Nov. 29, 1960 T. J. SCULLY 2,962,573

ELECTRIC CIRCUIT INTERRUPTER

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Fig. 2.

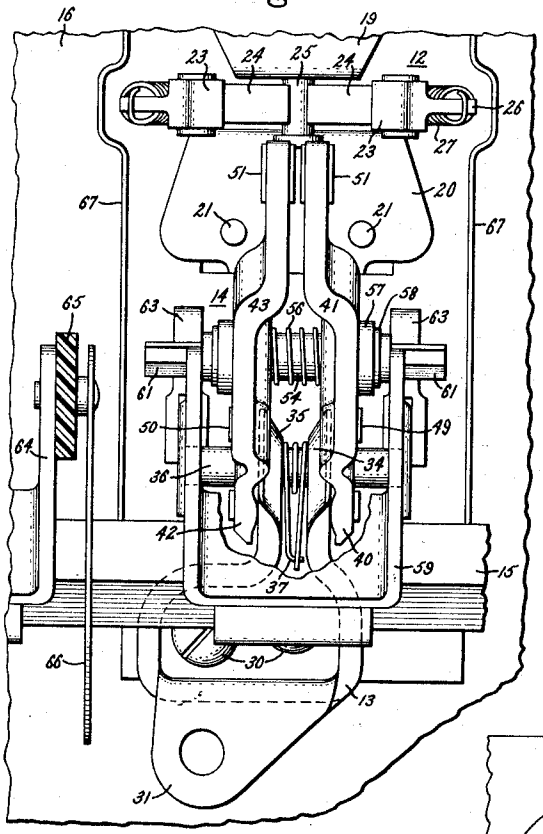


Fig. 1.

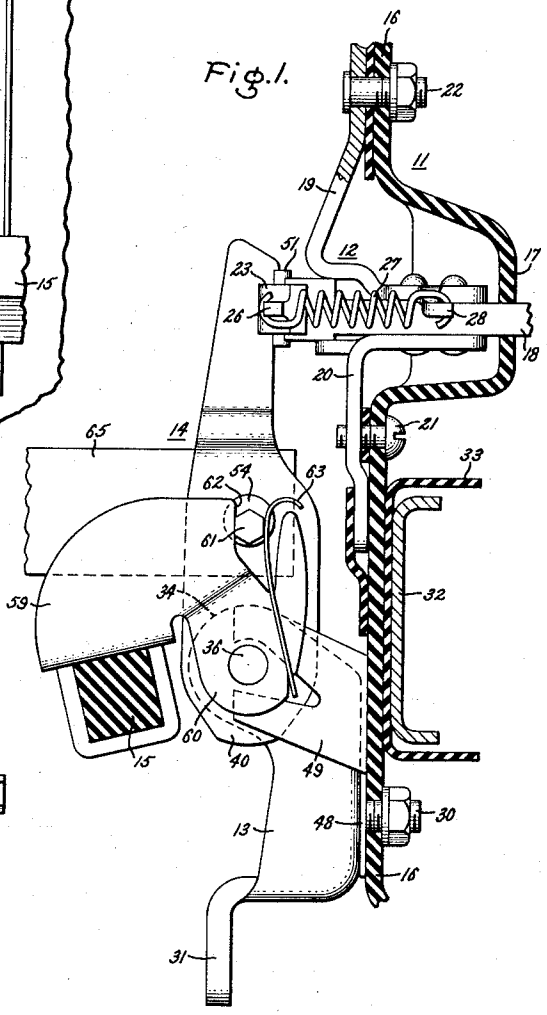
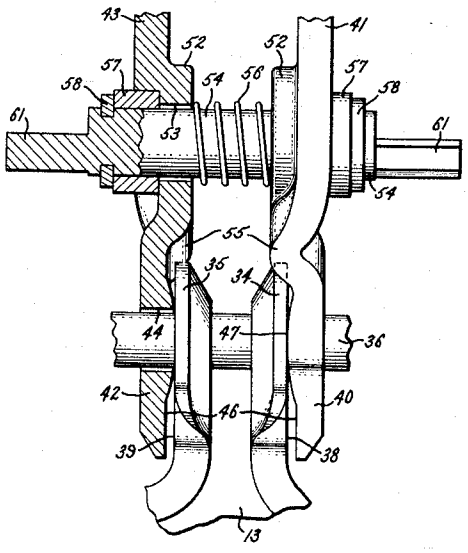


Fig. 3.



