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(54) **FASTENER FOR CORRUGATED SHEETING**

BEFESTIGUNGSELEMENT FÜR GEWELLTE DACHEINDECKUNGEN

FIXATION POUR TOLE ONDULEE

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(56) References cited:
DE-A- 1 906 105
FR-A- 2 564 916
GB-A- 993 021
GB-A- 2 292 432
US-A- 3 340 761

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Description

[0001] The invention relates to a fastener for fixing corrugated sheeting, especially, but not exclusively, flexible corrugated sheeting or fragile corrugated sheeting with little compressive strength, to supporting structures in buildings.

[0002] 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 sheeting.

[0003] 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 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.

[0004] The amount of compression of the corrugation has important effects on the performance of the sheeting. 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 collects and thus adversely affect weathering. It may also reduce the resistance to 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 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.

[0005] Often the force used to tighten the fastener, such as the force used to drive a nail or screw into the 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 into the structure. It is, therefore, difficult to judge when tightening of the fastener should stop.

[0006] Another problem which is encountered when a drill screw with a long threaded portion is used as part of the fastener is that the thread of the drill screw engages with the sheeting as the tip of the screw is being driven into the supporting structure. As the screw is turned there is a tendency for the sheeting to be lifted upwards and this may cause damage to the sheeting.

[0007] Our UK patent GB-A-2 292 432 describes a fastener for securing flexible corrugated sheeting which addresses these problems. The fastener comprises a spacer with a body for insertion through a hole in the crown of a corrugation of the sheeting, and a flexible flange for overlapping the sheeting around the hole. The fastener also comprises a fixing, such as a bolt or drill screw, for securing the sheeting with the spacer to the supporting structure, which passes through a hole in the body and which engages with the top of the spacer. When the fixing is tightened the bottom of the spacer is brought to bear against the supporting structure and the flange holds the sheeting down. The tightening force applied to the fixing is transferred to the spacer, and part of this force is transferred from the flange of the spacer to the sheeting. The dimensions of the spacer are such that when the fixing is fully tightened the sheeting is held down at a predetermined compression, which is the optimum compression for that sheeting.

[0008] The spacer of this fastener does not have much "give". This has the advantage that it ensures that the sheeting is held at the predetermined compression. However, the person driving the screw is not aware when the sheeting is about to reach the predetermined compression and, thus, when the tightening force should be removed. The operator may continue to drive the fixing for a short time after it is engaged fully with the spacer and thus is prevented from moving further into the supporting structure. This is most likely to happen when a power drill is being used to drive the fixing into the supporting structure. Power drills are frequently necessary to drive fixings into supporting structures of very hard materials such as steel and are often set to rotate at constant torque. When the fixing is still being driven but, due to engagement with the spacer, cannot move further into the supporting structure, the thread formed by the drill screw in the supporting structure may be stripped, particularly if the supporting structure is thin. The result of this is that the fixing is not held securely by the supporting structure.

[0009] The present invention proposes an improved fastener of the above mentioned type which addresses this problem. The invention is defined in the appended claims to which reference should now be made.

[0010] In accordance with the invention there is provided a fastener for securing corrugated sheeting to a structural support according to claim 1.

[0011] As the fixing is drilled into the structure the teeth at the lower end of the sleeve are brought to bear against the upper surface of the sheeting and they cut through the sheeting as the fixing continues to be tightened, thereby enlarging the hole formed by the fixing. In addition, the teeth formed by the areas of the spacer between the notches at the lower end of the spacer can deform when the fastener is tightened and the lower end of the sleeve engages the supporting structure, thereby reducing the length of the spacer. Thus this fastener has the advantages as will be described below as consequences of having a partially collapsible spacer, and additionally has the advantage that no hole needs to be cut into the corrugated sheeting before the fastener can be inserted because it drills its own hole when the fas-

tener is being installed.

[0012] Preferably the spacer comprises a tubular sleeve with an axial hole through which the fixing passes, the wall of the sleeve having a longitudinally extending slit which facilitates deformation of the spacer under compressive loads. The slit in the spacer allows the spacer to collapse slightly as the slit can open up when the force on the spacer reaches a certain level. The larger the force which is applied to the spacer the more the slit opens up. Thus the spacer may progressively collapse.

