United States Patent [19]

Araki

[11] **3,774,126**

[45] **Nov. 20, 1973**

[54] **MULTI-POLE TYPE FUSELESS CIRCUIT BREAKER**

[75] Inventor: **Yoshitake Araki**, Tokyo, Japan

[73] Assignee: **Tokyo Shibaura Electric Company, Ltd.**, Kawasaki, Japan

[22] Filed: **Nov. 9, 1972**

[21] Appl. No.: **305,079**

[52] **U.S. Cl.** **335/9**

[51] **Int. Cl.** **H01h 75/00**

[58] **Field of Search** 335/8, 9, 10

[56] **References Cited**

UNITED STATES PATENTS

3,353,127	11/1967	Francis et al.	335/9
3,073,926	1/1963	Ellsworth et al.	335/9
3,369,202	2/1968	Gryctko	335/9

Primary Examiner—Harold Broome
Attorney—Norman F. Oblon et al.

[57] **ABSTRACT**

A multi-pole type fuseless circuit breaker comprising a molded casing made of insulating material, a plurality of switching mechanisms mounted in the casing and having a common manually operable handle, and automatic trip devices respectively combined with the corresponding switching mechanisms. Each of the automatic trip devices respectively includes an actuator member secured to a latching member thereof and extending toward a latching member of an adjacent automatic trip device. The actuator member has a free end which is normally separated from the adjacent actuator through a gap and is engageable with the adjacent actuator member to cause successive tripping thereof when the former has finished its tripping operation prior to the latter being actuated.

3 Claims, 6 Drawing Figures

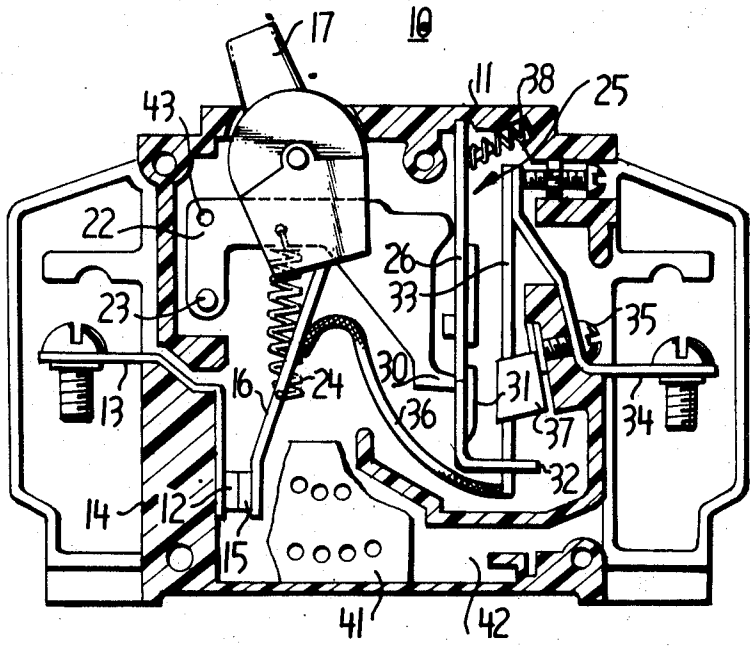
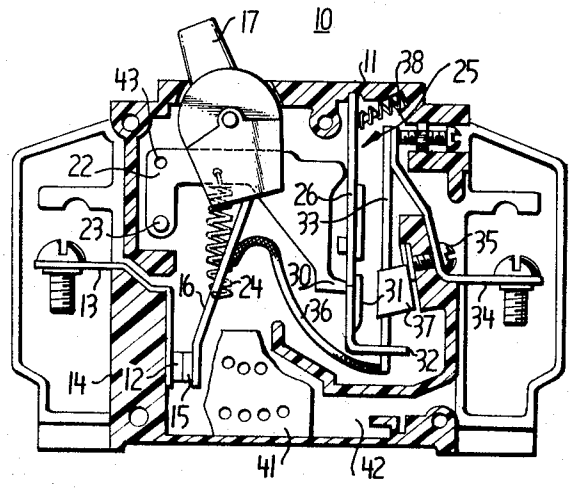


