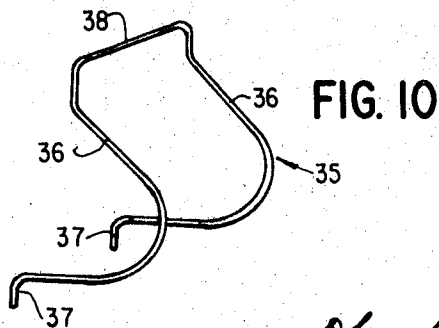
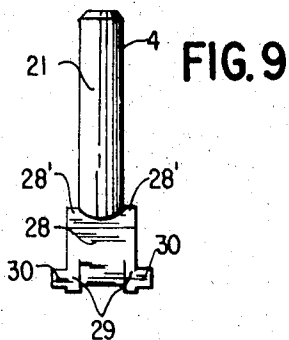
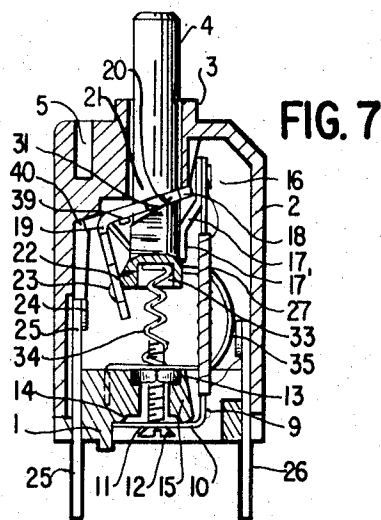
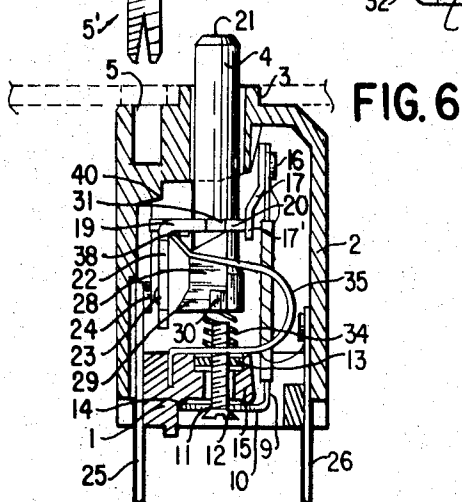
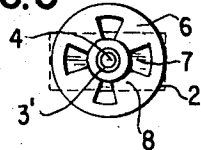
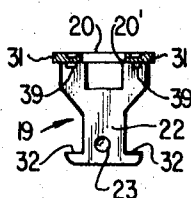
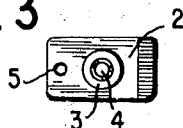
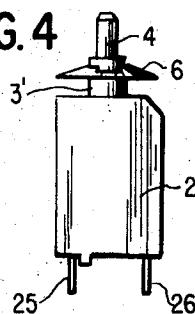
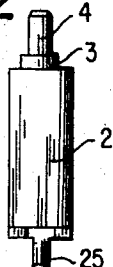
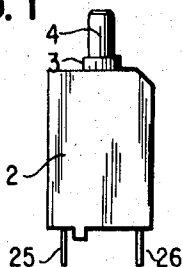


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PUSH-BUTTON OPERATED OVERLOAD-CURRENT SWITCH WITH ADJUSTABLE THERMAL TRIP

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9 Claims

ABSTRACT OF THE DISCLOSURE

A push-button operated overload-current switch with an adjustable thermal trip and trip-free release, having a contact bridge constructed as an angled lever. The contact bridge is mounted freely pivotable on projections of a switch bridge rigidly connected to a switch rod and push-button under spring pressure, and is movable in the axial direction against the force of a spring producing the trip-free release, and on switching off, is brought at a casing stop into an inclined position, in which a shoulder of the contact bridge is located in the range of movement of a driver of the switch bridge, so that on the resetting movement of the push-button, the contact bridge is carried along by the switch bridge driver, and is brought to engagement behind a retention nose of the bimetallic strip. The bimetallic strip is adjustably clamped against the base by a screw arranged between spaced supporting projections. Tightening of the screw causes the strip to bend so as to lower the trip current.

