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VERIFICATION OF TRANSLATION

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hereby declare as follows:

FA(87)

1. I am a translator and am familiar with both the English and German languages.
2. I am the translator of the documents attached hereto and certify that the following is a true translation of European Patent Application No 94105358.9 to the best of my knowledge and belief.

Dated this 12th day of February 1996

Joachim R. Büchner
Signature of Translator

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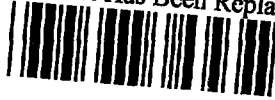


A Wire Retainer for Wiring Layouts in Low-Voltage
Circuits of Electrical Apparatus

The invention relates to a wire retainer for wiring layouts in low-voltage circuits of electrical apparatus, comprising a base provided with fastening means and at least two legs joined with the base, between which legs a continuous channel accommodating the wires is defined, the channel being open on one side over its entire length and forming a wire insertion opening, with spring-elastic wire hold-back means accommodated in the channel being associated with the channel, and with these wires normally situated in a position confining the free passage cross section of the channel and/or of the lateral wire insertion opening.

When low-voltage circuits of electrical apparatus are wired, e.g., in switchboxes, luminaires, etc., but also on circuit boards or switch panels and the like, the electrical wires extending between the various connection points of the circuit elements are either assembled into often prefabricated cable harnesses or are laid out individually. It has been known in practice to fasten cable harnesses to the substrate by means of clips, wire-pack clips, retaining straps, and the like to obtain a mechanically stable structure of the apparatus. Also relatively long wires which are laid out individually require support and retention at intermediate points in order to establish well-defined wire paths and to ensure that there is no undesired mobility of the conductors as this would cause unacceptable conditions during operation of the apparatus. In industry, there exist a large number of dissimilar wire retention means for wires also in the form of round and flat cables which are configured, e.g., as clips or in the form of U-shaped straps between the legs of which the individual conductors are retained. Strips, tabs or lid-like parts are moulded onto the extremities of the legs and, acting as hold-back means for the wires, after insertion of the wires into the channel, are either locked in a special operation or snap on automatically to close the wire-insertion opening to an extent such that the conductors can no longer exit from the channel.

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It is a common feature of these known wire-retaining means that they are configured so that the wires are pressed into the wire-accommodating channel through the insertion opening by a movement perpendicular to their longitudinal direction.

With the growing rationalisation of the manufacture of equipment, there exists the desire to have automated wiring without need for resorting to prefabricated cable trees. For this purpose, one employs a wire-laying tool which, controlled by a program, is moved by a robot along a predetermined placement path between the connection terminals to be interconnected and which, on this occasion, continuously runs the wire paid out from a reel from one point of connection to the next. If the arrangement of the connection points necessitates wires of increased lengths, wire-retainers must be provided at intermediate points of the laying path, as indicated above, and these retaining means are stationary and the wires must be placed into them.

The wire retainers known so far require either that the wire-laying tool perform its own operation of placing the wires into the wire retainers, which usually requires additional placement motions oriented perpendicular to the direction of laying, or the wires, after having been laid out, must be inserted by hand into the wire retaining means the wire hold-back means of which may also have to be closed by hand afterwards.

It is therefore the goal of the invention to create a wire retainer for wiring work in low-voltage circuits of electrical apparatus, which retainer is suitable for fully automated assembly of the wiring, particularly by using a wire-laying tool moved along a predetermined path in such a way that it does not retard the wire-laying process.

In order to solve this problem, the above-specified wire retainer according to the invention is characterised in that the channel is designed so that a tool protruding through the insertion opening and moving in the longitudinal direction of the wire can pass through the channel over its entire length and that the legs delimiting the channel and/or the wire hold-back means are configured so as to yield temporarily in spring-elastic fashion to the tool passing through.

This design of the novel wire retainer achieves that the wire-laying tool can pass through the wire retainer during the laying motion along the

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predetermined placement path in a simple way, and, as a rule, without need for changing its speed. After passage of the wire-laying tool and insertion of the respective wire into the channel during that passage, the temporarily elastically yielding hold-back means return to their original position in which the wire is securely held without need for additional measures, especially manual measures, for this purpose. In addition, if necessary, wires can be inserted manually through the insertion opening and are retained as safely.

