

DESCRIPTION

5 The invention concerns a push-button operated overcurrent protective circuit breaker, in particular a protective circuit breaker for an on-board supply system with a manual release, with the features indicated in the introductory part of claim 1.

10 Such overcurrent protective circuit breakers are known, for example, from the DE-C 21 23 765 or the EP-A 0 081 290. In these circuit breakers the bimetal of the bimetal tripping device is arranged in essence parallel to the narrow side wall extending in the pressing direction (D). The adjustment is effected by means of an adjustment screw which passes through a bore in this side wall and acts laterally directly on the bimetal or on its connector base.

20 The accuracy of the bimetal adjustment in the known circuit breakers requires improvement. Moreover, any direct action on the bimetal or its connector base is to be avoided.

25 In the overcurrent protective circuit breaker known from the US-C-36 87 915, an improvement is already provided in this respect. The connecting lug, and the region adjoining the cooperating contact fixed to the casing, of a connector to the cooperating contact that is fixed to the casing are there firmly held with an accurate fit in corresponding mounting recesses in the casing. Moreover, for the adjustment, the bimetal is not acted on directly, but the connector is acted on in the zone inside the casing by an adjustment screw that is screwed laterally into the circuit breaker casing. To facilitate the adjustment displacement of the part of the connector inside the casing, provision is made between its fixing zone on the casing and the zone for action by the adjustment screw for a reduction in cross-section in the form of sunk portions in the lateral faces of the connector.

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40 Moreover, from the DE-U-88 06 964.8, an electric overcurrent protective circuit breaker is known, wherein the strip-shaped bimetal is secured on a connector which is also held firmly fixed with an accurate fit in corresponding mounting recesses in the casing. This connector has an extension, which can be acted on by an adjustment screw from the opposite side of the circuit breaker casing, for adjusting the response value of the bimetal.

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50 Starting from the overcurrent protective circuit breakers of the state of the art described above, the invention is based on the problem of further improving a push-button actuated circuit breaker of the kind indicated at the outset with regard to the adjustment potential of the bimetal.

The solution of this problem is indicated in the characterizing features of claim 1.

5 Between the connecting lug of the connector for the second arm end of the bimetal and the region of the connector adjoining the cooperating contact fixed to the casing, the connector has a constriction which is formed by a slot passing through the plate-shaped central section of the connector transversely to the plane of the plate. The connecting lug can be rotated
10 round the constriction by the action of an adjustment screw for the purpose of adjusting the response value of the bimetal. Due to this design, the tripping value of the bimetal can be adjusted in a particularly sensitive and exact way by bracing the two bimetal arms against each other.

15 The constriction has, moreover, the advantage that the heat generated by the inherent heating of the bimetal for the tripping flows more slowly out of the bimetal into the adjoining conductive parts of the module. By this means, the nominal tripping value can be reproduced in a better way and is subject to less scatter.

20 Claims 2 and 3 characterize advantageous modes of embodiments of the slot and of the mounting of the adjustment screw in the casing. Thus, in one embodiment by means of an arcuate stamped-out portion, the slot can be immediately produced at the same time in a particularly simple way during the stamping of the connector. The adjustment screw is held in the casing in a captive manner due to its radially projecting ring at its head
30 supported in a casing groove.

The bimetal module is fixed still better in the casing because of the extension of the connecting lug indicated in claim 4, and its accurate firm fit in a corresponding casing recess.

35 The characteristic of claim 5 describes a bimetal tripping device which has two bimetals. By this means it is possible to use a self-heated bimetal tripping device, even for low nominal currents, which moreover, does not provide any lower tripping forces as compared with a single part bimetal. Because of the claimed sandwich design, the whole bimetal device remains very compact and can be arranged and used in essence like a single part bimetal. The insulating layer between the two bimetals screens them with respect to each other in such a way that the whole current path remains preserved through the overall length
40 of the two bimetals.

45 In claim 6 a structurally particularly simple sandwich design is indicated which is distinguished by a reliable and durable connection between the two bimetals in the form of a weld, a soldered joint or the like. In this arrangement, the design of the two bimetals in an identical shape is advantageous for manufacturing and stock-keeping reasons.

