Dec. 6, 1966 R. B. DAVIS ET AL 3,290,627

CIRCUIT BREAKER

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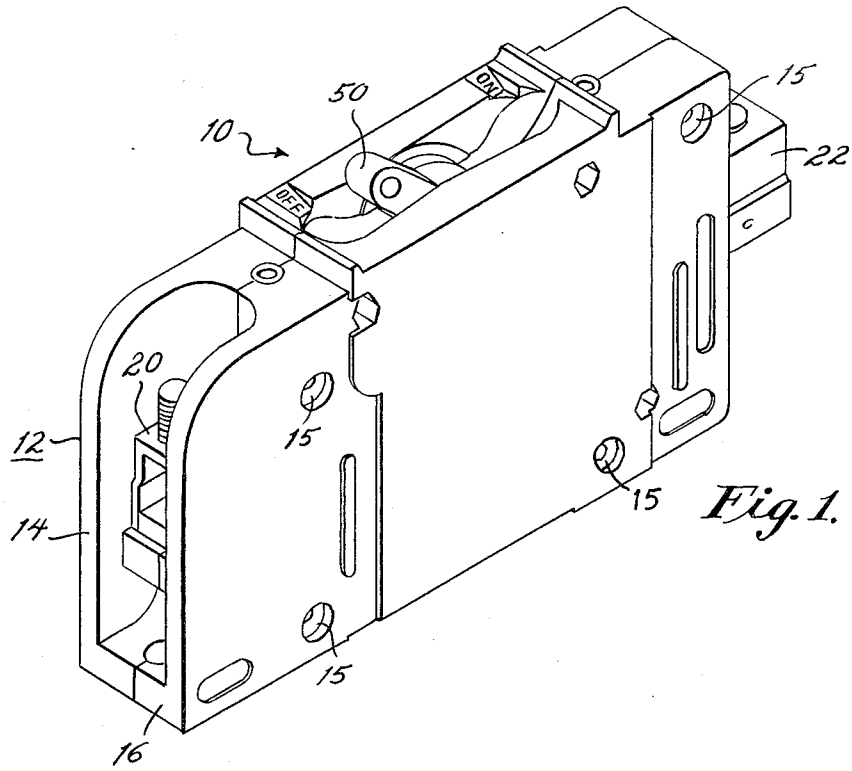

Fig. 1.

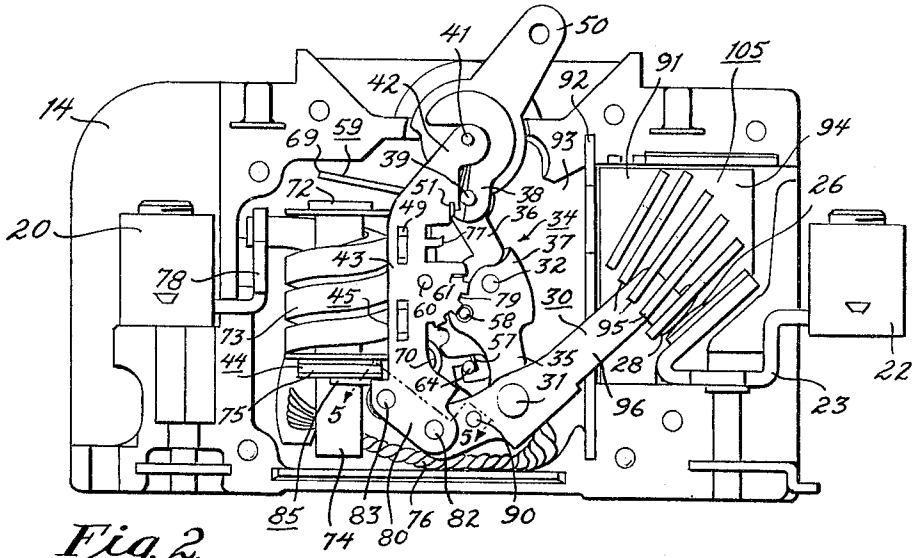

Fig. 2.

