

Description**Anchor sleeve**

The invention relates to an anchor sleeve for fixing an anchor rod with a curable composition in a hole in an anchoring substrate, having the features of the preamble of claim 1. In addition, the invention relates to a fixing arrangement having the anchor sleeve, having the features of the preamble of claim 13 and to a method of fixing an anchor rod with the anchor sleeve, having the features of the preamble of claim 15. The anchoring substrate is, for example, a brick or concrete wall, ceiling, beam, joist or the like of a building. The hole can, for example, have been drilled, that is to say can be a drilled hole, or it can have been made by a suitable core or the like during the casting of concrete. The curable composition can be an adhesive, a resin or a mortar; in the case of mortar, in addition to cement mortar, synthetic resin mortars especially come into consideration. The curable composition can have one or more components. The list is not exhaustive. After curing, the curable composition is also referred to as the cured composition. The anchor rod can be, for example, a threaded rod or a DYWIDAG bar. This list is likewise not exhaustive. A special anchor rod having, as expansion body, a number of cones which are integral with one another and are arranged one after the other axially is not provided *per se*, but is also not excluded. Strictly speaking, the cones are truncated cones. The fixing of an anchor rod with a curable composition in a hole in an anchoring substrate is also referred to as chemical anchoring.

German Offenlegungsschrift DE 38 31 683 A1 discloses an anchor rod having, as expansion body, a number of cones arranged one after the other axially, the last of which cones is adjoined by a smooth-walled shank and then by a threaded portion. On the anchor rod there is arranged an expansion sleeve from which the threaded portion projects. In the region of the cones, the expansion sleeve has complementary hollow cones, so that, in the event of axial displacement of the anchor rod in the expansion sleeve, the anchor rod expands the expansion sleeve. The expansibility of the expansion sleeve is provided by longitudinal slots. If the hole in which the expansion sleeve is anchored becomes wider, for example as a result of cracks being formed in the anchoring substrate, the anchor rod, when subjected to tensile stress, is displaced

in the anchor sleeve and expands the sleeve further. The further expansion of an anchor sleeve in the event of a hole's becoming wider is also referred to as "follow-up expansion". In the case of a friable anchoring substrate, the Offenlegungsschrift suggests a hole of relatively large diameter in which the expansion sleeve is fixed
5 using a composite composition or an adhesive mortar.

International patent application WO 2005/124163 A1 discloses, as anchor rod, a threaded rod which is arranged in an anchor sleeve. The anchor sleeve is perforated, the holes forming openings allowing passage of a mortar. The anchor sleeve has the
10 purpose of holding the mortar in cavities in the anchoring substrate in the region of the anchor rod and of counteracting loss of mortar into the cavities, so that sufficient mortar remains for fixing the anchor rod in the anchoring substrate outside the cavities. Anchoring substrates having cavities are, for example, perforated bricks and hollow blocks.

15 The problem of the invention is to propose an economical anchor sleeve for fixing an anchor rod with a curable composition in a hole in an anchoring substrate, which anchor sleeve exhibits follow-up expansion behaviour.

20 That problem is solved according to the invention by the features of claims 1, 13 and 15. The anchor sleeve according to the invention has on its outer side at least one expansion surface which – seen in a longitudinal direction of the anchor sleeve – runs from inside to outside. In other words, the spacing of the expansion surface from a longitudinal centre axis of the anchor sleeve increases in the longitudinal direction of
25 the anchor sleeve. For fixing, the anchor rod is arranged in the anchor sleeve and the anchor sleeve is arranged in the hole in the anchoring substrate, it also being possible for the anchor sleeve to be arranged in the hole in the anchoring substrate first and for the anchor rod then to be arranged in the anchor sleeve. The anchor sleeve is fixed in the anchoring substrate with the curable composition and the anchor rod is fixed in the
30 anchor sleeve, which can be carried out using the same curable composition or using a different curable composition or in some other way, for example by screwing the anchor rod into the anchor sleeve. The curable composition can be introduced into the anchor sleeve and/or into the hole in the anchoring substrate, the order in which the anchor rod is introduced into the anchor sleeve, the anchor sleeve introduced into the
35 hole and the curable composition introduced into the anchor sleeve and/or into the

hole not being fixed but being adaptable to the circumstances. If the anchor rod is subjected to axial load, the load is transmitted to the anchor sleeve, the at least one expansion surface of which exerts an expansion pressure on the curable composition, which has cured in the meantime and fixes the anchor sleeve in the hole. The expansion pressure is an outwardly directed force exerted on the cured composition by the at least one expansion surface of the anchor sleeve in the event of axial stress. The cured composition is the curable composition after curing. In the event of a hole's becoming wider, the expansion pressure expands the cured composition, so that the anchor rod remains fixed, that is to say anchored, in the anchoring substrate. The anchor sleeve effects follow-up expansion, so that if the hole becomes wider the anchor rod remains fixed in the hole.

