

Description

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Expansion Anchor

The invention relates to an expansible fixing plug having the features of the preamble of claim 1.

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Fixing plugs, especially made of plastic material, for expansion using a screw or a nail are known. Patent specification DE 32 08 347 C1 discloses an expansible fixing plug having a Christmas-tree profile formed by axially successive truncated cones; adjacent to the larger-diameter end of the latter are short cylindrical portions, after which the fixing plug narrows by means of an annular step to the smaller-diameter end of the next truncated cone. In a side view, the known expansible fixing plug has a sawtooth profile, the teeth of which are comparable to backwards-facing barbs, that is to say they are oriented opposite to the pull-out direction of the expansible fixing plug.

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The problem of the invention is to propose an expansible fixing plug having greater anchoring strength in soft building materials, for example in aerated concrete.

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In accordance with the invention the problem is solved by the features of claim 1. The expansible fixing plug according to the invention, having the features of claim 1, has holding surfaces which are oppositely oriented to the sawtooth profile of the known expansible fixing plug, that is to say the holding surfaces of the expansible fixing plug extend in the outwards direction from the rear to the front. The "rear" is that end of the expansible fixing plug which is accessible when the expansible fixing plug has been placed in an anchoring substrate and through which it is possible to introduce an expander rod, for example a nail or a screw, into the expansible fixing plug. The front end is located in a hole in an anchoring substrate towards the front in the direction of introduction of the expansible fixing plug. "In the outwards direction" means a radial direction of the expansible fixing plug. In the circumferential direction of the expansible fixing plug, the holding surfaces extend over a circumferential portion of greater or lesser magnitude; they are preferably interrupted at one or more circumferential locations in

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order to allow the expansible fixing plug to be expanded more readily. The holding surfaces can be flat in the circumferential direction; they are preferably curved in the circumferential direction. In the longitudinal direction of the fixing plug, the holding surfaces can be straight, convex or concave. A number of holding surfaces are preferably arranged one after another in the longitudinal direction of the fixing plug. In the longitudinal profile of the expansible fixing plug the holding surfaces constitute a substantial portion in an expansion region, preferably more than half and especially more than 70 % of the length. It has been found that reversing the profile contour increases the anchoring strength of the expansible fixing plug in, for example, aerated concrete.

The increase in anchoring strength is presumed to be due to the fact that, when a force is applied to the expansible fixing plug in the pull-out direction, the holding surfaces act in comparable manner to wedges, that is to say they apply an outwardly directed compression force to the wall of a hole in which the fixing plug has been expanded and anchored. This application of pressure increases the strength of the aerated concrete and counteracts breaking of the walls of pores in the aerated concrete, as a result of which the hold of the expansible fixing plug is increased.

The holding surfaces of the expansible fixing plug according to the invention especially extend at an acute angle to the longitudinal direction of the fixing plug, which is less than 45 degrees, especially less than 30 degrees. In the event of a force on the expansible fixing plug in the pull-out direction, this brings about a large force in the outwards direction at the holding surfaces compared to a force in the longitudinal direction of the fixing plug and/or parallel to the holding surfaces. When a force is applied to the expansible fixing plug in the pull-out direction, the holding surfaces, as a result of the acute angle, exert a high compressive force on the surrounding wall which counteracts breaking-off in, for example, aerated concrete.

In an embodiment of the invention, holding surfaces further forward on the expansible fixing plug in the longitudinal direction of the fixing plug are longer and/or at a smaller angle to the longitudinal direction of the fixing plug, and/or holding surfaces further to the rear on the expansible fixing plug in the longitudinal direction of the fixing plug are shorter and/or at a greater, but still acute, angle to the longitudinal direction of the fixing plug. These embodiments of the invention have been found to be advantageous for high anchoring strength of the expansible fixing plug in, for example, aerated concrete.

Presumably the front holding surfaces, which are longer and/or which extend at a more

acute angle to the longitudinal direction of the fixing plug, make a greater contribution to the anchoring strength of the expansible fixing plug than the rear holding surfaces, which are shorter and/or which extend at a shorter angle to the longitudinal direction of the fixing plug. The front holding surfaces are located at a greater depth in a hole in the anchoring substrate, where the risk of material of the anchoring substrate breaking off at a wall of the hole in the pull-out direction of the expansible fixing plug is already reduced as a result of the rear holding surfaces.

