Feb. 5, 1963 E. B. JUDD ET AL 3,076,882

ELECTRIC CIRCUIT BREAKER

Original Filed Aug. 22, 1957 3 Sheets-Sheet 1

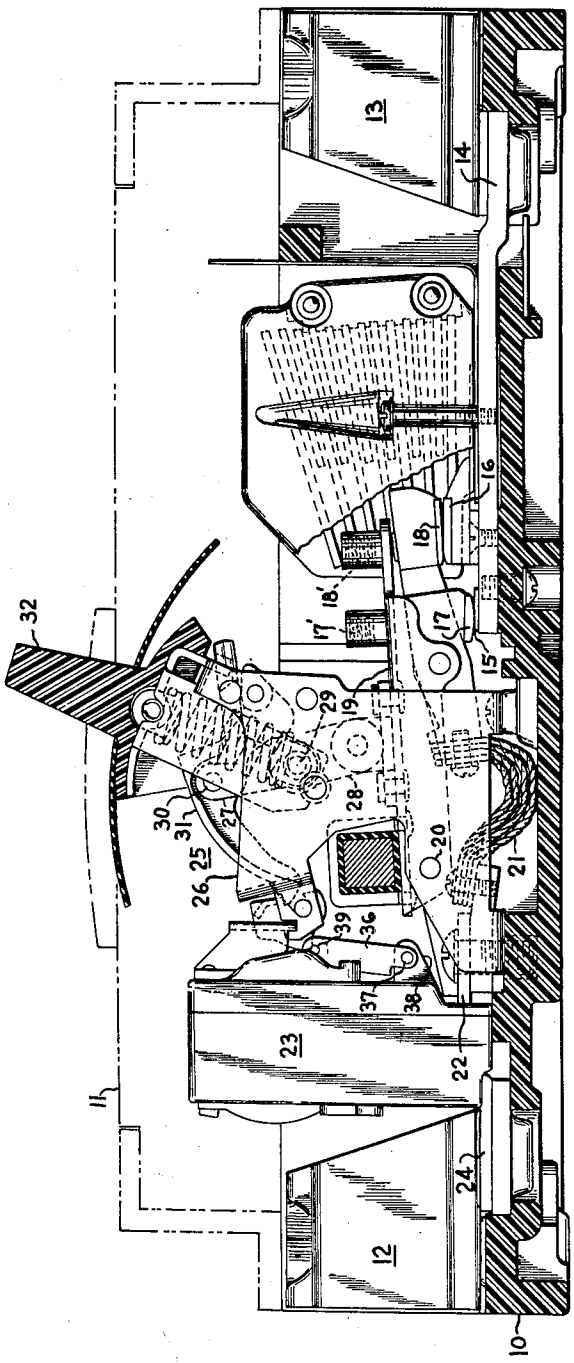


Fig. 1

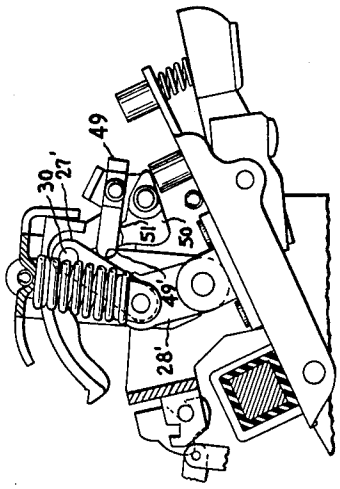


Fig. 5

INVENTORS
EDWIN B. JUDD,
JOHN D. YOUNG
BY Robert H. Casey
ATTORNEY

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3 Sheets-Sheet 2

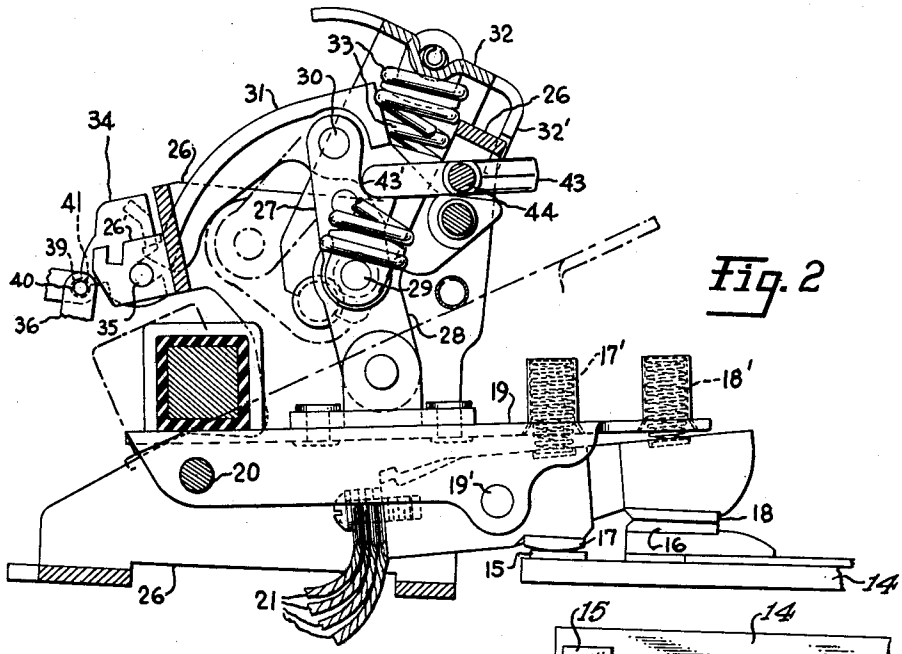


Fig. 2

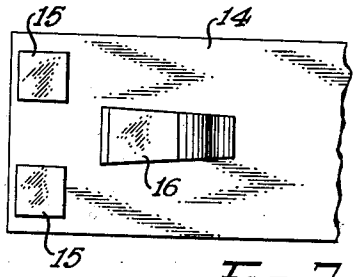


Fig. 7

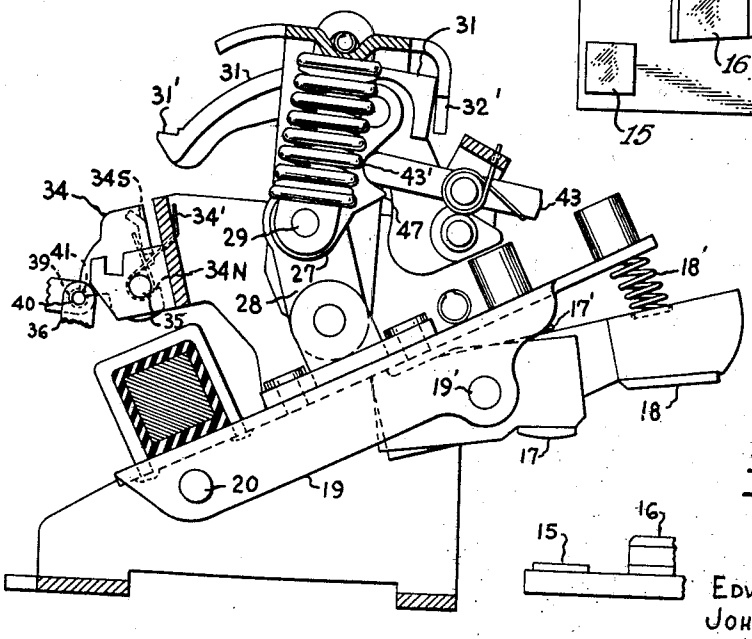


Fig. 3

INVENTORS
EDWIN B. JUDD,
JOHN D. YOUNG
BY Robert H. Casey
ATTORNEY

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ELECTRIC CIRCUIT BREAKER

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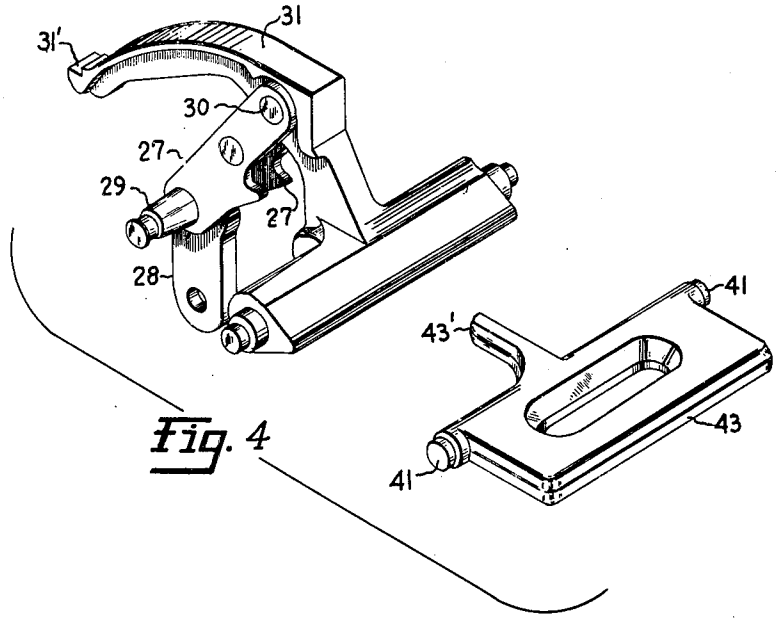


Fig. 4

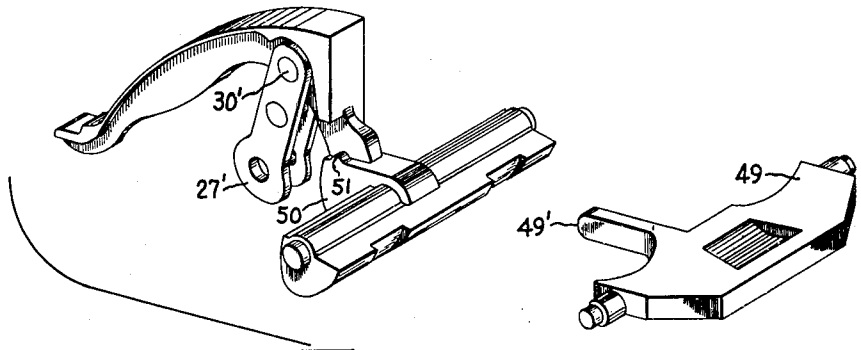


Fig. 6

INVENTORS
EDWIN B. JUDD,
JOHN D. YOUNG
BY Robert F. Casey
ATTORNEY

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ELECTRIC CIRCUIT BREAKER

Edwin B. Judd and John D. Young, Schenectady, N.Y., assignors to General Electric Company, a corporation of New York

