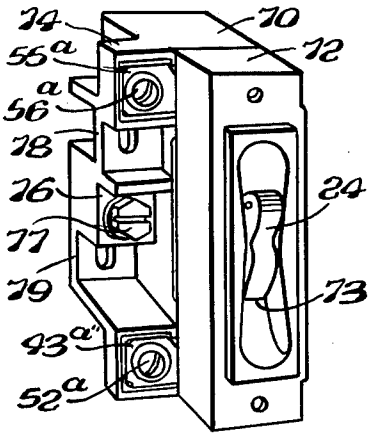
Dec. 23, 1952 K. W. WILCKENS 2,623,141

CIRCUIT BREAKER

Original Filed April 6, 1939 2 SHEETS—SHEET 1

Fig. 1.



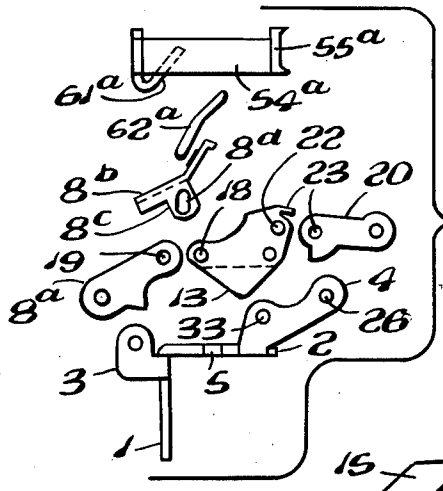


Fig. 4.

Fig. 5.

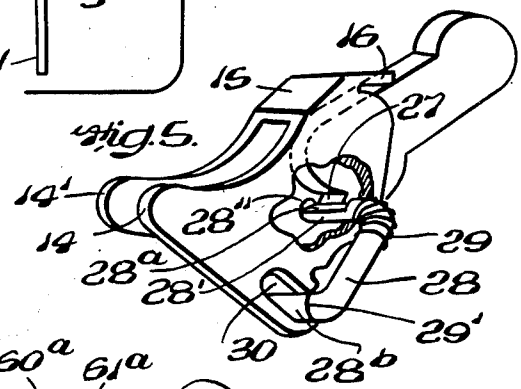
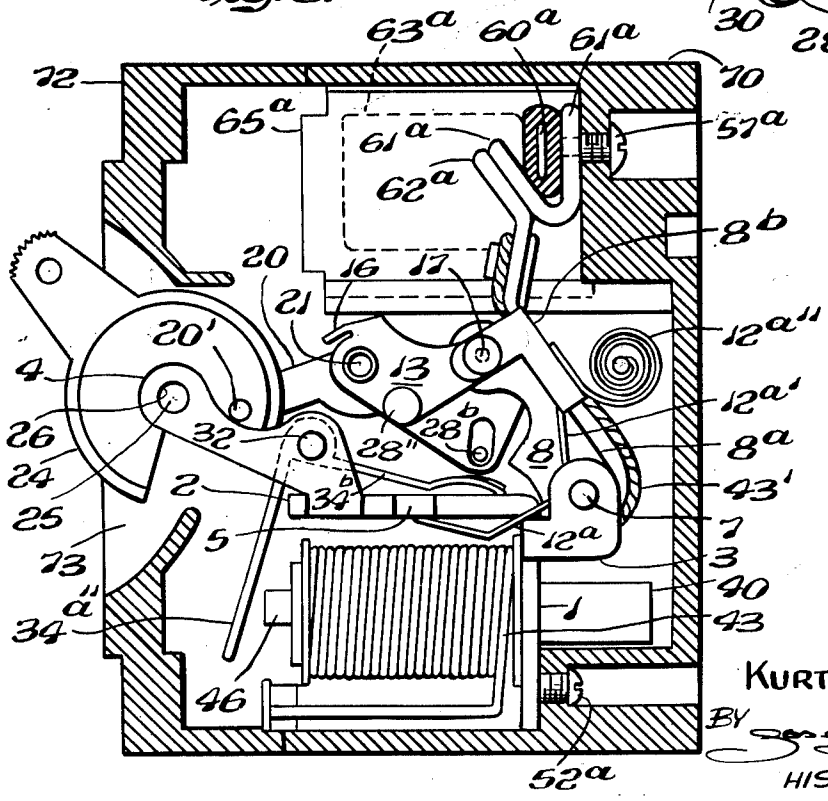


Fig. 2.