The anchor sleeve can be, but need not be, expansible. It is possible for the anchor rod to expand the anchor sleeve in the event of axial stress, that is to say to bring about follow-up expansion behaviour. It is, however, provided *per se* that in the event of axial stress the anchor rod does not move in the anchor sleeve but, *via* the anchor sleeve, exerts an expansion pressure on, and thus further expands, the surrounding cured composition. As a result of the anchor sleeve, an anchor rod, for example a threaded rod not having follow-up expansion behaviour *per se*, is as it were provided with follow-up expansion behaviour in co-operation with the anchor sleeve and the surrounding cured composition.

The anchor sleeve is preferably elongate, that is to say its length corresponds to at least twice, especially at least three times, its largest external diameter, its cross-section not necessarily being circular. If the cross-section is not circular, any reference to the diameter is to be understood as meaning the diameter of a circle circumscribing the cross-section. In particular, the length of the anchor sleeve corresponds to from 4 to 20 times the smallest internal diameter.

An advantage of the invention is that it is economical to manufacture, because the anchor sleeve needs to be provided with an expansion surface not on the inner side but on the outer side. A special anchor rod, for example having expansion cones arranged one after the other axially, is unnecessary.

Each outwardly extending expansion surface defines a smallest external diameter d and a largest external diameter D , which circumscribes the expansion surface at the respective end. Preferably, the ratio D/d is between 1.1 and 2.5. In order to be able to effect the stablest possible fixing of an anchor rod with as small as possible a hole diameter, the ratio is preferably from 1.2 to 1.4.

Preferably, the anchor sleeve has one or more circumferential expansion surfaces, the expansion surface also being able to run helically around the circumference.

The anchor sleeve can have, for example, a circumferential saw-tooth profile, that is to say, as it were, expansion cones, but triangular profiling with mutually opposing cones is also possible. One construction in accordance with the invention provides circumferential corrugation, the flanks of the corrugation that rise in a longitudinal direction of the anchor sleeve forming the circumferential expansion surfaces. The corrugation can, as already mentioned, also run helically around the circumference. What is important for the invention is that the shaping of the anchor sleeve is such that it has regions that rise in a longitudinal direction, which regions form the expansion surfaces which, in the event of the anchor sleeve's being subjected to axial stress, give rise to the outwardly directed expansion pressure on the cured composition surrounding the anchor sleeve in the hole in the anchoring substrate.

The anchor sleeve preferably has a plurality of expansion surfaces which are arranged one after the other in the longitudinal direction of the anchor sleeve. The expansion surfaces can be distributed uniformly or non-uniformly on the anchor sleeve in the longitudinal direction and optionally also in the circumferential direction. In a preferred construction, the expansion surfaces are distributed over substantially the entire length of the anchor sleeve, so that a first expansion surface is located at one end and/or a last expansion surface is located at the other end of the anchor sleeve. If the expansion surfaces have been formed by profiling of the anchor sleeve, for example the afore-mentioned saw-tooth profile, triangular profile or corrugation, the profiling extends over the entire length of the anchor sleeve from one end to the other.

Preferably, the anchor sleeve is of symmetrical construction insofar as it has expansion surfaces which act in opposite directions. In the event of axial stress in a longitudinal direction of the anchor sleeve, the expansion surfaces that rise in a

longitudinal direction exert an expanding action on the surrounding cured composition; in the event of axial stress in the opposite direction, the other expansion surfaces exert the expanding action. That construction in accordance with the invention has the advantage that the anchor sleeve can be introduced into the hole with its one or other end at the front; the anchor sleeve cannot be introduced into the hole incorrectly. Although symmetry is actually provided, it is not mandatory; the expansion surfaces that rise in one direction need not correspond in terms of shape and size to the expansion surfaces that rise in the other direction. For example, the afore-mentioned triangular profiling or the corrugation of the anchor sleeve creates expansion surfaces that rise in opposite directions.

