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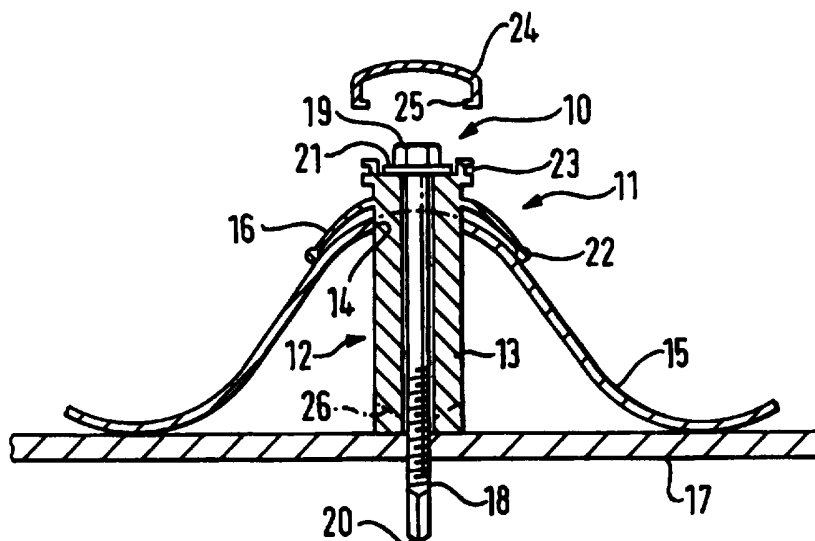
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(54) Title: FASTENER FOR CORRUGATED SHEETING



(57) Abstract

A fastener (11) for securing flexible corrugated sheets (15) to a structural support (17). The fastener (11) comprises a spacer (12) which has a body (13) for insertion through a hole (14) in the corrugated sheeting, and a flange (16) near to the upper end of the body for overlapping the sheeting around the hole. The body has a hole through which a screw (10) passes. The screw secures the spacer to the supporting structure. The corrugated sheeting is held down by the flange of the spacer. The spacer thus controls the force on and compression of the corrugated sheeting.

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FASTENER FOR CORRUGATED SHEETING

The invention relates to a fastener for fixing flexible corrugated sheeting to supporting structures in buildings.

5 Corrugated sheeting is often used as a roofing or wall cladding material. The sheeting is usually secured to supporting structures, such as purlins or rafters of a roof, by fasteners such as nails, screws or bolts which pass through the crowns of the corrugations of the
10 sheeting.

 In many applications, such as on a curved roof, flexible sheeting has an advantage over rigid sheeting because it is more easily fitted to the shape of the roof. When flexible sheeting is secured to a supporting
15 structure by a fastener which may be tightened, for example by a nail or screw being driven through the crown of a corrugation into the structure, the corrugation is compressed. The amount of compression of the corrugation has important effects on the performance of the sheeting.
20 Too much compression will result in deformation of the sheeting with resultant serious structural implications. The depression formed around the fixing may form a well in which rain water may collect and thus adversely affect weathering. It may also reduce the resistance to
25 deflection along the length of the corrugations and thus impair the spanning performance. Too little compression also impairs the spanning performance of the sheeting since it allows upward movement of the corrugation in the region of the fixing in response to downward pressure
30 elsewhere and this might lead to deflection of the sheeting. Insufficient compression would also allow movement of the sheeting in winds with possible consequential damage to the sheeting. Thus there is an optimum compression of the sheeting.

35 Often the force used to tighten the fastener, such as the force used to drive a nail or screw into the

- 2 -

supporting structure, is much larger than that required to compress the corrugation to its optimum compression. This is especially the case when the supporting structure is made of a hard material, such as steel, when power tools must be used to drive the fastener. It is, therefore, difficult to judge when the tightening of the fastener should stop.

The present invention aims to overcome this problem by introducing a spacer to control the amount of force transferred to the corrugated sheeting and thus control the compression of the sheeting.

The invention proposes a fastener for securing flexible corrugated sheeting to a structural support, the fastener comprising a spacer with a body for insertion through a hole in the crown of a corrugation of the sheeting and a flexible flange at or near to the upper end of the body for overlapping the sheeting around the hole, and a fixing means engageable with the spacer for securing the spacer to the supporting structure which passes through a hole in the body and has anchoring means at one end for securing the fixing to the supporting structure and tightening means for adjusting the force applied by the fixing to the body, whereby the final force applied by the flange to the sheeting is independent of the tightening force applied by the tightening means and is the force required to hold the sheeting at its optimum compression.

Thus by making the spacer of the appropriate size for the corrugations of the sheeting the fastener can be used to achieve optimum compression of the sheeting.

At the optimum compression the flange exerts sufficient pressure on the sheeting around the crest of the corrugation that the underside of the sheeting bears against the supporting framework of the roof at the troughs in the sheeting. Thus when the fixing is fully tightened the vertical distance from the base of the

- 3 -

spacer to a point at which the underside of the flange contacts the corrugation at optimum compression is less than the vertical distance between the trough and that point on the corrugation when no compression is applied.
5 However, the force exerted by the flange on the sheeting should not be so large that, for example, the sheeting is caused to buckle or a depression forms around the fixing.

