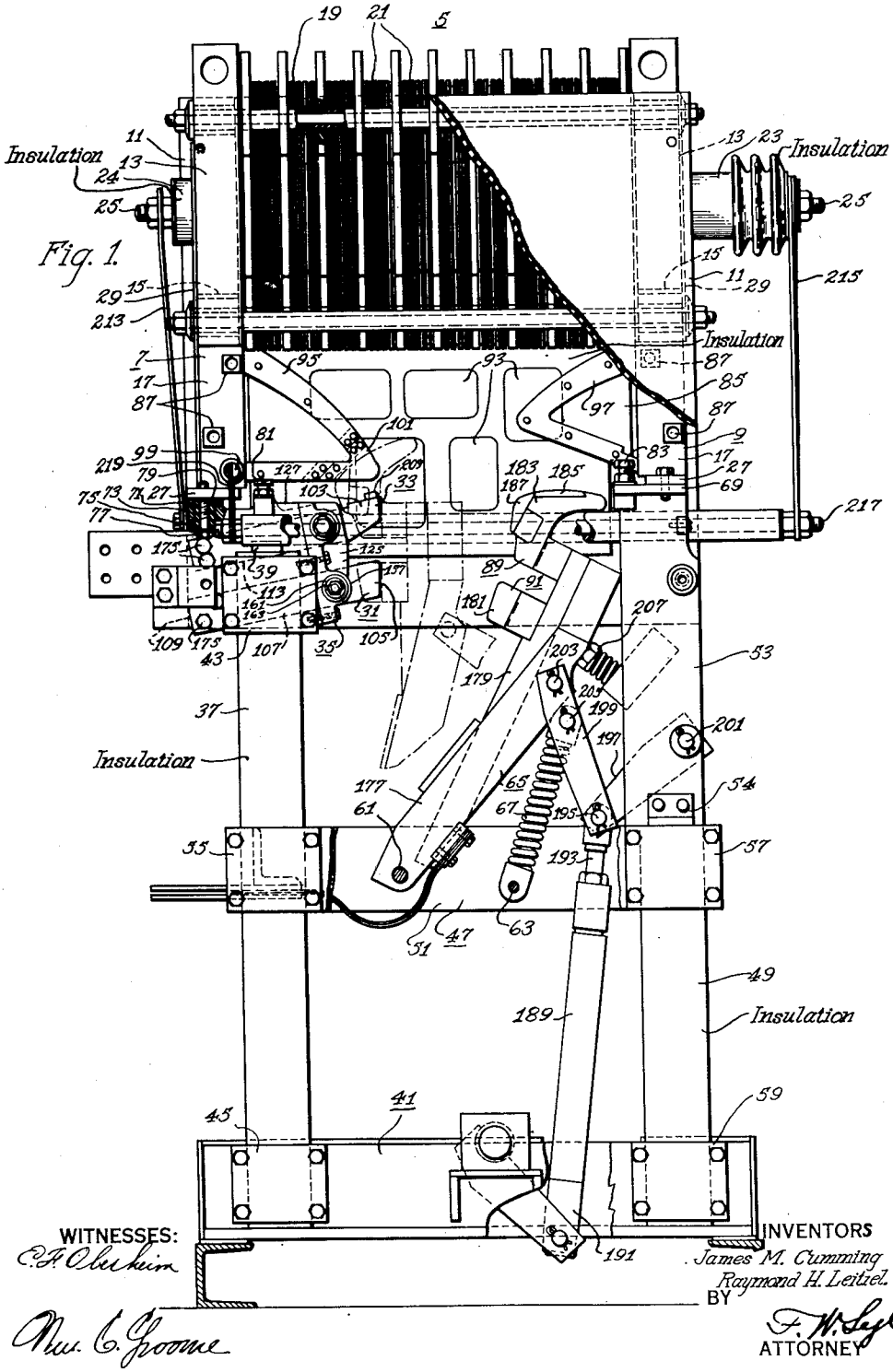
Oct. 21, 1941. J. M. CUMMING ET AL 2,259,971

CIRCUIT BREAKER

Filed Nov. 2, 1938 4 Sheets-Sheet 1

Fig. 1.



