

**Cage terminal****FIELD OF THE INVENTION**

The present invention refers to the field of electrical connection technology; it relates to a cage terminal as  
5 claimed in the preamble of claim 1.

**BACKGROUND TO THE INVENTION**

A very wide variety of embodiments of connection  
10 terminals for electrical installations are known from the prior art. A significant distinguishing criterion is the manner in which a cable or a conductor is fixed in such connection terminals, specifically by means of a spring or a screw. The present case is concerned with  
15 a connection terminal in which a screw connection and a cage terminal interact.

DE 693 020 103 discloses a connection terminal in which a closed cage, which is composed of a metal conductor  
20 material, has an approximately rectangular frame with a base, two lateral crosspieces and an upper face, with the upper face being in the form of a screw nut which is provided with a threaded hole. The base of the cage serves as a first clamping area. A contact clip with a  
25 second clamping area is inserted into the cage in such a way that one or more electrical conductors can be clamped between the first and the second clamping areas.

30 FR 253 55 34 likewise discloses a connection terminal with a closed cage comprising a base, two lateral crosspieces and an upper face with a threaded hole for a screw. This connection terminal provides the option of fixing a cable between two clamping areas in the  
35 interior of the cage or of connecting a busbar between the screw and a third clamping area which is situated on the outer face of the cage.

The connection terminal known from EP 336 251 exhibits a terminal frame with an outer clamping area and a box frame with an inner clamping area, it being possible to fix a conductor between said terminal frame and box frame. The terminal frame and the box frame are interleaved one in the other in such a way that the two frames are also connected to one another when the conductor is screwed. The box frame is substantially surrounded by the terminal frame and is in the form of a closed cage with a base, two lateral crosspieces and an upper face. In this case too, the upper face has a threaded hole for receiving a screw. In this case, the base is bent; its inner face serves as the abovementioned inner clamping area.

EP 59 939 discloses a cage terminal having a U-profile-shaped cage which comprises a first and a second limb and a crosspiece which connects said two limbs at one end, with said limbs each having a limb window, these limb windows being aligned with one another. A nut, which is mounted by way of projections which are arranged on it such that it is guided into the limb windows, is inserted between the limbs. A screw which engages in said nut is supported by way of its screw head on a pressure plate which covers the two limbs of the open cage. The inner face of the U-profile-shaped cage serves as a clamping area for inserted conductors.

All the connection terminals presented above share the common feature that they have a plurality of individual parts and/or inherently closed cages, as a result of which the production of such connection terminals is accordingly complex. Furthermore, the cables which are fixed with said connection terminals have a comparatively large contact area with respect to the clamping area of the connection terminal compared to the conductor cross section, as a result of which, with a prespecified torque as the tightening torque of the

screw, a maximum contact pressure which corresponds to said torque is produced at the clamping area of the connection terminal. This contact pressure on the clamping area of the connection terminals may not be entirely sufficient to prevent such connections coming loose, without being screwed on, under particular, external influences - for example rotation of the connection conductor. The present invention presents a remedy to these disadvantages.

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#### DESCRIPTION OF THE INVENTION

The object of the invention is therefore to provide a connection terminal in the form of a cage terminal which avoids the disadvantages of known connection terminals and is distinguished, in particular, by simplified design, simple assembly, a low number of parts and a secure connection.

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The object is achieved by all the features of claim 1.

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It is essential to the invention that a cage terminal has a U-profile-shaped cage which comprises a first and a second limb and a crosspiece which connects said two limbs at one end, with said limbs each having a limb window, these limb windows being aligned with one another, and the crosspiece having a threaded hole for receiving a screw, as a result of which at least one conductor, which is inserted through the two limb windows, can be securely clamped; in comparison to the abovementioned prior art, the clamping area or clamping areas between the cage terminal and the conductor or conductors is/are significantly smaller.

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A preferred refinement of the cage terminal according to the invention is distinguished in that the crosspiece which connects the two limbs is bent. Such a bent geometry of the crosspiece is particularly dimensionally stable and flexurally rigid when the terminal is screwed.

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According to an advantageous refinement of the invention, at least one of the limb windows has a substantially rectangular limb window frame structure, with a first, short frame segment being situated on that side which faces the crosspiece, and a second, short frame segment being arranged on a side which faces a limb end, and these two short frame segments being connected by means of two long frame segments; the two long frame segments are arranged substantially at a right angle to the first, short frame segment in the direction of the crosspiece and are beveled in the direction of the second, short frame segment; advantageously, the long frame segments are beveled with axial symmetry with respect to the screw in the direction of the second, short frame segment.

The bevel of the two long frame segments should run at least at an angle of  $15^\circ$ , and at most at an angle of  $60^\circ$ , in the direction of the second, short frame segment, specifically in an extension of the respective long frame segment as viewed from an imaginary line to the respective limb end; the angle is particularly advantageously  $30^\circ$ .