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CIRCUIT BREAKER

Original Filed April 6, 1939 2 SHEETS—SHEET 2

Fig. 6.

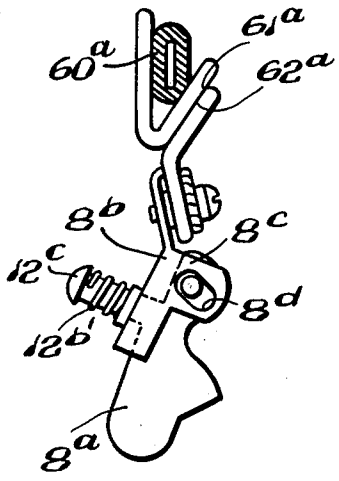


Fig. 7.

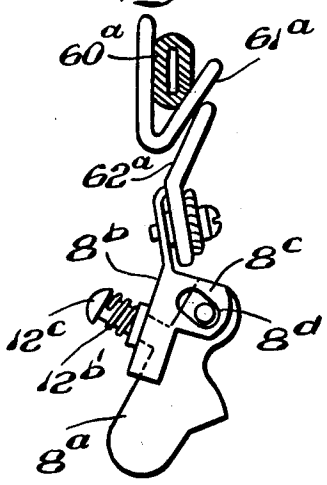


Fig. 8.

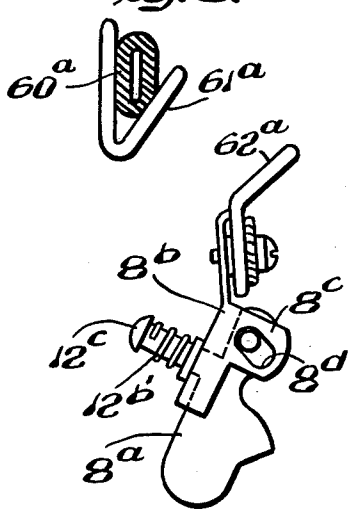
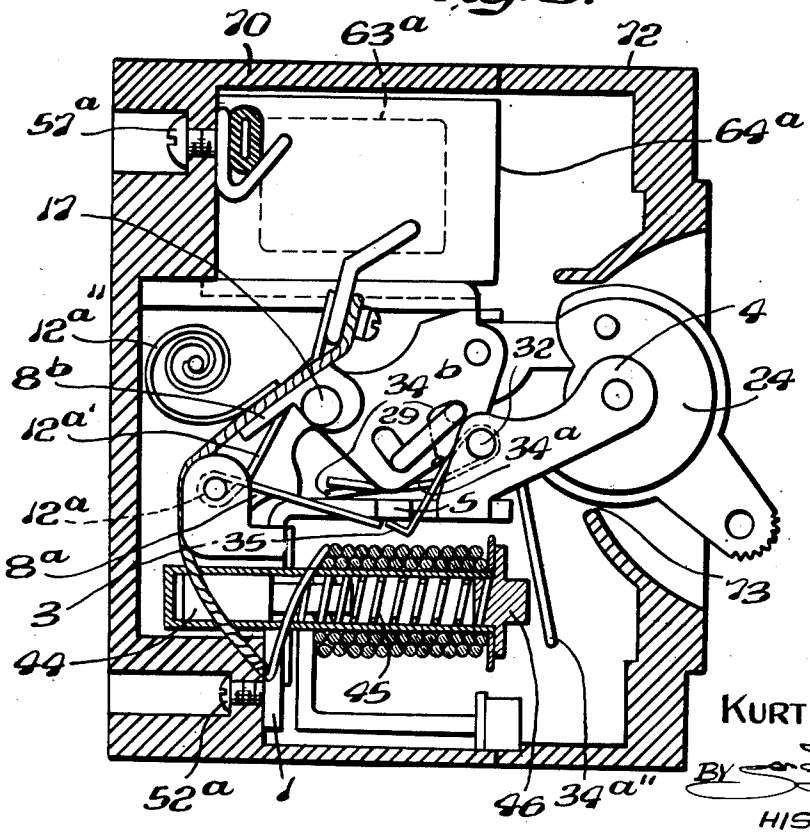


Fig. 3.



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2,623,141

CIRCUIT BREAKER

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Original application April 6, 1939, Serial No. 266,316, now Patent No. 2,360,922, dated October 24, 1944. Divided and this application October 23, 1944, Serial No. 559,950

6 Claims. (Cl. 200—153)

1

My invention relates to circuit breakers and is designed to increase the efficiency, safety, compactness and simplicity of such devices.