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CIRCUIT BREAKER

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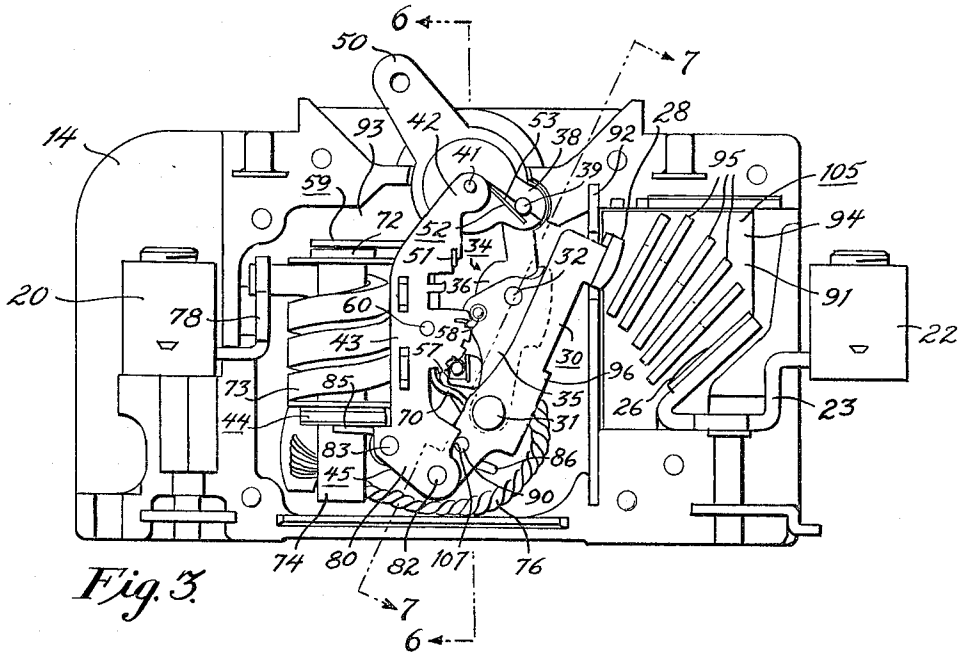

Fig. 3.

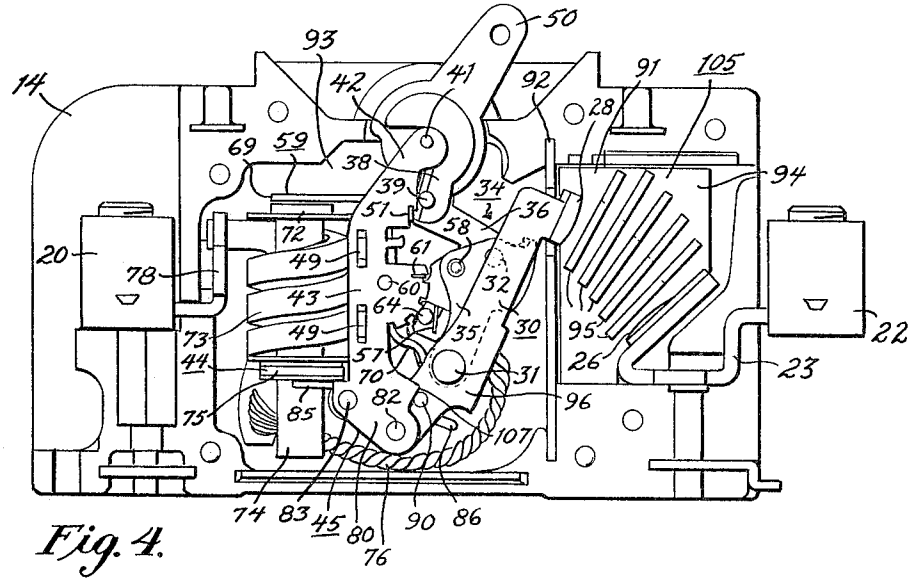

Fig. 4.

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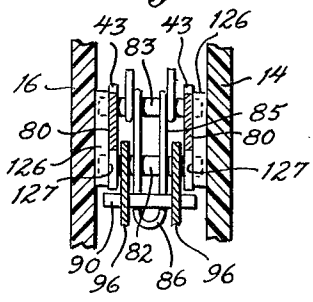
Fig. 5.



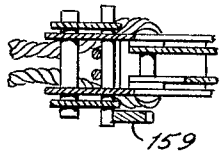
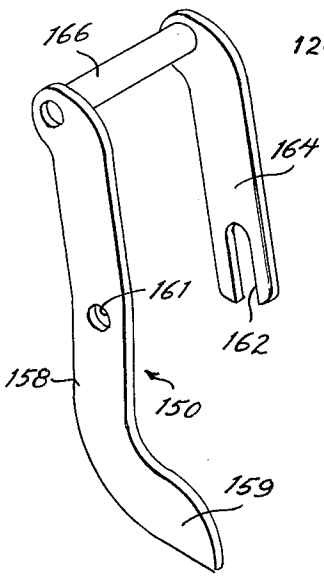


Fig. 12.

Fig. 13.



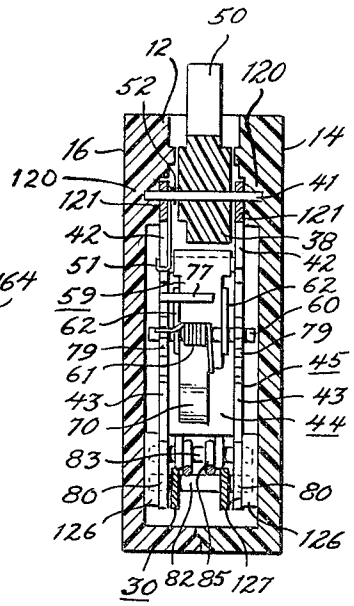


Fig. 6.

