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(54) **Title**: A SPACE AND LEVEL ADJUSTER AND JOIST DEVICE FOR A FLOOR CONSTRUCTION

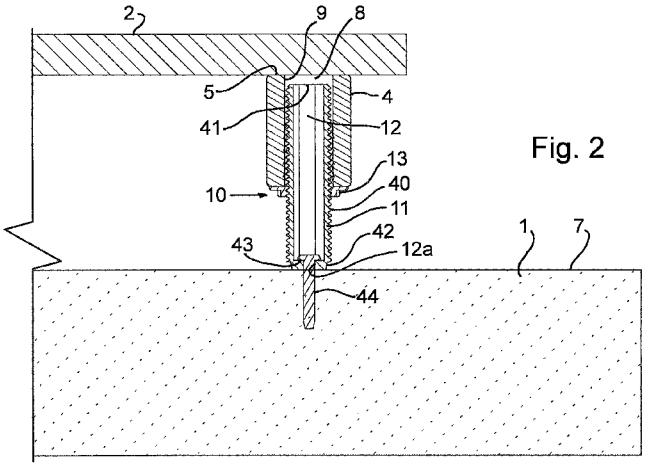


Fig. 2

(57) **Abstract**: A space and level adjuster (10) of a floor construction (1), whose joists (4) have vertical drill holes (8), wherein the adjusters comprise screws (11) and joist sleeves (13) with support flanges (19), which abut against a bottom planar surface of the joists (4). According to the invention, the joist sleeve comprises engagements means for fastening the joist sleeve to the joist, said engagement means comprising one or several radial, first protrusions (18), which are formed on the outside (22) of an intermediate portion (47) of the joist sleeve in order to form a stable engagement joint with the joist by penetrating into the wood material, said engagement joint providing a predetermined, axial locking force which is greater than the lift force the joist subjects the engagement joint to due to external loads. Furthermore, the joist sleeve has reinforcement means, which are arranged at the lower end portion (46) of the joist sleeve for reinforcing the connection of the support flange with the sleeve wall (21), said reinforcement means comprising a circumferential, lower extension (20) of the sleeve wall, in an axial direction downward, as seen from the support flange, as well as in a radial direction outward, as seen from the sleeve wall whereby the sleeve wall is thicker at the lower end portion than at the intermediate portion.

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A space and level adjuster and joist device for a floor construction

The present invention relates to a space and level adjuster for joists of a wood material of a floor construction which is supported by a support, said joists having vertically through-going, drilled holes, said adjusters each comprising

- an elongated screw having an external thread, said screw having a smaller diameter than said joist holes and being rotatably attached to the support, and
- an elongated joist sleeve having
  - a tubular wall,
  - an upper end,
  - a lower end,
  - an axially through-going hole extending between said ends and being enclosed by said wall,
  - an upper end portion comprising said upper end,
  - a lower end portion comprising said lower end,
  - an intermediate portion, extending between the upper end portion and the lower end portion and having a rotationally symmetrical outside,
  - an internal thread formed in the sleeve wall, and
  - supporting means for supporting the load from the floor construction, said supporting means comprising
    - a radially directed support flange, which is a part of the lower end portion and arranged to abut against a lower planar surface of the joist.

It is known to use screws in joists for supporting a floor structure on a support, wherein the joists are adjusted to level and a predetermined space is formed between the joists and the support by means of the screws. For this purpose the joists are provided with vertically through-going, drilled and threaded holes, the diameter and threads of which are adapted to the diameter

and threads of the screws in order to provide strong thread joints. Such thread joints, which are formed by the screws and the threaded holes in the joists, can only be used in connection with dry wood and in dry environments, i.e. indoors, which does not influence the moisture content of the joists to any considerable extent. They cannot be used in connection with moist wood, e.g. pressure impregnated wood, and in humid environments, i.e. outdoors, which influences the moisture content of the joists due to shifting weather conditions and season of the year. The reason for this is difficulties in screwing the screws into the threaded holes because the diameter of the threaded hqles may decrease when the moisture content of the joists is changed, and, when the screws have been possible to screw into the holes, difficulties in turning the screw in the hole during an adjustment to level of the joist required later, because the thread joint becomes rigid when the moisture content of the joist is changed so that the hole diameter decreases, with the consequence that the threads of the hole are locked to the threads of the screw.

However, there is a great need to be able to adjust the level and space of the joists by means of screws, which are accessible from the top side of the joist via vertically through-going holes, in which the screws are located without being in direct engagement with the joist.

The object of the invention is to provide a space and level adjuster for the above-mentioned joists, that fulfils said object and that provides a strong joint between the space and level adjuster in order to resist large loads, applied on top of the floor construction, as well as large lift forces, applied from below indirectly to the joists by wind, or directly to the joists by adjusting non-straight joists to level.

The space and level adjuster according to the invention is characterized in

- that the joist sleeve further comprises
  - engagement means for fastening the joist sleeve to the joist, said engagement means comprising
    - one or several, radial, first protrusions, which are formed on the outside of the intermediate portion and arranged to form a stable engagement joint with the joist by penetrating into the wood material, said engagement joint providing a predetermined, axial locking force which is greater than the lift force the joist subjects the engagement joint to due to external loads, and
  - reinforcement means arranged at the lower end portion for reinforcing the connection of the support flange with the sleeve wall, said reinforcement means comprising a circumferential, lower extension of the sleeve wall in an axial direction downward, as seen from the support flange, as well as in a radial direction outward, as seen from the sleeve wall whereby the sleeve wall is thicker at the lower end portion than at the intermediate portion.

The joist sleeve according to the present invention is designed to be mounted in drilled holes in joists of dry as well as moist wood material, and to then be able to allow that the moisture content of the wooden joist decreases or increases after installation with unchanged functions. In this way, the joist sleeve can handle the large movements which occur in the wood material when it changes from a wet to a dry condition, and vice versa. Such movements can produce a deformation of up to 10% between wet and dry condition.

The joist sleeve according to the invention is designed to allow assembly and disassembly of the floor construction several times without causing damages to the included components. This is particularly important in floor constructions which are only used during the warm season to then be disassembled for winter storage in a condition requiring a minimum of storage space.

The joist sleeve according to the invention is designed to support its share of the pressure forces, produced by the load from the joist framework, the floor covering and the objects present on the floor covering, and which are transferred to the support via the joist sleeves and the screws. Of course, it is also designed to be able to handle overloads caused by pressure forces in accordance with norms for the floor constructions in question.

