May 7, 1935. G. A. HEALIS 2,000,442

ELECTRIC CIRCUIT INTERRUPTER

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FIG. 1

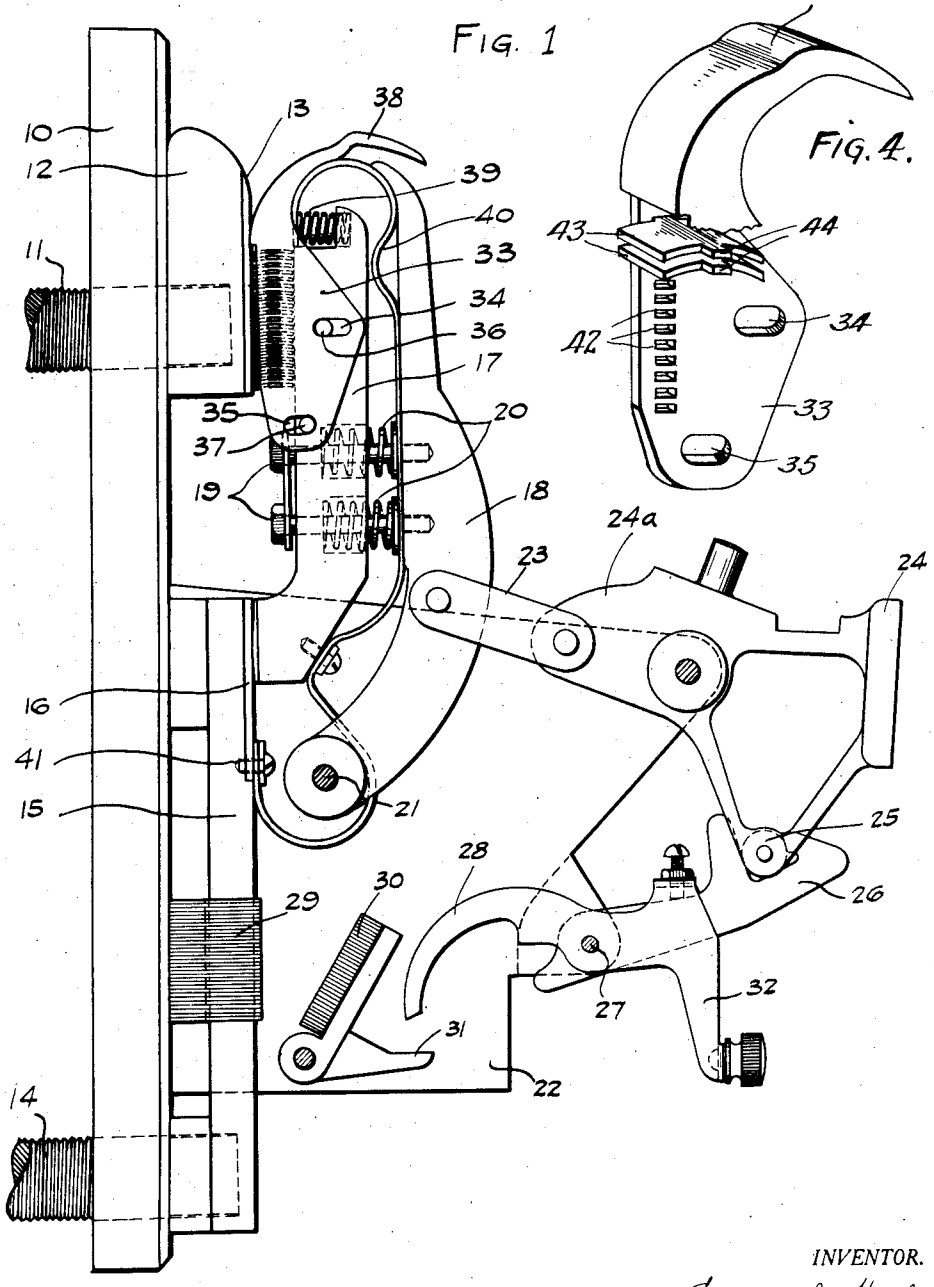

FIG. 4.

