

PATENT SPECIFICATION

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DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Wall Plug Assembly.

I, ARTUR FISCHER, a German citizen, of Tumlingen, Kreis Freudenstadt, 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 wall plug assembly including a plug member in the form of an expansible sleeve provided with a longitudinal bore, which sleeve can be made to expand by drawing an expanding element into its longitudinal bore by means of the shank of a fastening element to be anchored in a bore in masonry by the plug member. Such a construction is employed in the case of heavy-duty plugs intended to serve mainly for securing heavy articles such as hot water boilers or wall-mounted cupboards. Expanding plugs of this kind have proved successful for these applications and are nowadays considered to be indispensable for the effective fastening of such heavy articles.

In the known plug assemblies of this type, the diameter of the expansible sleeves, even in the non-expanded condition, is greater than that of the shank of the fastening element. The ratio between the large outer sleeve diameter and the diameter of the associated fastening element depends both on the strength of the materials employed and on the dimensions of the expanding element. The size of the latter depends on the extent to which the sleeve is to be expanded. The greater the sleeve expansion, the larger must be the difference between the diameters of the two ends of the expanding element. However, the maximum diameter of the expanding element must not be larger than the outer diameter of the sleeve in the non-expanded condition, because otherwise the expanding element could no longer be introduced into the bore drilled in the masonry. Thus, if the maximum expansion is to be

achieved so as to obtain the most reliable anchorage of the fastening element, the diameter at the other end of the expanding element must be kept as small as possible. This, in turn, necessitates the use of a fastening screw of small outer diameter. If the plug assembly is inserted in hard material, for example concrete, it is quite possible that the retaining forces capable of being achieved will be greater than the tensile strength of the fastening element so that these retaining forces cannot be fully utilised.

A further disadvantage arises in the methods of fixing the known plug assemblies. There are two ways of fixing, one of which provides for holes to be drilled both in the article to be secured and in the wall in one and the same operation, the diameter of these holes corresponding to that of the fastening element. Then the article to be secured has to be removed again from its intended position, so that the hole drilled in the masonry can be widened to receive the expansible sleeve. Only after the sleeve has been inserted in the masonry can the article again be located in position and secured in place.

Since this process is rather time-wasting, a second method has been developed in which the plug assembly is inserted in to the wall through the hole drilled in the article to be secured. A bore of a diameter corresponding to the outer diameter of the expansible sleeve is drilled in the article and in the masonry in one operation. In this case the plug assembly is inserted in the masonry without the article having to be removed from its position, and is then expanded in the masonry by means of the fastening element.

This method of attachment saves quite a lot of time, but the hole drilled in the article to be attached is too large for the fastening element and sometimes leads to the disadvantage that the suspended article does not rest directly on

the fastening element itself, or can rest thereon only after displacement from its original position.

Another very great disadvantage arises when the plug sleeve is inserted more deeply into the masonry bore than is necessary to accommodate its own length. This is often done in order to prevent the material at the mouth of the masonry bore from breaking away when the sleeve is expanded. When a plug sleeve has been inserted more deeply, the fastening element has no support at that part of the mouth of the bore which is not filled by the plug sleeve and is therefore subjected to additional flexural stress. Such flexural stress may be overcome by subjecting the fastening element to an increased tensile stress. However, the tensile stress capable of being exerted is limited by the anchorage attainable, which cannot be assumed to be very high, especially in the case of porous masonry such as brick, because the inserted plug might break away together with the wall material immediately surrounding it.

The object of the present invention is to provide a wall plug assembly which is easy to fit and by means of which high retaining forces can be attained without experiencing the above-described disadvantages.

The invention accordingly provides a wall plug assembly comprising a plug member in the form of an expansible sleeve having a longitudinal bore, an expanding element capable of expanding said sleeve upon entry of the bore therein and a fastening element having a shank part of which at one end is dimensioned for entry into the bore in said sleeve and is adapted for engagement with the expanding element in order to draw the same into the sleeve at the opposite end from that at which the fastening element is inserted, and part of which is of the same external diameter as that of the sleeve so that it remains outside the sleeve during expansion of the same.

Although a fastening element of special design is needed in the plug assembly of the invention, this is more than compensated for by the advantages obtained and is therefore acceptable. In any case there is a general tendency to manufacture plug assemblies together with a fastening element and to sell the whole assembly as a single unit.

When made of the same material throughout, the large-diameter part of the fastening element can withstand a higher tensile stress than the remaining part which engages the sleeve. While the tensile forces which the large-diameter part can withstand without fracture are probably always greater than the retaining forces of the plug or of the material surrounding it, the reverse conditions might apply to the small-diameter portion.

