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2,403,051

CIRCUIT BREAKER CONSTRUCTION

Original Filed May 9, 1941

2 Sheets-Sheet 1

Fig. 1

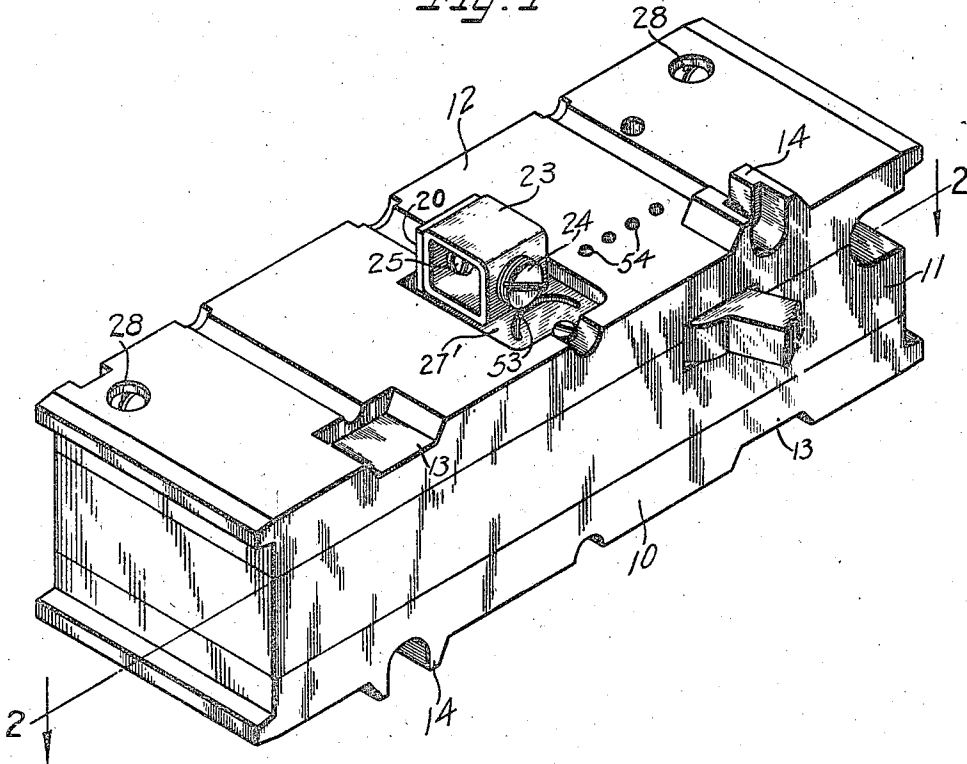
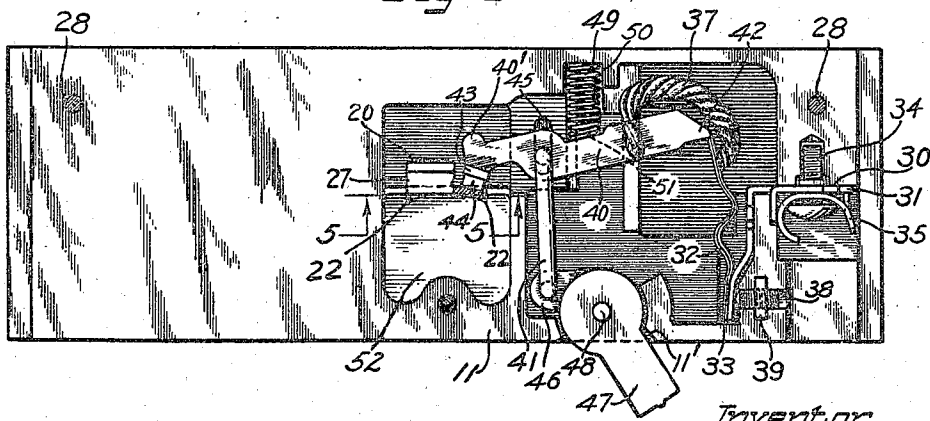