FIG. 1


17
10
11
38
25
43
22
26
33
23
35
16
24
30
31
36
37
34
13
14
12
32
15
41
42

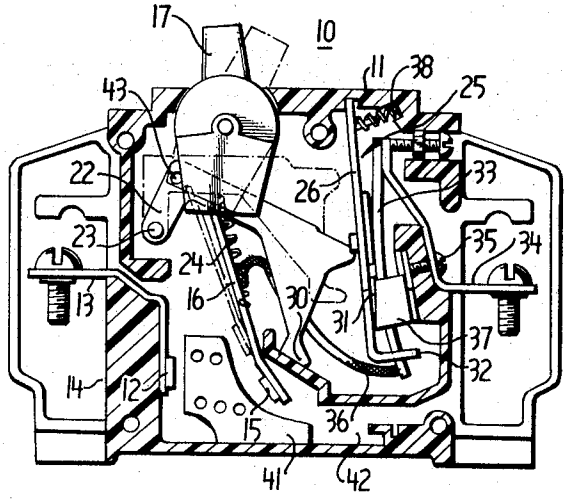

17
10
11
38
25
43
22
26
33
23
35
34
24
16
30
31
13
37
14
12
32
15
36
41
42

FIG. 2

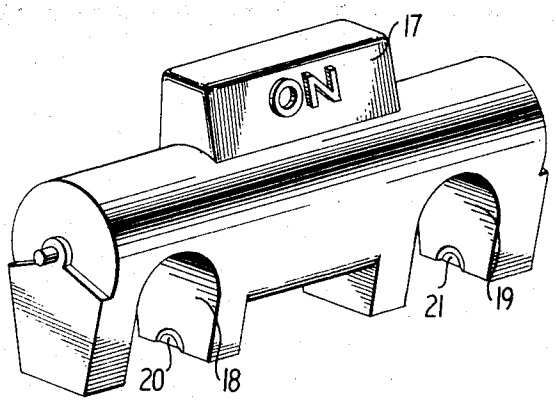


FIG. 3

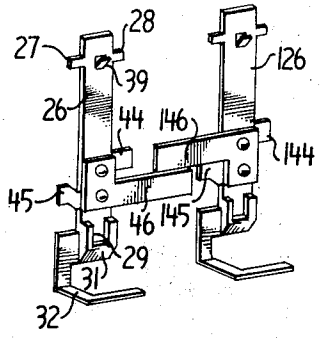


FIG. 4

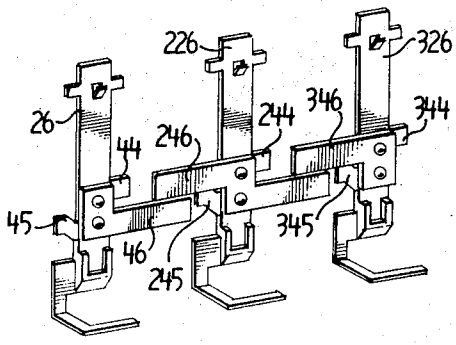


FIG. 5

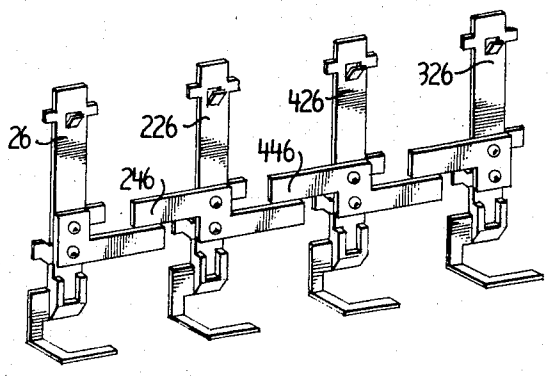


FIG. 6

MULTI-POLE TYPE FUSELESS CIRCUIT BREAKER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a multi-pole fuseless circuit breaker of the type including multi-pole switching mechanisms which are mounted in a molded case made of an insulating material and operate to open an electric circuit through corresponding trip devices linked with each other.

2. Description of the Prior

Multi-pole fuseless circuit breakers, as heretofore known, and mounted in molded insulative cases, have been provided with a plurality of stationary contacts mounted in the molded case, corresponding movable contacts mounted in the same case and being capable of movement between circuit opening and closing positions, automatic trip devices in a number corresponding to the number of pole contacts and an elongated common trip bar extending across the automatic trip devices to achieve simultaneous movement of all the movable contacts toward a circuit opening position even when only one of the automatic trip devices is operated in response to overload condition in the circuit.