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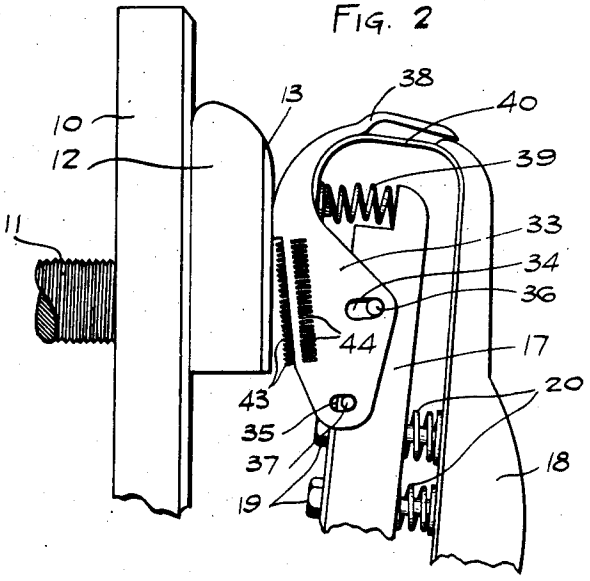
FIG. 2



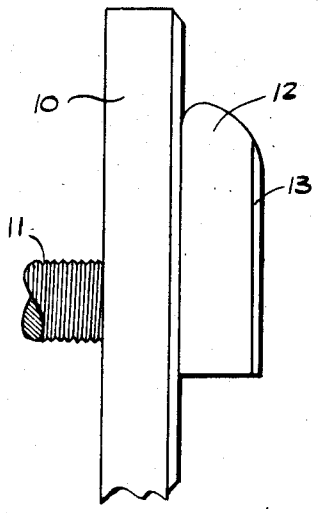
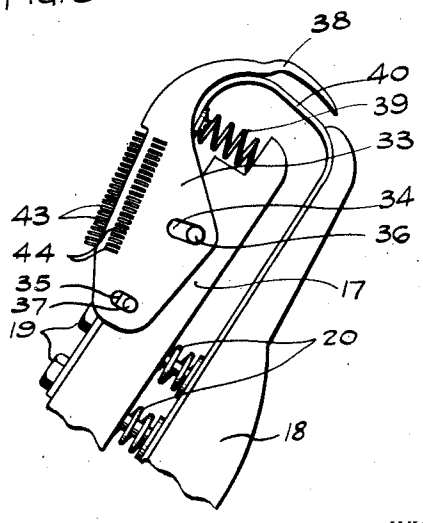


FIG. 3



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UNITED STATES PATENT OFFICE

2,000,442

ELECTRIC CIRCUIT INTERRUPTER

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17 Claims. (Cl. 200—146)

My invention relates to electric circuit interrupters and more particularly to new and improved separable contacts therefor. While my invention is of general application, it is particularly suitable for use in circuit interrupters of the automatic circuit breaker type.

In the art of electric circuit interrupters, it is well-known that, if the cooperating separable contacts are rigid metallic blocks or elements, any appreciable misalignment between the contact surfaces due to inaccuracies of manufacture or assembly, or due to wear or other unforseen causes, results in unequal pressure distribution throughout the contact surfaces and, in extreme conditions, in single point contact. Among well-known consequences of such faulty contacts is localized overheating which may result in welding or pitting of the contacts.

In accordance with my invention, an electric circuit interrupter comprises a pair of cooperating relatively movable contact structures having opposed substantially plane contact surfaces normal to, or at any other suitable angle to, the plane of relative motion. There is provided one or more conducting elements disposed to form a bridging connection between the opposed contact surfaces which, in circuit-closing position of the interrupter, may be substantially parallel. Specifically, this bridging connection may comprise one or more resilient, arcuate, plate-like members mounted substantially parallel in a housing supported with a limited freedom of motion from one of the relatively movable contact structures. Further, and more specifically in accordance with my invention, the housing for the bridging conducting elements may terminate in an arcing contact extending to, or projecting beyond, a movable contact arm from which the movable contact structure is supported, and forming therewith a recess in which is looped a flexible conductor interconnecting the housing and a stationary terminal of the interrupter.

For a better understanding of my invention, together with other and further features thereof, reference is had to the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

In the drawings, Fig. 1 is a view in side elevation of the essential elements of an automatic circuit breaker embodying the improved contact structures of my invention, illustrated in circuit-closing position;

Figs. 2 and 3 are fragmentary details of the cooperating movable contact structures in intermediate and final positions, respectively, during operation of the circuit interrupter to circuit-opening position, while Fig. 4 is a fragmentary perspective view of the housing supported from the movable contact structure.