10 The invention also provides a roof structure comprising flexible corrugated sheeting secured to a supporting structure by a plurality of fasteners as described above.

15 The flange of the spacer provides a convenient way of holding the fastener and allows the spacer to be fitted from the exterior without the need for an extra pair of hands within the wall or roof space. The flange also improves the weathering characteristics of the fastener.

20 To secure the corrugated sheeting to the supporting structure a hole may be drilled through the crown of corrugation of the sheeting in the desired position over the supporting structure and the body of the spacer is inserted. The flange rests on the sheeting around the hole. The fixing means is passed through a bore in the
25 body of the spacer so that the body forms a sleeve to the fixing means. The fixing means is then anchored to the structural support and the fastener is then tightened using the tightening means. The top of the fixing engages with the body of the spacer and the tightening force is
30 then transferred to the body of the spacer. This brings the bottom of the body into contact with and bearing against the supporting structure. The flange in consequence is pulled down and exerts a force on the sheeting. The force exerted by the flange depends on the
35 distance in the final configuration of the spacer from the bottom of the body of the spacer to the junction of the body and the flange and on the size, shape and flexibility of the flange. This force may be much less than the

- 4 -

tightening force used and so the compression of the sheeting is greatly reduced.

In embodiments where the anchoring means involves driving a screw thread into the supporting structure the body of the spacer may also comprise one or several recesses near its base to provide a exit for swarf from the drilling screw.

The flange may be integral with the body of the spacer, although preferably they are separate parts, made of different materials and then connected together. The flange is preferably convex, dome-shaped and sufficiently flexible that the outer rim of the flange fits closely against the outer surface of the sheeting around the ridge in the corrugation. The flange may have one or more annular ribs on its underside. These help to prevent water reaching the fixing and thus improve the weathering characteristics of the fastener. The flange is preferably made of a material that has a high resistance to UV degradation.

The body of the spacer is made of a strong material to withstand the fixing load, preferably high density plastics or galvanised metal.

Preferably the flange and the body form a unit for ease of handling during insertion of the fixings. Where they are made of different materials, to provide the different properties desired for the flange and the body, they may be formed with interlocking parts to hold them together.

Although the holes for the spacer may be pre-drilled, with some embodiments of the invention pre-drilling is not necessary. A portion of the body near to its bottom may be inwardly tapered. This has been found to enable the body of the spacer to be knocked into a hole in the sheeting at the same time as the hole for the fixing is

- 5 -

made. The spacer widens the hole in the corrugated sheeting as it is knocked through it.

Preferred embodiments of the invention will now be described with reference to the accompanying drawings in which:-
5

Figure 1 is a cross-sectional view of a fastener in accordance with the invention installed in a roofing structure;

Figure 2 is a perspective view of some of the component parts of the fastener shown in Figure 1;
10

Figure 3 is a cross-sectional view of another fastener in accordance with the invention installed in a roofing structure;

Figure 4 is a perspective view of some of the component parts of the fastener shown in Figure 3;
15

Figure 5 shows an enlarged detail of a possible modification of a drill screw;

Figure 6 shows a enlarged view of another possible modification;

Figures 7 and 8 show cross-sectional views from the front and side respectively of yet another fastener in accordance with the invention in which the fixing means is a 'J' type hook bolt;
20

Figure 9 shows a perspective view of some of the components parts of the fastener shown in Figures 7 and 8;
25

Figure 10 is a cross-sectional view of another fastener in accordance with the invention;

Figure 11 is a cross-sectional view of the body of the spacer shown in Figure 10.

Referring to Figure 1, a fastener 11 comprises a spacer 12 and a fixing 10. The spacer has a body 13 for insertion through a hole in the crown of a corrugation of the sheeting 15 and a flange 16 at or near to the upper end of the body for overlapping the sheeting 15 around the hole 14. The fixing 10 is engageable with the top of the body 13 of the spacer 12 and secures the spacer to a supporting structure 17. The fixing 10 has anchoring
30
35

- 6 -

means in the form of a screw thread 18 at one end for securing the fixing to the supporting structure 17 and also has tightening means in the form of a hexagonal faceted head 19 for screwing the fixing means into the supporting structure 17 and thereby adjusting the force applied by the fixing means to the body of the spacer 12. Part of the force is transferred by the flange 16 to the sheeting 15 to compress the sheeting to its optimum compression.

10 The body 13 of the spacer comprises a rigid, cylindrical tube which forms a sleeve around the fixing 10. The fixing 10 is a drill screw which has a drill bit 20 formed at its lower end below the screw thread 18. The head of the drill screw has an outwardly extending flange 21 which engages with the upper end of the spacer body. 15 The head is faceted for engagement with a spanner.

