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(54) FASTENING DEVICE /

(71) I, ARTUR FISCHER, a German Citizen, of 7241 Tumlingen, Altheimerstrasse 219, Germany, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a fastening device for anchoring in building components.

Many known metal fastening devices work according to the stay bolt principle in which a nut, which can be screwed onto the external thread of a bolt and is supportable on a wall, draws the bolt and also an expansion member towards the mouth of the bore and into an expansible sleeve. The shaft of the bolt projecting from the bore serves to attach a structural component and is of a smaller diameter than the expansible sleeve, so that push-through assembly is not possible. Moreover, the relatively weak shaft of the bolt must absorb all the bending and shearing forces produced by the attachment.

Push-through assembly of fastening devices saves a great deal of time since first, the bores in the structural component to be attached and in the masonry are of the same diameter, and secondly the fastening device can, without removing the structural component to be attached, be pushed through the latter into the bore in the masonry.

In order to expand the known fastening device working on the stay bolt principle, it is necessary for the nut required for drawing the expansion member into the expansible sleeve to be supported on the wall surface. However, if the support is not solid, as for example when soft and compressible insulating slabs are mounted on a wall, satisfactory anchorage of such a fastening device is not possible without destroying the insulating slabs.

The present invention provides a fastening device for anchoring in building components, the device comprising an expandible sleeve, an expansion member having an expansion portion fast to a screw-threaded shank, and a shaft having a bore provided with an internal screw thread matching that of the shank, the

device being such that, in use, the shank passes through, and projects from, the sleeve and into engagement with the shaft so that turning the shaft causes relative movement between the expansion portion of the expansion member and the shaft towards one another thereby expanding the sleeve, wherein the end of the expansible sleeve remote from the expansion portion is provided with a cover cap having a flange surrounding the adjacent end portion of the sleeve.

To anchor this fastening device in a building component such as a slab of masonry, first of all bores are made in a structural component to be attached and in the masonry, these bores being of a diameter corresponding to the external diameter of the expansible sleeve and to that of the shaft. After inserting the fastening device into the bore, the device is anchored by turning the shaft. If a solid component is being attached to the masonry, the shaft may be provided with a head which is supported on the surface of the component. In this case, by screwing the shaft onto the screw-threaded shank, the expansion portion is drawn towards the shaft and the sleeve, which is held against the free end of the shaft is expanded. Simultaneously, the structural component being attached is pressed by the head against the masonry. This avoids the disadvantage occurring in a stay bolt attachment of the bolt projecting beyond the structural component being attached. Such a projecting end is quite a considerable accident risk. Moreover, the thread on such a projecting end may be damaged or destroyed by, for example, corrosion so that it is no longer possible to loosen the attachment and, for example, exchange the attached component.

The fastening device can also be used to attach structural components, however when the shaft does not have a head supported on the component to be attached. In this case, the expansion portion is not moved and the shaft itself is moved towards the expansion portion by being screwed onto the screw-threaded shank, so that the expansible sleeve, is pushed by the free end of the shaft against the expansion portion. The fastening device

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can, therefore, also be anchored if insulating slabs, which do not provide a solid support for a head, are mounted on the masonry. Moreover, the shaft may be lengthened where it is required to attach a component such as a facing plate at a distance from the masonry.

An important advantage of this fastening device is that the thicker shaft is subjected to the torsional stress whilst the thinner screw-threaded shank is only subjected to tractive stress, thereby permitting the device to support a heavier load than known devices.

Preferably, the expansion portion of the expansion member is frustoconical and the shank portion has a diameter corresponding to the smallest diameter of the frustoconical expansion portion.

Since the expansion portion and the screw-threaded shank are in effect a unitary member, it is possible for the difference in diameter between the greatest diameter of the frustoconical expansion portion and that of the screw-threaded shank to be kept small. This is particularly the case when the screw-threaded shank and expansion portion are produced in one piece. A relatively thick screw-threaded shank can, therefore, be used which contributes to a substantial increase in the extraction value.

So that the fastening device can be loaded at any point with the same tractive stress, the screw-threaded shank of the expansion member is preferably made of a stronger material than the shaft.