A further advantageous refinement of the invention makes provision for the material thickness of the U-profile-shaped cage to be less than the distance between the two limbs. In this case, the bearing of a conductor on the clamping area or areas of the cage is influenced by the edge effect of the limbs, in particular in relation to the second, short frame segment, this making the conductor particularly resistant to rotation in relation to the cage terminal in the screwed state.

The cage terminal according to the invention is primarily distinguished in that cables with a cable

cross section of between 2 and 50 square millimeters can be securely screwed with said cage terminal in the form of a standard terminal with a predefined, fixed standard size, without the terminal size as such having to be subjected to a change in geometry.

According to another refinement of the invention, a conductor, which is inserted into the two limb windows, is a cable and, furthermore, a busbar is arranged between said cable and the screw end, said busbar forming an electrical connection with the cable when the cage terminal is screwed.

According to a further refinement of the invention, the first, short frame segment has first recesses for improved distribution of force; against the same background, the cage can have second recesses to the side of the crosspiece, and/or the long frame segments have third recesses which facilitate insertion of the conductor.

#### **BRIEF DESCRIPTION OF THE FIGURES**

The invention will be explained in greater detail below using exemplary embodiments in conjunction with the drawing, in which

- fig. 1 shows a perspective illustration of a cage terminal according to the invention with a screw;
- fig. 2 shows a side view of the cage terminal with a U-profile;
- fig. 3 shows a perspective illustration of the cage terminal with a cable inserted (with twisted individual wires) and a busbar;

fig. 4 shows a further side view of the cage terminal with a plan view of a limb window with a screwed cable and a screwed busbar;

5 fig. 5 shows a perspective illustration of an embodiment of the cage terminal according to the invention with recesses for improved distribution of force and with further recesses for simplified insertion of cables  
10 with large cross sections, and

fig. 6 shows a side view of the cage terminal according to fig. 5 with a plan view of a limb window with a screwed cable and a  
15 screwed busbar.

#### **DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS**

Fig. 1 shows a perspective view of the cage terminal 10 according to the invention with a screw 27 and a cage  
20 23. The cage 23 is of U-profile-shaped design and comprises two limbs 11a, b which are connected at one end by means of a crosspiece 12. The crosspiece 12 has a threaded hole 26 for the screw 27 and is of bent design, this constituting a particularly dimensionally  
25 stable structure for tightening the screw 27.

The two limbs 11a, b are each provided with a limb window 13a, b, these limb windows being arranged aligned with one another. Said limb windows 13a, b are  
30 bounded by a substantially rectangular limb window frame 15 which comprises the following frame segments: a first, short frame segment 16 is arranged in the direction of the crosspiece 12; a second, short frame segment 17 is located opposite said first, short frame  
35 segment - at a respective free limb end 18; the two short frame segments 16, 17 are connected to one another by two long frame segments 19a, b. Said long

frame segments 19a, b each have a bevel 33 in the direction of the limb end 18.

As will be discussed below using further figures, the inner faces of the limb window frames 15 exhibit clamping areas 25 and edges 28 which essentially firmly hold electrical conductors (not shown here) which are inserted through the limb windows 13a, b.

Fig. 2 shows a side view of the cage terminal 10, the U-profile-shaped cage 23 with its bent crosspiece 12 and the limbs 11a, b being clearly illustrated in said side view. Said view likewise shows the screw end 24 of the screw 27. It should be noted that the material thickness 21 of the cage 23 is less than the distance 22 between the adjacent limbs 11a, b. This dimensional ratio between the material thickness 21 and the distance between the limbs 11a, b is important for reliable functioning of the cage terminal 10 according to the invention.

The perspective illustration in fig. 3 shows two electrical conductors 14a, b which are inserted into the limb windows 13a, b, specifically a cable 14a and a busbar 14b which is arranged between said cable 14a and the screw end (24, see fig. 2, not visible here). Similarly clear is the effect of the second, short frame segment 17 in conjunction with the bevels 33, the edge 28 of said bevels allowing a clamping action which is significantly improved in relation to the disclosed prior art in the screwed state of the cage terminal.

A further side view of the cage terminal in fig. 4 shows the conductors 14a, b which are fixed to one another by the screw end 24 of the screw 27, with the cable 14a being inserted into the tub-like structure which is formed from the second, short frame segment 17 and the adjoining bevels 33 of the long frame segments

19a, b. The bevels 33 form an angle  $\alpha$  with a line 29, with said line 29 representing an imaginary extension of the long frame segments 19a, b in the direction of the respectively free limb ends 18 and the bevels 33 additionally being arranged on both long frame segments 19a, b with axial symmetry with respect to an axis 20 of symmetry of the screw 27. This angle  $\alpha$  should be between  $15^\circ$  and  $60^\circ$ ; particularly good - that is reliable - properties of the screw connection are given by the cage terminal according to the invention when the angle  $\alpha$  is  $30^\circ$ .

Figs 5 and 6 shows variants of the cage terminal 10 described above in conjunction with figs 1 to 4. In this case, the cage 23 has function-optimizing recesses 30, 31 and 32.