The joist sleeve according to the invention is also designed to absorb its share of the lift forces produced by the wind on a floor construction for an outdoor environment in a wind-exposed location, such as, for example, a floor construction with a wooden deck for a pavement café or for a balcony, which lift forces are transferred via the joist sleeves and the screws to the fastening means between the screws and the support. Of course, it is also designed to be able to handle overloads caused by lift forces in accordance with norms for the floor constructions in question.

The joist sleeve according to the invention is also designed to absorb the torsional forces which are produced in the joist sleeve when its screw is turned around to lower or raise the joist and the screw connection, while the joist sleeve is loaded by the joist framework and the wooden deck, wherein said torsional forces which the joist sleeve can absorb are greater than the friction force in said thread connection at said

load, when the screw is turned, in order to prevent rotation of the joist sleeve in the joist hole.

The joist sleeve according to the invention can be designed with such dimensions that it can be installed in a joist having a smallest dimension of 34 x 45 mm in cross-section without causing the joist to crack during shrinkage, which occurs when the installation has been made on a wet joist which then dries, such as during a warm day. For this purpose the joist sleeve is designed to absorb such shrinking forces without being detrimentally deformed. A marginal elastic deformation of the joist sleeve is allowed within the tolerance for the thread connection between joist sleeve and screw to thereby reduce the risk of tensions in the wood material.

The invention will be described further with reference to the drawings.

Figure 1 schematically shows a floor construction with space and level adjusters, each comprising a joist sleeve according to a first embodiment.

Figure 2 is an enlarged sectional view along the line II-II in Figure 1.

Figure 3 is an enlarged part of the space and level adjuster of Figure 2.

Figure 4 is an enlarged sectional view of the joist sleeve of Figures 2 and 3, but rotated 45°, wherein the internal thread has not been depicted.

Figure 5 is a perspective view of a joist sleeve according to a second embodiment.

Figure 6 is a side view of the joist sleeve of Figure 5.

Figure 7 is an end view of the joist sleeve of Figure 5, as seen from above.

Figure 8 is an end view of the joist sleeve of Figure 5, as seen from below.

Figure 9 is a perspective view of a joist sleeve according to a third embodiment.

Figure 10 is a perspective view of a joist sleeve according to a fourth embodiment.

Figure 11 is a perspective view of a joist sleeve according to a fifth embodiment.

Figure 12 is a side view of the joist sleeve of Figure 11.

Figure 13 is an end view of the joist sleeve of Figure 11, as seen from above.

Figure 14 is a perspective view of a joist sleeve according to a sixth embodiment.

Figure 15 is a side view of the joist sleeve of Figure 14.

Figure 16 is a longitudinal sectional view of the joist sleeve along the line XVI–XVI in Figure 15.

Figure 17 is a perspective view of a joist sleeve according to a seventh embodiment.

Figure 18 is a side view of the joist sleeve of Figure 17.

Figure 19 is a longitudinal sectional view of the joist sleeve along the line IXX–IXX in Figure 18.

Figure 20 is a vertical sectional view of a joist sleeve according to an eight embodiment.

Figure 21 is a perspective view of a joist sleeve according to a ninth embodiment.

Figure 22 is a side view of the joist sleeve of Figure 21.

Figure 23 is an end view of the joist sleeve of Figure 22, as seen from below.

Figure 24 is a longitudinal sectional view of the joist sleeve along the line XXIV–XXIV in Figure 23.

Figure 25 is a sectional view of a joist, and the joist sleeve of Figure 21 in a fixed position in the joist.

Figure 26 is a sectional view of the joist and the joist sleeve of Figure 24 and, furthermore, of a screw in a position when screwed into the joist sleeve.

Figure 1 schematically shows a part of a floor construction, mounted on a firm, load-bearing support 1 of, for example, concrete. The floor construction comprises a floor covering 2 and a joist framework 3, on which the floor covering 2 is installed. The floor covering can be constructed in any suitable manner, such as a layer of boards, wooden grating, etc. The joist framework 3 comprises a plurality of parallel joists 4, which are arranged at a predetermined distance from each other. The joists 4 have a rectangular cross-section and exhibit a horizontal, planar top side 5, on which the floor covering 2 rests, and a bottom side 6, facing

toward the subfloor 1 and being located at a predetermined distance from the surface 7 of the subfloor 1. Each joist 4 has a plurality of vertical holes 8, extending centrally through the joist 4 from its top side 5 to its bottom side 6. The hole 8 is drilled for the formation of a through-going, relatively smooth, cylindrical hole wall 9 in the joist 4, said hole wall 9 thus having no thread. The threadless holes 8 have a predetermined diameter. The joist framework 3, or more precisely its joists 4, further comprises a plurality of load-carrying space and level adjusters 10, which are arranged adjacent to the holes 8 in the joists 4. Each space and level adjuster 10 comprises an elongated screw 11, having an external thread 40 with a predetermined, relatively small pitch and having a constant, predetermined diameter, which is smaller than the diameter of the hole 8. The thread 40 of the screw 11 extends from its upper end portion 41 to its lower end portion 42. The screw 11 is provided with an axially through-going hole 12, which thus extends between the end surfaces of the end portions 41, 42, wherein the lower end portion 42 of the screw 11 has an internal step 43, from which the hole 12 has a narrower portion 12a for passing through a fastening means 44 in the form of a nail, screw, or plug, for rotatable fastening of the screw 11 to the support 1, wherein the head of the fastening means 44 is fixed against said step 43.

Furthermore, each space and level adjuster comprises an elongated, multi-functional joist sleeve 13 for rotatable mounting of the screw 11 therein and for fastening to the joist 4 for absorption of external forces from the joist 4 and the screw 11. A first embodiment of such a joist sleeve 13 is shown more closely in Figures 2-4. The joist sleeve 13 has a tubular wall 21, enclosing an axially through-going hole 16. As seen in the position of use, the joist sleeve 13 has an upper end portion 45 with an

end or end surface 14, and a lower end portion 46 with an end or end surface 15, and an intermediate portion 47, extending between the two end portions 45, 46 and constituting a major part of the joist sleeve 13. On its inside, the joist sleeve 13 has a thread 17, extending between the two ends 14, 15 of the joist sleeve 13 and being designed to interact with the thread 40 of the screw 11, so that a strong thread joint is formed. Accordingly, the thread 17 of the joist sleeve 13 has the same pitch as the thread 40 of the screw 11, and has a slightly larger diameter than the externally threaded screw 11 in order to allow rotation of the screw 11 in the joist sleeve 13 also when the joist sleeve 13 exerts a load on the screw 11.

