

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) AUTOMATIC CIRCUIT INTERRUPTER

- (71) We, MITSUBISHI DENKI KABUSHI-
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 organised and existing under the laws of Japan,
 do hereby declare the invention, for which
 we pray that a patent may be granted to us,
 and the method by which it is to be performed,
 to be particularly described in and by the following
 statement:—
- This invention relates to a circuit interrupter
 comprising a manually operated switching
 handle, a toggle mechanism, an overcurrent responsive
 mechanism and a tripping mechanism and capable of
 interrupting an associated circuit not only manually
 but also automatically upon the occurrence of an
 overcurrent in the circuit. In particular the invention
 is concerned with improvements in the tripping
 mechanism included in such a circuit interrupter.
- The conventional type of automatic circuit
 interrupter has a switching mechanism composed
 essentially of a manually operated switching
 handle and a pair of toggle link elements, one of
 the toggle elements being articulated at one end,
 to the switching handle, the other toggle element
 being articulated to a movable contact rod, both
 the toggle elements being adapted to be maintained
 substantially in straight extended relationship by
 the associated latch. A locking element is mounted
 to either one of the two toggle elements. This
 causes the latch to effect a complicated movement
 upon moving the toggle elements and also to change
 in position in accordance with the positions of
 the moved toggle elements. Upon the occurrence
 of an overload current in the associated circuit,
 it was required to release the latch from its
 holding state regardless of the magnitude of
 contact pressure under which the associated
 movable contact was in engagement with the
 mating stationary contact. Therefore the use of
 a tripping mechanism of small dimensions and
 short operating stroke led to the disadvantage
 that it could

not ensure that the latch was released from
 its holding state. 45

According to the invention there is provided
 an automatic circuit interrupter comprising a
 stationary contact disposed on an electrically
 insulating member, a movable contact cooper-
 ating with the stationary contact to open and
 close an associated circuit, a pivoted switching
 handle manually operable to move the movable
 contact toward and away from the stationary
 contact, a pair of toggle link elements opera-
 tively connecting the movable contact to the
 switching handle, overcurrent-responsive
 means, and a rotatable latch pivotably mount-
 ed to a stationary supporting plate by a pivot
 pin, said latch being normally prevented from
 moving and being released by said overcur-
 rent-responsive means upon the occurrence of
 an overcurrent in the circuit, and a link ele-
 ment connecting said latch to said pair of to-
 ggle link elements whereby the elements are
 held substantially in alignment against the ac-
 tion of a spring until said latch is released
 whereupon the elements fold into a V-forma-
 tion with its apex on that side away from the
 said latch. 50 55 60 65 70

The invention will further be described in
 conjunction with the accompanying drawings in
 which:

Figure 1 is a plan view of a circuit inter-
 rupter according to the invention with a cover
 member removed for the purpose of illustrat-
 ing the internal construction; 75

Figure 2 is an elevational view, partly in
 longitudinal section of the interrupter illus-
 trated in Figure 1, in its closed position; 80

Figure 3 is a view similar to Figure 2 but
 illustrating the interrupter in its tripped po-
 sition;

Figure 4 is a view also similar to Figure
 2 but illustrating the interrupter in its open
 position; 85

Figure 5 is a diagrammatic view illustrating
 those components shown in Figures 1 to 4 in-

clusive and associated with the operations of opening and closing contacts with the circuit interrupter in its closed position; and

Figures 6 and 7 are views similar to Figure 5 but illustrating further embodiments of the invention.

Throughout the Figures like reference numerals designate the same or similar components.

Figures 1 and 2 illustrate a double pole circuit interrupter which comprises a housing member 10 and a cover member 12 detachably covering an upper opening (as viewed in Figure 1) of the housing member to define an internal space in which components are disposed. The members 10 and 12 are preferably made of any suitable electrically insulating, synthetic resin by moulding.

The housing member 10 has attached to the opposite sides a pair of terminal boxes 14 and 16 of the same material as the housing and cover members in which a source terminal 18 and a load terminal 20 are planted on the bottom wall surface respectively. A terminal strip 22 attached to the lefthand portion as viewed in Figure 2 of the bottom wall surface is connected at one end to the source terminal 18 and has a stationary contact 24 secured at the other end. Another terminal strip 26 is attached on the other or righthand portion of the bottom wall surface of the housing member 10 and connected at one end to the load terminal 20.