One construction in accordance with the invention provides at least one opening in the anchor sleeve allowing passage of the curable composition. If the anchor rod is introduced into the anchor sleeve after the curable composition, the anchor rod displaces the curable composition through the openings, with the result that both the intermediate space between the anchor sleeve and the anchor rod and the intermediate space between the anchor sleeve and the wall of the hole are well filled. Conversely it is also possible for the curable composition to enter the anchor sleeve through the openings from the outside. The anchor sleeve can be made, for example, from perforated sheet metal or expanded metal, the holes of which form the openings allowing passage of the curable composition. The anchor sleeve can also be made from sheet metal bent to form the anchor sleeve. The longitudinal slot of the anchor sleeve forms the at least one opening allowing passage of the curable composition. In addition to its function as an opening allowing passage of the curable composition, a longitudinal slot has the advantage that it allows or facilitates radial expansion and contraction of the anchor sleeve. As a result, both expansion of the anchor sleeve when the anchor rod is subjected to axial stress and contraction of the anchor sleeve for its introduction into the hole in the anchoring substrate are facilitated if the anchor sleeve in the non-deformed state has a larger diameter than the hole in order that it can be held clamped in the hole before the introduction or curing of the curable composition. The longitudinal slot is not limited to an anchor sleeve made of sheet metal, but can also be present in an anchor sleeve made of some other material, for example of plastics. The longitudinal slot can be continuous or discontinuous or closed at one or both ends. It is also possible for there to be a plurality of longitudinal slots staggered in the circumferential direction. A longitudinal slot is also to be understood

as being a slot which runs at an angle relative to the longitudinal direction, that is to say, for example, helically or sinuously. The angle of the longitudinal slot relative to the longitudinal direction of the anchor sleeve can change over the length of the slot.

- 5 One construction in accordance with the invention provides an anchor rod which is insertable into the anchor sleeve. Such a construction also includes the converse in that the anchor sleeve can be placed on the anchor rod or generally that the anchor rod is introducible into the anchor sleeve or, conversely, the anchor sleeve is mountable on the anchor rod. In the non-deformed state the anchor sleeve can have a
- 10 smaller or a larger (smallest) internal diameter than the diameter of the anchor rod, so that the anchor rod and the anchor sleeve are held against one another in the longitudinal direction with a preferably limited force or are freely displaceable relative to one another as long as they have not yet been introduced into the drilled hole or the curable composition has not yet been introduced into the anchor sleeve. If the anchor
- 15 sleeve has a smaller internal diameter than the diameter of the anchor rod, the anchor sleeve can be introduced into the hole with the anchor rod inserted and the anchor sleeve centres itself on the anchor rod and, conversely, centres the anchor rod in the anchor sleeve.
- 20 One construction in accordance with the invention provides a cleaning element at the end of the anchor sleeve that is at the front in the direction of introduction of the anchor sleeve into the hole, which cleaning element sweeps along the wall of the hole on introduction of the anchor sleeve into the hole. The cleaning element serves to clean the wall of the hole in order to improve adhesion of the curable composition. The
- 25 cleaning element can be a kind of brush or scraper. For example, it is also possible for the front edge of the anchor sleeve to have outwardly projecting tongues as cleaning element.
- 30 Preferably, the cleaning element is detachable from the front end of the anchor sleeve, the cleaning element being mounted, for example, on the front end of the anchor sleeve. It can be detached from the anchor sleeve as a result of the anchor rod's piercing the anchor sleeve. Preferably, the cleaning element has a blind bore or similar receptacle for the anchor rod, so that by means of the anchor rod the cleaning element can be pushed as far as the base of the hole, or at least further into the hole than the

anchor sleeve is long, in order to clean the wall of the hole. It is unnecessary for the cleaning element to be held securely on the anchor rod.

One construction in accordance with the invention provides that the anchor sleeve has an inward indentation which is in engagement or enters into engagement with the anchor rod when the anchor rod is being inserted or has been inserted into the anchor sleeve. The indentation can be, for example, one or more beads projecting inwards from the anchor sleeve, which beads, similarly to teeth or the like, engage in, for example, a thread of the anchor rod in order to hold the anchor sleeve on the anchor rod in the longitudinal direction and, conversely, to hold the anchor rod in the anchor sleeve. It can be necessary or at least advantageous for the anchor sleeve to be held on the anchor rod in the longitudinal direction in order to be able to introduce the anchor sleeve into the hole with the anchor rod when the anchor sleeve has a larger external diameter than the diameter of the hole and the anchor sleeve is thus clamped in the hole. In the case of overhead mounting, the anchor sleeve holds the anchor rod in the hole when the anchor sleeve is held clamped in the hole and the anchor rod is held in the anchor sleeve. It is also possible for the anchor sleeve in the non-deformed state to taper towards one end, so that at the tapered end it has a smaller (smallest) internal diameter than the anchor rod and is held on the anchor rod in the longitudinal direction.