Fig. 2



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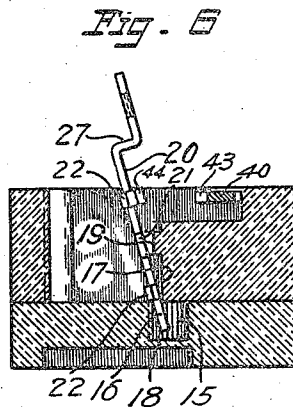
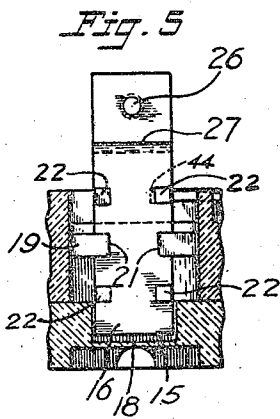
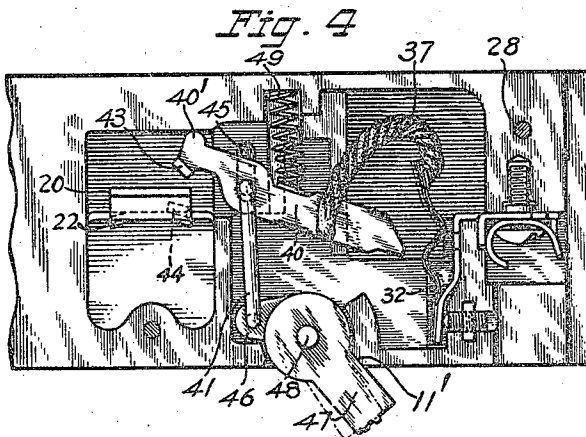
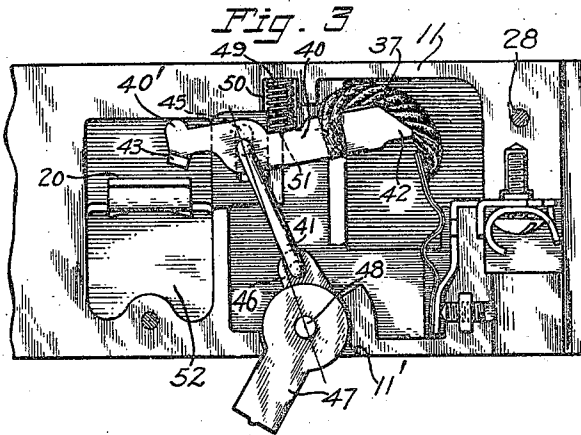
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2 Sheets-Sheet 2



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## UNITED STATES PATENT OFFICE

2,403,051

## CIRCUIT BREAKER CONSTRUCTION

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Original application May 9, 1941, Serial No. 392,618, now Patent No. 2,352,517, dated June 27, 1944. Divided and this application March 3, 1944, Serial No. 524,864

5 Claims. (Cl. 200—168)

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This invention relates to improvements in circuit breaker constructions which include switching mechanism automatically operable in response to conditions existing in circuits in which they are connected as well as being manually operable to establish the switch mechanism in "on" and "off" positions. The present application is a division of application, Serial No. 392,618, filed May 9, 1941, Patent No. 2,352,517.

Said patent issued upon application Serial No. 392,618 is directed principally to the mechanism comprising the relatively movable switching members and the mechanism which operates and controls said members to either manually establish the same in "on" and "off" positions or automatically move the switching members to "off" position in response to certain conditions existing in the circuit in which the switch mechanism is connected. In said construction, the stationary contact is mounted on a conducting bus bar stationarily positioned in the insulating casing for the circuit breaker and one end of said bus bar projects through one side wall of the casing in order that an exterior terminal might be secured thereto for purposes of connecting the circuit breaker to a line conduit.

The present divisional application relates primarily to the casing construction and the means therein by which the stationary contact carrying bus bar is connected to and supported by said casing.

It is an object of the invention to provide a sectional casing, different from that illustrated in my prior Patent No. 2,130,369, in order that the insertion of the bus bar in the casing may be facilitated.

It is another object of the invention to provide the bus bar and casing respectively with interfitting parts by which the bus bar is maintained in proper operative position within the casing, whereby the stationary contact carried by the bus bar is also properly positioned in its operative position within the casing.

Details of said objects as well as details of the construction comprising the invention and other objects of the invention are set forth in the following specification and illustrated in the drawings comprising a part thereof.

The accompanying drawings show the embodiment of the invention which is deemed preferable, but it will be understood that the drawings are intended for illustrative purposes only and are not to be construed as defining or limiting the scope of the invention, the claims forming

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a part of this specification being relied upon for that purpose.

