

May 8, 1962

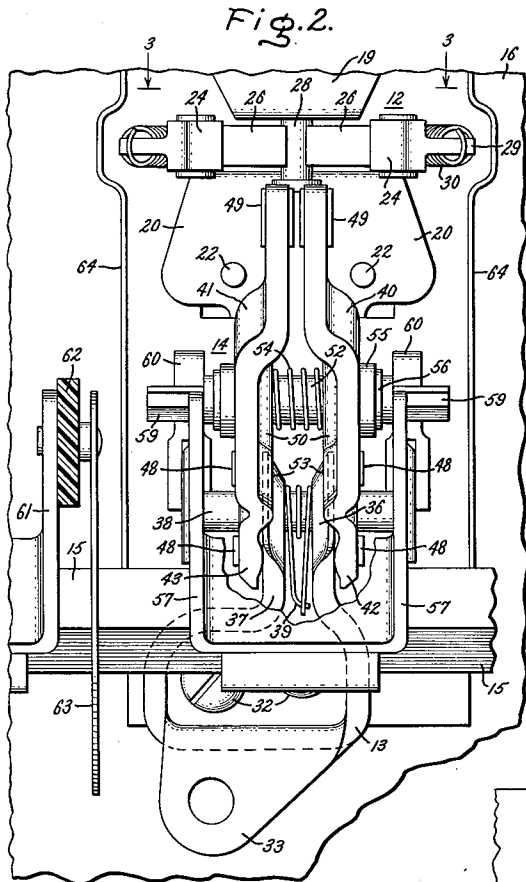
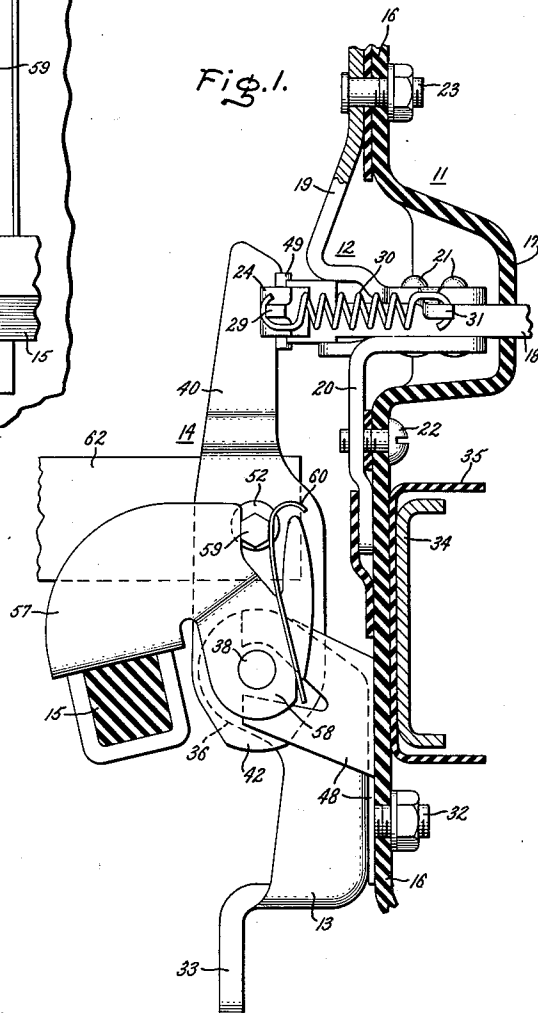
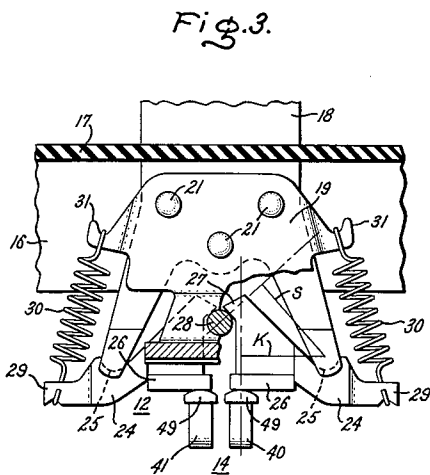
C. H. TITUS

3,033,964

ELECTRIC CIRCUIT INTERRUPTER

Filed Oct. 1, 1958

2 Sheets-Sheet 1



Inventor:
Charles H. Titus,
by *Erving H. Marshman*
His Attorney.