Because of the meander-type shape of the arms and the base of the U-shaped bimetals (claim 7), the nominal response current can be drastically reduced further, with substantially unchanged dimensions of the bimetal. To offset the mechanical weakening of the bimetal by the meander-type shape of the arms and base according to claim 8, provision is made for clip-type stiffeners which can be fitted on the said bimetal sections with the interposition of appropriate insulating layers. Because of this, the bimetal device of this type also has substantially unchanged mechanical properties.

Claims 9 and 10 characterize a so-called fail-safe device for the circuit breaker. The latter is advantageously integrated into the connector of the bimetal device.

According to claim 11, the connecting lug, one or more bimetals, the connector, provided if required with a fail-safe device, and the adjustment screw are combined into a module that can be preassembled and installed in the circuit breaker as a whole. This also entails advantages with a view to an automated manufacture in the assembly of the circuit breaker.

Claims 12 and 13 are characterized by an advantageous further development of the bimetal module, whereby a fast response of the bimetal tripping device is achieved at high currents, thus in particular, in the case of a short circuit.

By means of the U-shaped extension of the connector which laterally flanks the U-shaped bimetal, a so-called "current loop" is created wherein because of the appropriate electrical and mechanical connection of the free end of the extension to the corresponding arm end of the bimetal, the current flowing through these two components flows in the corresponding sections respectively in opposite directions. According to the known laws of electrodynamics, this causes a repulsion between the extension of the connector and the bimetal. Since the connector and its extension are fixed in the casing, the repelling forces fully act on the bimetal which is thus additionally deflected in the tripping direction out of its rest position beyond its normal heat-related deflection, and this above all immediately on the inception of the high current.

By means of the insulating layer between the extension of the connector and the bimetal indicated in claim 13, these two components can be positioned particularly closely towards each other without the risk of an electric short circuit, so that a particularly high repulsion effect is achieved, with an extremely short tripping time.

It should be emphasized that with low currents as occurring in the case of an overload, the dynamic action of the "current loop" does not become effective, or only to a negligible extent. Here it is the heat-related deflection of the bimetal on its own that produces the tripping of the overcurrent

protective circuit breaker.

Further features, details and advantages of the invention may be gathered from the description that follows wherein various examples of embodiments of the object of the invention are explained in greater detail with reference to the attached Figures. There are shown in:

- Fig.1 an external view of the overcurrent protective circuit breaker in perspective,
- Fig.2 an exploded representation in perspective of the circuit breaker, divided into functional modules,
- Figs.3-5 a longitudinal section through the circuit breaker along the joint between the two casing half shells respectively in the switched-off position, switched-on position and in the overcurrent related tripped position of the latch,
- Fig.6 an exploded representation in perspective of a bimetal device in a first alternative mode of embodiment,
- Fig. 7 an exploded representation in perspective of a bimetal device in a second alternative mode of embodiment,
- Fig. 8 a representation in perspective of the bimetal device according to Figure 7,
- Fig. 9 a representation in perspective of a bimetal device with an integrated fail-safe device,
- Fig.10 a representation in perspective of a bimetal device with a current loop and
- Fig. 11 an exploded representation in perspective of the bimetal device according to Figure 10.

Figure 1 shows the external view of an example of the embodiment of a circuit breaker in accordance with the invention. The latter has an approximately parallelepiped casing made of an insulating material and composed of two casing half-shells (1, 2), on whose end narrow side wall (3), the push-button assembly (4) is inserted with its threaded neck (40) and with the push button (41) carried therein for longitudinal displacement in the pressing direction (D). From the opposite narrow side wall (3') at the bottom, the two bent connecting lugs (5, 6) project from the casing of the circuit breaker.

Figure 2 shows the various functional components that are integrated in the circuit breaker. Apart from the push-button assembly (4), these are the latch (7) and the bimetal module

(10) which is electrically and mechanically connected to one connecting lug (5). Detached from the bimetal module (10), the second connecting lug (6) may be seen in Figure 2, which carries on an extension (8) one cooperating contact (9), fixed to the casing, of the switching path. In the lateral edge zone of the upper narrow side wall (3), the stop catch (11) is held for rotation between the two casing half shells (1, 2), which can be brought into engagement with the groove (42) at the outer side of the threaded neck (40) and which constitutes a means preventing rotation for the threaded neck (40) and for the circuit breaker itself when it is installed in a switch panel. There should, moreover, be mentioned the frame-shaped tripping lever (12) forming a kinematic connecting element between the latch (7) and the bimetal module (10) and the cover (13) for the adjustment means, which can be catch engaged on the bottom narrow side wall (3').

