United States Patent [19]

Fischer

[11] **3,733,959**

[45] **May 22, 1973**

[54] EXPANSION ANCHOR

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[22] Filed: **July 30, 1971**

[21] Appl. No.: **167,748**

[30] **Foreign Application Priority Data**

Aug. 8, 1970 Germany.....P 20 39 559.9
Sept. 3, 1970 Germany.....P 20 43 620.8

[52] **U.S. Cl.**.....**85/75,** 85/77
[51] **Int. Cl.**.....**F16b 13/06**
[58] **Field of Search**.....F16b/13/06; 85/75, 85/76, 73, 77, 85, 86, 74, 78

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[57] **ABSTRACT**

An expansion anchor for use in a hole formed in a support of porous material. The anchor has a sleeve provided with two or more slots extending rearwardly from its front end, and an expander member for expanding the sleeve located entirely or in part in the latter and provided with at least two flat substantially triangular wings projecting radially outwardly beyond the circumference of the sleeve by a multiple of the diameter of the latter in combination with twice the wall thickness of the sleeve. Outer edge faces of these wings diverge outwardly from the axis of the sleeve in direction axially away from the trailing end of the sleeve and at an acute angle.

9 Claims, 7 Drawing Figures

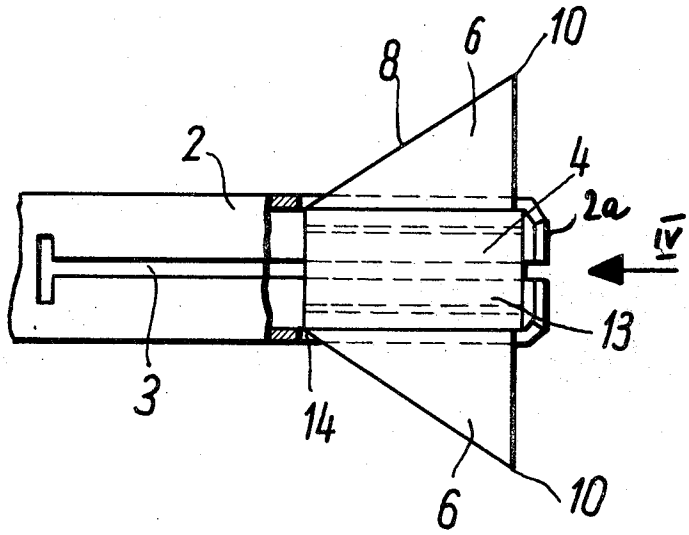

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Fig. 1

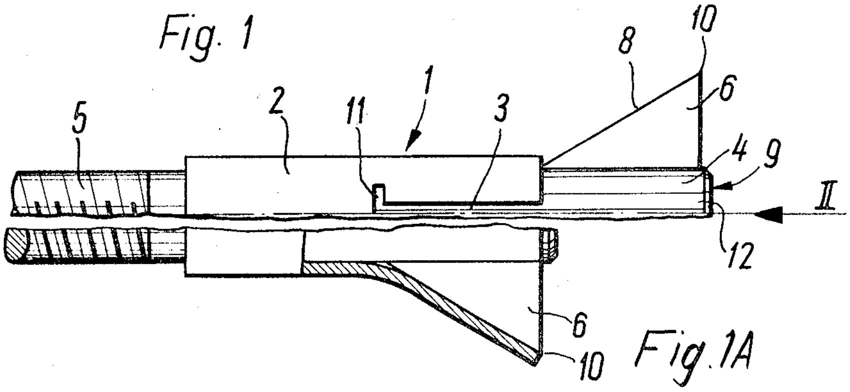

Fig. 1A

Fig. 2

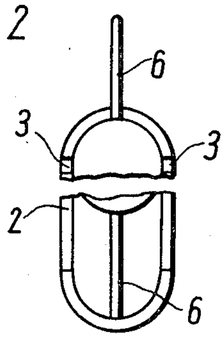

Fig. 2A

Fig. 4

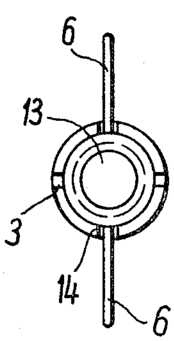

Fig. 3

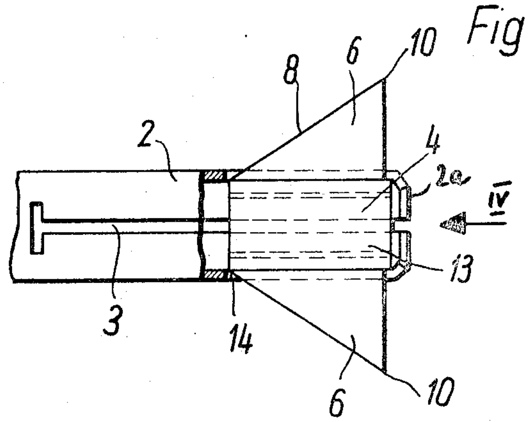

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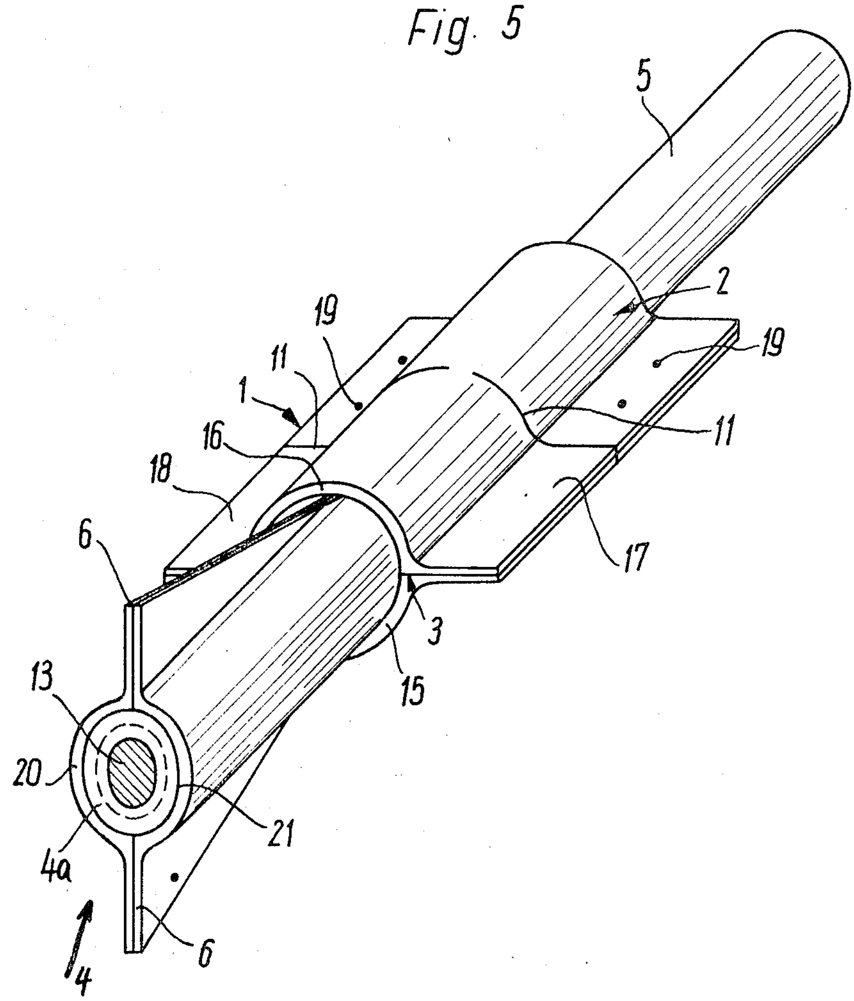
Fig. 5



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EXPANSION ANCHOR

BACKGROUND OF THE INVENTION

The present invention relates generally to an expansion anchor, and more particularly to an expansion anchor for anchoring in a hole formed in a support structure. More particularly still the invention relates to an expansion anchor adapted to be anchored in a hole of a support structure which consists completely or in part of porous material.