May 8, 1962

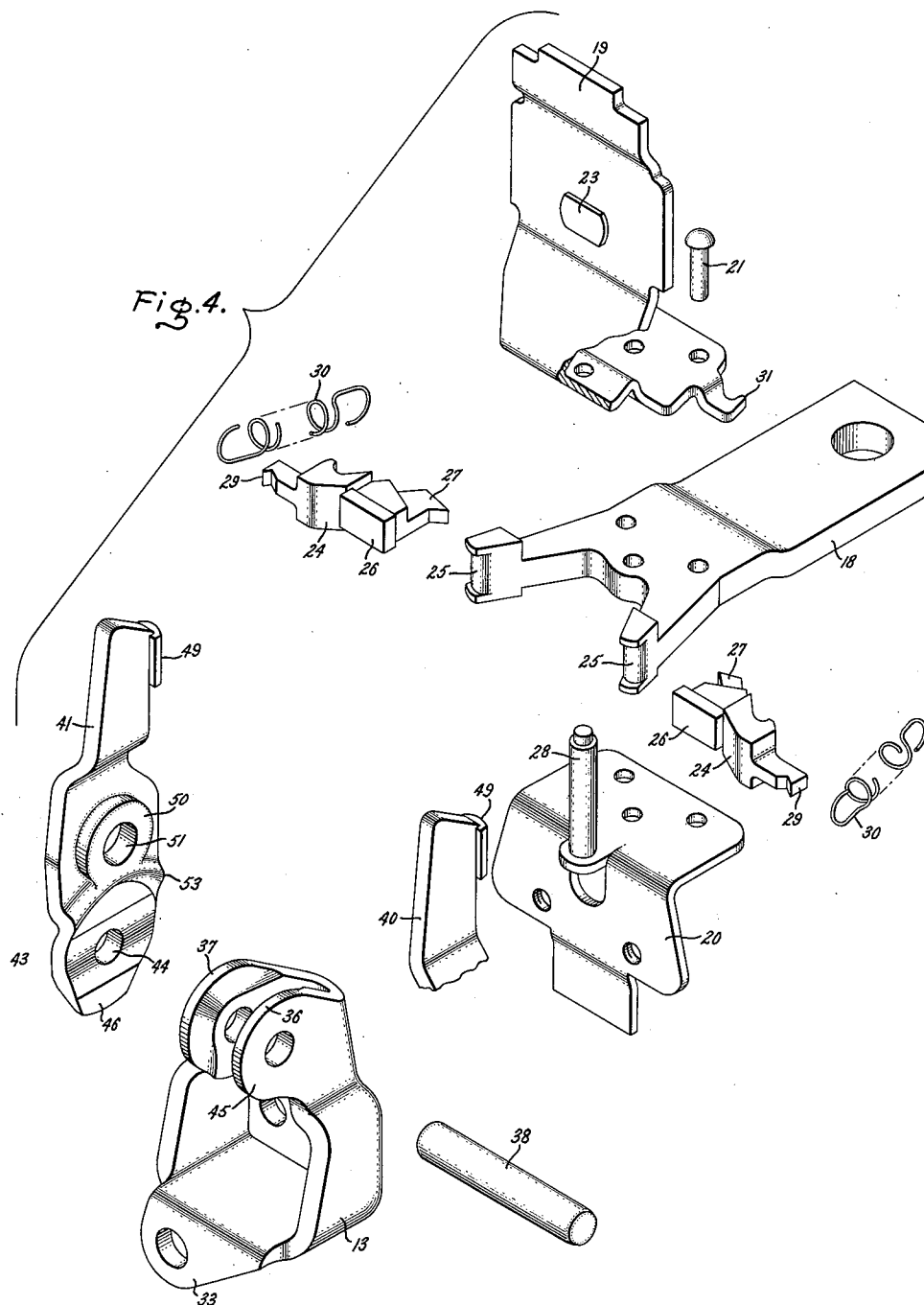
C. H. TITUS

3,033,964

ELECTRIC CIRCUIT INTERRUPTER

Filed Oct. 1, 1958

2 Sheets-Sheet 2



Inventor:
Charles H. Titus,
by *Irving H. Marshman*
His Attorney.

