Oct. 5, 1965 R. E. FRINK 3,210,506

CIRCUIT BREAKER WITH IMPROVED CONTACT STRUCTURE

Original Filed Dec. 13, 1957 3 Sheets-Sheet 1

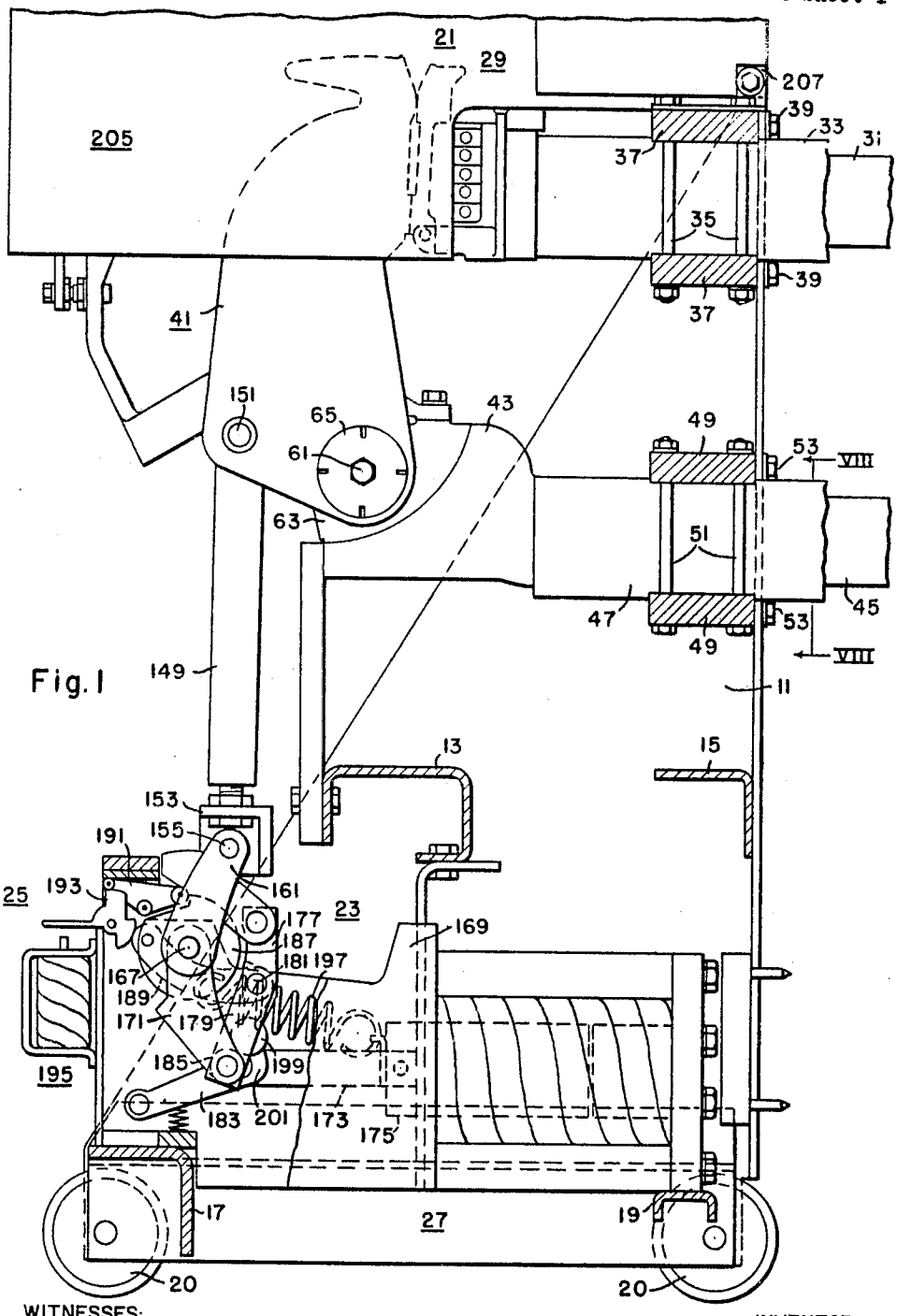

Fig. 1

WITNESSES:

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CIRCUIT BREAKER WITH IMPROVED CONTACT STRUCTURE

Original Filed Dec. 13, 1957 3 Sheets-Sheet 2

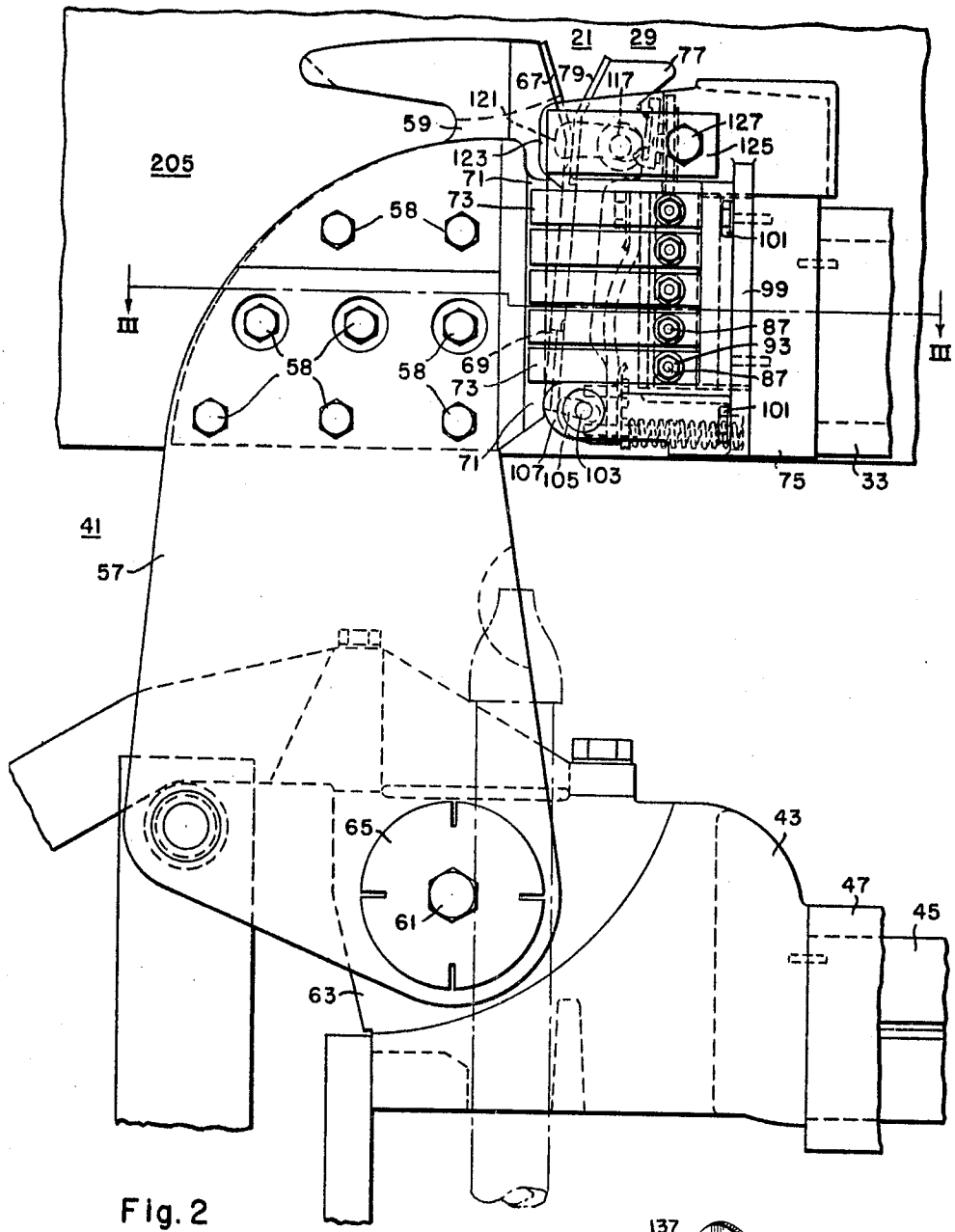

Fig. 2

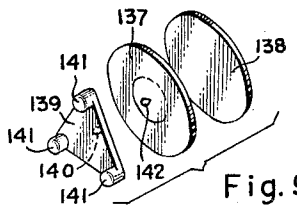

Fig. 9

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CIRCUIT BREAKER WITH IMPROVED CONTACT STRUCTURE

Original Filed Dec. 13, 1957 3 Sheets-Sheet 3

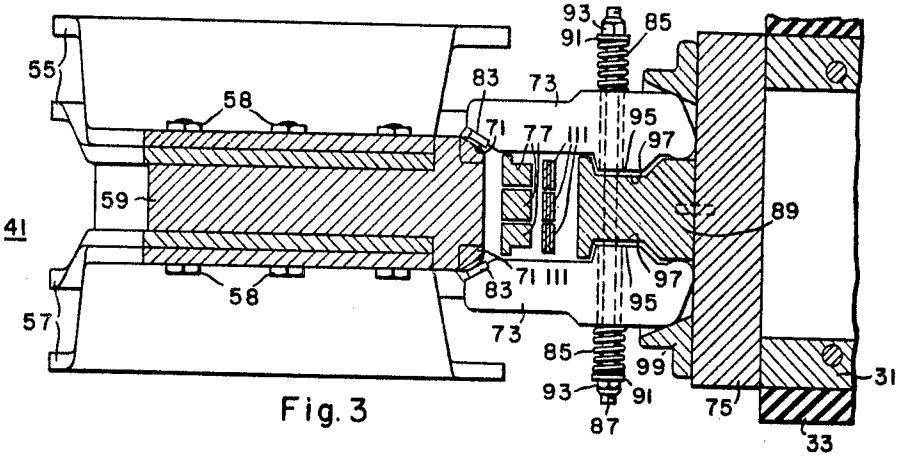

Fig. 3

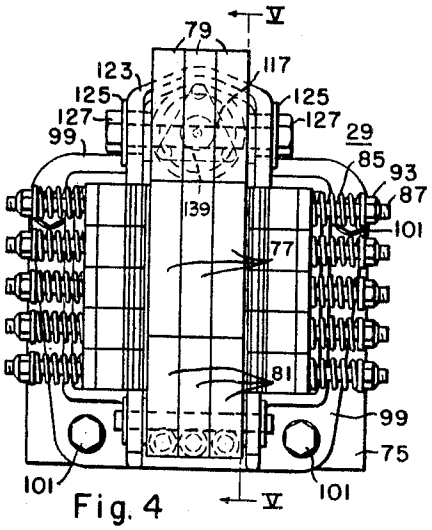

Fig. 4

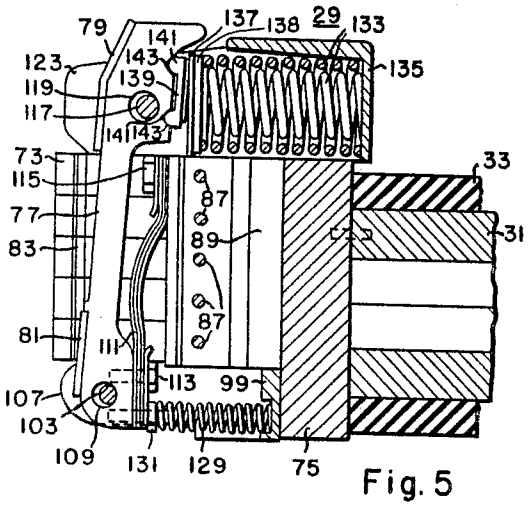

Fig. 5

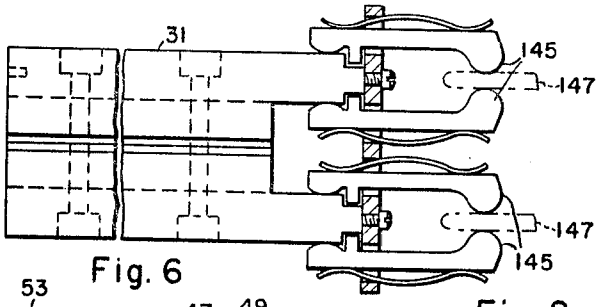

Fig. 6

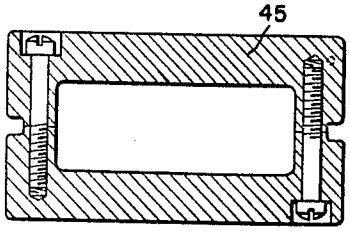

Fig. 7

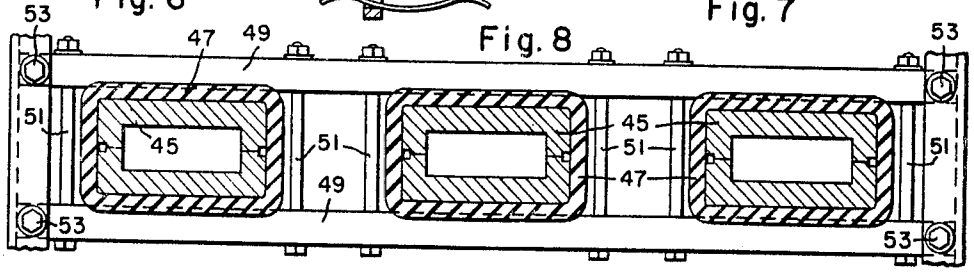

Fig. 8

United States Patent Office

3,210,506
Patented Oct. 5, 1965

3,210,506

CIRCUIT BREAKER WITH IMPROVED CONTACT STRUCTURE

Russell E. Frink, Forest Hills, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Original application Dec. 13, 1957, Ser. No. 702,576, now Patent No. 2,993,105, dated July 18, 1961. Divided and this application Sept. 20, 1960, Ser. No. 57,320
11 Claims. (Cl. 200—146)

This invention relates to contact structure and more particularly to contact structures for circuit breakers.

This is a division of the application of Russell E. Frink titled, "Circuit Breaker," Serial No. 702,576, filed December 13, 1957, now Patent No. 2,993,105.

An object of the invention is to provide a circuit breaker embodying an improved contact structure that is compact and has high momentary and continuous current-carrying capacity.

Another object of the invention is to provide a circuit breaker embodying an improved contact structure having high interrupting and current-carrying capacities.

Another object of the invention is to provide a circuit breaker embodying an improved contact structure having main, secondary and arcing contacts for heavy duty and which are so compact that all of the separating contacts may be located within an arc chute to prevent the arc from restriking outside of the arc chute where it will not be extinguished.