In a preferred embodiment of the invention, those front ends of the holding surfaces terminate at the same cylindrical envelope surface; that is to say, they all extend equally far in the radially outwards direction. As a result it is ensured that all the holding surfaces are in contact with the wall of a cylindrical hole.

In an embodiment of the invention, rear holding surfaces extend further inwards at their rear ends than do front holding surfaces; that is to say, at the rear ends of rear holding surfaces the expansible fixing plug becomes narrower than at the rear ends of front holding surfaces. This embodiment too has been found to be advantageous for high anchoring strength of the expansible fixing plug in aerated concrete.

The invention is explained hereinbelow in greater detail with reference to an exemplary embodiment shown in the drawing. The single Figure shows an expansible fixing plug according to the invention in an oblique side view from the front.

The expansible fixing plug 1 according to the invention shown in the drawing is, for example, made of plastic material by injection-moulding. It is sleeve-shaped and has, in a rear region, a tubular hollow shank 2 which is closed in the circumferential direction and which terminates in a hollow conical flange 3 at a rear end of the expansible fixing plug 1. To the front in the direction of introduction there is an expansion region 4 adjacent to the hollow shank 2, the "direction of introduction" E being that direction in which the expansible fixing plug 1 is introduced into a drilled hole in the prescribed manner. Along the expansion region 4 there extend two limbs 5 in a longitudinal direction of the fixing plug parallel to the direction of introduction E up to a front end of the expansible fixing plug 1 where, just as at the rear of the expansion region 4 at the transition to the hollow shank 2, they are integrally connected to one another. The

limbs 5 are arranged opposite one another on a circumference of the expansible fixing plug 1.

Expansion elements 6 project from longitudinal sides of the limbs 5 in opposite circumferential directions of the expansible fixing plug 1. The expansion elements 6 in each case project alternately from one and then the other limb 5, so that they extend in between one other in a manner similar to a gear arrangement or the teeth of a zip fastener, albeit spaced apart from one another. The expansion elements 6 are hook-shaped; they project at an angle towards the rear from the limbs 5 and, after a bend in a mid-plane of the expansible fixing plug 1 between the limbs 5, they point at an angle towards the front. Alternatively, the expansion elements 6 can also, vice-versa, project from the limbs 5 at an angle towards the front and, after the bend, point at an angle towards the rear (not shown). The expansion elements 6 are not in contact with one another but rather, as said, there are spaces between them when the expansible fixing plug 1 is in the non-deformed state. As a result of their hook shape, the expansion elements 6 which extend in between each other extend behind one another and connect the limbs 5 to one another by means of an interlocking connection with play which results from the spaces between the expansion elements 6.

In the event of flexion, torsion or movement of the limbs 5 apart from one another, the holding elements 6 move relative to one another and come to abut one another and/or extend behind one another in an interlocking connection, when the spacings between them have been reduced to zero. The holding elements 6 then transfer forces between the limbs 5 and provide resistance to further movement of the limbs 5 relative to one another. The expansible fixing plug 1 is made more rigid as a result; its flexural strength and torsional strength and security against buckling-out of the limbs 5 are increased.

On their outsides, the limbs 5 have holding surfaces 7 which slope at an acute angle to the longitudinal direction of the fixing plug; they extend on a slope in an outwards direction from the rear to the front, that is to say the rear ends of the holding surfaces 7 are further to the inside of the expansible fixing plug 1 than the front ends. "Rear" means that end of the expansible fixing plug 1 which is to the rear in the direction of introduction E, which end has the hollow-conical flange 3 and has an opening for introduction of an expander rod (not shown). The front end of the expansible fixing plug 1 is to the front in the direction of introduction E, and so to the left in the drawing. In