1

3,033,964

ELECTRIC CIRCUIT INTERRUPTER

Charles H. Titus, Havertown, Pa., assignor to General Electric Company, a corporation of New York
Filed Oct. 1, 1958, Ser. No. 764,643
4 Claims. (Cl. 200—166)

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

One object of the invention is the provision of a circuit interrupter contact structure having a simple but effective relatively stationary contact member that is both inexpensive to manufacture and conveniently accessible for the purpose of servicing.

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

In carrying out my invention in one form, an electric circuit breaker is provided with a relatively stationary contact member comprising an elongated contact element pivotally supported intermediate its ends on an electroconductive fulcrum. Spring means is associated with one end of the contact element for establishing a biasing torque in the element, and suitable stop means is disposed to engage the other end of the element to determine the limit of its pivotal movement under the influence of the biasing torque. The contact element forms a current-conducting joint with the fulcrum. The contact element is provided with a contact surface at its other end, and a cooperating movable contact member is disposed for circuit making abutting engagement with this contact surface whereby the relatively stationary contact element is tilted on its fulcrum in opposition to the biasing torque.

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 shown in its closed circuit position;

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

FIG. 3 is a plan sectional view of the contact structure of FIG. 2 taken along the line 3—3 and showing the stationary contact member with the cooperating movable contact member in an intermediate position; and

FIG. 4 is an exploded perspective view of the relatively stationary contact member constructed in accordance with my invention together with a pair of cooperating movable contact arms and their supporting bracket.

Referring now to FIG. 1, I have shown an electric circuit 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, and other similar pole units (not shown) can be mounted for gang operation on the base member 11 adjacent to the pole unit that has been illustrated in FIGS. 1 and 2.

The base member 11 supports the current-conducting

2

studs of the breaker and the other breaker parts directly connected to the studs. As illustrated in FIG. 1, the base member 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 purpose of the present description, the contact structure 12—14 will be considered to be mounted on the front of the base, and the upper breaker stud 18 is connected to a suitable electric power source (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 is 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 best 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 21 or the like. The lower angle 20 is provided with a pair of tapped holes, and a pair of appropriate bolts 22 and 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 FIGS. 1 and 4, serves as an arc runner in cooperation with the stationary contact member 12. This angle is provided with a stud 23 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 accordance with my invention, the stationary contact member 12 comprises at least one pair of elongated elements or fingers 24, each finger 24 being pivotally supported intermediate its ends on the outer end of a different diverging branch of the breaker stud 18 as is shown most clearly in FIGS. 3 and 4. For this purpose, I provide the outer ends of the diverging branches with generally cylindrical bearing surfaces 25, respectively, having centerlines oriented in a vertical direction as viewed in the drawings. Each bearing surface 25 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 24 in side-by-side relation.

Each of the two bearing surfaces 25 at the outer ends of the diverging branches of the breaker stud 18 provides a fulcrum or pivot for at least one contact finger 24, and the pivotal connection between each contact finger and the breaker stud forms a current-conducting joint. As can be clearly seen in FIGS. 2—4, the contact fingers 24 are respectively supported on opposite bearing surfaces 25 in opposing relationship with respect to each other for pivotal movement in a common horizontal plane. The opposing or inner ends of the contact fingers are movable in separate relatively short arcuate paths, and the opposing ends are respectively provided with generally flat complementary contact surfaces 26 normally disposed in a common vertical plane as viewed in the drawings.

