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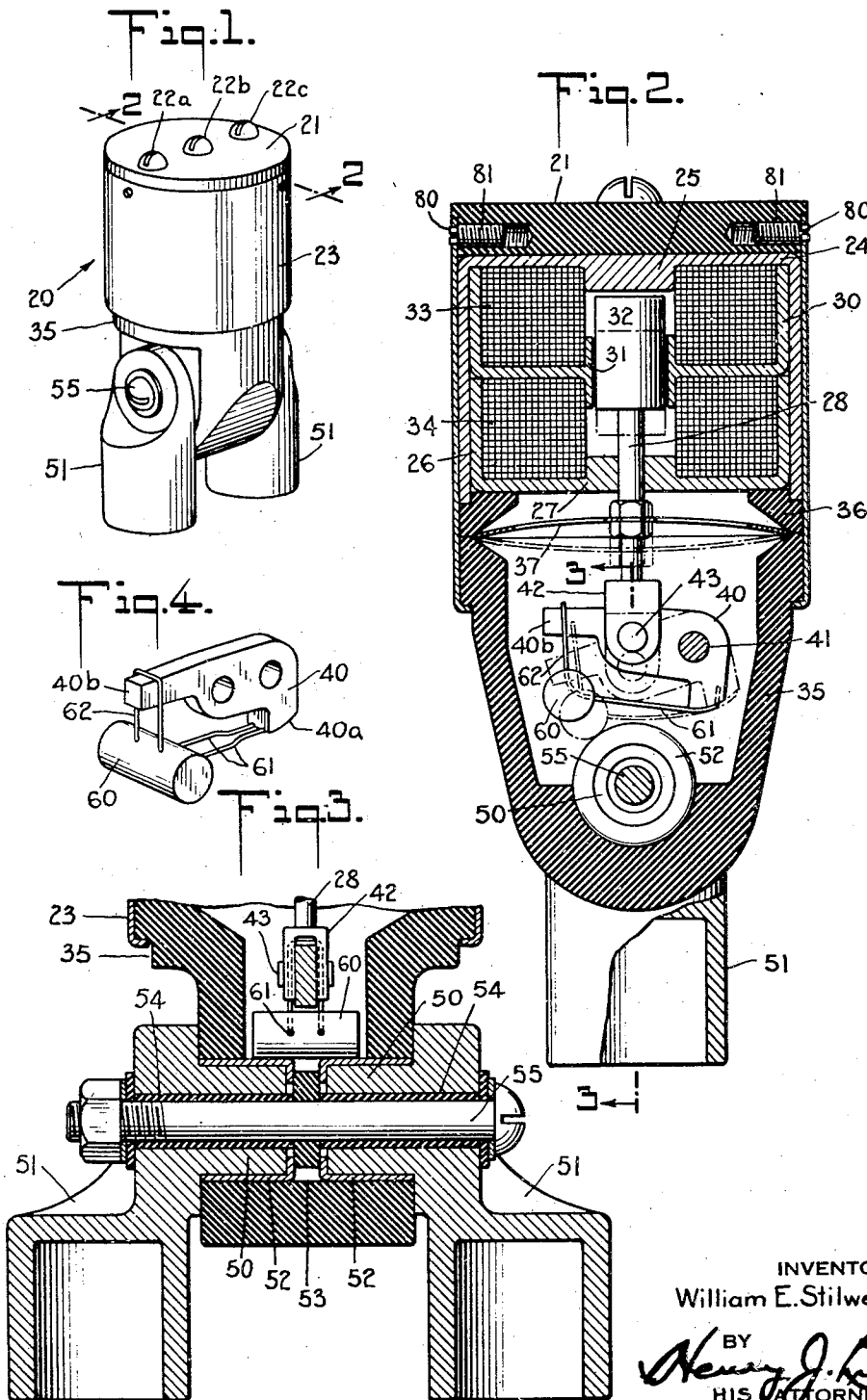
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ELECTRIC CIRCUIT BREAKER

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ELECTRIC CIRCUIT BREAKER

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10 Claims. (Cl. 200—166)

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This invention relates to electric circuit breakers, and particularly to improvements in the contact members and terminals thereof.

It is an object of the invention to provide an electric circuit breaker or switch, which may be of the remotely controllable type, having great current-carrying capacity and ability to break high amperage circuits without damage.