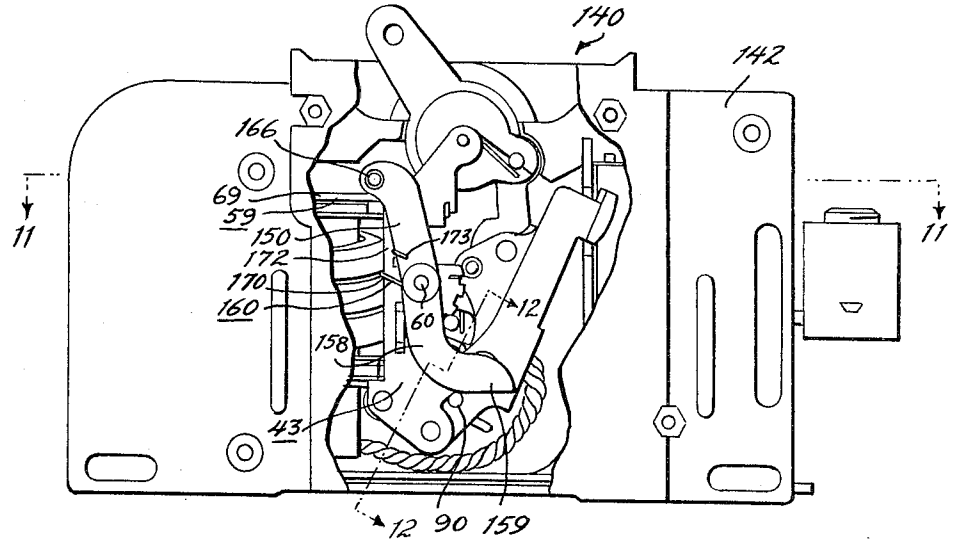


Fig. 10.

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Fig. 11.

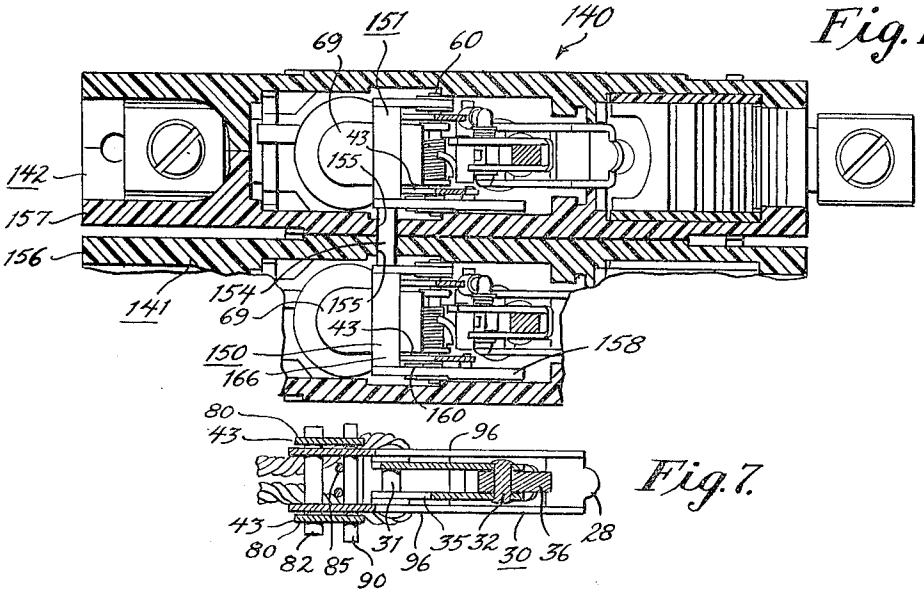

Fig. 7.

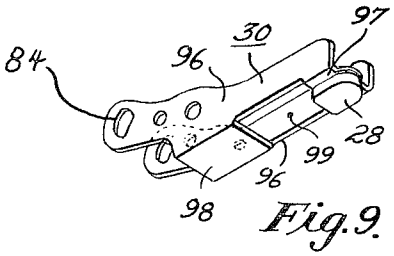

Fig. 9.