The inner end of each contact finger 24 has an extension 27 disposed to engage a common stop 28 for determining the limit of the arcuate movement of the contact surface 26 in one direction. The stop 28, as is shown in the illustrated embodiment of my invention, comprises a cylindrical pin disposed intermediate the diver-

gent branches of the breaker stud 18 and fixedly connected to the upper and lower supporting angles 19 and 20. Thus, as best seen in FIGS. 3 and 4, the pin 28 is intermediate the opposing contact fingers 24 and is normal to the common horizontal plane of movement of these fingers. A stop pin having a square cross-section or the like may be used instead of the illustrated cylindrical pin if desired, and I have found a square pin to be advantageous from the point of view of easy assembly of the contact fingers 24 on the breaker stud 18.

Associated with the outer end 29 of each contact finger 24 is suitable spring means, for example, the illustrated tension spring 30 which may be anchored at one end to a fixed member such as provided by the laterally extending lugs 31 of the upper supporting angle 19. Springs 30 establish oppositely directed biasing torques in the respective contact fingers 24 tending to move each contact surface 26 along its arcuate path in a forward direction away from the base member 11, and such movement of the respective fingers is limited by the stop pin 28. The bias springs 30 also serve releasably to hold each of the fingers 24 against its respective bearing surface of fulcrum 25. The above-described structure provides for a relatively limited deflection or tilting of the contact fingers in a rearward direction.

The biasing torque is opposed and overcome and each contact finger 24 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 49 which move in parallel planes disposed approximately perpendicular to the plane defined by the arcuate paths of the contact surfaces 26 of the fingers 24. The actuating means 15 provides actuating force for moving each contact surface 49 of member 14 into and out of circuit-making abutting engagement with the contact surface 26 of a different contact finger with relatively little sliding movement taking place between the cooperating surfaces 26 and 49.

During a circuit making operation, the contact surfaces 49 of the movable contact member 14 are jointly carried rearwardly from their open circuit position (FIG. 2) into substantially simultaneous engagement with both of the cooperating contact surfaces 26. FIG. 3 shows the relative positions of the parts when circuit-making engagement is initially established, and further rearward movement of the contact surfaces 49 to their fully closed position (FIG. 1) forces spring means 30 to yield as the relatively stationary contact fingers 24 tilt on their respective fulcrums 25. In this manner, conventional contact wiping action is obtained.

With the movable contact member 14 in its fully closed position in cooperation with the relatively stationary contact member 12, two parallel paths for current flow are established. When the contact structure is conducting alternating current, an electromagnetic force proportional to the square of current magnitude will tend to reduce the spacing between these two parallel paths. As a result, a desirable increase in contact pressure is realized at the cooperating contact surfaces 26 and 49, but an undesirable reduction in contact pressure tends to take place at the point of contact between each finger 24 and its fulcrum 25. In order to ensure that there is always sufficient force effective to obtain a good current-conducting joint between the fingers 24 and breaker stud 18, with negligible pitting or erosion at fulcrums 25, I constructed and arranged the relatively stationary contact member 12 so that the arcuate path of the portion of each contact surface 26 engaged by a contact surface 49 of the movable contact member is spaced from the associated fulcrum 25 a distance substantially greater than the length of the moment arm of the line of action of the tension spring 30 with respect to the fulcrum

25. In other words, the line of action of the biasing spring force is placed relatively close to the fulcrum, and consequently the force exerted by the contact finger 24 on fulcrum 25 will be more than twice the amount of force that is applied to contact surface 26 by the movable contact member 14.

It is particularly important for successful performance of the contact member 12 that the high contact pressure between each contact finger 24 and its fulcrum 25 be maintained as the cooperating contact surfaces 49 and 26 part and an electric arc is drawn during circuit opening or breaking action of the contact structure. Toward this end, the relatively stationary contact member 12 is constructed so that the length of the moment arm (K of FIG. 3) of the resultant contact force exerted on surface 26 with respect to fulcrum 25 just before the cooperating surface 49 disengages surface 26 is substantially equal to the length of the moment arm (S in FIG. 3) of the resultant reactive force at stop pin 28 with respect to fulcrum 25. By thus making the moment arm S approximately equal to the distance between fulcrum 25 and the portion of surface 26 that is engaged by surface 49, the contact pressure at fulcrum 25 is not significantly reduced during the relatively short arcing period immediately following physical separation of the movable and relatively stationary contact members 14 and 12.

