Jan. 20, 1953 R. T. BASNETT 2,626,331

ARC QUENCHING DEVICE FOR ELECTRIC CONTACTORS

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Fig.1.

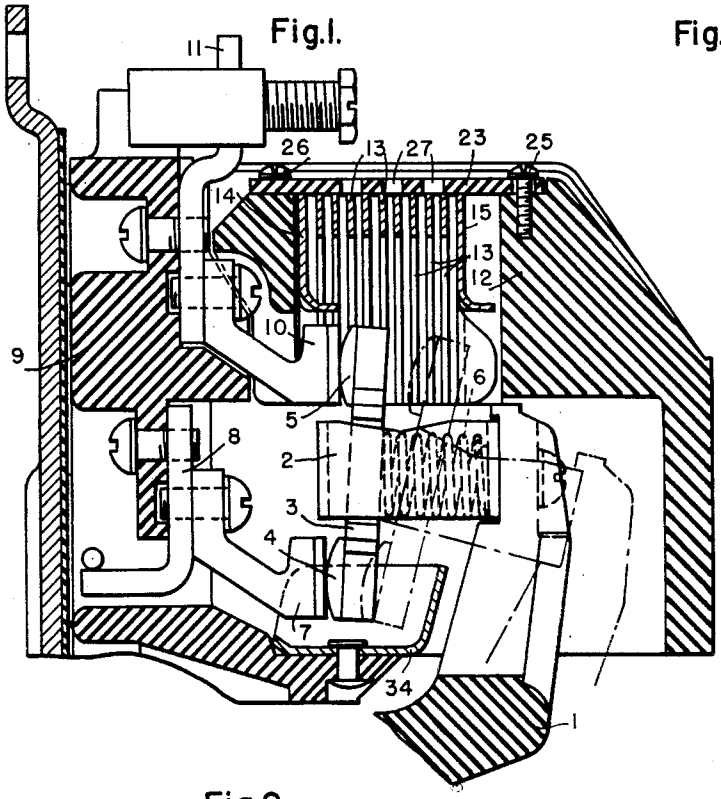


Fig.3.

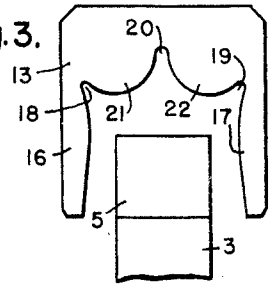


Fig.4.

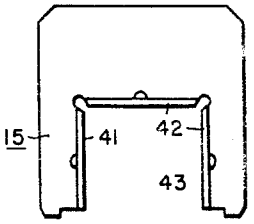


Fig.5.

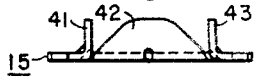


Fig.2.

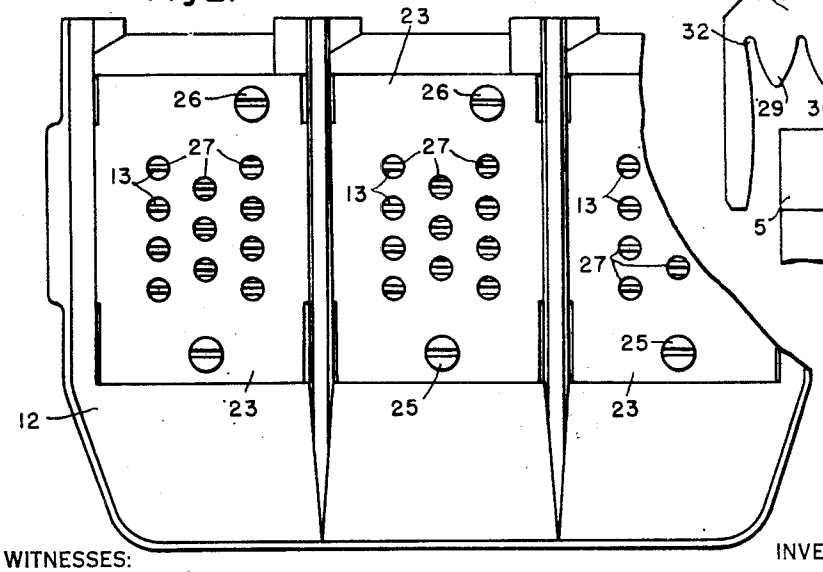
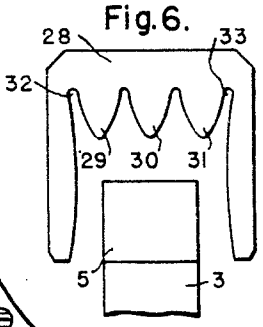


Fig.6.