[0013] The slit in the body of the spacer may be a partial slit in the wall of the body or may run along the entire length of the spacer. The slit body may be formed by cutting along the side of a tube, or by rolling up a substantially rectangular sheet.

[0014] The deformation of the spacer enables the operator to feel when the fastener is reaching the correct level of fixing tightness. The spacer will resist compression and the operator will feel resistance to penetration into the supporting structure and this will cause the operator to remove the torque applied to the fixing. For example if the operator is using a power tool he will release the power trigger. However, the fixing will continue to be turned for a short time after the operator feels the extra resistance due to his reaction time and also while the fixing is decelerating. During this time, the slit in the spacer opens up so that the spacer slightly collapses. The progressive collapse of the spacer allows the advance of the fixing into the supporting structure to continue, and at the same time absorbs some of the torque. Thus, during the operator's reaction time and while the fixing is decelerating, stripping of the thread formed by the fixing in the supporting structure is avoided because as the spacer collapses the drill screw can move further into the supporting structure. Thus the fastener of the present invention allows a greater degree of tolerance to achieve the correct result.

[0015] US-A-3340761 described a sleeve with a longitudinal slot.

[0016] Preferably the fastener comprises a fixing which has drill means and the spacer comprises a split sleeve which has several teeth at least one of its ends. The teeth may for example be provided in a saw tooth arrangement or may be formed as castellations. The fixing has a head for engaging the spacer and the washer which may be covered in a plastics material such as EPDM.

[0017] A preferred embodiment of the invention will now be described by way of example with reference to the drawings in which:

Figure 1 is a perspective view of the component parts of a fastener in accordance with an embodiment of the invention;

Figure 2 is a partial cross-sectional, partial end-on view of the fastener of Figure 1 installed in a roofing structure;

Figure 3 shows a cross-sectional view of a modified washer which may be used; and

Figure 4 shows a cross-sectional view of one end of a modified spacer.

[0018] Referring to Figures 1 and 2, the fastener 10 comprises a spacer 12, a washer 14 and a fixing 16. The spacer comprises a body in the form of a cylindrical sleeve 18 of zinc-coated steel which has a split or slit 20 along its entire length. The sleeve is castellated around its upper and lower ends to form teeth 22 which are separated by intervening notches 23.

[0019] The washer 14 comprises a convex, generally dome-shaped skirt 24 attached to a waist portion 26. Several annular ribs 28 are provided on the underside of the skirt 24. The washer is made of ultra-violet (UV) resistant PVC or other engineering grade plastics material.

[0020] The fixing 16 is a drill screw which has a drill bit 30 at the lower end of the shank 31 below the screw thread 32. The screw is about 65mm long with a diameter of about 5.5mm and a 36mm thread. The screw has an anti-corrosion coating. The head of the screw is covered in PTA and is colour-coded to indicate the types of corrugated sheeting for which it is suitable. The head 34 of the drill screw is faceted for engagement with a spanner or drive socket of a power tool and has an outwardly extending flange 36 at its base for engaging with the waist 26 of the washer 14. The underside of the screw head 34 is also engageable with the top of the spacer 12.

[0021] The corrugated sheeting 40 is typically a material made into a monolayer from organic fibres impregnated with bitumen under high pressure and at high temperatures. The corrugations are typically 38 or 40 mm.

[0022] To install the fastener 10, first the shank 31 of the screw 16 is passed through the washer 14 and then through the spacer 12, so that the spacer forms a sleeve around the screw.

[0023] Next the fastener is positioned above a crown of a corrugation of the sheeting 40 in the desired position over the supporting structure 42. The screw is then rotated and driven through the corrugated sheeting 40 forming its own hole through the sheeting 40 by means of its drill bit 30. As the screw continues to be driven the lower end of the spacer is brought into contact with the upper surface of the corrugated sheeting 40 around the hole formed by the drill bit. The castellations 22 of the spacer 12 act as cutting teeth and cut through the corrugated sheeting, thereby enlarging the hole already cut by the drill screw. The spacer then moves through the hole in the sheeting 40 as the drill advances.

[0024] The lower end of the drill screw then reaches the upper surface of the supporting structure and begins to cut into the structure. At this stage if no spacer was being used the corrugated sheeting might be lifted up

by the engagement of the sheeting with the rotating thread of the drill screw. However, because the spacer has passed down into the crown of the corrugation it acts as a barrier between the sheeting and the drill screw, thereby preventing this from happening.