The performance of the current-conducting joint between each relatively stationary contact finger 24 and its fulcrum 25 is further improved by minimizing the translation between these cooperating parts, that is, by ensuring that the point of contact between each finger and its fulcrum does not shift appreciably as the movable contact member 14 separates from the stationary contact member 12 during a circuit breaking operation. This desired result is achieved by the above-described structure of the relatively stationary contact member 12. Furthermore, as is apparent from the drawings, the relatively stationary contact structure is uncomplicated to manufacture and very conveniently accessible for servicing. By simply releasing the tension springs 30, the stationary contact fingers 24 can be easily and quickly removed and replaced for the purpose of carrying out a routine maintenance procedure without any particular skill being required on the part of the maintenance man.

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 32 or the like, as can be seen in FIGURES 1 and 2. The bracket 13 has a lower lip 33 provided with a hole for the purpose of connecting a suitable current-conducting member or another breaker stud (not shown) to the bracket. Part of the bracket 13 is disposed adjacent the front surface of the insulating sheet 16 of the base member 11, and a rigid reinforcing member 34 is disposed adjacent the rear surface of the sheet 16 in overlapping relationship with bracket 13 and the lower supporting angle 20, respectively. The reinforcing member 34 is provided so that the loading of the insulating sheet 16 in the area between the bracket 13 and the relatively stationary contact member 12 will be in compression rather than in flexure. A channel 35 of insulating material is disposed intermediate the reinforcing member 34 and the rear of sheet 16 to provide additional electrical insulation between the sides of member 34 and the fastening bolts 22 and 32.

The bracket 13 includes a pair of spaced-apart upstanding lugs 36 and 37 projecting in front of base member 11. A removable pivot pin 38 is supported by the lugs 36 and 37, 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 pivot pin 38, which passes through both of the lugs 36 and 37 and protrudes from their outwardly facing sides, respectively, is retained in place by a releasable clamp 39 connected to the pin intermediate the lugs. The clamp 39 prefer-

5

ably comprises a resilient helical coil loosely encircling pin 38, the length of the helix corresponding approximately to the span between the lugs 36 and 37. The opposite ends of the coil of clamp 39 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 in accordance with the resilience of the coil, the circumference of the coil can be expediently expanded for assembling or disassembling purposes.

The connection between the movable contact member 14 and the supporting bracket 13 will now be described with particular reference to FIGS. 2 and 4. The movable contact member 14 comprises a pair of elongated contact arms 40 and 41 arranged in generally parallel relation for joint operation. One end 42 of the arm 40 is disposed adjacent the outwardly facing side of the upstanding lug 36 and is rotatably mounted on a protruding portion of pivot pin 38; and one end 43 of the other contact arm 41 is disposed adjacent the outwardly facing side of lug 37 for rotatable mounting on the opposite protruding portion of the pivot pin.

The connection between each movable contact arm 40, 41 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 38 on which it rotates, that is, between pin 38 and the periphery of a hole 44 which has been located in the one end 42, 43 to accommodate the pin 38. The surface of the pivot pin 38 and the periphery of hole 44 may be silver plated and burnished to ensure a wear-resistant, low electric resistance current-conducting path.

The second current-conducting joint is obtained by providing the outwardly facing side of each lug 36, 37 of the bracket 13 with a substantially flat, smooth slide surface 45 disposed generally perpendicular to the axis of the pivot pin 38. Each slide surface 45 is contiguous to a smooth, pertaining slide surface 46 provided on the relatively broad inner side of the pivoted end 42, 43 of each movable contact arm 40, 41, 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 45 of the bracket 13, and therefore all of the slide surfaces 45 and 46 are substantially perpendicular to the axis of pivot pin 38 which corresponds to the axis of rotation of the movable contact arms 40 and 41.