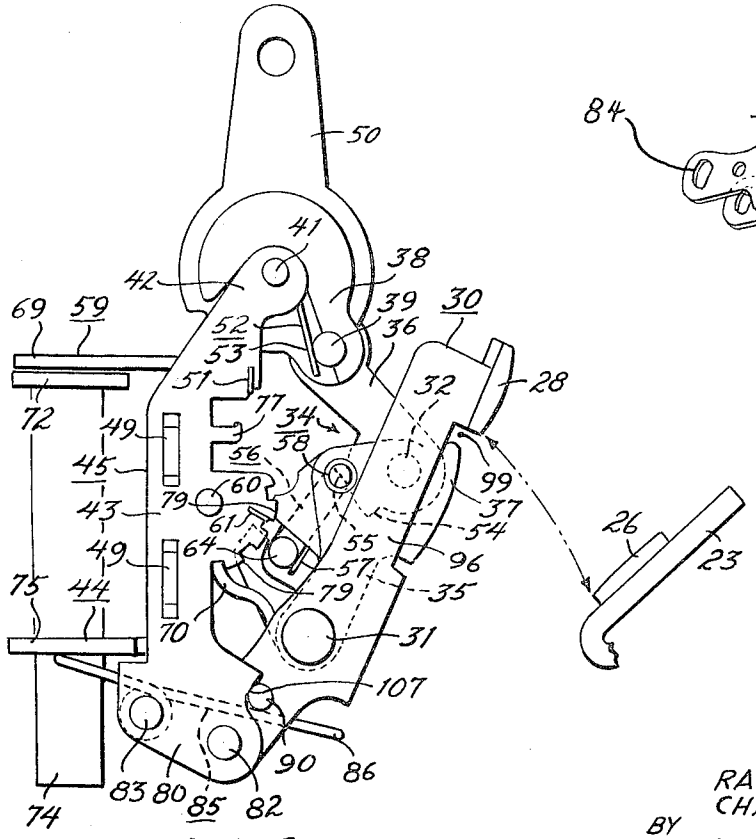

Fig. 8.

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United States Patent Office 3,290,627 Patented Dec. 6, 1966

3,290,627

CIRCUIT BREAKER

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Filed Apr. 26, 1965, Ser. No. 450,983
9 Claims. (Cl. 335—9)

This invention relates to electrical circuit breaker units, and more particularly to a compact linkage mechanism for increasing the separation distance between the contacts, when the contacts open, by permitting the movable contact arm of the mechanism to telescope with a portion of the remainder of the mechanism.

Circuit breaker linkage mechanisms are known in which an automatically resettable linkage mechanism, including a movable contact arm, are used to open and close the contacts either manually, through a handle, or electromagnetically upon overload conditions, through an electromagentic tripping device, as shown, for example, in Wilckens Patent No. 2,360,922 and in Sprague Patent No. 3,098,912.

To update an existing model to have an arrangement, among others, in which the circuit breaker unit is adapted to receiving substitute external terminals, it is desirable to raise the stationary contact relative to the bottom of the circuit breaker unit, but to maintain about the same contact separation in the new model as existed in the prior model, or to increase the contact separation, without increasing the overall size of the unit, it is required that the movable contact arm be moved closer to the remainder of the linkage mechanism than heretofore.

Such movement of the movable contact arm, however, would result in interference between it and the rest of the linkage mechanism unless changes are made to the mechanism.

It is, therefore, an object of this invention to provide a movable arm telescoping with a portion of the remainder of the linkage mechanism so as to achieve the desired contact separation and a compact arrangement.

Therefore, the movable contact arm is made of bent sheet metal and defines a space between the end portion thereof which carries the movable contact and the opposite end portion which is pivotally connected to the remainder of the linkage mechanism, into which a part of the mechanism may telescope, that is, through which a part of the mechanism may move through and back toward its automatically reset position subsequent to electromagnetic stripping of the mechanism and prior to achieving the reset position, to avoid interference between the rest of the linkage mechanism and the movable contact arm during electromagnetic tripping of the circuit breaker unit.

In this circuit breaker unit, the linkage mechanism is carried by two flat plates and is pivotally connected thereto by pins. By extending the pins beyond the frame plates and providing bosses projecting toward the frame plates on the inside of the case, a convenient arrangement is provided for properly locating the linkage mechanism and the electromagnetic tripping device within the case.

Further, by providing a common trip cam in each circuit breaker unit and connecting the cams of adjacent units by a common bar, a multipole arrangement results in which all of the poles are tripped open substantially simultaneously upon the electromagnetic tripping of any one pole, as generally disclosed in the aforementioned Sprague Patent No. 3,098,912. In the present circuit breaker unit, a drive pin is added to the movable contact arm and the common trip cam is biased into engagement with the drive pin. The frame plates are also provided

with stop portions which are also engaged by the drive pins to limit the opening movement of the linkage mechanism under the bias of an opening spring which also engages the drive pin.

The foregoing and other objects of the invention, and the best mode in which we have contemplated applying such principles will more fully appear from the following description and accompanying drawings in illustration thereof.