Disposed on the middle portion of the internal space confined by the housing and cover members 10 and 12 respectively are a pair of opposite supporting plates 28 for each pole with the two pairs longitudinally positioned in spaced parallel relationship. One of the supporting plates 28 adjacent to the corresponding side wall of the housing member 10 has a folded protrusion 28a rigidly fitted into a groove formed on that side wall. A movable arm 30 of U-shaped cross-section is disposed between each pair of supporting plates 28 and pivotably mounted at one end to those plates by a pivot pin 32. The movable arm 30 has pivotably mounted to the other end a movable contact arm 34 which in, in turn, provided at the free end with a movable contact 36. As shown in Figure 1, the movable arms 30 are connected to each other through a connecting plate 38 of any suitable electrically insulating material.

As shown in Figure 2, a switching mechanism 40 comprises a toggle mechanism including a lower toggle link element 42 pivotably mounted at one end or lower end to the movable contact arm 34 by a pivot pin 44, and an upper toggle link element 46 articulated to the lower toggle link element 42 by a pivot pin 48, and a manually operated switching handle 50 articulated at one end or lower end to the upper toggle element 46 by a pivot pin 52. The handle 50 is pivotably mounted by a pivot pin 54 to the pair of supporting plates

28 for one pole alone and therebetween and has the other or upper end portion movably extending through an opening 12a formed on the upper wall of the cover member 12 such that it projects externally from the cover member. Each of two springs 56 disposed one on either side of the handle 50 has one end engaging the pivot pin 52 and the other end suitably fixed to the adjacent supporting plate 28 with its intermediate portion loosely wound around the pin 54. The springs 56 tend to rotate the switching handle 50 about the axis of the pin 54 in the clockwise direction as viewed in Figure 2 and also to maintain the toggle link members 42 and 46 substantially straight extended.

As shown in Figure 2, an overcurrent responsive mechanism 58 includes a L-shaped yoke member 60 disposed between the pair of supporting plates 28 for each pole and having a plurality of lugs 60a secured in corresponding holes on the supporting plates 28 as by staking. The yoke member 60 is provided on the horizontal leg with an aperture 60b through which a stationary magnetic core 62 is secured. That portion of the magnetic core 62 extending from the aperture 60b toward the side of the other leg of the "L" has an electromagnetic winding 64 inductively disposed thereon and electrically connected at one end to the movable contact arm 34 through a flexible conductor 66. The winding 64 has the other end electrically connected to the terminal strip 26. The stationary magnetic core 62 has attached to the upper end of a magnetic pole piece 68 which, in turn, faces a longer leg of a V-shaped movable magnetic core or armature 70 disposed between and pivotably mounted to the outer supporting plates 28 by a pivot pin 72. The other leg of the "V" extends upwardly to form an acute angle between both legs. In order to normally maintain the longer leg of the V-shaped armature 70 separated away from the pole piece 68, a spring 74 is engaged at one end by the armature 70 and at the other end by the yoke member 60 with its intermediate portion loosely wound around the pin 72. In other words, the spring 74 tends to rotate the armature 70 about the axis of the pin 72 in the counterclockwise direction as viewed in Figure 2.

In order to limit this counterclockwise rotational movement of the armature 70 a bell crank 76 for one pole alone is pivotably mounted by the pivot pin 72 to the outer one of those supporting plate 28 having pivotably mounted thereto the switching handle 50 so as to overlap the supporting plates and includes an end portion horizontally folded to abut against the longer leg of the armature 70. The bell crank 76 is provided on the other end portion with a pin 78 loosely fitted in to aligned elongated slots 28b formed on the pair of supporting plates 28.