BACKGROUND OF THE INVENTION

Field of the invention

The invention relates to push-button operated overload-current switches, and in particular to overload-current switches having an adjustable thermal trip.

Description of the prior art

An overload-current switch is known (British patent specification No. 995,587 and U.S. Pat. No. 3,185,793), in which the switch bridge consists of a metal plate secured, preferably riveted, to the free end of the switch rod. The contact bridge is stamped of one piece with its projections and a driver. Due to the fact that the switch rod and switch bridge are made separately and are connected to each other subsequently, in addition to difficulty of production, there is the drawback that a certain amount of space must be provided for this connection. In addition, in this known overload-current switch, the retention nose of the bimetallic strip is so far removed from the fixing end as to result in a relatively large axial length of this known overload-current switch. The adjusting device for the bimetallic strip also contributes to this axial length. Furthermore, in the known overload-current switch, the spring serving for trip-free release is located on the switch rod between the switch bridge and the contact bridge, and it is of weaker construction than the spring which acts on the push-button, and which produces substantially the contact pressure in the switched-on position. If in the switched-on position, the push-button is pressed into the casing, the stronger spring becomes wholly inactive, and the weaker spring is partly relaxed, so that the contact pressure is reduced to an inadmissible value.

SUMMARY OF THE INVENTION

A push-button operated overload-current switch which includes an adjustable thermal trip, a trip-free release,

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a contact bridge in the form of an angle lever mounted freely pivotable on projections of a switch bridge rigidly connected to a switch rod to the push button under spring pressure, the contact bridge being movable in the axial direction of the switch rod against the force of a spring producing the trip-free release. The contact bridge on switching off is adapted to be brought at a casing stop into an inclined position, in which a shoulder of the contact bridge is located in the range of movement of a driver of the switch bridge. During the resetting movement of the push-button, the contact bridge is carried along by the driver of the switch bridge and is brought into engagement behind a retention nose of the bimetallic strip, the switch rod being made of a plastics material in one piece with the switch bridge, the driver and the projections of the switch bridge.

The switch bridge may have in-line extensions engaging corresponding guide grooves of the casing. These extensions may also be formed in one piece with the switch bridge and switch rod.

In order further to save space and simplify production, the switch rod may have a constant diameter, and its upper part projects from the casing acting as push-button.

In order to obtain reliable driving of the contact bridge on resetting, the driver consists of two tooth-shaped projections spaced apart and in-line with each other, and the shoulder co-operating with them consists of two shoulders located on either side of the contact button on the contact bridge and made by stamping. This precludes jamming of the contact bridge when it is being driven.

The switch rod on its lower side end may have a blind hole engaged by a pressure spring, the other end of which is supported on a base carrying the connecting lugs.

Just like the bimetallic strip of the known overload-current switch, the bimetallic strip of the invention may include a right-angled mounting leg and an adjusting device with an adjusting screw. In the overload-current switch of the invention the adjusting screw also holds the bimetallic strip. A separate fixing screw and the space required for it are thereby saved. On either side of the adjusting screw the base has a projection, on which projections the mounting leg of the bimetallic strip is supported. If the adjusting screw is tightened the latter is bent between the two projections and thus also the free end of the bimetallic strip, provided with the retention nose, is moved away from the contact bridge, thereby adjusting a smaller trip current. This construction considerably reduces the axial length of the overload-current switch.

In further development of the invention, the adjusting screw projects beyond the base and into the pressure spring, thereby securing the advantage of saving a separate retaining means for the other end of the pressure spring and the space required for such means.

A further substantial saving in axial length of the switch is obtained when a small metal plate is fixed to the freely movable end of the bimetallic strip for arresting the contact bridge in its contact position, and the free end of the metal plate directed is spaced away from the bimetallic strip and serves as retention nose. It is thereby possible of course to locate the retention nose of the bimetallic strip in the region of its heating coil, so that the space in which the contact bridge moves between its switched-on and -off positions is lower relative to the base than in the known excess-current switch. This permits a substantial shortening of the excess-current switch according to the invention.