Leading objects of my invention are to overcome the tendency of switch contacts to bond together on a short circuit after having been roughened on a previous short circuit, and to thereby avoid the need for constructing contacts of, or facing them with, expensive non-bonding materials; and to provide a switch arm normally strongly biased toward open position but making, when closed, a yielding engagement with its complementary contact so as to insure perfect engagement of the contact surfaces.

In a preferred embodiment of my invention, a hollow, rectangular insulated housing, containing a fixed contact and blow-out plates, has its walls internally grooved to provide a seat or slideway for a switching and tripping unit which may be held in place in the housing by a single screw.

This unit comprises an L-shaped frame having lugs projecting laterally from one leg thereof for engagement in the body grooves, a pair of ears extending from each of the legs of the frame and forming bearings for a switch arm and switch-throwing and tripping mechanisms, and a tube mounted in and extending through the leg of the frame transverse to the leg engaged in the body grooves and having wound thereon an electromagnetic coil which is largely shielded by the frame.

The switch arm is manually operable, through pivoted latching links, by a handle fulcrumed on the second pair of ears bent from the frame. To automatically open the breaker, on overload, the latched links are tripped by a thermally-biased and electro-responsive L-shaped lever fulcrumed on the frame-ears carrying the handle; the rocking of this lever being limited by the frame or a stop carried thereby as set forth in my Letters Patent No. 2,360,922, whereof the present application is a division.

In the present embodiment of my invention, the switch arm consists of a rigid base section connected with the frame by a rocking joint and a rigid contact section connected with the switch base section by a rocking and sliding joint; each of the sections being biased by an independent spring. The switch arm is thereby movable as a unit on its frame fulcrum to close or open the breaker and the contact section and base section may rock and slide relatively to one another to permit the contact section of the arm to yieldingly engage the fixed contact and permit the

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base section of the arm to impart a blow and splitting movement to the contact section to insure the separation of the contacts.

My improvements are primarily applicable to automatic electro-responsive circuit breakers and particularly to those which are immune to temperature changes and have magnetic trip mechanism which permit continuous flow of current, when the breaker is closed, up to slight harmless overloads of, say, 125% of rated capacity, which effect instantaneous tripping on short circuits or heavy overloads of, say, 1000% of rated capacity, and which have an inverted time delay between these limits which will effect tripping within a time inverse to the extent of overload so that the larger the overload the more quickly the breaker will open. Certain advantages of my improvements are, however, applicable to circuit breakers having instantaneous electro-magnetic tripping devices or direct or supplementary thermal tripping devices, or even to circuit breakers devoid of automatic tripping means.

The characteristic features and advantages of my improvements will further appear from the following description and the accompanying drawings in illustration thereof.

In the drawings, Fig. 1 is a perspective view, partly in section, of a circuit breaker embodying my improvements; Fig. 2 is an enlarged longitudinal sectional view through the casing of the circuit breaker shown in Fig. 1 with the switch arm closed; Fig. 3 is an enlarged longitudinal sectional view of the circuit breaker shown in Fig. 1 with the switch arm open and taken from the opposite side from Fig. 2; Fig. 4 is an exploded view of parts of the circuit breaker shown in Figs. 1 to 3 but on a smaller scale; Fig. 5 is a greatly enlarged perspective view of the latching toggle, with parts broken away; Fig. 6 is a detached, somewhat diagrammatic, side elevation showing a further modified switch arm shown in closed position; Fig. 7 is a view similar to Fig. 6 but showing the parts in the position occupied in breaking a bond between switch electrode surfaces; and Fig. 8 is a view similar to Fig. 7 with the switch arm in open position.

In the embodiment of my invention illustrated in the drawings, a blank of magnetic metal is bent to form an integral frame comprising an L-shaped body having legs 1 and 2 disposed at right angles to one another, a pair of parallel L-shaped ears 3 extending transversely to the leg 1 from the edges thereof near the angle of the body, a pair of parallel slanting ears 4 extending transversely to the leg 2 from the edges

thereof near its outer extremity, and a pair of lugs 5 projecting laterally from the leg 2 between the ears 3 and 4. The ears 3 contain circular apertures forming bearings for a pintle 7. The pintle 7 forms a fulcrum for a switch arm 8 composed of a base section 8a pivoted on the pintle 7 and a contact section yieldingly connected with the base section as hereinafter described and including a channeled member 8b having ears 8c containing elongated diagonal slots 8d. The end of the member 8b has riveted thereto a contact member 62a. A spring 12a, wound on the pintle 7, has its ends anchored under the bosses 5 and a looped section 12a' tending to bias the switch bar toward open position.