For convenience of explanation, it is assumed that the circuit breaker is of a double-pole type having a common trip bar combined with a pair of automatic trip devices. In this case, it will be easily understood that the releasing force to be added to the common trip bar upon the occurrence of a simultaneous tripping operation of both devices is twice as great as the releasing force that is caused by the operation of a single tripping device. Accordingly, it is likely that a difference in the setting current value may occur between a single pole trip and a double-pole simultaneous trip.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a new, improved and unique multi-pole fuseless circuit breaker in which the trip operation can be achieved at the same current setting value in either a single pole trip or a multi-pole trip.

Another object of the present invention is to provide a multi-pole fuseless circuit breaker in which a trip device of each pole respectively has an actuator member extending toward an ajdacent trip device to cause sequential tripping of each other after the preceding trip operation of one of the trip devices.

Still another object of the present invention is to provide a multi-pole fuseless circuit breaker in which a successive trip operation of all poles can be positively achieved through a single pole trip operation.

The foregoing and other objects are attained, in accordance with at least one aspect of the present invention, through the provision of a multi-pole fuseless circuit breaker which comprises a molded casing made of an insulating material, at least two stationary contacts mounted in the casing, at least two movable contact assemblies mounted in the casing respectively having movable contacts for making and breaking the corresponding stationary contacts, a manually operable handle mounted in the casing to move the movable contact assemblies between circuit closed and open positions, at least two releasable members mounted in the casing and respectively having one end pivotally supported on the casing, and tension springs respectively stretched between the releasable members and corresponding movable contact assemblies to maintain contact pressure between the movable and stationary contacts. At least two automatic trip devices are mounted in the casing, each having a swingable member pivotally supported at one end on the casing and having a recess for latching the other end of a corresponding releasable member to hold the movable contact assembly in the contact closed position. Each of the swingable members further has an actuator member extending toward an adjacent swingable member of an adjacent automatic trip device, a free end of which is normally disposed through a gap against the adjacent swingable member, and the free end of the actuator member is capable of engagement with an adjacent swingable member to provide successive trip operations when a trip operation of one of the preceding trip devices occurs.

BRIEF DESCRIPTION OF DRAWINGS

Various other objects, features and many of the attendant advantages of the invention will be more fully appreciated as the same become better understood from the following detailed description when considered in connection with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the several views thereof, and wherein:

FIG. 1 is a cross-sectional view, in a circuit closed position, of a preferred embodiment of a multi-pole fuseless circuit breaker formed in accordance with the present invention;

FIG. 2 is a view similar to that of FIG. 1, showing the multi-pole fuseless circuit breaker thereof in an automatic trip position;

FIG. 3 shows a perspective view of a manual operable handle for the circuit breaker of this invention;

FIG. 4 is an exploded perspective view of the swingable members designed for use in a double-pole type circuit breaker;

FIG. 5 is an exploded perspective view of another embodiment of the swingable members for use in a three-pole type circuit breaker; and

FIG. 6 shows an exploded perspective view of a further embodiment of swingable members for use in a four-pole type circuit breaker.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and particularly to FIG. 1 thereof, a multi-pole fuseless circuit breaker is generally designated by the reference numeral **10** and comprises a molded casing **11** made of an insulating material, such as phenol resin, a stationary contact **12** secured to one end of a line conductor **13** mounted through an end wall **14** of the casing **11**, a movable contact **15** carried on one end of a movable contact arm **16** to make and break the stationary contact, and a manually operable handle **17** pivotally mounted in the casing to move the movable contact arm **16** between circuit closed and open positions.

The manually operable handle **17** designed for use with a double-pole circuit breaker is shown in FIG. 3 and includes two notches **18** and **19** respectively having recesses **20** and **21** in the defining walls thereof for pivotally receiving shoulder portions of the movable contact arms **16**.

A releasable member or cradle 22 is pivotally mounted at its one end 23 in the casing 11 and has an elongated central portion located in the recess 18 of handle 17. The upper half of the movable contact 16 is divided into parallel legs respectively having a shoulder portion to be pivotally received in the recesses 20 of notch 18 of handle 17. A tension spring 24 is stretched between the central portion of the cradle 22 and a lower portion of the movable contact arm 16 such that the spring 24 can be passed through a gap existing between the legs of the movable arm 16.

In order to maintain cradle 22 in the position shown in FIG. 1, against the tension of spring 24 or to release the cradle 22, an automatic trip device generally designated by the reference numeral 25 is mounted in the casing 11. The automatic trip device 25 has a swingable member 26, shown in detail in FIG. 4. The swingable member 26 has a pair of projections 27 and 28 extending laterally from the top portion thereof and pivotally engaged within holes in the side walls of the casing 11. The swingable member 26 also has a through hole 29 in its lower portion to latch the releasable end 30 of cradle 22 therein. A U-shaped armature member 31 is welded to the lower portion of the swingable member 26 being cooperative with the through hole 29 to hold the releasable end 30 of the cradle 22. The swingable member 26 is further provided with a horizontally bent portion forming hook 32 at its lower end.