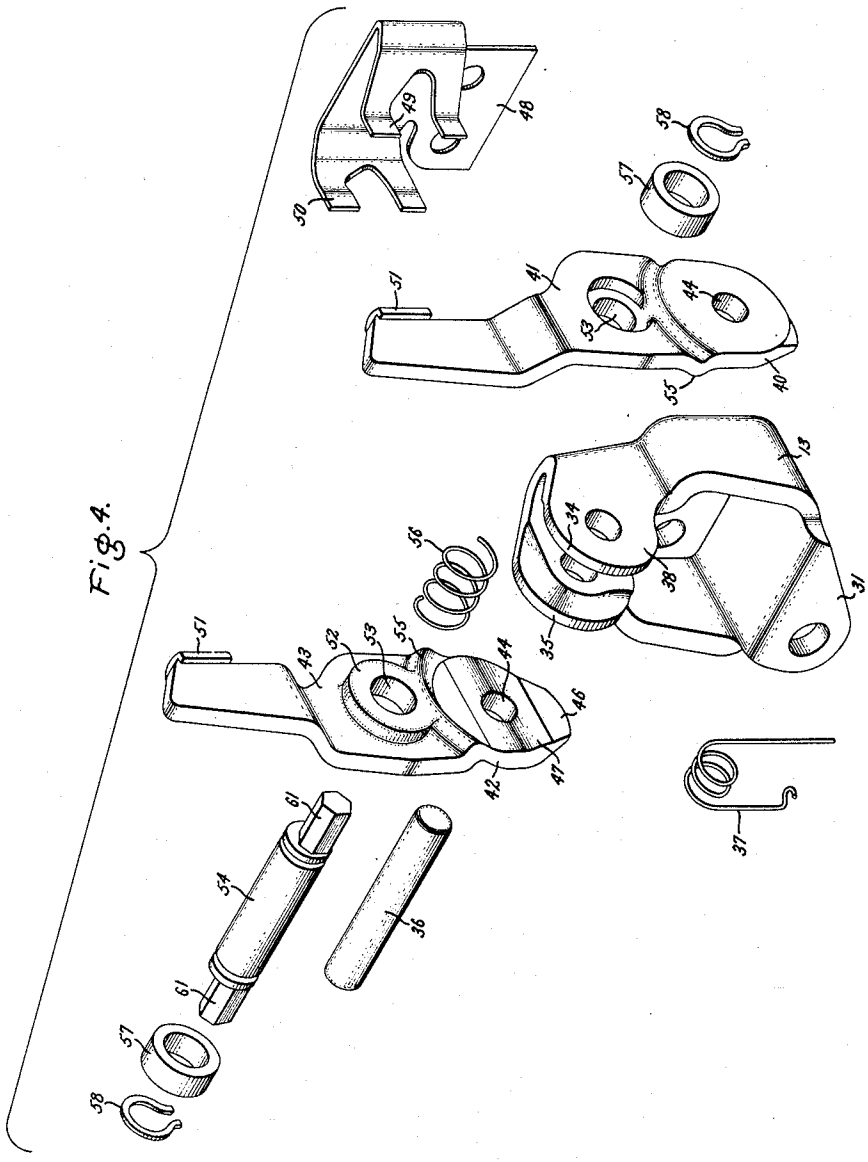
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Fig. 4.



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2,962,573

ELECTRIC CIRCUIT INTERRUPTER

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7 Claims. (Cl. 200—166)

This invention relates to electric circuit interrupters or breakers, and more particularly it relates to improvements in the contact structure of a low voltage air circuit breaker.

One object of the invention is the provision of a relatively simple and inexpensive circuit interrupter contact structure having a movable contact member pivotally connected to a stationary electroconductive support in a manner so that direct and positive electric contact is obtained between the movable member and its support without flexible braids or the like and without need for untoward precision in the manufacture and alignment of the various cooperating parts of the contact structure.

A general object of the invention is to provide an improved circuit breaker contact structure of the character described hereinafter.

In carrying out my invention in one form, an electroconductive bracket provided with at least one slide surface is mounted on the base of a circuit breaker in spaced relation to a relatively stationary contact member. A cooperating movable contact arm is pivotally supported by the bracket for rotation about an axis oriented approximately perpendicular to the slide surface. The movable contact arm is provided with a pertaining slide surface disposed in contiguous relationship with the slide surface of the bracket to form a current-conducting joint therebetween. One of the slide surfaces has a raised section relative to the other slide surface thereby to provide a straight-line contact which serves as a fulcrum for rocking movement by the movable contact arm with respect to the axis of rotation. Contact pressure between the contiguous slide surfaces of the current-conducting joint is maintained by resilient clamping means which, in one aspect of the invention, comprises an electroconductive spring member secured to the bracket and disposed in engagement with the movable contact arm to provide a second current-conducting joint therewith.

My invention will be better understood and its various objects and advantages will be more fully appreciated from the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a side elevation of a circuit breaker contact structure embodying a preferred form of my invention, with the movable contact member of the contact structure shown in its closed circuit position;

Fig. 2 is a front elevation of the contact structure illustrated in Fig. 1, with the movable contact member to its open circuit position;

Fig. 3 is an enlarged partial section of the connection between the movable contact member and its supporting bracket in accordance with my invention; and

Fig. 4 is an exploded perspective view of the movable contact member and supporting bracket.