A spring 12a'' fixed to the breaker housing tends to bias the contact section 8b relative to the base section 8a.

A sheet metal blank is bent to form a link 13 (Fig. 5) comprising cheeks 14 and 14' connected by a cross-head 15 having an adjustable tongue 16 projecting therefrom. A pintle 17 passes through apertures 18 in the cheeks 14 and 14' and through the aperture 19 in the switch blade base 8a and through the slots 8d in the ears of the switch arm contact section 8b to pivotally connect the link 13 with the switch blade above the upper extremity of the spring member 12a'. The coaction of the pintle 17 with the walls of the elongated slots 8d and apertures 19 and 18 provide a lost motion connection between the member 8b and the members 8a and 13. The link 13 is pivotally connected with an end of a link 20 by a pintle 21 passing through apertures 22 and 23 in the respective members, and the opposite end of the link 20 is pivotally connected by the pintle 20' with a handle 24 having a shaft 25 journalled in bearings 26 in the ears 4.

The link 20 has a tooth 27 adapted to abut against the convex surface of the leg 28' of a yoke-shaped pin 28 journalled in the cheeks 14 and 14' to latch the links 13 and 20 rigidly together. Preferably either the yoke 28 or the link 13 is made of non-magnetizable material. A spring 29, has one end anchored to the link 13 in any suitable manner, as for instance by being bent under the lower edge thereof, and is wound about the leg 28' and bears against the cheek 14 so as to bias the leg 28' so that its head 28'' bears against the cheek 14' and the flat surface 28a of the leg 28' is positioned between the cheeks 14, 14'. The free end 29' of the spring 29 bears against the leg 28b of the yoke 28 so as to bias it downward toward the lower end of a slot 30 in the cheek 14 and rock the leg 28' so that a convex face thereof normally lies in the path of the tooth 27. The flat face 28a is formed by recessing the leg 28' sufficiently to permit the passage of the tooth 27 past the leg 28' when the face 28a is brought into line with the tooth by rocking the leg 28b to the upper extremity of the slot 30.

Force is transmitted between the handle 24 and the switch arm 8 through the pivotally connected link 20 and 13 when the toggle formed thereby is rendered rigid by the engagement of the tooth 27 with a convex surface of the leg 28', but when the leg 28b is rocked to disengage the leg 28' from the path of the tooth the toggle is tripped to permit the spring 12a' to operate the switch arm 8.

The throw of the handle 24 and the links 13 and 20 connecting it with the switch arm are so proportioned that when the pin 17 is at the ends of the elongated slots 8d nearest the member 8b and the tail of the member 8b is flush with the member 8a, the contact 62a engages the face of a fixed contact 61a before the throw of the handle 24 is completed. This causes the member 8b to rock on its fulcrum 17 against the biasing action of the coiled leaf spring 12a'' mounted on the wall of the casing. If the contact 62a should be bonded to the fixed contact 61a when the handle 24 is thrown, or the links 13 and 20 are unlatched, to open the breaker, the spring 12a' throws the arm 8a outward so that the pintle 17 strikes sharply against the ends of the slots 8d most remote from the member 8b, thereby imparting a jar or shock to the contact 62a tending to break its bond with the fixed contact 61a of the breaker, and this jar is supplemented by the splitting or shearing force imparted to the contact section 8b by the actions of the springs 12a' and 12a'' tending to turn it on the point of bonding as a fulcrum.

The fixed contact 61a of the breaker forms a part of a V-loop constituting an integral part of a conducting bar 54a (Fig. 4) extending forwardly along the inner wall of the breaker housing and terminating in a contact 55a bent normally to the bar 54a and fixed to a lateral extension of the casing by a binding screw 56a. If desired, the V-loop may be held firmly against the wall of the casing by a screw 57a so that the V-loop will provide ample support for an insulated core 60a on the ends of which are mounted the blow-out plates 63a and the fibre and asbestos shields 65a and 64a.