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CIRCUIT BREAKER

Filed Nov. 2, 1938 4 Sheets-Sheet 2

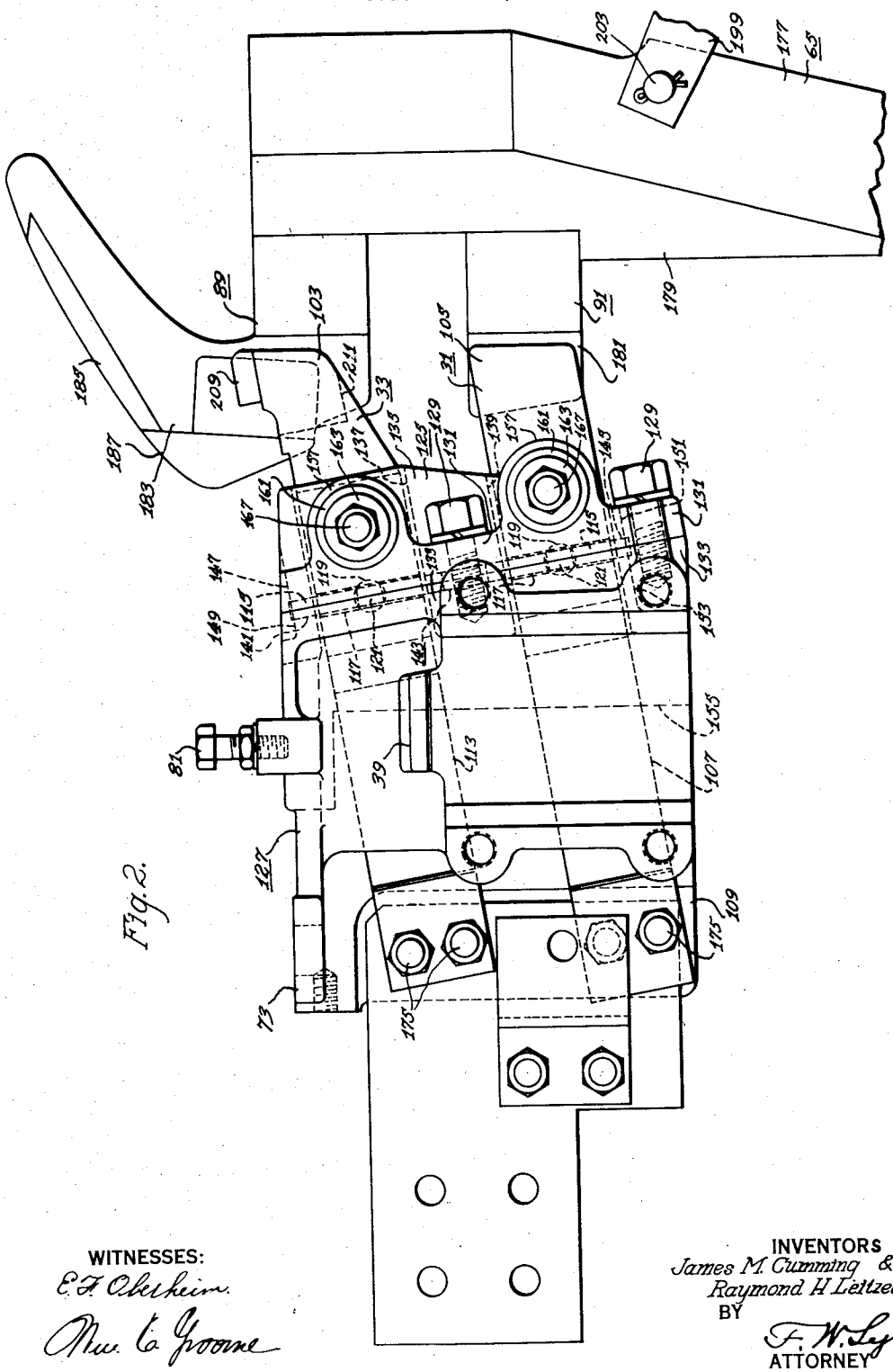


Fig. 2.

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CIRCUIT BREAKER

Filed Nov. 2, 1938 4 Sheets-Sheet 3



Fig. 6.

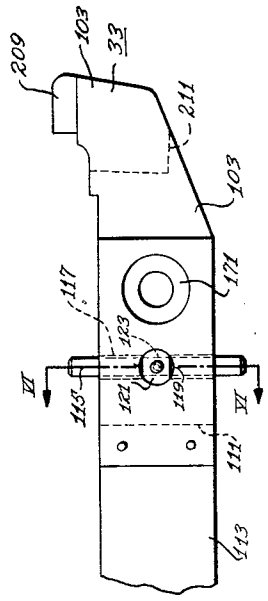


Fig. 5.

Fig. 3.