In order further to save space, the spring serving for trip-free release consists of a wire, bent into a U-shape the parallel arms of which are bent into a substantially V- or U-shape, and are supported by their one end on

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the base and by their other end on the contact bridge. The trip-free release spring therefore occupies very little space. To simplify assembly, the free ends of the arms of this spring have their ends bent at right angles which engage corresponding recesses of the base, while the spring cross-piece connecting together the two arms is supported in the apex of the contact bridge. To prevent displacement of this spring cross-piece, the contact-bridge arm embracing the switch rod has two pressed-out studs for retaining the cross-piece. The trip-free release spring also produces the contact pressure.

Just as in the known overload-current switch, the present overload-current switch also has a casing of plastics material possessing a tubular extension surrounding the push-button. In further development of the invention, the casing may consist of thermoplastic material and it may have adjacent and parallel to the tubular extension a blind hole into which is screwable a self-tapping screw. The production of the housing and hence of the excess-current switch according to the invention is thereby made easier and less expensive.

It is also possible for fixing the overload-current switch according to the invention, to fit a claw clamping disc on the tubular extension. This provides an extremely simple method of fixing the overload-current switch according to the invention and further simplifies its production.

BRIEF DESCRIPTION OF THE DRAWING

An illustrative embodiment of the invention will now be described with reference to the accompanying drawings.

FIG. 1 shows a front view of an overload-current switch embodying the invention,

FIG. 2 is a view from the left in FIG. 1,

FIG. 3 is a plan view of FIG. 1,

FIG. 4 is a view similar to that of FIG. 1, the casing being provided with a claw clamping disc,

FIG. 5 is a plan view of FIG. 4,

FIG. 6 is a vertical section through the switch according to FIG. 1 in the switched-on position on a larger scale,

FIG. 7 is the same section as FIG. 6, the switch being in its switched-off position,

FIG. 8 is a view of the contact bridge as seen from the right in FIG. 6,

FIG. 9 is a view of the switch rod seen from the left in FIG. 6,

FIG. 10 is a perspective view of the spring serving for trip-free release.

The overload-current switch shown in FIGS. 1 to 10 has a base 1 of insulating material, for example moulded material, and a casing 2, adapted to be assembled by rivets or screws. The casing 2 has a tubular extension 3, which is made in one piece with it and surrounds the push-button 4. Adjacent to the tubular extension 3, the casing 2 has a blind hole 5 and a self-tapping screw 5' is adapted to be screwed into the hole, the tubular extension 3 of the casing 2 engaging a corresponding hole in the plate to which the overload-current switch is to be secured. The tubular extension 3 together with the screw 5' prevent rotation of the overload-current switch.

For fixing the switch, a claw clamping disc 6 may also be fitted on a longer tubular extension 3' of the casing 2' as shown in FIGS. 4 and 5, which disc is supported on its periphery on the panel to which the overload-current switch is fixed. The somewhat conically formed claw clamping disc 6 has openings 7 forming spring tongues 8 which yield resiliently when the claw clamping disc 6 is fitted on the tubular extension 3', and are thereupon pressed into the tubular extension 3'. The casing 2 or 2' formed in one piece with the tubular extension 3 or 3' may consist of plastics material, preferably a thermoplastic material, which is as heat resistant as possible, for example a polyamide.

As follows from FIGS. 6 and 7, a bimetallic strip 9 is

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adjustably mounted to the base 1. For this purpose, the bimetallic strip 9 has a horizontal leg 10 with a hole 11, through which passes an adjusting screw 12 which clamps the bimetallic strip 9 to the base 1. The adjusting screw 12 is screwed into a nut 13 which is non-rotatably inserted in a suitable recess in the base 1. On both sides of the adjusting screw 12, the leg 10 of the bimetallic strip 9 bears on two projections 14 and 15 of the base 1. If the adjusting screw 12 is tightened, the leg 10 of the bimetallic strip 9 bends upwardly, as shown in FIG. 6, the top free end of the bimetallic strip 9 being moved outwardly. Adjustment of the trip current strength is effected in this way.