The core component of the bimetal module (10) is the bimetal (101) formed as a flat U-shaped stamped component that is secured with one free arm end (102) on the extension (103) fixed to the casing, of the connecting lug (5). The second free arm end (104) is welded onto the bent-up connecting lug (105) of a connector (106) which carries at its diametrically opposite end an extension (107), also bent upwards, with the second cooperating contact (9'), fixed to the casing, of the switching path. The two cooperating contacts (9, 9') are arranged with their contact surfaces in a plane that extends transversely to the joint plane between the two casing half shells (1, 2) and approximately parallel to the pressing direction (D). In an approximately central position, the connector (106) has an arcuate stamped-out portion (108), in the centre whereof there is arranged a tapped hole (109). The adjustment screw (110) is screwed into said hole from the narrow side wall (3') at the bottom, by the turning whereof the connector (106) can be tilted round the constriction (111) formed by the stamped-out portion (108) to ensure that the two arms (112, 113) can be braced with respect to each other, and that the tripping value of the bimetal (101) is adjustable by this means. The base (114) constitutes its deflecting end whose deflecting movement is transmitted by the transmitting slide (14) and the tripping lever (12) connected thereto to the latch (7) in the direction of its tripping action.

The manual switching on and off of the circuit breaker is effected by means of the push button (41) of the push-button assembly (4) which will be explained in greater detail below with reference to Figures 3 to 6. The substantially cylindrical push button (41) made of an insulating material is provided with a blind hole-type mounting recess (43) open towards the inside of the casing and extending in the pressing direction (D), whereby it is guided additionally in the pressing direction (D) on a guide component anchored in the casing. The guide component is formed jointly by a cap-shaped formed bearing part (44) for the helical-type push-button spring (46) that

is inserted between the bearing part and the bottom (45) of the mounting recess (43) on the actuation side, and by the supporting part (47) which is U-shaped in a longitudinal section parallel to the pressing direction. Its two U-arms (48, 49) point in a direction opposed to the pressing direction and engage with their free ends with the shaped bearing part (44). In the apex zone between its U-arms (48, 49) and its U-base (50), the supporting part (47) has on each side laterally projecting tabs (51) which bear on a corresponding casing projection (52) (Figure 2). By this means, the supporting part (47) and the shaped bearing part (44) are held fixed in position in the casing. On its opposed side walls that are parallel to the pressing direction, the shaped bearing part (44) has guide slots (67) for the pin (55) which each extend in the pressing direction (D) and are open towards the bottom. Due to their design, the supporting part (47) and the shaped bearing part (44) form for their part a guide means (53) for a supporting lever (15) which extends substantially in the pressing direction (D) and is connected with its end (16) on the push button side via a pivoting/sliding joint to the end inside the casing of the push button (41). This articulated joint is created by the passing of the pin (55) held on two lateral projections (54) of the bottom (45) through the guide-type slot (17) in the end (16) of the supporting lever (15) on the push-button side. The slot (17) is angular and its arm (18) pointing against the pressing direction (D) extends parallel to this direction, and its arm (19) pointing in the pressing direction (D) extends at an acute angle (W) pointing against the engagement direction (20). The supporting lever (15) has laterally next to the slot (17) an engagement projection (21) that can be brought into engagement with an engagement recess (56) in one of the U-arms (48, 49) of the supporting part (47), since the supporting lever (15) is capable of sliding in the pressing direction (D) and of being pivoted transversely to this direction.

The end of the supporting lever (15) pointing in the pressing direction (D) is connected by means of a pivot pin (70) to the latch (7) of the circuit breaker. The central portion of this latch (7) is the L-shaped contact link support (71) that is displaceable in the pressing direction (D) and pivotable in a pivoting plane that is parallel to this direction, which support is connected in its apex zone by means of the pivoting joint, formed by the pivot pin (70), to the end (22) of the supporting lever (15) inside the casing. The contact link arm (72) extending approximately in the pressing direction (D) carries in the zone of its free end the contact link (73) serving to bridge the two cooperating contacts (9, 9') that are fixed to the casing. This link is articulated on the contact link support (71) by means of the pivoting joint (74). The pivoting joint (74) is additionally loaded in the contact closing direction by a contact compression spring (75) designed as a leg spring.