In the drawings:

Fig. 1 is a perspective view of one form of the present invention showing the handle or manually operable member in "on" or circuit closing position;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 2 showing the switch in open position by operation of the handle;

Fig. 4 is a view showing the switch in open position as a result of automatic operation due to abnormal conditions in the circuit;

Fig. 5 is a transverse sectional view of the casing showing the bus bar in established position in the casing and taken on the line 5—5 of Fig. 2;

Fig. 6 is a view similar to Fig. 5 illustrating the manner of inserting a bus bar in accordance with the present invention.

Referring to the drawings, there is shown a sectional casing for the switch mechanism of the circuit breaker. In my prior Patent No. 2,130,369 I disclosed a sectional casing composed of two sections enclosing all of the movable parts of the switch mechanism except the manually engageable portion of the operating member or handle. In Figs. 1-6 of the present application the sectional casing is shown as composed of three parts, namely, a middle section 11, and covers 10 and 12, suitably secured together. As will be presently explained in detail, the middle section 11 supports the movable parts of the switch mechanism to which access may be had. The covers 10 and 12 are provided on their outer surfaces with grooves 13 and projections 14 to facilitate nesting or grouping of the casings where the requirements are such that more than one circuit breaker is necessary. The structure defined in the foregoing which facilitates nesting or grouping of the casings is such that two casings may be nested and, when so nested, the bus bar 20 and terminal 23, to be described in detail subsequently, project from opposite sides of the nested pair of casings. If it is desired to closely associate more than two casings, said casings are first disposed in nested pairs and then additional casings are mounted adjacent thereto as closely as the terminals of the adjacent casings will permit. As best shown in Figs. 5 and 6, the cover 10 has formed therein a well or recess 15 to receive the lower end 16 of the bus bar 20. When the cover 10 and middle section 11 are

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properly assembled in superposed relation, the wall 17 of an opening in the middle section 11 is located transversely in spaced relation to, but above, the wall 18 of the recess or well 15 so as to provide a restricted opening through which the end 16 of the bus bar is insertable upon tilting movement of the bus bar, as illustrated in Fig. 6. The width of the well or recess 15 is such as to permit this tilting movement of the bus bar during insertion thereof during assembly of the parts and the relative positions of the walls 17 and 18 is such as to permit the bus bar to be pivotally moved into the upright position illustrated in Fig. 5, in which it is properly located for cooperation with the other parts of the switch mechanism, as hereinafter will become more apparent. Complementary elements are provided on the bus bar and the wall 17 of the part 11 of the casing to interengage when the bus bar is moved from the tilted position of Fig. 6 to its upright position of Fig. 5. In this application I have illustrated such elements as being projections 19 formed on the wall 17 and notches 21 in the bus bar. However, the arrangement may be reversed and other suitable means provided so long as the bus bar is insertable in the manner described and after insertion and proper location by interengageable elements is maintained against lateral movement so that the switch will function properly.

I have shown ears or struck-up portions 22 on the bus bar which are provided for definitely locating the stationary contact 44 in the process of manufacture. When each ear 22 is struck up from one side of the bus bar, a corresponding depression is formed on the other side and a stationary contact 44 is mounted in said depression by securing the contact to ear 22 by welding, soldering, or in any other suitable manner. It will thus be seen that said depression forms a convenient means for locating and properly positioning each stationary contact 44. The lower ears 22 may serve as stops for limiting the movement of the bus bar while inserting the same into recess 15. Said lower ears 22 also serve as fulcrums for the tilting movement of the bus bar when moved from the position of Fig. 6 to that of Fig. 5 by resting on the top of the section 10 of the casing, as shown in the drawings. However, this is not essential because the end 16 of the bus bar may be of such length as to contact the bottom of the well 15 and thus providing the fulcrum for tilting movement of the bus bar to bring the interfitting elements 19 and 21 into engagement to prevent lateral movement of the bus bar during operation of the switch.