The fixing arrangement according to the invention having the features of claim 13 has an anchor rod which is arranged in an anchor sleeve of the kind described above. The anchor sleeve is arranged in a hole in the anchoring substrate. The anchor rod is fixed in the anchor sleeve with a cured composition and the anchor sleeve is fixed in the hole in the anchoring substrate preferably with the same cured composition or with some other cured composition, the cured composition being the curable composition after curing. The anchor sleeve has the at least one expansion surface described above which, in the event of the anchor rod's being subjected to axial stress which is transmitted to the anchor sleeve *via* the cured composition, exerts an expansion pressure on the cured composition surrounding the anchor sleeve and thus, if the hole becomes wider, for example as a result of cracks being formed in the anchoring substrate, effects follow-up expansion of the cured composition surrounding the anchor sleeve. As a result, the anchor rod remains fixed in the anchoring substrate

even if the hole becomes wider. The anchor sleeve is constructed in accordance with one or more of the embodiments of the invention described above.

5 The fixing arrangement according to the invention is provided especially also for a cracked anchoring substrate or for fixing the anchor rod in an anchoring substrate where crack formation is possible. In the event of tensile stress being exerted on the anchoring substrate transversely with respect to the hole and transversely with respect to the crack, such a crack, running into the hole, will result in opening of the crack and widening of the hole. By virtue of the follow-up expansion behaviour described, the
10 fixing arrangement according to the invention also has good hold in a hole that is becoming wider. Not only is the fixing arrangement chemically anchored in the hole but also, in the event of the anchor rod's being subjected to axial stress, the cured composition is expanded by the expansion surfaces of the anchor sleeve and thereby pressed outwards against the wall of the hole. The crack running into the hole can
15 pass through the drilled hole; it is also possible for a plurality of cracks to run into the drilled hole.

The method according to the invention having the features of claim 14 has been described above with reference to the anchor sleeve and the fixing arrangement. The
20 anchor rod is introduced into the anchor sleeve and the anchor sleeve is introduced into the hole in the anchoring substrate and the curable composition is introduced into the anchor sleeve and/or into the hole, the order not being specified and can be varied. One form of the method according to the invention provides that the hole is deeper than the anchor sleeve is long, for example the hole is approximately twice as
25 deep as the anchor sleeve is long. The anchor rod is pushed through the anchor sleeve and projects out of the anchor sleeve at the end that is at the front in the direction of introduction of the anchor sleeve into the hole, the amount by which the anchor rod projects from the front end of the anchor sleeve not being greater than the amount by which the drilled hole is deeper than the anchor sleeve is long. On
30 introduction of the anchor rod into the hole, the anchor rod displaces the curable composition previously introduced into the hole in a similar way to a piston so that, in a gap in the hole around the anchor rod, the curable composition flows back towards the mouth of the hole in a direction opposite to the direction of introduction of the anchor rod. If an intermediate space between the anchor sleeve and the anchor rod is not
35 filled with the curable composition, the curable composition also enters the anchor

sleeve and fills the intermediate space between the anchor sleeve and the anchor rod. With this form of the method according to the invention, the gap between the anchor sleeve and the anchor rod and the gap between the hole and the anchor sleeve and the anchor rod are well filled with curable composition. The anchor sleeve can be introduced into the hole and the anchor rod then pushed through, or the anchor rod is pushed through the anchor sleeve and the anchor rod then introduced into the hole with the anchor sleeve. Curable composition can be introduced into the anchor sleeve before the anchor rod is pushed through the anchor sleeve.

The invention is described in greater detail below with reference to exemplary embodiments shown in the drawing, wherein

Figures 1 and 2 are axial sections through two fixing arrangements having anchor sleeves in accordance with the invention; and

Figures 3 to 5 show different constructions at one end of the anchor sleeve in accordance with the invention.

The anchor sleeve 1 according to the invention shown in Figure 1 is made from perforated sheet metal bent to form a sleeve, the anchor sleeve 1. The anchor sleeve 1 has a number of circumferential corrugations 2. Seen in a longitudinal direction of the anchor sleeve 1, the corrugations 2 have rising and falling flanks. At the rising flanks, the distance of the wall of the anchor sleeve 1 from its longitudinal centre axis increases; the rising flanks of the corrugations 2 of the anchor sleeve 1 form circumferential expansion surfaces 3. Holes 4 in the perforated sheet metal from which the anchor sleeve 1 is made form openings 5 allowing passage of a curable composition 10. As a result of the bending of the perforated sheet metal to form the anchor sleeve 1, the anchor sleeve 1 has a continuous longitudinal slot 6 which likewise forms an opening 5 allowing passage of the curable composition 10.