The joist sleeve 13 is manufactured in one piece and has a predetermined length for providing said internal thread 17 which provides a sufficient thread engagement for the screw 11 screwed thereinto while taking into account the vertical forces acting on this thread connection, wherein the screw 11 has a predetermined length so that one partial length of the screw 11 provides said thread engagement with the joist sleeve 13 and one partial length of the screw 11 projects out of the joist 4 in order to provide the required space between the joist 4 and the support 1.

The intermediate portion 47 of the joist sleeve has a rotationally symmetrical, conical outside 22 having a relatively small conicity (i.e. not directly discernable to the naked eye), wherein the largest diameter D_1 is at the transition to the lower end portion 46 and the smallest diameter D_s is at the transition to the upper end portion 45, see Figure 4. The upper end portion 45 is relatively short and has a conical outside 33 with a relatively large conicity, (i.e. directly discernible to the naked eye). The conical end portion 45 is intended to

facilitate the axial insertion of the joist sleeve 13 into the non-threaded hole 8 in the joist 4, particularly in connection with automated, mechanized installation of the joist sleeve 13 in the hole 8 in the joist 4.

The described joist sleeve 13 comprises engagement means for fastening the joist sleeve 13 to the joist 4, supporting means for supporting the load from the floor construction, and reinforcement means for reinforcing the connection of the supporting means with the wall 21 of the joist sleeve 13 in order to ensure the transmission of said load to the screw 11 supporting the joist sleeve 13.

The engagement means for fastening the joist sleeve 13 to the joist 4 comprise radial, first protrusions 18, which are formed on the conical outside 22 of the intermediate portion 47 in order to form a stable engagement joint with the hole wall 9 of the holes 8 in the joist 4, said engagement joint providing a predetermined axial locking force which is greater than the lift force the joist 4 subjects the protrusions 18 to due to external loads such as from wind flows, which can influence the floor construction and produce lift forces on the entire joist framework 3 and the floor covering 2. In the embodiment shown in Figures 2-4, the protrusions 18 are constituted of several, more precisely four gripping rings, each extending continuously around the conical outside 22 of the joist sleeve 13. The gripping rings 18 have a triangular, right-angled cross-section, the triangular shape and size of which are equal for all the gripping rings 18. Since the outside 22 of the joist sleeve 13 is conical with an increasing diameter in a direction toward the lower end portion 46, the outer diameter of the gripping rings 18 will thus increase to a corresponding degree. The gripping rings 18 are arranged at a predetermined, equal distance from each other, wherein

the lower gripping ring 18 is located at the same distance from the lower end portion 46 as the distance between two adjacent gripping rings 18. The inclined side 34 (the hypotenuse) of the gripping ring 18 is facing forward against the pushing-in direction, see Figure 3, whereas the side 35 (the cathetus), facing rearward in a direction toward the lower end portion 46, is perpendicular to the outside 22 and forms an efficient engagement surface for the wood material of the joist 4, which will be present behind the gripping ring 18 when the joist sleeve 13 has been pushed into the hole in the joist 4. The free tip of the gripping ring 18 transitions into a thin, elastically bendable lip 23, extending continuously around the entire gripping ring 18. The increasing diameter of the gripping rings 18 can be achieved by making the outside 22 conical and designing the gripping rings 18 with a triangular cross-section, whose triangular shape and area are equal, as shown in Figure 8. Alternatively, the triangular shape can be equal, i.e. the triangles have the same acute angle, whereas the area is different so that the cross-sectional area of the gripping rings increases in a direction toward the support flange 19 through an increase of the radial extension of the cross-sectional area. According to another embodiment (not shown), the outside 22 of the joist sleeve is cylindrical, wherein the gripping rings are designed with a triangular cross-section, whose triangular shape is equal and area different so that the cross-sectional area of the gripping rings increases in a direction toward the support flange 19 through an increase of the radial extension of the cross-sectional area. Suitably, the acute angle of the triangle is the same or substantially the same in all designs of the cross-section of the support ring, whereby the hypotenuse gets the same or substantially the same inclination irrespective of the area of the triangle. Suitably, said angle is selected within a range of 5°-20°. Suitably, the

radial extension of the support ring is selected within the range 0.7-3.0 mm, depending, inter alia, on the diameter of the joist sleeve. The axial extension of the support ring becomes dependent on which values are selected for said acute angle and radial extension of the support ring.

The advantage of the increasing diameter of the gripping rings 18 is that all gripping rings 18 will be in engagement with wood material that a preceding gripping ring 18 has not been in contact with. The first gripping ring 18 will push aside wood material around the hole wall 9 of the joist 4, because the wood material is relatively soft. The wood material is partially elastic and at least part of the wood material pushed radially aside will therefore be elastically brought back in order to accumulate behind the gripping ring 18. Each subsequent gripping ring 18 will thereafter also push aside wood material that a preceding gripping ring has not been in contact with, wherein this "new" wood material, and previous, once again pushed aside wood material, will at least partially be elastically brought back in order to accumulate behind the gripping ring 18. Accordingly, each subsequent gripping ring 18 will interact with wood material that has not been pushed aside by the preceding gripping ring 18. When the floor construction is subjected to a lift force, the engagement of the gripping rings with the wood material will increase in that the rearwardly facing gripping surfaces of the gripping rings 18 press against the wood material, out of which part has not been influenced by the preceding gripping ring 18 or rings. Since the wood material is elastic, also said "previously non-influenced part" of the wood material will first be pushed aside by the gripping ring 18, in order to then, at least partially, recover its shape, so that when subjected to loads from said lift forces the gripping ring 18 will

have a grip-improving contact with said "previously non-influenced part" of the wood material, so that the gripping ring 18, with its tip, penetrates into the relatively firm wood material when said lift forces act on the engagement joint, while forming a ridge of wood material. In this way, the engagement joint between joist sleeve 13 and joist 4 becomes stronger so that it resists the lift forces acting on the joist sleeve 13 via the joist 4. As mentioned previously, the screw 11, supporting the joist sleeve 13, is fastened to the support 1 in order to prevent axial movement upward of the screw 11, when its fastening joint with the support 1 is subjected to said lift forces. Also the elastically bendable lip 23 contributes to increasing the strength of the engagement joint.