Further means for firmly maintaining the bus bar in position during operation of the breaker is shown best in Fig. 1 and comprises a terminal 23 having in one wall an enlarged screw-threaded opening to receive a clamping screw 24. A screw 25 is insertable through an opening in the opposite wall to be threaded into the opening 26 (Fig. 5) in the top offset end of the bus bar. When the parts thus far described are assembled in the position shown in Fig. 1, the lower end of the terminal 23 rests on the offset portion projecting from the shoulder 27 of the bus bar and the inner side of said terminal normally engages the inner wall of recess 27' formed in the outer wall of cover 12. When the parts are completely assembled, the upper offset end of the bus bar 20 is secured to the terminal 23 by the screw 25 and the upper offset end extends through a slot in the cover 12. The length of said slot is sub-

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stantially the same as the width of the bus bar and the width of said slot approximately equals the length of the shoulder 27 since the outer surface of said shoulder is substantially planar with the inner wall of recess 27' when said parts are assembled. Thus the bus bar is firmly held in position by the interengaging elements 19 and 21, the abutment of the lower end 16 against the wall 18 of recess 15 and the reception of the shoulder 27 in the slot in the cover as well as by the terminal 23 secured to the bus bar by screw 25.

Under the construction and arrangement of parts of the casing, sections 10, 11 and 12 are shown held together by screws 28 which may be threaded into the section 10 or into nuts or sleeves (not shown). However, the means for holding the sections in assembled relation is not necessarily an essential feature of the present invention.

The other terminal 30 may be of any suitable construction to clamp or hold the end of a wire, but in the present case I have shown a plate 31 electrically and mechanically connected at one end to the bimetallic or thermostatic strip 32, as indicated at 33, by welding or soldering or other suitable means not interfering with the conductivity. A screw 34 is threaded through one leg of the plate 31 and a clamp 35 so that the wire or cable leading into the device may be inserted between the head of the screw 34 and the clamp or clip 35 to be tightly gripped. The bimetallic strip or thermally responsive element 32 is connected to a flexible conducting wire or cable 37 at its end opposite the connection 33. The bimetallic element or strip 32 may be readily adjusted or calibrated at the time of assembly to regulate the current value in response to which strip 32 is distorted, by means of a screw 38 cooperating with a nut 39 partially embedded in the section 11, it being understood, of course, that after the calibration is accomplished and test has been made that the screw 38 is sealed against movement relative to the elongated arm of the plate 31 against which it bears adjacent the point of connection 33 between said elongated arm of the plate 31 and the bimetallic element 32.

The other end of the flexible copper cable or wire is electrically and mechanically connected with an operating contact bar or blade 40 which is pivotally mounted on one end of a slidable link 41 forming part of the toggle mechanism by which the circuit-controlling device is manually operable. Under normal current conditions the free end of the current responsive element 32 is contacted by the end 42 of the contact bar or blade 40, as shown in Fig. 2. The other end of the contact bar or blade 40 has connected therewith a contact point 43 to cooperate with the stationary contact 44 on the bus bar 20. The depending end of the link 41 on which the contact bar or blade 40 is pivotally mounted extends into a groove 45 provided therefor in the top of the middle section 11 of the casing for guided sliding movement transversely of the casing during actuation of the contact bar, as will be hereinafter pointed out in detail. The slot 45 is proportioned to the amount of movement required in accordance with the relation of the movable parts of the switch.

The other end of the link 41 is inserted in a lug 46 on the operating handle 47 pivotally mounted on a pin 48 extending through the handle and engageable in sockets in the sections 11 and 12.

A spring 49 bears at one end against a recess provided by complementary formations on the

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sections 11 and 12, as indicated by the numeral 50, with its other end surrounding a lug 51 adjacent the connection between the link 41 and the operating plate or bar 40.

In assembling the parts of the circuit breaker shown and described, the section 11 is superimposed upon the section 10 so that the bus bar 20 may be inserted as illustrated in Figs. 5 and 6 and previously described in connection therewith. The section 12 may then be applied so that the top of the bus bar extends through the slot provided therefor in the section 12 with the terminal 23 located in the recess 27' to assist in stabilizing the bus bar during operation of the circuit breaker manually and automatically, as hereinabove described. The sections may then be secured together by any suitable means, but in the present application I have illustrated screws 28 extending through these sections and serving the purpose in connection with nuts (not shown) to hold the sections in assembled relation. After the sections have been assembled the terminal 23 is connected to the top of the bus bar, preferably by a screw 25 which has threaded engagement with the top of the bus bar. The screw 24 is then inserted in the terminal 23 to clamp the conductor to which the bus bar is adapted for electrical connection to establish the circuit breaker in circuit; the other conductor being electrically connected to the terminal 30.