The contact link support (71) is loaded against the contact closing direction by means of a switching-off spring (77) designed as a double leg spring and disposed on the pivot pin (70). The switching-off spring (77) bears in this arrangement on the one hand on a slanting projection (23) (Figure 2) on the inner sides of the casing half shells (1, 2) and on the other hand, on the top of the latch arm (76) extending transversely to the pressing direction (D).

At the free end of the latch arm (76), a hinged lever (79) is articulated with one of its ends, which lever can be secured in a latching means (V) with its opposite free end (80). For this purpose, the articulated lever (79) has at its free end (80) a pin (81) extending transversely to the pressing direction (D) which on one side passes through a passage opening (82) extending in the longitudinal direction and which is, on the other side, carried for lateral displacement in casing grooves (24) extending approximately transversely to the pressing direction (D). At its end remote from the latch, the passage opening (82) has an angled portion (84) wherein the pin (81) can be latched in cooperation with the guidance of the casing grooves (24). The pivotable latch lever (83) loaded in the latching direction by the leg spring (85) is disposed in a kinematic connection with the bimetal (101) via the tripping lever (12) and the transmitting slide (14). Its deflection is transferred by means of the transmitting slide (14) and the tripping lever (12) into a pivoting movement of the latch lever (83) against the latch engagement direction, so that the pin (81) is released from its latched position.

The mode of operation of the circuit breaker will be described below.

In Figure 3, the circuit breaker is shown in its switched-off position. If the push button is actuated, the pin (55) runs along the arm (18) of the slot (17) that is parallel to the pressing direction until it arrives at the lower side edge of the slot arm (19) extending obliquely to this direction. From this position, the supporting lever is entrained in the pressing direction (D) and at the same time is loaded transversely thereto. As soon as the engagement projection (21) on the supporting lever (15) comes into a congruent position with the engagement recess (56) on the supporting part (47), the supporting lever (15) is pivoted in an anticlockwise direction with reference to Figure 3, and the engagement projection (21) engages in the engagement recess (56). Due to the displacement of the supporting lever (15) in the pressing direction (D), the contact link support (71) is at the same time brought in a rotational/sliding movement into a position wherein the contact link (73) is disposed in the switched-on position (Figure 4). Due to the engagement of the supporting lever (15) and the securing of the pivot pin (70) to the contact link support (71) related thereto, and due to the latching means (V), the contact link (73) is fixed in the switched-on posi-

tion. In this position, the pin (55) of the push button (41) is held fast in the slanting lower arm of the slot (17), since the push-button spring (46) is not capable of urging the push button (41), and hence the pin (55), with such a force against the pressing direction (D) that the engagement between the engagement projection (21) on the supporting lever (15) and the engagement recess (56) in the supporting part (47) could be released. However, if the push button (41) is pulled for actuating the switching off, the supporting lever (15) is pivoted in the clockwise direction by the loading of the oblique side edge of the slot arm (19) by means of the pin (55); the engagement projection (21) is pulled out of the engagement recess (56) and this engagement is thus released. Therewith the supporting lever (15) can move upward, entraining the contact link support (71) and transferring the contact link (73) into the switched-off position (Figure 3).

In a tripping of the circuit breaker by means of the bimetal (101) due to an overcurrent, the contact link support (71) is released by a release of the latching means (V) and rotates under the action of the switching-off spring (77) round the pivot pin (70) in a clockwise direction with reference to Figure 5. Thus the opening of the contact by the lifting off of the cooperating contacts (9, 9') is also operative in the case where the push button (41) is held fast in its switched-on position. Thus this is a genuine free release.

Some details of the push-button assembly (4) will be explained below with reference to Figures 3 to 6. Thus the shaped bearing part (44) has at its upper transverse wall (58) an integrally formed-on pin (57) which engages from below in the helical-type push-button spring (46) and provides additional guidance for it. The supporting lever (15) passes through the U-base (50) of the supporting part (47) via a transverse slot (59) with lateral play, so that the scope for pivoting the supporting lever (15) remains ensured. Moreover, a cylindrical insulating sleeve (60) is inserted between the threaded neck (40) and the push button (41), which sleeve carries at its lower end a plate-shaped insulating cover (61) extending transversely to the pressing direction (D). The latter delimits the interior of the circuit breaker towards the side of the push button and has at its centre a circular opening (68) corresponding to the internal opening of the insulating sleeve (60).

