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[54] **EXPANSION ANCHOR FOR USE IN SUPPORT STRUCTURES OF RELATIVELY SOFT MATERIAL**

[76] Inventor: **Artur Fischer**, Altheimer Strasse 219, Tumlingen, Germany

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[52] **U.S. Cl.** **85/76**

[51] **Int. Cl.** **F16b 13/06**

[58] **Field of Search** 85/76, 75, 88, 86, 85/87, 77, 73, 74

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Primary Examiner—Edward C. Allen
Attorney—Michael S. Striker

[57] **ABSTRACT**

An expansion anchor sleeve is composed of two elongated shell sections of U-shaped cross-section whose open sides face one another and are bounded by juxtaposed edge faces. A transverse recess is provided in the front portion of the sleeve tapering towards the rear portion and bounded by sections of the aforementioned edge faces on which an expander member, located in the recess, rides when it is drawn rearwardly by a threaded actuating member.

8 Claims, 4 Drawing Figures

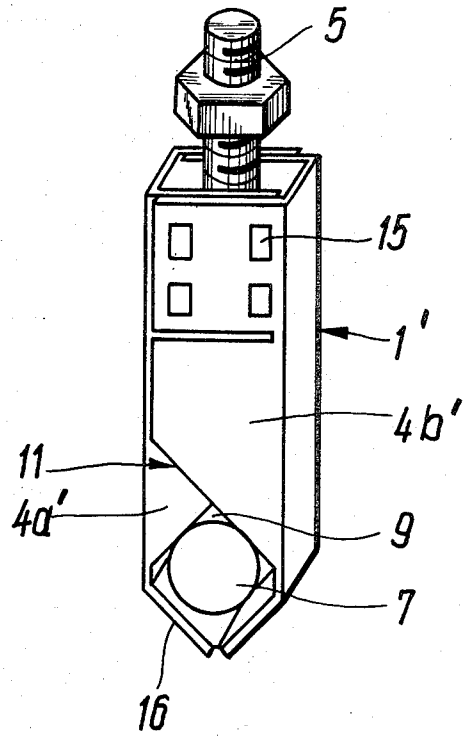


Fig. 1

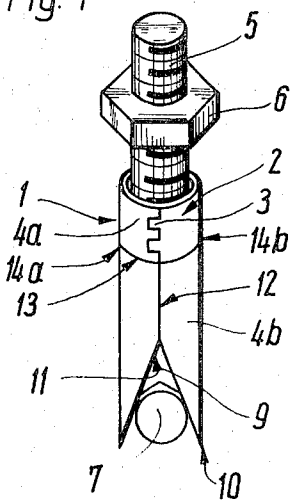


Fig. 2

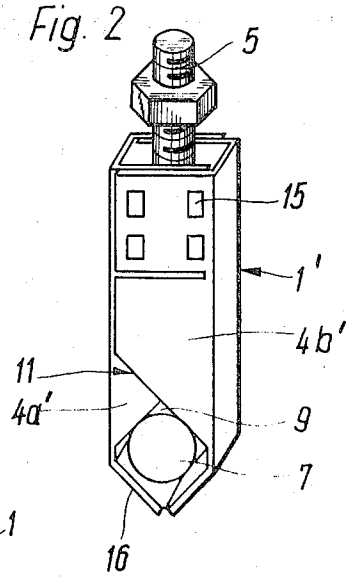


Fig. 4

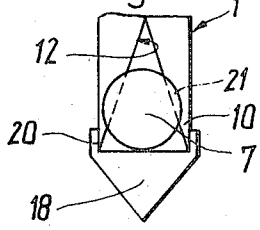
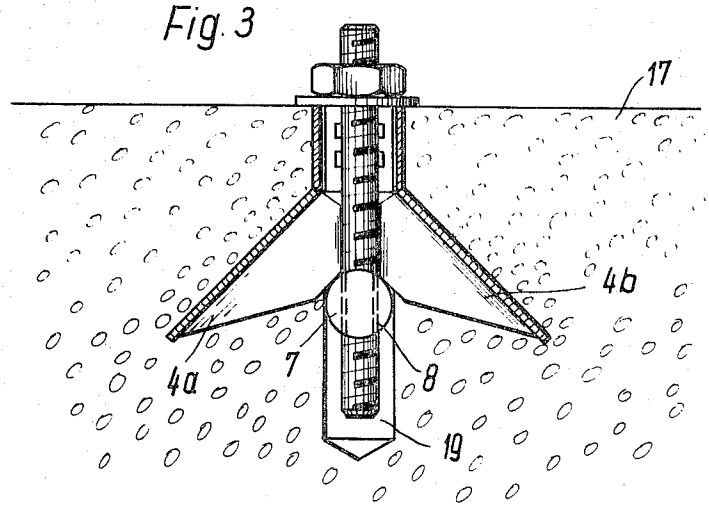