[0025] As the drill screw continues to be turned the fastener 10 becomes tighter and the head of the drill screw 34 engages with the upper end of the spacer 12 and the top of the washer 14. The washer 14 in turn holds down the sheeting around the fastener. The lower end of the spacer is then brought to bear against the supporting structure 42. The tightening force is borne predominantly by the spacer 12, rather than by the corrugated sheeting 40 alone. At this point the drill operator should sense the increase in resistance to penetration and the increase in torque required by the power tool to turn the drill screw. The castellations or teeth 22 at the lower end of the sleeve of the spacer splay outwards under the increasing tightening force and thus allow a progressive deformation of the spacer so that it collapses slightly in the vertical direction. In addition the slit 20 in the sleeve can open up, thereby allowing further deformation of the spacer and collapse in the vertical direction. The spacer initially has a length of about 40mm which is reduced by about 12% to about 35mm/36mm on tightening.

[0026] This deformation of the spacer provides the installer with a "feel" of the correct level of fixing tightness and allows a greater degree of tolerance to achieve the correct result.

[0027] Moreover, because the collapse of the spacer is progressive, the operator of the drill is given time to react to the resistance of the spacer and remove the power applied to the drill before the spacer totally prevents further penetration of the drill screw into the supporting structure. Stripping of the thread in the supporting structure is avoided because, whilst the power is being taken off the drill screw and the drill screw is decelerating, the spacer collapses and the drill screw can move further into the supporting structure.

[0028] The slit 20 in the sleeve 18 and the notches between the castellations 22 have the further function that they provide an exit for swarf produced from the screw drilling into the purlin.

[0029] Since the spacer is castellated at both ends it does not matter which way up the spacer is placed over the drill screw when the fastener is being assembled. Also the teeth at the upper end of the spacer may be adjusted during assembly of the fastener, for example by bending them, to improve the grip between the spacer and the washer and/or between the spacer and the drill screw, as required. A good grip between the spacer and the drill screw means that the spacer may be forced to rotate about its axis as the fixing is rotated. The teeth at the lower end of the spacer provide a cutting action through the sheeting as the spacer rotates. On the other hand, if the castellations at the upper end of the spacer are arranged so that the grip between the spacer and the fixing is weak the spacer may not rotate with the drill screw when its lower end engages with the corrugated sheeting. In this case the downward movement of the head of the fixing forces the spacer downwards so that the teeth of the spacer cut through the sheeting.

[0030] Figure 3 shows a modified washer which may be used. This washer 46 is readily available on the marketplace and is of annular, shallow frusto-conical shape. It comprises two layers 48,50 : a first layer 48 of aluminium; and a second layer 50, beneath the aluminium layer, of felt, rubber, or synthetic rubber material. The washer does not have any annular ribs on its underside, but the layer 50 being of compressible material forms a watertight seal with the sheeting when the fastener is installed.

[0031] The hole 52 defined by the second layer 50 of the washer is smaller than the hole 54 defined by the first layer, which is of slightly larger diameter than the external diameter of the spacer. The castellations at the top of the spacer bite into the second layer 50 of the washer around the hole. This provides a good grip between the washer 46 and the spacer 12.

[0032] As an alternative, the top layer of the modified washer may be of stainless steel rather than aluminium.

[0033] Referring to Figure 4, for some types of corrugated sheeting, such as plastic sheeting, the spacer used is preferably modified so that the teeth 22' of the spacer 12' are bevelled to form chisel portions 60. The inner surface of each tooth 22' is bevelled, so that the edges 62 of the chisel portions 60 are provided on the outer surface of the spacer. These chisel edges can improve the cutting action of the spacer through certain types of sheeting.

[0034] Obviously, the dimensions of the spacer, drill screw, and washer required depend on the size of the corrugations of the sheeting to be fixed. Thus the dimensions given in the preferred embodiment are examples, rather than fixed dimensions. Preferably, the dimensions of the teeth and body of the spacer are such that the spacer is compressed by about 10 to 15% of its original length on tightening of the fixing.

[0035] The present invention thus provides a highly effective but simple fastener which enables corrugated sheeting to be secured to supporting structures at its optimum compression and also helps an operator securing the sheeting to judge when to stop drilling.