It is an object of the invention to provide an improved circuit breaker in which the fixed and movable contacts are of a novel type, so organized that the movable contact, after initially engaging the fixed contact to complete the circuit, is drawn over the surface of the said fixed contact and is subsequently held firmly against said fixed contact to maintain a closed circuit condition without danger of accidental interruption from means such as excessive vibration or the inertia of sudden change in position.

It is an object of the invention to provide an electric circuit breaker of small size and light weight embodying improved contact means capable of breaking high amperage circuits and having a long life span.

It is an object of the invention to provide improved movable contact mechanism in an electric circuit breaker.

It is an object of the invention to provide an improved fixed contact organization for an electric circuit breaker.

It is an object of the invention to provide an improved combined terminal and fixed contact.

It is an object of the invention to provide an improved soldering lug combined with a fixed contact capable of ready renewal and adjustability.

According to a preferred form of the invention, the circuit breaker includes one or more fixed contacts associated with which is a movable contact assembly which is movable into or out of circuit closing position by any suitable means, such as an electro-magnet and armature organization or the like. Most preferably, the movable contact is of the nature of a shorting bar of silver or other material of high conductivity, carried by a lever having two lever arms. The shorting bar is secured by a spring fixed to one of the arms of the lever; and the mounting of the lever is such that the arm to which the shorting bar spring is attached rotates away from the fixed contact.

In such preferred embodiment, means, desirably electromagnetic, are provided to rotate the lever and associated shorting bar in the direction of the fixed contacts, the movable contact mak-

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ing engagement therewith prior to the completion of the lever movement. The movable contact is drawn over the surface of the fixed contact after its initial engagement therewith, thereby effecting a "wipe" contact, which is highly desirable. The final stage of rotation of the lever—it being understood that the operations enumerated above are almost instantaneously effected—is for a second arm or structure of the lever to press the movable contact forcibly against the fixed contact to insure the making of a firm connection. By suitable mounting of the movable contact with respect to the lever, the wipe contact of said movable contact may continue during the stage when the second arm of the lever is pressing the movable contact into the firm circuit-closing engagement aforesaid.

In a preferred form of the invention, the load-line connection terminals have cylindrical extensions provided with a coating or sleeve of silver which may be shrunk thereon or otherwise secured thereto in good electrical connection therewith. Such combination of connection terminal and fixed contact assembly eliminates troublesome connections of the nature of wires, buss-bars or the like which must be soldered or otherwise connected to the fixed contacts and terminals or soldering lugs respectively. By providing said cylindrical extensions on the terminals, and by suitable mounting of the same, the terminals may be rotated to bring fresh contacting surfaces within the field of engagement of the movable contact.

A material reduction in weight of contacts, without sacrifice of current-carrying capacity, derives from the employment of cylindrical fixed contacts placed in end-to-end adjacency, as later more fully set forth.

According to a second form of fixed contact organization the contacting element thereof is not integral with the load-line terminal per se and is rotatable over a 360° angle to utilize the full contacting surface presented by the silver coating or the like; in this second embodiment, also, the electrical connection between the fixed contacts and their associated load-line terminals is highly efficient.

Features of the invention, therefore, reside in the provision of an improved fixed-movable contact assembly in which the movable contact is initially drawn over the surface of the fixed contact and is subsequently or coincidentally held firmly thereagainst, and the provision of improved terminal means having fixed contacts electrically connected therewith.

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Other features and advantages will be apparent from the description of the invention, and the drawings, in which:

Fig. 1 is a perspective of a preferred embodiment of the invention;

Fig. 2 is an enlarged vertical sectional elevation taken on the lines 2—2 of Fig. 1;

Fig. 3 is an enlarged vertical section taken on the lines 3—3 of Fig. 2, particularizing the structure of a preferred form of contact and the relationship of the movable shorting bar thereto; Fig. 3 does not necessarily show the circuit breaker in closed circuit position;

Fig. 4 is a perspective of the shorting bar and actuating lever therefor;

Fig. 5 is a vertical elevation partly in section of another embodiment of circuit breaker embodying the invention;

Fig. 6 is an elevation in section taken on the lines 6—6 of Fig. 5;

Fig. 7 is a detailed plan view of the lever and shorting bar assembly of the embodiment of Fig. 5;

Fig. 8 is a detailed elevation in section of another form of fixed contact suitable for application with the Fig. 1 embodiment; and

Figs. 9 and 10 are respectively side and end elevations of another form of movable contact organization especially suitable for application to the embodiment of Figs. 1 through 4.

