Feb. 9, 1954 A. LATOUR 2,668,890

DEVICE FOR EXTINGUISHING ELECTRICAL ARCS

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Fig. 1

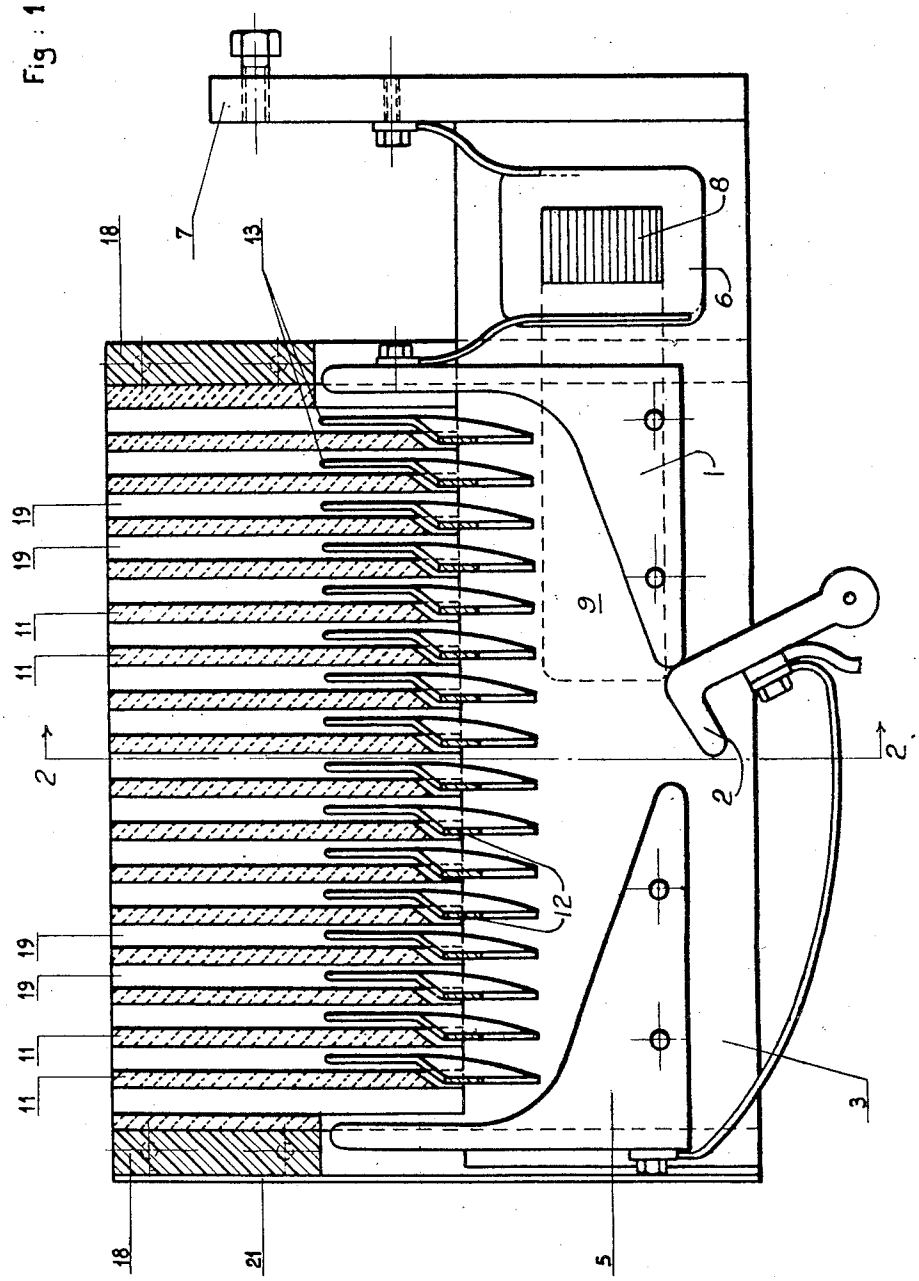

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Fig. 2

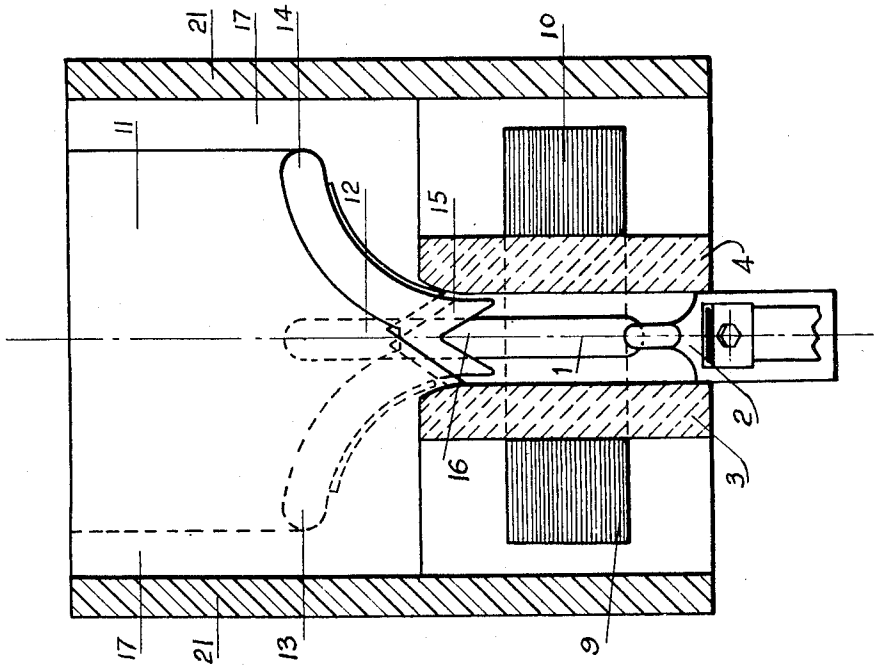

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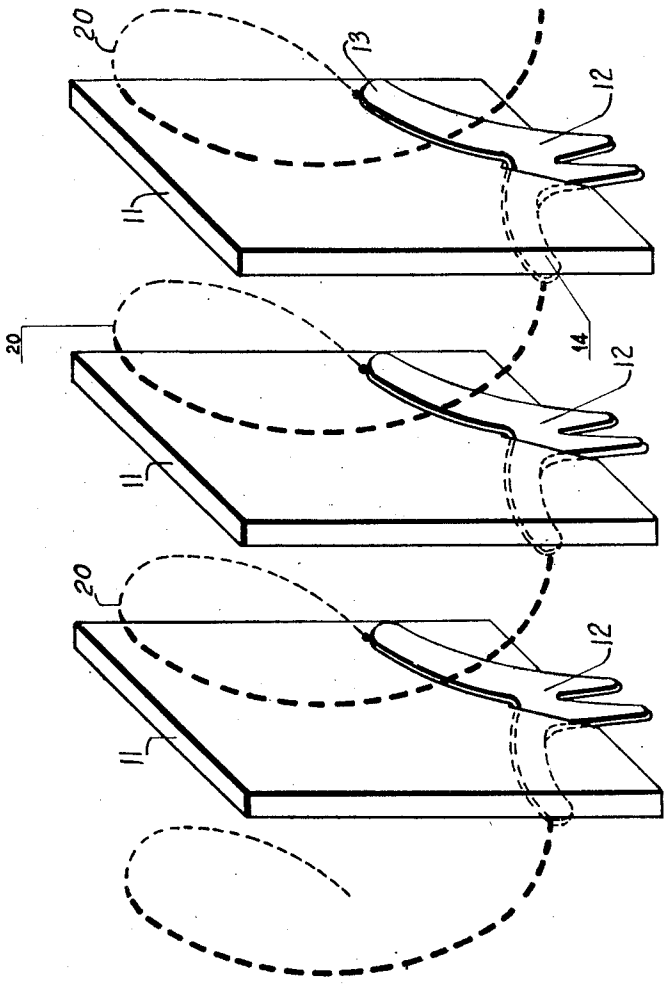
Fig: 3



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DEVICE FOR EXTINGUISHING ELECTRICAL ARCS

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7 Claims. (Cl. 200—144)

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The invention refers to circuit breakers of the type in which the arc is drawn between separable contact members contained in an arc formation chamber provided with means for expanding, until extinction, the arc into and within an arc extinguishing chamber contiguous with the arc formation chamber.

More particularly the invention is concerned with a development of an arc extinguishing chamber which makes possible in a circuit breaker to be employed for heavy currents and high voltages to expand or elongate peripherally the arc to a multiple of its initial length.

It is a further object of the invention to provide such a circuit breaker with arc extinguishing means which as to their dimensions are not limited by the dimensions and configuration of the circuit breaker proper but, contrariwise, allow for ready adaptation of the arc extinguishing means to the various requirements of voltage and current or power to be disconnected.