In the drawings,

FIG. 1 is a perspective view of a circuit breaker unit incorporating the present invention, showing the handle in the open position of the contacts;

FIG. 2 is a side elevation, with one of the two case halves of the circuit breaker unit removed, but showing the handle and the contacts in the closed position;

FIG. 3 is a view similar to FIG. 2, but showing the open position of the contacts and showing the armature before it returns to the position shown in FIG. 2.

FIG. 4 is a view similar to FIG. 2, but showing the open position of the contacts after electromagnetic tripping, but before automatic resetting of the mechanism and before the armature returns to the position shown in FIG. 2, the handle being held in the contacts, closed position;

FIG. 5 is a partial, sectional view taken generally along the line 5—5 in FIG. 2;

FIG. 6 is a sectional view taken generally along the line 6—6 in FIG. 3, but omitting the toggle links;

FIG. 7 is a partial sectional view taken generally along the line 7—7 in FIG. 3;

FIG. 8 is a partial view similar to FIG. 4, but at a larger scale, showing the mechanism after tripping and the handle during its return to the contacts, open position, illustrating the maximum telescoping of the toggle and the movable contact arm;

FIG. 9 is a perspective view of the movable contact arm at a smaller scale than FIG. 8;

FIG. 10 is a view similar to FIG. 3 but showing one pole of a multipole unit including a common trip cam;

FIG. 11 is a partial, sectional view taken generally along the line 11—11 in FIG. 10 and showing a two pole unit;

FIG. 12 is a partial, sectional view taken generally along the line 12—12 in FIG. 10, but showing only a portion of one pole of the two pole unit; and

FIG. 13 is a perspective view of the common trip cam illustrated in FIGS. 10 and 12.

Referring to the drawings, this invention is embodied in a circuit breaker unit 10 comprising an insulator case 12 divided into two halves 14 and 16 (longitudinally through the width of the circuit breaker unit), as illustrated in FIG. 1, and secured together by suitable rivets 15.

The circuit breaker unit 10 is provided with external terminals 20 and 22 for connecting the unit to a circuit. Referring to FIG. 2, the terminal 22 is connected to a conductor 23 which carries the stationary contact 26. The stationary contact 26 is engaged by a movable contact 28 carried by a movable arm 30.

The movable arm 30 comprises a part of a linkage means or mechanism which includes a toggle 34 comprising lower and upper links 35 and 36. The lower link 35 is pivotally connected to the movable arm 30 by a pin 31 at one end and to the upper link 36 at the other end by another pin 32 to form the knee 37 of the toggle. The upper link 36 is pivotally connected at the other end to the handle link 38 by a pin 39, the handle link 38 oscillating about a pin 41 supported by extending through openings in two spaced extensions 42 of two parallel and flat, side plates 43 which together with an L-shaped

plate 44 jointly form a frame 45, the plate 44 having lugs 49 peened to the plate 44.

The handle link 38 is integral with a handle 50 extending outside of the case 12 through a suitable opening, and the handle 50 and handle link 38 are biased to the off position of the contacts by a coiled spring 52 (FIG. 3) wound about the pin 41. The spring 52 has one end portion 51 restrained by one of the two frame extensions 42 and the other end portion 53 biased against the pin 39.

The upper link 36, as shown in FIG. 8, is provided with a tooth portion 54 for engaging a half moon 55 formed on one leg 58 of a U-shaped latch 56 carried by the lower link 35 for locking the toggle 34 in the overcenter position during automatic resetting, the latch 56 being biased, in the clockwise direction, toward engagement with the tooth portion 54, by a spring 57 which engages the other leg 64 of the latch 56. The latch 56 is tripped by a pivotal armature 59 having an attracted end 69 and an unlatching end 70 when the end 70 engages the latch leg 64.

Referring to FIG. 6, the side plates 43 carry a pin 60 which extends through bent up armature ears 62 and about which the armature pivots, the armature being biased clockwise (FIG. 8), against a limiting stop finger 77, by one end portion of a coil spring 61 the other end portion being restrained by serrated teeth 79. When the armature end 69 is attracted, upon sufficient overload, sufficiently toward the pole piece 72 of an electromagnet comprising a coil 73 formed about a tube 74, the armature unlatching end 70 engages the latch leg 64, and turns the latch 56 against the bias of the spring 57 to present the flat portion of the half moon 55 to the tooth portion 54, whereupon the toggle 34 collapses under the bias of an opening spring 85.

The tube 74 (FIG. 8) projects through the horizontal leg 75 of the L-shaped frame plate 44 and houses a movable core (not illustrated) of magnetizable material biased toward the lower end of the tube 74 to provide a time delay below certain overload currents before the mechanism is tripped. The tube 74 is soldered to the frame leg 75 and the coil 73 has one end connected to the movable arm 30 by a length of flexible conductor 76 and the other end connected by a conductor 78 to the terminal 20. The flexible conductor 76 is welded at its two ends to one end of the coil and the midportion of the conductor 76 is welded to the movable arm 30 so as to provide two parallel paths from the coil to the movable arm.