The insulating sleeve (60) has at its inner wall flanking the push button (41) a projection (62) which engages in a groove (42') in the outer wall of the push button for preventing rotation of the push button (41). The push button (41) is, moreover, provided on its wall with a peripheral annular shoulder (63) which, by bearing on the end side of the threaded neck (40), limits the pressing movement of the push button when the push button is being actuated.

The mounting of the of the bimetal module (10) in the casing and its adjustment will be discussed in greater detail below with reference to Figures 2 to 5. Thus the extension (103) inside the casing has on the connecting lug (5) a plate-shaped extension (115) which is held in the casing with an accurate fit and being firmly fixed in a fixing pocket (27) formed by a lateral partition (26) in the casing half shells (1, 2). Thereby the extension (103), and hence the mounting point of the bimetal arm (112), are held fast in position and are exactly defined.

In the same way, the region of the connector (106) adjoining the extension (107) with the cooperating contact (9') is held in the casing half shells (1, 2) with an accurate fit and being firmly fixed in the mounting gap (25) between the narrow side wall (3') and the bent portion (28) arranged in front thereof. Apart from a stable fixing of the bimetal module (10), a special mounting stability of the cooperating contact (9') is also achieved by this taut bearing mode.

As has already been mentioned, the substantially plate-shaped connector (106) is divided into two zones by an arcuate stamped-out portion (108) which are connected by a constriction (111). The adjustment of the bimetal device is effected by the adjustment screw (110) that is inserted in the connector (106) into a tapped hole (109) in the radial centre of the stamped-out portion (108). Aligned with this tapped hole (109), the narrow side wall (3) on the bottom side has an adjustment bore (29) into which the adjustment screw (110) is inserted and is accessible from the outside. On the opposite side of the adjustment bore (29), the bent portion (28) has in each casing half shell (1, 2) a semicircular recess (30) wherein the end of the thread of the adjustment screw (110) can freely move. The adjustment bore (29) has approximately in the middle in its inner wall an annular peripheral supporting groove (31), wherein there bears the radially projecting ring (117) on the head (118) of the adjustment screw (110). As has already been indicated, by rotating the adjustment screw (110) which is thus defined in its longitudinal axial direction, the zone of the connector (106) disposed at the side of the connecting lug (105) is tilted round the constriction (111) by rotation, whereby the two arms (112, 113) of the bimetal (101) are braced against each other and the response value of the bimetal (101) is correspondingly altered. After the adjustment, the adjustment screw (110) is fixed in position by the cap-shaped cover (13) for the adjustment means, which can be catch engaged on the casing. The said cap can be permanently joined to the casing, for example by ultrasound welding, whereby a subsequent manipulation of the circuit breaker with a view to a modification of the nominal release value is effectively prevented.

The constriction (111) constitutes at the same time a thermal resistor which prevents the heat required for tripping the

bimetal (101) from flowing too fast in the direction towards the cooperating contact (9') from the bimetal (101) via the connecting lug (105) and the connector (106). By this means one achieves a fast response and an accurate adjustment facility of the bimetal (101).

Figure 6 shows an alternative design (10') of the bimetal module wherein, instead of one bimetal (101), two bimetals (121, 122) are used which are again approximately U-shaped. They are arranged surface-wise on top of one another in the manner of a sandwich design with the interposition of an insulating layer (123). One bimetal (121) is secured with its free arm end (102) on the connecting lug (105); the second bimetal (122) is welded with its free arm end (104) onto the connecting lug (105). The remaining free arm ends (102', 104') of the two bimetals (121, 122) have an inwardly directed angled portion (124). As may be seen in Figure 6, the two bimetals (121, 122) have an identical shape, but are arranged in an inverted mirror symmetry, so that in their installed position, their angled portions (124) overlap one another. In the overlap region, the insulating layer (123) of a corresponding shape is provided with a cutout (125), whereby the two angled portions (124) of the free arm ends (102', 104') can be directly welded together, and thus a durable electrical and mechanical joint is created between the two bimetals (121, 122). The latter are thus electrically disposed in series. By this means a doubling of the current path is obtained by the bimetal device, whereby tripping also becomes possible with lower nominal currents. Due to the superposed arrangement of the two bimetals (121, 122), the resultant tripping force remains substantially unaltered as compared with that of the single bimetal (101). A further reduction of the nominal tripping current becomes possible by a thinner design of the bimetals, whereby the mechanical stability remains preserved by the sandwich structure.