A tripping mechanism 80 includes the bell

crank 76 as above described, a tripping plate 82 secured to the horizontally folded portion of the bell crank 76 as by riveting and latch 84 engaged at one end or the upper end by pin 78 and pivotably mounted at the other end or lower end to the outer supporting plate 28 by a pivot pin 86. The tripping plate 82 extends in the cross direction to overlap and contact a longer leg of an armature 70 for the other pole. The latch 84 is provided on the middle portion with a pin 88 loosely fitted into aligned elongated slots 28c formed on the supporting plates 28. A spring 90 having an intermediate portion loosely wound around the pin 86 is engaged at one end by the pin 88 and at the other end by the yoke member 60 in order that the latch 84 tends to be rotated in the clockwise direction as viewed in Figure 2. A holding link member 92 has one end operatively connected to the pin 88 and the other end operatively connected to the pin 48 articulating the two toggle link elements 42 and 46 to each other.

A spring 94 having an intermediate portion loosely wound around the pin 32 is engaged at one end by the other end of the movable contact arm 34 and at the other end by the yoke member 60 in order that the movable contact arm 34 tends to be rotated about pin 44 in the counterclockwise direction as viewed in Figure 2 and that with contacts 24 and 36 engaging each other a force is exerted on the toggle link elements 42 and 46 tending to fold them into a "V" shape having its apex directed leftward as viewed in Figure 2.

It is noted that the spring 94 is stronger in resilience than the spring 56 which is, in turn, stronger in resilience than the spring 90.

With the circuit interrupter put in its closed position as illustrated in Figure 2 a current flows from a source of electric power (not shown) through the source terminal 18, the terminal strip 22, the stationary contact 24, the movable contact 36, the movable contact arm 34, the flexible conductor 66, the electromagnetic winding 64, the terminal strip 26 and the load terminal 20 to a load (not shown).

Under these circumstances, the switching handle 50 can be manually rotated from its position as illustrated in Figure 2 to its position as illustrated in Figure 4 about the axis of the pin 54 and against the action of the spring 56 thereby to separate the movable contact 36 from the stationary contact 24 resulting in an interruption of the associated circuit. In order to re-close the contacts the handle can be manually returned to its original position as shown in Figure 2.

If an overload current whose magnitude exceeds, for example, 125% of the rating current for the circuit interrupter flows through the latter at its closed position then an electromagnetic force generated by the winding 64 due to that flow of overload current causes the armature 70 to be rotated about the axis

of the pin 72 in the clockwise direction as viewed in Figure 2 and against the action of the spring 74 until the armature approaches the pole piece 68. At that time the shorter leg of the armature 70 abuts against the tripping plate 82 to rotate the latter along with the bell crank 76 in the clockwise direction (see Figure 3). Therefore the pin 78 on bell crank 76 is moved from its position as illustrated in Figure 2 to its position as illustrated in Figure 3 within the slots 28b on the supporting plate 28 whereupon the pin 78 disengages from the latch 84.

This disengagement of the pin 78 from the latch 84 permits the latter to be rotated in the counterclockwise direction as viewed in Figures 2 and 3 by the action of the spring 94. Therefore the pin 88 on the latch 84 is moved from its position as viewed in Figure 2 to its position as illustrated in Figure 3 within the slots 28c. This movement of the pin 88 is accompanied by a movement of the holding link element 92 and therefore of the toggle pin 48 in the lefthand direction as viewed in Figure 2 with the result that the two toggle elements 42 and 46 folds in a "V" shape as illustrated in Figure 3 or shown at dotted line in Figure 5. This causes the movable contact 36 to be separated from the stationary contact 24 resulting in an interruption of the associated circuit (see Figure 3).

Then the springs 56 and 90 cooperate with each other to rotate the handle 50 and the latch 84 about the axes of the respective pins 54 and 86 to their positions as illustrated in Figure 4 or shown at thin solid line in Figure 5.

As the interruption of the associated circuit results in the disappearance of the electromagnetic force the armature 70 returns back to its original position by the action of the spring 74 whereupon the pin 78 on the bell crank 76 again engages the latch 84. Thus the interrupter is put in its open position as shown in Figure 4.

Then the handle 50 can be manually thrown from its position as illustrated in Figure 4 and in the counterclockwise direction. This causes the two toggle elements 42 and 46 to extend substantially straight thereby to force the movable contact 36 into engagement with the stationary contact 24.

In Figure 6 a holding link element 82 has the other end operatively connected to a pin 96 separately mounted on the upper toggle link element 46 rather than to the toggle pin 48.