Referring now to Fig. 1, I have shown an electric circuit breaker or interrupter comprising a base member **11**, a relatively stationary contact member **12** mounted on the base, an electroconductive bracket **13** mounted on the base in spaced relation to the stationary contact

member, a movable contact member **14** pivotally supported by bracket **13** and disposed in cooperative relationship with the stationary contact member **12**, and actuating means such as a crossbar **15** coupled to the movable contact member **14** for moving this member into and out of circuit-making engagement with the stationary contact member **12**. The components **12**, **13** and **14** comprise the contact structure of one pole unit of an alternating or direct current circuit breaker or interrupter. It will be understood that other similar pole units (not shown) could be mounted for gang operation on the base member **11** adjacent to the unit that has been illustrated in Figs. 1 and 2.

The base member **11** supports the current-conducting studs of the breaker and other breaker parts connected directly to the studs. As illustrated in Fig. 1, the base member **11** comprises a sheet **16** of electric insulating material of substantially uniform thickness. The sheet **16** is shaped to form a channel-shaped section or depression at **17**, and the bottom of this section is provided with an aperture for snugly admitting and partially supporting an upper breaker stud **18**. For the purposes of the present description, the contact structure **12—14** will be considered mounted on the front of the base **11**, and the breaker stud **18** is connected to a suitable electric power source or bus (not shown) located behind or to the rear of the base. The contact structure shown in the drawings and described herein to illustrate a preferred embodiment of my invention has been particularly designed for connection to an electric power bus rated 600 volts A.-C. and capable of supplying as much as 25,000 amperes short-circuit current.

The stationary contact member **12** is mounted on the upper breaker stud **18**. As can be seen in Fig. 1, the upper stud **18** is secured to the sheet **16** of base member **11** by suitable support means such as generally L-shaped angles **19** and **20**. The angles **19** and **20** are respectively disposed above and below stud **18** and are fastened thereto by three copper rivets or the like. The lower angle **20** is provided with a pair of tapped holes, and a pair of appropriate bolts **21** is used to secure this angle to the base member **11**. The supporting angle **19**, which extends above the breaker stud **18** as is shown in Fig. 1, serves as an arc runner in cooperation with the stationary contact member **12**. This angle is provided with a stud **22** for securing it to the insulating sheet **16** of the base **11**.

The end of breaker stud **18** extending forward from the base member is divided into two horizontally diverging branches, whereby this stud in plan view has a generally Y-shaped appearance. In the preferred embodiment of my invention illustrated in Figs. 1 and 2, the stationary contact member **12** comprises at least one pair of elongated contact elements or fingers **23**, each finger **23** being pivotally supported intermediate its ends on the outer end of a different diverging branch of the breaker stud **18**. For this purpose, the outer ends of the diverging branches are respectively provided with generally cylindrical bearing surfaces having centerlines oriented in a vertical direction as viewed in Figs. 1 and 2. Each bearing surface is recessed so that shoulders are formed at its upper and lower ends to prevent vertical movement of the associated contact finger. If desired, the length of the bearing surface can be made sufficient to accommodate more than one contact finger **23** in side-by-side relation.

Each of the two bearing surfaces at the outer ends of the diverging branches of the breaker stud **18** provides a fulcrum for at least one contact finger **23**, and the pivotal connection between each contact finger and the breaker stud forms a current-conducting joint. As can be clearly seen in Fig. 2, the contact fingers **23** are re-

spectively supported on opposite bearing surfaces in opposing relationship with respect to each other. The opposing or inner ends of the contact fingers are movable in separate, relatively short arcuate paths disposed in a common horizontal plane, and the opposing ends are respectively provided with generally flat, complementary contact surfaces **24** normally defining a common vertical plane as viewed in Figs. 1 and 2.

The inner end of each contact finger **23** is arranged to engage a common stop **25** for determining the limit of the arcuate movement of the contact surface 24 in one direction. The stop **25**, as is indicated in Fig. 2, comprises a pin vertically disposed intermediate the divergent branches of the breaker stud **18** and fixedly connected to the upper and lower supporting angles **19** and **20**. Associated with the outer end **26** of each contact finger **23** is suitable spring means, for example, the illustrated tension spring **27** which may be anchored at one end to a fixed member such as provided by a laterally extending lug **28** of the supporting angle **19**. Thus, spring means **27** establishes a biasing torque in the contact finger **23** tending to move the contact surface **24** along its arcuate path in a forward direction away from the base member **11**, and such movement by the finger is limited by stop pin **25**. The above-described structure permits a relatively limited deflection of each contact finger in a rearward direction.

The biasing torque is opposed and overcome and each contact finger **23** of the relatively stationary contact member **12** is tilted slightly on its fulcrum by the action of the movable contact member **14**. As will be more fully explained hereinafter, the movable contact member **14** in the illustrated embodiment of the invention includes a pair of arms respectively provided with contact surfaces **51** which move in parallel planes disposed approximately perpendicular to the plane defined by the arcuate paths of the contact surfaces **24** of the fingers **23**. The actuating means **15** provides actuating force for moving each contact surface of member **14** into and out of circuit-making abutting engagement with the contact surface **24** of a different contact finger. During a circuit making operation, the contact surfaces **51** are jointly carried rearwardly from their open circuit position (Fig. 2) into substantial simultaneous engagement with both of the cooperating contact surfaces **24**, and further rearward movement of the contact surfaces **51** to their fully closed positions (Fig. 1) forces the spring means **27** to yield as the relatively stationary contact fingers **23** tilt on their fulcrums. In this manner, conventional contact wiping action is obtained.

