CIRCUIT BREAKER WITH ARC CHUTE ASSEMBLY

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Fig. 1.

Fig. 2.

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This invention relates to electric circuit breakers and more particularly to an improved compact circuit breaker. It is an object of the invention to provide an arc chute structure which may be easily assembled and placed within the circuit breaker casing. To facilitate the assembly of the arc chute structure it is desired that the various components thereof be placed in the circuit breaker casing without first being permanently secured to each other. It is still a further object of the invention to provide insulating support plates for the grids and insulating plates for defining the arc chute, so constructed in relation to each other and the casing walls that they need not be rigidly and permanently secured to each other prior to or after assembly in the casing. The improved arc structure utilizes grids which are held in place by projections in openings in insulating plates. The insulating plates, in turn, are held in proper position by portions of the casing walls. One of the insulating plates is provided with slots through which a portion of the circuit breaker mechanism extends. To make the slot of minimum size, the slot is made with an enlarged portion which is closed when the arc chute structure is in proper operating position. The foregoing and other objects of my invention, the principles of my invention, and the best modes in which I have contemplated applying such principles will more fully appear from the following description and accompanying drawings in illustration thereof.

In the drawings,

FIG. 1 is a longitudinal sectional view, partly in elevation, illustrating a circuit breaker incorporating the present invention, in the "off" position of the contacts;

FIG. 2 is a plan view of the two pole circuit breaker illustrated in FIG. 1, partly cut away, to show the arc chute;

FIG. 3 is a view taken along the line 3-3 of FIG. 1;

FIG. 4 is a sectional view similar to the left-hand portion of FIG. 1 but showing the contacts in the "on" position and also showing a spring for biasing a movable contact arm;

FIG. 5 is a plan view, taken along the line 5-5 in FIG. 4, of the movable contact arms and springs therefor;

FIG. 6 is an exploded perspective view illustrating the arc chute structure but wherein all but one of the grids have been omitted for clarity;

FIG. 7 is a sectional view showing part of the chute structure in elevation and taken along the line 7-7 of FIG. 1;

FIG. 8 is a perspective view of the electromagnet and frame assembly; and

FIG. 9 is an exploded perspective view showing the connection between the coil of the electromagnet and a terminal.

The invention is embodied in a two pole circuit breaker the poles of which are identical and only one of which is hereinafter described it being understood that the other is similarly constructed.

The outer insulating casing 10 is divided into a lower or main portion 11 and an upper or cover portion 12 retained by suitable screws passing through the lower portion 11 and not illustrated. The circuit breaker structure housed by the casing 10 includes two stationary contacts 15 secured to stationary resilient arms 14, of U-shape, as illustrated in FIG. 1. The stationary arms 14 are spaced from each other by a slot 16, as illustrated in FIG. 3, but are integral with the terminal conductor 17. A line conductor may be secured to the terminal conductor 17 and, thus, the contacts 15 are in electrical parallel with each other, but in electrical series with the line terminal conductor 17.

The stationary contacts 15 mate with two movable contacts 19 carried by two movable arms 20 which are spaced from each other. The movable arms 20 are each connected by one of two flexible conductors 22 to one end 23 of a conductor 24 forming part of an electromagnet. The conductor 24 is in turn connected at its other end 27 to a terminal 28 which is also connected to a load conductor. Thus, the movable contacts 19 are also in electrical parallel with each other and in electrical series with the conductor 24 and the terminal 28.

Each of the movable arms 20 is part of the circuit breaker mechanism, generally designated as 20, and each of the arms 20 is biased away from the stationary contacts 15 by individual springs 32 for each of the arms.

The action of the movable contacts on predetermined overload is fully set forth in Patents Nos. 2,530,522, 2,690,486 and such mechanisms therefore do not form a part of this invention but for clarity they may be briefly described as follows. The movable contact arms 20 are each biased by springs 32 away from the stationary contacts 15 to the open position of the contacts. The arms 20 are connected by a pintle 33 to a latch mechanism 34 which is in turn connected to a handle 36. When the handle 36 is rotated counter-clockwise, as viewed in FIG. 1, the latch mechanism 34 and the movable arms 20 all move downward and bring the contacts 15 into engagement with the contacts 19 against the bias of the springs 32, the contacts 15 and 19 assuming the position illustrated in FIG. 4. The arms 20 are pivoted about pintles 37 extending through side supporting plates 38.