The supporting means for supporting the load from the floor construction comprise a circumferential support flange 19 of the lower end portion 46, said support flange 19 being formed radially outward from the wall 21 and having a planar top side 26, which is perpendicular to the centre axis C (see Figure 4) of the joist sleeve 13, and a bottom side 24. When pushing in the intermediate portion 47 of the joist sleeve 13, the support flange 19 will function as a stop for further insertion, wherein the planar top side 26 of the support flange 19 will abut against a horizontal surface of the joist 4, which surface is formed by the bottom side 6 of the joist 4 in the embodiment described herein. The load transferred by the joist 4 produces pressure forces on the support flange 19, which pressure forces are in their turn transferred to the supporting screw 11 via the support flange 19 itself and the remaining part of the joist sleeve 13. The support flange 19 has a predetermined diameter that is, among other things, sufficient to provide the desired supporting area and stop function.

Figures 5-8 show a joist sleeve according to a second embodiment, similar to the one in Figures 2-4, but in this case the engagement means for fastening the joist sleeve 13 to the joist 4 further comprise several, more precisely four protrusions 27 being uniformly distributed in the circumferential direction, which extend radially outward from the outside of the sleeve wall 21, axially upward from the top side 26 of the support flange 19. The protrusions 27 are adapted to form a stable engagement joint with the hole wall 9 of the hole 8 in the joist 4, said engagement joint providing a predetermined locking force in the circumferential direction which is greater than the torsional forces that the joist sleeve 13 is subjected to when the supporting screw 11 is turned around - in order to lower or raise the joist 4 - under the influence of the forces acting on the thread 40 of the supporting screw 11 due to the load being transferred via the joist 4 and the joist sleeve 13 and the thread 17 of the joist sleeve 13, see Figure 3. If said locking force is too small, the friction between the joist sleeve 13 and the hole wall 9 of the hole 8 in the joist 4 is easily overcome, with the consequence that the joist sleeve 13 and the screw 11 are rotated in the hole 8 as a unit, and the desired lowering or raising of the joist 4 cannot be accomplished. Another inconvenience is that the screw 11 cannot be removed. In the embodiment shown in Figures 5-8, the protrusions 27 are formed as cutting elements which, as mentioned previously, extend radially outward from the outside 22 and axially outward from the support flange 19. In other words, each cutting element 27 is located at the corner transition between the outside 22 of the intermediate portion 47 and the top side 26 of the support flange 19. The cutting element 27 has a predetermined thickness and has its free edge directed upward so that the cutting element 27 will cut into the relatively soft wood material of the joist 4

around the opening of the hole 12, when the joist sleeve 13 is pushed into the hole 8 in the joist 4. Since the joist sleeve 13 is formed in a single, continuous piece, the cutting elements 27 form rigid, fixed connections with the intermediate portion 47 and the support flange 19, wherein thus the cutting elements 27 furthermore provide a reinforcement of the support flange 19. Accordingly, the protrusions or cutting elements 27 also function as upper reinforcement means for reinforcing the connection of the support flange 19 with the wall 21 of the joist sleeve 13. The edges of the cutting elements 27 are arcuate with a predetermined radius. According to another embodiment, the edges are straight.

The embodiments shown in Figures 2-8 have reinforcement means, comprising a circumferential, upper extension 48 of the wall 21 of the joist sleeve, said extension 48 forming an arcuate transition surface 49 between the top side 26 of the support flange 19 and the outside 22 of the intermediate portion 47, wherein the transition surface 49 has a predetermined radius, which is suitably smaller than 5 mm. Accordingly, the upper extension or reinforcement 48 is relatively small, in order not to obstruct the pushing-in of the joist sleeve 13 into the hole 8 in the joist 4, so that the opposite surfaces 6 and 26 can be brought into abutment against each other, but has still proven to be sufficient in order to achieve an advantageous reinforcement of the wall 9 of the joist sleeve 4 in close vicinity to and above the support flange 19, where ruptures can occur when loading the support flange 19 in the same way as below the support flange 19. If the upper reinforcement 48 is made larger and with the same shape as shown, or with a different shape, a recess has to be cut around the inlet opening of the hole 8.

The reinforcement means further comprise a circumferential, lower extension 20 of the joist sleeve 13 within its lower end portion 46, in an axial direction downward from the support flange 19, as well as in a radial direction outward from the wall 21 of the joist sleeve 13, so that the diameter D_e of the lower extension 20 closest to the support flange 19 is larger than said diameter D_1 of the intermediate portion 47, wherein the turns of the thread groove at the support flange 19 and in the immediate vicinity of it, first pass the upper extension 48, then the support flange 19, and finally the thicker wall portion, which is thus formed by the lower extension 20. In the embodiment shown, said lower extension 20 is shaped as a cylinder with a rotationally symmetrical, cylindrical outside 28. Accordingly, the lower extension 20 means that the wall 21 becomes thicker in the lower end portion 46 relative to the intermediate portion 47, in order to thereby form a lower reinforcement of the support flange 19 and reduce the risk of rupture between the support flange 19 and the remaining part of the joist sleeve 13 adjacent to an opposite part of a valley portion of the internal thread 17, which thus extends through the lower end portion 46 comprising the extension 20.

The lower end portion is further provided with a mounting support for an installing tool. In the embodiments shown in Figures 2-8, the mounting support comprises, on the one hand, said lower extension 20, which thus has two main functions, and on the other hand, several, more precisely four support elements 30, which are radially and axially formed between the lower extension 20 and the support flange 19. The above-mentioned installing tool is used for mechanized, automated alignment and pushing in of the fastening intermediate portion 47 of the joist sleeve 13 into the non-threaded, pre-drilled holes 8 in a joist 4, which joist 4 is advanced step by step past an

installation station, which is provided with said installing tool. The installing tool has four corresponding recesses for receiving the four support elements 30 of the joist sleeve 13, at the same time as the installing tool is in engagement with and encloses the extension 20. In this way, the joist sleeve 13 is fixed in axial alignment with the hole 8 and against rotation, so that axial pushing-in of the joist sleeve 13 without rotating the joist sleeve 13 is ensured.

Figure 9 shows a joist sleeve 13, similar to the one in Figures 5-9, with the exception of the design of the protrusions 27 forming said engagement joint, which provides a predetermined locking force in the circumferential direction in the joist. In the joist sleeve 13 according to Figure 9, the protrusions 27 are formed as conical pins, extending upward from the top side 26 of the support flange 19 in order to be pressed into the wood material and to thereby fix the joist sleeve 13 against torsional forces, wherein the pointed shape facilitates the pressing-in. Alternatively, the pins 27 can be pyramid-shaped, with three to six triangular sides. Instead of pointed pins, sharp-edged pins, comprising two angled sides meeting in a horizontal edge, can be used.