Figures 7 and 8 show a further alternative design of the bimetal module, wherein two bimetals (131, 132) are used whose arms (112, 113, 112', 113') have an inherent meander-type shape because of appropriate stamped out portions. Thereby the current path through these two bimetals (131, 132) is multiplied and consequently the nominal tripping current is reduced to a fraction. The two bimetals (131, 132) are designed in a so-called sandwich structure similarly to the bimetals (121, 122), with an insulating layer (123') between them. Their shape is also identical and their installed position is arranged in an inverted mirror symmetry. The connection of their free arm ends (102, 104) to the connecting lug (6) and to the connecting lug (105), as well as of their free arm ends (102', 104') is effected in a way similar to that of the bimetals (121, 122).

Since the bimetals (131, 132) are mechanically weakened by the meander-type shape of their arms, provision is made in the region of their base (114 114') and of their free arm ends

(102, 102', 104, 104') for clip-type stiffeners (133) which are disposed on the above mentioned bimetal sections with the interposition of further small insulating plates (134). Here too, the tripping force is almost unaltered as compared with the single bimetal (101).

It should be pointed out that the adjustment of the alternative bimetal modules (10', 10'') according to Figure 6, or Figures 7 and 8, is effected in a way corresponding to the adjustment in the bimetal module (10) according to Figures 2 to 5.

Figure 9 shows a further alternative design (10'') of the bimetal module, wherein provision is made for a so-called fail-safe device. The principle of this fail safe device is already known from the EP-A 0 081 290. For this purpose, the connector (106') is separated approximately centrally into two parts (119, 120) which are electrically connected by a thin sheet metal bridge (126). The sheet metal bridge constitutes at the same time the flexible rotatable part in the connector (106') which corresponds in its function to the constriction (111). It is, moreover, a fusible conductor that is provided with several stamped cutouts (127). In the shown normal state of the circuit breaker, at least the central circular cutout (127') is closed up with fusible solder (128).

The mentioned fail-safe device operates as follows:

If the circuit breaker is traversed by a normal current, neither the bimetal device nor the fail-safe device is tripped. If an overcurrent is flowing, the bimetal (101) is deflected and releases the latching means (V) in the latch (7) via the transmitting slide (14) and the tripping lever (12) (Figure 5). The contact link 73 should now pass into its switched-off position and should interrupt the flow of the current through the circuit breaker. If this does not happen for any reason, (a defect in the latch, welding of the contacts), the overcurrent continues to flow in the circuit breaker ensuring a further heating of the bimetal (101), and hence of the connector (106'). After a short time, the connector (106') and the sheet metal bridge (126) will reach such a temperature that the fusible solder (128) will melt. Thereby the longitudinal cross-section of the sheet metal bridge (126) is further reduced, which again entails a distinct heating of the sheet metal bridge (126) and finally leads to the melting of the sheet metal bridge (126). By this means the flow of the current through the circuit breaker is definitely and irreversibly interrupted. The entire defective circuit breaker has to be changed.

Figures 10 and 11 show a further alternative bimetal module 10''' with an improved tripping characteristic at high overcurrents. In this bimetal module 10''', the connecting lug 5' does not have an plate-shaped extension 115, but a U-shaped extension 135 which laterally flanks the U-shaped bimetal 101.

This means that in a plan view of the plane of the bimetal 101, the latter and the extension 135 are arranged in a way in which they substantially overlap.

5 The free end 136 of the extension 135 is welded to the free arm end 102 of the bimetal 101. The second free arm end 104 of the bimetal 101 is welded, in a way corresponding to the mode of embodiment according to Figure 2, to the connecting lug 105 of the connector 106.

10 An L-shaped insulating layer 139 is inserted between the U-arm 137 attached to the connecting lug 105, as well as the U-base 138 of the extension 135, and the U-arm 137 as well as the base 114 of the bimetal 101.