The handles of the two poles of the circuit breaker are joined by a common bar 40 and a bolt 41 which extends through both handles and the common bar 40 and which is secured by a fastener 42 at one end.

The conductor 24 surrounds a tube 44 containing a magnetically permeable core (not illustrated) and takes the place of the coil usually associated with the electromagnet. The magnetic flux of the conductor 24 acts on the core to the upper end (FIG. 1) of the tube upon overload condition. Also, an L-shaped frame member 46 is about the conductor 24 and the tube 44 is mechanically secured to the frame 46 at the lower portion of the tube by being soldered to the frame.

Upon the occurrence of an overload, the core inside the tube 44 is attracted to the upper end of the conductor 24, as viewed in FIG. 1, and the upper end of the armature 48 is attracted to the conductor 24 to bridge the space between the frame 46 and the pole face 45, thereby closing the magnetic circuit. This attraction of the armature also moves the lower portion of the armature to trip the arm 50 forming part of a U-shaped pintle, so that the latching mechanism 34 is free to collapse under pressure from the springs 32. The collapse of the latching mechanism 34 actuates the trip springs 52 in accordance with the disclosure of Patent No. 2,690,486 so that the tripping of one pole of the circuit breaker is effective to trip the other pole of the circuit breaker.

The arc chute structure 55 is placed in an arc chamber 56 formed in the casing 10. The chamber 56 is defined by walls 57, in the lower casing 11, and walls 58 in the cover 12. The walls 58 are provided with slots 59 through which the gases generated by the arc may
escape. The walls 57 are molded integral with the lower casing 11 except for wall 61 which is a separate piece and is placed in grooves 62, after the terminal 17 has been located in position, and retained by the overlapping cover 12, FIG. 1. As illustrated by FIG. 6, the arc chute structure 55 comprises two identical vertical front plates 65 and 66, vertical side plates 67 and 68 and a top plate 69 all of fibrous insulating material, the side plates retaining magnetizable grids 70.

The front plates 65 and 66 are provided with slots 71 through which the movable arms 20 extend, portions of the slots 71 being enlarged as at 72 (off to one side of the center of the slot) to allow entry of the wider movable contacts 19 during assembly. Each of the front plates 65 and 66 has one end provided with projecting key portions 73 and 74, respectively. The key 73 of plate 65 is received in a recess 77 formed between two shoulders 78. The end 81 of the plate 66 rests upon the shoulders 78.

The depth of the key 73 is such that when the plates 65 and 66 are in position, as in FIG. 7, the enlarged portions 72 of the slots 71 on one plate 65 or 66 are covered by portions of the other plate 65 or 66, portions 72 being immediately next to the centers of slots 71 and the key 73 having a depth so that the centers of the slots of plates 65 and 66 are in juxtaposition, FIG. 7.

The edges of the plates 65 and 66 extend to the side walls 82 defining the arc chamber 56 and are in slip fit relationship therewith. Movement of the plates 65 and 66 into the circuit breaker mechanism is prevented by walls 80. Disposed against the side walls 82 are the side plates 67 and 68. The grids 70 have side projecting portions 83 which slip into grooves 84 in the side plates 67 and 68 but are not staked over. The side plates 67 and 68 are made wide enough to extend between the front plate 66 and the wall 85, as illustrated in FIG. 3, thereby preventing the front plates 65 and 66 from moving to the left as viewed in FIG. 3. The side plates also rest on the shoulders 78, preventing downward movement of the side plates 67 and 68. Upward movement of the side plates 67 and 68, as viewed in FIG. 1, is prevented by the fact that the side plates 67 and 68 extend upwardly and engage the inside of the cover 12.