Referring to the drawings, a circuit breaker 20, Fig. 1, comprises a cap 21 of insulation material provided with any suitable number of binding posts 22a, 22b, 22c serving as connection points for the control circuit, not shown. Within a preferably cylindrical housing 23 are a plurality of shells of magnetically responsive material, said shells including a deep cup-like member 24 having a central pole-piece 25; a lower cup-like member 26 having a central pole-piece 27 drilled for the slidable passage of an armature rod 28, and an intermediate shell 30 having a central cylindrical structure 31 which may serve to guide a magnetic armature 32 secured to the end of the rod 28. Preferably said rod 28 is of non-magnetic material such as brass, bronze, or equivalent.

Within the respective chambers provided by the enumerated shells is a pair of electro-magnets 33, 34, the windings of which are connected to the posts 22a etc., in such manner that a wire common to the windings of the two electro-magnets is connected to post 22b; the remaining wire of magnet 33 may be connected to post 22a, and the remaining wire of magnet wire 34 may be connected to post 22c. Therefore an electric circuit embodying a single pole double throw switch, desirably of momentary contact characteristics, may be suitably connected to energize either the electro-magnets 33, 34 independently but not conjointly. An alternative wiring arrangement within the ability of any average electrician may include momentary contact switches individually connected to the respective electro-magnets.

In the discussion of operation of the device to follow, the magnet 33 will be designated the "off" magnet and the magnet 34 will be identified as the "on" magnet.

The contact housing of the circuit breaker may include the combination of a deep cup 35 of moulded insulation material and a ring 36, which may be of moulded insulation material, or of aluminum or other suitable material.

As shown in Fig. 2, the upper edge of body

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member 35 and the lower edge of the ring-like member 36 are sloped to provide, in combination, a circumferential V-shaped slot.

Mounted within the lower body member 35, by engagement of its periphery with the V-slot formed by the confluence of members 35 and 36 is a snap spring 37 having two positions of stable equilibrium, and preferably being of the type disclosed and claimed in my presently co-pending application Ser. No. 441,382, filed May 1, 1942, entitled Toggle springs. A feature of such snap spring is that it throws from one position of stable equilibrium to its second such position upon the exertion of a driving force less than is required to throw the snap-spring through its dead center position; in other words, the snap spring has a "positive flipping" characteristic in its transition from one to the other of its two positions of stable equilibrium.

Said snap spring 37 is mounted on the lower portion of the armature rod 28 as by the illustrated lock nuts; a suitable extent of threading of said rod 28 provides for an adjustment of the rod with respect to the snap spring.

A contact lever 40 of rigid material which may be of the nature of a bell crank having its two operating legs pivoted within the housing 35 as by a shaft 41. At the lower end of the armature shaft 28 is fixed a forked connector 42, secured to the lever 40 as by a wrist pin 43, and it will be apparent that movement of the armature rod 28 downwardly as when the "on" coil 34 is energized, will rotate the lever 40 counter-clockwise, and an opposite direction of rotation accomplished by energization of the "off" coil 33.

The lower portion of housing 35 is provided with a passage within which are located the cylindrical ends 50 of terminals 51 which may have the illustrated socketed soldering lugs or other means for connection to the conductors of the load circuit which is to be controlled by the circuit breaker.

Placed about each cylindrical extension 50, and preferably shrunk thereon to eliminate the necessity of soldering or brazing while insuring adequate electrical connection, is a sleeve 52 of silver or other material of high conductivity, said sleeve 52 forming the fixed contact member of its associated terminal 51. As appears in Fig. 3, cylindrical extensions 50 of the contacts 51 are of such length that they do not meet; in practice they are held apart by a spacer 53 of insulation material. The respective cylindrical portions of the terminals 51 are drilled to receive an insulating sleeve 54 through which extends a bolt 55 or equivalent to hold the two terminals securely in position. By suitable insulating washers, the bolt and associated nut are completely insulated from the respective terminals.

The elements 50 of each of the terminals 51 being cylindrical, the terminals may be rotated with respect to each other within the limits of rotation determined by the shape of the apparatus; in the illustrated form a rotation of some 225° is possible. Therefore, substantially the entire surface of the silver sleeves 52 is available for service as fixed contacts of the circuit breaker.

For association with the fixed contacts, to close the circuit, is a shorting bar 60, of silver or the like, preferably cylindrical, or having a curved contacting surface. Bar 60 is suspended from lever 40 by spring means in which spring members 61 are secured at one end to bar 60 and at the other end to the leg 40a of lever 40. To bar 60 is secured a resilient saddle 62 extending upwardly

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and over the forward leg 40b of the lever 40, see Fig. 4.