Expansion anchors are known in a great variety of different types, and all of them have utility to a greater or lesser extent. All of them, however, also have in common that they either cannot be properly anchored at all —or only with great difficulty —in a support structure of porous material. The reason for this is that when the sleeve of the expansion anchor is spread in radial direction, the manner in which the anchor is to be secured in the hole formed in the support structure, the material of the support structure surrounding the hole becomes destroyed, that is the particulate matter of which the porous material is constituted is broken out of its bonds. As a result the anchor can, even in expanded state, readily be withdrawn together with the separated particulate matter. Attempts to overcome this problem by providing the outer circumference of the expansion anchor sleeve with projections or teeth which are intended to be pressed into the material surrounding the expansion anchor hole, and to therefore facilitate anchoring, have also not provided much of an improvement. The reason for this is that the shanks formed by longitudinally slotting the expansion anchor sleeve from its leading towards its trailing end, and which shanks are spread radially outwardly for anchoring purposes, can be spread only to a diameter which is greater than the outer diameter of the expanding member by double the thickness of the sleeve wall. This means that teeth provided at the outer circumference of the sleeve can be pressed into the material of the support surrounding the anchoring hole only to the same depth, less the wall thickness at the bottom of the teeth—that is where the latter join with the wall of the sleeve—so that the improvement in the anchoring which is obtained in this manner is at most minimal.