The top plate 69 has a portion 88 which is oblique to the front plates 65 and 66 and designed to deflect the gases out the slot 59. The oblique portion 88 is integral with and hinged to a horizontal portion 89 which rests upon the surfaces 90 of the lower casing 11 and which restricts escape of gases through the opening 97 in the cover 12 for the handle 36. The horizontal portion 89 is provided with an opening 92 for slidably receiving the key 74. Also, the oblique portion 88 has side projection 93 slidably received in mating openings 94 in the side plates 67 and 68. Thus, the top plate 69 is retained in position.

The horizontal portion 89 is provided with a slot 95, of suitable shape, to receive a portion of the latching mechanism, as illustrated in FIG. 1. Also, the horizontal portion 89 is spaced from the peripheral surface 96 of the handle which overlies the horizontal portion 89 to prevent frictional binding therebetween.

Thus, the front plates 65 and 66 in conjunction with the oblique portion 88 provide primary protection against damage to the circuit breaker mechanism by the arc or gases formed therein. A secondary consideration is to restrict the escape of any hot metal beads or gases through the opening 97 in the cover 12, through which the handle 36 extends, to minimize fire hazards. For this purpose, a wall 98 abuts the top surface 99 of the horizontal portion 89 and, forming therein a chamber, which effectively traps the escape of metal or gases through the handle opening 97. At the same time this abutment also prevents the dispersed metal and gases from going downwardly into the circuit breaker mechanism, providing secondary protection to the circuit breaker mechanism.

However, some gases do enter the circuit breaker mechanism chamber through the slots 71. If the opening 97 were sealed completely, the pressure of the gases within the casing might rise to a dangerous level. To prevent this from happening a minimum gas escape through the opening 97 is desired and for this purpose the slot 95 is made larger than would be necessary merely to receive the latching mechanism.

Movement of the front plates 65 and 66 to the left is further restricted by uppermost grid, as illustrated in FIG. 4, which has rightmost portions which tend to prevent movement of the plates 65 and 66 to the left.

Four grids 70 are utilized and are disposed, as illustrated, to straddle the movable contacts 19 during the opening movement of the contacts. Two grids are combined and disposed in abutment with each other, as illustrated, for concentrating the magnetic flux during the initial separating of the contacts. The lowermost grid, FIGS. 1 and 4, has a face 87 which is coplanar with the plane of contact between the contacts 15 and 19. The lower groove 84 of each of the insulating plates 67 and 68 of the arc chute assembly is made large enough to accommodate two grids 70. The third grid is spaced from the combined first and second grid and, in turn, the fourth grid is spaced from the third grid.

Each of the grids 70 has a general M-shape to accommodate the two movable contacts 19, and are all identical with each other.

The L-shaped frame member 46 is keyed to the supporting plates 38 by projections 110 extending through openings in the plates 38, the projections 110 having edge portions swaged against the plate 38. The projections 110 are slidably received in vertical slots 109 in the side walls and the partition between the two poles of the circuit breaker for longitudinally positioning the mechanism.

The entire circuit breaker mechanism is supported by the plates 38 and the frame 46. The frame 46, in turn, has a foot portion 111, having a threaded hole 112. The foot portion 111 rests upon a portion 114 of the lower casing 11. A screw 116 is placed in a suitable hole in the lower casing 11 for engaging the foot portion 111 and securing the circuit breaker mechanism.

The terminal 25 is similarly provided with a threaded opening for receiving a screw 118 extending upwardly through the lower casing 11 for securing the terminal 25 and the conductor 24. To provide for expedient and economical assembly, the conductor 24 has an inner diameter substantially larger than the outer diameter of the tube so that manufacturing variations are compensated for by this difference in diameter.