Automatic rocking of the yoke 28 may be effected by the engagement of the leg 28b by electro-responsive tripping means such as an L-shaped lever 31 having ears 31' journalled on a pin 32 seated in the bearings 33 of the ears 4. The lever 31 has its arm 34a' normally biased toward the leg 2 and away from the pin 28b by a coiled spring 35 wrapped around the pintle 32 and having one end engaged beneath an ear 5 and the other end pressing against the top of the lever 31 as more fully shown in my Patent No. 2,360,922. The handle 24 is normally biased into position for straightening the toggle by a spring wound on the pin 25 and having one end anchored in the handle 24 and the other end bearing against the pin 32 as more fully set forth in my said Patent No. 2,360,922.

The arm 34a'' of the lever 31 is made of magnetically permeable material so as to form an armature attracted by the poles of an electromagnet preferably consisting of a non-magnetizable tube 40 secured in an aperture in the leg 1 and having wound thereon, between insulating discs, a coil 43 for creating a magnetic flux upon the passage of electric current therethrough. One end of the coil is connected through a flexible looped pigtail 43' with the switch blade member 62a and the other end of the coil may have connected therewith a terminal 43a'' which is secured by a binding screw 52a to a lateral projection on the casing.

The tube 40 contains a magnetically permeable cylindrical core 44 which is moved by a magnetic flux of sufficient intensity, against the biasing action of a coiled spring 45, into direct contact with a magnetic pole piece 46 forming an end closure for one end of the tube 40. The periphery of the core 44 is recessed to permit the passage of the forepart of the core through the spring 45 against the pole piece 46. The frame in which the tube is mounted forms the other pole of the electromagnet and the end of the leg 2 thereof is so aligned with the pole piece 46 as to coact therewith in attracting the armature 34a''.

The core 44 is of a length substantially equal to the distance between the inner face of the pole piece 46 and the plane of the pole piece formed by the leg 1 at the opposite end of the coil so that a highly permeable magnetic circuit is established when the core 44 contacts the inner face of the pole piece 46, thereby creating sufficient magnetic attraction to draw the armature 34*a*'' against the pole pieces 2 and 46, and rock the arm 34*a* to engage and lift the end 28*b* of the yoke 28.

The mechanism is preferably housed in a casing consisting of a hollow moulded base 70 containing a chamber 71 housing the bulk of the breaker mechanism which is covered by a hollow cap 72 containing an opening 73 for the passage of the handle 24. The base 70 has an integral crenelated extension at the side thereof providing a seat 74 for the terminal contact 55*a*, a seat 75 for the terminal contact 43*a*, a recessed seat 76 for a ground contact 77 and apertured recessed walls 78 and 79 through which mounting screws may be passed to support the breaker casing without objectionably decreasing the non-conductor distance between terminals or conducting members.

When normal current or current not in excess of 125% of normal capacity is flowing through the coil 43, the magnetic flux created is insufficient to overcome the biasing action of the spring 45. Hence the core 44 is not moved against the pole piece 46, and the pole pieces 2 and 46 exert too little magnetic attraction to rock the armature 34*a* when the core 44 is retracted. Upon the occurrence of a momentary overload, not exceeding ten times rated capacity, the dash-pot action of the fluid, such as air or oil, in the tube 40, prevents the movement of the core 44 against the pole piece 46 and the armature 34*a* is not attracted. But if an overload, exceeding say 125% of capacity, is long continued, the fluid seeps gradually past the core 44 and this core is moved forward slowly by the abnormal flux until it contacts the pole piece 46. This so closes the magnetic circuit that the armature 34*a*'' is attracted to the pole pieces 2 and 46 and operates the mechanism above described to break the circuit. In the event of a short circuit or excessive overload, exceeding say ten times normal capacity, the armature 34*a*'' is instantaneously attracted against the pole pieces 2 and 46 to break the circuit without awaiting any movement of the core 44.

The closing of the magnetic circuit by bringing the core 44 into direct engagement with the pole piece 46 and into close juxtaposition with the pole piece formed by the leg 1 results in an effective pull of the pole pieces 2 and 46 on the armature 34*a*'' at 125% of rated capacity substantially equal to the pull created by the flow of 1000% of rated current with the core 44 fully retracted, or a ratio of approximately 8 to 1. In other words, the closing of the magnetic circuit by the core's coaction with the two pole pieces permits the operation of the breaker with one-eighth the ampere turns required to operate the breaker in the absence of the core or with the core retracted. The positioning of the armature member 34*a* along the frame member 2 does not cause objectionable overheating by eddy currents and the like because in the normal position of the device the bulk of the mass of the core 44 is removed from the coil and there is consequently a minimum of eddy currents and iron losses generated in the overlapping frame and armature member 34*a*.