The side frame plates 43 have lower extensions 80 with two pairs of aligned holes. The movable arm 30 pivots about a pin 82 which extends through one of the pairs of holes in the extensions 80 and an elongated slot 84 in the arm 30, the opening spring 85 being coiled about the pin 83 which extends through the other pair of aligned holes in the extensions 80, the straight but yoke-like portion 86 of the spring 85 bearing linearly against a circular drive pin 90 between the plates 96 of the movable arm 30.

The pin 39 has end portions extending beyond the handle link 38 which abut against the side plate extensions 42 to limit overcenter movement of the links 36 and 38, FIG. 2.

An insulator plate 92, received in suitable grooves in the case halves 14 and 16, separates the main interior portion 93 from the right hand or arcing chamber portion 94. The insulator plate 92 is provided with suitable openings to receive the movable arm 30. Within the arcing chamber 94 is placed an arc grid assembly 105 comprising a suitable number of magnetizable grids 95 supported by insulator plates 91 for facilitating extinction of any arc that may form between the contacts 26 and 28 as they separate.

Referring to FIG. 9, the movable arm 30 has a generally channel or U-shape in cross section. The movable arm 30 comprises two side plates 96 bridged by integral upper and lower plates 97 and 98 to define a space 99 therebetween. The movable contact 28, mentioned previously, is suitably secured to the upper plate 97.

When the contacts are manually opened, that is, when the movable handle 50 is manually turned from the position of FIG. 2 to that of FIG. 3, the toggle 34 is generally raised and rotated to the right, which simultaneously pivots the movable arm 30 counterclockwise until the end portions of the drive pin 90 abut the frame stop portions 107 to limit rotation of the mechanism. During such movement from the contacts closed to the contacts open positions, portions of the toggle lower link 35 and a part of the toggle upper link 36 are received between the two side plates of the movable arm 30, as viewed in FIGS. 3 to 8.

When the circuit breaker unit is in the position illustrated in FIG. 2, and an overload energizes the coil 73 sufficiently to attract the armature end 69 sufficiently toward the pole piece 72 so as to pivot the end 70 and turn the latch 56 for collapsing the toggle 34 the mechanism collapses to the contacts open position of FIG. 3, but in so doing, when it achieves the momentary position illustrated in FIG. 8, where the pins 32, 39, and 41 are substantially in line, the upper right hand portion of the link 35 has moved a maximum amount into and through the space 99 and the toggle 34 has telescoped its maximum amount with the movable arm 30. It will be noted, as illustrated in FIG. 8, that at this time a portion of the toggle 34 extends to the right of the surface to which the movable contact 28 is secured. After the momentary position of FIG. 8 is achieved, as the mechanism continues its movement to the contacts open position, the portion of the toggle which is shown extending through the opening 99 in FIG. 8 moves to the left, out of the opening 99, and to the position illustrated in FIG. 3.

As illustrated in FIGS. 5, 6 and 7, the pins 41, 82 and 83 have end portions which extend beyond the frame side plates 43. The case halves 14 and 16, referring to FIG. 6, are provided with opposed upper bosses 120 projecting from and integral with the inner case walls. The bosses 120 have a flat face 121 and each has a hole into which the end portions of the pin 41 are received.

Similarly, the case halves 14 and 16, referring to FIG. 5, are provided with lower opposed bosses 126 projecting from the inner case walls. The bosses 126 have flat faces 127, coplanar with the flat faces 121 of the upper bosses 120, and each boss 126 has two holes into which the end portions of the pins 82 and 83 are received.

Thus, the flat side frame plate 43 abuts the flat faces 121 and 127 to space the frame 45 and the linkage mechanism from the inner walls of the case halves and to properly position the frame 45, and the linkage mechanism which it carries, within the case.

Referring to FIGS. 10, 11, 12 and 13, the linkage mechanism illustrated in FIGS. 1 to 9 is illustrated in a multipole circuit breaker unit 140. Essentially two units or poles 141 and 142, each constructed according to FIGS. 1 to 9, are placed in side-by-side relation, as illustrated in FIG. 11. To each pole 141 and 142 is added a common trip cam 150 and 151 and the cams 150 and 151 are interconnected by an insulator rod 154. The side-by-side walls 156 and 157 of the two poles are provided with suitable arcuate openings 155 through which extends the rod 154.

