

TAMPERPROOF SETTING DEVICE OF AN ELECTRICAL APPARATUS

The invention relates to a setting device to adjust a value of a characteristic for operation and/or tripping of an electrical apparatus with a moulded insulating case, comprising a rotary adjustment knob having a cylindrical lateral surface, and a locking means designed to immobilize the knob in rotation after said value has been set.

It is state-of-the-art to immobilize a screw or rotary adjustment knob of a circuit breaker by means of a coating material, notably hardening glue or putty, covering the head of the knob after the setting operation. A system of this kind is achieved in the factory, but is not fully tamperproof, for the user has the possibility of removing the coating material to gain access to the knob, and modify the setting.

According to the document GB-A-2,169,139, the engagement part comprises a triangular portion which engages in a hollow of a serration to lock the rotary knob. Such an arrangement does not enable an accurate continuous adjustment of the knob, as the angular position on the protruding edge between two successive serrations is impossible.

The engagement part is moreover urged elastically towards the hollow of a serration. This results in the setting being able to be readjusted at any time by the customer.

According to the document US-A-3,831,120, immobilization in rotation is achieved by means of a spigot inserted in a circular orifice, formed by two semi-circular conjugate notches facing one another, and belonging respectively to the case and to the knob. An adjustment device of this kind has a limited number of positions, corresponding exactly to the number of notches in the case, and is not suitable for accurate continuous adjustment.

Factory setting of the tripping threshold of electromagnetic trip devices associated with miniature circuit breakers can also be performed by means of the choice of the hardness of the moving core return spring. Each tripping curve is assigned a predetermined spring, whose opposing force determines the tripping threshold. This type of state-of-the-art trip devices gives rise to problems of storage and manufacturing control.

In moulded case circuit breakers of ratings higher than 100 Amperes, the tripping threshold of certain electromagnetic trip devices can be adjusted by the user by means of a knob which either brings about a variation of the air-gap or an adjustment of the return spring tension. After adjustment, the knob is immobilized in rotation, and at the same time displays the tripping threshold. A customer adjustment system of this kind cannot be tamperproof, for the knob must be operational at all times to modify the tripping characteristics.

The object of the invention is to improve the factory setting of an electrical apparatus with a rotary knob.

The setting device according to the invention is characterized in that the locking means comprise a first mechanical locking pin arranged to be driven in along the lateral surface of the knob regardless of its angular adjustment position, the knob and locking pin being made from materials of different hardnesses enabling an incrustation effect during the drive-in phase, to make the setting device tamperproof.

The locking means can comprise a second pin centred on the spindle of the rotary knob with a predetermined angular offset with respect to the first pin.

The knob then simply has to be turned to the predetermined setting position, and the two locking pins then driven in to

lock the knob in this position. The phases involving setting of the knob and driving-in of the two pins can be performed by an automatic machine at the end of assembly of the circuit breaker, and after the moulded case has been closed.

The two locking pins can be cast with the second half-shell and remain attached to the latter by breakable zones. The two locking pins protrude out with respect to the large side panel of the second half-shell, and are angularly staggered around a circular orifice, in which the actuating head of the adjustment knob fits when the two half-shells are assembled.

This adjustment system can be used to set the tripping threshold of an electromagnetic trip device, by adjusting the prestressing of the return spring associated with the moving core.

Other applications are possible, notably adjustment of the position of a bimetal strip or rotary selector switch requiring a high setting precision.

The 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 an elevational view of a miniature circuit breaker in the adjustment position of the electromagnetic trip device;
- Figure 2 shows a cross-sectional view along the line II-II of figure 1;
- Figure 3 represents the arrangement of the electromagnetic trip device on the first half-shell of the circuit breaker of figure 1, after the second half-shell acting as cover has been removed;

- Figure 4 shows a side view of the second half-shell of the insulating case;
- Figure 5 is an elevational view of the second half-shell;
- Figure 6 is a bottom view of figure 5;
- Figure 7 represents the immobilization principle of the rotary adjustment knob;
- Figure 8 is a detailed view of figure 6 after the two locking pins have been driven in;
- Figure 9 is a detailed enlarged scale view of the electromagnetic trip device of figure 3, the attraction position of the moving core being represented in broken lines.

In the figures, a miniature electrical circuit breaker 10 is housed in a moulded insulating case 12, formed by assembly of two half-shells 11, 13, bounding a front panel 14 through which a handle 16 passes, a rear panel 18 equipped with a clipping base 20 for fitting on a fixing rail, and two large side panels 22, 24.

The circuit breaker 10 comprises a pair of connection terminals 26, 28 (figure 3) and a separable contact device (not represented), the movable contact of which is actuated by an operating mechanism of the type described in French Patents FR-A-8,708,037 and FR-A-2,605,454.

