

DEVICE FOR MODULAR ASSEMBLY OF A MULTIPOLE DIFFERENTIAL
CIRCUIT BREAKER

The invention relates to a multipole differential circuit breaker formed by modular side-by-side assembly of a differential trip unit to a circuit breaker unit, which comprises a pair of first and second connection terminals per pole, disposed on the opposite narrow side faces, and a first large side face for adjoinment provided with an aperture for access to a trip bar of a first switching mechanism with handle, said trip unit comprising :

- a summing transformer with secondary winding supplying a trip relay,
- a second operating mechanism controlled by the relay and a handle, and having a tripping finger protruding out from an orifice arranged in a conjugate second large side face of a moulded case,
- fixing means to perform assembly of the two units after automatic establishment of a first mechanical tripping link resulting from insertion of the finger in the aperture in the course of the adjoinment phase of the first and second large side faces,
- and connecting conductors connecting the primary circuit of the transformer to the second terminals of the circuit breaker unit.

A circuit breaker of this kind with an add-on differential trip unit is described in French Patent FR-A-2,437,692. The connecting conductors which connect the primary windings of the summing transformer to the electrical circuit of the trip unit pass through the insulating case of the differential trip unit via an opening arranged in its narrow side face. The ends of the connecting conductors are then engaged from outside in

the load-side connection terminals of the circuit breaker unit. Adjoining of the first and second large side faces of the units to establish the mechanical tripping and resetting links is performed easily, since the interface between the two units does not contain the connecting conductors. Final mechanical assembly is then performed by various fixing means such as are described in French Patents FR-A-2,512,582, 2,411,329 and 2,420,049.

It is also state of the art from French Patent FR-A-2,588,438 to use a double hinge to perform initial coupling of the two units with respect to one another, and to then perform final locking of the adjoined units. It is nevertheless noted that pivoting takes place near the base plates according to a fictitious horizontal axis parallel to the back panel of the modules. Final locking is achieved either by simple clipping of a fixed nose or flexible tab onto a conjugate part of the other unit in the case of a "light" auxiliary unit, or by means of screws able to be inserted in the hollow rivets of the circuit breaker unit in the case of a "heavy" auxiliary unit, notably a differential trip unit.

In French Patent FR-A-2,125,425, the connecting conductors pass through passages provided in the circuit breaker unit and are connected to the terminals from inside.

The object of the invention is to achieve easier fitting of a differential trip unit with lateral connecting conductor outputs and electrical connection external to the circuit breaker unit.

The circuit breaker according to the invention is characterized in that the second large side face of the differential trip unit presents an opening for the connecting conductors to pass through to the interface between the two units, and that the fixing means comprise an articulated latching, and a locking strap, arranged respectively on the

side of the opposite first and second terminals, said strap being able to be operated to an active position to perform placing of the connecting conductors against the second large side face when the two units are progressively moved towards one another.

According to claims concerning particular embodiments, the second large side face of the case is equipped with parallel grooves, in which the connecting conductors fit in the active position of the locking strap. This results in assembly without transverse clearance of the two units, in spite of the presence in the interface of the connecting conductors passing through the opening of the second large side face of the trip unit. The free ends of the connecting conductors are then engaged from outside in the two terminals of the circuit breaker unit.

The articulated latching comprises a pin securedly united to the case and designed to engage in a conjugate recess of the circuit breaker unit, in such a way as to enable, at the beginning of the assembly phase, relative pivoting of the two units around a fictitious vertical axis extending in the depthwise direction. Such a pin is sufficient to achieve articulated latching, which is located opposite the second connection terminals of the ends of the connecting conductors to facilitate electrical connection of the trip unit to the circuit breaker unit.

The locking strap is pivotally mounted around a spindle in a housing of the circuit breaker unit case, and comprises a securing arm designed to engage in a fixing recess of the circuit breaker unit, said arm having a ramp arranged to perform a cam effect on a cheek of the recess when the strap is moved from the inactive position to the active position.