Fig. 3



EXPANSION ANCHOR FOR USE IN SUPPORT STRUCTURES OF RELATIVELY SOFT MATERIAL

BACKGROUND OF THE INVENTION

The present invention relates generally to an expansion anchor, and more particularly to an expansion anchor which is especially intended for use in support structures of relatively soft material, such as porous matter including porous concrete.

Expansion anchors are already well known in a substantial variety of different types. Many of these operate by drawing a usually conical expander member into a slotted expansion anchor sleeve from the leading end towards the trailing end of the same, thereby radially spreading the sleeve into frictional engagement with the wall surrounding a bore in the support structure in which the expansion anchor is to be retained.

This type of expansion anchor is entirely sufficient for affording the necessary frictional retention of the expansion anchor against withdrawing forces from the expansion anchor hole, provided that the expansion anchor is used in a support structure—such as masonry—which is composed of rather hard material. It is possible with this type of expansion anchor to expand the sections into which the expansion anchor sleeve is subdivided by longitudinally slotting it, to an extent which is greater than the outer diameter of the expander member by twice the wall thickness of the sleeve. The situation is different, however, if the material of the support structure in which the expansion anchor is to be retained is relatively soft —for instance porous—and will tend to crumble or collapse when the sleeve is expanded and attempts to contact it under pressure. This means that the material surrounding the expansion anchor hole will crumble and its integrity be destroyed, so that a conventional expansion anchor sleeve of the type mentioned above can be withdrawn without any significant resistance, when it has been "anchored" in an expansion anchor hole provided in a support structure of such relatively soft material.

Of course, the realization that this porblem exists is not new. Attempts have already been made to overcome it, for instance by providing the outer surface of the expansion anchor sleeve with projections or teeth. The purpose is that for the teeth to bite into the surrounding material of the support structure when the sleeve is expanded and to thereby increase the resistance of the sleeve to undesired withdrawal from the expansion anchor hole. Promising as this approach may appear at first sight, it has been found that even the provision of such teeth or projections does not significantly increase the resistance of the sleeve to withdrawal from an expansion anchor hole formed in a support structure of relatively soft material. The reason is that the strength of the bond between the support structure material particles located between the teeth and those located exteriorly of the teeth is not sufficient, so that forces acting upon the expansion anchor sleeve in a sense tending to withdraw it from the expansion anchor hole result in shearing-off of the particles which are located between the teeth from the particles which are located exteriorly of the teeth.

There is, in fact, to my knowledge no expansion anchor in existence in the prior art which satisfactorily meets the aforementioned requirements and overcomes the aforementioned disadvantages.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention to provide such an expansion anchor which meets the aforementioned requirements and overcomes the disadvantages of the prior art.

It is in particular an object of the present invention to provide such an expansion anchor which is especially suitable for use in support structures of relatively soft material, and which when used in conjunction with such support structures will provide an expansion ability substantially greater than what is known from the prior art with a concomitant increase in the resistance of it to undesired withdrawal from the expansion anchor hole.

An additional object of the invention is to provide such an expansion anchor which is simple and relatively inexpensive to construct.

With the above objects in view, and others which will become apparent hereafter, one feature of the invention resides in an expansion anchor for use in support structures of relatively soft material, which anchor comprises, briefly stated, an expansion anchor sleeve having a front portion and a rear portion and including a pair of elongated shell sections of substantially U-shaped cross-section having facing open sides bounded by juxtaposed edge faces. A transverse recess is provided in the front portion of the sleeve, being bounded by sections of the edge faces which converge in direction from a leading end of the front portion towards the rear portion of the sleeve. An expander member is located in this recess extending transverse of the elongation of the sleeve, and threaded means extends from the region of the rear portion towards the leading end and is fast with the expander member. With this expansion anchor according to the present invention, turning of the threaded means in requisite sense will result in displacement of the expander member in direction towards the rear end in sliding engagement with the edge faces, leading to concomitant outward deflection of the shell sections at least in the region of the front portion.