The invention has been illustrated by showing a contact structure and mounting arrangement therefor, designed for a magnetic air circuit breaker having a momentary current rating of 100,000 amperes, a continuous current-carrying rating of 3,000 amperes, and an interrupting rating of 50,000 amperes, but the invention may be used with advantage in circuit breakers of other ratings. In such heavy duty circuit breakers, it has been found that: (1) There should be main, secondary and arcing contacts in order to keep the main contacts in good condition to conduct the heavy currents, (2) The physical size of the contact assembly in the direction along the length of the moving contact arm should be as small as possible compared to the length of the moving contact arm to provide a maximum rate of contact separation, and to keep the separating main contacts from being significantly closer together at any point during their separation than are the separating arcing contacts, so that there will be little chance that the arc will restrike across the gap between the main contacts rather than to remain on the arcing contacts, and (3) The contact assembly should be so small that the main, secondary and arcing contacts may all be positioned up within the arc chute of the circuit breaker, so that if the arc should restrike between any of the contacts, due to the switching of capacitor banks or to abnormal circuit conditions, the restrikes will be confined to the arc chute where the arc will be extinguished by the arc-extinguishing structure provided. Accordingly, other objects of the invention are to provide for these features.

Another object of the invention is to mount the contact structure on insulated terminal studs having a compact and efficient arrangement for conducting the heavy current to the contacts.