The supporting means for bar 60 is so disposed that in open-circuit position, bar 60 is held above and to the side of the contact sleeves 52, see Fig. 2.

When the "on" coil 34 is momentarily energized, the downward impulse of armature 32 and rod 28 causes the snap spring 37 to invert, with counter-clockwise rotation of lever 40. Before the snap spring has completed its full travel, as shown in broken line in Fig. 2, bar 60 has engaged the sleeve contacts 52 and spring 61 is flexed. Continued rotation of lever 40 causes leg 40a thereof to draw bar 60 across the surface of sleeves 52, and either immediately following or coincident with such wiping action, forward leg 40b of lever 40 strikes the shorting bar and holds it firmly against the surface of the sleeves 52, maintaining a secure contact against any tendency to flutter on the sleeves 52. Desirably the leg 40b of the lever 40 engages bar 60 immediately prior to full throw of the snap spring 37 whereupon the constraint thereof imposes a continuous resilient pressure on bar 60.

When "off" coil 33 is energized, lever 40 is rotated clockwise; bar 60 moves across sleeves 52, remaining in contact therewith until forward leg 40b of lever 40 engages saddle 62 to forcibly and smartly break bar 60 out of contact. The closing of the circuit is therefore carried out with an initial wiping action and immediately following pressure engagement, and the breaking of the circuit is delayed for the instant required for the rod 28 to attain a maximum velocity of movement.

Substantial advantages derive from the opposed cylindrical contacts 52 as against conventional domed or button contacts. For a capacity of 400 amperes, for example, domed contacts are three-quarters of an inch in diameter. Assuming a one quarter inch spacing between such contacts, the shortest practicable length of shorting bar for use therewith would be one and a half inches, with a weight of several ounces.

With cylindrical contacts, as 52, spaced one quarter of an inch apart, and allowing for a one quarter inch engagement of the shorting bar with each contact, the length of bar need be but three-quarters of an inch. It has also been established that the shorter the length of the shorting bar, the less its diameter need be for equal current capacity, thus effecting great saving in weight.

Electrical efficiency, simplicity, and reduction of weight of the circuit breaker are accomplished by the combination of cylindrical contacts 52 with the terminal lugs 51.

In another embodiment of terminal construction, see Fig. 8, the member 50a carrying the sleeve 52a has a taper fit with a conical extension 51b of terminal lug 51a. Such construction affords a 360° rotation of the cylinder 50a to make the entire sleeve surface 52a available, and the accommodation of variant angular positioning of cables of the load-line circuit. The taper fit of the cylinder 50a with the terminal 51a provides excellent electrical connection.

The housing 23 is preferably of aluminum, and has a flange which engages with a suitable peripheral shoulder about the member 35. The upper portion of the housing 23 is drilled with a suitable number of relatively small holes, just large enough to accommodate the heads 80 of set-screws 81, an enlarged threaded shank of which engages with threaded holes in the cap 21.

When the respective body members of the cir-

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cuit breaker are assembled they are held together by the housing 23 and its securement by the heads 80 of the set-screws. When it is desired to disassemble the structure, the terminals 51 are removed and the set-screws 81 are screwed inwardly to an extent wherein the heads thereof clear the housing 23. The cap 21 may be removed and the housing 23 slid downwardly over the body 35 to permit the complete disassembly of the circuit breaker.

Figs. 9 and 10 show a second form of movable contact organization, illustratively employed with the embodiment of Fig. 1. Such movable contact assembly includes a head 70 fixed to the end of rod 28; a pair of generally U-shaped springs 71 passes through head 70 and carry at their inwardly turned ends, a pair of silver shorting bars 72, 72. The bars 72 are therefore suspended from the head 70 by the pair of spring members 71, and in an "off" position of the circuit breaker corresponding to Figs. 9 and 10, the two shorting bars 72 are positioned above the fixed contacts 52, equidistant from the vertical center plane of such contacts 52.

Secured to each of the shorting bars 72 and extending upwardly and over the spring members 71 are U-shaped saddles 73 which may or may not be of spring material.

In a circuit breaker embodying this type of movable contact, a downward movement of the armature rod 28 causes the shorting bars 72 to strike against the surface of the fixed contact 52; and by having the initial contact occur before the bar 28 has attained its full downward travel the shorting bars, being resiliently mounted on the spring structure, spread apart, while maintaining contact with the terminals 52 to attain a wiping action. By making the spring members 71 of suitable stiffness, the shorting bars are held firmly in engagement with a surface of the fixed contacts.