The ratio of the largest external diameter D to the smallest external diameter d in the region of the expansion surfaces 3 is 1.37.

An anchor rod 7 is arranged in the anchor sleeve 1. In the exemplary embodiment, a threaded rod is used as anchor rod 7. The diameter of the anchor rod 7 is smaller than

the smallest internal diameter of the anchor sleeve 1, so that the anchor rod 7 can be inserted into the anchor sleeve 1 or, conversely, the anchor sleeve 1 can be pushed onto the anchor rod 7.

5 The length of the anchor sleeve 1 corresponds to approximately 4.5 times the smallest internal diameter and 3 times the maximum external diameter of the anchor sleeve 1. To fix the anchor rod 7 in a hole 8, for example a drilled hole, in an anchoring substrate 9 made, for example, of concrete, the anchor sleeve 1 is introduced into the hole 8 and the curable composition 10 is introduced into the hole 8. The curable
10 composition 10 can be introduced through the anchor sleeve 1 or can be introduced into the hole 8 before the anchor sleeve 1. The curable composition 10 can be introduced using an injection nozzle (not shown) or a static mixer. The curable composition 10 is preferably introduced beginning at the base of the hole 8. The anchor rod 7 is inserted into the anchor sleeve 1 in the hole 8, the anchor rod 7
15 displacing the curable composition 10 so that the curable composition 10 both passes through the openings 5 in the anchor sleeve 1 and flows, in a direction opposite to the direction of insertion of the anchor rod 7, towards the mouth of the hole 8. The curable composition 10 flows towards the mouth of the hole 8 both inside and outside the anchor sleeve 1, that is to say it flows towards the mouth of the hole 8 both between
20 the anchor sleeve 1 and the anchor rod 7 and between the anchor sleeve 1 and the wall 11 of the hole 8. In addition, the curable composition 10 is also displaced in the direction of the base of the hole 8. Overall there is obtained good and complete filling of the hole 8 surrounding the anchor sleeve 1 and of an intermediate space between the anchor sleeve 1 and the anchor rod 7. The amount of curable composition 10 is
25 such that it fills the hole 8 and the interior of the anchor sleeve 1 surrounding the anchor rod 7 completely from the base to the mouth of the hole 8, with any excess curable composition 10 escaping from the hole 8 and/or from the anchor sleeve 1 at the mouth of the hole 8. Once the composition 10 has cured, the anchor rod 7 is fixed in the hole 8 in the anchoring substrate 9, this also being referred to as anchoring or
30 chemical anchoring of the anchor rod 7 in the anchoring substrate 9.

The curable composition 10 is, for example, a mortar, especially a synthetic resin mortar or a hybrid mortar, that is to say a mixture of a cement mortar and a synthetic resin mortar. The curable composition 10 or the mortar can have one or more

components. After curing, the curable composition 10 can also be referred to as the cured composition 10.

After curing, the curable or cured composition 10 joins the anchor sleeve 1 to the anchor rod 7, an axial force being transferred from the anchor rod 7 to the anchor sleeve 1. Tensile stress exerted on the anchor rod 7 in a direction away from the anchoring substrate 9 is transmitted to the anchor sleeve 1. In the event of such tensile stress, the expansion surfaces 3, by virtue of their rising in the longitudinal direction of the anchor sleeve 1, exert an expansion pressure on the cured composition 10 surrounding the anchor sleeve 1. The expansion pressure is an outwardly directed force exerted on the cured composition 10 surrounding the anchor sleeve 1 by the expansion surfaces 3 of the anchor sleeve 1 in the event of tensile stress. The expansion pressure presses the cured composition 10 outwards against the wall 11 of the hole 8, thus improving the hold of the anchor sleeve 1 and together therewith of the anchor rod 7 in the hole 8 in the anchoring substrate 9. In the event of the hole 8 becoming wider, for example as a consequence of cracks being formed in the anchoring substrate 9, the expansion pressure exerted by the anchor sleeve 1 on the surrounding cured composition 10 in the event of tensile or axial stress expands the cured composition 10, the cured composition 10 surrounding the anchor sleeve 1 being expanded in accordance with the widening of the hole, so that the anchor rod 7 with the anchor sleeve 1 remains anchored in the hole 8 in the anchoring substrate 9. The expansion of the cured composition 10 surrounding the anchor sleeve 1 in the event of the hole 8 becoming wider is also referred to as "follow-up expansion".