Figure 10 shows a joist sleeve 13, which is different from the one in Figure 9 only in that the support flange 19 is provided with four radially projecting supporting arms 31 for carrying the four cone-shaped pins 27, wherein these supporting arms 31 also can function as a mounting support for the installing tool together with the cylindrical extension 20. The design of the pins 27 can be varied as described above in connection with Figure 9.

Figures 11-13 show a joist sleeve 13, similar to the one in Figures 2-4 with the exception of the design of the protrusions 18 on the outside 22 of the intermediate portion 47, which protrusions 18 in this case are formed as elongated gripping bodies, each having a larger length than width and being axially directed on the outside 22, wherein the gripping body 18 has two axial side surfaces 36, 37 being inclined toward each other while forming an axial edge 38, which is arcuate and terminates against the outside 22, in addition to which the gripping body 18 has a rear radial engagement surface 32 for interaction with the wood material. The gripping bodies 18 are arranged in axial rows with two gripping bodies 18 in each row, wherein the gripping bodies 18 of two adjacent rows are displaced relative to each other. In this embodiment, the gripping bodies 18 also form an engagement joint with the wood material, in order to lock the joist sleeve 13 in the circumferential direction and to thereby prevent the joist sleeve 13 from rotating in the hole 8 in the joist 4. In this embodiment, the protrusions 27 in Figure 5 can be omitted. In another, not shown, embodiment of the gripping bodies 18, they are formed as pyramids having three free triangular sides, wherein the tip of the gripping body is facing in the pushing-in direction of the joist sleeve, and has a radial rear engagement surface with the same function as the previously described engagement surfaces.

In other embodiments (not shown), the engagement means comprise a protrusion, having the form of a thread or spiral, which extends continuously around the outside 22 in a counter-clockwise direction or clockwise direction and which also provides locking against torsional forces in either one or the other direction.

Figures 14-16 show a joist sleeve 13, similar to the one in Figures 2-4 with the exception of the design of the

protrusions 18 on the intermediate portion 47, which in this case are formed as three gripping rings 18, each extending in a wave shape around the outside 22. The cross-section of the gripping ring is triangular, as described previously for the embodiment according to Figures 2-4.

Figures 17-19 show a joist sleeve 13, similar to the one in Figures 2-4 with exception of the design of the protrusions 18, which in this case are formed as two divided gripping rings 18, each being divided into four ring members 39, wherein each ring member 39 extends from a lower point to an upper point, wherein the four lower points of the ring members 39 of each gripping ring 18 are located on one and the same lower circumference and the four upper points of the ring members 39 of each gripping ring 18 are located on one and the same upper circumference.

Figure 20 shows a joist sleeve 13, similar to the one in Figures 2-4 with the exception of the design of the reinforcing extension 20. In this case, the extension 20 extends radially outward so that its diameter closest to the support flange 19 is the same as the diameter of the support flange 19, wherein the extension 20 is united (without visible border) to the support flange 19 along its entire radial extension. The side of the extension 20 facing away from the support flange 19 is rounded. Alternatively, it can be straight, as is indicated by the dashed line. The extension 20 can also comprise an axial, tubular extension having a cylindrical outside, in the same way as the joist sleeve in Figures 2-4, wherein the extension can have a smooth inside, i.e. be without a thread, or be internally threaded, i.e. the thread 17 also extends through the extension. The extension constitutes a support for an installing tool, as described previously.

In the embodiment of the joist sleeve shown in Figures 21-24, the protrusions 18 are constituted of several, more precisely four articulated tongues 50, instead of support rings as in Figures 2-4. The tongues 50 are formed in one piece with the intermediate portion 47. Each tongue 50 has a longitudinal dimension, extending in the longitudinal direction of the joist sleeve 13 from an upper end 51 to a lower end 52 in order to assume a free, non-influenced initial position, in which the tongue 50 projects obliquely downward from the outside 22, as is evident from Figure 22. As seen in a longitudinal section, the tongue 50 has a substantially triangular shape such that it has a thicker portion adjacent to its lower end 51 and a narrower portion adjacent to its upper end 52. Thereby, the narrower potion forms an articulated connection 53 with the intermediate portion 47. At its lower end 51, the tongue 50 has a radial end surface 54, an inclined surface 55, and two axial, parallel side surfaces 56. Radially inside of each tongue 50, there is a rectangular recess or opening 57 formed in the wall of the intermediate portion 47, said opening 57 being radially through-going. The opening 57 and the tongue 50 are so adapted to each other that the tongue 50 without problem can be received in the opening 57 and thereby also occupy opposite portions of the thread groove of the internal thread 17 of the joist sleeve 13. When pushing in the joist sleeve 13 into the hole 8 in the joist 4, the hole wall 9 will thereby push the tongues 50 into their openings 57, as is evident from Figure 25, so that the tongues 50 occupy opposite portions of the thread groove. During the subsequent screwing-in of the screw 11, which is suitably carried out from above with the shown shape of the tongues 50, the screw 11 comes into engagement with the tongues 50 and during the continued screwing-in, the screw 11 pushes the tongues 50 radially outward and into the wood material of the joist 4. The

lower, radial end surface 54 and the axial side surfaces 56 of each tongue 50 will thereby be in engagement with the hole wall 9 of the joist 4, so that the joist sleeve 13 is fixed in the joist 4, whereby the joist sleeve 13 cannot be rotated in any direction, nor be axially displaced. Furthermore, the tongues 50 will take up some loads.

The wall portion around the hole 8 in the joist 4 can be provided with a countersink on the bottom side 6 of the joist, wherein the countersink has a diameter which is equal to or slightly larger than the diameter of the support flange, and a depth which is equal to or slightly smaller or slightly larger than the distance between the top side of the support flange and the lower end of the joist sleeve, so that the lower end portion will be received in the countersink, with the consequence that the joist sleeve does not add any construction height. In this way, the volume of the joists provided with joist sleeves is reduced when they are packed into packages, which volume reduction is advantageous during transport.

In its external diameter D_1 closest to the support flange 19, the wall of the joist sleeve 13 is at the most equal to, or slightly smaller than, the diameter of the pre-drilled hole in the joist. Suitably, "slightly smaller" means no more than 0.3 mm, preferably no more than 0.1 mm. The joist sleeve 13 has a predetermined ratio relative to the hole pre-drilled in the wooden joist, as seen in a newly drilled condition, which means that the installation of the joist sleeve should, or preferably should, take place in immediate connection with the drilling operation, so that the wood material has no time to change because of it drying and shrinking. Since the drilling and installation of the joist sleeve is carried out in unit operations connected to each other, no measurement of the moisture content of the

wooden joist is required, but it can vary between different wooden joists and from day to day.