Although for the sake of illustration I have shown and described cooperating contact members constructed and arranged for abutting circuit-making engagement, I do not wish to be limited to such an abutting type contact structure. It will soon become apparent that the successful application of my invention does not depend in any respect on the particular nature of the cooperating relationship between the movable and stationary contact members. In lieu of the abutting arrangement illustrated the movable contact member could comprise, for example, a pair of generally parallel contact elements to slide over and be spread-apart by a cooperating blade-like member.

In Figs. 1 and 2 it can be seen that the electroconductive bracket **13** for supporting the movable contact member **14** is mounted on base member **11** by means of a pair of suitable bolts **30** or the like. The bracket **13** has a lower lip **31** provided with a hole for the purpose of connecting a suitable current-conducting member or another breaker stud (not shown) to the breaker. Part of the bracket is disposed adjacent the front surface of the insulating sheet **16** of base member **11**, and a rigid reinforcing member **32** is disposed adjacent the rear surface of the sheet **16** in overlapping relationship with the bracket **13** and the lower supporting angle **20**, respectively. The reinforcing member **32** is provided so that the loading of the insulating sheet **16** in the area between bracket **13** and the relatively stationary contact member **12** will be in compression rather than in flexure. A channel **33** of insulating material is disposed intermediate the reinforcing member **32** and the rear of sheet **16** to provide additional electrical insulation between the sides of member **32** and the fastening bolts **21** and **30**.

The bracket **13** includes a pair of distinct portions comprising spaced-apart upstanding lugs **34** and **35** projecting in front of base member **11**. A removable pivot pin **36** is supported by the lugs **34** and **35**, the axis of the pivot pin extending in a horizontal direction generally parallel to the plane of the base member **11** as viewed in Figs. 1 and 2. The ends of the pivot pin **36** protrude on opposite sides of the lugs **34** and **35**, respectively, and the pin is retained in place by a releasable clamp **37** disposed intermediate the lugs. As is most clearly seen in Fig. 4, the clamp **37** comprises a resilient helical coil loosely encircling pin **36**, the length of the helix corresponding approximately to the span between the lugs **34** and **35**. The opposite ends of the coil of clamp **37** extend tangentially therefrom and are arranged for movement between first and second cooperating positions. In Fig. 2 the ends are shown in a position wherein they releasably engage each other, and in this self-locked position the circumference of the coil is contracted for firmly grasping the encircled pin and preventing axial movement and removal thereof. By separating the ends and permitting them to assume their other position (shown in Fig. 4) in accordance with the resilience of the coil, the circumference of the coil can be expediently expanded for assembling or disassembling purposes.

The opposite sides of the upstanding lugs **34** and **35** are respectively provided with outwardly facing substantially flat, smooth slide surfaces **38** and **39**, and the axis of pivot pin **36** is oriented approximately perpendicular to the slide surfaces **38** and **39**. Disposed adjacent the slide surface **38** of lug **34** and rotatably mounted on a protruding portion of pivot pin **36** is one end **40** of an elongated contact arm **41**; and disposed adjacent the slide surface **39** of lug **35** and rotatably mounted on the oppositely protruding portion of the pivot pin is one end **42** of an elongated contact arm **43**. The contact arms **41** and **43** are arranged in generally parallel relation for joint operation and comprise the movable contact member **14**.

The connection between each movable contact arm **41**, **43** and the electroconductive bracket **13** is arranged to provide three separate current-conducting joints. The first such joint is provided by the bearing surfaces between the contact arm and the pivot pin **36** on which it rotates, that is, between pin **36** and the periphery of a hole **44** which has been located in the one end **40**, **42** to accommodate the pin **36**. The surface of the pivot pin **36** and the periphery of hole **44** may be silver plated and burnished to ensure a wear-resistant, low electric resistance current-conducting path.

It has been found that satisfactory performance of the contact structure will not be realized if the only current-conducting path between a movable contact arm and its supporting bracket is that provided by the pivot pin. This is because pivotal movement of the arm during a circuit breaking operating causes the bearing surfaces and consequently the point of contact between the pivot pin and the cooperating arm to shift from one side of the pin to the other. Such shifting of the contact point during circuit interruption will rapidly lead to an undesirable pitted or eroded condition at this first current-conducting joint unless means is provided for shunting current from the joint while such shifting is taking place. Accordingly, it has been customary to provide a flexible braid or conductor connected in shunt with the pivot pin

between the movable arm and its stationary support. However, this solution to the problem is not entirely satisfactory. Strong magnetic forces present during the interruption of high short-circuit currents tend to deform the flexible braid and cause it to loose the necessary degree of freedom and flexibility. The braid is subject to fatigue and becomes brittle after a time. I prefer not to use a flexible braid.