Recognizing the existing problems, and the fact that proper anchoring of an expansion anchor in material which is porous in nature can be achieved only when portions of the anchor extend into the material surrounding the expansion anchor hole—and thus behind the material thickness which extends from the particular location to the outer end of the hole—over as large an area as possible and as far inwardly of the outer end of the hole as possible, the prior art has provided an expansion anchor the expander member of which is provided with deflecting surfaces for the shanks of the expansion anchor sleeve. When this expander member is drawn into the sleeve, the shanks are deflected by these deflecting surfaces from their original orientation into a radial orientation forcing them to penetrate into the material of the support and extend into and behind it. However, it has been found that in this construction the shanks must assume a substantially funnel-shaped orientation even before the expansion operation begins, because otherwise they cannot penetrate properly into the material of the support. Unfortunately, this means that the outer diameter of the expanding member must be greater than the outer diameter of the sleeve, with

the result that the hole provided in the support structure must be at least as large in diameter as the expander member. The space between the inner surface of the hole and the outer surface of the smaller-diameter sleeve must therefore be taken up by an appropriate centering element which increases the expense of the expansion anchor and the complexity of its operation. Furthermore, particularly in supports of porous materials the oversized—with respect to the diameter of the expansion anchor sleeve—expansion anchor hole is undesired and disadvantageous.

SUMMARY OF THE INVENTION

It is, accordingly, a general object of the present invention to provide an improved expansion anchor which is not possessed of the disadvantages outlined above with respect to the prior art.

More particularly it is an object of the present invention to provide such an improved expansion anchor especially suitable for use in expansion anchor holes provided in support of porous material.

A concomitant object of the invention is to provide such an expansion anchor which is relatively simple in its construction and inexpensive to produce and sell.

A further object of the invention is to provide such an expansion anchor which provides a much greater resistance to undesired or unintentional withdrawal from the expansion anchor hole than was heretofore possible, at least in support structures of porous material.

In pursuance of the above objects, and of others which will become apparent hereafter, one feature of the invention resides in an expansion anchor adapted to be anchored in a hole of predetermined diameter formed in a support, particularly a support of porous material. The expansion anchor comprises, according to one embodiment of the invention and briefly stated, an elongated expansion anchor sleeve having a front end, a rear end and at least two longitudinal slots extending from the front end towards the rear end longitudinally of the axis of the sleeve. The expansion anchor further comprises an expander member for expanding the sleeve in the region of the slots in response to displacement relative to the sleeve in direction from the front end towards the rear end of the latter. The expander member is elongated and comprises a trailing portion extending outwardly from the rear end, a leading portion in the region of the front end, and at least two flat wings projecting from the leading portion radially outwardly beyond the circumference of the sleeve in planes other than the general planes of the slots. The wings have outer edge faces which diverge outwardly of the axis and in direction axially away from the rear end, and the outermost regions of these wings are located on a circle whose diameter is a multiple of the outer diameter of the sleeve with double the wall thickness of the sleeve added to it.

With the expansion anchor according to the present invention two definite advantages are achieved. Firstly, the wings which are located in planes other than the general plane of the slots in the sleeve, will cause the shanks into which the sleeve is subdivided by the slots to become radially outwardly deflected to a very significant extent when the expander member is drawn into the sleeve. At the same time the edge faces of the wings will support the thus-expanded shanks and will prevent the latter from elastically returning towards or to their original position, or from being deflected in that sense.

Furthermore, the large-area contact of the wings with the material of the support surrounding the expansion anchor hole—which is in contrast to what is known from the prior art—the wings provide a highly reliable and effective means of preventing the expansion anchor from being rotated in the expansion anchor hole even if the material of the support is highly porous. The overall effect is to obtain a reliable and simple anchoring of the expansion anchor in the expansion anchor hole, preventing the anchor from being turned therein and providing a high degree of resistance to undesired or inadvertent withdrawal of the expansion anchor from the hole despite the relatively small outer diameter of the expansion anchor.