The slide surface 46 of each movable contact arm includes a raised section which, as can best be seen in FIG. 4, preferably comprises a portion of a cylinder. The crest of this raised section is oriented so that it extends in a direction substantially perpendicular to the longitudinal centerline of the contact arm, and it is intersected by the hole 44 provided for pivot pin 38. The crests of the raised sections of the two slide surfaces 46 respectively cooperate with and are contiguous to the slide surfaces 45 of bracket 13, and pivotal movement of the contact arms on pin 38 causes each crest to slide over the associated slide surface of the relatively stationary bracket 13. The contiguous portions of each pair of cooperating slide surfaces define a line contact which provides the second current-conducting joint between each movable contact arm and the supporting bracket. Of course, as an alternative to the specific arrangement illustrated and described above, a raised section could be located on each of the slide surfaces 45 and the slide surfaces 46 could be made substantially flat.

Contact pressure at the joints formed by the respective pairs of contiguous slide surfaces 45 and 46 is maintained by means of an electroconductive spring member 48 which

6

preferably comprises a U-shaped spring clip. As indicated in FIGS. 1 and 2, the resilient upstanding legs of the clip 48 are split for respectively bearing against the outer sides of the pivoted ends 42 and 43 of the contact arms 40 and 41 at points disposed on opposite sides of the pivot pin 38. The electroconductive spring member 48 is secured to the bracket 13, and since it also is in engagement with 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 45 and 46. This force is supplemented by an electromagnetic force whenever the movable contact member 14 is conducting current. Whenever the parallel contact arms 40 and 41 conduct alternating current, a magnetic force is established tending to reduce the spacing between these two arms and thereby establishing additional contact pressure at the contiguous slide surfaces, the magnitude of this sidewise force being proportional to the square of the current magnitude.

The diameter of the hole 44 in the pivoted ends of the movable contact arms is made slightly greater than the diameter of pivot pin 38. This arrangement permits the contact arms 40 and 41 to rock on pivot pin 38. The crests of the raised sections of the slide surfaces 46 provide fulcrums for the rocking movement of the arms 40 and 41, respectively, and this rocking movement takes place in a plane perpendicular to the planes of pivotal movement of the arms. 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.

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 pivotal connection has been efficiently reduced thereby significantly decreasing temperature rise. In this manner it is possible to obtain a successful contact structure without conventional flexible braids or conductors.

In the illustrated embodiment of my invention, the corresponding free ends of the contact arms 40 and 41 are provided respectively with transverse contact surfaces 49 disposed for abutting engagement with the contact surfaces 26 of the relatively stationary contact fingers 24. Rotary or pivotal movement of the contact arms on pivot pin 38 carries the contact surfaces 49 through arcuate paths which define vertical planes intersecting at approximately right angles the horizontal plane of movement of the relatively stationary contact surfaces 26, as viewed in the drawings. 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 26 and 49 preferably are made of silver tungsten carbide material which will successfully perform the continuous current-carrying function 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 contact fingers (24) are respectively disposed adjacent those shown and by appropriately extending the contact surfaces 49 of the movable contact arms.

In order to obtain a compact arrangement at the cooperating contact surfaces 26 and 49, the contact arms

7

40 and 41 are spaced closer together at their corresponding free ends than at the pivot pin 38. 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 the pivotally connected ends 42 and 43, respectively. In addition, the contact arms are oppositely offset at intermediate portions 50. As is indicated in FIG. 4, the offset portion 50 of each arm is provided with a transverse hole 51 the centerline of which is oriented parallel to the pivot pin 38.