In one embodiment, the wire retainer may comprise at least one holding member which at least partially extends beyond the wire-insertion opening and is configured and/or supported in spring-elastically yielding fashion. This hold-back member may be a flexible tongue mounted on the side of the wire-insertion opening, and, in a preferred embodiment, the arrangement is such that one such flexible tongue is provided on either side of the channel. The extremities of the two tongues may either terminate in closely spaced relationship or overlap each other. Particularly simple conditions result if each of the tongues is configured as an upright thin platelet which by the passing tool can be pushed aside like a swing door or bent and which returns to its initial operational state under the influence of its intrinsic elasticity.

In order to ensure orderly distribution of the retained wires, the channel can have at least one pocket-like widened portion the inner width of which is smaller than, or equal to, the outer diameter of the wires. The wires are clamped into this pocket-like widened portion; they are situated in a row in side-by-side relationship or one on top the other. The wire-laying tool itself can insert the wires from the channel into the pocket-like widened portion, with the wire-laying tool performing a small lateral movement for this purpose.

It is also possible to subdivide the channel in the longitudinal direction by at least one separator member protruding from the bottom so that there is obtained a double channel or a multiple channel in which the various wires and wire groups are retained separate from each other.

The wire retainer is a single-piece member made from an insulating plastic, e.g., polyethylene or polyamide; its shape can be to a large extent



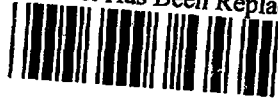
adapted to the respective requirements of the intended use. Thus, the channel can extend through a moulded part which is joined with the base and comprises the legs, with the moulded part having substantially the shape of a plate oriented transversely to the longitudinal direction of the channel.

In other embodiments, the legs delimiting the channel are configured as elongated wall members so that the wires are supported and retained laterally over an extended length.

It also proved to be advantageous to have the wire retaining means comprise spring-elastic clamping means for the wires placed into the channel, with the clamping means adjoining the channel on at least one face. These clamping means have the effect that, when the wire-laying tool enters from the front face, the tool passes first through the clamping means which, immediately after passage of the wire-laying tool, apply themselves automatically and clampingly to the inserted wire and retain the same in its position before the wire-laying tool has run through the channel proper and, hence, releases the wire portion situated in the channel.

In a practical embodiment, the clamping means can comprise at least one spring-elastic clamping clip which extends over the height of the channel and, together with a facing clamping clip or an abutment defines a point of clamping. At this point of clamping, wires which were inserted in succession are retained in precise order and superposed relationship in a row, which implies the advantage that at least over sections close to the wire retainer, there are obtained equally long and equally configured wire placement paths for the individual wires. If the wires were arranged in side-by-side relationship or without order, bending of the common placement path on the horizontal plane would result in different placement paths which would pose difficulties to programming the wire-laying tool or would cause undesirable wire crossover.

In order to enhance the clamping effect, it is convenient to delimit the point of clamping at least on one side by the clamping edge at a clamping clip or at the abutment. Such a clamping clip and/or abutment can have a funnel-like inwards pointing insertion ramp for the tool; this can be obtained in a simpler way if the clamping clip has a substantially part-cylindrical coiled-in wall section arranged at a support arm joined



with the base or with a leg, with which is joined over at least part of its height. In order to increase mobility, the support arm may be separated from the adjacent leg by a slit which extends over at least part of the leg's height.

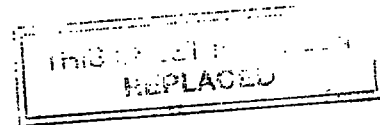
In order to facilitate passage of the wire-laying vehicle, the retaining member, which is arranged on at least one leg, may have on the front face a funnel-like inwards pointing insertion ramp for the tool. Besides that, in order to facilitate the insertion of additional wires by hand, this retaining member, like the aforementioned clamping means, may be configured to have an insertion ramp sloping toward the channel bottom.

The fastening means arranged on the base, e.g., in the form of pins, expanding clips or the like, are conveniently configured so that the wire holder is mounted in non-rotatable fashion and, hence, all the time maintains its alignment required for the passage of the wire-laying tool. Finally, a code, which can be read from the outside and facilitates identification of the respective wire retainer and/or of the individual inserted wires by code recognition means arranged on the wire-laying tool can be provided on the base or on a part joined with the same.