 The flange 16 of the spacer is a convex, generally dome-shaped flexible washer which is integral with the body 13. The flange 16 has a thickened portion 22 around its rim. The shape of the flange is such that when the spacer is installed through a hole in the sheeting, as in Figure 1, the flange 16 touches the sheeting only at its rim 22. In the region of the hole 14 the sheeting is spaced from the flange 16 by a distance of approximately 6mm. 25

 The spacer has a portion extending upwards from the top of the body which forms a circumferential groove 23 for releasably retaining a cap 24 of resilient plastics material to cover up the otherwise exposed head of the drill screw. The cap has an inwardly extending flange 25 which is received within the groove 23. 30

 The body of the spacer also has one or more recesses 26 near its base which provide space for the drilling swarf from the drill screw. In the embodiment shown in Figure 1 the spacer has two such recesses which are radial channels in the foot of the body. 35

- 7 -

To install the fastener the hole 14 is first cut into the crown of a corrugation of sheeting 15 in the desired position over the supporting structure 17. The spacer 12 and drill screw 10 are then inserted into the hole with the drill screw passing through the bore of the body 12 of the spacer. The rim 22 of the washer rests on the top of the sheeting around the hole 14. The drill screw is then driven into the supporting structure 17 which may be in the form of a steel girder in accordance with accepted practice. The swarf produced does not build up inside the tube but enters the recesses 26 in the side of the tube.

As the fastener is tightened the head 19 of the drill screw engages with the upper end of the body 13 of the spacer and force begins to be applied to the spacer as the drill screw is tightened. The spacer resists the compressive force and prevents the distance between the head of the screw and the point at which the drill screw enters the supporting structure from becoming smaller than a given distance even when the fastener is fully tightened. The dimension of the spacer relative to the depth of the corrugation is set such that the washer holds the sheeting down at its optimum compression when the fastener is fully tightened.

By designing the washer so that it engages the sheeting at its rim with a gap between the washer and the sheeting in the region of the hole and by making the washer flexible the fastener may be used equally effectively with a range of corrugated sheeting of different thicknesses and also accommodates the increased thickness where an overlap of the sheeting occurs.

Even when the fastener is installed where there is an overlap of sheeting and hence a double thickness of sheeting beneath the flange 16, the flange is spaced from the sheeting in the region of the hole 14 and the flange makes contact with the sheeting only at its rim 22. The flexibility and resilience of the flange is sufficient to apply pressure to the sheeting when the fitting is

- 8 -

installed in both double thickness and single thickness regions. It is desirable that the flange should be sufficiently flexible to make contact with the corrugated sheeting at its rim around the entire periphery.

5 In practice a plurality of fasteners would be used to secure each piece of sheeting to a supporting structure to form a roof or wall cladding.

Figure 3 shows another embodiment of the invention, in which the fastener 11' differs to the one above in that
10 the fixing 10' is modified at its upper end. Instead of having an outwardly extending flange with a hexagonal head, the fixing comprises a recess or slot 32 in its upper end, for engagement with a driving tool. In the embodiment of Figure 3 the drill screw has a slotted head
15 for engagement with a screwdriver.

The fastener of Figure 3 and 4 is fitted into the supporting structure first by drilling a hole in the sheeting and inserting the spacer in a similar manner to that described with reference to Figures 1 and 2. The
20 drill screw is then driven into the supporting structure using a screwdriver in the slot 32 and the fastener is then tightened by turning the retaining nut 31.

Figures 5 and 6 show possible modifications to the drill screws of Figures 1 and 3. A projection may be
25 provided on the shank of the anchoring screw adjacent the thread to limit the penetration of the screw into the supporting structure. This projection may be a ridge or nodules 40 as shown in Figure 6 or a fixed washer 41 as shown in Figure 5.

30 Figures 7, 8 and 9 show another embodiment of the invention in which the fixing is a 'J' type hook bolt 50. The anchoring means is the hook portion 51 at the lower end of the fixing 10". A portion of the shank of the drill screw 30 near to its upper end is screw threaded.
35 An internally threaded member in the form of a nut 31 is

- 9 -

threaded onto the screw thread portion. The nut can engage with the upper end of the body of the spacer. The upper threaded portion is threaded in the opposite direction to the thread of the anchoring means.

5 In other respects the fixing of Figure 3 is the same as that of Figure 1. The spacers of Figure 1 and 3 are identical. At the other end the bolt has a portion 51 which is screw threaded and has an internally threaded nut 52 threaded onto it. This type of fixing is particularly
10 used for securing corrugated sheeting to a supporting structure of L shaped girders.

 The spacer 12' of Figures 7, 8 and 9 differs from the spacer 12 of Figures 1 to 4 in that it further comprises
15 portion 60 which extends laterally from the lower end of the body 13'. As shown in Figures 7 and 8 this portion may extend laterally in one direction perpendicular to the length of the body, to form generally 'L' shaped spacer.

 To fit the fastener of Figures 7 and 8 the 'L' shaped spacer with the hook bolt passing through its body is fed
20 through a hole in the sheeting so that the hook portion 60 rests on the horizontal flange of the L shaped girder 17'. The hook of the bolt is then manipulated so that it is hooked around the lower edge of the vertical flange of the L-shaped girder. The retaining nut 52 is then screwed
25 down the threaded portion 51 to tighten the fastener. The compression exerted on the bolt is transmitted by the nut to the top end of the body rather than directly to the sheeting and the hook portion is pulled tightly against the underedge of the girder to fix the fastener in
30 position.