The locking strap is equipped with an operating lever located opposite the articulation spindle, and appreciably perpendicular to the securing arm.

A tamperproof cover is fitted onto the second terminals and the strap to prevent any electrical disconnection and mechanical disassembly of the differential trip unit.

Other advantages and features will become more clearly apparent from the following description of an illustrative embodiment of the invention, given as a non-restrictive example only and represented in the accompanying drawings, in which :

Figure 1 is a schematic elevational view of a two-pole differential circuit breaker in the assembled position of the circuit breaker unit and differential trip unit;

Figure 2 is a perspective view of the circuit breaker of figure 1, in the separated position of the two units;

Figure 3 shows an exploded perspective view of the differential trip unit of figure 2;

Figures 4 and 5 represent partial cross-sectional views along the line V-V of figure 2, showing the locking strap respectively in the course of insertion and at the end of insertion;

Figure 6 is a cross-sectional view along the line VI-VI of figure 2, showing the two units adjoined and the strap in the inactive position;

Figures 7 and 8 are identical views to figure 6, in intermediate and active positions of the strap;

Figure 9 is a perspective view of a four-pole differential trip unit equipped with an insulator for protection of the connecting conductors.

In figures 1 to 3, a two-pole differential circuit breaker 10 is formed by modular side-by-side assembly of a differential trip unit 12 with a circuit breaker unit 14. The two units 12, 14, with moulded insulating cases 16, 18, 20 of parallelipipedic shape are connected to one another by a first mechanical tripping link 22, and a second mechanical resetting link 24 via the handles 26, 28. Each pole-unit of the circuit breaker unit 14 comprises a pair of first and second terminals 30, 32 with connecting tunnels and securing screws, situated at the level of the opposite narrow side faces 34, 36 of the respective case 16, 18. The base plate 37 of each case 16, 18, 20 is provided with a clip-on profiled section for assembly on a support rail.

The first large side face for adjoining the case 18 comprises a curved aperture 40 enabling access to the automatic trip bar of the switching mechanism of the circuit breaker unit 14. Two fixing recesses 42, 44 are arranged at the level of each vertical edge at the junction between the large face 38 and the other two narrow side faces 34, 36. The first large face 38 of the circuit breaker unit 14 in addition comprises circular orifices 46 for insertion of conjugate centering and error prevention pins 48 belonging to the differential trip unit 12.

The trip unit 12 houses a summing transformer 50 having two primary windings 52, 54 and a secondary winding 56 wound onto a toroidal core. The secondary winding 56 is electrically connected to a trip relay 58 cooperating with the operating mechanism 60 associated with the handle 28. The primary windings are connected to a pair of connecting terminals 62, housed in the case 20, on the same side as the second terminals 32 of the circuit breaker unit 14.

The operating mechanism 60 of the type described in French Patent Application 8,802,907 is equipped with a tripping finger 64 protruding out from an orifice 66 arranged in the second large side face 68 of the trip unit 12. The second large face 68 comes into engagement against the first conjugate adjoining face 38 of the circuit breaker unit 14, and comprises in addition to the pins 48, an aperture or opening 70 for passage of the conductors 72, 74 connecting the primary windings 52, 54 with the circuit breaker unit 14. The conductors 72, 74 are formed by rigid copper wires.

One of the edges of the second large side face 68 comprises a latching pin 76 cast with the case 20 and designed to engage in the conjugate recess 42 when modular assembly of the two units 12, 14 is performed. At the level of the opposite edge of the second large side face 68, the case 20 comprises a housing 78 for receiving a locking strap 80.