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ARC QUENCHING DEVICE FOR ELECTRIC CONTACTORS

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5 Claims. (Cl. 200—144)

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My invention relates to arc extinguishing devices for alternating-current circuit breakers and the like contactors and, more particularly, to an arc deionizing structure of the grid stack type.

Structures of this type have a stack of conductive grid plates which are spaced from each other along the path of a movable contact. As originally known, each plate of the stack had a V-shaped notch in alignment with the V-notch of the other plates so that a groove is formed into which the arc is forced by the magnetic effect of the arc current. Such V-type stacks are satisfactory where the moving contact is narrow relative to the width of the grid plates or where a blow-out magnet can be applied to force the arc into the grid stack. For limited space requirements that do not permit using a blow-out magnet and in designs where the moving contact is wide relative to the grid width, however, such V-type grid stacks were found to be far short of the desired advantages. More favorable for the just-mentioned exacting conditions are grid stack designs, known from U. S. Patent 2,416,164 in which the notch is M-shaped and the grid plates of the stack straddle the path of the movable contact member so closely that arcs may strike laterally and frontally between the moving contact member and the plate. Under the mentioned conditions, these stacks of M-type grids have a superior arc-quenching performance and a longer period of useful life.

However, I found that when such M-type grid stacks eventually become defective due to highly excessive overloads, or after the stacks have been in use for long periods of time, most or all of the wear or damage occurs in most cases at the saddle portion of the M-configuration where it faces the path of movable contact. As a rule, the grid material is burnt away or pitted near this particular spot. This gave me the idea to try changing the shape of the grid plates by intentionally cutting away the material at the saddle portion thus giving the grid plate a plurality of lobes projecting toward the path of the movable contact member instead of the single saddle portion of the M-type grids. Grids of such a plural-lobe design were made and tested, and I found that a conspicuous improvement was achieved. In comparison with M-type grids under the same operating conditions, the new plural-lobe grids offer a more efficient arc quenching performance which is manifested by considerably reduced wear or a correspondingly increased span of useful life.

My invention, therefore, has for its objects to

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improve the known arc quenching grids and grid stacks toward increased efficiency, reduced wear, or increased useful life period; and I achieve these objects by providing notched grid plates whose legs straddle the path of the movable contact member and whose bottom portion has a plurality of mutually spaced lobes extending toward the path of the peripheral or front side of the contact member as will be more fully understood from the embodiments shown in the drawing and described in the following.

Figure 1 of the drawing shows a cross section of the arc extinguishing structure of a circuit breaker, the section being taken in a plane parallel to that of the contact movement;

Fig. 2 shows a top view of the insulating arc box of the same structure;

Fig. 3 shows one of the grid plates of the structure shown in Fig. 1 in relation to the movable contact;

Figs. 4 and 5 show arc plane and side views, respectively, of an end plate also appertaining to the structure of Fig. 1; and

Fig. 6 shows a modified grid plate, applicable instead of the one shown in Fig. 3.

The circuit breaker partially illustrated in Fig. 1 has a movable contact arm 1 which carries a saddle 2. A contact bridge 3 is seated in saddle 2 and has two contacts 4 and 5. A coiled compression spring 6 between arm 1 and bridge 3 biases the bridge away from the arm. Contact 4 is engageable with a stationary contact 7 which is connected with a terminal 8 and firmly mounted on the insulating base structure 9 of the circuit breaker. Another stationary contact 10 for cooperation with the movable contact 5 is provided with a terminal 11 and also firmly attached to the insulating base 9.