 Figure 10 shows another embodiment of the invention which differs to that shown in Figure 1 in several respect. Firstly the body 13' and flange 16' of the spacer 12" are separate parts, connected together
35 mechanically. The flange 16' has parts 80 which interlock with parts 81 on the body so that the two parts can be

- 10 -

snapped together to form a unit 12" prior to use. In this way the flange can be made of a different material to the body and yet the two parts form a single unit for ease of handling during installation. Preferably the flange is
5 made of a flexible weather and UV resistant plastics and the body is formed of a rigid plastics or of galvanised steel.

The flange has several annular ribs 70 at various radii on its underside. The ribs come close to or make
10 contact with the outer surface of the corrugated sheeting and help to prevent the ingress of rainwater by capillary action.

The spacer 12" also comprises a flexible strap 71 extending from near its top which is integral with the
15 flange 16' and the cap 24. The strap prevents the cap getting lost during storage and installation.

A portion 74 of the body 13' near its base tapers inwardly. This enables the body of the spacer to be
20 knocked into a hole in the sheeting at the same time as the hole for the fixing is made. The spacer widens the hole in the corrugated sheeting as it is knocked through it.

Figure 11 shows the body of the spacer of Figure 10 in more detail. The body also has two triangular openings
25 26' diametrically opposite one another at its base which provide an exit for swarf from the drilling.

In another embodiment in which the body is preferably made of galvanised metal, the walls of a portion of the body near to its lower end incline inwardly. When the
30 fastener is tightened and the body bears against the supporting structure the walls of that portion of the body collapse inwardly. The proximity of the zinc-rich metal to the fixing 10 helps to prevent rusting of the fixing.

- 11 -

The fastener of the present invention has several advantages over know fasteners. The fastener may be fitted from the top of the sheeting without the need for a pair of hands within the roof space. The spacer controls
5 the amount of force which is transferred to the sheeting and therefore maximises the sheet's spanning performance and resistance to damage by the weather. Finally due to the flexibility of the washer and the gap between the washer and the sheeting in the region of the hole in the
10 sheeting the fastener may be used equally effectively with sheeting of different thicknesses.

- 12 -

CLAIMS

1. A roof structure comprising flexible corrugated sheeting secured to a supporting structure by a plurality of fasteners, each fastener comprising a spacer which has a body for insertion through a hole in the crown of a corrugation of the sheeting and a flange at or near to the upper end of the body for overlapping the sheeting around the hole and a fixing means which engages with the spacer for securing the spacer to the supporting structure, the dimensions of the spacer being such that the corrugated sheeting is held down by the flange of the spacer at its optimum compression when the fixing means is fully engaged.

2. A roof structure according to Claim 1, in which the flanges of the fasteners make contact with the sheeting at their rims around the entire periphery.

3. A roof structure according to Claim 1 or 2 including a plurality of overlapping pieces of flexible corrugated sheeting, the flanges of the fasteners being spaced from the sheeting in the region of the holes, even for the fasteners installed in the regions of overlap, and the flanges being sufficiently flexible and resilient to apply pressure to the sheeting at their rims both in the region of overlap and in the regions of single thickness.

4. A fastener for securing flexible corrugated sheeting to a structural support, the fastener comprising a spacer with a body for insertion through a hole in the crown of a corrugation of the sheeting and a flexible flange at or near to the upper end of the body for overlapping the sheeting around the hole, and a fixing means engageable with the spacer for securing the spacer to the supporting structure which passes through a hole in the body and has anchoring means at one end for securing the fixing to the supporting structure and tightening means for adjusting the force applied by the fixing to the

- 13 -

body whereby, in use, the final force applied by the flange to the sheeting is independent of the tightening force applied by the tightening means and is the force required to hold the sheeting at its optimum compression.

5 5. A fastener according to Claim 4, in which the flexible flange has one or more annular ribs on its underside.

6. A fastener according to Claims 4 or 5, in which the flange, in its unstressed state, is dome-shaped.

10 7. A fastener according to any preceding claim, wherein the anchoring means comprises a screw thread.

8. A fastener according to Claim 7, in which the end of the fixing means remote from the screw thread includes means for engaging a driving tool.

15 9. A fastener according to Claim 8, wherein the engaging means is a slot to receive a screw driver.

10. A fastener according to Claim 8, in which the engaging means is a faceted head for engagement with a spanner.

20 11. A fastener according to any of Claims 7 to 10, in which the fixing means comprises a drill screw.

25 12. A fastener according to any of Claims 7 to 11, in which the fixing means includes means projecting radially outwardly adjacent the anchoring means for limiting the penetration of anchoring means into the supporting structure.

13. A fastener according to any preceding claim, in which the body of the spacer has one or more recesses near its lower end for drilling swarf.

- 14 -

14. A fastener according to any of Claims 4 to 6, wherein the anchoring means comprises a hook or L-shaped portion.

5 15. A fastener according to any of Claims 4 to 14, in which the fixing means includes a flange at or near the end remote from the anchoring means for engagement with the upper end of the body of the spacer.

10 16. A fastener according to any of Claims 4 to 14, in which a portion of the fixing means remote from the anchoring means is screw threaded and an internally threaded member is threaded onto the said screw threaded portion for engagement with the upper end of the body of the spacer.

15 17. A fastener according to any preceding claim, wherein the spacer further comprises a portion which extends laterally from the lower end of the body.