Claims

1. A fastener for securing corrugated sheeting to a structural support, the fastener (10) comprising a spacer (12), a washer (14) for overlapping the sheeting in the proximity of the fastener, and a fixing (16) for securing the sheeting, the spacer and the washer to the supporting structure, the spacer (12) having a body (18), and the fixing (16) being engageable with the spacer (12) and, in use, passing

through a hole in the body of the spacer, and comprising means (32) for adjusting the force applied by the fixing to the spacer, **characterised in that** the spacer has a plurality of deformable teeth (22) with intervening notches (23) formed at its lower end.

2. A fastener according to claim 1 in which the body of the spacer (12) has a plurality of deformable teeth (22) with intervening notches (23) formed at each end.

3. A fastener according to claim 1 or 2 in which the body of the spacer (12) comprises a tubular sleeve with an axial hole through which the fixing passes, the wall of the sleeve having a longitudinally extending slit (20) which facilitates deformation of the spacer.

4. A fastener according to any preceding claim in which the washer (14) comprises a convex, generally dome-shaped skirt (24) attached to a waist portion (26).

5. A fastener according to claim 4 in which the washer (14) further comprises several annular ribs (28) on the underside of the skirt (24).

6. A fastener according to any of claims 1 to 5 in which the washer (46) comprises a first layer (48), and a second layer (50), beneath the first layer, the second layer being of a compressible material.

7. A fastener according to claim 6, in which the first layer (48) is made of aluminium or stainless steel.

8. A fastener according to any preceding claim in which the fixing (16) comprises drill means (30) for drilling into supporting structures the drill means comprise a screw thread (32) which comprises the means for adjusting the force applied by the fixing to the spacer.

9. A fastener according to any preceding claim in which the fixing (16) comprises means (34) for engaging a driving tool.

10. A fastener according to any preceding claim in which the spacer (12) is compressed by about 10 to 15% of its original length on tightening of the fixing.

11. A roof structure comprising corrugated sheeting secured to a supporting structure by a plurality of fasteners according to any preceding claim.

Patentansprüche

1. Befestigungselement zum Befestigen von Wellplatten an einer tragenden Struktur, wobei das Befestigungselement (10) einen Abstandshalter (12), eine Unterlegscheibe (14) zum Überlappen der Platte in der Nähe des Befestigungselements und ein Fixierelement (16) zum Befestigen der Platte, des Abstandshalters und der Unterlegscheibe an der tragenden Struktur umfasst, wobei der Abstandshalter (12) einen Körper (18) hat und das Fixierelement (16) mit dem Abstandshalter (12) in Eingriff bringbar ist und im Gebrauch durch ein Loch im Körper des Abstandshalters passiert und eine Vorrichtung (32) zum Einstellen der vom Fixierelement auf den Abstandshalter ausgeübten Kraft aufweist, **dadurch gekennzeichnet, dass** der Abstandshalter an seinem unteren Ende eine Mehrzahl von verformbaren Zähnen (22) mit dazwischenliegenden Kerben (23) hat.

2. Befestigungselement nach Anspruch 1, bei dem der Körper des Abstandshalters (12) an jedem Ende eine Mehrzahl von verformbaren Zähnen (22) mit dazwischenliegenden Kerben (23) hat.

3. Befestigungselement nach Anspruch 1 oder Anspruch 2, bei dem der Körper des Abstandshalters (12) eine röhrenförmige Hülse mit einem axialen Loch umfasst, durch welches das Fixierelement hindurch verläuft, wobei die Wand der Hülse einen längs verlaufenden Schlitz (20) hat, der die Verformung des Abstandshalters erleichtert.

4. Befestigungselement nach einem der vorangehenden Ansprüche, bei dem der Abstandshalter (14) einen konvexen, allgemein kalottenförmigen Rand (24) hat, der an einem Bauchteil (26) angebracht ist.

5. Befestigungselement nach Anspruch 4, bei dem die Unterlegscheibe (14) an der Unterseite des Rands (24) ferner mehrere ringförmige Rippen (28) aufweist.

6. Befestigungselement nach einem der Ansprüche 1 bis 5, bei dem die Unterlegscheibe (46) eine erste Schicht(48) und eine zweite Schicht (50) unter der ersten Schicht hat, wobei die zweite Schicht aus einem zusammendrückbaren Material ist.