the example of an embodiment, the holding surfaces 7 have the shape of portions of truncated cones, which in the circumferential direction extend over slightly less than a quarter of the circumference. Neither the shape nor the extension distance in the circumferential direction is mandatory for the invention. From the rear to the front, the holding surfaces 7 become longer and the angles at which the holding surfaces 7 extend relative to the longitudinal direction of the fixing plug become less from the rear to the front. The front ends of all the holding surfaces 7 terminate on the same diameter; the rear ends of the holding surfaces 7 terminate on a diameter which becomes increasingly larger from the rear to the front in the longitudinal direction of the fixing plug but which is always smaller than the diameter at the front ends of the holding surfaces 7. As a result, the expansible fixing plug 7 is, at the rear ends of the holding surfaces 7, narrower at rear holding surfaces 7 than at front holding surfaces 7. The holding surfaces 7 occupy about 75 per cent of the length of a longitudinal profile in the expansion region 4. In the circumferential direction each one extends over about 90 degrees.

For the purpose of expansion, an expander rod (not shown), for example an expander screw, is screwed into the expansible fixing plug 1 through the open rear end of the expansible fixing plug 1 in the hollow conical flange 3 and through the hollow shank 2 into the expansion region 4 as far as the front end. The expander rod can come out of the front end of the fixing plug 1. The expander rod pushes the holding elements 6 and the limbs 5 apart in an outwards direction, that is to say it expands the expansible fixing plug 1 in the expansion region 4. As a result it can be anchored in a hole in an anchoring substrate (not shown). In a soft building material, for example aerated concrete, the holding surfaces 7 act like wedging elements: when the expansible fixing plug 1 is subjected to a force in the direction of pulling out from the hole in which it is anchored, the holding surfaces 7, because of their orientation on a slant at an acute angle to the longitudinal direction of the fixing plug, subject the wall of a hole to a high, outwards directed compression force and, in a comparison thereto, a small force in the pull-out direction. At the hole wall the anchoring substrate is, as a result, subjected substantially to compression and only to a slight extent to shear, as a result of which the risk of the anchoring substrate breaking off at the hole wall in a soft or porous building material such as, for example, aerated concrete is greatly diminished. In such an anchoring substrate, the anchoring force of the expansible fixing plug 1 is substantially increased as a result.

When an expander screw (not shown) is being screwed in, the expansible fixing plug 1 has two longitudinal ribs 8 to prevent it from turning too, which longitudinal ribs 8 extend along the middle of the limbs 5 in an axial plane of the expansible fixing plug 1 over approximately the middle third of the length of the expansible fixing plug 1.

List of reference numerals and letters

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Expansible fixing plug

	1	expansible fixing plug
	2	hollow shank
10	3	flange
	4	expansion region
	5	limb
	6	expansion element
	7	holding surface
15	8	longitudinal rib
	E	direction of introduction

Claims

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1. Expandable fixing plug for expansion using a screw or nail, **characterised by** holding surfaces (7) on the outside of the expandable fixing plug (1) which extend in the outwards direction from the rear to the front.

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2. Expandable fixing plug according to claim 1, **characterised in that** the holding surfaces (7) extend at an acute angle to the longitudinal direction of the fixing plug, which angle is less than 45 degrees, especially less than 30 degrees.

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3. Expandable fixing plug according to claim 1 or 2, **characterised in that** front holding surfaces (7) in the longitudinal direction of the fixing plug are longer and/or rear holding surfaces (7) in the longitudinal direction of the fixing plug are shorter.

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4. Expandable fixing plug according to one of claims 1 - 3, **characterised in that** front holding surfaces (7) extend at a more acute angle to the longitudinal direction of the fixing plug and/or rear holding surfaces (7) extend at a more obtuse angle to the longitudinal direction of the fixing plug.

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5. Expandable fixing plug according to one of claims 1 - 4, **characterised in that** the front ends of the holding surfaces (7) end on the same cylindrical envelope surface, seen in a radial direction relative to the expandable fixing plug (1).

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6. Expandable fixing plug according to one of claims 1 - 5, **characterised in that** rear ends of rear holding surfaces (7) are radially further in on the expandable fixing plug (1) and/or rear ends of front holding surfaces (7) are radially further out on the expandable fixing plug (1).