The automatic trip device 25 includes a bimetallic strip 33 having a top end secured to one end of a load terminal conductor 34 which is in turn secured by means of a screw 35 to another end wall of the casing 11. The lower end of the bimetallic strip 33 extends downwardly through the inside of the hook 32 and is connected to the movable contact arm 16 through a flexible lead wire 36. A U-shaped magnetic pole unit 37 is secured to the end wall of casing 11 by the screw 35 such that the magnetic pole surfaces thereof are positioned against the armature 31 of swingable member 26 through a suitable air gap. The pair of magnetic poles of the U-shaped magnetic pole unit 37 is located in surrounding relation to the bimetallic strip 33 so as to provide a magnetic pull on the armature 31 proportional to the electric current flowing through the bimetallic strip 33.

A biasing spring 38 is positioned between a projection 39 on an upper portion of the swingable member 26, taking the form of a bent-out tab portion as shown in FIG. 4, and an upper rightward corner of the casing 11, as seen in FIGS. 1 and 2, and normally biases the swingable member 26 toward pivotal movement in a clockwise direction.

The bimetallic strip 33 is pressed at its top portion by an adjusting screw 40 to adjust the separation between the hook 32 of swingable member 26 and the lower end of the bimetallic strip 33. In this way, the thermal tripping current level can be adjusted to a desired value for response to an overload current flowing through the bimetallic strip 33.

In order to extinguish an electric arc to be initiated between the stationary and movable contacts 12 and 15, suitable arc chute 41 is mounted on a base portion of the casing 11 so as to allow the movable contact 15 to pass therethrough. The ionized products occurring during the arc extinguishing process thus are expelled from the inside of the casing 11 through a discharge path 42.

FIG. 1 shows the stationary and movable contacts 12 and 15 in their circuit closed position. Manual separation of the movable contact 15 from the stationary contact 12 can be achieved, when required, by manually rotating the handle 17 in a clockwise direction, as shown in FIG. 2 in dotted line. In this case, since counter-clockwise rotation of the swingable member 26 does not occur, the cradle 22 will remain held horizontally, also as shown by dotted line. Accordingly, only the movable contact arm 16 will move over the center line of tension spring 24, as shown by dotted line, to thereby separate the movable contact 15 from the stationary contact 12.

On the other hand, when an overload current occurs in the electric circuit, the bimetallic strip 33 will be bent by the self-heating thereof due to the overload current flowing therethrough, as shown in FIG. 2, and accordingly the engaged end 30 of cradle 22 will be released from the swingable member 26. As a result, the cradle 22 will rotate about pivot 23 in a clockwise direction, as shown in FIG. 2, and the movable contact arm 16 will be moved rapidly by the tension spring 24 to separate the movable contact 15 from the stationary contact 12. The electric arc initiated between the contacts will be extinguished within the arc chute 41, and the arc products will be expelled out through the path 42, as described hereinbefore.

It will be understood that such a tripping operation will also occur electromagnetically. If a short circuit occurs in the electric circuit, the magnetic pole unit 32 will attract the armature 31 magnetically to cause the swingable member 26 to rotate in a counterclockwise direction. Thus, the tripping of the cradle 22 will occur similarly to cause a quick separation of the movable contact 15 from the stationary contact 12.

In FIG. 2, clockwise rotation of the handle 17 is required in order to reset the cradle 22. In this way, the left side of the handle 17 pushes a pin 43 secured to the cradle 22 to rotate the cradle 22 in a counterclockwise direction until the engageable end 30 of the cradle 22 re-engages within the through hole 29 of the swingable member 26. Thus, the cradle 22 will again be held horizontally, as shown in FIG. 1, so as to permit counterclockwise rotation of the handle 17 to engage the movable contact 15 with the stationary contact 12.

The mechanism having parts as described above, except for handle 17, is provided respectively for each line phase of a multi-pole type fuseless circuit breaker.