Original application Aug. 22, 1957, Ser. No. 679,607, now Patent No. 2,921,169, dated Jan. 12, 1960. Divided and this application Oct. 21, 1959, Ser. No. 847,731

1 Claim. (Cl. 200—146)

Our invention relates to electric circuit breakers and particularly to manually operable circuit breakers adapted to control relatively high values of current. This application is a division of our copending application Serial No. 679,607, filed August 22, 1957, now Patent No. 2,921,169, issued January 12, 1960.

Circuit breakers of the prior art have been provided with contact assemblies for interrupting electrical currents, which assemblies include a composite contact structure including a first or "arcing" contact portion, and a second or "current carrying" contact portion. These contact portions are usually provided on a single contact member which moves in such a way as to cause the "arcing" portions of the contact assemblies to meet first during closing operation, followed by the "current-carrying" portions. Conversely, in opening, the current-carrying portions open first, followed by the arcing contacts, which thereby bear the burden of the most severe arcing.

In circuit breakers using such composite contacts, difficulty is encountered in ensuring the proper sequence of operation of the contacts, especially during short-circuit interruption, when the contacts move extremely fast. In addition, such contact assemblies have relatively high resistance, due to the fact that not all contact surfaces are utilized.

Circuit breakers of the type referred to herein are called upon to interrupt "normal" currents of the order of 100 to 800 amperes at 250, 400, or 600 volts.

Accordingly, it is an object of our invention to provide a circuit breaker for relatively high currents and voltages including a composite contact member which includes articulated "main" or current-carrying contacts and "arcing" or current-interrupting contacts, so arranged that the speed of opening helps to provide a predetermined desired sequence of opening thereof.