Advantageously, the expansible sleeve is a "block spring" preferably wound from a soft wire such as copper. Throughout this specification the term "block spring" should be taken to mean a helical spring which is so closely wound that adjacent turns are in contact so as to provide a generally tubular sleeve. Using a "block spring" as the expansible sleeve has the advantage that the sleeve conforms closely to the shape of the bore wall as a result of its elasticity, thereby being braced against the bore wall before the sleeve is expanded by the expansion member. This bracing action helps to prevent the fastening device from rotating when the expansion portion is drawn into the sleeve. The expansion of the "block spring" produces only radial expansion forces so there is no fear of the masonry breaking away even when a high load is applied to the device and the bore is very short.

Preferably, the expansion member is provided with a collar at that end remote from the expansible sleeve, the collar having a diameter corresponding to the external diameter of the unexpanded sleeve.

This collar prevents the expansion portion from being drawn completely into, or even through, the expansible sleeve. Moreover, it also has the result that the expansion force increases as the extraction force increases over a given range.

The arrangement of the cover cap on the end of the expansible sleeve ensures that the effective external diameter of the expansible sleeve is increased slightly which increases the friction of the fastening device in the bore. This produces an additional safeguard against rotation which helps to prevent rotation of the expansible sleeve with the shaft in the initial stage of anchoring. Moreover, since this cover cap clings closely to the bore wall it acts as a seal and thus prevents liquid from penetrating into the expansion region of the fastening device.

That portion of the shaft remote from the shank of the expansion member may be provided with an external screw thread. By this arrangement the shaft may be provided in a simple manner with a means such as a cap nut, for attaching a turning tool. After anchoring the fastening device the cap nut can be screwed off the shaft so that the end of the shaft projecting from the bore may be used, for example, for attaching a component at a distance from the masonry. Alternatively, a component may be attached by the device, the component being tightened against the masonry surface by the cap nut or some other nut.

Preferably, the internal thread of the shaft starts a short distance from the mouth of the bore so that the bore has a smooth portion adjacent its mouth. This smooth bore portion facilitates threading the shaft onto the screw-threaded shank of the expansion member, and also shortens the screwing-on path of the shaft.

Advantageously, a screw-locking device is provided in the smooth portion of the bore. The screw-locking device is chiefly for preventing the shaft from being unscrewed from the screw-threaded shank as a result of vibrations, for example, both during transport and after anchorage. There may be used as screw-locking device a plastics ring which is embedded in an annular groove in the smooth bore portion and is braced between the screw-threaded shank and the inner wall of the smooth bore portion. It is also possible to produce this plastics ring in one piece with the cover cap.

The expansible sleeve may be constituted by a plurality of expansible segments. The fastening device can then be anchored in hollow cavity bricks, each of the expansible segments being arranged to contact a respective one of the bridging pieces of such a brick. Thus, the anchoring load is distributed over several bridging pieces of the hollow cavity brick so that the load per bridging piece is not too high and does not cause the bridging pieces to come away from the main portion of the brick. Moreover, as several bridging pieces take part in the anchorage high extraction values can be achieved. The anchoring force of such a fastening device is not produced

merely by the pressure of the expansible segments on the bridging pieces but also by the expansion and bulge formation of the expansible segments behind the bridging pieces.

5 Each of the expansible segments may be provided with a frustoconical bore and with a chamfered end portion which mates with the frustoconical bore of the adjacent expansible segment. Thus, as axial pressure is applied to the segments they are pushed into one another and expand radially. This expansion is facilitated by providing each of the expansible segments with a slot over part of its length.

15 Instead of being frustoconical, the expansion portion can, where the expansible sleeve is constituted by a plurality of expansible segments, be a stop member which cannot penetrate into the sleeve, the sleeve segments being radially expansible in reaction to axial pressure exerted thereupon by the stop member.

20 In many known fastening devices of the type where a fixing screw is screwed into a stop member to apply axial pressure to radially expansible segments to anchor the device, it is, of course, possible that, as a result of unintentional turning of the fixing screw, the engagement between the stop member and the fixing screw is broken so that the expansible segments slip off the fixing screw and may fall into the bore or into the hollow chambers of the brick. This is not possible with the fastening device according to the invention, however, since during the anchoring process the screw-threaded shank and the expansion portion are fast together, particularly when the two parts are produced in one piece.