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CIRCUIT BREAKER

Filed Nov. 2, 1938 4 Sheets-Sheet 4

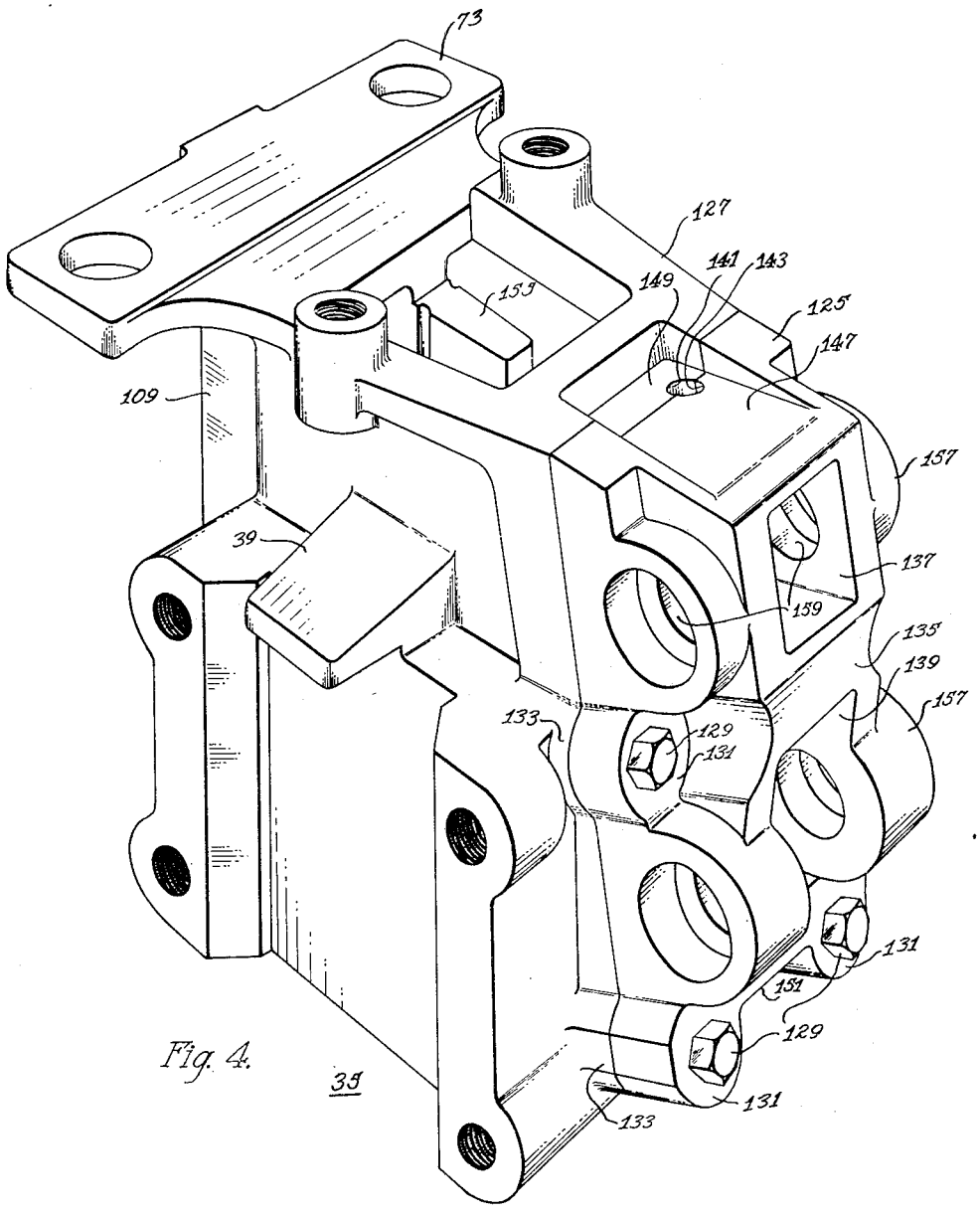


Fig. 4.

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Patented Oct. 21, 1941 2,259,971

UNITED STATES PATENT OFFICE

2,259,971

CIRCUIT BREAKER

James M. Cumming, Turtle Creek, and Raymond H. Leitzel, Wilkinsburg, Pa., assignors to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application November 2, 1938, Serial No. 238,382

17 Claims. (Cl. 200—166)

Our invention relates to circuit interrupters and has particular relation to circuit breakers having a high interrupting capacity. The principal concepts of our invention have general applicability and may be embodied in circuit breakers of any general type regardless of the medium in which the interruption takes place. However, they shall be described herein as applied to an air circuit breaker of the type disclosed in a copending application, Serial No. 238,122, filed November 1, 1938, of John B. MacNeill assigned to the Westinghouse Electric & Manufacturing Company and now Patent No. 2,227,507, issued January 7, 1941. The apparatus disclosed in this application was developed for an interrupting capacity of at least 900,000 kilovolt amperes at 15 kilovolts.

In high power circuit breakers, the forces exerted between the fixed and movable contacts when a circuit is opened or closed are of considerable magnitude. In particular, when a circuit is being closed, the movable contact is thrust between the fixed contact fingers at a high speed and any portions of the finger contacts which happen to be in the path of its movement are subjected to heavy impacts. It often happens that the contact surfaces of the fingers are at a slight angle to the surface of the corresponding movable contact and under such circumstances they are often damaged by the force of the shock and need be replaced. In addition, the contacts may be severely burned by the arc.

In apparatus constructed in accordance with the teachings of the prior art, of which we are aware, the replacement of the contacts is a relatively complex operation. The fixed contact fingers are customarily attached to their support, usually a casting, by pins about which they pivot towards the movable contact. When the fixed contacts are burned or damaged by the impact from the movable contact, the fingers are removed from the circuit interrupter and replaced by new ones. To accomplish this object, the pivoting pins are first extracted from the casting and the fingers. This is a difficult operation, particularly when the damage occurs after the interrupter has been in service for a long time and the fingers cohere tightly to the casting. It often happens, however, that when the movable contact engages the fixed contacts improperly, it not only deforms the fingers but also bends the pins so that their extraction from the casting is a highly troublesome matter. The difficulties and inconveniences involved here are increased by the construction of the casting. It is a large cumbersome structure having numerous juts, openings and crevices and even the most simple operations with it demand tools of unusual character.

It is, accordingly, an object of our invention to provide a circuit interrupter arrangement in which it shall be possible to replace deformed or damaged contacts with facility.

Another object of our invention is to provide a circuit interrupter arrangement in which the fixed contacts shall be so mounted that their replacement shall offer little difficulty.

A further object of our invention is to provide a circuit interrupter in which the fixed contacts shall be mounted as a unit removable from the remainder of the apparatus with facility.

A more specific object of our invention is to provide a circuit interrupter in which the bending of the elements about which the finger contacts pivot shall in no way impede the replacement of the damaged fingers.

Another specific object of our invention is to provide a circuit interrupter in which the fixed finger contacts shall be so mounted as to minimize the possibility of damage by reason of the impacts exerted by the movable contact.

An ancillary object of our invention is to provide a simplified supporting structure for the fixed contacts of a high power circuit interrupter.