The joist sleeve can also be subjected to lift forces other than those when the floor construction is subjected to wind, namely when installing a joist which is not completely straight, meaning that at least the top side of the joist is curved. When adjusting the level of such a joist relative to the other joists, which requires that the curved top side has to be brought into a planar, straight shape, the joist is forced to straighten out by turning the screws 11 in the joist sleeves so that the joist, in its upwardly curved section or sections, is displaced in a direction toward the support, to which the screws are rotatably fixed, so that stresses arise in the joist, resulting in the joist sleeves being subjected to lift forces from the joist.

The joist sleeve is particularly suited to be used for floor constructions in an outdoor environment, but it can of course be used for floor constructions in an indoor environment. The above-mentioned problem with bowed joists, which have to be straightened out, exists in both environments.

The joist sleeve according to the invention is manufactured of a material which is resistant to aging, and which provides a strong joist sleeve resisting the loads it is subjected to, particularly in a floor construction for outdoor use. The material should be a non-corroding material. On the other hand, the joist sleeve can alternatively be provided with a corrosion protection. Examples of suitable materials are plastic materials, ceramic materials and metals with or without corrosion protection. A presently preferred plastic material is POM, which is a polyoxymethyl plastic.

The number of gripping protrusions 18, e.g. gripping rings, can vary depending, inter alia, on the strength required from the engagement joint in each individual case. Furthermore, their shape and radial extension are, inter alia, dependent on the width of the joist in question being selected. Thus, for example, a narrower joist, such as 45 mm, requires a radial extension of the gripping protrusions 18 which cannot be so large that he joist cracks during the pushing-in of the joist sleeve into the joist hole. In such cases, the number of gripping protrusions has to be increased, such as, for example, to four gripping rings according to the above-described embodiments. With joists having a larger width, e.g. 95 mm, the joist sleeve can have a larger diameter without causing the joist to crack, wherein the gripping protrusions can be given a larger radial extension and shape. Also the number of protrusions can be reduced in this case. For instance, such a joist sleeve with a larger diameter can have only one or two gripping rings, which then have a larger radial extension than the one shown. It is appreciated that a greater force is then required to push the joist sleeve into the joist hole, whose diameter is adapted to the joist sleeve as described above.

The joist sleeve has such a length that a sufficient length of its internal thread is obtained, so that its screw joint with the screw is secure at least for the load the building structure in question, with various objects placed on top of it, exerts on the screw joint. Suitably, said thread length is at least 40 mm for floor constructions intended for normal loads, such as outdoor floors on the ground, or patios on roofs of houses.

The screw has such a length that, in addition to providing said thread joint with the joist sleeve, it will be able to form a minimum space between the bottom

side of the joist and the load-bearing support. Suitably, such a space is at least 1 mm, preferably at least 3 mm.

According to an alternative embodiment, the joist sleeve is designed with gripping rings having one and the same diameter, i.e. the outside 22 of the intermediate portion 47 is cylindrical and the gripping rings have the same radial extension.

In the following, a test is described which has been performed with a floor construction using space and level adjusters according to the invention.

Test

A floor construction in the form of an outdoor floor was built on a support 1 of a packed bed of gravel and sand, onto which a plurality of uniformly distributed ground slabs had been positioned to form screw supports for the screws 11 of the outdoor floor. The outdoor floor had an area of 15 m^2. The assembled joist framework 3 consisted of joists 4 having a cross-section with the dimensions 45 x 45 mm. The joists, which had been fitted at 300 mm cc, were provided with vertically through-going, drilled holes 8 having a diameter of 26 ± 0.1 mm for 76 pieces of joist sleeves 13 and associated screws 11. In each hole, a joist sleeve 13 according to Figures 2-9 had been pushed in so that its support flange 19 was in contact with the bottom side 6 of the joist 4. The joist sleeve 13 had a total length of 39.5 mm, wherein the portion received in the joist hole 8 had a length of 34 mm. The conical outside 22 of the intermediate portion 47 had a diameter D_s of 25.5 mm and a diameter D_1 of 25.9 mm, i.e. a diameter difference of 0.4 mm. The four gripping rings 18 had an external diameter of 27.3; 27.4; 27.5 and 27.6 mm, as counted from the upper end portion. Each gripping ring 18 had an axial extension of 1.65 mm

and a radial extension of 0.9 mm, whereas the length of the lip 23 was 0.1 mm. The lower extension 20 had a diameter D_e, as measured closest to the support flange 19, which was 30.0 mm, and an axial dimension of 3.0 mm, as measured from the support flange 19. The circle-sector shaped protrusions 27 had a radius of 5.6 mm. The finished outdoor floor was test loaded with an increasing load up to 300 kg/m^2. It was also subjected to increasing lift forces up to 300 kg/m^2. At the higher load, the possibility of turning several of the screws was investigated in order to determine whether the rotary joint was sufficiently strong to be able to turn around the screws without destroying the rotary joint at the existing high load on the thread engagement between joist sleeve and screw. The result was that the rotary joints of all investigated joist sleeves resisted the torsional forces applied when turning the screw also at said high test load. Furthermore, it was found that the engagement joint between each joist sleeve and joist was intact also when the outdoor floor was subjected to the higher lift forces. The above-mentioned upper load and said upper lift force are far above the values that the outdoor floor is subjected to in normal conditions.

C L A I M S

1. A space and level adjuster (10) for joists (4) of a wood material of a floor construction which is supported by a support (1), said joists (4) having vertically through-going, drilled holes (8), said adjusters (10) each comprising

- an elongated screw (11) having an external thread (40), said screw (11) having a smaller diameter than said joist holes (8) and being rotatably attached to the support (1), and
- an elongated joist sleeve (13) having
  - a tubular wall (21),
  - an upper end (14),
  - a lower end (15),
  - an axially through-going hole (12) extending between said ends (14, 15) and being enclosed by said wall (21),
  - an upper end portion (45) comprising said upper end (14),
  - a lower end portion (46) comprising said lower end (15),
  - an intermediate portion (47) extending between the upper end portion (45) and the lower end portion (46) and having a rotationally symmetrical outside (22),
  - an internal thread (17) formed in the sleeve wall (21), and
  - supporting means for supporting the load from the floor construction, said supporting means comprising
    - a radially directed support flange (19), which is a part of the lower end portion (46) and that is arranged to abut against a lower planar surface of the joist (4),

characterized in

- that the joist sleeve (13) further comprises
  - engagement means for fastening the joist sleeve (13) to the joist, said engagement means comprising
    - one or several radial, first protrusions (18) formed on the outside (22) of the intermediate portion (47) and arranged to form a stable engagement joint with the joist (4) by penetrating into the wood material, said engagement joint providing a predetermined, axial locking force which is greater than the lift force the joist (4) subjects the engagement joint to due to external loads, and
  - reinforcement means being arranged at the lower end portion (46) for reinforcing the connection of the support flange (19) with the sleeve wall (21), said reinforcement means comprising a circumferential, lower extension (20) of the sleeve wall (21) in an axial direction downward, as seen from the support flange (19), as well as in a radial direction outward, as seen from the sleeve wall (21) whereby the sleeve wall (21) is thicker at the lower end portion (46) than at the intermediate portion (47).