7. Befestigungselement nach Anspruch 6, bei dem die erste Schicht (48) aus Aluminium oder Rostfreistahl ist.

8. Befestigungselement nach einem der vorangehenden Ansprüche, bei dem das Fixierelement (16) eine Bohrvorrichtung (30) zum Bohren in tragende Strukturen aufweist, wobei die Bohrvorrichtung ein

Schraubgewinde (32) hat, das das Mittel zum Einstellen der von dem Fixierelement auf den Abstandshalter ausgeübten Kraft beinhaltet.

9. Befestigungselement nach einem der vorangehenden Ansprüche, bei dem das Fixierelement (16) eine Vorrichtung (34) zum Ansetzen eines Treibwerkzeugs aufweist.

10. Befestigungselement nach einem der vorangehenden Ansprüche, bei dem der Abstandshalter (12) beim Festziehen des Fixierelements um ungefähr 10 bis 15 Prozent seiner ursprünglichen Länge zusammengedrückt wird.

11. Dachstruktur, die mit einer Mehrzahl von Befestigungselementen nach einem der vorangehenden Ansprüche an einer tragenden Struktur befestigte Wellplatten umfasst.

Revendications

1. Attache pour fixer de la tôle ondulée à un support structurel, l'attache (10) comprenant une pièce d'écartement (12), une rondelle (14) pour chevaucher la tôle à proximité de l'attache, et une fixation (16) pour fixer la tôle, la pièce d'écartement et la rondelle à la structure de support, la pièce d'écartement (12) ayant un corps (18), et la fixation (16) étant engageable avec la pièce d'écartement (12) et, lors de l'utilisation, passant à travers un orifice dans le corps de la pièce d'écartement, et comprenant un moyen (32) pour régler la force appliquée par la fixation à la pièce d'écartement, **caractérisée en ce que** la pièce d'écartement a une pluralité de dents déformables (22) avec des encoches intermédiaires (23) formées au niveau de son extrémité inférieure.

2. Attache selon la revendication 1, dans laquelle le corps de la pièce d'écartement (12) a une pluralité de dents déformables (22) avec des encoches intermédiaires (23) formées à chaque extrémité.

3. Attache selon la revendication 1 ou 2, dans laquelle le corps de la pièce d'écartement (12) comprend un manchon tubulaire avec un orifice axial à travers lequel passe la fixation, la paroi du manchon comportant une fente s'étendant longitudinalement (20) qui facilite la déformation de la pièce d'écartement.

4. Attache selon l'une quelconque des revendications précédentes, dans laquelle la rondelle (14) comprend une jupe généralement bombée, convexe (24) fixée à une partie de ceinture (26).

5. Attache selon la revendication 4, dans laquelle la rondelle (14) comprend en outre plusieurs nervures annulaires (28) sur le dessous de la jupe (24).

6. Attache selon l'une quelconque des revendications 1 à 5, dans laquelle la rondelle (46) comprend une première couche (48), et une deuxième couche (50), en dessous de la première couche, la deuxième couche étant en une matière compressible.

7. Attache selon la revendication 6, dans laquelle la première couche (48) est réalisée en aluminium ou acier inoxydable.

8. Attache selon l'une quelconque des revendications précédentes, dans laquelle la fixation (16) comprend un moyen de perçage (30) pour percer dans des structures de support le moyen de perçage comprend un filetage de vis (32) qui comprend le moyen pour régler la force appliquée par la fixation à la pièce d'écartement.

9. Attache selon l'une quelconque des revendications précédentes, dans laquelle la fixation (16) comprend un moyen (34) pour engager un outil d'entraînement.

10. Attache selon l'une quelconque des revendications précédentes, dans laquelle la pièce d'écartement (12) est comprimée par environ 10 à 15% de sa longueur initiale lors du serrage de la fixation.

11. Structure de toit composée de tôle ondulée fixée à une structure de support par une pluralité d'attaches selon l'une quelconque des revendications précédentes.