In accordance with our invention, we further provide a contact assembly including at least one "main" or current-carrying contact, and one "arcing" or current-interrupting contact. Each contact is pivotally supported on a contact arm. The weight of each contact is so distributed with respect to its pivotal support that in a high-speed automatic opening operation, inertia tends to cause the "main" contacts to open first, and the "arcing" contacts to open second, thereby providing a more effective and less-damaging interrupting action.

Additional aspects of our invention will be pointed out in the following detailed description and illustrated in the accompanying drawings, while the scope of our invention will be more particularly pointed out in the appended claim.

In the drawings:

FIGURE 1 is a side elevation view partly in section, of an electric circuit breaker incorporating our invention;

FIGURE 2 is a side elevation view of the operating mechanism of the circuit breaker of FIGURE 1, the near side of the mechanism supporting frame being removed for clarity, and the parts being shown in the "On" condition;

FIGURE 3 is a view similar to FIGURE 2, the parts being shown in the "tripped" condition;

FIGURE 4 is an exploded view in perspective of some of the parts of the mechanism of FIGURES 1 and 2;

FIGURE 5 is an elevation view of a modified form of the invention of FIGURE 1;

FIGURE 6 is an exploded view in perspective of some of the parts of the mechanism of FIGURE 5; and

FIGURE 7 is a plan view of the stationary contact assembly of one pole of the circuit breaker of FIGURE 1.

In the drawings, we have shown our invention as embodied in a three-pole electric circuit breaker comprising an insulating outer or main insulating casing having a base 10 and a cover 11.

Mounted on the base 10 at one end thereof are three load terminals 12 (only one shown) and, at the opposite end of the base 10 three line terminals 13 (only one shown). The line terminals 13 are each connected to line contact straps 14 carrying at the opposite end thereof a pair of side-by-side stationary main contacts 15 (only one shown) and a stationary arcing contact 16, the three contacts 15, 15, 16, of each pole being arranged in a triangular configuration, as shown in FIGURE 7.

Each of the main and arcing contacts 15 and 16 of each pole cooperates with a corresponding movable main contact 17 and a movable arcing contact 18, respectively. Each of the three movable contacts of each pole is independently movable and is pivotally supported on a common pivot pin 19' carried by the contact arm 19, and each is biased away from the contact arm 19 by a separate one of the contact pressure springs 17' and 18'. The contact arm 19 is pivotally supported on axis 20 in frame 26, carried by the base 10.

The movable arcing contact member 18 of each pole has most of its weight forward of the pivot pin 19'. Each of the movable main contacts has most of its weight to the rear of the pivot pin 19'. The effect of this is that the inertia of the contacts tend to cause the main contacts to open first and the arcing contact to open last, which is the desired sequence. The movable contacts 17 and 18 of each pole are connected by means of multi-strand flexible braids 21 to one terminal 22 of the trip unit 23, and the load terminal 24 of the trip unit 23 is connected directly to the main load terminal 12 of the circuit breaker.

For the purpose of moving the movable contacts 17 and 18 into and out of engagement with the stationary or line contacts 15 and 16, both manually and automatically, we provide a main operating mechanism indicated generally at 25. The operating mechanism 25 includes a generally U-shaped supporting frame member 26 and a plurality of parts pivotally supported between the opposite sides thereof. These parts include three contact arms 19, there being one contact arm for each pole of the circuit breaker.

The contact arms 19 are adapted to be rotated about their pivotal support by means of a toggle action linkage including the toggle links 27 and 28 connected together at a toggle knee point 29 and supported at their upper end on a pivot pin 30 carried by a toggle carrier 31. The toggle links 27 and 28, in turn, are operated between straightened and collapsed positions by means of an operating handle 32 in cooperation with a pair of tension type springs 33 interconnected between the handle 32 and the knee point 29 of the toggle linkage 27, 28. When the handle member 32 is in the position shown in FIGURE 1, the contacts are in closed position, and when the handle is moved counterclockwise from this position toward the left end of the breaker as viewed, the contacts are moved to the open circuit position.