The drawing shows embodiments of the object of the invention. There show:

- Fig. 1, a perspective view of a first embodiment of the wire retainer according to the invention;
- Fig. 2, a plan view of the wire retainer of Fig. 1 to a different scale;
- Fig. 3, a frontal side view, from the left, of the wire retainer of Fig. 2;
- Fig. 4, a side view of the wire retainer of Fig. 2;
- Fig. 5, a side view of the wire retainer of Fig. 4, cut along line V-V of Fig. 2;
- Fig. 6, a perspective view of a second embodiment of a wire retainer according to the invention; and
- Fig. 7, a perspective view of a modified embodiment of the wire retainer of Fig. 6, to a different scale.

The first embodiment of the wire retainer shown in Figures 1 to 5 has a socket composed of two bottom parts 1 each of which bears a moulded-on detent foot 2. The two detent feet 2 facilitate rapid mounting of the wire retainer by press-snap fastening in appropriate bores in the base plate of



the apparatus. At the same time, non-rotatable fixing of the wire retainer is ensured in this way.

The two bottom parts are followed by two facing, spaced legs 3 each of which is moulded onto the full-length strip-like wall portion 4 and, together with the wall portions 4, confines a rectilinear full-length channel 5 to accommodate two wires shown at 6 (Fig. 5). Near the upper edges, onto the two flat legs 3 there are moulded two thin strips 7 which, as shown especially in Fig. 5 (at 80), are inclined inward like a funnel, and define a wire-insertion opening running over the length of the channel 5 on the upper side of the wire retainer. The front faces of the substantially trapezoidal strips 7 (at 70) are inclined inwards like a funnel, whereby an insertion ramp for a wire-laying tool 10, which is shown at 10 and will be described below, is formed.

Following the channel 5, on the two sides of the legs 3 there are provided wire-clamping means, each composed of two part-cylindrical coiled-in clamping clips 11 defining a point of clamping situated symmetrically with respect to the longitudinal plane of symmetry of the channel 5, with the point of clamping extending over the height of the channel. The spacing of the two straight edges 12 is smaller than the diameter of the wires 6 to be inserted so that the same are retained securely in superposed rows between the edges 12 at the respective point of clamping (see Fig. 5).

The two clamping clips 11 are moulded at 14 onto two strip-like support arms 13 which form wall portions of the channel 5 and are moulded to the respective wall portion 4 above the bottom parts 1. In order to increase their hinge-like elastic movability along the fastening strips at 14, they are separated from the support arms 13 by a slit 15 over part of their height, beginning from the bottom parts 1. On the other side, between each of the support arms 13 and the adjacent leg 3, there is provided a separating slit 16 which extends from above to the full-length wall portion 4 and enhances the elastic movability of the legs 3 across the longitudinal central plane of the channel 5.

Finally, at the point of clamping confined by the two vertical edges 12, each pair of clamping clips 11 has insertion ramps 17 which merge downward in funnel-like fashion and facilitate insertion of the wires 6 into



the respective point of clamping and into the channel 5. The edges 12, which delimit the point of clamping, are the vertical corner portions of two brackets 18 moulded onto the respective pair 11 of clips, which are arranged so that together they define an angle 19 or 20 (Fig. 2) of 90° in both sides. The slits 15, 16 extend from below or from above approximately to a common plane 65 which is parallel to the base.

When a wire 6 is laid automatically, its extremity is moved from the left (in Fig. 2) to the front face of the wire retainer by the head of the wire-laying tool 10 moving under program control. The wire-laying head enters into the angle region 20 the confining surfaces of which automatically direct the wire retainer precisely to the wire 6 which is held in the wire-laying head 10. In the course of the advance movement of the wire-laying head 10, the two clips 11 are spread outward in spring-elastic fashion so that, by yielding outwards, they allow the wire-laying head 10 to pass, with the head entering into the angle region 19 directly behind the edges 12 and moving from there into the channel 5 between the support arms 13.

Since the edges 12 extend along the angle line of the two brackets 18, the intrinsic elasticity of the clips 11 automatically returns the same immediately into their initial clamping position (Fig. 2) as soon as the wire-laying head 10 has passed the narrow passage or point of clamping between the edges 12. This achieves that the edges 12 clamp the wire 6 to be laid directly behind the wire-laying head upon passage of the same and retain the wire in friction-locking fashion so that a precisely ordered placement of wires is ensured.