An actuating member such as a cylindrical impelling shaft 52 is rotatably disposed in the holes 51 of both contact arms 40 and 41, and by this means actuating force is applied to the movable contact member 14 for jointly moving the contact arms 40 and 41 between open and closed circuit positions. In the vicinity of the offset portions 50 of the contact arms, protrusions 53 are formed. The protrusions 53, which preferably are in the form of curved embossments on the inner sides of the contact arms, are respectively disposed to extend in overlapping relationship with the lugs 36 and 37 of bracket 13. In this manner, the current-conducting joints formed by the two pairs of contiguous slide surfaces 45 and 46 are shielded from the electric arc and arc products which may be produced during circuit breaking action of the contact structure. The protrusions 53 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 52 fits relatively loosely in the holes 51 of the offset portions 50 of the movable contact arms 40 and 41, whereby each arm can slide on shaft 52 while rocking on pivot pin 38. Thus the contact surface 49 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 FIG. 2, the resilient means preferably comprises a helical spring 54 disposed on impelling shaft 52 intermediate the contact arms 40 and 41. The spring 54 applies a transverse force to each contact arm and establishes in each 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 45 and 46. 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 55 disposed on shaft 52 between a retaining ring 56 or the like and the circular outer side of the offset portion 50 of the arm. See FIG. 2.

During circuit making action of the contact structure, each contact surface 49 comes into abutting engagement with a contact surface 26 of a relatively stationary contact finger 24, and as the cooperating contact surfaces wipe the contact finger 24 is tilted in opposition to its biasing torque provided by spring 30. The arrangement is such that transverse force is supplied to contact surface 49 by contact surface 26 as the contact finger 24 is tilted. Due to the resilient means 54 and to the fulcrum provided by the crest of the raised section of the contiguous slide surfaces 45 and 46, the movable contact arm is able to yield to this transverse force, and contact surface 49 moves laterally while following the arcuate path of contact surface 26. As a result, the relative movement between the cooperating contact surfaces 26 and 49 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 an actuating member 57 coupled to the impelling shaft 52 and preferably comprising a generally U-shaped connecting link securely fastened to the crossbar. Each leg of the connecting link 57 is provided with an extension 58 connected to

8

the pivot pin 38 as shown in FIG. 1, and thus the crossbar 15 is supported for pivotal movement by pin 38. End portions 59 of impelling shaft 52 extend laterally from the contact arms 40 and 41 and are made eccentric with respect to the cylindrical body of the shaft, as is shown in FIGS. 1 and 2. The end portions 59 are coupled to the connecting link 57 in a manner permitting controlled rotation of the shaft 52. This has been done by providing each end portion 59 with flat sides forming a hexagon, parallel sides of the hexagon being positively but resiliently locked between a shoulder of a connecting link 57 and a cooperating cantilever flat spring 60 carried by link 57. See FIG. 1.

By means of a conventional open-end wrench applied to the hexagonal end portion 59, the shaft 52 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 61 and a connecting member 62. The operating mechanism, which has not been shown, may be of any suitable type for moving the connecting member 62 in a generally horizontal direction (as viewed in FIGS. 1 and 2) thereby reciprocally moving 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 63 of insulating material is shown mounted on the crossbar 15 in FIG. 2. Other barriers 64 are provided for the purpose of isolating the various current-conducting parts of the illustrated pole units 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 26 and 49 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 is:

1. In a contact structure of an electric circuit interrupter; a base member; a relatively stationary contact mounted on the base comprising an elongated contact element pivotally supported intermediate its ends on a fulcrum, spring means associated with one end of the contact element for releasably holding the element against said fulcrum and for establishing a biasing torque in the element, and stop means disposed to engage the other end of the element to determine the limit of its pivotal movement under the influence of the biasing torque, the stop means being disposed so that the moment arm of the resultant reactive force at the stop means with respect to the fulcrum is a predetermined length, said element having at said other end a generally flat contact surface spaced from the fulcrum a distance approximately equal to said predetermined length; a bracket mounted on the base in spaced relation to the stationary contact; a movable contact member supported by the bracket for movement into circuit making engagement with the contact surface of the relatively stationary contact element thereby tilting the element on its fulcrum in opposition to the biasing torque; and actuating means coupled to the movable contact member for moving said member.