The end 31' of the toggle carrier 31 is formed to act as a latching element and to engage an intermediate latch member 34 which is pivotally supported on a pin 35 carried by an extension 26' of the frame 26. The action of the tension springs 33 is such as to bias the toggle carrier 31 for rotation in a clockwise direction. The toggle car-

rier 31 is restrained from movement in such a direction, however, by its engagement with the intermediate latch member 34. A biasing spring, 34', constantly urges the intermediate latch 34 in a clockwise direction as viewed in the figures. By reason of the greater force exerted on it by the toggle carrier 31, however, the intermediate latch member 34 is biased in a counterclockwise direction whenever the breaker is latched.

For the purpose of normally restraining the intermediate latch member, and therefore the toggle carrier 31 and the operating mechanism as a whole, in the "on" position except in the case of predetermined overload conditions, we provide a trip unit generally indicated at 23. The particular construction and operation of the trip unit is not critical to our present invention and any suitable type may be used. The particular trip unit illustrated, however, is described more fully and claimed in application Serial No. 679,606, filed August 22, 1957, by H. M. Steven and R. W. Marshall, and assigned to the same assignee as the present invention.

The trip unit 23 includes a latch member 36 adapted normally to prevent the intermediate latch member 34 from rotating in a counterclockwise direction. The latch member 36 is pivotally supported on the trip unit 23 on a pivot pin 37, extending through aligned openings in a boss 38 molded integral with the housing of the trip unit 23.

The latch member 36 carries a latch roller 39 supported on a pin 40 extending between opposed, spaced apart, portions of the latch member 36. The intermediate latch member 34 is provided with a cam surface 41 which, when the breaker is "latched," as shown in FIGURE 1, bears against the roller 39 and biases the latch member 36 in a counterclockwise direction, that is, to the left as viewed in the figures. The latch member 36 is prevented from moving to the left by means which is releasable upon the occurrence of predetermined current conditions. When released by such current-responsive means, the latch 36 moves to the left, allowing the intermediate latch member 34 to rotate counterclockwise, releasing the carrier 31. Following such release, the intermediate latch 34 is moved clockwise by its bias spring 34' against a stop portion of the frame 26.

In order to reset the breaker following a tripping operation, the handle 32 is moved manually to the left as viewed to and slightly beyond the normal "off" position. During this movement, a portion 32' of the handle engages the carrier 31 and rotates it counterclockwise. When the latch tip of the carrier 31 engages the surface 34S of the intermediate latch 34, further counterclockwise movement of the carrier causes the intermediate latch 34 to move to the left, as viewed, with a combined pivoting and sliding action, as permitted by the elongated pivot notch 34N. The ends of the bias spring 34' also are adapted to slide along the inner surface of the portion 34S to permit this sliding retracting action. The latch tip 31' of the carrier 31 finally clears the latch surface of the intermediate latch 34, and the intermediate latch is returned to its normal position by the action of the spring 34', thereby relatching the breaker.

When the toggle carrier 31 is released from the intermediate latch 34, the carrier 31 is rotated in a clockwise direction by the action of the main operating springs to the position substantially as shown in FIGURE 3. As the pivot point 29 moves upwardly, the contact arms 19 are also moved upwardly or in a counterclockwise direction, toward open circuit position. Because of the necessary proportioning and dimensions and arrangement of the parts, it will be found that, for substantial angular opening movement and maximum contact pressure, it is not possible to allow the toggle carrier to rotate clockwise far enough to carry the pivot pin 30 definitely across the center line of action of the main springs 33.

The action of the parts, as so far described, therefore, is such as to move the movable contact arm 19 in an opening direction by movement of the toggle linkage upwardly as a whole, without any substantial breaking or collapsing thereof.

The distance through which the movable contact is moved by this means, however, is not as great as is ordinarily desirable for circuit breakers of the rating of the subject device, i.e., 600 to 800 amperes at 600 volts.

In order to provide additional contact opening movement, and also to accelerate the contact opening movement, we provide a toggle lever 43 supported on a pivot pin 44 between the sides of the mechanism frame 26. The toggle lever 43 is movable independently of the toggle carrier 31, and is biased by a biasing spring 45 in a counterclockwise direction against a portion 46 of the mechanism frame 26. The forward end 43' of the toggle lever 43 is rounded and is adapted to coact with a projection or detent 47 on the upper toggle link 27 in a manner to be described.