The two connecting conductors 72, 74 are in the shape of U-shaped half-loops whose free ends 82, 84 are inserted from outside into the respective tunnels of the terminals 32 of the circuit breaker unit 14. Between the vertical aperture 70 and the narrow side face 86 there extend perpendicularly two parallel grooves 88, 90 made in the second large face 68 of the case 20. Opposite the ends 82, 84, the output branches of the conductors 72, 74 fit into the respective grooves 88, 90 so as to prevent any transverse clearance between the two assembled units 12, 14.

A sealing cover 92 associated with a sealing wire is fitted on the terminals 32 of the circuit breaker unit 14 after the units 12, 14 have been assembled to ensure that the apparatus is tamperproof. Electrical connection of the differential circuit breaker 10 is performed via the terminals 30 and 62 connected to the active input conductor 94 and output conductor 96.

The case 20 of the differential circuit breaker unit 12 is formed by clipping two half-shells 98, 100 together depthwise, i.e. perpendicularly to the transverse direction of adjoinment of the two units 12, 14. The bottom half-shell 100 houses the summing transformer 50, terminals 62 and connecting conductors 72, 74. The top half-shell 98 houses the operating mechanism 60 and relay 58. One 102 of the side walls of the insulating half-shell 98 forms at the same time an internal flange for mounting the mechanism 60. This flange comprises positioning tabs 104, 106 designed to engage in vertical guide grooves 108, 110 made in the bottom half-shell 100.

In figures 4 and 5, fitting of the locking strap 80 in the housing 78 of the case 20 is achieved by a pushing action in the direction of the arrow F1. The base of the strap 80 comprises an articulation spindle 112 formed by two cylindrical end parts arranged at the ends of two flexible branches separated from one another by a middle slot 113. The entrance of the housing 78 is slightly frustum-shaped so as to compress the two branches when the strap 80 is inserted (figure 4). At the end of the insertion travel (figure 5), expansion of the two end parts 114, 116 takes place in a cylindrical bearing provided in the bottom of the housing 78. The spindle 112 is then locked by clipping in the housing 78, and the strap 80 can be actuated pivotally around the spindle 112 between an inactive position and an active position.

With reference to figures 6 to 8, the mechanical locking operation by the strap 80 after the two units 12, 14 have been adjoined is represented. The strap 80 comprises an operating lever 120 opposite the articulation spindle 112, and a securing arm 122 arranged appreciably perpendicularly with respect to the lever 120. The securing arm 122 is provided with a ramp 124 in the form of a cam designed to cooperate with a cheek 126 of the case 18 inside the recess 44.

Figure 6 shows the strap 80 in the inactive position after the spindle 112 has been inserted in the housing 78 of the case 20. A manual lateral tightening action of the two units 12, 14 holds the large face 68 of the case 20 against the conjugate adjoining face 38 of the case 18.

Figure 7 represents the beginning of the locking operation of the two units 12, 14 in the course of which the strap 80 is driven in counterclockwise rotation, by means of the operating lever 120 operated from outside in the direction of the arrow F2. It can be noted that in an intermediate position, the reaction of the ramp 124 of the securing arm 122 on the cheek 126 causes a cam effect enabling the two units 12, 14 to be progressively moved towards one another.

The manual lateral tightening action can be interrupted, followed by rotation of the strap 80 to the active position (figure 8) in which the securing arm 122 performs positive locking of the two units 12, 14. A boss 130 provided on the securing arm 122 opposite the ramp 124 cooperates with the case 18 in the active position to form a hangup point opposing reverse movement of the strap 80 to the inactive position.

The mechanical locking operation by the strap 80 takes place at the end of assembly. The previous phases involving coupling of the two units 12, 14 are apparent from figure 2.

Inserting the latching pin 76 in the conjugate recess 42 forms a latch or articulated coupling allowing relative pivoting of the two units 12, 14. In the course of this first pivoting phase, the pins 48 engage in the orifices 46, and the tripping finger 64 of the operating mechanism 60 of the differential trip unit 12 penetrates into the aperture 40 of the face 38 to form the first mechanical tripping link 22. The two ends 82, 84 of the connecting conductors 72, 74 are positioned from outside in the respective tunnels of the terminals 32. It can

be noted that coupling to the articulation of the pin 76 in the recess 42 is arranged opposite the terminals 32.