15 Due to the design described, the following current conduction is obtained: the current entering at the connecting lug 5 flows via the extension 135 in the direction indicated by the arrows. The current enters into the bimetal via the connecting point at the free ends 136, 102 of the extension 135 or of the
20 bimetal 101 and passes through the bimetal 101 in the direction indicated by the arrows that are there shown, which direction runs respectively in an opposite way to the directions of the current in the individual sections of the extension 135. The
25 current enters via the second free arm end 104 of the bimetal 101 into the connector 106 and there passes to the cooperating contact 9', fixed to the casing, for the contact link 73.

30 Because of the above mentioned opposite directions of the current in the bimetal 101 and the extension 135 respectively, these two parts strongly repel each other, in particular with high current intensities. Because of the mounting of the connecting lug 5' and of its extension 135 in the casing, these repelling forces are thus wholly acting on the bimetal as additional dynamic forces so as to deflect it in the tripping
35 direction. This effect occurs in particular with currents of over 1000 ampere. By this means, a particular short switching-off time is achieved in the case of a short circuit.

40 In the case of low currents, the dynamic action of the current loop arrangement is not effective.

LIST OF REFERENCE NUMERALS

5	1	casing half shell,
	2	casing half shell
	3, 3'	narrow side wall
	4	push-button assembly
10	5	connecting lug
	6	connecting lug
	7	latch
	8	extension
	9, 9'	cooperating contact (9
15	10, 10, 10"	bimetal module
	10", 10"	bimetal module
	11	stop catch
	12	tripping lever
	13	adjustment cover
20	14	transmitting slide
	15	supporting lever
	16	end at the side of the push button
	17	slot
	18	arm
25	19	arm
	20	engagement direction
	21	engagement projection
	22	end
	23	slanting projection
30	24	casing groove
	25	mounting gap
	26	partition
	27	fixing pocket
	28	bent portion
3"	29	adjustment bore
	30	recess
	31	supporting groove
	40	threaded neck
	41	push button
40	42, 42'	groove
	43	mounting recess
	44	shaped bearing part
	45	bottom
	46	push-button spring
45	47	supporting part
	48	U-arm
	49	U-arm
	50	U-base
	51	tabs
50	52	casing projection
	53	guide means
	54	projection
	55	pin
	56	engagement recess

	57	pin
	58	transverse wall
	59	transverse slot
	60	insulating sleeve
5	61	insulating cover
	62	projection
	63	annular shoulder
	70	pivot pin
	71	contact link support
10	72	contact link arm
	73	contact link
	74	pivot joint
	75	contact compression spring
	76	latch arm
15	77	switching-off spring
	78	free end
	79	articulated lever
	80	free end
	81	pin
20	82	passage opening
	83	latch lever
	84	angled portion
	85	leg spring
	101	bimetal
25	102, 102'	free arm end
	103	extension
	104, 104'	free arm end
	105	connecting lug
	106, 106'	connector
30	107	extension
	108	stamped-out portion
	109	tapped hole
	110	adjustment screw
	111	constriction
35	112, 112'	arm
	113, 113'	arm
	114	base
	115	extension
	117	ring
40	118	head
	119	part
	120	part
	121	bimetal
	122	bimetal
45	123, 123'	insulating layer
	124	angled portion
	125	cutout
	126	sheet metal bridge
	127, 127'	stamped out portion
50	128	fusible solder
	131	bimetal
	132	bimetal
	133	stiffener
	134	small insulating plate

	135	extension
	136	free end
	137	U-arm
	138	U-base
5	139	insulating layer
	D	pressing direction
	W	angle
	V	latching means