2. The space and level adjuster (10) according to claim 1, **characterized in** that the reinforcement means also comprise a circumferential, upper extension (48) of the sleeve wall (21), said upper extension (48) forming an arcuate transition surface (49) between the top side (26) of the support flange (19) and the outside (22) of the intermediate portion (47), said transition surface (49) having a relatively small radius.

3. The space and level adjuster (10) according to claim 1 or 2, **characterized in** that said engagement means comprise one or several radial, second protrusions (27), which are arranged to form a stable engagement joint with the hole wall (9) of the hole (8) in the joist (4), said

engagement joint providing a predetermined locking force in the circumferential direction, which is greater than the torsional forces that the joist sleeve (13) is subjected to when the supporting screw (11) is turned around - in order to lower or raise the joist (4) - under the influence of the forces acting on the thread (40) of the supporting screw (11) due to the load transferred via the joist (4) and the joist sleeve (13) and the thread (17) of the joist sleeve (13).

4. The space and level adjuster (10) according to any one of the claims 1-3, **characterized in** that said first protrusions (18) are fixedly, immovably connected to the intermediate portion (47) and formed in one continuous piece therewith, wherein the fixed protrusions (18) are adapted to form said stable engagement joint with the joist (4) when pushing the intermediate portion (47) into the hole (8) in the joist (4).

5. The space and level adjuster (10) according to claim 1, **characterized in** that said first protrusions (18) are constituted of a plurality of gripping rings extending around the outside (22) of the joist sleeve (13).

6. The space and level adjuster (10) according to claim 5, **characterized in** that the gripping rings (18) have a triangular cross-section so that each gripping ring (18) has an inclined side (34) facing in the insertion direction of the joist sleeve (13), and a side (35) projecting substantially perpendicularly from the outside (22) facing rearwardly toward the support flange (19) in order to form an efficient engagement surface for wood material of the joist (4), which is forced in behind the gripping ring (18) when the joist sleeve (13) is pushed into the hole (8) in the joist (4).

7. The space and level adjuster (10) according to claim 6, **characterized in** that said sides (34, 35) of the gripping ring (18) form a tip transitioning into a circumferential, thin, elastically bendable lip (23).

8. The space and level adjuster (10) according to any one of the claims 5-7, **characterized in** that the diameter of the gripping rings (18) increases, as seen in a direction from the gripping ring (18) located closest to the upper end portion (45) to the gripping ring (18) located closest to the support flange (19).

9. The space and level adjuster (10) according to claim 8, **characterized in** that the outside (22) of the intermediate portion (47) is a rotationally symmetrical cylinder surface, wherein the cross-sectional area and radial extension of the gripping rings increase, as seen in a direction from the gripping ring (18) located closest to the upper end portion (45) to the gripping ring (18) located closest to the support flange (19), in order to thereby obtain said increase of the diameter of the gripping rings (18).

10. The space and level adjuster (10) according to claim 8, **characterized in** that the outside (22) of the intermediate portion (47) is a rotationally symmetrical, conical surface, having a smallest diameter located at the transition to the upper end portion (45) and a largest diameter located at the transition to the lower end portion (46), whereby the gripping rings (18) have the same cross-sectional area and radial extension, whereby said conicity of the outside (22) provides said increase of the diameter of the gripping rings (18).

11. The space and level adjuster (10) according to claim 3, **characterized in** that said second protrusions (27) are formed as cutting elements with a free edge, which is

directed in the advancing direction in order to cut into the wood material during the advancement of the joist sleeve (13).

12. The space and level adjuster (10) according to any one of the claims 1-11, **characterized in** that said extension (20), at least closest to the support flange (19), has a diameter D_e which is larger than the diameter of the intermediate portion (47) as measured closest to the support flange (19).

13. The space and level adjuster (10) according to claim 12, **characterized in** that said diameter difference is at least 4 mm and that the axial extension of the extension (20) is at least 3 mm.

14. The space and level adjuster (10) according to claim 12 or 14, **characterized in** that the extension (20) has a cylindrical outside with a diameter D_e which is smaller than, or equal to, the diameter of the support flange (19).

15. The space and level adjuster (10) according to claim 12 or 13, **characterized in** that the extension (20) has an outside which is conically or arcuately inclined in a direction inward toward the end surface (15) of the joist sleeve (13).

16. The space and level adjuster (10) according to any one of the claims 1, 2, 12-15, **characterized in** that said first protrusions (18) are articulately connected to the intermediate portion (47) and formed in one continuous piece therewith, whereby the articulated protrusions (18) are adapted to form said stable engagement joint with the joist (4) when screwing the screw (11) into the joist sleeve (13).

17. The space and level adjuster (10) according to claim 16, **characterized in** that said first protrusions (18) are constituted of a plurality of articulated tongues (50), which are distributed around the outside (22) of the joist sleeve (13), said tongues (50) being arranged adjacent to radially through-going openings (57) in the wall of the intermediate portion (47) in order to, on the one hand, be pushed thereinto during the pushing-in of the joist sleeve (4) into the hole (8) in the joist (4) while simultaneously temporarily blocking the internal thread grooves of the joist sleeve (13) and, on the other hand, be pushed out of the openings (57) by the screw (11) when it is screwed into the joist sleeve (13), wherein the tongues are brought into engagement with the wood material of the joist (4) in the hole wall (9).

18. A joist device for a floor construction, which is supported by a support, said joist device comprising

- an elongated joist (4) having vertically through-going, drilled, threadless holes (8), and
- a space and level adjuster (10) according to any one of the claims 1-17.