In the second phase the lateral manual securing action of the two units takes place, followed by mechanical locking by the strap 80, as described previously with reference to figures 6 to 8. Bringing the two units 12, 14 together by rotation of the strap 80 from the intermediate position (figure 7) to the active position (figure 8) causes the output branches of the connecting conductors 72, 74 to be embedded in the respective grooves 88, 90 of the large face 68 of the trip unit 12. The depth of the grooves 88, 90 corresponds appreciably to the diameter of the connecting conductors 72, 74 so as to enable a perfect adjoinment between the two faces 38, 68 when the strap 80 is in the active position (figure 8).

When mechanical assembly has been completed, the trip unit 12 then simply has to be electrically connected to the circuit breaker unit 14 by tightening the screws of the terminals 32. Final assembly of the sealing cover or cache 92 and sealing wire on the terminals 32 and recess 44 of the circuit breaker unit 14 prevents any disassembly of the strap 80 or electrical disconnection of the differential trip unit 12. The differential circuit breaker 10 is then tamperproof, and can be put into operation by connecting the active conductors 94, 96.

The location or size of the centering and error prevention pins 48 depends on the rating of the differential trip unit 12. Such a safety precaution prevents any non-compatible assembly as far as the ratings of the two units 12, 14 are concerned.

The sealing cover 92 is equipped with a locking bolt 140 (figure 2) movable in the direction of the arrow F3 so as to engage in an orifice 142 of the case 16. The bolt 140 comprises a tab having a hole 144 for insertion of the sealing

wire. In the case of a plant assembly, the bolt 140 can be locked without any possibility of disassembly.

According to figure 9, the four-pole differential trip unit 12 comprises four rigid conductors 72, 74, 172, 174 for electrical connection with the associated circuit breaker unit (not represented). The conductors 72, 74, 172, 174 are protected by an insulator 176 made of plastic material having an L-shaped configuration. The shorter branch 177 of the insulator 176 is provided with a clipping tab 178 designed to clip onto the base of the trip unit 12 to the right of the opening 70. The other branch 180 is applied against the narrow side faces 36 of the circuit breaker unit to prevent access to the second terminals 32. The sealing cover 92 is then fitted over the branch 180 of the insulator 176 to perform locking of the mechanical link between the two units. The internal face of the insulator 176 is equipped with grooves 182 for housing the rigid conductors 72, 74, 172, 174.

The presence of the insulator 176 provides :

- mechanical protection of the conductors 72, 74, 172, 174 against any deformation, when the differential trip unit 12 is handled or transported;
- refitting of the conductors 72, 74, 172, 174 with the predetermined separating distances enabling perfect insertion in the terminals 32 of the circuit breaker unit;
- dielectric partitioning between the different conductors 72, 74, 172, 174 preventing any flashover in the cambering zones liable to damage the insulating enamel.

Fitting of the insulator 176 moreover prevents any additional connections being made on the terminals 32 of the circuit breaker unit, if the sealing cover 92 is not fitted.

The insulator 176 constitutes a flexible pin support preventing any retightening of the terminals 32 after a certain period of use.

CLAIMS

1. A multipole differential circuit breaker formed by modular side-by-side assembly of a differential trip unit (12) to a circuit breaker unit (14), which comprises a pair of first and second connection terminals (30, 32) per pole, disposed on the opposite narrow side faces (34, 36), and a first large side face (38) for adjoinment provided with an aperture (40) for access to a trip bar of a first switching mechanism with handle (26), said trip unit (12) comprising :