With the parts in the assembled relation described above, the operation is as follows, it being assumed that the switch is in "off" position shown in Fig. 3 wherein the movable contact 43 and the end 42 of the bar 40 are not contacting the stationary contact 44 nor the end of the bimetallic element 32. Thus the manually controlled "off" position of the operating handle 47 is to the left, as shown in Fig. 3. To close the circuit the handle is moved to the right or to the position of Fig. 2. This moves the link 41 to the position of Fig. 2 from the position of Fig. 3 by a toggle action.

It will be noted that when the switch is in completely "off" position under the manual control that the link 41 extends obliquely across the casing with the end which pivotally supports the bar 40 adjacent the rear of the slot 45. When the operating handle is moved from left to right the link is straightened in its position so that it is substantially at right angles to the longitudinal side walls of the casing and the end of the link on which the bar 40 is pivotally supported has been moved to adjacent the front end of the slot 45. This manual movement of the operating handle from the "off" to the "on" position establishes the handle in the full line position of Fig. 2 which corresponds to the dotted line position of Fig. 4. The full line position of the operating handle in Fig. 4 is established upon automatic actuation of the switch mechanism under the means responsive to abnormal conditions in the circuit, as will be presently pointed out. Also, as will be pointed out in detail, during the movement of the operating handle the contact bar has both sliding and pivotal movement.

The projection 40' on the end of the bar 40 which carries the movable contact 43 serves as a fulcrum for the bar as the end 42 thereof is brought into engagement with the end of the member 32, and thereafter as the link continues its straightening movement the movable contact 43 is brought into engagement with the stationary contact 44 as the end of the link on which the contact bar is pivoted slidably moves in the slot

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45. When the circuit is broken by manually moving the operating handle from the position of Fig. 2 to the position of Fig. 3 the action is reversed for then the end 42 contacting the bimetallic strip serves as a fulcrum for the initial movement of the movable contact away from the stationary contact and then the sliding and swinging movement of the link 41 moves the end 42 away from the bimetallic element reestablishing parts in the "off" position of Fig. 3.

As previously mentioned, the structure affords three possible positions which the operating handle may occupy. Two of these positions have been fully described, namely, the manually "on" and "off" positions of Figs. 2 and 3 respectively. As shown in Fig. 3 where the switch is in "off" position, the link connecting the contact bar and operating handle extends obliquely across the casing and in such position the toggle compresses the spring 49 preventing the spring from moving the contact bar on its pivot. When the linkage is straightened, as shown in Fig. 2, the spring 49 acts upon the contact bar 40 to maintain it in "on" position. These two positions are possible during manual operation of the switch under normal conditions. However, when abnormal conditions occur the link 41 moves slightly forward and is swung to the left when the end 42 of the contact bar 40 is released by the current responsive means employed to engage the end 42 of the contact bar under normal conditions. Release of the end 42 of the contact bar permits the spring to expand from the position of Fig. 2 to the position of Fig. 4 rocking the contact bar on its pivot and also exerting its force against the contact bar to move the link forwardly and swinging it slightly to the left so that the toggle then maintains the switch in open position until it is manually restored to closed position. This movement of the link under abnormal current conditions moves the operating handle from the dotted line position of Fig. 4 to the full line position where it contacts the beveled surface 11' at one side of the opening in the sections 11 and 12 through which the operating handle extends. The dotted line position of Fig. 4 may be termed the "on" indicating position because when the switch handle is contacting the beveled surface 11' there is a clear indication that the switch has been tripped.

The structure also provides a chamber 52 on the interior of the casing in front of the bus bar 20, which chamber is substantially closed by complementary surfaces or formations on the sections 10, 11 and 12. Since the action between the movable contact 43 and the stationary contact 44 occurs within the chamber 52, I provide an opening 53 for the escapement of gases created by arcing. In Fig. 1, I have shown the opening 53 as being arcuate thus obtaining substantial length for the opening across the top of the chamber 52. Some of the gases may escape into the relatively shallow chamber in which the bar 40, bimetallic element 32 and flexible conducting wire or cable 37 are housed. To permit escapement of the gases which may enter this portion of the casing, I provide a plurality of small openings 54 in the cover.