The expander member itself may be made fast with or of one piece with an exteriorly threaded component which extends outwardly of the expansion anchor hole and can be engaged with appropriate means serving to draw the expander member into the sleeve in a sense effecting expansion thereof. The wings and the main body portion of the expander member may advantageously be configurated as a relatively flat element of substantially triangular outline. However, the expander member can also be provided with a tapped bore into which a bolt or screw can be threaded from the exterior of the expansion anchor hole to thereby effect drawing of the expander member into the sleeve for expanding the latter. In this case it is advantageous to so connect the expander member with the sleeve that they cannot be inadvertently separated, as will be discussed more fully below.

It is further possible to provide the expansion anchor sleeve with slits extending rearwardly from the front end to a lesser depth than the aforementioned slots, and to have the portion of the expander member provided with the wings located entirely or substantially entirely in the interior of the sleeve with the wings projecting through the slits and radially outwardly beyond the expansion anchor sleeve. In such an arrangement it is particularly simple to connect the sleeve and the expander member with one another against inadvertent separation by providing a collar or bead at the leading open end of the sleeve which extends partially across this open end and prevents the expander member from being withdrawn from or falling out of the sleeve. Furthermore, with such a construction—in which no or substantially no portion of the expander member is located outwardly and forwardly of the leading end of the sleeve when the expansion anchor is inserted into the hole—the sleeve itself will provide proper guidance for the exapnsion anchor during insertion so that lateral undesired displacement of the expander member with reference to the sleeve is avoided.

The radially outermost edges or corners of the wings may be provided with wedge-shaped tapers which taper in direction towards the trailing end of the sleeve to facilitate driving of the expansion anchor into the material of the support, it being understood that those portions of the wings which project radially outwardly beyond the outer circumference of the sleeve will be driven into the material of the support which surrounds the hole.

The radially outer edge faces of the wings which contact and outwardly deflect the shanks of the expansion anchor sleeve can be so configurated that on expansion of the sleeve they will deflect the shanks in radial direction with reference to the axis of the sleeve so that the shanks are forced to penetrate into the material surrounding the expansion anchor hole. Because the wings themselves extend to a relatively significant depth into the material surrounding the hole they provide proper guidance for the shanks over a rather long distance so that undesired bending or kinking of the shanks is avoided despite their originally axial orientation. Despite this the expansion anchor according to the present invention can be used in expansion anchor holes whose diameter is substantially smaller than that heretofore necessary for expansion anchors known from the prior art.

If the expansion anchor as a small outer diameter it is advantageous to use an expander member having two of the wings; however, if the outer diameter of the expansion anchor is large or very large, it is possible and in many instances probably very advantageous to use an expander member having three or more of the wings with the sleeve then being provided with a corresponding number of longitudinally extending slots in order to provide a number of shanks which corresponds to the number of wings.

It is also possible, according to a further embodiment of the inVention, to make the expansion anchor sleeve nOt in form of a one-piece tubular member but to assemble it from two or more sleeve sections or shell sections. These shell sections will have a longitudinally extending recess with the recesses facing one another and defining an interior passage of the sleeve, and at opposite sides of the recess projecting strip portions which overlie and abut one another when the shell sections are connected.

Conversely, the expander member itself may also be so constructed as to have a core portion surrounded by shell portions on which the radially projecting wings are proVided. Of course, the two last-mentioned possibilities can be used independently of one another or in combination with one another. The expander member having a core portion and the shell portions provided with the wings can be made particularly simply and inexpensively because the shell portions can be formed by stamping or pressing and be placed about the core portion to which they are secured in suitable manner, for instance by spot welding.

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

FIGS. 1 and 1*a* are fragmentary partially sectioned perspective views illustrating one embodiment of the invention in two positions;

FIGS. 2 and 2*a* are end views of the embodiment shown in FIGS. 1 and 1*a* as seen in the direction of the arrow II and again showing the two positions;

FIG. 3 is a view similar to FIG. 1 illustratinG a further embodiment of the invention;

FIG. 4 is a view similar to FIG. 2 but of the embodiment in FIG. 3, as seen in the direction of the arrow IV; and

5 is a perspective view illustrating still another embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail, and firstly the embodiment illustrated in FIGS. 1 and 2, it will be seen that the expansion anchor in toto is identified with reference numeral 1 and composed essentially of the expansion anchor sleeve 2 and the expander member 4.

