18 so as to cooperate with the blowout coil in the conventional manner at the outer sides of the arc chute.

In accordance with the invention, the arc chute 15 comprises a new and improved structure for interrupting the arc by lengthening, cooling, and increasing the resistance of the arc stream. The arc extinguishing structure may have walls including two end walls 21, 22 composed of arc resisting material, such as, for example, an asbestos compound or a suitable arc resisting ceramic material.

For the purpose of greatly increasing the interrupting capacity and efficiency of the arc chute a first group of metallic members, which for example may be a row of copper rods or pins 23, are disposed between end walls 21, 22 so that the pins extend transversely to the direction of movement of the arc. Pins 23 form a first arc path through the strongest part of the magnetic field of the magnetic blowout means. A plurality of partitions 24 forming an insulating barrier may be disposed between the side walls 21, 22 to extend transversely of the arc with one end thereof disposed adjacent the pins 23 and the other end extending toward the exhaust end of arc chute 15. A second group of metallic members, which for example may also be of a row of copper rods or pins 25, is disposed between the side walls 21, 22 so that the pins extend transversely to the direction of movement of the arc and adjacent the exhaust end of the partitions 24. Pins 25 provide a second or alternative path for the arc to travel and may comprise a plurality of pins greater in number than those defining the first arc path. A resistor 26 may be connected to at least one of the pins 25 and to the end of the magnetic blowout coil 16 connected to contact 10, thus forming an arc path through a current limiting resistor for aiding arc extinguishment.

As shown, an insulating baffle 27, comprising a plurality of strips of a suitable arc resisting insulating material, such as asbestos board, is arranged near the exhaust end of the arc chute 15. This baffle which extends the full length of the exhaust end of the arc chute retains the arc within the chute and aids arc extinction.

Under normal interrupting conditions the arc enters the chute along the arc runners 19 and 20 and is driven by the magnetic blowout means and the thermal effect of the arc into the pins 23 which form a first arc path through the magnetic field of coil 16. The arc following the first arc path comprises a series of arc segments each elongated and reduced in cross section as the arc moves outward through the arc passage under the influence of the blowout means. Partitions 24, forming an insulating barrier, may be used to further extend and cool the arc.

If the arc restrikes after the first current zero, it will have a tendency to follow a second alternative arc path formed by pins 25 and builds up through resistor 26 which is connected in series therewith. The second arc path may comprise a plurality of pins greater in number than those forming the first arc path. The arc segments between pins 25 are further elongated, attenuated, cooled and rapidly extinguished.

Fig. 2 illustrates a fluid blast circuit breaker structure embodying the new and improved arc extinguishing device. The circuit breaker includes as a constructive element thereof a reservoir 31 constituting a source of supply of fluid under pressure which will be assumed herein to be compressed air ,supplied from a suitable compressor (not shown).

The circuit breaker comprises a fixed arcing contact 32 and a cooperating movable arcing contact 33 connected in an electric circuit through terminal studs 34 and 35. The arcing contacts 32 and 33 are mounted to engage within a tubular arcing chamber 36 which is axially aligned with and supporting an arc chute 37. The arcing chamber 36 is axially aligned with and supported by a hollow insulator 38 which provides a connection between reservoir 31 and arcing chamber 36 through a suitable blast valve 39 for the purpose of directing a blast of arc extinguishing fluid under pressure between the arcing contacts and through the arcing chamber 36.

The operation of blast valve 39 is correlated with that of a contact actuating fluid operated motor 41 to boost the action of the contact operating motor, thereby increasing the initial speed of contact separation. Motor 41 and particularly piston rod 42 rotates shaft 43 counterclockwise and in turn actuates connecting rod 44 to separate the arcing contacts 32 and 33. The blast valve 39 through a series of lever arms 45, 46, and connecting rods 47, 48 boosts the action of motor 41 by actuating shaft 43 counterclockwise in conjunction with motor 41. This type of booster means for fluid blast circuit breakers is more fully described and claimed in U. S. Patent No. 2,597,126, granted May 20, 1952 upon the application of Ira W. Paterson.

Arc chute 37 comprises a structure similar to that illustrated in Fig. 1, but adapted to fit into an air blast circuit breaker. The arc chute has walls including end walls 51, 52 composed of arc resisting material, an arc runner 53 mounted within arc chute 37 and associated with the movable arcing contact 33, an arc runner 54 mounted within an arc chute 37 and associated with fixed arcing contact 32, a first group of metallic members or pins 55 forming a first arc path, and a second group of metallic members or pins 56 forming a second or alternative arc path. The metallic members or pins 55 and 56 are similar to

pins 23 and 24 of Fig. 1 and are mounted within arc chute 37 to extend transversely to the direction of movement of the arc. A resistor 57 may be connected to at least one of the pins 56 and to the conductive structure of the fixed arcing contact 32, thus forming an arc path through a current limiting resistor for aiding arc extinguishment. As shown, an insulating baffle 58 comprising a plurality of strips of suitable arc resisting material is arranged to form a barrier near the exhaust end of the arc chute 37 for retaining the arc within the chute but permitting suitable exhausting of the arc gases.

Upon separation of the arcing contacts 32 and 33 by the joint operation of the contact actuating motor 41 and the blast valve booster means, a blast of air under pressure drives the arc into the arc chute 37 and against the first group of pins 55 forming the first arc path. Here the arc is broken up into segments which are elongated, attenuated, and cooled. After a current zero if the arc restrikes it is driven to the second group of pins 56 forming the second or alternative arc path where the arc current builds up through a resistor 57 which is connected in series therewith. Here the arc is broken up into a greater number of segments and is further elongated, attenuated, cooled, and rapidly extinguished.