The recesses 30 and 31 are arranged in the crosspiece 12 and have the effect of improved distribution of force - not illustrated here - within the cage 23 when the screw 27 is tightened; specifically, semicircular recesses 30 are provided at the two corners between the first, short frame segment 16 and the adjoining long frame segments 19a, b for this purpose. The two free edges of the crosspiece 12 are provided with recesses 31 with the same effect.

Further recesses 32 are provided on the inner faces of the long frame segments 19a, b; said recesses simplify insertion of cables 14a with large cross sections into the limb windows 13a, b by providing a corresponding geometric widening of the limb window frame width.

The overall result of the invention is a connection terminal which is of simple design and is easy to assemble and manages with a small number of individual parts and allows particularly secure screwing.

## List of reference symbols

|          |                                                    |
|----------|----------------------------------------------------|
| 10       | Cage terminal with a screw                         |
| 11a, b   | Limb                                               |
| 12       | Crosspiece                                         |
| 13a, b   | Limb window                                        |
| 14a      | Conductor, cable                                   |
| 14b      | Conductor, busbar                                  |
| 15       | Limb window frame                                  |
| 16       | First, short frame segment close to the crosspiece |
| 17       | Second, short frame segment close to the limb end  |
| 18       | Limb end, free                                     |
| 19a, b   | Long frame segment                                 |
| 20       | Axis of symmetry of the screw                      |
| 21       | Material thickness of the U-profile                |
| 22       | Distance between adjacent limbs 11a, b             |
| 23       | Cage                                               |
| 24       | Screw end                                          |
| 25       | Clamping face                                      |
| 26       | Threaded hole                                      |
| 27       | Screw                                              |
| 28       | Edge                                               |
| 29       | Line                                               |
| 30       | Recesses in 16                                     |
| 30       | First recesses in 16 (first, short frame segment)  |
| 31       | Second recesses in 12 (crosspiece)                 |
| 32       | Third recesses in 19a, b (long frame segment)      |
| $\alpha$ | Angle of the bevel                                 |

**PATENT CLAIMS**

1. A cage terminal having a U-profile-shaped cage (23) which comprises a first and a second limb (11a, b) and a crosspiece (12) which connects said two limbs (11a, b) at one end, with said limbs (11a, b) each having a limb window (13a, b), these limb windows being aligned with one another, characterized in that the crosspiece (12) has a threaded hole (26) for receiving a screw (27), as a result of which at least one conductor (14a, b), which is inserted through the two limb windows (13a, b), can be securely clamped.

2. The cage terminal as claimed in claim 1, characterized in that the crosspiece (12) which connects the two limbs (11a, b) is bent.

3. The cage terminal as claimed in either of claims 1 and 2, characterized in that at least one of the limb windows (13a, b) has a substantially rectangular limb window frame (15), with a first, short frame segment (16) being situated on that side which faces the crosspiece (12), and a second, short frame segment (17) being arranged on a side which faces a limb end (18), and these two short frame segments (16, 17) being connected by means of two long frame segments (19a, b), and in that the two long frame segments (19a, b) are arranged substantially at a right angle to the first, short frame segment (16) in the direction of the crosspiece (12), and the two long frame segments (19a, b) have a bevel (33) in the direction of the second, short frame segment (17).

4. The cage terminal as claimed in claim 3, characterized in that the long frame segments (19a, b) are beveled with axial symmetry with respect to the screw (27) in the direction of the second, short frame segment (17).

5. The cage terminal as claimed in either of claims 3 and 4, characterized in that the two long frame segments (19a, b) are beveled at least at an angle ( $\alpha$ ) of 15°, and at most at an angle ( $\alpha$ ) of 60°, in the direction of the second, short frame segment (17), specifically in an extension of the respective long frame segment (19a, b) as viewed between the respective bevel (33) with respect to an imaginary line (29) to the respective limb end (18).

6. The cage terminal as claimed in claim 5, characterized in that the angle ( $\alpha$ ) is 30°.

7. The cage terminal as claimed in one of the preceding claims, characterized in that the material thickness (21) of the U-profile-shaped cage (23) is less than the distance (22) between the two limbs (11a, b).

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8. The cage terminal as claimed in one of the preceding claims, characterized in that a conductor (14a, 14b) which is inserted into the two limb windows (13a, b), is a cable (14a), and a busbar (14b) is arranged between said cable (14a) and the screw end (24), said busbar forming an electrical connection with the cable (14a) when the cage terminal is screwed.

9. The cage terminal as claimed in claim 8, characterized in that the cable (14a) forms a secure connection with the edges (28) of the limb windows (13a, b) in the screwed state of the cage terminal.

10. The cage terminal as claimed in one of claims 3 to 9, characterized in that the first, short frame segment (16) has first recesses (30) for improved distribution of force, and/or the cage (23) has, on the sides of the crosspiece (12), second recesses (31) for improved

distribution of force, and/or in that the long frame segments (19a, b) have third recesses (32) which facilitate insertion of the conductor (14a, b).