When entering into the channel 5, the wire-laying head 10 impinges on the frontal insertion ramp 70 of the two strips 7; the legs 3 with the strips 7 are pushed aside in elastically yielding fashion and, after passage of the wire-laying head, return into their initial position as per Fig. 2, and this occurs preferably before the wire-laying head 10 enters into the narrow passage or point of clamping between the edges 12 of the second pair of clips 11. Since entry into this narrow passage or point of clamping takes place via the funnel-like tapering angle region 19, the clips of the second pair of clips are likewise spread by yielding sideways in spring-like elastic fashion when the wire-laying head 10 passes. They close automatically behind the wire-laying head, whereby the laid wire 6 is clamped in friction-locking fashion in the precise position also at this extremity of the wire retainer.



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Since the edges 11 on the two front faces of the wire retainer are the edges of brackets 18 enclosing a 90° angle, in the ensuing laying movement of the wire-laying head, the wire can be simply drawn in the axial direction through the wire retainer without that the clips could get caught up in the insulation or could damage the same.

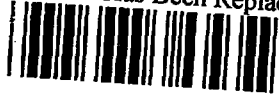
It is ensured by the above-described configuration of the clips 11 and the points of clamping confined between their edges 12 in vertical alignment, that wires 6 which are laid in succession are kept in precise vertical alignment in superposed rows between the edges 12, as shown in Fig. 5. Therefore, all these wires 6 have the same placement path close to the wire retainer; horizontal curves of the wires at a common point of bending can be given the same radius.

For example, when thinner wires are to be laid together with the wires 6 all of which have preferably the same outer diameter, or if it has to be ensured that, for example, in wiring work on a ceiling, the wires 6 in the course of time do not slip out of their clamping holders between the edges 12, the inwardly directed strips 7, which overlay the channel 5, become effective. Their extremities overlay the inner width of the points of clamping between the pairs of edges 12 and in this way ensure form-locking retention of the wires 6 accommodated in the channel 5. Since the strips 7 are bent inwards in hook-like fashion (see Fig. 5), even wire portions, which for some reason were not fixed between the pairs of edges 12 at the points of clamping, are securely held. This is shown in Fig. 5 by two wires 60 which illustrate how the wires can get hooked under the strips 7. The inclination of the strips 7 and the insertion ramps 17 facilitate also vertical insertion of the wires from above.

Figures 6 and 7 show two other embodiments of novel wire retainers which are also distinguished by the fact that they are suitable and designated for automated wire laying by means of the wire-laying head 10 and that they have a channel designed to accommodate wires and configured to be run through over its entire length by the wire-laying head, with the channel-delimiting wire hold-back means being configured to yield to the passing wire-laying tool or wire-laying head in spring-elastic fashion and with the wire-laying tool protruding from above into the channel through the insertion opening.

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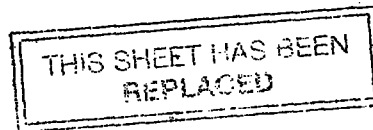
The embodiment of Fig. 6 includes a plate-shaped base 21 onto which two locking feet 22 are moulded in axially recessed fashion within U-shaped convex arches 23. The base 21 is integral with a substantially rectangular plate-shaped moulded member 24 through which a channel 25 of approximately trapezoidal cross section for accommodating wires runs. The two sides of the channel 25 are confined by plate portions forming two legs 26 on the ends of which two flexible retaining members in the form of two spring-elastic thin tongues 27, 28 are moulded on both sides of the channel 25. The tongues 27, 28 are thinner than the moulded member 24; therefore, they can be considered thin platelets which are moulded in upright position at their respective roots 27a and 28a, respectively, on the moulded member 24. The two tongues 27, 28 extend beyond the inner diameter of the channel 25 and overlap each other at 29. Since each of them is over its length accessible at 31, 32 via a slit in the moulded member 24, they can yield in spring-elastic fashion sideways like swing doors before the passing wire-laying head 10 and, after its passage, return into the initial position illustrated in Fig. 6, whereby the wire laid down in channel 25 is securely enclosed and retained and the insertion opening on top is closed.