The opening of circuit breakers under short circuit conditions causing heavy arcing tends to form small beads or burrs on the faces of metallic contacts and if the breaker is reclosed during the maintenance or recurrence of short circuit conditions such beads or burrs may be melted by the passage of heavy current therethrough in the instant before the contacts make full engagement. Contacts are thereby sometimes instantaneously so bonded or soldered together as to resist a direct pull of a biasing spring tending to open the circuit breaker. My improvements minimize such bonding tendencies by giving a slight sliding or wiping and splitting movement to the arm contact 62*a* and any bond which may be formed is broken by the jar or shock imparted to the member 8*b* by the member 8*a* when the toggle is broken or released.

The arm 34*a* of the armature may be split longitudinally to provide a readily bendable finger 34*b* for engagement with the arm 2 to adjustably limit the outward movement of the armature arm 34*a*''.

As shown in Figs. 6 to 8, there may be substituted for the coiled leaf spring 12*a*'', a coiled spring 12*b*' sleeved on the headed pin 12*c* which is fixed to the arm 8*a* and passes through an aperture in the member 8*b*, which is otherwise similar to the member 8*b*. This construction is however less desirable than the embodiments of my invention above described because of the tendency of the spring 12*b*' to counteract the action of the spring 12*a*' in opening the breaker when the contact 62*a* is bonded to the contact 61*a*.

Having described my invention, I claim:

1. A circuit breaker comprising a switch arm having a base section fulcrumed on a fixed member and a contact section containing an elongated slot, a pin projecting from said base section and through said slot and thereby providing a lost motion connection between said contact section and said base section, an operating toggle having a link through which said pin projects and thereby provides a lost motion connection between said contact section and said toggle, biasing means rocking said base section relatively to said contact section when the latter is held stationary, and a contact complementary to said contact section.

2. A circuit breaker comprising a contact, a switch arm having a base section fulcrumed on a support and a contact section movable relatively to said base section, one of said sections containing an elongated slot extending diagonally to a radius from said fulcrum, toggle means including jointed members for operating said arm, a pintle passing through said elongated slot and connecting together said sections and one of said members, and biasing means rocking said base section relatively to said contact section when said members are moved toward opening position and said contact section is bonded to said contact.

3. A circuit breaker comprising a contact, a fixed member, a switch arm having a base section fulcrumed on said member and a contact section movable by said base section toward and from said contact, coupling means connecting said sections and comprising a pintle and means forming an elongated slot extending diagonally to a radius from said fulcrum in which said pintle is movable transversely to its axis to impart a wiping movement to said contact section, a spring biasing said base member to move said contact section away from said contact, and a spring

biasing said contact section relatively to said base section and biasing said base section to move said contact section away from said contact.

4. A circuit breaker comprising a contact, a switch arm complementary to said contact and comprising a base section fulcrumed at one end thereof and a contact section connected with the other end of said base section, said contact section having an elongated slot between its ends and extending diagonally to a radius from said fulcrum, a toggle member, a pintle passing through said base section, toggle member and slot in said contact section, said pintle being movable along said slot and permitting rocking movement of said contact section relative to said base section and to said toggle member, a spring biasing said base section, and a spring engaging said contact section between said slot and the end of said contact section nearest the fulcrum of said base section.

5. A circuit breaker comprising a contact, an arm having a contact section complementary to said contact and a base section fulcrumed on a support, said base section and contact section having a pin-and-slot connection, said pin and base section being shiftable along said slot relatively to said contact section independently of movement thereof when said contact section is bonded to said contact, a spring tending to move said base section and pin independently of said contact section, link mechanism connected to said pin for restraining movement thereof, or effecting movement thereof independently of said contact section and means for releasing said restraining mechanism and permitting said spring

to move said pin suddenly and impart a shock to said contact section.

6. A circuit breaker comprising a contact and an arm having a contact section complementary to said contact and a fulcrumed base section, one of said sections having an apertured web partially overlying the other of said sections and having a flange containing an elongated slot and the other of said sections having a pin having a portion disposed in said slot and a pin projecting through said aperture, and a spring positioned by said pin last named biasing said overlying section relatively to the other section, and a toggle member on said pin first named for operating said base section independently of said contact section.

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