20 18. A fastener according to any of claims 4 to 16 wherein the spacer further comprises a portion at the bottom end of the body which tapers inwardly.

19. A roof structure substantially as herein described, with reference to the drawings.

20. A fastener substantially as herein described, with reference to the drawings.

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FIG. 1

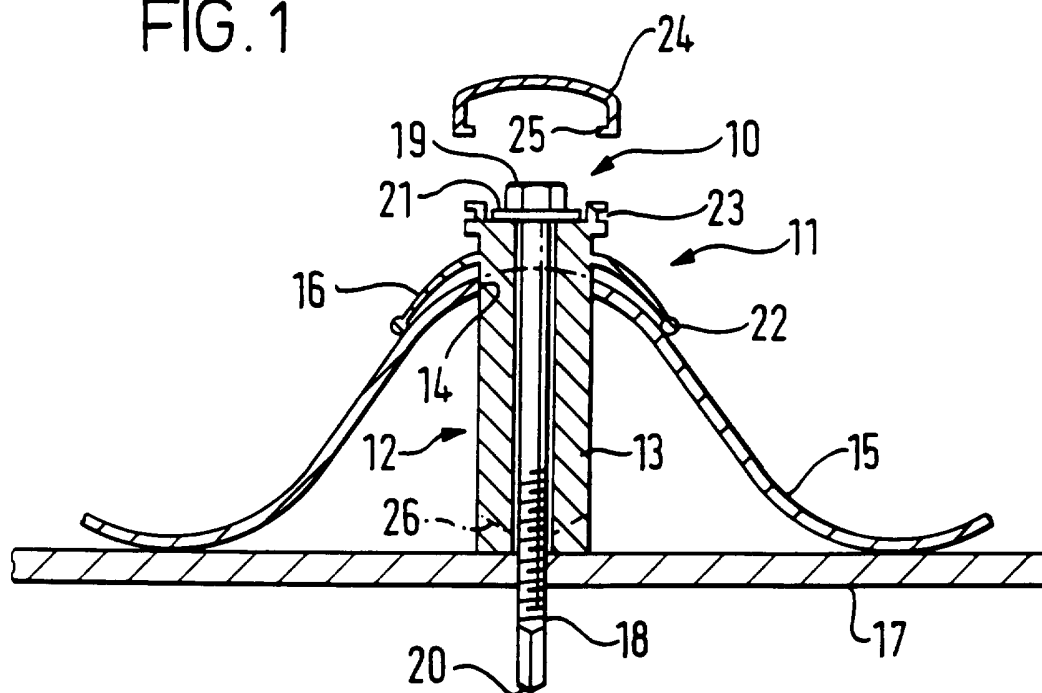
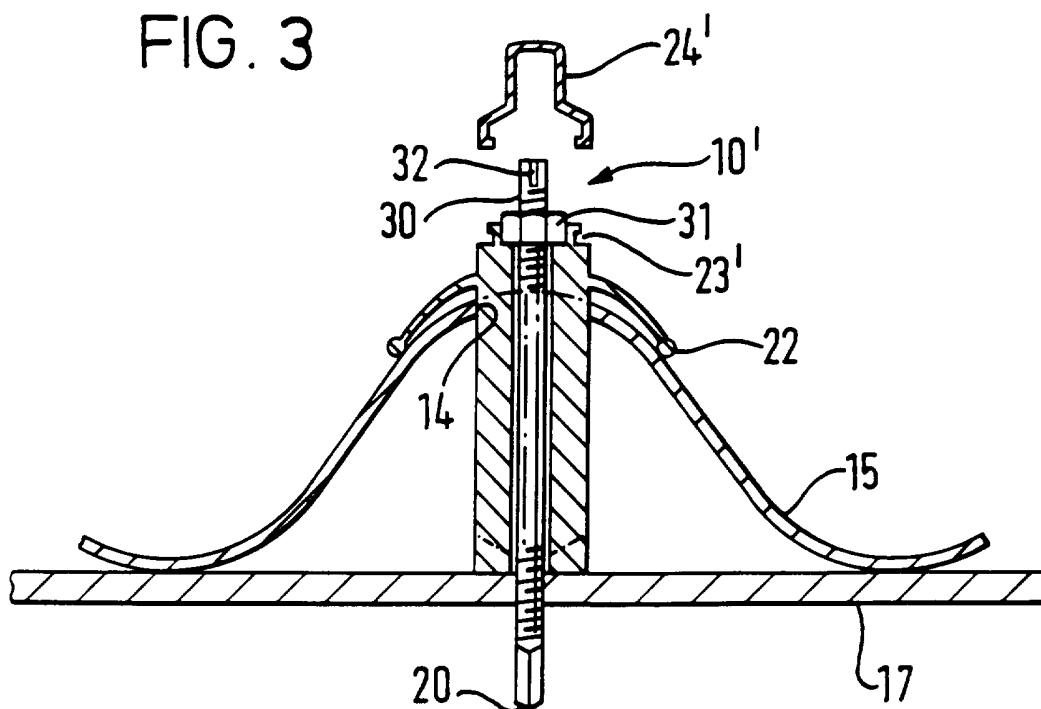