In the embodiment of FIGS. 1 and 2 the expansion anchor sleeve is a tubular member which is provided at diametrally opposite locations with a pair of axially extending slots 3 which extend inwardly from the leading end (the one which is to be inserted first into an expansion anchor hole in a support) towards the trailing end of the sleeve 2. The expander member 4 in this embodiment is of one piece with an externally threaded portion 5 which constitutes the trailing portion of the expander member and projects rearwardly and outwardly beyond the trailing end of the sleeve 2 so that it can be engaged exteriorly of the expansion anchor hole by a suitable component, for instance by a nut, to draw the expander member 4 into the sleeve 2 in a sense effecting expanding of the latter. The expander member 4 is provided at two diametrally opposite locations with radially projecting wings 6 which are of flat configuration and the member 4 is so inserted into the sleeve 2 that the planes of the wings 6 are inclined (here at right angles) to the general planes of the slots 3. In other words, the wings 6 must not extend into or through the slots 3.

The wings are each provided with a radially outwardly directed edge face 8 which diverge at an acute angle with reference to the longitudinal axis of the expansion anchor in direction towards the leading end 9 of the member 4. Their radially outermost corners 10 are located on a circle surrounding the axis of the member 4 and having a diameter which is a multiple of the outer diameter of the sleeve 2 with double the wall thickness of the sleeve 2 added to it. The trailing ends of the slots 3 are each provided with a transversely extending or circumferentially extending portion 11 to make the radially outward spreading of the shanks formed on the sleeve by the slots 3 simpler. A short cylindrical projection 12 is provided on the expander member 4 for guiding the latter while it is driven into an expansion anchor hole.

The embodiment illustrated in FIGS. 3 and 4 is somewhat different from that in FIGS. 1 and 2 in that the expander member 4 is provided with a centrally located tapped bOre 13 which extends from the trailing portion towards the leading portion of the expander member 4 and into which a non-illustrated bolt, screw or the like can be threaded in order to effect drawing oF the expander member into the sleeve.

In this embodiment the expander member 4 is also connected with the sleeve 2 in such a manner that they cannot be separated inadvertently or in undesired manner. To achieve this the sleeve 2 extends to the end of the expander member 4, that is the latter is entirely located within the sleeve 2 in so far as its elongation is concerned. This is made possible by providing the sleeve 2 with longitudinally extending slits 14 which are of lesser length than the slots 3 and through which the respective wings 6 extend radially outwardly beyond the circumference of the sleeve 2. The open leading end of the sleeve 2 is provided with a radially inwardly extending bead or collar 2*a* which retains the member 4 in the sleeve 2.

The embodiment in FIG. 5, finally, utilizes an expansion anchor sleeve 2 which is composed of two sleeve sections 15 and 16 each of which is provided with a recess and which recesses together define the internal passage of the sleeve 2. At opposite sides of the recess extending along the longitudinal edges thereof the sleeve sections 15 and 16 are provided with radially projecting strip portions 17 and 18 which in the illustrated embodiment extend over the entire axial length of the sleeve 2, but which should extend at least over the length of the slots 3. The sections are placed together as illustrated, and 11 the strip portions 17 and 18 are connected in suitable manner, for instance by spot welding as at 19 or in other ways, in order to maintain the sections 15 and 16 connected with one another.

The expander member 4 in this embodiment utilizes a core portion 4*a* surrounded by and connected to two sleeve portions 20 and 21 on which the radially projecting wings 6 are formed. The wings are located in a plane which is at right angles to the general plane of the strip portions 17 and 18 and thus of the slots 3 of the sleeve 2. The sleeve portions 20 and 21 are again connected in suitable manner with the core portion 4*a*, as by spot welding or the like. The core portion 4*a* is provided with a tapped bore 13 into which a bolt or screw can be threaded, and this can be closed by means of a cap or the like which is removable, in order to protect the topped bore 13 against the entry of particles of the support during driving of the expansion anchor into the expansion anchor hole formed therein.

When an expansion anchor according to the embodiments of FIGS. 1–4 is to be secured in a support, the support is formed with an expansion anchor hole as by drilling or the like. The diameter of the hole corresponds to the outer diameter of the sleeve 2. Thereupon the expansion anchor is now forcibly driven into the expansion anchor hole, and in so doing the wings which of course project radially beyond the circumference of the expansion anchor hole will be driven into and enter the material of the support surrounding the expansion anchor hole. When subsequently the expander member 4 is drawn into the expansion anchor sleeve 2 to expand the same, the shanks formed in the sleeve 2 by the provision of the slots 3 slide on the edge faces 8 of the wings 6 and are spread to a multiple of the bore diameter during continued movement of the expander member 4 in direction towards the rear end of the anchor sleeve 2. During such expansion the shanks are supported and maintained in their expanded position by the edge faces 8 of the wings 6 and a permanent expansion with large-area penetration into the material of the support is thereby achieved. The material of the support which is destroyed—that is becomes crumbly and loose—during the expansion is actually compacted during continued expansion by the shank and partially driven into the slots formed in the surrounding material during the passage therethrough of the wings 6, so that these slots are at least in part closed and further resistance to withdrawal of the expansion anchor from the hole is obtained.