The mechanism is operated manually by the handle 16 and automatically by a magnetothermal trip device having a bimetal strip (not represented) and an electromagnetic trip device 30 (figures 3 and 9) sensitive respectively to overload and short-circuit currents.

The electromagnetic trip device 30 is formed by an electromagnet with a plunger core comprising a cylindrical coil 32, mounted coaxially on a tubular insulating sheath 34, inside which a moving core 36 cooperating with a fixed core 38 moves in translation. The moving core 36 is provided with a trip rod 40 passing through an axial bore of the fixed core 38. The end of the rod 40 is shaped as a striker 42 designed to cooperate with the trip lever to bring about release of the latching, and with the contact arm to bring about high-speed movement of the movable contact to the open position in the event of a short-circuit.

The assembly formed by the sheath 34, coil 32 and core 36, 38 is positioned on a U-shaped ferromagnetic yoke 43.

Opposite from the trip rod 40, the moving core 36 comprises an annular notch 44 housing a strand 46 of a return spring 48 (figure 9). When the circuit breaker 10 is in operation, the coil 32 has flowing through it continuously the nominal current flowing between the two terminals 26, 28. The opposing force of the return spring 48 outweighs the electromagnetic attraction force exerted in the air-gap 50 separating the two cores 36, 38. The moving core 36 is urged into engagement against a stop 52 of the half-shell 11, and the striker 42 remains inactive in this separated position of the core 36.

In the event of a short-circuit, the excitation current of the coil 32 increases, and causes the moving core 36 to be attracted against the fixed core 38 as soon as the magnetic tripping threshold is exceeded. The striker 42 is propelled at high speed to the right in the attracted position of the moving core 36, to bring about tripping of the mechanism (see broken line in figure 9).

The magnetic tripping threshold of the electromagnetic trip

device 30 depends on the prestressing of the return spring 48 which determines the return force opposing the magnetic attraction force of the moving core 36. The return spring is formed by a torsion spring wound on a positioning spindle 54 securedly united to the first half-shell 11. Opposite from the strand 46 maintaining the moving core 36 against the stop 52, the spring 48 is equipped with an operating lug 56 inserted in a drive notch arranged in a rotary adjustment knob 58.

The adjustment knob 58 is mounted on the spindle 54, and comprises an actuating head 60 of circular shape, which fits like a plug into a conjugate orifice 62 opening onto the side panel 24 of the second half-shell 13. The circumference of the adjustment plug or knob 58 is equipped with serrations 64 designed to cooperate with two locking pins 66, 68, in such a way as to achieve locking of the adjustment knob 58 in rotation after the tension of the return spring 48 has been adjusted. The actuating head 60 is provided with a blind hole 67 of polygonal or cruciform cross-section (figure 7).

The adjustment knob 58 is achieved by moulding a very hard plastic material, whereas the insulating case 12 is moulded with a more flexible plastic material. To give an example, the material of the adjustment knob 58 is a polyarylamide with a glass fibre based charge. The material of the case 12 is a polyamide with the addition of a mineral charge.

The two locking pins 66, 68 are cast directly with the half-shell 13 (see figures 4 to 6) of the case 12. The two pins 66, 68 protrude out extending perpendicularly to the panel 24, and remain attached to the half-shell 13 by breakable zones 70 (figures 2 and 6).

A knocking action on the pins 66, 68 causes breaking of the breakable zones 70, followed by penetration of the pins 66, 68

into the case 12, in the direction of penetration indicated by the arrows F1 (figure 7). This results in immobilization of the adjustment knob 58 in rotation, due to the catching effect of the locking pins 66, 68 made of flexible material with the serrations 64 of the knob 58 made of hard material. The precision of penetration of the locking pins 66, 68 results from the presence of guide grooves 72, 74 (figure 6) in the half-shell 13.

In the locked state of the adjustment knob 58, the two locking pins 66, 68 are appreciably centred on the spindle 54, with a predetermined angular offset, notably comprised between 90 and 180 degrees. Penetration of the two pins 66, 68 generates a resulting radial force F2 (figure 8), which urges the knob 58 against a bearing surface 78 of a fixed boss 76 belonging to the half-shell 13.

The adjustment mode of the electromagnetic trip device 30 is performed as follows :

After the component parts of the circuit breaker 10 have been assembled on the half-shell 11, the return spring 48 of the trip device 30 is wound onto the spindle 54 with the strand 46 inserted in the notch 44 of the moving core 36. The adjustment knob 58 is then fitted on the spindle 54 above the spring 48, followed by coupling with the operating lug 56. The other half-shell 13 acting as cover is adjoined to the half-shell 11, and rivets 80, two of which are represented in figure 1, achieve final assembly of the circuit breaker 10.