The device of the invention makes use of an arc extinguishing chamber which includes at least two parallel plates of insulating material, spaced apart from one another to leave a narrow space therebetween and disposed substantially transversely of the direction of separation of the contacts or the initial direction of the arc. It is a particular object of the invention to provide in this device the plates with linearly extended conductive elements or paths which not only draw a section of the arc into the space between the plates and turn it around into a position substantially perpendicular to its initial path but cause the section of the arc to expand peripherally to a loop of a length which is a multiple of the greatest distance between the conductive elements.

The device for extinguishing an electric arc to be drawn between separable contact members thus includes at least two plates of insulating material, spaced apart from each other to leave a narrow space therebetween and disposed substantially transversely of the direction of separation of the contacts, or the initial direction of the arc. Each plate is provided on both its faces with conductive elements or paths so disposed that they not only draw the arc into the narrow space, or the arc in sections into the narrow spaces between the plates, but turn the arc or the arc sections into a position parallel to the plates or substantially perpendicular to the plane of the arc as initially drawn, or perpendicular to the direction of separation of the contact members.

These conductive elements or paths of the invention are linearly extended and project into the space between the plates, laterally and along the surfaces of the plates, and terminate within the space at a point intermediate the entrance and the exit of the space and are so disposed upon opposite faces of each plate and upon the faces of opposite plates within each space so as to diverge relatively to each other.

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Through this arrangement the roots of the arc or arc sections progress into the space or spaces only part-ways until they reach the terminal points of the conductive elements or paths whereupon the arc or the arc sections will expand peripherally to a multiple of their lengths within the space or the spaces until extinction.

In the arrangement of this arc extinguishing device where an arc extinguishing chamber is contiguous to an arc formation chamber wherein the arc is ignited or drawn by interruption of the current, the arc formation chamber may consist of two parallel insulating plates between which the contacts of the switch are located, the insulating plates with the contacts therebetween being placed between the branches of a magnetic circuit in the shape of a horseshoe. This magnet, owing to the narrow air gap within which the contacts are disposed between the insulating plates, is capable of driving the ignited arc with great force into the arc extinguishing chamber.

This chamber consists of a certain number of insulating plates and conductive elements or paths which in the form hereinafter illustrated are generally in the shape of a V, its branches or legs embracing or straddling the individual insulating plates and extending along both sides and faces of the insulating plates which themselves are extended transversely of the initial path of the arc. These conductive elements are so placed that in the space between neighboring plates conductive elements on opposite faces diverge relatively to each other.

In this manner, on its way out of the arc formation chamber, the ignited arc is split into as many sections as there are conductive elements or paths plus one, and each section on its travel along the branches or legs of the conductive elements or paths is turned around an angle of about 90° with relation to the axis of the initial arc. Conductive elements alternating with arc sections thus form from that very moment a veritable solenoid which through its electrodynamic effect brings a powerful blow out action on each one of the elementary arc sections which now are easily displaced and extended in the spaces between each two insulating plates.

The invention and its mode of application

will now be described more in detail with reference to the accompanying drawings in which:

Fig. 1 is a cross sectional view of a device constructed in accordance with the present invention;

Fig. 2 is a section taken on line 2—2 of Fig. 1; and

Fig. 3 is a schematic representation showing the formation of the solenoid during the blow out.

In Figs. 1 and 2 the fixed and movable contacts are respectively represented by 1 and 2. The two contacts are located inside the arc formation chamber formed by two parallel plates 3 and 4 made of insulating material.

In order to develop the ignited arc more rapidly than the movement of the movable contact would allow there may be placed within the arc formation chamber an arcing contact 5 connected either permanently, as in the embodiment represented in the drawing, or temporarily, to the movable contact 2. The fixed contact 1 is connected in series with the blow out coil 6 which in its turn is connected to one of the terminals 7 of the circuit breaker. The coil 6 acts upon the magnetic core 8 whose legs 9 and 10 enclose the arc formation chamber. One may, if necessary, provide, although this is not shown on the drawing, in a symmetrical arrangement a second blow out coil connected to the arcing contact 5.