A small metal plate 17 is fixed by means of a rivet 16 to the top free end of the bimetallic strip 9, and has its free end 17' directed downward as shown in FIG. 6 and spaced away from the bimetallic strip. This free end 17' of the metal plate 17 has a downwardly opening, U-shaped recess into which projects the suitably formed nose 18 of an angle-shape contact bridge 19, and bears on the bottom of the U-shaped recess in the free end of the metal plate 17. The horizontal arm 20 of the contact bridge 19 has a hole 20' (FIG. 8) through which passes the switch rod 21 made in one piece with the push-button 4 and having the same diameter. This hole in the horizontal arm 20 of the contact bridge 19 is so formed that the contact bridge 19 can be easily moved and rocked on the switch rod 21. The vertical arm 22 of the contact bridge 19 has a contact 23 adapted to co-operate with a stationary contact 24 fixed to a connecting lug 25. This connecting lug 25 is inserted in a suitable recess in the base 1 and is held in its position by the casing 2 mounted on the base 1. The same also applies to a second connecting lug 26, electrically connected to a heating coil 27 surrounding the bimetallic strip 9. The other end of the heating coil 27 is electrically connected by means of the rivet 16 to the bimetallic strip 9 and to the metal plate 17. In the switched-on position shown in FIG. 6, therefore, the electric current passes from the connecting lug 25 through contacts 24 and 23, contact bridge 19, metal plate 17, partly through the bimetallic strip 9 and the heating coil 27 to the connecting lug 26.

As shown more particularly in FIG. 9, the switch rod 21 at its lower end has a switch bridge 28, formed in one piece with it and having projections 28', by means of which in both the switched-on and switched-off positions it bears on the lower side of the horizontal arm 20 of the contact bridge 19. Furthermore, the switch bridge 28 has on its lower end a driver 29 with two tooth-like projections, as well as two in-line extensions 30, by means of which the switch rod 21 is guided in guide grooves in the wall of the casing 2. The horizontal arm 20 of the contact bridge 19, formed as a stamping, also has similar extensions 31, which engage the same grooves as the extensions 30 of the switch rod 21. By means of these extensions 30 and 31, respectively, the switch rod 21 and contact bridge 19 are guided non-rotatably in the corresponding guide grooves of the casing 2.

Lateral shoulders 32 on the vertical arm 22 of the contact bridge 19 are adapted to co-operate with the driver 29. The switch rod 21, shown in FIG. 9, is made with all parts 4, 28, 28', 29 and 30 of a thermoplastic material, for example heat resistant polyamide.

At the lower end, the switch rod 21 has a blind hole 33, in which is inserted a compression spring 34, which is supported by its lower end on the nut 13 and is guided by the adjusting screw projecting from the base 1.

The contact bridge 19 is biased upwardly by a spring 35 producing the trip-free release and shown in FIG. 10. The spring 35 consists of a piece of wire bent into a U-shape the parallel arms 36 of which are bent substantially into a V or U. The bent ends 37 of these arms 36 engage corresponding lateral cuts in the base 1. The arms 36 are supported on the base 1 by their lower portions. The cross-piece 38 connecting the two arms 36 engages

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the inner end of the horizontal arm 20 of the contact bridge 19 that is to say at the apex. On the right, adjacent the cross-piece 38 as shown in FIGS. 6 and 7, the horizontal arm 20 of the contact bridge 19 has, on its under-
side, two pressed-out studs, securing the cross-piece 38 in its position.

The mode of operation of the switch is as follows:

If an overload current occurs, the bimetallic strip 9 will be bent to the right in FIG. 6 such that its metal plate 17 releases the contact bridge 19 under the influence of the spring 35 which kicks the contact bridge 19 against an inclined surface 40 of the casing 2, so that the circuit within the switch is broken. If the push-button 4 is in this case held in the switched-on position as shown in FIG. 6 or if the push-button is jammed in this switched-on position, then the so-called trip-free release occurs, independently of tripping. If, on the contrary, the push-button 4 is released or is not jammed, the spring 34 pushes the switch rod 21 into the switched-off position shown in FIG. 7. In this switched-off position, the shoulder 32 of the vertical arm 22 of the contact bridge 19 is located in the range of movement of the driver 29.