Other objects and advantages of the invention will

be pointed out in the following description and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In said drawings:

FIG. 1 is a side elevational view, partly in section of a circuit breaker embodying the principles of the invention;

FIG. 2 is an enlarged elevational view, partly in section, showing the improved contact structure in the closed-contact position;

FIG. 3 is a horizontal sectional view taken through the contact structure on line III—III of FIG. 2;

FIG. 4 is a front elevational view of the stationary contact structure;

FIG. 5 is an elevational sectional view through the the stationary contact structure taken on lines V—V of FIG. 4;

FIG. 6 is a side elevational view showing one of the terminal studs having contact fingers thereon for plugging the breaker into a cubicle;

FIG. 7 is a vertical sectional view taken through one of the terminal studs;

FIG. 8 is an elevational sectional view taken on line VIII—VIII of FIG. 1 and showing the terminal studs and the mounting means therefor; and

FIG. 9 is a perspective view illustrating parts of the pressure equalizing means of this invention.

The invention is illustrated as applied to a circuit breaker of the general type disclosed in Patent No. 2,717,292, issued September 6, 1955 to Russel E. Frink and Paul Olson and assigned to the assignee of the present invention.

The circuit breaker comprises generally a set of is of the roll-out type and is mounted on a wheeled truck to facilitate movement of the breaker into and out of a cubicle in order to connect and disconnect the breaker in an electrical circuit.

Referring to FIG. 1 of the drawings, the circuit breaker is of the three pole type (only one pole being shown) and is mounted in a rigid frame comprising spaced triangular side plates **11** (only one being shown) rigidly secured together by cross members **13**, **15**, **17** and **19** to form a rigid frame. The frame, together with the circuit breaker, is mounted on wheels **20** to facilitate rolling the breaker into and out of a cubicle.

The circuit breaker comprises generally a set of separable contact means **21** for each pole, a common operating mechanism **23**, a trip device **25** and closing means **27**.

The contact structure comprises generally a stationary contact assembly **29** rigidly mounted on the inner end of an upper terminal stud **31** of hollow rectangular shape.

The terminal stud **31** is encased in insulating material **33** and is rigidly clamped by means of bolts **35** between supporting aluminum cross bars **37** which extend across the three poles of the breaker and are secured by means of bolts **39** to the spaced side plates **11** of the frame. The contact structure also includes a movable switch arm **41** pivotally supported on a casting **43** rigidly secured to the inner end of a lower terminal stud **45** which also is of hollow rectangular shape. The lower terminal stud **45** (FIGS. 7 and 8) is surrounded by insulating material **47** and is rigidly clamped between supporting

cross bars 49 by means of bolts 51, the cross bars 49 extending across all these poles and are secured to the side plates 11 by bolts 53 (FIG. 8).

The terminal studs 31 and 45 are made hollow to provide greater conductivity by reduction of the skin effect. A substantial reduction in the overall height of the breaker is effected by making the terminal studs rectangular rather than round, and supporting them between the cross bars 37 and 49 eliminates metal flanges on the bushings.

The movable switch arm consists of two pairs of arms 55 and 57 (FIG. 3) bolted together at their upper ends by means of bolts 58 (FIG. 2) with a movable contact member 59 between them. The lower ends of the pairs of switch arms 55 and 57 are spaced apart as shown in FIG. 3 and each pair is pivotally supported by means of pins 61 (only one being shown) supported in projection 63 (FIGS. 1 and 2) on the casting 43. Spring washers 65 disposed on the outer sides of each pair of switch arms 55 and 57 provide good contact pressure between the switch arms and the projections 63. The movable switch member 59 has an arcing contact 67 (FIG. 2) rigidly secured to the upper end thereof and a secondary contact 69 rigidly secured thereto adjacent the lower end thereof. Arc resisting main movable contact strips 71 are rigidly secured to the opposite edges of the contact member 59 for engagement with main stationary contact fingers 73.

The stationary contact assembly 29 is mounted on a conducting block 75 rigidly secured to the inner end of the upper terminal stud 31 and comprises a plurality of stationary contact fingers 73 and a plurality of stationary contact fingers 77 which at their upper ends have stationary arcing contacts 79 rigidly mounted thereon for cooperating with the movable arcing contact 67. Stationary secondary contacts 81 are mounted on the lower ends of the fingers 77. Each of the main stationary contact fingers 73 has an arc resisting contact 83 rigidly secured thereto for cooperating with the movable main contact strips 71. The main stationary contact fingers 73 are biased inwardly to provide pressure by springs 85 surrounding rods 87 which extend horizontally through openings in the contact fingers 73 and through an opening in a contact support member 89 rigidly secured to the block 75. The springs 85 are compressed between the contact fingers 73 and washers 91 which are retained in place by nuts 93 threaded onto the outer ends of the rods 87. The springs 85 press rounded inner ends of the main contact fingers against the contact support member 89 to provide good electrical contact. Each of the contact fingers 73 is provided with an inwardly projecting portion 95 which extends into recesses 97 in the contact support members 89 to prevent longitudinal movement of the fingers. As is shown in FIGURE 3, the beveled contact surface of the contacts 71, 83 engage along two planes that converge in the direction toward the support member 89. Thus, the contacts 71, 83 cooperate to form a wedging contact structure with the contacts 71 wedging the contacts 83 apart in the closed position of the contact structure. Each pair of contact fingers 73 comprises two elongated contact members supported in cantilever support on the support member 89 to provide generally parallel conducting paths between the contacts 71, 83 and the support member 89. The magnetic forces generated by current in the generally parallel conducting paths attract the members 73 together to off-set below-off forces at the contacts 71, 83.