At the end of the assembly operation, the actuating head 60 of the adjustment knob 58 is engaged in the circular orifice 62 of the half-shell 13. The strand 46 urges the moving core 36 in engagement against the stop 52, and the adjustment knob 58 is in an initial position corresponding to a minimum value of the

magnetic tripping threshold. Adjustment of said threshold to a preset value is achieved by clockwise rotation of the head 60 of the knob 58 (see arrow F3, figure 9) to a required setting position. During this first adjustment phase, the air-gap 50 between the two cores 36, 38 remains invariable, only the tension of the torsion spring 48 is modified.

Immobilisation of the knob 58 in its setting position is then performed during a second phase by driving in the two locking pins 66, 68 bringing about incrustation of the serrations 64 in the vertical faces of the pins 66, 68. The setting and locking operation of the adjustment knob 58 is carried out in the factory, and lends itself well to automation. The device for adjustment of the knob 58 is tamperproof after the two pins 66, 68 have been driven in.

The components of the electromagnetic trip device 30 are standard for a range of circuit breakers having different tripping curves. The magnetic tripping threshold merely has to be set at the end of assembly due to a predetermined calibration of the return spring 48.

According to an alternative embodiment, a different number of locking pins 66, 68 can be used to lock the adjustment knob 58 in rotation. These pins can be arranged on a distinct part fitted automatically by the machine at the end of the adjustment operation of the knob 58.

Incrustation of the serrations in the locking pins 66, 68 enables an accurate continuous adjustment of the adjustment knob 58, regardless of its immobilization position.

The tamperproof adjustment device according to the invention can also be used for adjustment of bimetal strips and in other electrical apparatuses with moulded insulating cases, notably

relays or contactors equipped with rotary adjusting selectors or selector switches.

CLAIMS

1. A setting device to adjust a value of a characteristic for operation and/or tripping of an electrical apparatus with a moulded insulating case (12), comprising a rotary adjustment knob (58) having a cylindrical lateral surface, and a locking means designed to immobilize the knob (58) in rotation after said value has been set, characterized in that the locking means comprise a first mechanical locking pin (66) arranged to be driven in along the lateral surface of the knob (58) regardless of its angular adjustment position, the knob (58) and locking pin (66) being made from materials of different hardnesses enabling an incrustation effect during the drive-in phase, to make the setting device tamperproof.
2. The setting device according to claim 1, characterized in that the lateral surface of the knob (58) is equipped with serrations (64) extending in the direction of penetration of the locking pin (66).
3. The setting device according to claim 1 or 2, characterized in that the knob (58) has a greater hardness than that of the locking pin (66).
4. The setting device according to claim 1 or 2, characterized in that the knob (58) has a lesser hardness than that of the locking pin (66).
5. The setting device according to one of the claims 1 to 4, characterized in that the locking means comprise a second pin (68) centred on the spindle (54) of the rotary knob (58) with a predetermined angular offset with respect to the first pin (66).
6. The setting device according to claim 5, the case (12) being formed by assembly of a first half-shell (11) and a second half-



shell (13), characterized in that the spindle (54) of the adjustment knob (58) is securedly united to the first half-shell (11), and that the two locking pins (66, 68) are cast with the second half-shell (13) and remain attached to the latter by breakable zones (70).

7. The setting device according to claim 6, characterized in that the two locking pins (66, 68) protrude out with respect to the large side panel (24) of the second half-shell (13), and are angularly staggered around a circular orifice (62), in which the actuating head (60) of the adjustment knob (58) fits when the two half-shells (11, 13) are assembled, the internal wall of the second half-shell (13) comprising facing each breakable zone (70), a groove (72, 74) extending in the direction of the serrations (64), to guide the locking pins (66, 68) in the direction of penetration during the incrustation phase.

8. The setting device according to claim 5, characterized in that the internal wall of the half-shell (13) is provided with a boss (76) having a bearing surface (78) against which the knob (58) is urged when the two locking pins (66, 68) are driven in.

9. The setting device according to one of the claims 1 to 8, characterized in that the adjustment knob (58) serves the purpose of adjusting the prestressing of a return spring (48) associated with a movable armature, notably a core (36) or blade, of an electromagnetic trip device (30) with excitation coil (32).

10. The setting device according to claim 9, characterized in that the return spring (48) is formed by a torsion spring wound onto the positioning spindle (54) of the adjustment knob (58), and having a strand (46) housed in an annular notch (44) to maintain the moving core (36) against a stop (52), when the tripping threshold of the electromagnetic trip device (30) has



not been exceeded, and that the spring (48) comprises an operating lug (56) inserted in a notch of the rotary adjustment knob (58).



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