FIG. 3



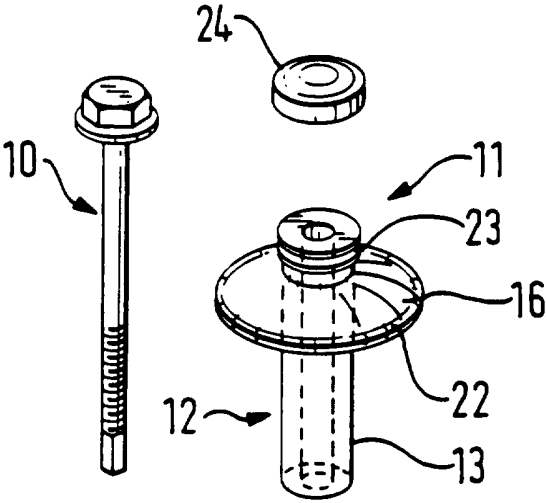


FIG. 2

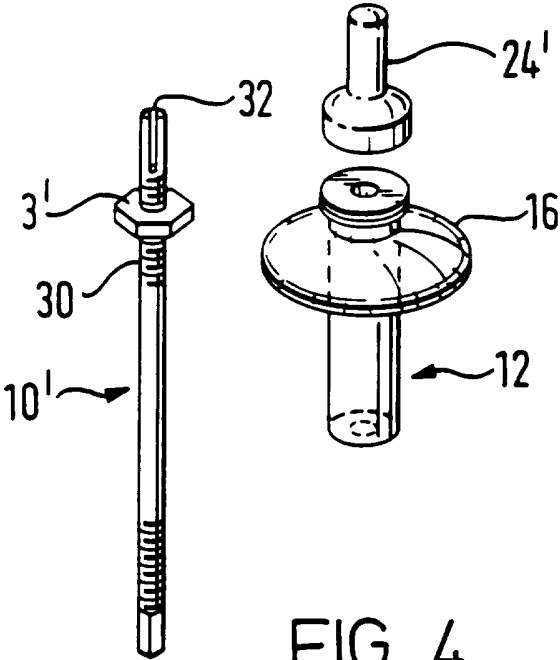


FIG. 4

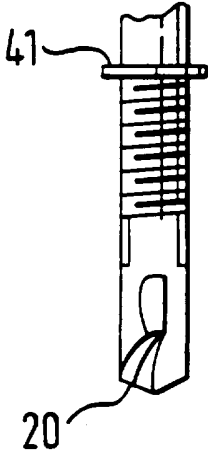