In the following description of Figures 2 to 5, elements corresponding to those in Figure 1 have been given the same reference numerals, and reference is additionally made to the descriptions of Figure 1.

In Figure 2, the sheet metal from which the anchor sleeve 1 has been bent has no holes, but only the longitudinal slot 6 as an opening 5 allowing passage of the curable composition 10. As in Figure 1, the anchor sleeve 1 in Figure 2 has corrugation 2 over its entire length, the flanks of which form the expansion surfaces 3. The anchor sleeve 1 is symmetrical; it has, seen in one direction, alternately rising and falling flanks. In the event of the anchor sleeve 1 being subjected to axial stress in one direction, the flanks of the corrugation 2 that rise in one direction form the expansion surfaces 3; in

the event of axial stress in the opposite direction, the flanks of the corrugation 2 that rise in the opposite direction form the expansion surfaces 3. The anchor sleeve 1 can be introduced into the hole 8 with either end at the front. Incorrect introduction of the anchor sleeve 1 into the hole 8 with the wrong end at the front is ruled out.

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The anchor sleeve 1 has its smallest internal diameter in the troughs of the corrugations, that is to say at the locations where the corrugation 2 is directed inwards. The smallest internal diameter of the anchor sleeve 1 is larger than the diameter of the anchor rod 7, so that the anchor rod 7 can easily be pushed into the anchor sleeve 1.

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The smallest internal diameter of the anchor sleeve 1 can also be chosen so that it is in any case smaller than the diameter of the anchor rod 7 when the anchor sleeve 1 has been introduced into the hole 8 and possibly compressed as a result. The anchor rod 7 is thus subjected to a certain clamping action in the anchor sleeve 1. The anchor sleeve 1 has its largest external diameter at the peaks of the corrugations, that is to say at the locations where the corrugation 2 is directed outwards. The largest diameter of the anchor sleeve 1, at least when the anchor sleeve 1 is located on the anchor rod 7, is larger than the diameter of the hole 8 into which the anchor sleeve 1 with the anchor rod 7 has been introduced. As a result, the anchor sleeve 1 is held clamped in the hole 8 in the anchoring substrate 9 and holds the anchor rod 7 clamped therein, so that overhead mounting, that is to say mounting from below in, for example, a ceiling or a beam, is readily possible. The longitudinal slot 6 enables the anchor sleeve 1 to open resiliently to the diameter of the anchor rod 7 and close resiliently to the diameter of the hole 8 in the anchoring substrate 9.

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To fix the anchor rod 7 in the hole 8 in the anchoring substrate 9, the anchor sleeve 1 and the curable composition 10 are introduced into the hole 8 in the anchoring substrate 9, a suitable amount of the curable composition 10 preferably being introduced in the region of the base of the hole. The anchor sleeve 1 or the curable composition 10 can be introduced into the hole 8 first. The anchor rod 7 is introduced into the anchor sleeve 1 and into the hole 8. In Figure 2 the hole 8 is approximately twice as deep as the anchor sleeve 1 is long. The anchor sleeve 1 is arranged close to the mouth 13 of the hole 8. The anchor rod 7, in a similar way to a piston, displaces the curable composition 10, so that the curable composition 10 is both displaced or compacted in the direction of the base 12 of the hole and flows back towards the mouth 13 of the hole 8 between the anchor rod 7 and the wall 11 of the hole, the

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curable composition 10 flowing into the anchor sleeve 1 and around it on the outside, so that an intermediate space between the wall 11 of the hole and the anchor rod 7 and the anchor sleeve 1 and an intermediate space between the anchor sleeve 1 and the anchor rod 7 is filled with the curable composition 10. It is also possible for the anchor rod 7 with the anchor sleeve 1 arranged thereon to be introduced into the hole 8 if the hold of the anchor sleeve 1 on the anchor rod 7 in the longitudinal direction is greater than the hold of the anchor sleeve 1 in the hole 8. In that case too, the anchor rod 7 displaces the curable composition 10 so that it fills the intermediate space between the wall 11 of the hole and the anchor rod 7 and the anchor sleeve 1 and the intermediate space between the anchor sleeve 1 and the anchor rod 7.