The main contact fingers 73 are positioned in two vertical opposed rows, with half of the fingers in each row. The length of the rows runs, in the same general direction as the length of the moving switch arm and in the same direction as the height, rather than the width of the arc chute. This keeps the width of the stationary contact assembly to a minimum and makes it possible to position the main contacts within the arc chute, in spite of the large number of main contact members required for the heavy currents. In the specific embodiment shown for the purposes of illustration, there are ten main contact members 73, and if these ten main contacts had been put in a single horizontal row, generally perpendicular to the length of the moving switch arm, the width of the assembly would be too great to be positioned in the portion of the arc chute which is lined with arc-resisting material and which is effective to act upon the arc to extinguish it.

The contact fingers 77 are pivotally and slidably supported at their lower ends by a rod 103 having its ends supported in slots 105 (FIG. 2) in forwardly extending projections 107 of a cage 99. The contact fingers 77 are provided with openings 109 which are larger than the diameter of the rod 103 to provide for individual movement of the contact fingers. Flexible conductors 111 secured by means of bolts 113 to the contact fingers 77 and by bolts 115 to the contact support member 89 electrically connect the fingers 77 through the member 89 and the block 75 to the terminal stud 31.

The upper ends of the contact fingers 77 are controlled in their movement by a rod 117 (FIGS. 2, 4 and 5) extending through openings 119 in the fingers. The openings 119 are somewhat larger than the diameter of the rod 117 to provide for individual movement of the fingers 77. The ends of the rod 117 engage in enlarged slots 121 (FIG. 2) in projections 123 of the retaining cage 99 and the rod 117 is retained in position by small retaining plates 125 secured to opposite sides of the projection 123 by means of bolts 127 and engaging the ends of the rod 117.

The lower ends of the contact fingers 77 are individually biased for secondary contact pressure by means of springs 129 compressed between spring seats in the retaining cage 99 and spring guide 131 on the contact fingers. The upper ends of the contact fingers 77 are biased by a pair of springs 133 (FIG. 5) compressed between a spring seat on a portion 135 of the retaining cage 99 and a movable spring seat 137. An insulating member 138 is disposed between the springs 133 and the spring seat 137. A pressure equalizing member 139 (FIGS. 4, 5 and 9) in the shape of an equilateral triangle is provided with a projection 141 on each of its apices which engage in notches 143 in the contact fingers 77. The equalizer 139 is also provided with a socket 140 (FIG. 9) at its geometric center which is engaged by a projection on ball portion 142 on the movable spring seat 137. The upper projection 141 on the pressure equalizer 139 engages a notch 143 (FIG. 5) in the center one of the contact fingers 77 and the lower projections engage the notches 143 for the outer fingers 77 thus equalizing the pressure of the springs 133 on all three of the fingers 77. Each of the members 137 and 139 comprises a body of rigid material such as bronze. The ball-and-socket or universal type connection 140, 142 permits a wobbling or universal type motion of the pressure equalizer 139 relative to the spring seat 137 to thereby provide that the pressure or force of the springs 133 acting on each of the three contact fingers 77 will be generally equal to the pressure or force of the springs 133 acting on each of the other two of the three contact fingers 77.

The use of the spring-biased main, secondary and arcing contacts, as at 73, 81 and 79, all on the stationary contact assembly, has the advantage that the moving contact assembly is greatly simplified in that one rigid structure includes the moving main, secondary and arcing contacts, which may all be brazed to a common contact member. Thus, the main contact surfaces 71, the secondary contact surfaces 69 and arcing contact surfaces 67 are rigid with each other and with the moving switch arm 57, and there is no need on the moving contact assembly for any biasing springs, any sliding contact surfaces, or any flexible current conductors.

Each of the terminal studs 31 and 45 are provided with a plurality of pairs of spring biased contact fingers 145 as shown in FIG. 6, for engaging fixed contacts 147 hav-

ing flat side surfaces to connect the breaker in an electrical circuit.

The use of the rectangular terminal studs **31** and **45** has the advantage that each of the two opposed parallel sides of the rectangle may directly support a plurality of pairs of the opposed contact fingers **145** in a straight row without the use of any intermediate member in the current path. This is true of both of the terminal studs **31** and **45**. This keeps the number of joints in the current path to a minimum and facilitates the carrying of heavy currents. The outer contact finger **145** of each pair in the row directly engages at its inner end with the outer surface of one side of the hollow rectangle and the inner finger of each pair in each row similarly engages the inner surface of one side of the hollow rectangle.

The movable switch arm **41** (FIG. 1) for operating the movable contacts (there being a switch arm **41** for each pole of the breaker) is operatively connected by means of an insulating operating rod **149** to the operating mechanism **23**. The upper ends of the operating rods **149** are pivotally connected by means of pivot pins **151** to the corresponding switch arms **41**, and the lower ends of the operating rods are connected by suitable means to an angular crossbar **153** which is common to all of the poles of the breaker.