The common trip cams 150 and 151 are substantially alike and referring, for simplicity, to only the cam 150, as illustrated in FIG. 13, the cam 150 comprises a long cam arm 158 having its lower cam end portion 159 biased in engagement with the drive pin 90 by a spring 160. The cam 150 pivots about the armature pin 60, the arm 158 having a hole 161 through which the pin 60 extends. The opposite end portion of the pin 60 extends through an open ended slot 162 in the short arm 164, the

long and short arms **158** and **164** being connected by a hollow tube **166** having end portions received in suitable holes in the arms **158** and **164** and secured thereto by solder or the like, the rod **154** extending through the tube **166** of each cam.

The arm **158** is slightly spaced from the adjoining frame plate **43** and between the two is disposed the spring **160** which is coiled about the pin **60** and has one end portion **170** restrained by the end portion **172** of the adjoining frame plate and the other end portion **173** hooked about the arm **158** above the pin **60** so as to bias the cam in a clockwise direction, whereby the lower cam end **159** will be biased into engagement with the drive pin **90**.

As illustrated in FIG. 10, the tube **166** overlies the attracted end portion **69** of the armature **59**, the armature end portion and the tube **166** being in engagement in the open and closed positions of the contacts and in manual movement therebetween.

Because of the slot **162**, the cam **150** may be easily assembled to the linkage mechanism after it has been secured to the frame plates **43**. After the spring is coiled about the pin **60**, the pin **60** is moved axially, away from the spring, backwards as viewed in FIG. 10, and the cam is placed over the armature end **69**, with the arms **158** and **164** straddling the frame plates **43**, and lowered toward the pin **60**. The cam lower end portion **159** just clears the near end face of the pin **60** and the slot **162** is moved over the far end of the pin **60**. The pin **60** is then pushed forward at which time a part thereof enters the hole **161**.

Upon an overload in one of the two poles **141** or **142**, sufficient to trip the pole, the associated armature is rotated about its pin into engagement with and rotates its latch against the bias of the latch spring sufficiently for the tooth to clear the half moon. The overcenter toggle immediately collapses under pressure from the opening spring and the movable arm starts to separate from the stationary contact. As the separating movement starts, rotation of the cam also starts because of the abutment of the drive pin and the cam lower end portion. Continued movement of the movable arm and continued pivoting of the cam causes the cam tube to rotate counterclockwise. Since the cams **150** and **151** are interconnected by the rod **154**, both cams pivot simultaneously.

Since the associated pole is not overloaded, the armature thereof has not been pivoted toward its pole piece. But because of the aforementioned movement of the cams, the cam tube in the nonoverloaded pole forces the associated armature to turn in the direction to unlatch its associated latch, whereby both poles are opened substantially simultaneously.

Having described this invention, we claim:

1. In combination, a case, a collapsible linkage means housed within said case, a stationary contact supported within said case; said linkage means comprising a handle extending outside of said case, a movable contact engageable with said stationary contact, a movable arm for moving said movable contact into and out of engagement with said stationary contact, a toggle pivotally connected at one end portion to said movable arm and at the other end portion to said handle, said toggle being formed by two links pivotally connected to each other to form the toggle knee portion, and spring means for automatically resetting said linkage means after electromagnetic tripping and collapsing of the linkage means so that the contacts can be reclosed by movement of said handle from the contacts open position to the contacts closed position; and an electromagnetic tripping device including an armature for initiating movement of said linkage means to the open position of said contacts, said movable arm defining a space between said movable contact and its pivotal connection to said toggle, the toggle knee portion being in telescopic relation with said space so that upon the electromagnetic tripping of, and the collapse of, said linkage means the toggle knee portion moves into said space and back toward its automatically reset position.

2. The structure recited in claim **1** wherein said case is an insulator case, said movable arm comprises a side plate and a lateral plate carrying said movable contact.

3. The structure recited in claim **1** wherein said case is of electrical insulating material, said movable arm comprises two side plates connected by two bridging plates, said bridging plates being spaced from each other along the length of said movable arm to define with said side plates said space, one of said bridging plates carrying said movable contact.

4. In a plurality of circuit breaker units, each unit having a pair of relatively movable contacts, an automatically resettable mechanism including a movable arm carrying one of the contacts and pivotal to a position for opening said contacts, an opening spring biasing said contacts to the open position, an electromagnetic tripping device including an armature for initiating movement of said mechanism to the open position of the contacts upon an overload, said mechanism including an automatically resettable latch, spring means for automatically relatching each mechanism after electromagnetic opening of the contacts, and a cam member associated with each mechanism, all of the cam members being interconnected for simultaneous movement upon the movement of any one to move said mechanisms in the contacts opening direction, each of the cam members having a portion in force transmitting relation with the movable arm to rotate the cam members as soon as the contacts of the first switch unit start to separate, each of said cam members having another portion impingeable upon portions of each of the armatures of the unit other than the overloaded switch unit, a frame to which said mechanism is secured, the improvement comprising a pin carried by said movable arm, said cam being biased into engagement with said pin, and said pin, when said contacts are in the open position, engaging a portion of said frame to limit the opening movement of said movable contact arm.