On the up stroke of the shaft 28 the shorting bars 72 draw toward each other, while maintaining engagement with the contacts 52 until the cross-over portion of the saddle 73 forcibly picks up the movable contact assembly and lifts it smartly out of engagement with the fixed contacts.

Referring now to the embodiment illustrated in Figs. 5 through 7, housing 100 has suitable provision for a pair of electro-magnetic coils as previously described, and terminals, not shown, for connecting the respective coils into a switching circuit for the individual energization thereof.

The lower housing of the instant embodiment of the invention may comprise separable members of mouldable plastic, said members being designated 100, 102 and being of identical shape and size but of opposite hand, whereupon when the two housing members are pressed into face to face engagement, they collectively form a chamber in which is located the contact organization of the circuit breaker.

The operating assembly includes an armature shaft 103 secured to a snap spring 37 supported about its periphery in a V-slot as shown in Fig. 5.

The load-line terminals 104 have preferably eccentrically shaped body portions, see Fig. 6, interfitting with the respective members 100, 102, in non-rotatable relation therewith. Integral lugs 105, to which are riveted contact buttons 106 of silver or like high conductivity material, extend forwardly of each terminal 104; each of the load-line terminals therefore has two contacting points.

Each of the contact members 103 has a bushing 107 of electrical insulation material, having an aperture to rotatively receive an end of a shaft 108.

Rotatably carried on said shaft 108 is the movable contact assembly 109, comprising lever portions or tables 110, 110 disposed on each side of the shaft 108. Secured to each of said levers 110 are the leaf-springs 112, 112 carrying on their free ends, see Fig. 7, a silver shorting bar 114. Therefore, for the two sets of fixed contacts there are two movable contacts or shorting bars.

The armature shaft 103 is offset at its end, see Fig. 6, and passes through an opening in the lever 110 of the movable contact structure 109. Suitable pins 115 passing through the end of the shaft 103 above and below the lever 110, operatively associate said shaft 103 with the movable contact structure 109 to rotate the same about its shaft 103.

The operation of this embodiment of the invention will be obvious from examination of Figs. 5 and 6. When the circuit breaker is in open circuit position, the movable contact structure 109 and its associated leaf springs are in a horizontal position with the shorting bars 114 out of engagement with the fixed contacts 106. When the "on" coil is energized the eccentric engagement of the shaft 103 with the movable contact structure 109 causes said structure to rotate counterclockwise bringing the shorting bars 114 into engagement with the spaced fixed contacts 106 of the load-line terminals. Such engagement takes place in advance of completion of downward travel of the rod 103 and it will be apparent that the continued downward movement of said rod causes the leaf springs 112 to flex and to wipe the shorting bars across the surface of the fixed contacts; as Figs. 6 and 7 show, the tables or levers 110, 110 extend over the shaft 108, and the springs 112, 112 are inside of the side walls of said levers. The springs 112, 112 associated with the levers 110, 110 tend to "wrap" about the hub of the contact structure 109, an action which contributes to the wiping movement of the shorting bars across the contacts. The final instant of rotation of the movable contact structure 109 brings the ends of the levers 110, 110 into engagement with the shorting bars 114, firmly pressing said shorting bars into engagement with the fixed contacts 106.

The terminals 104 are adapted for the pressure connection of electrical conductors. Soldered to the end of a cable 115, see Fig. 5, is a hollow conical sleeve 116. The interior of each terminal 104 is provided with a mating conical depression, and is interiorly threaded. The sleeve 116 has a shoulder 117 for cooperation with a nut 118. The sleeve 116 is introduced into the cavity within the terminal 104 and the nut 118 engaged with the interior threading of such terminal. The sleeve 116 is thereby wedged into excellent electrical connection with the terminal.

Whereas I have described my invention by reference to specific forms thereof, it will be understood that many changes and modifications may be made provided they do not depart from the scope of the claims.

I claim:

1. In a circuit breaker, a substantially hollow housing, terminals for interconnection with a circuit to be controlled, said terminals being disposed on opposite sides of said housing, and each having an integral contact member extending into

said hollow housing, said contact members being in mutually insulated relationship and collectively forming the fixed contact structure of said circuit breaker; a lever pivotally mounted within said housing, spring means secured to said lever, a shorting bar carried by said spring means in operative association with said fixed contacts, a saddle secured to said movable contact and extending up and over an arm of said lever, and means for oscillating said lever toward or away from said fixed contacts, the association of said spring means and said lever being such that during movement of said lever in one direction the shorting bar makes a sliding engagement with said fixed contacts, and during reverse movement breaks the engagement of said fixed and movable contacts smartly after an initial wiping movement of said movable contact on said fixed contact.