The specific structure of the operating mechanism, trip mechanism and the closing means shown are fully disclosed in Patent No. 2,515,994, issued July 18, 1950, to Joseph D. Findley, Alvin W. Ogg and Fritz E. Florschutz and assigned to the assignee of the present invention, for which reason only a brief description of these mechanisms is given herein.

The crossbar **153** is pivotally connected at its ends by pivot pins **155** (only one being shown) to an operating lever **161** which is pivotally mounted on a shaft **167** supported in the side members of a generally U-shaped frame **169**. The frame **169** is supported on the cross members **13**, **17** and **19** and is shown partly broken away more clearly to show the operating mechanism.

In addition to the operating lever **161**, the operating mechanism consists of a closing lever **171** also pivotally mounted on the shaft **167** and connected by means of a link **173** to the moving armature **175** of the closing solenoid **27**. The operating lever **161** and the closing lever **171** are connected by means of an underset thrust-transmitting toggle comprising toggle links **177** and **179** which are pivotally connected together by a knee pivot pin **181**. The toggle link **177** is pivotally connected to the operating lever **161** and the toggle link **174** is pivotally connected to the closing lever **177**.

The closing lever **171** is held in the closed position by a spring biased latch **183** which normally engages a roller **185** on the closing lever **171** and holds the latter in the position shown.

The toggle **177** and **179** is releasably held in a slightly underset position by a latch member **187** mounted on the shaft **167** for rotary movement relative thereto. A link **189** connects the latch member **187** to the knee of the toggle **177–179** and the latch member is normally releasably held in latching position by the latching and tripping mechanisms **25** thus holding the toggle **177–179** in thrust-transmitting position. The latch member **187** is held in latching position by an intermediate slip-off latch **191** which, in turn, is held in latching position by a trigger latch **193**. A tripping electromagnet **195** is provided to operate the latch mechanism and effect release of the operating mechanism and opening of the breaker.

When an overload current occurs, the tripping electromagnet **195** is energized and operates the latch mechanism to effect release of the latch member **187**. Upon release of the latch member **187**, the toggle **177–179** collapses permitting clockwise rotation of the operating lever **161** and opening movement of the switch arms **41** for the several poles of the breaker.

During the opening operation, the toggle **177–179** automatically is reset to thrust-transmitting position and the latch member **187** is reset and relatched. This is effected by spring means **197** which is connected under tension between the armature **175** of the closing solenoid **27** and the closing lever **171** at a point near the shaft **167**. When the toggle **177–179** collapses during an opening operation, a roller **199** on the toggle link **179** engages a nose **201** on the latch **183** and moves the latch to disengage it from the roller **185**. This releases the closing lever **171** whereupon the spring **197** moves the armature **175** and, through the link **173** connecting the armature to the closing lever **171**, moves the latter clockwise. This movement extends the toggle **177–179** to its thrust transmitting position and, through the link **189**, rotates the latch member **187** clockwise to its latching position, permitting resetting of the latch mechanism. Thereafter, the circuit breaker is closed by energization of the closing solenoid **27** from any suitable source. When energized, the solenoid attracts its armature **175** and, through the link **173**, rotates the closing lever **171** counterclockwise. Since, at this time, the toggle **177–179** is held in thrust transmitting position, the movement of the closing lever is transmitted therethrough and actuates the operating lever **161** and the rods **149** to close the contact means for the several poles of the breaker. As the mechanism reaches the closed position, the latch **183** re-engages the roller **185** and restrains the breaker mechanism in the closed contact position.

The separating contacts are all disposed well within an arc-extinguishing structure indicated generally at **205** (FIGS. 1 and 2) so that when the contacts separate and the moving contact means moves to the full open position, the arc drawn between the separating arcing contacts is drawn into the arc-extinguishing structure where it is quickly extinguished. The arc extinguisher **205** may be of the general type shown in Dickinson and Frink Patent No. 2,442,199, issued May 25, 1948 or in Frink Patent No. 2,769,065, issued October 30, 1956. As seen in FIG. 1, the arc-extinguisher **205** is pivotally mounted by means of spaced brackets **207** (only one being shown) secured to the upper crossbar **37** by the bolts **35** which clamp the upper terminal stud in position.

The invention provides an improved contact structure which increases the momentary and continuous current-carrying capacity in a small, compact contact arrangement which permits placing the entire separating contact structure inside the arc chute, hence, any restriking of the arc will occur between the contact structure and will be confined within the arc-extinguisher.

While the invention has been disclosed in accordance with the provisions of patent statutes, it is to be understood that various changes in the structural details and arrangement of parts may be made without departing from the spirit of the invention.

I claim as my invention:

1. A circuit breaker comprising a first contact structure and a second contact structure, means for effecting relative movement between said contact structures to operate said contact structures between open and closed positions, said first contact structure comprising a conducting support structure, two main contact members mounted on said conducting support structure in a spaced relationship, oppositely disposed main contact surfaces one on each of said two main contact members, intermediate contact means supported on said support structure between said main contact members, said intermediate contact means comprising a secondary contact and an arcing contact, secondary contact means on said second contact structure cooperating with said secondary contacts, arcing contact means on said second contact structure cooperating with said arcing contact, spaced main contact means on said second contact structure cooperating with said oppositely disposed main contact surfaces, said spaced main contact means and said oppositely disposed main contact surfaces comprising a cooperating wedging contact structure with

the engaging surfaces between said spaced main contact means and said oppositely disposed main contact surfaces engaging generally along two planes that converge in the direction toward said conducting support structure.