In the invention illustrated in this application I have shown but a single chamber, whereas the invention is adapted for use in casings having several switches and chambers therefor formed in the casings.

What I claim is:

1. In an electric switch mechanism, the com-

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combination of a casing having a wall provided with a recess opening into the interior of the casing, relatively movable switch contacts supported within the casing, a terminal connected to one of said switch contacts, a bus bar connected to the other switch contact and having sufficient length to project at one end beyond one side of said casing, the other end of said bus bar being adapted to extend into said recess in the wall of said casing, complementary formations respectively formed on the casing and bus bar integral with casing and bus bar, respectively, and adapted to interengage when the bus bar is moved from a tilted position within the casing to its operative position therein, and a cover for the casing having an opening therein through which said one end of the bus bar extends when operatively positioned in the casing, one wall each of said opening and recess engaging said bus bar when in its operative position and cooperating with said complementary formations to maintain the same interengaged and said bus bar in its operative position in the casing during operation of the switch mechanism.

2. In an electric switch mechanism, the combination of a casing having a wall provided with a recess opening into the interior of the casing, relatively movable switch contacts supported within the casing, a terminal connected to one of said switch contacts, a bus bar connected to the other switch contact and having sufficient length to project at one end beyond one side of said casing, the other end of said bus bar being adapted to extend into said recess in the wall of said casing, complementary formations respectively formed on the casing and bus bar integral with casing and bus bar, respectively, and adapted to interengage when the bus bar is moved from a tilted position within the casing to its operative position therein, and a cover for the casing having an opening therein through which said one end of the bus bar extends when operatively positioned in the casing, said complementary formations being between said recess and opening and one wall each of said opening and recess engaging said bus bar when in its operative position and cooperating with said complementary formations to maintain the same interengaged and said bus bar in its operative position in the casing during operation of the switch mechanism.

3. In an electric switch mechanism, the combination of a casing having a wall provided with a recess opening into the interior of the casing, relatively movable switch contacts supported within the casing, a terminal connected to one of said switch contacts, a bus bar connected to the other switch contact and having sufficient length to project at one end beyond one side of said casing, the other end of said bus bar being adapted to extend into said recess in the base of said casing, complementary formations respectively

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formed on the bus bar and a surface in said casing in integral relation to said surface and adapted to interengage when the bus bar is moved from a tilted position within the casing to its operative position therein, and a cover for the casing having an opening therein through which said one end of the bus bar extends when in its operative position within the casing, one wall of said opening and one wall of said recess respectively engaging spaced portions of one side of said bus bar and said surface in said casing engaging the other side of said bus bar intermediately of said spaced portions to secure said complementary formations in interengagement and maintain said bus bar in its operative position in said casing during operation of said switch mechanism.

4. A circuit breaker of the character described comprising a casing composed of two side parts and an intermediate part, an opening in each of the side parts, an opening in the intermediate part, said openings in the side parts each having a wall substantially coinciding in superposed relationship when the parts are operatively assembled and the opening of the intermediate part partially overlying said other openings and having a wall offset from said superposed walls, switch mechanism mounted on said middle part and including a bus bar disposed in and extending between said openings and engaged on opposite sides in longitudinally spaced positions by said superposed walls and said offset wall of the intermediate part to hold the bus bar in operative position in a direction transverse to the length of the bar, and locking means on one of said walls in integral relation therewith and engaging said bus bar to maintain the bus bar against movement longitudinally thereof with respect to said casing parts.

5. A circuit breaker of the character described comprising a casing composed of two side parts and an intermediate part, an opening in each of the side parts, an opening in the intermediate part, said openings in the side parts each having a wall substantially coinciding in superposed relationship when the parts are operatively assembled and the opening of the intermediate part partially overlying said other openings and having a wall offset from said superposed walls, switch mechanism mounted on said intermediate part and including a bus bar disposed in and extending between said openings and engaged on opposite sides in longitudinally spaced positions by said superposed walls and said offset wall of the intermediate part to hold the bus bar in operative position in a direction transverse to the length of the bar, and locking means comprising complementary formations respectively integral with one of said walls and said bus bar adapted to maintain the bus bar against movement longitudinally thereof with respect to said parts.

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