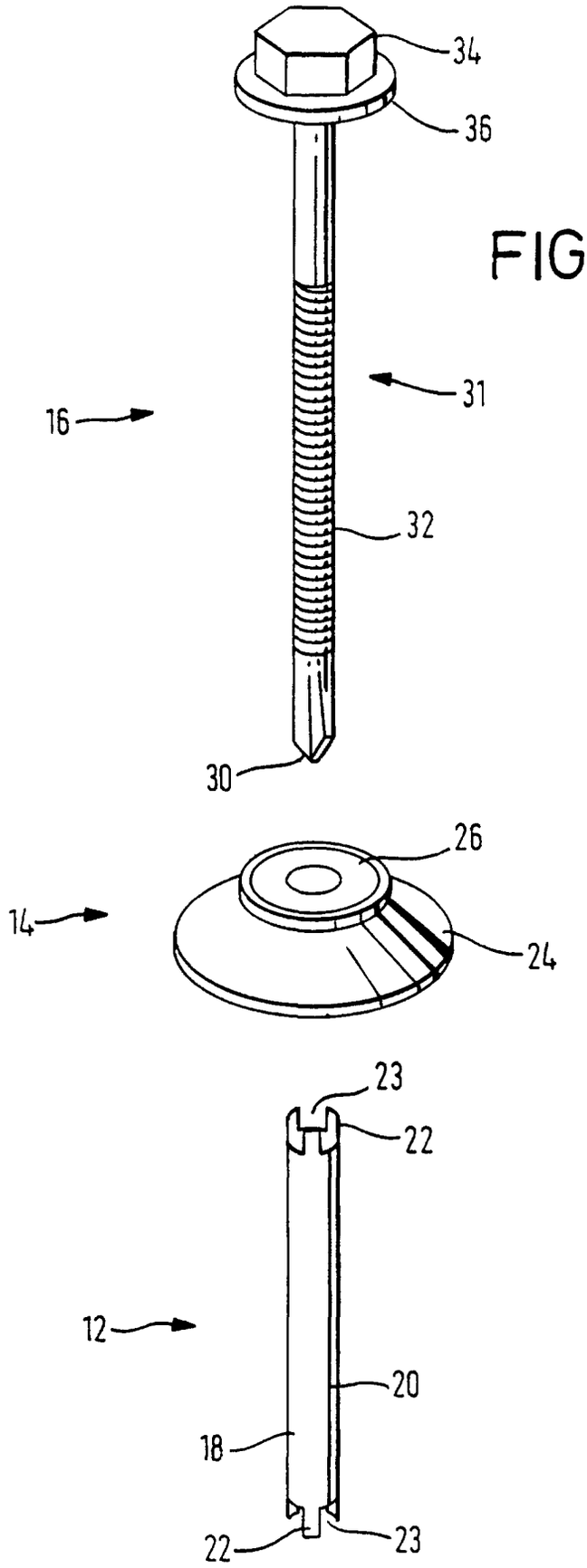

FIG. 1

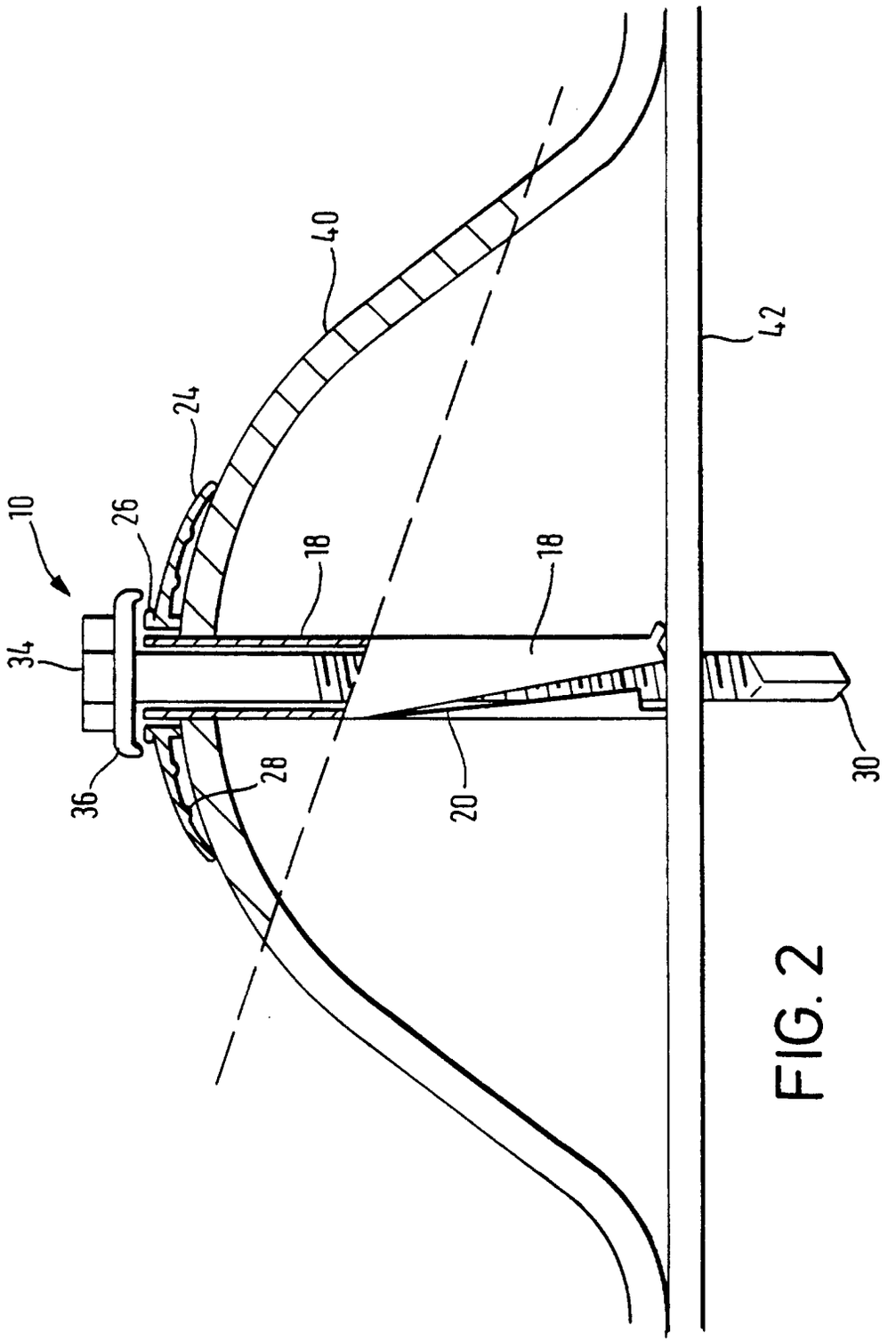

FIG. 2