Under the two tongues 27, 28 on both sides of the channel 25 there extend two horizontal, pocket-like recesses 34 configured as slits with parallel sides and a width slightly smaller than the diameter of the wire to be laid.

The various wires 6 are pushed by a slight lateral movement of the wire-laying head 10 into the respective slit at 34 as illustrated in Fig. 6 for one wire 6. This pushing-in is facilitated by the trapezoidal cross section of the channel. The wires 6 are retained in the slits in precise order in side-by-side relationship by friction locking. In principle, it would also be possible to provide corresponding pocket-like recesses in the bottom region of the channel 25 to facilitate vertical arrangement of the wires 6 in a row.

Finally, the embodiment according to Fig. 7 is substantially identical with that of Fig. 6. Identical parts are therefore denoted by the same reference numbers and are not described once more.

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In contrast with the embodiment of Fig. 6, here the channel (25) is subdivided in the longitudinal direction into two adjacent partial channels 25a, 25b by means of a pin-like separator member 35 extending upright from the base 21 in order to separate the bundles of inserted wires. The two tongues 270, 280 have the same form. They have the form of two rectangular, elongated, thin strips the front faces of which are close above the separator member 35 at 290 and, hence, together with the separator member, ensure form-locking closure of the two channels 25a, b.

Both tongues 270, 280 once more yield sideways in the form of swing doors in spring-elastic fashion when a wire-laying head 10 runs through the respective channel 25a or b and inserts into the same a wire 6 which is then inserted by a slight lateral movement via the inclined channel wall into the neighbouring horizontal pocket-like recess 34 to be retained therein in friction-locking fashion.

All the wire retainers, of which various embodiments are shown, are produced as a single piece from a synthetic material, e.g., polyethylene or polyamide. Only examples of their fastening means are shown; they may have some other design. As a rule, it must be ensured that non-rotatable fastening of the respective wire holder on its support exists so that the wire-laying tool can find the entry to the channel 5 or 25.

The tongues 27, 28 or 270, 280 of the embodiment of Figures 6 and 7 may be rod-shaped, and it is also conceivable to arrange a plurality of plate-shaped moulded members 24 in spaced relationship upright on a common base.

The wire-laying tool can pass from both sides through the embodiment according to Figures 1 to 5 as well as through the embodiment of Figures 6 or 7 of the novel wire retainer. The hold-back means for the wires laid down in channel 5 or 25 and 25 a,b, respectively, are either form-locking, like the strips 7 (Fig. 1) or the tongues 27, 28 and 270, 280, respectively (Figures 6, 7), or they may be friction-locking like the terminal points between the edges 12 of the elastic clips 11 (Figure 2) or the points of clamping between the walls confining the pocket-like recesses 34 of Figures 6, 7. Since all the pocket-like recesses are upwardly limited by finger-like extensions 36 moulded only onto one end of the associated leg 26, these

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finger-like extensions 36 can be configured to yield in spring-elastic fashion upwards and/or sidewise when the lines are inserted. In the embodiment of Figure 6, they protrude into the channel 25 so that, if necessary, they can be elastically pushed aside by the passing wire-laying tool.

Finally, in the embodiment according to Figures 1 to 5, the channel 5 can be subdivided into at least two parallel subchannels like in Figure 7 by at least one upright separator member in the form of a partition wall.

In order to identify the wire retainers and/or the wires retained in them, the base 1 or 21 and/or a component joined with the same can be provided with a code 40 which can be read by a sensor affixed to the wire-laying head 10. Examples are schematically shown in Figures 4, 7.

Spring-elastic clips 11 are provided on each point 2 of locking of the embodiment according to Figures 1 to 5. However, in principle one may contemplate embodiments in which only one such spring-elastic clip 11 and a movable clamping edge 12 are provided, with the clamping edge cooperating with a stationary, rigid countersupport, e.g., in the form of a matching plate-like extension of the facing support arm 13. Also this countersupport can have at least one clamping edge 12.

Appropriate locking means, of the type of the spring clips 11, may be moulded onto the plate-shaped moulded member 24 of the embodiments of Figures 6, 7.