On the upper parts of plates 3 and 4, thus above the arc formation chamber, there is arranged a set of plates 11, transversely of the contacts 1, 2, 5, and of the insulating plates 3, 4, and in a space which constitutes the arc extinction chamber. Each plate 11 is provided with a piece of metal 12, generally in the form of a V, formed by two branches or legs 13 and 14 which extend laterally in opposite directions along the front and rear faces, respectively, of each plate 11. To this end, the pieces 12 are warped at their apexes and are passed each through a notch 15 of inverted V-shape of the appertaining insulating plate 11. The pieces 12 thus straddle each with its apex the notched edges of the insulating plates 11. The linearly extended metal elements or conductive paths 13, 14 terminate at points intermediate the entrance into and the exit out of the spaces between each pair of insulating plates. The metal strips may be extended into the arc formation chamber by means of a notched extension 16 in the shape of a V, for thus securing the centering of the arc in the median plane of the device.

Furthermore, each insulating plate 11 bears on each of its faces a re-enforcing layer or rib 17, the ribs on both faces of a plate being diametrically opposed each other and facing opposite directions. These ribs 17 or layers constitute at the same time a spacer and an abutment between each two adjacent plates and simultaneously, as Fig. 2 illustrates, a rest or support each for one leg, 13 or 14 respectively, of the V-shaped conductive element. By means of the ribs 17, the plates 11 can be stacked with fixed and regular spacing and the whole stack or set of plates 11 then be enclosed between two terminal plates 18. Two insulating side plates 21 allow the assembly of the whole device and the closing of the chamber. The plates 11 are thus held firmly against any displacement and so are, within each of the spaces 19 between successive plates 11, the V-shaped conductive elements, secured against downward displacement by the ribs 17 and against upward displacement by means of the edges of the notches 15 which the V-shaped conductive elements straddle. It will be realized that the space 19 between each two successive plates 11 of the set encloses simultaneously the laterally and oppositely extended legs 13 and 14, respectively, of the successive conductive elements 12 associated with these two successive insulating plates.

When on breaking a circuit an arc is ignited between the contacts 1 and 2, the blow out coil 6 will rapidly draw out or expand the arc between the fixed contact 1 and the arcing contact 5 and guide it towards the top between the walls 3 and 4 of the arc formation chamber. On coming into contact with the extensions 16 of the metal pieces 12, the arc subdivides into sections between successive metal pieces 12 and the arc sections will continue their upward movement along the branches or legs 13 and 14 of the V-shaped metal strips until the roots of the arc sections reach the terminal points of the conductive legs 13, 14, or paths, part-ways within the spaces 19. The arc sections between these terminal points or substantially stationary roots will now expand peripherally and elongate as an arc loop of a length which is a multiple of the distance between these terminal points. During this movement and development of the arc sections in the spaces 19, each arc section is turned round an angle of about 90° with regard to the initial path of the arc so that each arc section in the space 19 between adjacent plates is approximately in a plane parallel to the two insulating plates 11. As soon as the angular displacement is completed the whole of alternating arc sections and conductive elements or paths 12 forms a solenoid which enhances the tendency of each one of the arc sections to expand within the space 19. A considerable elongation of each arc section and, as a result, of the whole of the arc is rapidly achieved.

Fig. 3 illustrates at 20 the final positions of such arc sections. For a clearer illustration the insulating plates 11 on the drawing are shown to be much farther apart than actually. The whole of arc sections 20 and metal pieces or conductive elements, alternating therewith, constitutes, as illustrated, a solenoidal path, the arc portions or arc loops of whose convolutions are separated from one another by means of the plates 11.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. A device for extinguishing an electric arc to be drawn between separable contact members, said device including an arc formation chamber and contiguous therewith an arc extinguishing chamber, said arc formation chamber containing said separable contact members and means for expanding said arc into said arc extinguishing chamber, said arc extinguishing chamber including at least two parallel plates of insulating material, spaced apart from one another to leave a narrow space therebetween and disposed substantially transversely of the direction of separation of said contacts, each plate provided with a linearly extended conductive element projecting into said space between the plates laterally along the surfaces thereof from the entrance into said space and adjoining said arc formation chamber, said conductive elements terminating within said space at a point intermediate the entrance and the exit of said space, the conductive elements disposed upon the opposite faces of each plate diverging relatively to each other; thereby to

draw a section of said arc into said space, turn it round into a position substantially perpendicular to its initial path, move it along said diverging conductive elements and, when it has reached the terminating points thereof, cause it to expand peripherally within said space and between said terminating points until extinction.