Fig. 1 shows the just-mentioned contact elements in the circuit closing position. The circuit between terminals 8 and 11 is interrupted when the arm 1 moves clockwise into the dotted-line position. During the opening movement, arcs will be drawn between contacts 4 and 7 and between contacts 5 and 10. It is the purpose of the arc extinguishing structure described hereinafter to quench the arc occurring between contacts 5 and 10, a separate arc quenching means being provided for extinguishing the arc between contacts 4 and 7.

An insulating box structure 12 encloses the interrupting and arcing space of the contacts and is firmly mounted on the insulating base 9 of the circuit breaker. A stack of plates 13, of magnetizable material, for instance of iron, is ar-

ranged in an opening of the insulating enclosure 12. The plates 13 extend in parallel and spaced relation to one another. Each of the grid plates is shaped in accordance with Fig. 3, with the exception of two end plates, denoted by 14 and 15, which serve to protect the adjacent surface of the insulating enclosure and are both designed as shown in Figs. 4 and 5.

Each plate 13 has a recess which may generally be described as being of drapery or curtain shape. The two legs 16 and 17 of the plate have their inner edge curved away from the path of the movable contact and extend from the center portion of the plate towards the path of contact motion and also beyond the periphery of this path, so as to offer the possibility that arcs may strike between the lateral sides (vertical in Fig. 3) of the movable contact and the adjacent inner edge of the respective legs 16 and 17. Located between the legs 16, 17 and the center portion of the plate are two respective notches 18, 19 which recede from the path of contact movement. Another similarly receding notch 20 divides the plate center portion into two lobes 21 and 22. The lobes project toward the path of the straddled movable contact so that arcs may strike between the lobes and the peripheral or front side (horizontal in Fig. 3) of the movable contact.

The plates 13, 14 and 15 are seated in respective parallel grooves of the molded enclosure 12 and are held in position by an insulating cover plate 23 which is attached to the enclosure by screws 25, 26 and has perforations 27 open to the outside to facilitate an equalization of pressure. The illustrated circuit breaker is of a three-phase design with three contact assemblies and three grid stacks. For that reason, three cover plates 23 are shown in Fig. 2. It will be understood that the invention is similarly applicable to single-pole or other breakers.

When the device is in operation, the arc drawn between the separating contacts 5 and 10 is forced by its magnetic field to blow against the grid stack and is divided into a number of series connected partial arcs, each extending in the interstices between two adjacent grid plates. As explained, the initial location of the arc between the movable contact and the adjacent plate 13 may occur at the peripheral end or front (horizontal in Fig. 3) of the contact as well as on the two lateral (vertical) sides of the contact. The magnetic field effective in the arcing space drives the foot point of any such arc away from its initial location and towards the apex of one of the adjacent notches 18, 19 or 20. Due to this displacement of the partial arcs, the resistance of the total gas path is increased and each partial arc is effectively cooled. As a result, the structure has the tendency to extinguish the partial arcs and to deionize the arc space to such an extent as to prevent a reignition when the current passes through one of the subsequent zero values. In this respect, the function of the deionizing grids is comparable with that of the known M-type grid plates; but, as mentioned, the plural-lobe grids according to the invention have greatly increased arc quenching qualities and an extended period of utility especially when the space available for the arc quenching structure is very limited.

The above-described performance requires, for best results, that extraneous magnetic material be kept away from the space around the grid stack. Therefore, the adjacent contact supports must be non-magnetic. It is also preferable to design the end plates 14, 15 with three ears as shown at 41, 42, 43 in Figs. 4 and 5. Even with grids to aid in deionizing, it is necessary to get the arc out of the space between the actual contact faces 5 and 10 and keep it away. If an ion source is present, the arc will restrike within the contact gap as soon as the voltage through the grid stack has built up to the point where extinction is imminent. By placing the three ears of plate 15 around the stationary contact in the manner of a picture frame and having a small clearance between the ears and the contact, I provide a convenient terminal for the arc that is out of the contact gap. My experience has indicated that the grid or plate immediately adjacent to the stationary contact plays a major part in the functioning of the entire grid stack.