In order to eliminate this possibility, the strength of the part of the fastening element which engages the sleeve may be increased relatively to that of the other part. Such an

increase may be achieved, for example, by subsequent heat treatment, such as hardening, of the part engaging the sleeve. Alternatively the fastening element may be formed of two parts one of which remains outside the sleeve, while the other engages the sleeve, the latter part being formed of a material stronger than the former. Preferably, in either case the arrangement is such that the said two parts are of substantially equal tensile strength. In this way, the part of the fastening element engaging the sleeve is enabled to withstand tensile forces equalling those which the other part can withstand.

With the assembly according to the invention, the bore in the masonry is completely occupied. The fastening element thus bears on the wall of the bore and is largely free from flexural stress. It therefore need no longer be additionally tightened, merely in order to reduce the flexural stress.

The fastening element is quite capable of withstanding the residual flexural stress because, unlike the fastening elements employed in conjunction with conventional plug assemblies, it has a larger cross-section at the critical point and therefore an increased bending strength. This is also an advantage in cases where the fastening element projects beyond the wall surface and the load causing flexural stress likewise engages it at a distance from the wall. The hole drilled in the suspended article is also fully occupied by the fastening element. It is therefore possible to choose a fastening element of a dimension corresponding to the available hole diameter in the article to be secured and such a fastening element will be capable of withstanding larger forces than the smaller diameter fastening elements employed in conventional expanding plugs.

When the fastening element is screwed into the expanding element in order to expand the sleeve, the latter, at the end opposite the expanding element, bears against that part of the fastening element which remains outside the sleeve. This makes it possible to fix the plug sleeve at any desired depth in the masonry bore, without there being any need for special locking means which would prevent axial displacement of the sleeve as in the case of conventional plugs. Thus, a simple solution has been found for making the part of the fastening element which projects beyond the wall surface as long as necessary to meet given requirements. This provides the possibility of fixing suspended articles in spaced relationship from the wall, as is required, for example, with suspended wall facings. These comprise cover plates mounted at a distance from the outer wall of a building. If the external part of the fastening element of the plug assembly is provided with a thread extending at least over part of its length, such cover plates may be clamped between a nut screwed on to this

thread and the head of the fastening element and be kept at a fixed distance from the surface of the outer wall of the building.

It has been found possible, in this way, to obtain fully adequate anchoring of the plug assembly, and thus adequate fastening of the article to be mounted, but, owing to the fact that the sleeve abuts on the large-diameter part of the fastening element, once the sleeve becomes anchored the fastening element cannot be screwed further into the hole. This is sometimes desirable, since when the fastening element is further tightened, all that happens is that the expander is drawn further into the sleeve and the expanding effect is increased.

According to a further embodiment of the invention, however the plug assembly further includes means arranged to extend between the sleeve and the part of said shank of the same external diameter, said means being capable of collapsing in the direction of the longitudinal axis of said shank to enable the fastening element to approach the sleeve, the force required for complete collapse of said means being greater than that required to expand the sleeve. This enables the fastening element to be introduced further into the bore in the masonry, after expansion of the sleeve, in order thus to urge the mounted article against the wall.

The said means may be a separate element, but may also be connected integrally with the sleeve. In the latter case it may be shaped as a thin-walled, deformable extension of the sleeve, or it may be provided in the form of axial projections capable of deformation.

The said means also offers the advantage that loosening of the fastening element due to vibration is rendered far less likely or even eliminated. While being collapsed, the said means is braced between the wall of the bore and the fastening element and thus prevents detachment of the fastening element from the expanding element. Finally, part of the vibration is also absorbed by the collapsible means so that the region in which the sleeve is anchored is not affected by these vibrations.

Preferably the said means comprises an annular member for arrangement over the part of said shank of reduced diameter, said member being capable of being elastically or plastically deformed by compression between the end of the sleeve and the other part of said shank. In the case of conventional plug assemblies of the type referred to above it has been found that the expanding element must be secured against twisting. This is usually achieved by providing the sleeve with suitable blocking means which engage the wall of the bore. The sleeve, moreover, is connected to the expanding element by means of lugs and/or recesses, so that, as a result, the expanding element is secured against rotation relatively to the sleeve. Advantageously, in the present invention the said annular member has an

axially extending projection for engagement in a corresponding recess at one end of said sleeve. When the fastening element is initially screwed into the sleeve, some deformation of the annular member takes place elastically or plastically. Since the material of the member can only escape substantially radially in the outward direction, it begins to bear firmly on the wall of the hole, so that it becomes increasingly difficult or impossible for it to participate in the rotation. This therefore also serves to hold the sleeve against rotation in the bore. If desired the annular member may be provided with radially extending projections in order to further improve the anchoring of the member in the hole.

The invention is illustrated by way of example in the drawing, in which:

Fig. 1 is an elevation, partly in section, of a plug assembly according to the invention,

Fig. 2 is a similar view of another embodiment of plug assembly according to the invention, and

Fig. 3 is a fragmentary view of the assembly shown in Fig. 2.