The insertion and anchoring of the embodiment of FIG. 5 is essentially similar to that of the embodiments of FIGS. 1–4. Here, however, the strip portions 17, 18

will also penetrate into the material of the support surrounding the expansion anchor hole, as well as the wings, except they will penetrate in different mutually inclined planes. When subsequently the expander member is drawn into the sleeve for expanding the sleeve, the sleeve sections **15** and **16** are spread apart and slide on the edge faces **8** of the wings **6.** The contact face between the shanks of the anchor sleeve **2** and the material surrounding the expansion anchor hole is increased by comparison to the preceding embodiments as a result of the provision of the strip portions on the sections **15** and **16** and the force exerted upon the material of the support during the spreading-apart of the anchor sleeve **2** is distributed over a larger surface area. As a result the specific surface loading or stressing is smaller and more material of the support is engaged by the penetrating shanks of the anchor sleeve **2,** so that the embodiment of FIG. **5** provides a very much higher resistance to undesired withdrawal from the expansion anchor hole than even the embodiments of FIGS. **1–4,** making it suitable for applications where higher loads or greater weights act upon the expansion anchor in a sense tending to withdraw it from the expansion hole.

Finally, it should be pointed out that, although the expansion anchor sleeve and expander member have been illustrated as being of metallic material, they could also be of other materials, and in particular they could also be of synthetic plastic material.

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 or 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 protected by Letters Patent is set forth in the appended claims.

1. An expansion anchor adapted to be anchored in a hole of predetermined diameter formed in a support, particularly a support of porous material, comprising an elongated expansion anchor sleeve having a circumferential wall of predetermined thickness and of an outer diameter which at least substantially correspond to said predetermined diameter, said wall having a front end, a rear end and at least two longitudinal slots extending from said front end towards said rear end longitudinally of the axis of said sleeve; and an expander member for expanding said sleeve in the region of said slots in response to displacement relative to said sleeve in direction from said front end towards said rear end, said expander member being elongated and comprising a trailing portion in the region of said rear end, a leading portion in the region of said front end, and at least two flat wings projecting from said leading portion radially outwardly beyond the circumference of said sleeve in planes other than the general planes of said slots, said wings having outer edge faces which diverge outwardly of said axis in direction axially away from said rear end and which have outermost regions spaced from one another by a diameter equal to a multiple of said outer diameter plus double said predetermined thickness.

2. An expansion anchor as defined in claim **1,** said expander member including a core portion and at least two shell portions surrounding and connected to said core portion and being provided with said wings.

3. An expansion anchor as defined in claim **1,** wherein said outer edge faces are inclined at acute angles outwardly from and with reference to said axis.

4. An expansion anchor as defined in claim **1,** said sleeve being open at said front end and further having at least two slits extending from said front end towards said rear end, and a collar extending inwardly and partially across said front end; and wherein said leading portion is accommodated and retained by said collar in said sleeve with said wings projecting outwardly through said slits.

5. An expansion anchor as defined in claim **4,** wherein said slots are longer than said slits.

6. An expansion anchor as defined in claim **1,** wherein said outermost regions are provided at the juncture of the respective edge face and an end face facing away from said trailing portion and extending substantially normal to said axis, said outermost regions having a wedge-shaped taper.

7. An expansion anchor as defined in claim **1,** said sleeve comprising at least a pair of elongated connected sleeve sections having respective central recesses which face one another and together define an interior passage of said sleeve, and strip-portions located at opposite sides of and extending along the respective recess, said strip-portions of said sleeve sections being juxtaposed and defining said slots at the juncture of their respective interfaces with said interior passage.

8. An expansion anchor as defined in claim **1,** said expander member being provided with a tapped bore extending through said trailing portion towards said leading portion and adapted for meshing engagement with a threaded component.

9. An expansion anchor as defined in claim **1,** said trailing portion of said expander member being provided with screw threads.

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