2. A circuit breaker comprising a first contact structure and a second contact structure, means for effecting relative movement between said contact structures to operate said contact structures between open and closed positions, said first contact structure comprising a first support means, two spaced rows of main contact members mounted on said first support means for resilient movement, a first main contact surface on each of said main contact members, an intermediate contact structure resiliently supported on said first support means, said intermediate contact structure comprising a secondary contact and an arcing contact, said secondary and arcing contacts being disposed in a line extending between said rows of main contact members which line extends generally in the direction of each of said rows, said second contact structure comprising spaced second main contact surfaces, a secondary contact surface and an arcing contact surface, in the closed position of said contact structures said secondary contact surface engaging said secondary contact, said arcing contact surface engaging said arcing contact, and said second main contact surfaces engaging said first main contact surfaces with said second main contact surfaces being disposed between the first main contact surfaces of said spaced rows of main contact members to bias the first main contact surfaces apart.

3. A circuit breaker comprising a first contact structure and a second contact structure, means for effecting relative movement between said contact structures to operate said contact structures betweeen open and closed positions, said first contact structure comprising a support structure comprising a conducting support member, a plurality of pairs of main contact members mounted on said conducting support member for resilient movement, each of said pairs comprising two spaced main contact members mounted on said conducting support member in cantilever support and extending out beyond said support member in a generally parallel relationship in the direction toward said second contact structure, each of said main contact members having a main contact surface thereon disposed in a position beyond said support member, each of said pairs of main contact members comprising generally parallel conducting paths between the main contact surfaces thereof and said conducting support member, intermediate contact means supported on said support structure between the spaced main contact members of said pairs of main contact members, said intermediate contact means comprising a secondary contact and an arcing contact, secondary contact means on said second contact structure cooperating with said secondary contact, arcing contact means on said second contact structure cooperating with said arcing contact, main contact means on said second contact structure cooperating with said main contact surfaces, in the closed position of said contacts said main contact means engaging said spaced main contact surfaces and being disposed between said spaced main contact surfaces of said spaced pairs of main contact members to bias said spaced main contact surfaces apart.

4. A circuit breaker comprising a first contact structure and a second contact structure, means for effecting relative movement between said contact structures to operate said contact structures between open and closed positions, said first contact structure comprising a support structure comprising a conducting support member, two main contact members resiliently mounted on said conducting support member in a spaced relationship, each of said main contact members being mounted on said conducting support member in cantilever support, each of said main contact members extending beyond said support member toward said second contact structure and having a beveled main contact surface in proximity to the outer end thereof, intermediate contact means supported on said support structure between said main contact members, said intermediate contact means comprising a secondary contact and an arcing contact, secondary contact means on said second contact structure cooperating with said secondary contact, arcing contact means on said second contact structure cooperating with said arcing contact, beveled main contact means on opposite sides of said second contact structure cooperating with said beveled main contact surfaces, said beveled main contact means and said beveled main contact surfaces comprising a cooperating wedging contact structure whereby in the closed position of said contacts said beveled main contact means engage said beveled main contact surfaces with a wedging action wedging said beveled main contact surfaces apart.

5. A circuit breaker comprising a first contact structure and a second contact structure, means for effecting relative movement between said contact structures to operate said contact structures between open and closed positions, said first contact structure comprising a support structure comprising a first conducting support member, a first row of main contact members resiliently supported on one side of said first support member, a second row of main contact members resiliently supported on the side of said first support member that is opposite said one side, intermediate contact means supported on said support structure between said first and second rows of main contact members, said intermediate contact means comprising a secondary contact resiliently supported on said first support member and an arcing contact resiliently supported on said first support member, said second contact structure comprising a second conducting support member, secondary contact means rigidly supported on said second support member for cooperating with said secondary contact, arcing contact means rigidly supported on said second support member for cooperating with said arcing contact, first main contact means rigidly supported on one side of said second support member for cooperating with said first row of main contact members, and second main contact means rigidly supported on the other side of said second support member for cooperating with said second row of main contact members, in the closed position of said first and second contact structures the points of engagement between said first row of main contact members and said first main contact means being disposed generally in a first plane that is slanted relative to the direction of relative movement between said contact structures and the points of engagement between said second row of main contact members and said second main contact means being disposed generally in a second plane that is slanted relative to the direction of relative movement between said contact structures, said first and second planes converging in the direction toward said support structure whereby in the closed position of said first and second contact structures said first and second contact means engages said first and second rows of main contact members with a wedging action.

6. A circuit breaker comprising a stationary contact structure and a movable contact structure movable into and out of engagement with said stationary contact structure, said stationary contact structure comprising support means, a plurality of pairs of elongated main contact fingers resiliently mounted on said support means, said elongated main contact fingers comprising two vertical rows of horizontally disposed contact fingers, said two rows being spaced whereby each of said pairs comprises one contact finger from each of said rows, each of said main contact fingers having a main contact surface thereon, a plurality of intermediate contact structures supported on said support means between said rows of contact fingers in a side-by-side relationship, each of said intermediate contact structures comprising a secondary contact and an arcing contact, said movable contact structure comprising secondary contact means for cooperating

with said secondary contacts, arcing contact means for cooperating with said arcing contacts, main contact means for cooperating with said main contact surfaces, and in the closed position of said contact structures the points of engagement between said main contact means and said main contact surfaces being disposed generally in opposite planes that converge in the direction generally toward said stationary contact structure.