Although but two embodiments of the present invention have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. An electric circuit interrupter comprising a stationary arcing contact, a cooperating movable arcing contact, means for drawing an arc between said contacts, an arc chute for receiving the arc at one end thereof and exhausting the arc products at the other end thereof, a source of fluid under pressure for imparting to the arc a movement in a predetermined direction through said arc chute, a current limiting resistor, and an arc extinguishing means within said chute comprising spaced metallic members mounted therein in two consecutive rows extending transversely of the arc for providing a first arc path and a second arc path in series with said resistor, at least a part of said members of said second arc path being aligned with the members of said first arc path in the said direction of movement of the arc through said chute, the distance between said arc paths being greater than the spacing between members of said arc paths for controlling the movement of the arc, and baffle means arranged adjacent the metallic members of said second arc path and extending toward the exhaust end of said chute for confining said arc.

2. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving the arc at one end thereof and exhausting the arc products at the other end, said chute comprising a first group of metallic members mounted therein to extend transversely of the arc for providing a first arc path, insulating barriers mounted to extend transversely of the arc each having one end thereof disposed adjacent a different one of said first group of metallic members and the other end thereof extending toward the exhaust end of said chute for elongating said arc, and a second group of metallic members mounted adjacent said other ends of said barriers for providing a second arc path which divides each arc section between adjacent barriers into a predetermined number of arc sections.

3. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving the arc at one end thereof and exhausting the arc products at the other end, said chute comprising a first group of metallic members mounted therein to extend transversely of the arc for providing a first arc path, insulating barriers mounted to extend transversely of the arc each having one end thereof disposed adjacent a different one of said first group of metallic members and the other end thereof extending toward the exhaust end of said chute for elongating said arc, and a second group of metallic members mounted adjacent said other ends of said barriers for providing a second arc path which divides each arc section between adjacent barriers into a predetermined number of serially connected arc sections.

4. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving the arc at one end thereof and exhausting the arc products at the other end, said chute comprising a first group of metallic members mounted therein to extend transversely of the arc for providing a first arc path, insulating barriers mounted to extend transversely of the arc each having one end thereof disposed adjacent a different one of said first group of metallic members and the other end thereof extending toward the exhaust end of said chute for elongating said arc, and a second group of metallic members mounted adjacent said other ends of said barriers for providing a second arc path which divides each arc section between adjacent barriers into two smaller arc sections.

5. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving the arc at one end thereof and exhausting the arc products at the other end, said chute comprising a first group of metallic members mounted therein to extend transversely of the arc for providing a first arc path, insulating barriers mounted to extend transversely of the arc each having one end thereof disposed adjacent a different one of said first group of metallic members and the other end thereof extending toward the exhaust end of said chute for elongating said arc, and a second group of metallic members mounted adjacent said other ends of said barriers for providing a second arc path which divides each arc section between adjacent barriers into a predetermined number of arc sections, said barriers being separated from all said metallic members by air gaps.

6. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving the arc at one end thereof and exhausting the arc products at the other end, said chute comprising a first group of metallic members mounted therein to extend transversely of the arc for providing a first arc path, insulating barriers mounted to extend transversely of the arc each having one end thereof disposed adjacent a different one of said first group of metallic members and the other end thereof extending toward the exhaust end of said chute for elongating said arc, a second group of metallic members mounted adjacent said other ends of said barriers for providing a second arc path which divides each

arc section between adjacent barriers into a predetermined number of arc sections, and a baffle structure comprising a plurality of insulating plates extending transversely of the arc mounted within the exhaust end of said arc chute for confining said arc.

7. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving the arc at one end thereof and exhausting the arc products at the other end, magnetic blowout means for driving the arc into said chute and toward the exhaust end thereof, and a current limiting resistor, said chute comprising a first group of metallic members mounted therein to extend transversely of the arc for providing a first arc path, insulating barriers mounted to extend transversely of the arc each having one end thereof disposed adjacent a different one of said first group of metallic members and the other end thereof extending toward the exhaust end of said chute for elongating said arc, and a second group of metallic members mounted adjacent said other ends of said barriers for providing a second arc path in series with said resistor which divides each arc section between adjacent barriers into a predetermined number of arc sections.

8. An electric circuit interrupter comprising means for drawing an arc, an arc chute for receiving the arc at one end thereof and exhausting the arc products at the other end, means for imparting to the arc a movement in a predetermined direction through said arc chute, said chute containing spaced metallic members mounted therein in two consecutive rows extending transversely of the arc for providing a first arc path and a second arc path, at least a part of said members of said second arc path being aligned with the members of said first arc path in the said direction of movement of the arc through said arc chute, said other members of said second arc path dividing each arc section between said members of said first arc path into a predetermined number of arc sections, a current limiting resistor in series with said second arc path, and a baffle structure comprising a plurality of insulating plates mounted within the exhaust end of said chute for confining said arc.

9. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving the arc at one end thereof and exhausting the arc products at the other end, said chute comprising a first group of metallic members mounted therein to extend transversely of the arc for providing a first arc path, insulating barriers mounted to extend transversely of the arc each having one end thereof disposed adjacent a different one of said first group of metallic members and the other end thereof extending toward the exhaust end of said chute for elongating said arc, and a second group of metallic members mounted adjacent said other ends of said barriers for providing a second arc path, said barriers being separated from all said metallic members by air gaps.

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