Once the composition 10 has cured, which composition can then be referred to as the cured composition 10, the anchor rod 7 is fixed in the anchoring substrate 9. The anchor rod 7 transmits tensile or axial stress to the anchor sleeve 1, the expansion surfaces 3 of which that rise obliquely outwards in a direction opposite to the direction of the stress exert an outwardly directed expansion pressure on the cured composition 10 and press the composition outwards against the wall 11 of the hole. If the hole becomes wider, for example as a consequence of crack formation, the expansion pressure of the expansion surfaces 3 in the event of tensile stress expands the cured composition surrounding the anchor sleeve 1, so that the anchor sleeve 1 and therewith the anchor rod 7 remain fixed in the anchoring substrate 9. The anchoring force with which the anchor rod 7 is held in the anchoring substrate 9 is virtually unchanged up to a crack width of about from 0.3 to 0.5 mm and therefore up to widening of the hole 8 in a transverse direction by the mentioned values.

Figure 3 shows a cleaning element 14 which has been inserted into one end of the anchor sleeve 1. The exemplary example chosen is a brush 15 having a circular-disc-shaped base part 16 which has bristles projecting from one end face and which has on its other face a tubular projection 17 that widens conically on its outer side, so that the brush 15 can be snapped into one end of the anchor sleeve 1. The bristles of the brush 15 project outwards in such a way that on introduction of the anchor sleeve 1 into the hole 8 they sweep along the wall 11 of the hole and brush drill dust and the like from the wall 11 of the hole. The wall 11 of the hole is thus cleaned on introduction of the anchor sleeve 1.

When the anchor rod 7 is pushed through, its front end passes into the tubular projection 17 of the brush 15 forming the cleaning element 14. By means of the anchor rod 7, the brush 15, or the cleaning element 14 generally, can be detached from the end of the anchor sleeve 1 and pushed into the hole 8 as far as its base 12 in order to clean the wall 11 of the hole over the entire depth of the hole 8.

The cleaning element 14 can also be mounted on the end of the anchor sleeve from Figure 1. In that case too, the bristles of the brush 15 must also project outwards to an extent such that, on introduction into the hole 8, they sweep along the wall 11 of the hole and clean the wall 11 of the hole. The diameter of the base part 16 can be selected to be larger, so that it projects outwards beyond the anchor sleeve 1.

A brush 15 is not essential for the cleaning element 14; an abrasive fleece disc would also be possible, for example, or the base part 16 could have a diameter corresponding to the hole 8 and could itself sweep over the wall 11 of the hole. The base part 16 can optionally have slots or teeth around its circumferential edge (not shown).

In Figure 4, the edge at one end of the anchor sleeve 1 is provided with slots, thus forming individual tongues 18 which curve obliquely outwards. The tongues 18 project outwards to an extent such that, on introduction of the anchor sleeve 1 into the hole 8, they sweep along the wall 11 of the hole and brush off any adherent drill dust or the like, that is to say they clean the wall 11 of the hole. The tongues 18 form the cleaning element 14. They define a front end of the anchor sleeve 1 which must be at the front when the anchor sleeve 1 is inserted into the hole 8. In order to prevent the anchor sleeve 1 from being introduced the wrong way round, tongues 18 that project obliquely outwards can also be formed at both ends of the anchor sleeve 1. The tongues 18, in addition to their cleaning effect, also have the effect of holding the anchor sleeve 1 in the hole 8, or improving the hold, before the curable composition 10 has been introduced or cured.

In Figure 5, an edge at one end of the anchor sleeve has an indentation 19 in the form of an inwardly projecting bead 20. It is also possible for a plurality of inwardly projecting beads 20 to be formed at the edge at the end of the anchor sleeve 1. The bead 20 engages the thread of the anchor rod 7 when the anchor rod 7 has been

introduced into the anchor sleeve 1. As a result, good hold is achieved between the anchor sleeve 1 and the anchor rod 7 in the longitudinal direction. It is also possible to provide the bead(s) 20 at both ends of the anchor sleeve 1 or to provide inwardly bent tongues instead of the beads 20 at one or both ends of the anchor sleeve 1, which
5 tongues engage the thread of the anchor rod 7 and hold the anchor rod in the anchor sleeve 1 (not shown).

The anchor sleeve 1 can also taper towards one end, that is to say its diameter can be smaller at one end than at the other end.