Another ancillary object of our invention is to prevent sparking at the contacts of circuit interrupters by reason of movement of the contact assemblies under the attractive electromagnetic forces between the shunts.

More concisely stated, it is an object of our invention to provide a circuit interrupter so constructed that it shall require a minimum of servicing.

According to our invention, the casting whereby the fixed contact fingers are supported is divided into two separable sections. One section, which we may designate as the front section, is a cradle through which the fingers extend. The shunts are secured to the fingers and project through the other section, which we may designate as the rear section.

The axes about which the fixed finger contacts pivot are inseparably attached to the contacts. In the preferred practice of our invention, the axes are in the form of pins which extend through the fingers in a direction parallel to the contacting surfaces. A ball is secured to each of the pins within the fingers and prevents the pins from sliding out of the fingers. The

openings in the fingers wherein the pins and balls are secured are sufficiently large to permit free movement of the fingers relative to the pins and balls.

When the circuit breaker is assembled, the pins are supported in bearings which are disposed in the region of separation between the front and rear sections of the castings, a portion of the bearing being disposed in each section. The fingers are moreover mounted as a unit with the front section. Hence when the fingers are in any way damaged, it is only necessary to remove the front section of the casting. The front section carries with it the contact fingers and their associated elements. The bending of the pins is of no consequence, since the separation of the sections of the casting removes the pins from the bearings, together with the remaining portions of the contact fingers.

The novel features that we consider characteristic of our invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings, in which—

Figure 1 is a view in front elevation, partly in section, of a circuit interrupter constructed in accordance with our invention;

Fig. 2 is a view in side elevation of the contact assembly of the circuit interrupter shown in Fig. 1;

Fig. 3 is a view in plan of the contact assembly shown in Fig. 2;

Fig. 4 is a view in perspective of a fixed contact support constructed in accordance with our invention;

Fig. 5 is a view in side elevation showing the detailed construction of a fixed contact finger and its pivoting pin; and

Fig. 6 is a view in section taken along the line VI—VI of Fig. 5.

The apparatus shown in the drawings comprises an arc extinguishing chamber 5 formed between composite metallic uprights 7 and 9 and covers 11 of insulating material secured to the uprights. Each upright 7 and 9 consists of a channel beam 13 with transverse plates 15 welded to the edges of the lower opening in the channel. The transverse plates 15 have a total width less than that of the channel and longitudinal plates 17 extend from the inner edges of the transverse plates forming between them an elongated opening of smaller width than that of the channel. The web of each channel is provided with openings near its four corners and with a central opening. Through the corner openings insulating bars 19 of phenolic condensation material pass and on them the plates 21, whereby an arc is broken up and deionized, are stacked. Cylindrical insulators 23 and 24 abut the central openings and a conducting bar 25 passes through the openings and the insulators.

The deionizing stack 21 is of the usual structure comprising vertical iron and copper plates with fish paper insulating sheets between them. As it does not concern the present invention, it will not be described here in detail.

The longitudinal plates 17 extending from the channels 13 rest on base blocks 27 to which they are secured. The openings in the channels 13 face away from the deionizing stack 21 and cover plates 29 are provided for these openings and the coextensive opening between the plates 17. The channels 13 and the coextensive plates 17 thus form flues through which the gases generated during the interruption of a circuit are exhausted.

The fixed current carrying contact assembly 31 and the fixed arcing contact assembly 33 are mounted in a box shaped casting 35 which is supported below the left-hand upright 7 on parallel columns 37. The latter columns are preferably composed of a phenolic condensation material. The upper ends of the columns 37 engage lips 39 projecting from the casting 35 and the lower ends are secured to a suitable supporting frame 41. The columns 37 are held laterally by blocks 43 and 45 bolted respectively to the casting 35 and the frame 41.

A large double walled beam 47 in the form of a right angle, with the wall spacing equal to the distance between the columns 37, is supported by the columns 37 and by a pair of short columns 49 of similar material. The angle 47 is disposed with its sides 51 and 53 horizontal and vertical respectively. The horizontal sides 51 are secured at the ends to the centers of the long columns 37 and the short column 49 passes through the apex of the angle and engages lips 54 projecting from the vertical sides 53. The vertical sides 53 of the angle are coextensive with the column 49. The columns 37 and 49 and the angle 47 are held laterally by blocks 55, 57 and 59 which are bolted to the parts to which they are secured.

The horizontal sides 51 of the angle 47 serve as bearing supports for the pins 61 and 63 which carry at their respective centers the movable contact arm 65 and the spring 67 whereby the arm is actuated. The arm 65 and spring 67 are mounted so that they may pivot about the axes of the pins. The width of the horizontal side 51 of the angle 47 is such that the vertical side 53 is coextensive with the right-hand upright 9 forming the arc extinction assembly 5.

The uprights 7 and 9 rest on the casting 35 and on the vertical sides 53 of the angle 47. For this purpose a slab 69 is secured to the upper ends of the vertical sides 53. The slab 69 is fastened to the right-hand block 27 and thus supports the right-hand upright 9. The left hand block 27 rests on an insulating washer 71 supported on a horizontal projection 73 extending from the casting 35. Below the projection 73 a second insulating washer 75 is provided and the projection is secured to the block 27 by a bolt 77 extending through the washers and the projection and insulated from the projection by a sleeve 79.