2. A device for extinguishing an electric arc to be drawn between separable contact members, said device including an arc formation chamber and contiguous therewith an arc extinguishing chamber, said arc formation chamber containing said separable contact members and magnetic means disposed for causing the arc drawn between said contact members to expand into said arc extinguishing chamber; said arc extinguishing chamber including a set of parallel plates of insulating material spaced apart from one another to leave narrow spaces therebetween, said plates disposed substantially transversely of the direction of separation of said contact members; each plate provided with a linearly extended conductive element projecting into the space between adjacent ones of said plates laterally along the surfaces thereof from the entrance into each of said spaces and adjoining said arc formation chamber, said conductive elements terminating within said spaces at points intermediate the entrances and the exits thereof; the conductive elements disposed upon the opposite faces of each plate diverging relatively to each other; thereby to draw said arc in sections into said spaces, turn said sections round into positions substantially parallel to said plates, move said sections along said diverging conductive elements and, when they have reached the terminating points thereof, cause them to establish within said spaces peripherally expanding arc loops between said terminating points of the conductive elements disposed, within each space, upon the faces of opposite plates.

3. A device for extinguishing an electric arc to be drawn between separable contact members, said device including an arc formation chamber and contiguous therewith an arc extinguishing chamber, said arc formation chamber containing said separable contact members and means for expanding said arc into said arc extinguishing chamber, said arc extinguishing chamber including at least two parallel plates of insulating material, spaced apart from one another to leave a narrow space therebetween and disposed substantially transversely of the direction of separation of said contacts, each plate provided with a linearly extended conductive element projecting into said space between said plates laterally along the surfaces thereof from the entrance into said space and adjoining said arc formation chamber, said linearly extended conductive elements being of V-shape, each V-shaped element straddling with its legs its plate and with its apex disposed in proximity to said arc formation chamber, the legs of opposite V-shaped elements in each space projecting laterally in opposite directions; thereby to draw a section of said arc into said space, turn it round into a position substantially perpendicular to its initial path and cause said arc section to expand within said space.

4. A device for extinguishing an electric arc to be drawn between separable contact members, said device including at least two spaced parallel plates of insulating material disposed transversely of the direction of separation of said contact members, said plates having along their faces conductive means disposed and adapted to

draw the arc into the space between said plates and turn it round into a position substantially parallel to said plates; the conductive means disposed, within said space, upon the faces of the opposite plates diverging relatively to each other and terminating within said space at intermediate points thereof, thereby to cause the arc to form a peripherally expanding curved path in said space.

5. A device for extinguishing an electric arc to be drawn between separable contact members, said device including a set of parallel plates of insulating material spaced apart from one another to leave narrow spaces therebetween; said plates having conductive linearly extended elements along both their faces and bridging the same, said conductive elements disposed and adapted to draw the arc in sections into said spaces and turn said sections round into positions substantially parallel to said plates; said conductive, linearly extended elements terminating within each of said spaces at intermediate points thereof, opposite elements within each of said spaces diverging relatively to each other, said conductive elements alternating with arc sections thus constituting a composite solenoidal path, the convolutions of said solenoidal path individually extending into the spaces between said plates so as to cause the arc sections to expand therein peripherally in the form of arc loops until extinction.

6. A device for extinguishing an arc between at least two parallel plates of insulating material spaced apart from one another to leave a narrow space therebetween, said plates arranged substantially perpendicular to the initial path of the arc, said plates being provided with conductive elements at their surfaces inside the space for establishing a section of said arc between said conductive elements as terminals, said conductive elements being linearly and laterally extended along said plates into said space and disposed so as to terminate at a point intermediate thereof, the conductive elements within said space and disposed upon the faces of the opposite plates diverging relatively to each other; thereby to guide the displacement of the arc into said space and cause peripheral expansion of the arc therein while turning the arc round into a position substantially perpendicular to its initial path; said conductive elements being further shaped and adapted to form with the displaced, turned and peripherally expanding arc a looped path inside the space between said plates.

7. A device for extinguishing an arc between a set of parallel plates of insulating material spaced apart from one another to leave narrow spaces therebetween, said plates arranged substantially perpendicular to the initial path of the arc, said plates being provided with conductive elements inside said spaces and disposed at both faces of the plates and bridging the same; thereby to cause said arc to establish itself in sections between said conductive elements as terminals; said conductive elements being linearly and laterally extended into the spaces for guiding displacement and expansion of the arc sections into and within said spaces while turning the arc sections round into positions substantially perpendicular to the initial path of the arc; said conductive elements terminating at intermediate points of said spaces, the conductive elements upon opposite faces within each of said spaces being disposed so as to diverge relatively to each other; conductive elements alternating with the dis-

placed and turned arc sections thus constituting a composite solenoidal path, the convolutions of the solenoidal path individually extending into the spaces between said plates so as to cause the arc sections to expand therein peripherally in form of arc loops until extinction.

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