List of reference numerals

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Anchor sleeve

	1	anchor sleeve
	2	corrugation
	3	expansion surface
10	4	hole
	5	opening
	6	longitudinal slot
	7	anchor rod
	8	hole
15	9	anchoring substrate
	10	curable composition
	11	wall (of the hole)
	12	base of the hole
	13	mouth
20	14	cleaning element
	15	brush
	16	base part
	17	projection
	18	tongue
25	19	indentation
	20	bead
	d	smallest external diameter in the region of the expansion surface 3
	D	largest external diameter in the region of the expansion surface 3

Patent claims

- 5 1. Anchor sleeve for fixing an anchor rod (7) with a curable composition (10) in a hole (8) in an anchoring substrate (9), **characterised in that** the anchor sleeve (1) has on its outer side at least one expansion surface (3) which runs from inside to outside in a longitudinal direction of the anchor sleeve (1).
- 10 2. Anchor sleeve according to claim 1, **characterised in that** the ratio of the largest external diameter to the smallest external diameter (D, d) of the anchor sleeve (1) in the region of the expansion surface (3) is from 1.1 to 2.5, especially from 1.2 to 1.4.
- 15 3. Anchor sleeve according to claim 1 or 2, **characterised in that** the anchor sleeve (1) has at least one circumferential expansion surface (3).
4. Anchor sleeve according to any one of claims 1 to 3, **characterised in that** the anchor sleeve (1) has a plurality of expansion surfaces (3) arranged one after the other in the longitudinal direction of the anchor sleeve (1), which expansion
20 surfaces are distributed over the entire length of the anchor sleeve (1).
5. Anchor sleeve according to any one of claims 1 to 4, **characterised in that** the anchor sleeve (1) has expansion surfaces (3) rising in opposite directions
25 which are operative when the anchor sleeve (1) is subjected to load in opposite longitudinal directions.
6. Anchor sleeve according to claim 3, **characterised in that** the anchor sleeve (1) has circumferential corrugation (2), the flanks of which that rise in a
30 longitudinal direction form the expansion surfaces (3).
7. Anchor sleeve according to claim 6, **characterised in that** the corrugation (2) extends over the entire length of the anchor sleeve (1).

8. Anchor sleeve according to any one of claims 1 to 7, **characterised in that** the anchor sleeve (1) has at least one opening (4, 6) allowing passage of the curable composition (10).
- 5 9. Anchor sleeve according to claim 8, **characterised in that** the anchor sleeve (1) has a longitudinal slot (6) which forms the opening (5).
10. Anchor sleeve according to any one of claims 1 to 9, **characterised in that** the anchor sleeve (1) has an anchor rod (7) which is insertable into the anchor sleeve (1).
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11. Anchor sleeve according to any one of claims 1 to 10, **characterised in that** the anchor sleeve (1) has a cleaning element (14) at the end that is at the front in the direction of introduction of the anchor sleeve (1) into the hole (8), which cleaning element sweeps along the wall (11) of the hole on introduction of the anchor sleeve (1) into the hole (8).
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12. Anchor sleeve according to claim 11, **characterised in that** the cleaning element (14) is detachable from the front end of the anchor sleeve (1).
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13. Fixing arrangement having an anchor rod (7) on which there is arranged an anchor sleeve (1), the anchor rod (7) with the anchor sleeve (1) arranged thereon being arranged in a hole (8) in an anchoring substrate (9), and the anchor rod (7) being fixed in the anchor sleeve (1) with a curable composition (10) and the anchor sleeve (1) being fixed in the hole (8) in the anchoring substrate (9) with the curable composition (10), **characterised in that** the anchor sleeve (1) has on its outer side at least one expansion surface (3) which runs from inside to outside in a longitudinal direction of the anchor sleeve (1).
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14. Fixing arrangement according to claim 13, **characterised in that** the anchoring substrate (9) has a crack running into the hole (8).
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15. Method of fixing an anchor rod (7) in a hole (8) in an anchoring substrate (9) with the aid of an anchor sleeve (1) and with the aid of a curable composition (10), **characterised in that** the anchor sleeve (1) has on its outer side at least
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one expansion surface (3) which runs from inside to outside in a longitudinal direction of the anchor sleeve (1), the anchor sleeve (1) and the curable composition are introduced into the hole (8), the anchor rod (7) is pushed through the anchor sleeve (1) so that it projects out of the anchor sleeve (1) at the end that is at the front in the direction of introduction of the anchor sleeve (1) into the hole and, on introduction into the hole (8), displaces the curable composition (10), in a direction opposite to the direction of introduction, towards the mouth (13) of the hole (8) through which the anchor sleeve (1) and the anchor rod (7) are introduced into the hole (8).

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