If, now, the push-button 4 is pressed into the casing from the position shown in FIG. 7, the driver 29 bears against the shoulder 32 of the vertical arm 22 of the contact bridge 19 and carries the latter with it until the right-hand end 18 of the horizontal arm 20 of the contact bridge 19 engages the U-shaped recess of the metal plate 17, its nose 18 bearing on the bottom of the U-shaped recess, of the metal plate 17. On releasing the push-button 4, pivoting of the contact bridge 19 now occurs in the clockwise direction in around the nose 18. After a slight movement, the driver 29 of the switch rod 21 releases the shoulder 32, so that under the action of the spring 35, the contact bridge 19 makes a backward rotation and its contact 23 is applied with a snap-in movement against the stationary contact 24. This is an instantaneous switching-on operation which protects the switch contacts. In the switched-on position the contact bridge 19 cannot be affected by operation of the push-button 4. The contact pressure is produced by the spring 35. The contact pressure of this spring 35 also cannot be reduced by operation of the push-button 4. As shown in FIG. 6, the spring 34 also contributes in producing the contact pressure.

I claim:

1. A push-button operated overload-current switch with an adjustable thermal trip, comprising in combination:

- (a) a casing assembly of non-conductive material with a guide bore representing the switch axis, said casing assembly including spaced protrusions forming a support plane with two parallel support fulcrums;
- (b) an elongated bimetallic strip having a free, temperature-responsive main portion and a bendable end portion, said end portion overlying said protrusions for detachable clamping against said support fulcrums said main portion including a tripping edge which moves from a contact position occupied at normal temperatures and normal current conditions to a trip position further away from the switch axis, when a predetermined over-current causes said temperature-responsive main portion to heat up and deflect;
- (c) means to adjustably clamp said flexible end portion against said protrusions by engaging it in an area between said fulcrums, whereby the adjustment of said clamping means determines the degree of bending of said end portion so as to change the orientation of said free, temperature-responsive main portion and to adjust the position of said tripping edge, thereby adjusting the intensity of electric current at which the switch is tripped;
- (d) connector means including at least one stationary contact button at which button the electric current can be interrupted and re-established;
- (e) a contact bridge movable between a contact posi-

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tion, where it engages said stationary contact button and said tripping edge so as to establish an electric contact, and a tripped position where said contact is broken;

- (f) spring means which hold said contact bridge in its contact position by simultaneously urging it against said stationary contact button and against said tripping edge as long as the latter remains in its contact position, and which kick said contact bridge away from said contact button as soon as said tripping edge moves to its trip position and releases said contact bridge;
- (g) a push-button assembly movable along the switch axis and including a push-button protruding through said guide bore to the outside of said casing; said push-button assembly further including resetting means to move said contact bridge to its contact position, whereby it is retained in this position, when said tripping edge of the bimetallic strip occupies its contact position.

2. The switch as defined in claim 1, wherein:

said casing assembly (a) includes an elongated switch casing having an open bottom end and a closed top end, said guide bore being arranged in said top end to represent a vertical switch axis;

a switch base fitting into said open bottom end for attachment to said casing, said base having a vertical bore substantially in alignment with the switch axis, the aforementioned spaced protrusions being arranged on its lower side at equal distances from said vertical bore, said base further including a screw thread in its vertical bore; and wherein:

said bimetallic strip (b) has the shape of an L, said free, temperature-responsive main portion representing its vertical leg extending at a distance from the switch axis, said tripping edge being arranged at the upper portion of said vertical leg closer to the switch axis and oriented downwardly; said end portion of the bimetallic strip representing the horizontal leg of said L and including a central hole; and wherein:

said adjustable clamping means (c) include

a clamping screw fitting through said central hole of the horizontal leg and screwable into said vertical bore of the base, whereby tightening of said screw causes said tripping edge of the bimetallic strip to move away from the switch axis so as to lower the intensity of current at which the switch is tripped.