Grid plates according to the invention may be given a somewhat modified design of the drape-shaped recess, for instance, as shown in Fig. 6. The grid plate 28, according to Fig. 6, corresponds essentially to plate 13 of Fig. 3 and may be used instead of plate 13. It differs only in having three lobes 29, 30 and 31 and two intermediate notches 32, 33, instead of the two lobes 21, 22 and the one intermediate notch 20 of plate 13.

Reverting to Fig. 1 of the drawing, it will be remembered that in the illustrated breaker a different arc quenching device is provided adjacent to contacts 4 and 7. This device consists essentially of a trough-shaped member 34 of magnetizable material, such as iron, which is fastened to the insulating body 12. Upon separation of contacts 4 and 7, an arc will be drawn between the contacts 4 and 7. The current flowing in the arc forms a current loop which has its highest curvature and hence its strongest magnetic field at the center of the loop between the contacts. Therefore, the arc will move outwardly toward the member 34. As the arc lengthens, the current will follow the path of least resistance, and an arc will strike from each of the contacts 4 and 7 to the member 34 so that the arc is divided into two separate portions which are further lengthened until their resistance increases sufficiently to extinguish the arc at one of the subsequent zero passages of the current. This particular extinguishing structure adjacent contacts 4 and 7 is not part of my invention proper. It will be understood that in the case of double-break interruptors, the extinguishing means provided near the second pair of contacts may also consist of a plate arrangement as described previously in this specification, and it will also be obvious that a similar plate arrangement can be applied to single-break interrupters so that a second extinguishing device is superfluous.

I claim as my invention:

1. With a current-interrupting device having a stationary contact and a movable contact engageable with each other, in combination, an arc quenching stack of mutually spaced and individually recessed grid plates of conductive material insulated from said contacts and straddling the path of said movable contact, each of said plates having two substantially parallel leg portions at opposite sides respectively of said path, at least two lobes projecting between the bases of said respective leg portions toward said path, said lobes defining respective intermediate notches receding from said path between said respective lobes and between each leg portion and the adjacent lobe.

2. With a current-interrupting device having a

stationary contact and a movable contact engageable with each other, in combination, an arc quenching stack of mutually spaced and individually recessed grid plates of conductive material insulated from said contacts and straddling the path of said movable contact, each of said plates having two substantially parallel leg portions with respective inner edges curving toward said path at opposite sides respectively of said path, at least two lobes with respective rounded edges projecting toward said path between the bases of said leg portions respectively, said lobes defining respective intermediate notches receding from said path between said leg portion bases and said lobes and between said respective lobes.

3. An arc quenching device for contactors, comprising a stack of aligned and mutually spaced grid plates of conductive material, each of said plates being generally U-shaped and having two substantially parallel leg portions and an intermediate base portion, a plurality of lobes projecting from said base portion toward the open side of the U-shape, said lobes defining notches receding from said side between each leg portion and the adjacent lobe and also between respective lobes.

4. A conductive grid plate for arc quenching grid stacks being generally U-shaped and having two substantially parallel leg portions and an intermediate base portion, a plurality of rounded

lobes projecting from said base portion toward the open side of the U-shape, said lobes defining rounded notches receding from said side between each leg portion and the adjacent lobe and also between respective lobes.

5. A conductive grid plate for arc quenching grid stacks being generally U-shaped and having two substantially parallel leg portions and an intermediate base portion, two lobes of rounded shape projecting from said base portion toward said path, said two lobes together with said leg portions defining three notches receding from said path, one notch between said two lobes and one notch between each lobe and the adjacent leg portion, said two lobes and three notches forming together a continuous undulated edge extending from one to the other leg portion

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,013,827	Jennings	Sept. 10, 1935
2,134,565	Leonard	Oct. 25, 1938
2,147,419	Baker	Feb. 14, 1939
2,244,061	Graves	June 3, 1941
2,416,164	Ellis et al.	Feb. 18, 1947