From the upper surface of the casting 35 and from the slab 69 extend studs 81 and 83 respectively, which are adjustable in height. Composite boards having internal insulating faces 85 are supported on the studs and secured to horizontal studs 87 projecting on both sides from the upright plates 17. A chamber extending from the deionizing stack 21 to the circuit interrupting contacts 31, 33 and 89 and 91 is thus formed between the boards. The arc is moved through the chamber into the deionizing stack 21.

The specific structure of the arc chamber does not concern the present invention. However, briefly, its walls are composed internally of fibrous insulating material 85, in which inserts 93 of a refractory insulating material are disposed, and

externally of iron (not shown). In Fig. 1 the interior surface 85 of a single wall is shown. The other wall is of similar structure but has been removed for the purpose of showing the interior of the chamber.

Within the arc chamber, arc transfer horns 95 and 97 are provided. The horns are secured to the channels 13 and to the plates 17 coextensive with the channels, the left hand horn 95 being fastened to studs 99 which project outwardly from the faces of the left hand plates 17. The tip 101 of the left-hand horn is located immediately adjacent to the contact fingers 103 of the fixed arcing contact assembly 33.

The fixed current carrying contact assembly 31 is of composite structure comprising a pair of contact fingers 105 preferably composed of silver plated copper. The ends of the contact fingers 105 are slotted and in the slots (not shown) flexible shunts 107 composed of thin ribbons of copper are fastened, preferably by sweating. At the other ends the shunts are bolted to a tail projection 109 integral with the casting 35. The fixed arcing contact assembly 33 is of similar composite structure comprising the pair of contact fingers 103 which are also slotted at their ends. The slots 111 (Fig. 3) receive the strands of the shunts 113 which, in turn, are secured to the tail projection 109 of the casting 35.

Each of the contact fingers 105 and 103 is provided with a pin 115 which passes loosely through the body of the finger near the end to which the shunt is secured. The pin 115 is substantially parallel to the contact surface 116 of the finger and extends at both ends beyond the sides of the fingers through which it penetrates. In addition to the opening 117 through which the pin 115 passes, each finger is provided with an opening 119 perpendicular to the contact surface 116 which passes through the pin opening at its center. Before the pin 115 is slipped into its corresponding opening 117, a ball 121 having a slot 123 therein capable of receiving the pin is inserted in the opening perpendicular to the contact surface 116. After this the pin 115 is passed through the opening 117 in the block and the opening 123 in the ball 121 and the ball is secured to the pin by riveting or in any other convenient manner. A pin 115 is thus inseparably secured to each of the fingers 103 and 105.

The casting 35 in which the fixed contact assemblies 31 and 33 are mounted is of composite structure consisting of a front section 125 and a rear section 127. The two sections 125 and 127, when the apparatus is assembled, abut each other over machined surfaces. They are fastened together by bolts 129 which pass through bosses 131 extending out from the abutting surface of the front section 125 at its lower end and at its center, and the bolts engage correspondingly internal threaded bosses 133 in the abutting surface of the rear section 127. The front section 125 of the casting 35 is divided by a partition 135 into upper and lower chambers 137 and 139 which are open in front and through which the fingers 105 and 103, respectively, extend.

The fingers are disposed with their contacting surfaces 116 perpendicular to the partition 135 and, therefore, the pins 115 attached to the fingers are also perpendicular to this partition. The ends of the pins 115 which extend beyond the sides of the fingers 103 and 105 are secured in bearings 141, 143 and 145 formed when the abutting surfaces of the sections 125 and 127 are in engagement. The bearings are cut into partition 135 and the upper and lower walls 147 and 149 and 151 and 153, respectively, of the front and rear sections of the casting at the abutting surfaces and are partly in the front section 125 and partly in the rear section 127. When the sections 125 and 127 are separated, the pins 115 are therefore entirely released. The fingers 103 and 105 are, moreover, loosely attached to the pins 115 so that when the pins are mounted in the bearings, the fingers are capable of swiveling about the balls 121 and pivoting about the pins as axes.

The rear section 127 of the casting 35 is provided with a partition 155 which extends from its rear towards the abutting surfaces and separates the shunts 107 and 113 extending from the cooperative pairs of fingers 103 and 105, respectively. When current flows through the fixed contacts 31 and 33, the current flow in the shunts 107 and 113 tends to cause the shunts from the cooperative fingers to attract each other and the partition 155 functions to prevent the shunts from coming into engagement. If the shunts should be capable of moving towards each other under the forces of attraction they would tend to pivot the corresponding fingers away from each other on the cooperative contact. This produces a decrease in the contact pressure at the movable contact surface and slight sparks result. The material used for the casting 35 is preferably bronze. To facilitate the passage of current, the tail 109 of the rear section through which connection is made to the fixed contact assemblies 31 and 33 is plated with copper.