3. The switch as defined in claim 1, wherein:

said casing assembly (a) includes

an elongated switch casing with a top end and a base, said guide bore being arranged in said top end to represent a vertical switch axis; and wherein:

said bimetallic strip (b) has its temperature-responsive main portion extending upward at a distance from the switch axis, said tripping edge being positioned closer to the switch axis and oriented downward from the upper end of said main portion; and wherein:

said connector means (d) include

a first connector lug mounted on the side of said bimetallic strip and electrically connected thereto, and a second connector lug mounted at the opposite side of the switch axis and carrying on its upper end said stationary contact button facing toward the switch axis; and wherein:

said contact bridge (e) has the shape of an inverted L and includes, as seen in its contact position, a vertical arm extending downward and to the inside of said stationary contact button, and

a horizontal arm reaching across the switch axis and push-button assembly to engage said tripping edge of the bimetallic strip; said contact bridge being guided for vertical motion and for pivoting out of the contact position around a horizontal transverse axis; and wherein:

said spring means (f) include

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a bridge spring urging said L-shaped contact bridge into its contact position independently of the position of said push-button assembly, and

a push-button spring urging said push-button assembly upwards against the direction of push-button depression.

4. The switch as defined in claim 3, wherein:

said casing assembly (a) further includes, in the top end of its switch casing,

an inclined inner shoulder slanting upward from the side of said stationary contact button to the opposite side, whereby said contact bridge, when it is kicked upward in the tripping movement, impacts against said shoulder on the side of the contact button, so as to forcibly pivot the tripped contact bridge away from said contact button;

said switch casing further including parallel vertical guide grooves at opposite sides of the switch axis to guide said contact bridge and wherein:

said contact bridge (e) further includes, extensions on both sides of its horizontal arm to engage said grooves for vertical motion therein and for pivoting of said bridge around the horizontal pivot formed by these extensions; and

a shoulder in the lower portion of said vertical arm for engagement by said resetting means during the downward motion; and wherein:

said push-button assembly (g) further includes

a switch rod extending in the switch axis, with said push-button arranged at the upper end of said rod; and

a switch bridge at the lower end of said rod, said bridge including the aforementioned resetting means in the form of a driver which, during its downward motion, engages said shoulder of the contact bridge when the latter is in its tripped position, thereby moving it downward for resetting; and wherein

said contact bridge (e) has a hole in its horizontal arm to accommodate said switch rod.

5. The switch as defined in claim 4, wherein:

said switch bridge of the push-button assembly further includes, at its upper end,

a shoulder bearing against the underside of said contact bridge, thereby holding said push-button assembly depressed and adding the force of said push-button spring to the contact force exerted by said bridge spring; said switch bridge still further including a pair of lateral extensions to engage said vertical guide

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grooves in the casing, thereby non-rotatably guiding said push-button assembly.

6. The switch as defined in claim 3, wherein:

said bimetallic strip (b) further includes a trip plate attached to the upper end of its upward-extending main portion so as to depend downward therefrom, the lower portion of said plate being offset toward the switch axis and linked to said plate by an incline, said offset portion having a U-shaped cutout therein, the bottom of said cutout forming the aforementioned tripping edge, and wherein:

said contact bridge (e) further includes

a nose extending from the end of its horizontal arm, said nose fitting said U-shaped cutout to engage said tripping edge and also serving to deflect said bimetallic strip during the resetting operation.

7. The switch as defined in claim 3, wherein:

said bridge spring is a wire bent into a form having two spaced parallel arms in the shape of parallel hooks and linked at their upper end by a cross-piece, said cross-piece engaging the inner bend of said contact bridge, and said arms having bent lower ends engaging suitable recesses in said switch base.

8. The switch as defined in claim 3, wherein

said switch casing further includes a tubular extension around said switch rod above its top end, and a blind vertical hole for a self-tapping screw in said top end, in the vicinity of said tubular extension, for the mounting of said switch to a support plate in a non-rotatable manner.

9. The switch as defined in claim 3, wherein

said switch casing further includes a tubular extension around said switch rod above its top end, said extension cooperating with a claw-type clamping disc for the mounting of said switch to a support plate.

References Cited

UNITED STATES PATENTS

2,952,757	9/1960	Ellenberger	337—66
2,913,552	11/1959	Roberts	337—66
2,639,348	5/1953	Ingwersen	337—66X

OTHER REFERENCES

German printed application: 1,216,976; May 1966; Ellenberger et al.; 337—66.

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