Referring now more particularly to Fig. 1, there is shown a circuit interrupter comprising a base or panel member 10 from which is supported a terminal stud or connector 11 connected to a stationary contact structure 12 preferably having an arc-resistant facing 13. A second terminal connector or stud 14 is also supported from the panel 10 and connects with a bus-bar or conductive strip 15, the upper portion of which is provided with an arc-resistant facing 16 forming a second stationary contact element. Cooperating with the stationary contact structures 12 and 15—16, is a movable bridging contact structure 17 resiliently supported from a movable contact arm 18 by means of screws 19 and biasing springs 20 which may be helical coil springs, as illustrated, or plate or leaf springs, or the like. The stationary contact structure 12 and the bridging contact structure comprise opposing plane contact surfaces which are at an angle to the plane of motion of the movable contact structure 17; in this instance the opposed contact surfaces are at right angles or normal to the plane of motion of the member 17, although any other suitable angle may be used, provided the contacts are brought into substantially abutting relation.

The movable arm 18 is journalled on a pivot 21 supported between side plates 22, the front one of which is omitted from Fig. 1 for the sake of clarity, secured to the base 10. An operating mechanism for the movable contact arm 18 comprises a link 23 and an arm 24a of a crank 24 forming a toggle and operable either manually or by any suitable automatic mechanism. The operating mechanism 23—24 is latched in circuit-closing position by the engagement of a roller 25, secured to the crank 24, with a detent in a latch 26 pivoted between the side plates 22 at 27. The latch 26 is provided with a unitary or a separate cooperating extension or tail 28 co-acting with an electromagnet 29 excited from the vertical bus-bar 15 and having a movable armature 30, the tripping arm 31 of which is disposed to engage the extension 28. If desired, a manually operable lever 32 may also be provided for manually disengaging the latch 26.

Supported from the upper end of the movable contact structure 17 is a housing 33 comprising side-plates overlying the sides of the member 17 and having a limited freedom of motion by virtue

of the slots 34 and 35 engaging cooperating pins 36 and 37, respectively, projecting from the contact structure 17. The upper portion of the housing structure 33 terminates in an arcing contact or extension 38 which projects to or beyond the upper end of the contact arm 18 forming therebetween an enclosed recess. The housing structure 33 is biased into an angular relationship with respect to the contact structure 17 by spring 39, which insures that the circuit is initially made and finally broken at the surface of the arcing contact or extension 38. The relationship of parts in the making or breaking of the circuits before complete separation of the contacts is shown in Fig. 2; while Fig. 3 illustrates the cooperating contact structures in completely separated relation.

Between the contact structure 17 and the movable contact arm 18 is disposed a flexible conductor, such as a braided connector 40, which is looped in the recess between the extension 38 and the upper end of the contact arm 18 and is connected at one end to the housing 33 and at the other end to the stationary bus-bar 15 by a suitable screw or clamp 41.

As shown more clearly in Fig. 4, the side plates of the housing structure 33 are provided with a plurality of longitudinally-spaced slots or apertures 42, the slots in the opposed side plates of the structure 33 being in substantial alignment. One or more conducting bridging elements 43 are formed with extensions or projections 44 conforming to and engaging the slots 42 for securing the members 43 within the housing 33. The conducting elements 43 are plate-like members, preferably resilient and of any suitable form, though I have shown, by way of example, substantially identical arcuate plate-like members having parallel edges disposed to form a plurality of edgewise contacts between the contact surfaces of the stationary contact 12 and the upper portion of the movable contact structure 17.