In Figure 7 the latch 84 has its central portion pivotably mounted on the pivot pin 86 and one end provided with the pin 88, the pin 48 being connected to the pin 88 through a holding link element 92. With this arrangement upon bending one of the links 42 and 46 relative to the other link, the latch 84 tends to be turned in the clockwise direction about the axis of the pin 86. This results in the

necessity of reversing the positional relationship between the pin 78 and the latch 84 from that in the previous arrangements.

From the foregoing it will be appreciated that a pair of foldable toggle link elements 42 and 46 for operatively connecting the switching handle 50 to the movable contact rod 34 is physically separated from the latch 84 with the holding link element 92 operatively connecting the toggle link elements 42 and 46 to the latch 84. Therefore upon the occurrence of an overload current flowing through the interrupter, the latch 84 is only rotated about the axis of the pivot pin 86 but it is prevented from being displaced along with the toggle elements 42 and 46 as in the conventional circuit interrupters. Thus a tripping mechanism of small size and short operating stroke can effectively perform the tripping operation.

Further, when the contacts 24 and 36 engage each other while the two toggle elements 42 and 46 extend substantially straight, these toggle elements are disposed so as to be foldable on that side thereof opposite to the latch 84. Therefore the direction in which the toggle link members fold through a tripping operation is away from the latch 84. This eliminates the necessity of providing a special space on the side of the tripping mechanism in order to fold the toggle elements. This also leads to a decrease in the overall dimensions of the circuit interrupter.

WHAT WE CLAIM IS:—

1. An automatic circuit interrupter comprising a stationary contact disposed on an electrically insulating member, a movable contact cooperating with the stationary contact to open and close an associated circuit, a pivoted switching handle manually operable to move the movable contact toward and away from the stationary contact, a pair of toggle link elements operatively connecting the movable contact to the switching handle, overcurrent-responsive means, and a rotatable latch pivotally mounted to stationary supporting plate

by a pivot pin, said latch being normally prevented from moving and being released by said overcurrent-responsive means upon the occurrence of an overcurrent in the circuit, and a link element connecting said latch to said pair of toggle link elements whereby the elements are held substantially in alignment against the action of a spring until said latch is released whereupon the elements fold into a V-formation with its apex on that side away from said latch.

2. A circuit interrupter comprising a stationary contact disposed on a electrically insulating member, a movable contact cooperating with the stationary contact to open and close an associated circuit, a pivoted switching handle manually operable to move the movable contact toward and away from the stationary contact, a pair of toggle link elements for operatively connecting the movable contact to the switching handle, electromagnetic tripping means responsive to the occurrence of overcurrent in the circuit, a tripping plate operative in response to the attraction of the tripping means, a latch normally prevented from moving by a pin disposed on said tripping plate and released upon the occurrence of an overcurrent in the circuit, and a holding link element operatively connecting said pair of toggle link elements to said latch whereby the elements are held substantially in alignment against the action of a spring till said latch is released whereupon the elements fold into a V-formation with its apex on that side away from said latch.

3. A circuit interrupter substantially as herein described and shown in figures 1 to 5 of the accompanying drawings.

4. A circuit interrupter as claimed in claim 3 when modified as herein described with reference to figures 6 or 7 of the accompanying drawings.

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by a pivot pin, said latch being normally prevented from moving and being released by said overcurrent-responsive means upon the occurrence of an overcurrent in the circuit, and a link element connecting said latch to said pair of toggle link elements whereby the elements are held substantially in alignment against the action of a spring until said latch is released whereupon the elements fold into a V-formation with its apex on that side away from said latch.

2. A circuit interrupter comprising a stationary contact disposed on a electrically insulating member, a movable contact cooperating with the stationary contact to open and close an associated circuit, a pivoted switching handle manually operable to move the movable contact toward and away from the stationary contact, a pair of toggle link elements for operatively connecting the movable contact to the switching handle, electromagnetic tripping means responsive to the occurrence of overcurrent in the circuit, a tripping plate operative in response to the attraction of the tripping means, a latch normally prevented from moving by a pin disposed on said tripping plate and released upon the occurrence of an overcurrent in the circuit, and a holding link element operatively connecting said pair of toggle link elements to said latch whereby the elements are held substantially in alignment against the action of a spring till said latch is released whereupon the elements fold into a V-formation with its apex on that side away from said latch.

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