In accordance with my invention, the first joint provided by the pivot pin **36** is shunted by a second current-conducting joint electrically interconnecting each movable contact arm **41**, **43** and bracket **13**. This second joint is a relatively simple and compact one obtained by providing the pivoted end **40**, **42** of each movable contact arm with a smooth, pertaining slide surface **46** on its relatively broad inner side, i.e., on the side of the contact arm facing the supporting bracket **13**. Each slide surface **46** is disposed generally parallel to the respective adjoining slide surface **38** or **39** of the bracket **13**, and therefore all of the slide surfaces **38**, **39** and **46** are substantially perpendicular to the axis of pivot pin **36** which corresponds to the axis of rotation of the movable contact arms **41** and **43**. The slide surface **46** of each movable contact arm includes at least one raised section **47** which, as can best be seen in Figs. 3 and 4, preferably comprises a convex portion of a cylinder whose axis is disposed perpendicular to the axis of pivot pin **36**. The crest of the raised section **47** is intersected by the hole **44** provided for pivot pin **36**, and it is oriented at approximately a right angle with respect to the longitudinal centerline of the associated contact arm.

The crests of the raised sections **47** of the two slide surfaces **46** respectively cooperate with and are contiguous to the slide surfaces **38** and **39** of bracket **13**, and pivotal movement of the contact arms **41** and **43** on pin **36** causes each crest to slide over the associated surface of the relatively stationary bracket **13**. The contiguous portions of each pair of cooperating slide surfaces define a straight-line contact which provides the second current-conducting joint between each movable contact arm and the supporting bracket. This straight-line contact is intersected by the axis of pivot pin **36**; therefore the second joint actually comprises two short, colinear lines of contact on opposite sides of hole **44**, and parallel paths are provided for current flow between the bracket **13** and each contact arm **41**, **43**. Of course, as an obvious alternative to the specific arrangement illustrated and described above, the raised sections could be located on slide surfaces **38** and **39** and the slide surfaces **46** could be made substantially flat. Furthermore, similar results could be effected by substituting, for example, a spherical portion on slide surface **46** for each half of the cylindrical raised section **47**, whereby the second current conducting joint would comprise two parallel points of contact.

Contact pressure at the joints formed by the respective contiguous slide surfaces is maintained by means of an electroconductive spring member **48** which comprises in one embodiment of my invention, for example, a U-shaped spring clip. As is seen in Figs. 1 and 4, the resilient upstanding elements **49** and **50** of the clip **48** are each split into two fingers and are disposed slidably to bear against the relatively broad outer sides of the contact arms **41** and **43**, respectively, at first and second respective points on each side of bracket **13** disposed on opposite sides of the pivot pin **36**. The electroconductive spring member **48** is securely anchored to the bracket **13**, and since it also slidably engages each movable contact arm it provides the third current-conducting joint. In addition spring member **48** applies a sidewise force which maintains contact pressure at the contiguous surfaces of both pairs of cooperating slide surfaces **38**, **46** and **39**, **46**. The spring member is arranged so that this sidewise force is relatively weak, whereby the movable contact member **14** can be freely pivoted on its supporting bracket **13**. This is possible because the sidewise force is supplemented by a strong electromagnetic force whenever the movable contact member is conducting current.

When the parallel contact arms **41** and **43** conduct alternating current, a magnetic force is established tending to reduce the spacing between these two arms. Since the supporting bracket **13** is disposed intermediate the contact arms, this sidewise magnetic force effectively establishes additional contact pressure at the contiguous slide surfaces **38**, **39** and **46**. In order to obtain optimum performance of the contact structure, it is particularly important that high contact pressure be maintained at the contiguous slide surfaces while these surfaces are moving relative to each other during circuit interruption. The desired strength of contact pressure, which is sufficient to ensure good electrical contact and prevent pitting of the cooperating slide surfaces during a circuit interrupting operation, is provided by the laterally-exerted magnetic force whose magnitude is proportional to the square of the current magnitude. Thus, the greater the current being interrupted the greater will be the contact pressure at the contiguous slide surfaces.

The diameter of hole **44** in the movable contact arms is made slightly greater than the diameter of pivot pin **36**. This loose mounting arrangement permits the contact arms **41** and **43** to rock on pivot pin **36**. The crests of the raised sections **47** of the slide surfaces **46** provide fulcrums for the rocking movement of the arms, and the plane of the rocking movement includes the axis of the pivot pin **36**. This arrangement allows for a certain degree of misalignment of the various parts and a liberal manufacturing tolerance without adversely affecting the positiveness of the electric contact between the movable elements and the supporting bracket **13**.