The cooperative fingers 103 and 105 of each of the contact assemblies 31 and 33 are resiliently urged into engagement with the movable contacts 89 and 91 when the circuit is closed. For this purpose the walls of the chambers 137 and 139 in the front section 125 of the casting 35 are provided with hollow bosses 157 having narrow inner flanges 159. Within each of the bosses 157, a cap 161 is supported. Each of the caps 161 extends outwardly to a considerable distance beyond the bosses and its outermost periphery is closed by a cover 163 provided with an opening 165 in its center. The openings 165 in the covers 163 of caps 161 supported in the horizontally opposite bosses 157 function as bearings for pins 167. Each pin 167 passes through a pair of fingers 103 and 105 in a direction perpendicular to their contact surfaces 116. The openings in the fingers 103 and 105 are substantially larger than the diameters of the pins 167 and the fingers are capable of easily sliding along the pins. The last-mentioned pins 167 are transverse to the pins 115 about which the fingers 103 and 105 pivot and, therefore, pivotal motion of the fingers is a sliding motion along the pins 167. Helical springs 169 encircle each of the pins 167 at both ends. Each spring 169 engages the cover 163 of the cap 161 at one end and an indentation 171 in the finger 103 or 105 at the other end. The springs 169 thus urge the fixed contact fingers 103 and 105 into engagement with the movable contacts 89 and 91 when the circuit is closed. To prevent the fingers 103 and 105 from being urged so close to each other, when the circuit is open, that they are damaged by the movable contacts 89 and 91 during the closing operation, an insulating washer 173 is provided on each of the pins 167 between the fingers.

The two sets of fixed contact fingers 103 and 105 and their associated pins and springs are attached to the front section 125 of the casting.

If the fingers 103 or 105 should in any way be damaged, they may be replaced without difficulty. In such a case, the bolts 129 whereby the sections 125 and 127 of the casting 35 are held together, and the bolts 175 whereby the shunts 107 and 113 are secured to the tail 109 of the casting are released and the front section 125 of the casting, together with the contact assemblies 31 and 33, are disengaged from the rear section 127 of the casting. Since the pivot pins 115 are released when the two sections of the casting are separated, no difficulty arises by reason of bent pins nor is there any difficulty in replacing the damaged finger. To accomplish the latter object, the pins 167 on which the finger contacts 103 and 105 slide and the caps 161 are removed from the corresponding bosses 157 and the damaged fingers 103 or 105 are then separated from the front section 125.

In the construction in accordance with our invention, the fingers 103 and 105 are less often damaged by the impact of the movable contacts 89 and 91 than in the prior art arrangements. This situation arises because the caps 161 on which the pins 167 transverse to the pivot pins 115 are supported provide spacings between the bearings for pins 167 which are substantially longer than in the prior art arrangements. For the same tolerances, therefore, the angle by which the finger contacts 103 and 105 deviate from the perpendicular position to the pins 167 is substantially smaller. Since the damaging impacts on the fixed contacts 103 and 105 in general depends on the angle of deviation from the perpendicular, the decrease in this angle amounts to a substantial decrease in the probability of damage.

The movable contact assembly 65 is of composite structure consisting of a heavy steel support 177 to which a copper contact carrier 179 is secured. Near the upper end of the carrier 179 the movable arcing contact 89 projects; the movable current carrying contact 91 extends parallel to the arcing contact 89 from a position below the latter. The movable contacts 89 and 91 are of the knife type adapted to be engaged and held firmly by the corresponding resiliently pivoted fingers 105 and 103.

The movable current carrying contact 91 is composed of silver plated copper and is preferably attenuated at its end 181 so as to limit the space necessary for the contacts when in engagement. The movable arcing contact 89 is similarly attenuated at its end 183 and in the attenuated region is provided with inserts 185 and 187 of an arc resistant silver tungsten alloy.

The fixed arcing contact fingers 103 project into the arc space 5 and, as has been explained, are adjacent to the tip 101 of the left-hand arc transfer horn 95. So as to expedite the movement of the arc into the arc space, the horn 95 is slotted near its tip 101 and the movable contact 89, when the circuit breaker is in the closed position, penetrates into the slot.

The movable contact assembly is actuated by a rod 189 which may be moved in the usual manner by an electro-magnetic system. The specific moving structure is not shown as it does not concern the present invention. In general, the rod 189 is pivotally connected to the actuating system at its lower end 191. At its upper end 193 the rod engages the common movable pivot pin 195 of a pair of sets of lever arms 197 and 199. The former set 197 pivots about a fixed pin 201 secured to the vertical sides 53 of the angle 47 and the other, 199, about a pin 203 in the steel support 177 of the movable contact assembly 65. Below the latter pivot pin 203 the circuit opening spring 67 is secured to a pivot pin 205. The movable contacts 89 and 91 are disengaged from the fixed contact fingers 105 and 103, respectively, by the action of the spring 67 when the mechanism whereby the rod 189 is moved into and held in the closed position is released. In opening the movable contact assembly 65 strikes against a shock absorbing stud 207 and thus is not damaged.

When the circuit interrupter is in the closed position, the current is primarily carried by the current carrying contacts 105 and 91 since the resistance between the arcing contacts 103 and 89 is relatively high. The current carrying contacts and the arcing contacts are so positioned in their respective supports that when the circuit breaker opens the current carrying contacts 105 and 91 are first disengaged and then the movable arcing contact 89 is disengaged from the fixed arcing fingers 103. An arc is, therefore, produced between the latter elements. When the current carrying contacts 105 and 91 are opening, the current in each of the arcing fingers 103 is increasing. Since the current paths through the fingers are parallel and in the same direction, the effect of the resultant increasing magnetic fields is to cause the fingers to hold the contact 89 more tightly until the moment for release as determined by the moving mechanism arrives. The establishment of an arc at the current carrying contacts 105 and 91 by reason of the opening of the arcing contacts 103 and 89 only a very slight fixed interval after the opening of the current carrying contacts is thus entirely precluded.