Of course, it will be appreciated that the dimension of the expander member in direction transverse to the longitudinal axis of the expansion anchor sleeve must correspond at least to the outer diameter of the sleeve in the region of the plane of separation of the two shell sections. This is necessary to assure that the expander member will slide on the juxtaposed edge faces of the shell sections when it is withdrawn in a sense tending to expand the sleeve. It has been found particularly advantageous to construct the expander member in cylindrical or substantially cylindrical configuration, in order to thereby reduce the friction between the expander member and the edge faces on which it slides during expansion, whereby the force required for effecting such expansion is held to a minimum. The longitudinal axis of the cylindrically configurated expander member of course extends transversely to the longitudinal axis of the sleeve and the expander member may be of one piece with a threaded actuating screw or bolt by means of which it is drawn towards the rear end of the sleeve or it may be connected with this screw or bolt in suitable manner, for instance via a screw connection. When an expansion anchor sleeve of the novel expansion anchor is expanded in this manner, the shell sections are displaced radially outwardly away from one another, and the minimum radial expansion will be de-

termined by the diameter of the expander member and double the depth of the U-shaped cross-section of the respective shell sections. In actual fact, however, the expansion obtained is significantly greater because the U-shaped cross-sectional configuration of the shell sections makes the latter so rigid that their bending or deflection inwardly towards one another at opposite sides of the expander member (as seen with respect to the longitudinal axis of the sleeve) is practically impossible. The expanding shell sections tend to force the soft and/or porous material of the support structure which surrounds the expansion anchor hole ahead of themselves and to compact it. It will be appreciated that the greater the angle of expansion of the shell sections is, the greater will be the amount of support structure material which is engaged and compacted. The amount of such material is determinative of the resistance which the expansion anchor sleeve can oppose to a force tending to withdraw it from the expansion anchor hole, so that the present expansion anchor is particularly advantageous and highly effective for use in support structures of porous and/or soft material.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view illustrating one embodiment of the novel expansion anchor;

FIG. 2 is a view similar to FIG. 1 but illustrating another embodiment of the expansion anchor;

FIG. 3 is an axial section showing the expansion anchor of FIG. 1 anchored in a support structure; and

FIG. 4 is a fragmentary somewhat diagrammatic detail view of the front end portion of an anchor similar to FIG. 1 but illustrating an additional embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail, and firstly the embodiment illustrated in FIGS. 1 and 3, it will be seen that the novel expansion anchor has an expansion anchor sleeve 1 which is composed of two elongated shell sections 4*a* and 4*b* which are of substantially U-shaped cross-section with their open sides facing one another. The open sides of each shell section are bounded by longitudinally extending edge faces each of which has a section 11 inclined with respect to the longitudinal axis of the sleeve 1, and a section 12 which extends in substantial parallelism with this longitudinal axis.

In the region of the trailing portion of the sleeve, the shell sections 4*a* and 4*b* are connected with one another. Such connection can be effected in various ways, for instance by spot welding, by tongue-and-groove connections, or in other ways, so that the sleeve 1 can be assembled from two identical shell sections which are connected with one another. In the embodiment of FIGS. 1 and 3 the connection is illustrated at 3 and is here in form of interlocking or interengaging notches and projections on the respective shell sections 4*a* and 4*b*, this being a particularly advantageous way of connecting the shell sections with one another. These notches and projections can also be so constructed that they serve as a guide for the threaded means, here illustrated as a screw or bolt 5 which cooperates with a nut 6. Guidance so provided prevents lateral yielding of the screw or bolt 5 during use of the expansion anchor.

In the region of the leading end 10 at the front portion of the sleeve 1, the sections 11 of the edge faces define with one another a recess 9 which converges or tapers in direction towards the trailing end portion or rear end portion 2 of the sleeve, and located in this recess 9 is an expander member 7 which is here of cylindrical configuration and may either be of one piece with the bolt 5 or, as in this embodiment (see FIG. 3), may be made fast therewith by being provided with a threaded bore through which the bolt 5 is passed. The recess 9 extends to the area where the edge face sections 12 extend in parallelism with the longitudinal axis of the sleeve 11 and its configuration not only serves to effect expansion of the shell sections 4*a* and 4*b* in cooperation with the expander member 7, but also to reduce friction during such expansion. The expander member 7, when withdrawn towards the portion 2 by the bolt 5, acts in the same manner as a wedge and forces the shell sections 4*a* and 4*b* apart. Because the expander member 7 is securely guided in the recess 9 by engagement with the sections 11, it is reliably secured against turning movement when the bolt 5 is turned in a sense withdrawing the expander member 7 towards the portion 2 of the sleeve 1.