5. The combination of a plurality of circuit breaker units, each unit having a pair of relatively movable contacts, an automatically resettable mechanism including a movable arm carrying one of the contacts and pivotal to a position for opening said contacts, an opening spring biasing said contacts to the open position, an electromagnetic tripping device including an armature for initiating movement of said mechanism to the open position of the contacts upon an overload, said mechanism including an automatically resettable latch, spring means for automatically relatching each mechanism after electromagnetic opening of the contacts, and a cam member associated with each mechanism, all of the cam members being interconnected for simultaneous movement upon the movement of any one to move said mechanisms in the contacts opening direction, each of the cam members having a portion in force transmitting relation with the movable arm to rotate the cam members as soon as the contacts of the first unit start to separate, each of said cam members having another portion impingeable upon portions of each of the armatures of the unit other than the overloaded unit, a frame to which said mechanism is secured, the improvement comprising a pin carried by said movable arm, and said cam being biased into engagement with said pin, and said pin, when said contacts are in the open position, engaging a portion of said frame to limit the opening movement of said movable contact arm, said opening spring having a substantially straight portion engaging said pin to bias said movable arm to the contacts open position.

6. In combination, an insulator case, a mechanism housed within said case, a frame carrying said mechanism, a stationary contact supported within said case, said mechanism including a movable contact engageable with said stationary contact, said mechanism being collapsible to

a position for opening said contacts, an electromagnetic tripping device including an armature for initiating movement of said mechanism to the open position of the contacts, said frame comprising two side plates, first and second pins spaced from each other and extending through holes in said plates, said first pin also extending through holes in said movable contact to provide a pivotal connection between said movable arm and said frame, a spring coiled about said second pin and biasing said movable arm to the open contacts position, a third pin carried by said movable arm, said spring having a substantially straight portion biased into engagement with said third pin.

7. In combination, an insulator case, a mechanism housed within said case, a frame carrying said mechanism, a stationary contact supported within said case, said mechanism including a movable contact engageable with said stationary contact, said mechanism being collapsible to a position for opening said contacts, an electromagnetic tripping device including an armature for initiating movement of said mechanism to the open position of the contacts, said frame comprising two side plates, first and second pins spaced from each other and extending through holes in said plates, said first pin also extending through holes in said movable contacts to provide a pivotal connection between said movable arm and said frame, a spring coiled about said second pin and biasing said movable arm to the open contacts position, a third pin carried by said movable arm, said spring having a substantially straight portion biased into engagement with said third pin, said first and second pins having end portions extending beyond said plates, said case having upstanding bosses, said pin end portions being received in said bosses.

8. In combination, an insulator case, a mechanism housed within said case, a frame carrying said mechanism, a stationary contact supported within said case, said mechanism including a movable contact engageable with said stationary contact, said mechanism being collapsible to a position for opening said contacts, said mechanism including a handle and handle link, an electromagnetic tripping device including an armature for initiating movement of said mechanism to the open position of the contacts, said frame comprising two side plates, first and second pins spaced from each other and extending through holes in said plates, said first pin also extending through holes in said movable contact, a spring coiled about said second pin and biasing said movable arm to the open contacts position, a third pin carried by said movable arm, said spring having a substantially straight portion biased into engagement with said third pin, said first and second pins having end portions extending beyond said plates, a fourth pin extending through said plates to pivotally connect said handle and handle link to said plates, said fourth pin having end portions extending beyond said plates, said case having upper bosses on opposite sides of said frame receiving the end portions of said fourth pin, said case having lower bosses on opposite sides of said frame receiving the end portions of said first and second pins, said upper and lower bosses having coplanar faces parallel to said plates.

9. The combination of a plurality of similar circuit breaker units, each unit having a pair of relatively movable contacts, an automatically resettable mechanism including a movable arm carrying one of the contacts and pivotal to a position for opening said contacts, an opening spring biasing said contacts to the open position, an electromagnetic tripping device including an armature pivotal about a pin for initiating movement of said mechanism to the open position of the contacts upon an overload, said mechanism including an automatically resettable latch, spring means for automatically relatching each mechanism after electromagnetic opening of the contacts, and a cam member associated with each mechanism, all of the cam members being interconnected for simultaneous movement upon the movement of any one to move said mechanisms in the contacts opening direction, each of the cam members having a portion in force transmitting relation with the movable arm to rotate the cam members as soon as the contacts of one unit start to separate, each of said cam members having another portion impingeable upon portions of each of the armatures of the unit other than the overloaded unit, a frame to which said mechanism is secured, the improvement comprising forming said cam member by spaced cam arms one of which has an open ended slot and the other a circular hole to receive the armature pin and joining said spaced cam arms by a tube, and a rod through said tubes for interconnecting the cam members.

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