The fixed arcing contact fingers 103 are provided with inserts 209 and 211. The inserts 209 are in the form of tips extending upwardly towards the tip 101 of the arc horn 95. The fixed arcing contact assembly 33 is moreover so disposed in the casting 35 that the direction of the current flow in it between the region of separation of the contacts 103 and 89 and the point of connection of the power supply line at the instant of interruption is first at a small angle to the horizontal and, as the point of interruption is approached, at an angle sharply approaching the vertical. The insert 187 of the cooperative movable contact 89 is also in the form of a tip so positioned that it engages the inserts 209 when the contacts 103 and 89 are last in engagement during the opening operation. The contour of the inserts 187 and 209 is such that at the point of final disengagement, the sides of the inserts 187 and 209 form an acute angle having its apex at the extreme upper region of the contacting surfaces 116, the apex being also the point of last engagement of the contacts 103 and 189. It happens, therefore, that in the region of separation of the arcing contacts the current flow is in a sharp loop convex towards the tip 101 of the adjacent arc transformer horn 95. For this reason when the arc is produced, it also is in a sharp loop convex towards the tip, and since the electromagnetic effect of current flowing in a loop is to increase the radius of curvature of the loop, the arc produced decreases its curvature towards the tip 101 and is quickly transferred to the horn.

By the transfer of the arc to the horn 101, the circuit through an inductance loop or blow-in coil is closed. The loop consists of vertical straps 213 extending between the projection 73 of the casting 35 and the adjacent end of the rod 25

passing through the insulators 23 and 24, vertical straps 215 extending from the remaining end of the rod 25, a pair of rods 217 extending from the lower ends of the straps 215 outside of the arc chamber 5 and metallic strips 219 extending from the remaining ends of the latter rods 217 to the studs 99 to which the arc transfer horn 95 adjacent to the fixed arcing contact 103 is secured. When the arc is transferred to the horn 95, a circuit is completed through this loop which extends from the line connection to the fixed contacts 103 through the straps 213, the bar 25, the straps 215, the rods 217, the strip 219, the arc horn 95, the movable contact assembly 65 to the other line connection. By the action of the inductive loop, the arc is now transferred to the other arc horn 97. Since the latter horn is connected to the right angle 47, the circuit through the inductive loop is not broken and the movement of the arc continues upward until it passes into the deionizing stacks 21 and is extinguished.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

We claim as our invention:

1. A circuit controller comprising a pair of finger contacts and a cooperative contact to be engaged by said finger contacts, at least one of said finger contacts having as a part thereof a pin which projects beyond the edges thereof and a supporting structure for said finger contacts, said structure consisting of a pair of separable sections and forming in a portion of the region of separation between said sections a bearing for the projecting portion of said pin permitting pivotal motion of said one finger, and said finger contacts being secured to one of said sections in such manner that when said sections are separated said finger contacts are separated with said one section from the other said section.

2. A circuit controller comprising a pair of finger contacts and a cooperative contact to be engaged by said finger contacts, at least one of said finger contacts having as a part thereof a pin which projects beyond the edges thereof, a supporting structure for said finger contacts, said structure consisting of separable front and rear sections and forming in a portion of the region of separation between said sections a bearing for the projecting portion of said pin permitting pivotal motion of said one finger, and said finger contacts being secured to said front section in such manner that when said front and rear sections are separated said finger contacts are separated from said rear section with said front section, and means forming a unit with said front section and said fingers for resiliently urging said one finger contact toward the other finger contact.

3. A pivotal finger contact comprising a block of conducting material, a pin passing through an opening provided in said block and having secured intermediate the ends thereof and in said block a ball preventing the disengagement of said pin and block, said pin and ball being so dimensioned that said block may move freely relative thereto, whereby said block is capable of a swivel motion about said ball when said pin is supported in bearings.

4. A circuit interrupter comprising a contact member, a cooperating pivoted finger contact comprising a block of conducting material having a surface for engaging said contact member, a pivot pin passing through an opening provided in said block substantially parallel to said surface and having secured intermediate the ends thereof and in said block a ball preventing the disengagement of said pin and block, said pin and ball being so dimensioned that said block may move freely relative thereto, whereby said block is capable of a swivel motion about said ball, and bearing means for supporting the ends of said pivot pin.

5. A circuit controller comprising a pair of finger contacts, each of said finger contacts comprising a block of conducting material having a surface at which electrical contact is to take place, a pin traversing said block in a direction substantially parallel to said surface and extending beyond the edges of said block and a ball secured in said block intermediate the ends of said pin, said pin and ball being so dimensioned as to permit free motion of said block relative thereto, supporting means for said finger contacts including bearing means for the extending ends of the pins so disposed in said supporting means that when mounted in said supporting means said blocks are capable of a swiveling pivotal motion causing the surfaces of electrical contact to move towards each other, and a cooperative contact to be engaged by said surfaces.

6. A circuit controller comprising a pair of finger contacts, each of said finger contacts comprising a block of conducting material having a surface at which electrical contact is to take place, a pin traversing said block in a direction substantially parallel to said surface and extending beyond the edges of said block and a ball mounted in said block and secured to said pin intermediate the ends thereof, said pin and ball being so dimensioned as to permit free motion of said block relative thereto, supporting means for said finger contacts including bearing means for the extending ends of the pins so disposed in said supporting means that when mounted in said supporting means said blocks are capable of swiveling pivotal motion causing the surfaces of electrical contact to move towards each other, a cooperative contact to be engaged by said surfaces and resilient means for urging said blocks into engagement with said cooperative contact.