It is also advantageous, and provided in the embodiment of FIGS. 1 and 3, to form transverse slots 13 which extend inwardly from the sections 12 in the two shank wall portions of the respective shell sections and terminate at or at least in the proximity of the bight wall portion associated with the respective shank wall portions. These slots are located just forwardly of the location 3 where the shell sections 4*a* and 4*b* are connected with one another and their provision forms the sleeve 1 with two strip-shaped wall portions 14*a* and 14*b* which are offset with respect to the plane of separation of the shell sections 4*a* and 4*b* through 90° in each case, and which in effect as pivots about which the shell sections 4*a* and 4*b* can be radially outwardly deflected as shown in FIG. 3, when the expander member 7 is drawn rearwardly in the direction towards the end portion 2. It will be appreciated that the relatively narrow strip-shaped wall portions 14*a* and 14*b* provide very little opposition to the radially outward deflection, thereby reducing the force required for drawing the expander member 7 into the sleeve.

It will be seen in FIG. 3 how the soft and/or porous material of the support structure 17 is compacted by the radially outward deflection of the shell sections 4*a* and 4*b*, after the expansion anchor is inserted into the expansion anchor hole 19 provided for this purpose in the support structure 17.

FIG. 2 illustrates a further embodiment of the invention according to which the shell sections 4*a*′ and 4*b*′ of the sleeves 1′ overlap one another or are partly encapsulated one within the other. In this construction an even more significant expansion of the shell sections is made possible because the expander member 7 slides on the sections 11 which overlap one another as shown in FIG. 2, so that the expander member can expand the shell sections 4*a*′ and 4*b*′ even further than in the embodiment of FIGS. 1 and 3. In FIG. 2 the cross-sectional configuration of the shell sections 4*a*′ and 4*b*′

is again substantially U-shaped, but of angular rather than rounded configuration to make possible a maximum overlapping of the shell sections without any significant reduction of the cross-section of the inner passage defined between them. The sleeve 1' is of course in this case of quadratic or rectangular cross-section, a configuration which affords an additional advantage in that it inherently precludes undesired turning of the sleeve in the expansion anchor hole when the bolt 5 is turned in a sense drawing the expander member 7 deeper into the sleeve.

The shell sections 4*a*' and 4*b*' in this embodiment are connected with one another by several—here four—depressions or kerfs 15 in the overlapping shank walls of the respective shell sections, and the projections resulting at the interior of the respective shell sections from the provision of the depression 15 have a cross-section across the central passage of the sleeve 1' which corresponds to the outer diameter of the bolt 5 to serve as a guide therefor.

In this embodiment the bight walls of the respective shell sections 4*a*' and 4*b*' extend beyond the shank walls and forwardly of the leading end of the sleeve 1', being bent towards one another transversely of the longitudinal axis of the sleeve and across the recess 9 to form a cap 16 which is of one piece with the sleeve.

In the embodiment of FIG. 4, finally, the fragmentarily illustrated sleeve 1 is similar to the sleeve of FIGS. 1 and 3. It is, however, provided with a separate cap 18—by contrast to the integral cap in FIG. 2—which is placed on—for instance pushed on and for instance frictionally retained on—the leading end of the sleeve 1 and which serves to prevent the expander member 7 from being driven inwardly into the sleeve when the expansion anchor is forcibly inserted into an expansion anchor hole; this precludes premature expansion of the shell sections 4*a* and 4*b*. It is particularly advantageous, and frequently even necessary, when the expansion anchor hole which is separately formed and accommodates the anchor, has dimensions which are smaller than the outer dimensions of the sleeve. The cap 18 must of course engage and be supported by the sleeve, and not by the expander member 7 and must be so configurated that it does not interfere with the subsequent radial expansion of the sleeve, for which purpose the portions 20 of the cap are advantageously made so thin that they will break off or at least yield in outward direction in response to even a slight force tending to expand the shell sections 4*a* and 4*b*. It is also advantageous to make the cap 18 pointed in forward direction to facilitate its insertion—together with the remainder of the expansion anchor—into an expansion anchor hole, particularly a tight one.