25 The expansion of the expansible sleeve is effected by screwing the shaft onto the screw-threaded shank. In doing this the stop member is drawn towards the shaft, so that the expansible segments are braced between the stop member and the free end of the shaft. As the pressure increases the expansible segments expand radially and as a result are braced against the individual bridging pieces. They also form bulges behind and in front of the bridging pieces which contribute substantially to the anchorage of the fastening device.

30 Preferably, the expansible segments are made of a rubber-like material which is resistant to aging. By using a rubber-like expansible segment, the chance of the bridging pieces breaking is reduced even further and the bulge formation behind and in front of the bridging pieces is facilitated. Owing to the material's resistance to aging, the anchoring force remains substantially constant over a long period of time.

35 Advantageously, a rigid disc, preferably made of metal, is provided between each adjacent pair of segments, the or each disc having a diameter corresponding to that of the unexpanded segments. These discs prevent the expansible segments from being pushed into

or over one another during their expansion and also ensure that the axial pressure produced by the stop member is distributed uniformly over the entire expansible sleeve. This ensures that all expansible segments, especially those arranged in the middle of the sleeve, are expanded approximately uniformly so that no stress peaks are produced.

40 It is also possible for each expansible segment to comprise a pair of collars joined by a plurality of arms, the arms extending axially when the segment is not subjected to axial pressure and being bent outwardly when axial pressure is applied. Here again the pressure of the expansible segments on the bridging pieces of the hollow chamber brick is kept low enough to prevent their breakage whilst bulges are formed in front of and behind the bridging pieces to increase the anchoring force of the device. These expansible segments may be made of metal, so that they may be used, for example, in places which are prone to fire hazards.

45 Four forms of fastening device constructed in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a part-sectional elevation of the first form of fastening device;

Fig. 2 is a part-sectional elevation of the second form of fastening device;

Fig. 3 is a part-sectional elevation of part of the third form of fastening device; and

Fig. 4 is a part-sectional elevation of part of the fourth form of fastening device.

Referring to the drawings, Fig. 1 shows a fastening device, indicated generally by the reference numeral 1 comprising an expansible sleeve 2 in the form of a "block spring" wound from copper wire and an expansion member 3 for expanding the expansible sleeve. The expansion member 3 is provided at its end opposite the insertion end with a screw-threaded shank 4 corresponding in external diameter to the smallest diameter of the frustoconical expansion portion 3a of the expansion member. A shaft 5 having an internal screw thread 6 is screwed onto the shank 4, the external diameter of which shaft corresponds to the diameter of the unexpanded expansible sleeve 2 and to the diameter of the bore 12 in masonry 13. The shaft 5 has a hexagonal head 7 by means of which it can be rotated. The internal thread 6 of the shaft 5 starts a short distance from its free end so that a smooth bore portion 8 is formed in the region of the mouth of the bore formed by the internal thread. This smooth bore portion 8 simplifies the threading of the shaft 5 onto the screw-threaded shank 4. Embedded in an annular groove 9 in the smooth bore portion 8 is a resilient plastics ring 10 which presses against the thread of the shank 4 to lock the two threaded members together.

The expansion member 3 has, at its inser-

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tion end, a collar 11 whose external diameter corresponds to that of the bore 12 in the masonry 13. This collar 1 prevents the expansion member 3 from being drawn into, or even through, the expansible sleeve 2;

5 A cover cap 14 made of plastics material is provided on that end of the expansible sleeve 2 remote from the frustoconical portion 3a of the expansion member 3, which cover cap reduces the friction between the shaft 5 and the expansible sleeve 2, and, as a result of a flange 15 formed integrally therewith and partly surrounding the adjacent outer surface of the expansible sleeve 2, acts to prevent the sleeve 2 rotating with the shaft 5 when the latter is turned to draw the frustoconical portion 3a into the sleeve to anchor the device 1. The cap 14 also provides a seal to prevent liquids reaching the sleeve 2 which otherwise could lead to corrosion of the sleeve and release of the anchoring force.