7. Apparatus according to claim 6 characterized by the fact that said supporting means is made up of two separable sections, one of said sections supporting the blocks and the resilient means so that when it is separated from the other, the blocks, pins and resilient means are removed as a unit therewith.

8. Apparatus according to claim 6 characterized by the fact that said supporting means is made up of two separable sections, one of said sections supporting the blocks and the resilient means so that when it is separated from the other, the blocks, pins and resilient means are removed as a unit therewith, and the bearing means being provided in the region between the sections.

9. In a circuit interrupter, in combination, a pair of contact fingers pivotal towards each other, a pair of relatively flexible shunt conductors disposed substantially parallel to one another and connected to the ends of said contact fingers which are on the opposite side of the pivots from the contact surfaces of the contacts, and means for preventing said shunt conductors from moving towards each other under the ac-

tion of forces produced by the current flowing therein.

10. In a circuit interrupter, a pair of finger contacts mounted for pivotal movement toward each other and adapted to engage a movable contact, each of said finger contacts having a pivot pin permanently secured thereto about which it is adapted to pivot, a supporting structure for said finger contacts comprising separable sections one of which is fixed and the other of which is removably mounted on the fixed section, said sections forming bearings for the contact pivot pins in the region of separation of said sections, a supporting pin for said finger contacts mounted in bearings provided by outboard bearing caps secured to the removable section, said supporting pin extending through openings provided in said finger contacts and having its axis disposed transversely with respect to the axes of said contact pivot pins, and spring means mounted on said removable section for biasing said finger contacts toward each other.

11. A circuit controller assembly comprising a pair of finger contacts, a cooperating movable contact movable into and out of engagement with said finger contacts, at least one of said finger contacts being capable of being pivoted towards the other and means for supporting said finger contacts, characterized by the fact that the axis about which the pivoting takes place is a pin mounted in a supporting structure, said pin loosely passing through said finger, said pin having intermediate the ends thereof and in the interior of said finger means to permit swiveling and pivotal motion of said finger relative to said pin.

12. A pivotal finger contact comprising a block of conducting material, a pin passing loosely through an opening provided in said block, the ends of said pin being mounted in a supporting structure, said pin having intermediate the ends thereof and in the interior of said block means mounted on said pin to permit pivotal and swiveling motion of said finger relative to said pin.

13. A circuit controller assembly comprising a pair of finger contacts, a cooperating movable contact movable into engagement with said finger contacts, at least one of said finger contacts being capable of being pivoted towards the other and means for supporting said finger contacts, characterized by the fact that the axis about which the pivoting takes place is a pin loosely passing through said finger, the ends of said pin projecting beyond the sides of said finger contact that are parallel thereto and being engaged by said supporting means which thus provides bearings about which the pivoting takes place, a ball mounted on said pin intermediate the ends thereof and in the interior of said finger contact, said ball permitting a limited amount of swiveling motion of said finger relative to said pin in addition to the pivoting motion of said finger.

14. A circuit controller comprising a pair of finger contacts and a cooperating movable contact movable into engagement with said finger contacts, at least one of said finger contacts having a pin which loosely passes through said finger contact and projects beyond the edges thereof, said pin having mounted thereon intermediate the ends thereof and in the interior of said finger means for permitting swiveling and pivotal motion of said finger contact relative to said pin, a supporting structure for said finger contacts, said structure consisting of separable sections and forming in a portion of the region of separation between said sections a bearing for the projecting portions of said pin.

15. A circuit controller comprising a pair of finger contacts and a cooperating movable contact movable into and out of engagement with said finger contacts, at least one of said finger contacts carrying as a part thereof a pin assembly comprising a pin which loosely passes through said finger contact and projects beyond the edges thereof substantially parallel to the surface of engagement of said finger contact, a ball mounted on said pin intermediate the ends thereof and in the interior of said finger contact to provide swiveling as well as pivotal motion of said finger contact with respect to said pin, a supporting structure for said finger contacts, said structure consisting of separable sections and forming in a portion of the region of separation between said sections a bearing for the projecting portions of said pin.

16. In combination in a circuit interrupter, finger contact means disposed to be engaged by a cooperating movable contact, a supporting structure consisting of two separable sections, said sections being secured together in the assembly of said circuit interrupter, an element extending across one of said supporting sections, said finger contact means being loosely mounted on said element, bearing means for said element comprising caps extending outwardly from the same supporting section across which the element extends, said caps having bearing surfaces at their outer ends for said element, said caps being mounted on said one section during assembly of the circuit interrupter so that when the two cooperating sections of the supporting structure are separated the finger contact means, said element, said bearing caps and said one section comprise a unit separable from said other section.

17. In combination in a circuit interrupter, finger contact means disposed to be engaged by a cooperating movable contact, a supporting structure, an element extending across said supporting structure on which said finger contact means is loosely mounted, the mounting being such that said finger contact means are substantially perpendicular to said element, resilient means mounted on said element for urging said finger contact means toward each other, bearing means for said element comprising caps extending outwardly from said supporting structure and mounted thereon during assembly of said circuit interrupter, said caps having bearing surfaces at their outer ends for said element.

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