Referring to FIGS. 8 and 9, the conductor 24 is secured to the terminal 28 by the key 27 extending into an opening 121 in the vertical portion 122 of the terminal 28. The flat terminal 28 is bent to the right angle shape simultaneously with or after being provided with the opening 121. After the key 27 is placed in the opening 121, the key is expanded, by suitable tools, to provide a mechanical connection between the conductor 24 and terminal 28. To increase the efficiency of the electrical connection, a chamfer of solder 128 is deposited between the conductor 24 and the vertical portion 122. The load line retaining device 124 is secured by suitable means to the horizontal portion of the terminal 28.

The foregoing construction provides a right angle connection between the key end 27 of the conductor 24 and the vertical portion 122, the connection being made in a minimum of space, aided by the parallel longitudinal axes of the approximate cylinder formed by the conductor 24 and the vertical portion 122. The large bearing surfaces provided by the key end 27 and the vertical portion 122 insure a strong mechanical connection.

The ends 131 of the flexible conductors 22 are connected to the conductor 24 by a screw 138 extending through a threaded hole in the end 23 of the conductor.
Prior to assembly, the ends 131 are dipped into molten solder. A washer 132 is placed between the head of the screw 130 and the conductor ends 131 and the washer is soldered to the screw 130 after suitable tightening of the latter. The heat at the time of soldering the washer 132 to the screw 130 simultaneously solders the washer to the conductor ends 131, due to their having been previously dipped in solder.

The terminal 28 is insulated from the conductors 22 and the end 23 of the conductor 24 by an insulator 125, as illustrated in FIG. 8. Also, the conductor 24 is insulated from the frame 46 and the tube 44 by insulators 136 and 138, and an insulating sleeve about the tube 44 is disposed between the disks 138.

After the circuit breaker mechanism 30 has been assembled the subassembly comprising the conductor 24, terminal 28 is assembled to the tube 44 and the latter soldered to the frame 46. The two front insulating plates 65 and 66 are then taken and positioned with respect to each other so that the keys 73 and 74 project from opposite ends. Further, the plates 65 and 66 are positioned relative to each other so that the enlarged slots 72 are aligned with each other and slipped over the movable contacts 19. Thereafter, the entire assembly is placed within the casing 11.

The grids 70 are placed between the two side plates 67 and 68 and slid into the chamber 56, locating the front plates 65 and 66 in proper position. Thereafter, the top plate 69 is added to the structure by placing the top plate 69 over the front plates 65 and 66 so that the key 74 enters the opening in the top plate 69. Also, the projection 93 of the top plate 69 or emmace to enter the openings 94 in the side plates 67 and 68 for properly positioning the oblique portion 38.

Having described this invention, I claim:

1. In apparatus of the character described, a casing, stationary and movable contacts enclosed by said casing, a switch mechanism enclosed by said casing and including a movable arm for actuating the movable contact, an arc extinguishing structure enclosed by said casing, said extinguishing structure comprising a plurality of magnetizable grids arranged one above the other in spaced relationship, said casing having wall structure defining a chamber for receiving said arc extinguishing structure, front plates and side plates of electrical insulating material in said chamber, each of said front plates having a slot aligned with each other and through which said movable arm extends, said front plates and side plates being separable from each other, said grids having projections slidably received by said side plates, a cover plate of electrical insulating material keyed to at least one of the aforementioned plates, said wall structure retaining said side plates and front plates in place, said movable arm having a portion which is in a plane transverse to the plane of movement of said movable arm between the contacts closed and contacts open positions larger than the portion of the movable arm which extends through the front plates, the slots in the front plates being enlarged in part, so that the enlarged movable arm portion is insertable therethrough during assembly, the enlarged slot portion of one front plate being closed thereafter by a portion of which is the wall of said plate.

2. In apparatus of the character described, a casing, a circuit breaker mechanism enclosed by said casing, a pair of contacts one of which is movable relative to the other, said mechanism including a movable arm for actuating the movable contact, said mechanism also including a handle for manual operation thereof, said casing including a handle opening through which said handle protrudes, an arc chute assembly comprising magnetizable grids, a front plate of electrical insulating material through which said movable arm extends, a top plate of electrical insulating material having a cover portion for deflecting the arc gases toward the arc gas opening, said casing having a further wall portion defining with said top plate a second chamber intermediate the arc gas opening and the handle opening to trap the metal beads and said gases not deflected out said arc gas opening by said cover portion and thereby further protect the mechanism, as well as minimizing the escape of metal beads and arc gases through the handle opening for the handle in the casing.