Referring to Fig. 1 of the drawings, a fastening element 1, i.e. a screw, comprises a head 2 at one end and a shank comprising two parts 3 and 4, the part 4 being provided with a screw thread. The part 4 of the screw engages a sleeve 5 having an internal bore 6 which widens conically towards the insertion end. An expanding element 7 can be drawn into this conically flared part of the bore 6 by means of the screw thread of the part 4 of the fastening element. The sleeve thus becomes radially expanded as the expanding element is drawn into it. To facilitate expansion, the sleeve 5 is provided with longitudinal slots 8 spaced around its circumference. The outer diameter of the part 3 of the screw is the same as the outer diameter of the sleeve 5.

As shown in Fig. 2, an annular member 9 is inserted between the sleeve 5 and the screw portion 3, this member being capable of elastic or plastic deformation by compression between the part 3 of the screw and the sleeve 5 when the screw 1 is screwed into the expanding element 7. When, after expansion of the sleeve 5, the resistance to further penetration of the sleeve 5 by the expanding element 7 becomes sufficiently large, the member 9 begins to be subjected to an elastic or plastic deformation, and the material will be displaced outwardly in radial direction. In this way it becomes possible for the screw 1 to penetrate further into the sleeve anchored in the wall (not shown) and thus to approach the wall surface more closely.

Fig. 3 shows an axial lug 10 of the member 9, which engages a matching recess 11 of the sleeve 5. In this way, both components are secured against relative rotation, so that the expanding element 7 is also secured against rotation during expansion of the sleeve 5,

provided that the sleeve 5 and expanding element 7 are likewise secured against relative rotation and that the adapter 9 bears firmly on the masonry bore. To increase the resistance to rotation still further, the adapter is provided with circumferential projections 12.

The invention is by no means confined to the embodiment illustrated. On the contrary, modifications necessitated by given design requirements may be made without thereby departing from the scope of the invention. Thus, the shape of the expanding element and the corresponding sleeve section may be of different design. Instead of widening conically, the sleeve bore may be provided with inwardly projecting elements which effect expansion of the sleeve as the expander is introduced. Also, instead of only one expander, two such expanders may be employed, for example in order to produce uniform expansion of the sleeve.

WHAT I CLAIM IS:—

1. A wall plug assembly comprising a plug member in the form of an expansible sleeve having a longitudinal bore, an expanding element capable of expanding said sleeve upon entry of the bore therein and a fastening element having a shank part of which at one end is dimensioned for entry into the bore in said sleeve and is adapted for engagement with the expanding element in order to draw the same into the sleeve at the opposite end from that at which the fastening element is inserted, and part of which is of the same external diameter as that of the sleeve so that it remains outside the sleeve during expansion of the same.

2. A wall plug assembly as claimed in claim 1, in which the said two parts of the shank of the fastening element are formed integrally of the same material, the part of reduced diameter being treated to increase the strength of the material relatively to that of the other part.

3. A wall plug assembly as claimed in

claim 1, in which the said two parts of the shank of the fastening element are formed of different materials, the material forming the part of reduced diameter being stronger than the material of the other part.

4. A wall plug assembly as claimed in claim 2 or 3, in which the said two parts of the shank of the fastening element are of substantially equal tensile strength.

5. A wall plug assembly as claimed in any one of claims 1—4, further including means arranged to extend between the sleeve and the part of said shank of the same external diameter, said means being capable of collapsing in the direction of the longitudinal axis of said shank to enable the fastening element to approach the sleeve, the force required for complete collapse of said means being greater than that required to expand the sleeve.

6. A wall plug assembly as claimed in claim 5, in which the said means comprises an annular member for arrangement over the part of said shank of reduced diameter, said member being capable of being elastically or plastically deformed by compression between the end of the sleeve and the other part of said shank.

7. A wall plug assembly as claimed in claim 6, in which said annular member has an axially extending projection for engagement in a corresponding recess at one end of said sleeve.

8. A wall plug assembly as claimed in claim 6 or 7, in which said annular member is provided with radial projections.

9. A wall plug assembly substantially as described herein with reference to Fig. 1 or Figs. 2 and 3 of the accompanying drawings.

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provided that the sleeve 5 and expanding element 7 are likewise secured against relative rotation and that the adapter 9 bears firmly on the masonry bore. To increase the resistance to rotation still further, the adapter is provided with circumferential projections 12.

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2. A wall plug assembly as claimed in claim 1, in which the said two parts of the shank of the fastening element are formed integrally of the same material, the part of reduced diameter being treated to increase the strength of the material relatively to that of the other part.

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4. A wall plug assembly as claimed in claim 2 or 3, in which the said two parts of the shank of the fastening element are of substantially equal tensile strength.

5. A wall plug assembly as claimed in any one of claims 1—4, further including means arranged to extend between the sleeve and the part of said shank of the same external diameter, said means being capable of collapsing in the direction of the longitudinal axis of said shank to enable the fastening element to approach the sleeve, the force required for complete collapse of said means being greater than that required to expand the sleeve.

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