FIG. 5

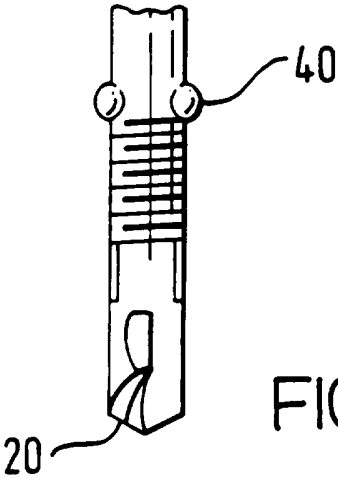


FIG. 6

FIG. 7

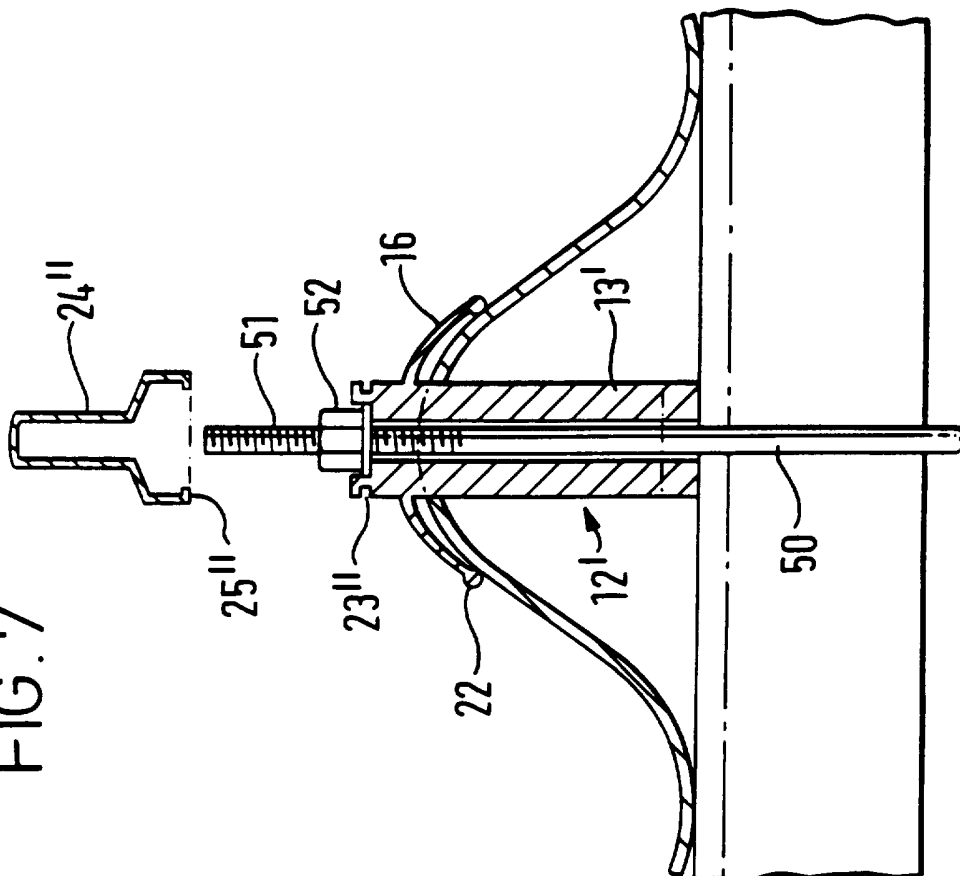
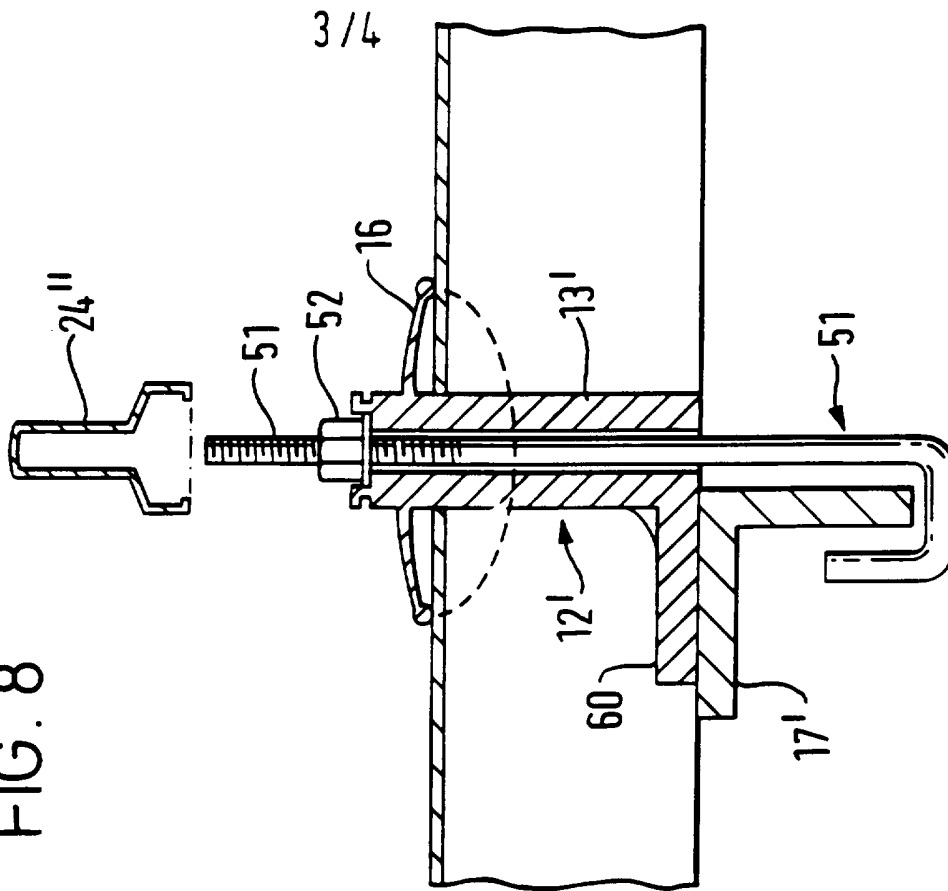