3. The structure recited in claim 1 wherein said front plates are identical and have projecting key portions at one end of each plate, the enlarged slot portion of the slot in each front plate being to one side of the center, in the lengthwise direction, of the slot, said casing having a wall portion for receiving and positioning the key of one of the front plates and supporting the inverted end of the other front plate, the front plates being received and supported in displaced, inverted relation to each other a distance sufficient for a portion of one front plate to cover the enlarged slot portion of the other front plate, and said top plate having an opening to receive the key of one of the front plates.

4. In apparatus of the character described, a casing, a circuit breaker mechanism enclosed by said casing, a pair of contacts one of which is movable relative to the other, said mechanism including a movable arm for actuating the movable contact, said mechanism also including a handle for manual operation thereof, said casing including a handle opening through which said handle protrudes, an arc chute assembly comprising magnetizable grids, a front plate of electrical insulating material through which said movable arm extends, a top plate of electrical insulating material having a cover portion, said casing having a wall portion which together with said front plate and cover define an arc chute chamber, said casing having an arc gas opening in communication with said arc chute chamber, said cover portion deflecting the arc gases toward the arc gas opening, said top plate having a portion extending toward said mechanism and having a slot to accommodate a part thereof but underlying said handle opening to restrict the latter, and said casing having other wall portions which with said cover portion define a second chamber to trap the metal beads and arc gases that would otherwise tend to leave through said handle opening.

5. In a circuit breaker, a mechanism, a case for said mechanism, said case being divided into a lower part and an upper part, a pair of contacts, one of said contacts being movable, said mechanism including a movable arm for actuating the movable contact, an arc chute assembly comprising magnetizable grids, end plates of insulating material slidably receiving said grids, a front plate of electrical insulating material for shielding the mechanism, said lower case part having spaced first and second walls, said end plates being in slidable fit relationship with said first walls and with said front plate but maintaining said front plate against said second walls, a top plate of electrical insulating material slidably keyed to said end plates and to said front plate, said case having an arc gas opening in communication with said arc chute chamber, said top plate having an oblique portion for deflecting said gases toward said arc gas opening, said top plate having an extension portion extending toward said mechanism and having a slot to accommodate a part thereof but said extension portion underlying said handle opening so as to restrict the latter, said upper case part having a retaining wall portion holding said extension portion against the lower case part, whereby the front plate and the extension portion jointly provide a shielding arrangement for the mechanism while the extension portion simultaneously restricts the handle opening, said top plate jointly with said retaining wall portion and another wall portion of the upper case part defining a chamber in communication with said arc chute for trapping the
metal beads that would otherwise tend to leave through said handle opening.  
6. The structure recited in claim 5 and further defined by said front plate being divided into two pieces in side-by-side relation, said movable contact is larger than the movable arm, said pieces of the front plate having an elongated slot to accommodate operating movement of the movable arm and enlarged to allow entry of the movable contact, the enlarged portion of the slot on one piece being offset relative to the enlarged portion of the slot on the other piece, whereby to insert the movable arm through the front plate pieces, the pieces are aligned so that the enlarged slots are in alignment, the arm is then extended therethrough, and thereafter the pieces are slide related to each other so that the enlarged portion of the slot in one piece is covered by a part of the other piece.

7. In apparatus of the character described, a casing, stationary and movable arms within said casing, the movable contact arm having an enlarged portion, a circuit breaker mechanism enclosed by said casing, an arc chute assembly within said casing, said arc chute assembly defining an arc chute and comprising two front plates of insulating material through which said movable contact arm extends, each of said front plates having a slot with an enlarged portion through which is insertable the enlarged portion of the movable arm, the enlarged portion of one plate being blocked by a portion of the other plate.

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