The operation of the above-described circuit interrupter, and particularly that of the separable contact structures, will be explained, assuming a movement from circuit-opening position, as shown in Fig. 3, to an intermediate position, as illustrated in Fig. 2, to circuit-closing position, as shown in Fig. 1. In circuit-opening position of the interrupter, as illustrated in Fig. 3, the housing structure 33 is biased to an angular position with respect to the movable contact structure 17 by the spring 39. As the circuit interrupter is moved from the position of Fig. 3 to that of Fig. 2 by the operating crank 24, the arcing contact surface or extension 38 initially contacts with the face of the stationary contact structure 12, both of these two surfaces preferably being of arc-resistant material. As the circuit interrupter is operated from the position of Fig. 2 to final circuit-closing position, as shown in Fig. 1, the housing 33 pivots about the pins 36 and 37, which allow it a limited freedom of motion, bringing the edges of the arcuate plate-like elements 43 into engagement with the contact surface 13 of the contact structure 12 and the inner surface of the movable contact structure 17. This pivotal motion of the housing 33 between the positions of Fig. 2 and Fig. 1 produces a sliding or wiping action between the contact elements 43 and the opposed contact surfaces which may be accentuated by the bowing of the resilient contact elements 43 as the movable contact structure 17 is urged into its final circuit-closing position. The wiping between the contact elements 43 and the opposed contact surfaces may be increased by mounting them at an angle to the contact surfaces rather than substantially normal thereto, as illustrated. With this arrangement, the plurality of independent resilient contact elements 43 insure substantial uniform contact pressures throughout the contacting surfaces and thus optimum current-carrying conditions.

If the proportioning of parts is such that the opposed contact surfaces 13 and 17 are parallel in the final circuit-closing position of the interrupter, the several elements 43 may be identical in shape and size and may be economically manufactured by punching or stamping from plates of conductive material.

The relationship of the parts, upon operation of the circuit interrupter to circuit-opening positions, is the same as that described above but with a reverse sequence; that is, the main contact is initially broken at the conducting edges of the bridging elements 43, and finally broken at the arcing contact extension 38 of the housing 33.

The operation of the tripping mechanism, comprising the elements 25 to 32 inclusive, which are of the conventional type, will be clearly understood by those skilled in the art. In brief, upon the occurrence of predetermined abnormal circuit conditions, the armature 30 is attracted by the core 29 causing the tripping arm 31 to engage the tail or extension 28 of the latch 26, releasing the same from the roller 25 of the operating crank, whereupon suitable biasing springs, not shown, are effective to move the circuit interrupter to circuit-opening position.

It will be apparent that a number of circuit interrupters of the type described may be operated in parallel where larger capacities are required, the several circuit interrupters being mounted and operated either individually or as a group, or they may be combined to form a multiple breaker.

While I have described what I at present consider the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from my invention, and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

I claim:

1. In an electric circuit interrupter, cooperating relatively movable contact structures having opposed substantially plane contact surfaces at an angle to the plane of relative motion, and a plurality of conducting elements disposed individually to engage both of said contact surfaces and to form a bridging connection therebetween in circuit-closing position of said interrupter.

2. In an electric circuit interrupter, cooperating relatively movable contact structures having opposed substantially plane contact surfaces at an angle to the plane of relative motion, and a plurality of similar plate-like conducting elements disposed individually to engage both of said contact surfaces and to form a bridging connection therebetween in circuit-closing position of said interrupter.

3. In an electric circuit interrupter, cooperating relatively movable contact structures having opposed substantially plane contact surfaces normal to the plane of relative motion, and a plurality of plate-like conducting elements disposed to effect edgewise engagement of said contact surfaces in circuit-closing position of said interrupter.

4. In an electric circuit interrupter, cooperating

relatively movable contact structures having opposed substantially plane contact surfaces normal to the plane of relative motion, and a plurality of identical arcuate plate-like conducting elements disposed to effect edgewise engagement of said contact surfaces in circuit-closing position of said interrupter.

5. In an electric circuit interrupter, cooperating relatively movable contact structures having opposed substantially plane contact surfaces at an angle to the plane of relative motion, a conducting element disposed to contact both of said opposed surfaces and to effect a wiping thereof during movement of said interrupter to circuit closing position.

6. In an electric circuit interrupter, cooperating relatively movable contact structures having opposed substantially plane contact surfaces at an angle to the plane of relative motion, and a plurality of resilient plate-like conducting elements disposed individually to engage both of said contact surfaces and to form a bridging connection therebetween in circuit-closing position of said interrupter.

7. In an electric circuit interrupter, cooperating relatively movable contact structures having opposed substantially plane contact surfaces at an angle to the plane of relative motion, and a plurality of similar resilient plate-like conducting elements disposed parallel to one another to effect edgewise engagement of said contact surfaces in circuit-closing position of said interrupter.