A pair of swingable members 26 and 126 are shown in FIG. 4 for the construction of a double-pole circuit breaker. For the convenience of illustration, both swingable members 26 and 126 are located laterally spaced apart from each other. Each of the members 26 and 126 has a pair of projections 44,45, and 144, 145, respectively, laterally projecting therefrom and respectively located at different heights on opposite sides thereof. An L-shaped member 46 is attached to the swingable member 26 at the leg portion thereof, and an arm portion of the L-shaped member 46 is extended to the adjacent swingable member 126 so that the front end of the member 46 overlaps the projection 145 of swingable member 126 through a suitable air gap. Similarly, an L-shaped member 146 is attached to the swingable member 126 at the leg portion thereof, and an arm portion of the L-shaped member 146 is extended to the adjacent swingable member 26 along the L-shaped member 46 thereof so that the front end of

the member **146** overlaps the projection **44** of the swingable member **26** through a suitable air gap.

The gap length is determined as follows. It is assumed that a single pole tripping operation has occurred to draw the lower end of the swingable member **26** backward. The swingable member **26** will thereby release the corresponding engageable end of cradle **22** from the through hole **29** thereof before touching the projection **44** with the front end of the L-shaped member **146** of the adjacent swingable member **126.** As a result, successive swinging movement of the adjacent swingable member **126** will occur after the cradle **22** of the initial or preceding mechanism has been released.

In this way, it can be understood that the single pole tripping operation can be precedingly achieved without any influence of the successive tripping device and, additionally, both of double-pole switch mechanisms can be surely tripped by the single pole trip operation.

Although a pair of projections **44, 45** and **144, 145** have been shown, the projections **45** and **144** can be eliminated so long as only a double-pole system is being produced.

FIG. **5** shows a three-phase arrangement of swingable members **26, 226,** and **326.** The center member **226** has a Z-shaped member **246** having a left arm extending toward the projection **44** of the swingable member **26** and a right arm extending toward a projection **345** of the swingable member **326.** It can be understood therefore that a relaying type tripping operation can be achieved similarly to that of the embodiment shown in FIG. **4.**

FIG. **6** shows another arrangement of swingable members **26, 226, 425** and **326** for use in a three-phase four-line type fuseless circuit breaker, wherein the two center members **226** and **426** have Z-shaped members **246** and **446,** respectively. The relaying trip operation can thus be achieved in the same manner as in the embodiments of FIGS. **4** and **5.**

From the above, in accordance with the multi-pole type fuseless circuit breaker of the present invention, the automatic trip device provided in each pole can achieve its tripping operation independently of the adjacent trip device when a single pole trip operation occurs, and after that, successive trip operations of the adjacent trip devices can be achieved by each of the respective preceding trip devices. Thus, the trip operation can be achieved at the same setting current value in either the single pole trip or the simultaneous multi-pole trip.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed as new and desired to be secured by letters patent of the United States patent office:

1. A multi-pole type fuseless circuit breaker comprising:

a molded casing constructed of an insulating material;

at least two stationary contacts mounted in said casing;

at least two movable contact assemblies mounted in said casing and respectively having a movable contact to make and break a corresponding one of said stationary contacts;

a manually operable handle mounted in said casing to move said movable contact assemblies between circuit closed and open positions;

at least two releasable members mounted in said casing and respectively having one end pivotally supported on said casing;

tension springs respectively stretched between each of said releasable members and a corresponding one of said movable contact assemblies to maintain contact pressure between said movable and stationary contacts thereof;

at least two automatic trip devices mounted in said casing and respectively having a swingable member with one end pivotally supported on said casing;

each of said swingable members having a recess for latching the other end of said releasable member to hold said movable contact assembly in a contact closed position;

each of said swingable members also having an actuator member extending toward an adjacent swingable member of an adjacent automatic trip device;

each of said actuator members having a free end normally separated through a gap from said adjacent swingable member;

whereby said free ends of said actuator members are capable of engagement with an adjacent swingable member to cause successive tripping thereof when a trip operation of a preceding trip device occurs.

2. A multi-pole type fuseless circuit breaker according to claim **1,** wherein

said actuator members of said swingable members respectively have an L-shaped configuration and are secured to said swingable member with an arm thereof extending toward an adjacent swingable member and having a free end overlapping a projection laterally projected from said adjacent swingable member with an air gap normally disposed therebetween.

3. A multi-pole type fuseless circuit breaker according to claim **1,** wherein

said actuator member of at least one of said swingable members has a Z-shaped configuration and a pair of arms extending laterally and oppositely therefrom, said arms of Z-shaped actuator member respectively having a free end overlapping a projection projected laterally from adjacent swingable members with an air gap normally provided therebetween.

* * * * *