The cap 18, as well as the integral cap 16 of FIG. 2, also serves to prevent the expander member 7 from falling out of the recess 9 if for any reason the expander member is not connected with the bolt 5 or if for instance the bolt 5 is not connected with the nut 6 in which case the expander member and the bolt could slide out the leading end of the sleeve together.

To prevent the expander member 7 from slipping, especially on the sections 12 when it is drawn into the sleeve in a sense expanding it, it is also advantageous to have it extend slightly outwardly beyond the outer periphery of the sleeve and to form it with slits or recesses 21 in its circumference, as illustrated in broken lines in FIG. 4, in which slits or recesses 21 the sections 11 and, depending upon the extent to which the expander member 7 is drawn into the sleeve, subsequently the sections 12, are partly accommodated so as to guide the expander member 7. This is particularly advantageous when the lateral play of the bolt 5 is large enough so that the expander member 7 could slide off—that is out of engagement with—the sections 11 and/or 12.

It will be appreciated that various modifications will offer themselves readily to those skilled in the art. The configuration of the expander member 7 may be changed, as long as its dimension transversely of the axis of the sleeve fulfills the requirements outlined earlier, and of course also the configuration of the shell sections themselves may be varied.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an expansion anchor, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is set forth in the appended:

1. An expansion anchor for use in support structures of relatively soft material, comprising an expansion anchor sleeve having a front portion and a rear portion and comprising a pair of elongated shell sections of substantially U-shaped cross-section, each having a pair of substantially parallel side walls bounded at one side by edge faces and integrally joined at the other side by a bight wall angularly related to said side walls, the side walls of one of said shell sections overlapping the side walls of the other shell section and the bight walls of said shell sections facing each other to define with said side walls a space of substantially rectangular configuration; a transverse recess in said front portion and bounded by sections of said edge faces which converge from said front portion towards said rear portion, each edge face section extending from the bight wall of one shell section towards the bight wall of the other shell section and having on the overlapping portion of the respective side wall an upper end adjacent said bight wall of the other shell section; an expander member located in said recess and extending transversely to the elongation of said sleeves; and threaded means extending from the region of said rear portion towards said front portion and being fast with said expander member, turning of said threaded means in the requisite sense resulting in displacement of said expander member in direction towards said rear portion in sliding engagement with said edge faces and leading to a concomittant outward deflection of said shell sections at least in the region of said front portion.

2. An expansion anchor for use in support structures of relatively soft material, comprising an expansion anchor sleeve having a front portion and a rear portion and comprising a pair of elongated shell sections of substantially U-shaped cross-section, each having a pair of substantially parallel side walls bounded at one side by edge faces and integrally joined at the other side by a bight wall, the side walls of one of said shell sections overlapping the side walls of the outer shell section and the bight walls of said shell sections facing each other; a transverse recess in said front portion and bounded by sections of said edge faces which converge from said front portion towards said rear portion, each edge face section extending from the bight wall of one shell section towards the bight wall of the other shell section and having an upper end located on the portion of the respective side wall which substantially overlaps the other side wall; an expansion member located in said recess and extending transversely to the elongation of said sleeve; and threaded means extending from the region of said rear portion towards said front portion and being fast with said expander member, turning of said threaded means in requisite sense resulting in displacement of said expander member in direction towards said rear portion in sliding engagement with said edge faces and leading to a concomittant outward deflection of said shell sections at least in the region of said front portion.

3. An expansion anchor as defined in claim 2; and further comprising connecting means connecting said shell sections with one another in the region of said rear portion.

4. An expansion anchor as defined in claim 3, said connecting means comprising interengaging notches and projections provided on the respective shell sections in the region of said rear portion.

5. An expansion anchor as defined in claim 3, and further comprising slots provided in said side walls forwardly of said connecting means and extending at least to the proximity of the respective bight wall.

6. An expansion anchor as defined in claim 2; and further comprising a cap covering and extending forwardly of said front portion.

7. An expansion anchor as defined in claim 6, wherein said cap is of one piece with said sleeve.

8. An expansion anchor as defined in claim 9, and wherein each of said bight walls comprises a wall portion extending forwardly of said side walls and of the leading end of said front portion, said wall portions extending towards one another transversely of a longitudinal axis of said sleeve and across said recess and together constituting said cap.

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