In order to anchor the device 1 in the masonry 13 and to attach a component 13a to the masonry, firstly bores are made in the component 13a and in the masonry (bore 12), these bores having a diameter corresponding to that of the shaft 5 and that of the unexpanded sleeve 2. The device 1 is then inserted into the bore 12 until its head 7 contacts the component 13a. The device 1 can then be anchored by turning the shaft 5 which draws the frustoconical portion 3a of the expansion member 3 into the sleeve 2.

Referring now to Fig. 2, a fastening device, indicated generally by the reference numeral 111, comprises an expansible sleeve 112 and a stop member 113 for expanding the expansible sleeve. The stop member 113 is provided at its end opposite the insertion end with a screw-threaded shank 114. A shaft 115 having an internal screw-thread 116 is screwed onto the shank 114, the external diameter of which shaft corresponds to the diameter of the unexpanded expansible sleeve 112. The shaft 115 has a hexagonal head 117 by means of which it can be rotated.

The expansible sleeve 112 consists of several expansible segments 112a arranged one behind the other. These segments 112a can be expanded radially by screwing the shaft 115 onto the screw-threaded shank 114 of the stop member 113. The expansible segments 112a are made of a rubber-like material resistant to aging. As the shank 114 of the stop member 113 is drawn into the shaft 115, the expansible segments 112a expand radially and are braced against the bridging pieces 120 of a hollow cavity brick 121. At the same time, bulges are formed in front of and behind the bridging pieces 120, these bulges increasing the anchoring force. For better distribution of the axial pressure on the expansible segments 112a, discs 122 preferably made of metal, are embedded between the segments, the discs each having a diameter corresponding to the

external diameter of the unexpanded expansible segments 112a. The internal thread 116 of the shaft 115 starts a short distance from its free end so that a smooth bore portion 118 is formed in the region of the mouth of the bore formed by the internal thread. This smooth bore portion 118 simplifies the threading of the shaft 115 onto the shank 114.

In order to anchor the device 111 in a hollow cavity brick 121, bores are made in a structural component 121a to be attached and in the brick, the diameter of these bores corresponding to that of the shaft 115 and to that of the unexpanded sleeve 112. The device 111 is then inserted through the bore in the component 121a and into the bore in the brick 121. The shaft 115 is then turned to draw the shank 114 into the bore defined by its internal screw thread 116. This forces the stop member 113 against the sleeve 112 to expand the segments 112a radially outwardly to anchor the device 111 in the brick 121. At the same time, the component 121a is tightened against the brick 121 by the head 117 of the shaft 115.

Fig. 3 shows part of a fastening device, indicated generally by the reference numeral 211, which is a modification of the device 111 shown in Fig. 2. The device 211 has an expansible sleeve 212, a stop member 213 having a screw-threaded shank 214, and a shaft 215 having an internal screw thread 216. The device 211 is practically identical with the device 111 of Fig. 2 except that the sleeve 212 is different from the sleeve 112. Thus, the sleeve 212 has several expansible segments 212a, each of which is constituted by a pair of collars 230 and a plurality of arms 231 joining the two collars. When the sleeve 212 is unexpanded, the arms 231 of its segments 212a are axially parallel, but when the sleeve is subject to axial pressure from the stop member 213 (as can be seen in Fig. 3) the arms 231 bow out to anchor the device within a hollow chamber brick (not shown); the bowed out arms 231 forming bulges in front of and behind the bridging pieces of the brick.

Fig. 4 shows part of a fastening device, indicated generally by the reference numeral 311, which is another modification of the device 111 of Fig. 2. The device 311 has an expansible sleeve 312 an expansion member 313 having a screw-threaded shank 314, and a shaft 315. Here again the sleeve 312 is different from the sleeve 112 and comprises a plurality of segments 312a each of which is provided with a frustoconical bore 332 and is longitudinally slotted over part of its length. On drawing in the expansion member 313, its conical expansion portion 334 penetrates the frustoconical bore 332 of the adjacent segment 312a to expand this segment radially. At the same time this segment penetrates the adjacent segment to expand this second segment and

5 this second segment expands the third segment and so on. To help with this "chain reaction" each segment 312a has its "leading end" provided with a conical chamfer 333 matching the frustoconical bore 332 of the adjacent segment.