Since the contiguous portions of the cooperating slide surfaces of each movable contact arm and the supporting bracket define a single straight line corresponding to the crest of the respective raised section **47**, and since this straight line is oriented at approximately a right angle with respect to the longitudinal centerline of the associated contact arm, a positive electric contact at the joint formed by the slide surfaces is ensured throughout a circuit breaking operation of the contact structure. It has been noted above that strong magnetic forces are exerted on the parallel contact arms when they conduct short-circuit current during circuit interruption. These lateral forces tend to deflect each arm, but in spite of such deflection the effectiveness of the current-conducting joint is not impaired and positive electric contact remains made at the fulcrum provided by the crest of raised section **47**.

By utilizing three parallel current-conducting joints for each of the two parallel arms of the movable contact member **14**, the overall electric resistance of the direct connection between each arm and the bracket **13** is efficiently reduced, and in the illustrated embodiment of my invention this resistance is sufficiently low to enable the contact structure to carry 600 amperes continuously at 600 volts A.-C. without exceeding permissible limits of temperature rise. The above-described arrangement permits significant economies to be realized in the required minimum sizes of the various current-carrying parts, and a successful contact structure is obtained without the conventional flexible braids or conductors. It will be noted that there are actually ten parallel paths for current to flow between the movable contact member **14** and the supporting bracket **13**. There are five parallel paths for each arm; namely, one path through pivot pin **36**, two paths through the straight-line contact comprising the respective portions of raised section **47** that are separated by the pin **36**, and two paths through the fingers of resilient element **49** that engage bracket **13** at respectively spaced points. Adequate contact pressure at the cur-

rent-conducting joints formed by the contiguous slide surfaces 38, 46 and 39, 46 is maintained independently of the force being supplied to the movable contact member 14 by the actuating means 15 and without the necessity of untoward precision in the manufacture and alignment of the parts.

In the illustrated embodiment of my invention, the corresponding free ends of the contact arms 41 and 43 are provided respectively with transverse contact surfaces 51 disposed for abutting engagement with the contact surfaces 24 of the relatively stationary contact fingers 23. Rotary movement of the contact arms on pivot pin 36 carires the contact surfaces 51 through arcuate paths which define vertical planes intersecting at approximately right angles the horizontal plane of movement of the relatively stationary contact surfaces 24, as viewed in Figs. 1 and 2. This arrangement permits the convenient utilization of more than one stationary contact finger for each movable contact arm, whereby more than two separate points of circuit-closing engagement can be provided between the movable contact member 14 and the relatively stationary contact member 12.

The cooperating contact surfaces 24 and 51 preferably are made of silver tungsten carbide material which will successfully perform the continuous current-carrying funtcion of the contacts and also the required circuit making and breaking duty without appreciable contact erosion or pitting or contact welding as a result of electric arcing. Therefore it is not necessary to provide separate arcing and main contacts. With the various parts shown in Figs. 1 and 2 appropriately dimensioned, the contact structure will safely carry at least 225 amperes continuously at 600 volts A-C, and the same contact structure can be modified to carry at least 600 amperes continuously merely by changing the relatively stationary contact member 12 so that two additional contact fingers (23) are respectively disposed adjacent those shown and by appropriately extending the contact surfaces 51 of the movable contact arms.

In order to obtain a compact arrangemnet at the cooperating contact surfaces 24 and 51, the contact arms 41 and 43 are spaced closer together at their corresponding free ends than at the pivot pin 36. As is shown in Figs. 2 and 4, this has been accomplished by axially offsetting the free ends of the contact arms with respect to their pivotally connected ends 40 and 42, respectively. In addition, the contact arms are oppositely offset at intermediate portions 52. As is indicated in Figs. 3 and 4, the offset portion 52 of each arm is provided with a transverse hole 53 the centerline of which is oriented parallel to the pivot pin 36.

An actuating member such as a cylindrical impelling shaft 54 is rotatably disposed in the holes 53 of both contact arms 41 and 43, and by this means actuating force is applied to the movable contact member 14 for jointly moving the contact arms 41 and 43 between open and closed circuit positions. In the vicinity of the offset portions 52 of the contact arms, protrusions 55 are formed. These protrusions, which preferably are in the form of curved embossments on the inner sides of the contact arms, are respectively disposed to extend in overhanging relationship with the lugs 34 and 35 of bracket 13. See Fig. 3. In this manner, the current-conducting joints formed by the two pairs of contiguous slide surfaces 38, 46 and 39, 46 are shielded from the electric arc and arc products which may be produced during circuit breaking action of the contact structure. The protrusions 55 will prevent particles of foreign matter generated during circuit breaking action from entering these joints by straight-line paths from the area of arc interruption. Such foreign matter, if permitted to enter the joint, could cause excessive wear and increased contact resistance.

The impelling shaft 54 fits relatively loosely in the holes 53 in the offset portions 52 of the movable contact arms 41 and 43, whereby each arm can slide on shaft 54 while rocking on pivot pin 36. Thus the contact surface 51 of each arm is free to move in a lateral or transverse direction, and such lateral movement is controlled by resilient means associated with the contact arm. As is shown in Figs. 2–4, the resilient means preferably comprises a helical spring 56 disposed on impelling shaft 54 intermediate the contact arms 41 and 43. The spring 56 applies a transverse force to each contact arm and establishes in the arm a relatively weak biasing torque with respect to the pivot provided by the line contact at the joint formed by the associated pair of contiguous slide surfaces. This biasing torque is in a direction tending to spread apart the contact arms. Such movement of each contact arm is stopped and its normal position is determined by a bushing 57 disposed on shaft 54 between a retaining ring 58 and the circular outer side of the offset portion 52 of the arm.