7. In a circuit breaker, a stationary contact structure comprising fixed support means, a plurality of pairs of elongated main contact members disposed horizontally on opposite sides of said fixed support means and biased inwardly toward said fixed support means, a contact surface at each end of each of said main contact members with the contact surfaces at one end engaging said fixed support means and the contact surfaces at the other end being beveled, a plurality of unitary elongated intermediate contact members mounted on said fixed support means and disposed vertically between said main contact members and biased away from said fixed support means, each of said intermediate contact members having a secondary contact and an arcing contact thereon, movable contact means cooperating with said stationary contact structure, beveled contact surfaces on opposite sides of said movable contact means cooperating with said beveled contact surfaces on said main contact members, secondary contact means on said movable contact means cooperating with said secondary contacts, and arcing contact means on said movable contact means cooperating with said arcing contacts.

8. A circuit breaker comprising a first contact structure and a second contact structure cooperable with said first contact structure to open and close an electric circuit, said first contact strucure comprising support means comprising a first support member of conducting material, a plurality of pairs of main contact members disposed on said first support member such that the two main contact members of each pair are disposed on opposite sides of said first support member, means supporting said main contact members on said first support member and comprising a rod for each of said pairs of main contact members which rod passes through an opening in each of the main contact members of the associated pair and through an opening in said first support member, two springs for each of said rods and disposed one each on each of the two opposite ends of said rods, said springs biasing said main contact members inwardly toward said first support member, each of said main contact members extending out past said first support member and comprising a main contact surface at the outer end thereof, a plurality of intermediate contact structures mounted on said support means and disposed between the oppositely disposed main contact members of said pairs of main contact members, each of said intermediate contact structures comprising a secondary contact and an arcing contact, said second contact structure comprising a second support member of conducting material, main contact surfaces disposed on opposite sides of said second support member for cooperating with said main contact surfaces on said main contact members, secondary contact means on said second support member for cooperating with said plurality of secondary contacts, arcing contact means on said second support member for cooperating with said plurality of arcing contacts, said first contact structure and said second contact structure being constructed for relative movement into closed and opened positions, and in the closed position of said contact structures said main contact surfaces on said second support member being disposed between the oppositely disposed main contact surfaces of said pairs of main contact members.

9. A circuit breaker comprising, in combination, a stationary contact structure and a movable contact structure movable into and out of engagement with said stationary contact structure, said stationary contact structure comprising support means comprising a stationary support member of conducting material, a plurality of pairs of elongated main contact members disposed horizontally in two vertical rows on said stationary support member, means supporting said main contact members on said stationary support member, a first spring means biasing said main contact members inwardly toward said first support member, said elongated main contact members extending out beyond said first support member, each of said main contact members comprising a beveled main contact surface at the outer end thereof, a plurality of elongated unitary intermediate contact members supported vertically in a side-by-side relationship between said main contact members, each of said unitary intermediate contact members having a secondary contact in proximity to the bottom thereof and an arcing contact in proximity to the top thereof, a second spring means biasing the tops of said intermediate contact members away from said support member and providing an individual bias against the top of each of the intermediate contact members, a third spring means biasing the bottoms of said intermediate contact members away from said first support member and providing a separate bias against the bottom of each of said intermediate contact members, means limiting movement of said intermediate contact members away from said first support member, said movable contact structure comprising a movable support member of conducting material, beveled main contact surfaces on opposite sides of said movable support member for cooperating with said beveled main contact surfaces of said main contact members, secondary contact means on said movable support member for cooperating with said plurality of secondary contacts, arcing contact means on said movable support member for cooperating with said plurality of arcing contacts, and in the closed position of said contact structures said beveled main contact structures on said movable support member engaging said beveled main contact surfaces on said main contact members with an orientation wedging said rows of main contact members apart.

10. In a circuit breaker, a stationary contact structure comprising support means, a plurality of pairs of main stationary contact members disposed on opposite sides of said support means and pivotally supported at one end on said support means, separate means biasing each of said pairs of main stationary contact members toward said support means, a plurality of intermediate stationary contact members disposed between said pairs of main stationary contact members, each of said intermediate contact members including a secondary contact and an arcing contact, means supporting one end of said intermediate contact members on said support means for pivotal and sliding movement toward and away from said support means, biasing means biasing the pivoted ends of said intermediate contact members for sliding movement away from said support means, separate means biasing the other ends of said intermediate contact members for pivotal movement away from said support means, and movable contact means cooperating with said stationary contact structure.

11. In a circuit breaker, a frame, a stationary contact structure comprising support means secured to said frame, a plurality of pairs of main stationary contact members disposed on opposite sides of said support means and pivotally supported at one end on said support means, separate means biasing each of said pairs of main stationary contact members toward said support means, a plurality of intermediate stationary contact members disposed between said pairs of main stationary contact members, each of said intermediate contact members comprising a secondary contact and an arcing contact, means supporting one end of said intermediate contact members on said support means for pivotal and sliding movement toward and away from said support means, individual biasing means biasing the pivoted ends of said intermediate contact members for sliding movement away from said support means, separate means common to said plu-

rality of intermediate contact members biasing the other ends of said intermediate contact members for pivotal movement away from said support means, and movable contact means cooperating with said stationary contact structure.

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