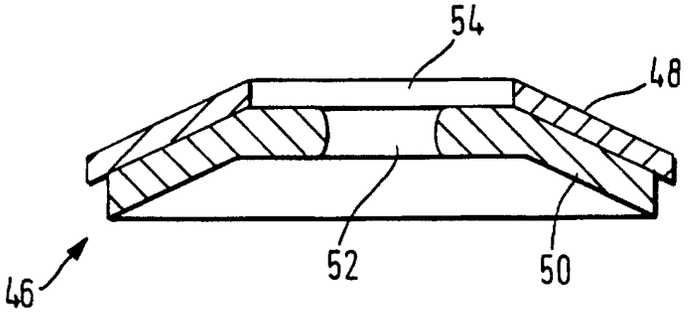

FIG. 3

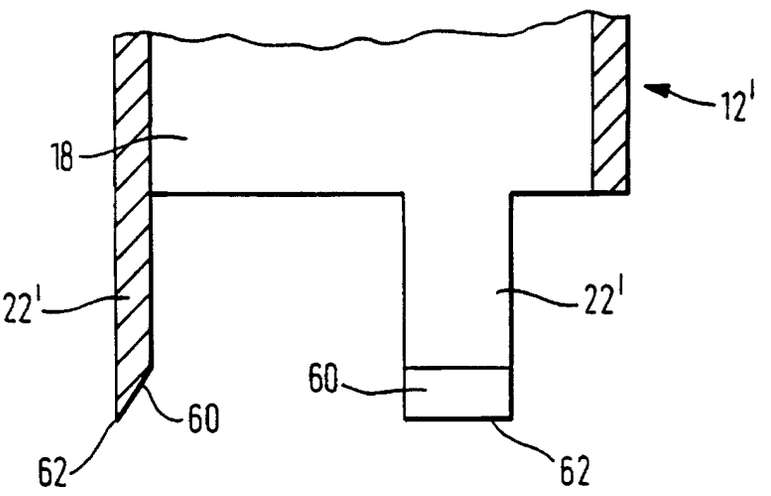

FIG. 4