2. In a circuit breaker, a substantially hollow housing, a terminal for connection to an electric circuit, said terminal having an element integral therewith extending into said hollow housing to operate as a contact of said circuit breaker, a lever pivotally mounted within said housing above said fixed contact, means for oscillating said lever with respect to said fixed contact, and a movable contact secured to said lever by spring means, the relation of said movable contact association to said fixed contact being such that during movement of said lever in one direction said movable contact is drawn across the surface of said fixed contact, and upon reverse movement to forcibly break engagement of said movable contact with said fixed contact.

3. In a circuit breaker, terminals for connection to an electric circuit, high conductivity material secured to said terminals to provide fixed contacts, a two-armed pivoted lever of rigid material, means for oscillating said lever to move one of its arms toward one of said fixed contacts and the second arm away from said one fixed contact, movable contacts, and spring means for respectively suspending said movable contacts from said lever, an end of each of said spring means being secured to the said second arm of said lever, the relationship of said arms being such that movement of the lever brings each of the movable contacts into engagement with said fixed contact and continued movement of said lever causes the spring means to draw said one movable contact over the surface of said fixed contact, and the first named arm of said lever ultimately rests upon said movable contact to hold it in resilient pressure engagement with said fixed contact.

4. In an electric circuit breaker, a substantially hollow housing, spaced fixed contacts therein, and a movable contact organization disposed within said housing in operative association with said fixed contacts, said movable contact organization comprising a hub member mounted for rotation within said housing, a pair of levers secured to said hub member and extending therefrom in opposite directions, leaf spring means secured to each of said levers and extending toward the respective spaced fixed contacts, contact means secured to the free ends of said leaf spring means in operative association with said fixed contacts, whereby movement of said movable contact organization in one direction brings said movable contacts into engagement with said fixed contacts, the said leaf spring resiliently maintaining said engagement, and means for oscillating said movable contact organization.

5. An electric circuit breaker as defined in claim

4, in which the spaced fixed contacts comprise integral extensions of conductor-receiving terminals disposed on opposite sides of said housing, each said terminal including a bearing of insulation material to rotatably mount said movable contact organization.

6. In an electric circuit breaker, a substantially hollow housing, a terminal for connection to an electric circuit disposed on each side of said housing, each said terminal having a cylindrical contact-carrying member extending into said housing, said contact-carrying members being in mutually-spaced relationship, movable contact means mounted in said hollow housing and associated with said cylindrical contact-carrying members, and common means for rotatably securing said contact-carrying members to said housing whereby the areas of said cylindrical contact-carrying members engaged by said movable contact means are varied.

7. In an electric circuit breaker, the combination with a substantially hollow housing, of terminals disposed on opposite sides thereof, said terminals including cylindrical members arranged in axio-alignment, and having exposed surfaces of substantial area within said housing, movable contact means mounted in said hollow housing and associated in common with said cylindrical terminal members, and common means for mutually securing said terminals in varied radial relationship with respect to said housing and thereby with respect to said movable contact means.

8. In an electric circuit breaker a lever, a spring secured to an arm of said lever, a contact mounted on a free end of said spring and a saddle secured to said contact and extending over a second arm of said lever.

9. A circuit breaker comprising a housing having aligned openings in opposite walls thereof, a pair of electrically conducting one-piece members disposed at opposite sides of said housing, each of

said members having a component extending outside said housing and an integral cylindrical portion passing through said openings into said housing, said cylindrical portions being co-axially aligned and co-axially bored and serving as electrical contacts, bolt means extending through said cylindrical portions for securing said members relative to one another, and insulating material disposed between said bolt means and said cylindrical portions.

10. In a circuit breaker a substantially hollow housing, a terminal for connection to an electric circuit, said terminal including an element integral therewith extending into said hollow housing and operating as a fixed contact of the circuit breaker, a lever of rigid material, means for pivotally mounting said lever within said housing above said fixed contact, said pivotal mounting means being disposed adjacent one end of said lever, a second contact, and resilient means for suspending said second-named contact from the end of said lever adjacent its said pivotal mounting means.

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