2. In the contact structure of an electric circuit interrupter: a base member; a relatively stationary contact member mounted on the base and including at least one pair of opposing contact fingers supported intermediate their respective ends on spaced-apart fulcrums for pivotal movement in a first common plane, spring means associated with said contact fingers for establishing oppositely directed biasing torques in the respective fingers, and a stop pin located intermediate the fingers for abutting engagement with the opposing ends of both fingers to determine the limit of pivotal movement of each finger under the influence of its biasing torque, the opposing ends of the fingers being respectively provided with generally flat contact surfaces normally disposed in a second common plane which is perpendicular to said first common plane; a bracket mounted on the base in spaced relation to the stationary contact member; a movable contact member supported by the bracket for movement into circuit making abutting engagement with the contact surfaces of both of the relatively stationary contact fingers thereby tilting the fingers on their respective fulcrums in opposition to their respective biasing torques; and actuating means coupled to the movable contact member for providing actuating force therefor.

3. In the contact structure of an electric circuit interrupter: a base member; a relatively stationary contact comprising an electroconductive member mounted on the base and disposed to provide a fulcrum, a contact finger pivotally supported intermediate its ends on the fulcrum to form therewith a first current-conducting joint, spring means associated with one end of the contact finger for establishing a biasing torque in the finger, and stop means disposed to engage the other end of the finger to determine the limit of its pivotal movement produced by the biasing torque, the stop pin being disposed so that the moment arm of the resultant reactive force at the stop pin with respect to the fulcrum is a predetermined length, the finger having at said other end a generally flat contact surface spaced from the fulcrum a distance approximately equal to said predetermined length; an electroconductive bracket mounted on the base in spaced relation to the stationary contact; a movable contact member rotatably connected to the bracket for movement into circuit making engagement with the contact surface of the relatively stationary contact finger and thereby tilting the finger on its fulcrum in opposition to the biasing torque, the connection between the bracket and the movable contact member including contiguous slide surfaces disposed generally perpendicular to the axis of rotation to form a second current-conducting joint; and actuating means coupled to the movable contact member for rotating said member.

4. In the contact structure of an electric circuit interrupter: a base member; a relatively stationary contact comprising an electroconductive member mounted on the

base and disposed to provide a fulcrum, a contact finger pivotally supported intermediate its ends on the fulcrum to form therewith a first current-conducting joint, the finger being movable at one end in an arcuate path, spring means associated with the other end of the finger for establishing a biasing torque in the finger tending to move said one end in a given direction along said arcuate path, and stop means disposed to engage the finger near said one end to determine the limit of the arcuate movement of said one end in said given direction; an electroconductive bracket mounted on the base in spaced relation to the stationary contact; a movable contact arm rotatably connected to the bracket for movement at one end along an arcuate path, said arm being disposed in relation to the contact finger so that the respective arcuate paths define intersecting planes, the connection between bracket and arm including contiguous slide surfaces disposed generally perpendicular to the axis of rotation to form a second current-conducting joint, one of said surfaces being substantially flat and the other being raised so that the contiguous portions of the surfaces define a straight line; an electroconductive spring member engaging the bracket and the movable contact arm to maintain contact pressure at the second joint and to provide another current-conducting joint with the movable contact arm; and actuating means coupled to the movable contact arm to move the one end of said arm into and out of circuit making engagement with the one end of said relatively stationary contact finger.

References Cited in the file of this patent

UNITED STATES PATENTS

856,737	Sill	June 11, 1907
1,935,512	Massey	Nov. 14, 1933
1,978,246	Bauerschmidt	Oct. 23, 1934
2,090,754	Graves	Aug. 24, 1937
2,095,554	Maseng	Oct. 12, 1937
2,347,030	Crabbs	Apr. 18, 1944
2,471,608	Caswell	May 31, 1949
2,546,366	Lindae	Mar. 27, 1951
2,581,181	Faure	Jan. 1, 1952
2,627,559	Metzel	Feb. 3, 1953
2,636,961	Schneider	Apr. 28, 1953
2,650,284	Volgovskoy	Aug. 25, 1953
2,691,085	Beatty	Oct. 5, 1954
2,790,050	Fawdrey et al.	Apr. 23, 1957
2,918,552	Fust	Dec. 22, 1959
2,938,986	Baskerville	May 31, 1960

FOREIGN PATENTS

566,402	France	Nov. 22, 1923
578,057	Germany	June 9, 1933
537,356	Great Britain	June 18, 1941