10 The shaft 315 has an internal thread 316 matching that of the screw-thread shank 314. It also has a separate, internally-threaded sleeve 335 provided in a widened smooth bore portion 318 in the shaft 315. The sleeve 335 is provided with corrugations 336 to hold it in place in the bore portion 318.

15 Alternatively, the thread 316 can be dispensed with and the sleeve 335 relied on for threading in the expansion member 313.

20 Obviously, each of the expansible sleeves 112, 212 and 312 would be provided with a cover cap similar to the cover cap 14 provides on the expansible sleeve 2 of the embodiment of Fig. 1.

WHAT I CLAIM IS:—

25 1. A fastening device for anchoring in building components, the device comprising an expansible sleeve, an expansion member having an expansion portion fast to a screw-threaded shank, and a shaft having a bore provided with an internal screw thread matching that of the shank, the device being such that, in use, the shank passes through, and projects from, the sleeve and into engagement with the shaft so that turning the shaft causes relative movement between the expansion portion of the expansion member and the shaft towards one another thereby expanding the sleeve, wherein the end of the expansible sleeve remote from the expansion portion is provided with a cover cap having a flange surrounding the adjacent end portion of the sleeve.

40 2. A device as claimed in claim 1, wherein the expansion portion of the expansion member is frustoconical and the shank portion has a diameter corresponding to the smallest diameter of the frustoconical expansion portion.

45 3. A device as claimed in claim 1 or claim 2, wherein the shank of the expansion member is made of a stronger material than the shaft.

50 4. A device as claimed in any one of claims 1 to 3, wherein the expansible sleeve is a "block spring" as hereinbefore defined.

55 5. A device as claimed in claim 4, wherein the "block spring" is wound from a soft wire such as copper.

6. A device as claimed in any one of claims 1 to 5, wherein the expansion portion of the expansion member is provided with a collar at

60 that end remote from the expansible sleeve, the collar having a diameter corresponding to the external diameter of the unexpanded sleeve.

65 7. A device as claimed in any one of claims 1 to 6, wherein that portion of the shaft remote from the shank of the expansion member is provided with an external screw thread.

70 8. A device as claimed in any one of claims 1 to 7, wherein the internal thread of the shaft starts a short distance from the mouth of the bore so that the bore has a smooth portion adjacent its mouth.

9. A device as claimed in claim 8, wherein a screw-locking device is provided in the smooth portion of the bore.

75 10. A device as claimed in claim 9, wherein the screw-locking device is made of plastics material.

80 11. A device as claimed in any one of claims 1 to 3 or 6 to 10, when appendant to any one of claims 1 to 3, wherein the expansible sleeve is constituted by a plurality of expansible segments.

85 12. A device as claimed in claim 11, wherein each of the expansible segments is provided with a frustoconical bore and with a chamfered end portion which mates with the frustoconical bore of the adjacent expansible segment.

90 13. A device as claimed in claim 12, wherein each of the expansible segments is slotted over part of its length.

14. A device as claimed in claim 12 or claim 13, wherein each of the expansible segments is made of plastics material.

95 15. A device as claimed in any one of claims 6 to 11, when appendant to any one of claims 1 to 3, wherein the expansion portion of the expansion member is constituted by a stop member which cannot penetrate into the sleeve, the sleeve segments being radially expansible in reaction to axial pressure exerted thereupon by the stop member.

100 16. A device as claimed in claim 15, wherein each of the segments is made of a rubber-like material which is resistant to aging.

105 17. A device as claimed in claim 15 or claim 16, wherein a rigid disc is provided between each adjacent pair of segments, the or each disc having a diameter corresponding to that of the unexpanded segments.

110 18. A device as claimed in claim 17, wherein the or each disc is made of metal.

115 19. A device as claimed in claim 15, wherein each segment comprises a pair of collars joined by a plurality of arms, the arms extending axially when the segment is not subjected to axial pressure and being bent outwardly when axial pressure is applied.

this second segment expands the third segment and so on. To help with this "chain reaction" each segment 312a has its "leading end" provided with a conical chamfer 333 matching the frustoconical bore 332 of the adjacent segment.