FIG. 8



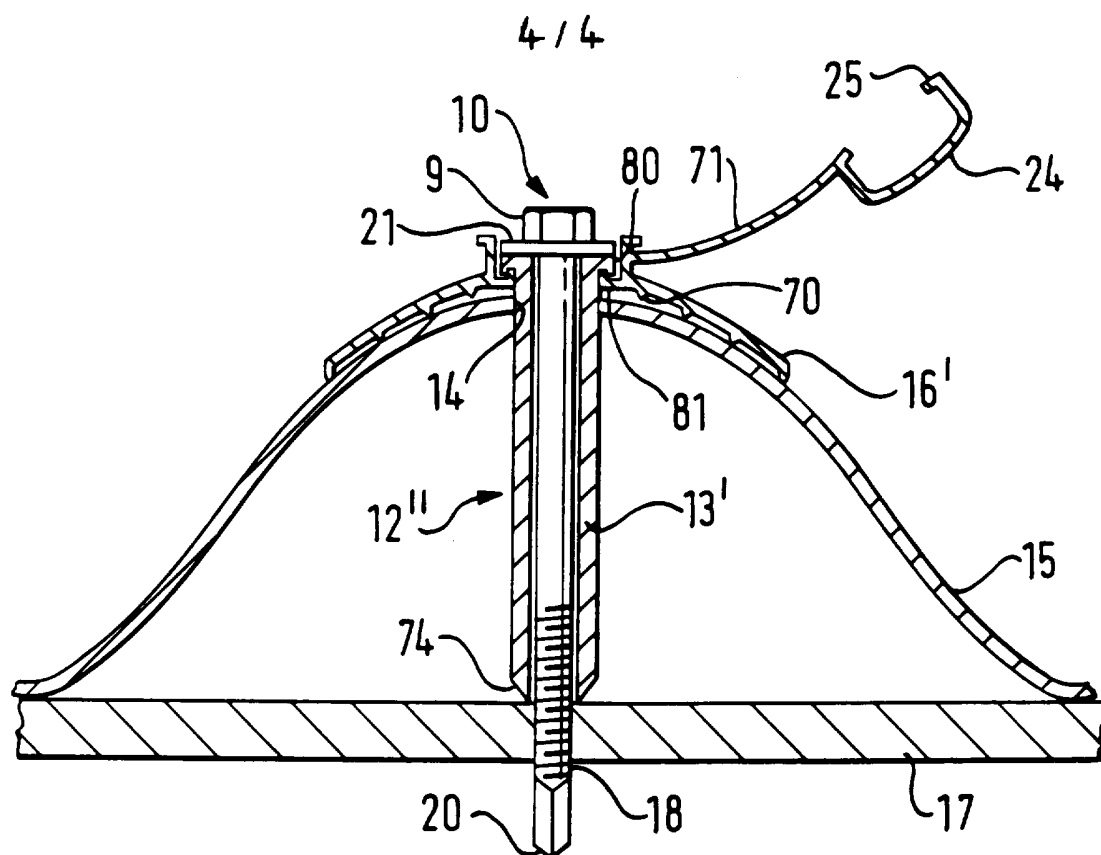
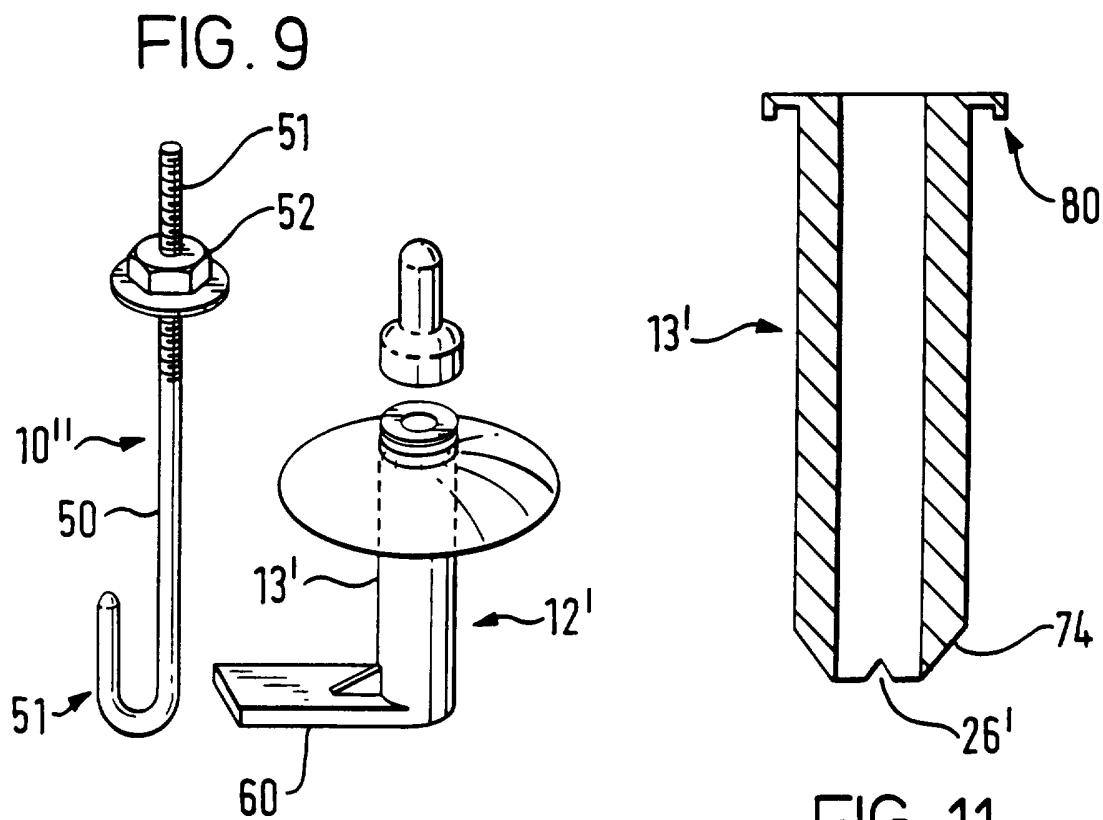


FIG. 10



INTERNATIONAL SEARCH REPORT

Internat. Application No
PCT/GB 95/01919

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E04D3/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 E04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	NL,C,120 225 (VAN HILLO) 16 August 1965 see column 2, line 44 - column 3, line 27 see figure 1 ---	1,4,7-9 2,3,5,6, 10-12, 14-18
Y	FR,A,2 160 137 (PORTER COMPANY, INC.) 22 June 1973 see page 7, line 20 - page 8, line 11 see figures 1,6,8 ---	2,5,6,14
Y	FR,A,1 377 182 (FISCHER) 15 February 1965 ---	2,3,5,6, 14,16
A	see page 1, column 2, paragraph 4 - page 2, column 1, paragraph 3 see page 2, column 1, line 5 see figure 1 ---	4
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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