8. In an electric circuit interrupter, cooperating relatively movable contact structures having opposed substantially plane contact surfaces at an angle to the plane of relative motion, and a plurality of conducting elements supported from one of said contact structures with a limited freedom of motion and disposed to form a bridging connection between said contact surfaces in circuit-closing position of said interrupter.

9. In an electric circuit interrupter, cooperating relatively movable contact structures having opposed substantially plane contact surfaces at an angle to the plane of relative motion, a housing structure supported from one of said contact structures with a limited freedom of motion, a plurality of plate-like conducting elements disposed in substantially parallel relation in said housing and forming a bridging connection between said contact surfaces in circuit-closing position of said interrupter.

10. In an electric circuit interrupter, cooperating relatively movable contact structures having opposed substantially plane contact surfaces, a housing structure supported from one of said contact structures with a limited freedom of motion, said housing structure comprising a pair of side plates having longitudinally-spaced apertures, the apertures in the two plates being in alignment, and a plurality of plate-like conducting elements having projections engaging said apertures to support the same in said housing, said conducting elements being disposed to form a bridging connection between said contact surfaces in circuit-closing position of said interrupter.

11. In an electric circuit interrupter, cooperating relatively movable contact structures having opposed substantially plane contact surfaces, a housing structure supported from one of said contact structures with a limited freedom of motion, said housing structure comprising a pair of side plates having longitudinally-spaced slots, the slots in said plates being in alignment, and a plurality of arcuate plate-like resilient conducting elements having projections conforming to and engaging said slots to support the same in said housing, said conducting elements being disposed to form a bridging connection between said contact surfaces in circuit-closing position of said interrupter.

12. In an electric circuit interrupter, cooperating relatively movable contact structures having opposed substantially plane contact surfaces, a housing structure supported from one of said contact structures with a limited freedom of pivotal motion, a plurality of conducting elements disposed in said housing to form a bridging connection between said contact surfaces in circuit-closing position of said interrupter, and means for biasing said housing away from its normal position with respect to its associated contact structure, movement of said contact structures to circuit-closing position effecting a wiping of said contact surfaces by said conducting elements.

13. In an electric circuit controller, cooperating relatively movable contact structures having opposed substantially plane contact surfaces at an angle to the plane of relative motion and substantially parallel in circuit-closing position of the interrupter, and a plurality of similar conducting elements disposed individually to engage both of said contact surfaces and to form a bridging connection therebetween in circuit-closing position of said interrupter.

14. In an electric circuit interrupter, cooperating stationary and movable contact structures having opposed substantially plane contact surfaces, a housing structure supported from one of said contact structures with a limited freedom of motion, a plurality of conducting elements disposed in said housing to form a bridging connection between said contact surfaces in circuit-closing position of said interrupter, an arcing contact associated with said housing, and means for biasing said housing away from its normal position with respect to its associated contact structure, whereby movement of said contact structures into and out of circuit-closing position affects the making and breaking of the circuit at the arcing contact.

15. An electric circuit interrupter comprising cooperating relatively movable contact structures having opposed substantially plane contact surfaces at an angle to the plane of relative motion, a plurality of conducting elements disposed individually to engage both of said contact surfaces and to form a bridging connection therebetween in circuit-closing position of said interrupter, and means for relatively moving said contact structures to effect circuit-closing by the interrupter.

16. An electric circuit interrupter comprising cooperating stationary and movable contact structures having opposed substantially plane contact surfaces at an angle to the plane of relative motion, a movable contact arm upon which is resiliently supported said movable contact structure, a plurality of conducting elements disposed individually to engage both of said contact surfaces and to form a bridging connection therebetween in circuit-closing position of said interrupter, and means for moving said contact arm into circuit-closing position.

17. An electric circuit interrupter comprising a pair of terminals, a contact structure fixed to one of said terminals, a cooperating movable con-

tact structure, said contact structures having opposed substantially plane contact surfaces, a movable contact arm upon which is resiliently supported said movable contact structure, a housing supported from said movable contact structure and provided with an arcing contact extending beyond and cooperating with said contact arm to form a substantially closed recess, a plurality of conducting elements disposed in said housing to form a bridging connection between said contact surfaces in circuit-closing position of said interrupter, a flexible conductor interconnecting the other of said terminals and said housing structure, said conductor being supported between said movable contact structure and said movable arm and forming a loop in said recess, and means for moving said contact arm into circuit-closing position.

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