During circuit making action of the contact structure, each contact surface 51 comes into abutting engagement with a contact surface 24 of a relatively stationary contact finger 23, and as the cooperating contact surfaces wipe the contact finger 23 is tilted in opposition to its biasing torque. The arrangement is such that transverse force is supplied to contact surface 51 by contact surface 24 as the contact finger 23 is tilted. Due to the resilient means 56 and the fulcrum provided by the crest of the raised section 47 of the contiguous slide surfaces, the movable contact arm is able to yield to this transverse force and contact surface 51 moves laterally while following the arcuate path of contact surface 24. As a result, the relative movement between the cooperating contact surfaces 24 and 51 is reduced thereby reducing the amount of friction between these cooperating surfaces and improving the performance of the contact structure.

The movable contact member 14 is coupled to the actuating means or crossbar 15 by means of the impelling shaft 54 and a generally U-shaped connecting link 59 securely fastened to the crossbar. Each leg of the connecting link 59 is provided with an extension 60, which as is clearly seen in Fig. 1, is connected to the pivot pin 36. In this manner the crossbar 15 is supported for pivotal movement on the same pin 36 that provides pivotal support for the movable contact member 14.

End portions 61 of impelling shaft 54 extend laterally from the contact arms 41 and 43 and are made eccentric with respect to the cylindrical body of the shaft, as is shown in Figs. 3 and 4. The end portions 61 are coupled to the connecting link 59 in a manner permitting controlled rotation of the shaft 54. This has been done by providing each end portion 61 with flat sides forming a hexagon, parallel sides of the hexagon being positively but resiliently locked between a shoulder 62 of the connecting link 59 and a cooperating cantilever flat spring 63 carried by link 59. See Fig. 1.

By means of a conventional open-end wrench applied to the hexagonal end portion 61, the shaft 54 may be rotated to any one of six angular positions. In each of these six positions, the movable contact member 14 is located in a different relative angular position with respect to the crossbar 15 and with respect to the relatively stationary contact member 12. The purpose of this adjustment is to accurately establish the fully closed position of the movable contact member regardless of liberal manufacturing tolerances, whereby the desired amount of contact wipe can be precisely obtained.

The crossbar 15 is connected to a circuit breaker operating mechanism by means of another link 64 and a connecting member 65. The operating mechanism, which has not been shown, may be of any suitable type for moving the connecting member 65 in a generally horizontal direction (as viewed in Figs. 1 and 2) and thereby reciprocally carrying the crossbar 15 about its pivot between first and second relatively fixed positions.

The crossbar 15 may be extended across the width of the circuit breaker for connection in a similar manner to

other pole units of a multipole circuit breaker. An isolating barrier **66** of insulating material is shown mounted on the crossbar **15** in Fig. 2. Other barriers **67** are provided for the purpose of isolating the various current-conducting parts of the illustrated pole unit from the corresponding parts of adjacent pole units and from ground. A suitable arc chute, not shown in the drawings, may be mounted on the base member **11** to enclose the cooperating contact surfaces **24** and **51** for the conventional purpose of arc extinction.

While I have shown and described a preferred form of my invention by way of illustration, many modifications will occur to those skilled in the art. Therefore, I contemplate by the concluding claims to cover all such modifications as fall within the true spirit and scope of my invention

What I claim as new and desire to secure by Letters Patent of the United States:

1. In the contact structure of an electric circuit interrupter: a base member; an electroconductive bracket mounted on the base member and provided with at least one slide surface; a relatively stationary contact member mounted on the base member in spaced relation to the bracket; a cooperating movable contact arm pivotally supported by the bracket for rotation about an axis oriented approximately perpendicular to the slide surface of said bracket, the movable contact arm having a pertaining surface disposed in contiguous relationship with said slide surface to form a current-conducting joint, one of the surfaces being substantially flat and the other surface having a single raised section defining with the flat surface a straight-line contact, whereby the joint provides for rocking movement by the movable contact arm with respect to the axis of rotation; resilient clamping means for maintaining contact pressure between the contiguous surfaces forming the joint as the movable contact arm rotates; and actuating means coupled to the movable contact arm for moving said arm into and out of circuit making engagement with the stationary contact member.