- a summing transformer (50) with secondary winding (56) supplying a trip relay (58),
- a second operating mechanism (60) controlled by the relay (58) and a handle (28), and having a tripping finger (64) protruding out from an orifice (66) arranged in a conjugate second large side face (68) of a moulded case (20),
- fixing means to perform assembly of the two units (12, 14) after automatic establishment of a first mechanical tripping link (22) resulting from insertion of the finger (64) in the aperture (40) in the course of the adjoinment phase of the first and second large side faces (38, 68),
- and connecting conductors (72, 74, 172, 174) connecting the primary circuit of the transformer (50) to the second terminals (32) of the circuit breaker unit (14), characterized in that the second large side face (68) of the differential trip unit (12) presents an opening (70) for the connecting conductors (72, 74, 172, 174) to pass through to the interface between the two units (12, 14), and that the fixing means comprise an articulated latching (76, 42), and a locking strap (80), located respectively on the side of the opposite first and second terminals (30, 32), said strap (80) being able to be operated to an active position to perform placing of the connecting conductors (72, 74, 172, 174) against the second



large side face (68) when the two units (12, 14) are progressively moved towards one another.

2. The differential circuit breaker according to claim 1, characterized in that the second large side face (68) of the case (20) is equipped with grooves (88, 90) in which the connecting conductors (72, 74) fit in the active position of the locking strap (80).

3. The differential circuit breaker according to claim 1, characterized in that the connecting conductors (72, 74, 172, 174) are housed in grooves (182) of an additional insulator (176), having a first branch (177) able to clip onto the case (20) of the trip unit (12) facing the orifice (70), and a second branch (178) pressing against the narrow side faces (36) of the circuit breaker unit to prevent access to the second terminals (32).

4. The differential circuit breaker according to one of the claims 1 to 3, characterized in that each connecting conductor (72, 74, 172, 174) is shaped as a U-shaped half-loop whose free end (82, 84) is engaged from the outside in the corresponding second terminal (32) of the circuit breaker unit (14).

5. The differential circuit breaker according to one of the claims 1 to 4, characterized in that said articulated latching comprises a pin (76) securedly united to the case (20) and designed to fit in a conjugate recess (42) of the circuit breaker unit (14), in such a way as to enable at the beginning of the assembly phase relative pivoting of the two units (12, 14) around a fictitious vertical axis extending in the depthwise direction.

6. The differential circuit breaker according to one of the claims 1 to 5, characterized in that the locking strap (80) is pivotally mounted around a spindle (112) in a housing (78) of



the case (20) of the trip unit (12), and comprises a securing arm (122) able to engage in a fixing recess (44) of the circuit breaker unit (14), said arm having a ramp (124) arranged to perform a cam effect on a cheek (126) of the recess (44) when the strap (80) is moved from the inactive position to the active position.

7. The differential circuit breaker according to claim 6, characterized in that the locking strap (80) is equipped with an operating lever (120) located opposite the articulation spindle (112), and appreciably perpendicularly with respect to the securing arm (122), which is provided with a boss (130) arranged opposite the ramp (124) to form a hangup point with the case (18) of the circuit breaker unit (14) when the locking strap (80) is in the active position.

8. The differential circuit breaker according to either one of the claims 6 or 7, characterized in that the base of the strap (80) comprises two flexible branches separated from one another by a slot (113), enabling the articulation spindle (112) to be clipped into said housing (78).

9. The differential circuit breaker according to one of the claims 1 to 8, characterized in that the second large side face (68) of the trip unit (12) comprises centering and error prevention pins (48), designed to engage in conjugate orifices (46), arranged in the first large side adjoinment face (38), and that a portion of said second face (68) acts as the mounting flange for the second operating mechanism (60).

10. The differential circuit breaker according to one of the claims 6 to 9, characterized in that a sealing cover (92) is fitted on the second terminals (32) and strap (80) after the trip unit (12) has been connected, to make the apparatus tamperproof in the assembled position of the two units (12, 14), the cover (92) being equipped with a bolt (140) having a hole (144) for insertion of a sealing wire.