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Claims

1. A wire retainer for wiring layouts in low-voltage circuits of electrical apparatus, comprising a base provided with fastening means and at least two legs joined with the base, between which legs a full-length channel accommodating the wires is defined, the channel being open on one side over its entire length and forming a wire insertion opening, with spring-elastic wire hold-back means accommodated in the channel being associated with the same, and with these wires normally situated in a position confining the free passage cross section of the channel and/or of the lateral wire insertion opening, characterised in that the channel (5, 25) is designed so that a tool (10) protruding through the insertion opening and moving in the longitudinal direction of the wire can pass through the channel over its entire length and that the legs (3; 26) delimiting the channel and/or the wire hold-back means (7, 11; 27, 28; 270, 280) are configured so as to yield temporarily in spring-elastic fashion to the passing tool.
2. The wire retainer according to Claim 1, characterised in that it comprises at least one holding member (7; 27, 28; 270, 280) which at least partially extends beyond the wire-insertion opening and is configured and/or supported to yield in spring-elastic fashion.
3. The wire retainer according to Claim 2, characterised in that the retaining member has a flexible tongue or strip (27, 28; 7) mounted on the side of the wire-insertion opening.
4. The wire retainer according to Claim 2, characterised in that one flexible tongue or strip (27, 28; 7) is arranged on each side of the channel (5, 25).
5. The wire retainer according to Claim 4, characterised in that the two tongues (27, 28) are configured so that their extremities overlap.

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6. The wire retainer according to Claim 4 or 5, characterised in that each of the tongues (27, 28; 270, 280) is configured as a thin, small upright platelet.

7. The wire retainer according to any one of the preceding claims, characterised in that the channel (25) has at least one pocket-like recess (34) the inside diameter of which is less than, or equal to, the outside diameter of the wire.

8. The wire retainer according to any one of the preceding claims, characterised in that the channel (25) is subdivided in the longitudinal direction by at least one separator member (35) protruding upright from the bottom.

9. The wire retainer according to any one of the preceding claims, characterised in that the channel (25) extends through a moulded part (24) which is joined with the base (21), contains the legs (26), and has substantially the shape of a plate extending perpendicular to the longitudinal direction of the channel.

10. The wire retainer according to any one of the preceding claims, characterised in that it has spring-elastic clamping means (11) adjoining the channel (5) on at least one front face for wires (6) inserted into the channel.

11. The wire retainer according to Claim 10, characterised in that the clamping means comprise at least one spring-elastic clamping clip (11) which extends over the height of the channel (5) and, together with an oppositely disposed clamping clip (11) or an abutment, delimits a point of clamping.

12. The wire retainer according to Claim 11, characterised in that the point of clamping is delimited at least on one side by a clamping edge (12) on a clamping clip (11) or the abutment.

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13. The wire retainer according to Claim 11 or 12, characterised in that a clamping clip (11) and/or the abutment has a funnel-shaped inwards pointing insertion ramp (20) for the wire-laying tool (10).
14. The wire retainer according to any one of the Claims 11 to 13, characterised in that the clamping clip (11) comprises a substantially part-cylindrical coiled wall section.
15. The wire retainer according to Claim 14, characterised in that the part-cylindrical coiled wall section is situated on a support arm (13) joined with the base (1) or with a leg (3) with which it is joined over at least part of its height.
16. The wire retainer according to Claim 15, characterised in that the support arm (13) is separated from the adjacent leg (3) by a slit (16) which extends over at least part of the leg's (3) height.
17. The wire retainer according to any one of the Claims 2 to 16, characterised in that the retaining member (7) provided on at least one leg (3) has on its front face a funnel-shaped, inwards pointing insertion ramp (70) for the wire-laying tool.
18. The wire retainer according to any one of the Claims 2 to 17, characterised in that the retaining member (7) which is arranged on at least one of the legs (3) and/or, optionally, the clamping means (11) are provided with an insertion ramp (8; 17) inclined toward the channel bottom, for the wires.
19. The wire retainer according to any one of the preceding claims, characterised in that the base (1) has an aperture communicating with the channel (5) (Figure 2).

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20. The wire retainer according to any one of the preceding claims, characterised in that the fastening means (2) arranged on the base (1, 21) are designed to be nonrotatable.

21. The wire retainer according to any one of the preceding claims, characterised in that a code (40) which can be read from the outside is arranged on the base (1, 21) or some part joined with the same.

22. The wire retainer according to any one of the preceding claims, characterised in that it is made as a single piece from a synthetic material.

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