C L A I M S

1. A push-button operated overcurrent protective circuit breaker, in particular a protective circuit breaker for an on-board supply system with a manual release and a bimetal-controlled free release with
- a latch (7) actuatable by the push button (41), by means of which latch a contact link (73) can be brought into a contact closing or opening position with respect to two cooperating contacts (9,9') fixed to the casing and
 - a bimetal tripping device for releasing the latch (7) which device has, designed as an approximately U-shaped stamped component and electrically connected in series into the current path by the circuit breaker, a self-heated bimetal (101), whose
 - one free arm end (102) is fixed at the end inside the casing of the one connecting lug (5) of the circuit breaker, secured in the casing,
 - second free arm end (104) is fixed at a connector (106, 106') to one cooperating contact (9') secured to the casing and
 - whose base (114) forms the deflecting end of the bimetal (101), kinematically connected to the latch (7), the connecting lug (5) and the region of the connector (106, 106') adjoining the cooperating contact (9') secured to the casing being fixedly held in corresponding mounting recesses with an accurate fit,
- characterized by the following features:
- between the connecting lug (105) of the connector (106, 106') for the second arm end (104) of the bimetal (101) and the region of the connector (106, 106') adjoining the cooperating contact (9') secured to the casing, the connector has a constriction (111),
 - which is formed by a slot passing through the plate-shaped central section of the connector (106, 106') transversely to the plane of the plate and
 - round which the connecting lug (105) can be rotated by the action of an adjustment screw (110) on the central section from the bottom of the circuit breaker for the purpose of adjusting the response value of the bimetal (101).
2. An overcurrent protective circuit breaker according to claim 1, characterized in that the slot is formed by an arcuate stamped-out portion (108) in the plate-shaped central section of the connector (106).
3. An overcurrent protective circuit breaker according to claim 2, characterized in that a tapped hole (109) is introduced into the central section, centrally with respect to the arcuate stamped portion (108), into which the adjustment screw (110) can be screwed in, which bears with a radially projecting ring (117) at its head (118) in a casing groove.



4. An overcurrent protective circuit breaker according to one of the preceding claims, characterized in that the connecting lug (5) has, at its end inside the casing, a preferably integrally formed-on extension (115), which, for its part, is held with an accurate fit firmly fixed in a corresponding casing recess.

5. An overcurrent protective circuit breaker according to one of the preceding claims, characterized in that the bimetal tripping device has two bimetals (121, 122),
- which are arranged surface-wise on top of one another in a sandwich design with the interposition of an insulating layer (123),
- whereof one is fixed with its one arm end (102) to the connecting lug, and the other with its one arm end (104) to the connector and
- which are electrically connected in series by means of an electrical connection between their remaining free arm ends (102', 104').

6. An overcurrent protective circuit breaker according to claim 5, characterized in that the opposite free arm ends (102', 104') of the two bimetals (121, 122) overlap one another by means of an inwardly directed angled portion (124), that the insulating layer (123) has a cutout in the overlapping region and in that a direct electrical connection is created between the overlapping arm ends (102', 104') by their being welded or soldered together or by a similar connection.

7. An overcurrent protective circuit breaker according to one of the preceding claims, characterized in that the arms (112, 112', 113, 113') and base (114) of the one or several U-shaped bimetal or bimetals (131, 132) each have a meander-type shape.

8. An overcurrent protective circuit breaker according to claim 7, characterized in that the bimetal or bimetals (131, 132) are each provided in the region of the free arm ends (102, 102', 104, 104') and of the base (114) with clip-type stiffeners (133) which are mounted with the interposition of corresponding insulating layers (small insulating plates 134) on the said bimetal sections.

9. An overcurrent protective circuit breaker according to claim 1, and/or one of claims 4 to 8, characterized in that, in order to form a slot, the connector (106') is divided approximately centrally into two parts that are interconnected by a thin sheet metal bridge (126) forming a



constriction which, being a fusible conductor, simultaneously forms a fail-safe device for the circuit breaker.

10. An overcurrent protective circuit breaker according to claim 9,

characterized in that

in order to reduce the conducting cross section, the sheet metal bridge (126) is provided with one or several stamped cutouts (127, 127') which, in the normal state of the circuit breaker, are closed up with fusible solder (128).

11. An overcurrent protective circuit breaker according to one of the preceding claims,

characterized in that

the connecting lug (5), one or more bimetals (101', 121, 121', 131, 132), the connector (106, 106') provided with a fail-safe device if required, and the adjustment screw (110) are combined into a bimetal module (10, 10', 10'', 10''') that can be preassembled and installed in the circuit breaker as a whole.

12. An overcurrent protective circuit breaker according to one of the preceding claims,

characterized in that

the connecting component (5') is provided with a U-shaped extension (135) laterally flanking the U-shaped bimetal (101), and that the corresponding free arm end (102) of the bimetal (101) is electrically and mechanically connected to the free end (136) of said extension,.

13. An overcurrent protective circuit breaker according to claim 12,

characterized in that

an L-shaped insulating layer (139) is inserted between the U-arm (137) attached to the connecting component (5'), as well as the U-base (138) of the extension (135), and the U-arm (113) flanked thereby, as well as the base (114) of the bimetal (101).