As long as the toggle carrier is in its latched condition as shown in FIGURE 2, the toggle lever 43 is maintained in the position shown in FIGURE 2. Thus the toggle linkage is moved between collapsed and straightened conditions without altering the position of the toggle lever 43. When the toggle carrier 31 is released from the intermediate latch member 34, and rotates clockwise, however, the projection 47 engages the rounded end 43' of the toggle lever 43 and the two parts remain in engagement as further rotation of the toggle carrier 31 occurs.

This action maintains the intermediate part of the upper toggle link 27 at a predetermined distance from the pivot pin 44, and causes the toggle linkage to assume a slightly broken or collapsed condition as illustrated in FIGURE 3. This shortens the distance between the opposite ends of the toggle linkage and results in accelerating the movement of the contact arm 19 and in moving the arm 19 further in a contact opening direction then would otherwise be possible. This is especially true, and also especially important, when the handle 32 is manually retained in the "on" or closed circuit position.

In FIGURES 5 and 6 we have illustrated another embodiment of our invention, in which the toggle linkage 27', 28' is adapted to be maintained in a slightly broken or collapsed condition when tripping occurs. In this form, the projection 47 on the upper link 27' is omitted. Instead, the toggle lever 49 is provided and the toggle carrier 50 is provided with a rounded abutment or cam follower surface 51 adapted to engage the underside of the toggle lever 49 and to rotate the toggle lever in a clockwise direction as tripping occurs. The end 49' of the toggle lever engages the link 27' and forces the toggle linkage to a collapsed condition in a manner similar to that described in connection with FIGURES 2 and 3.

In the form of FIGURE 5 the end 49' of the toggle lever 49 is arranged to initially engage the upper toggle link 27' at a predetermined point, and the action of the abutment 51 exerted on the toggle lever 49 causes the point of engagement of the toggle lever 49 to move upwardly along the toggle link 27' toward the upper pivot point 30'. In this manner, the leverage action of the toggle lever 49 on the toggle link 27' is greatest at the initial point of movement and decreases as the tripping action progresses. This affords an important prying action which assists in breaking any welds which might occur between the stationary and movable contacts, while at the same time affording a maximum rate of acceleration and a maximum opening distance of the movable contact. While the toggle lever 49 has been shown as of a different configuration from the toggle lever 43, it will be apparent that these toggle levers are substantially interchangeable.

While we have shown only particular embodiments of our invention, it will be apparent that many modifications thereof may readily be made by those skilled in the art and we, therefore, intend by the appended claim to cover all such modifications as fall within the true spirit and scope of our invention.

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

An electric circuit breaker comprising;

(a) a support,

(b) at least one elongated contact arm pivotally supported adjacent one end thereof on said support,

(c) means for operating said contact arm between open and closed circuit positions, said operating means comprising an overcenter operating spring adapted to move said contact arm between said open and closed positions with a snap action,

(d) an elongated arcing contact carrier pivotally supported on said contact arm adjacent the movable end of said contact arm and carrying an arcing contact at the end thereof remote from the pivotally supported end of said contact arm,

(e) a pair of main contact carriers pivotally supported on said contact arm co-axially with said arcing contact carrier and each having a main contact supported thereon adjacent the end thereof remote from said pivotally supported end of said contact arm,

(f) a compression spring between the outer end of each of said main contact carriers and said contact arm and between the outer end of said arcing contact carrier and said contact arm respectively,

(g) flexible electrical conductor means connecting each of said contact carriers electrically in common,

(h) said arcing contact carrier having the greater part of its mass on the side of its pivotal support remote from the pivotally supported end of said contact arm,

(i) each of said main contact carriers having the greater part of its mass on the side of its pivotal support adjacent said pivotally supported end of said contact arm,

(j) whereby rapid acceleration of said contact arm from said closed position toward said open position causes the effect of inertia to act on said contact carriers in such a way as to cause said main contact carriers to be rotated about their pivotal support in a direction to open said main contacts and to cause said arcing contact carrier to rotate about its pivotal support in a direction to close said arcing contact.

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