The shaft 315 has an internal thread 316 matching that of the screw-thread shank 314. It also has a separate, internally-threaded sleeve 335 provided in a widened smooth bore portion 318 in the shaft 315. The sleeve 335 is provided with corrugations 336 to hold it in place in the bore portion 318.

Alternatively, the thread 316 can be dispensed with and the sleeve 335 relied on for threading in the expansion member 313.

Obviously, each of the expansible sleeves 112, 212 and 312 would be provided with a cover cap similar to the cover cap 14 provides on the expansible sleeve 2 of the embodiment of Fig. 1.

WHAT I CLAIM IS:—

1. A fastening device for anchoring in building components, the device comprising an expansible sleeve, an expansion member having an expansion portion fast to a screw-threaded shank, and a shaft having a bore provided with an internal screw thread matching that of the shank, the device being such that, in use, the shank passes through, and projects from, the sleeve and into engagement with the shaft so that turning the shaft causes relative movement between the expansion portion of the expansion member and the shaft towards one another thereby expanding the sleeve, wherein the end of the expansible sleeve remote from the expansion portion is provided with a cover cap having a flange surrounding the adjacent end portion of the sleeve.

2. A device as claimed in claim 1, wherein the expansion portion of the expansion member is frustoconical and the shank portion has a diameter corresponding to the smallest diameter of the frustoconical expansion portion.

3. A device as claimed in claim 1 or claim 2, wherein the shank of the expansion member is made of a stronger material than the shaft.

4. A device as claimed in any one of claims 1 to 3, wherein the expansible sleeve is a "block spring" as hereinbefore defined.

5. A device as claimed in claim 4, wherein the "block spring" is wound from a soft wire such as copper.

6. A device as claimed in any one of claims 1 to 5, wherein the expansion portion of the expansion member is provided with a collar at

that end remote from the expansible sleeve, the collar having a diameter corresponding to the external diameter of the unexpanded sleeve.

7. A device as claimed in any one of claims 1 to 6, wherein that portion of the shaft remote from the shank of the expansion member is provided with an external screw thread.

8. A device as claimed in any one of claims 1 to 7, wherein the internal thread of the shaft starts a short distance from the mouth of the bore so that the bore has a smooth portion adjacent its mouth.

9. A device as claimed in claim 8, wherein a screw-locking device is provided in the smooth portion of the bore.

10. A device as claimed in claim 9, wherein the screw-locking device is made of plastics material.

11. A device as claimed in any one of claims 1 to 3 or 6 to 10, when appendant to any one of claims 1 to 3, wherein the expansible sleeve is constituted by a plurality of expansible segments.

12. A device as claimed in claim 11, wherein each of the expansible segments is provided with a frustoconical bore and with a chamfered end portion which mates with the frustoconical bore of the adjacent expansible segment.

13. A device as claimed in claim 12, wherein each of the expansible segments is slotted over part of its length.

14. A device as claimed in claim 12 or claim 13, wherein each of the expansible segments is made of plastics material.

15. A device as claimed in any one of claims 6 to 11, when appendant to any one of claims 1 to 3, wherein the expansion portion of the expansion member is constituted by a stop member which cannot penetrate into the sleeve, the sleeve segments being radially expansible in reaction to axial pressure exerted thereupon by the stop member.

16. A device as claimed in claim 15, wherein each of the segments is made of a rubber-like material which is resistant to aging.

17. A device as claimed in claim 15 or claim 16, wherein a rigid disc is provided between each adjacent pair of segments, the or each disc having a diameter corresponding to that of the unexpanded segments.

18. A device as claimed in claim 17, wherein the or each disc is made of metal.

19. A device as claimed in claim 15, wherein each segment comprises a pair of collars joined by a plurality of arms, the arms extending axially when the segment is not subjected to axial pressure and being bent outwardly when axial pressure is applied.



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20. A fastening device substantially as
hereinbefore described with reference to, and
as shown in Fig. 1, Fig. 2 or Fig. 2 as modi-
fied by Fig. 3, or Fig. 4, of the accompanying
5 drawings.

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