2. In the contact structure of an electric circuit interrupter: a base member; an electrocondctive bracket mounted on the base member and including at least one distinct portion having a relatively smooth surface; a relatively stationary contact member mounted on the base member in spaced relation to the bracket; a cooperating movable contact arm pivotally supported by the bracket for rotation about an axis oriented approximately perpendicular to the surface of the distinct portion of said bracket, the movable contact arm having a pertaining surface disposed in contiguous relationship with the surface of said distinct portion to form a current-conducting joint, one of the surfaces being substantially flat and the other surface having a raised section defining with the flat surface a straight-line contact intersected by the axis of rotation, whereby the joint provides a pivot for rocking movement by the movable contact arm in a plane including the axis of rotation; means for maintaining contact pressure between the contiguous surfaces forming the joint; and actuating means coupled to the movable contact arm for rotating said arm into and out of circuit making engagement with the stationary contact member.

3. In the contact structure of an electric circuit breaker: a base member; a relatively stationary contact member mounted on the base; an electroconductive supporting bracket mounted on the base in spaced relation to the stationary contact member; an elongated movable contact member pivotally connected to the bracket for rotation about an axis, the connection between supporting bracket and movable contact member including contiguous slide surfaces disposed generally perpendicular to the axis of rotation to form a current-conducting joint, one of said surfaces being substantially flat and the other surface being raised so that the contiguous portions of the surfaces define a single straight line oriented at approximately a right angle with respect to the longitudinal centerline of the movable contact member; means for maintaining contact pressure between the contiguous surfaces forming the joint; and actuating means coupled to the movable contact member to move said member into and out of circuit making engagement with the stationary contact member.

4. In the contact structure of an electric circuit interrupter: a base member; an electroconducitve bracket mounted on the base member; a relatively stationary contact member mounted on the base in spaced relation to the bracket; a cooperating movable contact comprising an elongated member pivotally connected near one end to the bracket for rotation about an axis, the connection between bracket and movable contact member including contiguous slide surfaces disposed generally perpendicular to the axis of rotation to form a current-conducting joint, one of said surfaces being substantially flat and the other surface having a raised section defining with the flat surface a straight-line contact intersected by the axis of rotation and oriented at approximately a right angle with respect to the longitudinal centerline of the movable contact member, whereby the straight-line contact provides a fulcrum for rocking movement by the movable contact member with respect to the axis of rotation; means for maintaining contact pressure between the contiguous surfaces forming the joint; and actuating means coupled to the movable contact member for rotating said member into and out of circuit making engagement with the stationary contact member.

5. An electric circuit breaker contact structure comprising: a base member; an electroconductive bracket including a pivot pin mounted on the base, the pivot pin being disposed to protrude on opposite sides of the bracket and said opposite sides respectively having outwardly facing slide surfaces disposed generally perpendicular to the axis of the pivot pin; a relatively stationary contact member mounted on the base in spaced relation to the bracket; a cooperating movable contact member including a pair of generally parallel arms loosely mounted for pivotal movement on the protruding portions of the pivot pin, respectively, said arms being provided with pertaining surfaces respectively disposed in contiguous relationship with the slide surfaces of said bracket to form a pair of parallel current-conducting joints, one of the contiguous surfaces of each joint being substantially flat and the other being raised to define with the flat surface a line contact; resilient clamping means for maintaining contact pressure between the respective contiguous surfaces of each joint; and actuating means coupled to the movable contact member for pivotally moving said member into and out of circuit making engagement with the stationary contact member.

6. In the contact structure of an electric circuit interrupter: a base member; an electroconductive bracket including a pivot pin mounted on the base, the pivot pin being disposed to protrude on opposite sides of the bracket and said opposite sides respectively having outwardly facing slide surfaces disposed generally perpendicular to the axis of the pivot pin; a relatively stationary contact member mounted on the base in spaced relation to the bracket; a cooperating movable contact member including a pair of generally parallel arms connected for pivotal movement to the protruding portions of the pivot pin, respectively, said arms being provided with pertaining surfaces respectively disposed in contiguous relationship with the slide surfaces of said bracket to form a pair of parallel current-conducting joints, one of the surfaces of each joint being raised relative to the other so that the contiguous portions of the surfaces forming each joint define a single straight line; means for maintaining contact pressure between the respective contiguous surfaces of each joint; and an actuating member pivotally supported by said pivot pin and coupled to the movable contact member for moving said latter member into and out

of circuit making engagement with the stationary contact member.

7. In the contact structure of an electric circuit interrupter: a base member; an electroconductive bracket mounted on the base member and having a substantially flat surface; a relatively stationary contact member mounted on the base member in spaced relation to the bracket; a cooperating movable contact arm pivotally supported by the bracket for rotation about an axis oriented approximately perpendicular to the flat surface of said bracket, the movable contact arm having a pertaining surface disposed in contiguous relationship with said flat surface to form a first current-conducting joint, the pertaining surface having a relatively curved section defining with the flat surface a line contact intersected by the axis of rotation, whereby the first joint provides for rocking movement by the movable contact arm with respect to the axis of rotation; an electroconductive spring member

anchored to the bracket and bearing against the movable contact arm to maintain contact pressure at the first joint and to provide a second current-conducting joint with the movable contact arm; and actuating means coupled to the movable contact arm for moving said arm into and out of circuit making engagement with the stationary contact member.

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