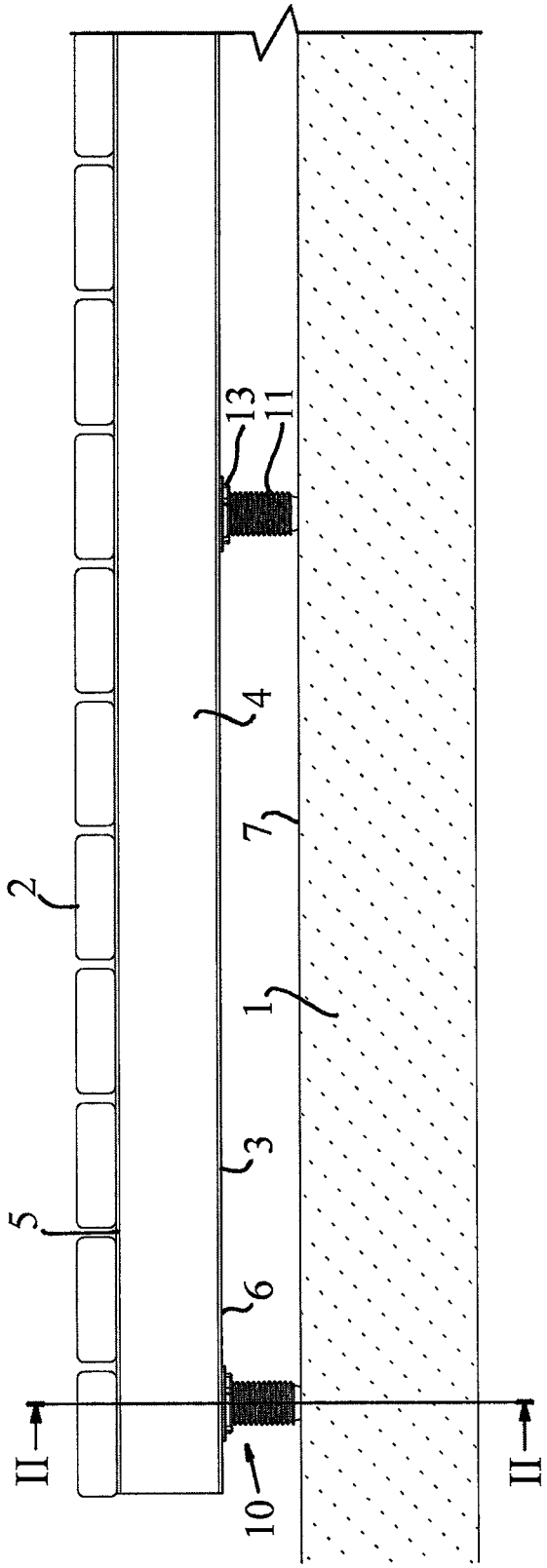
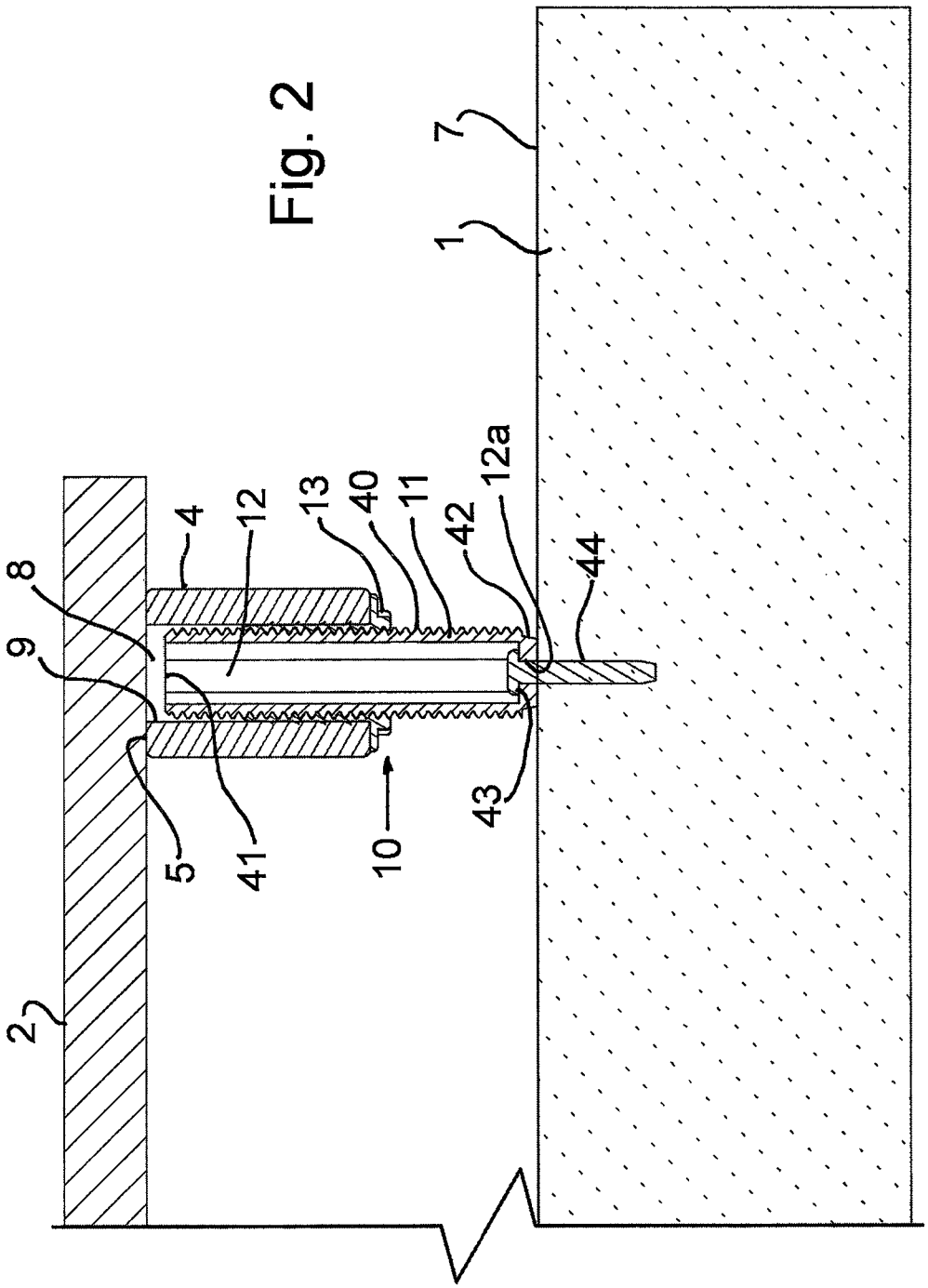


Fig. 1

Fig. 2



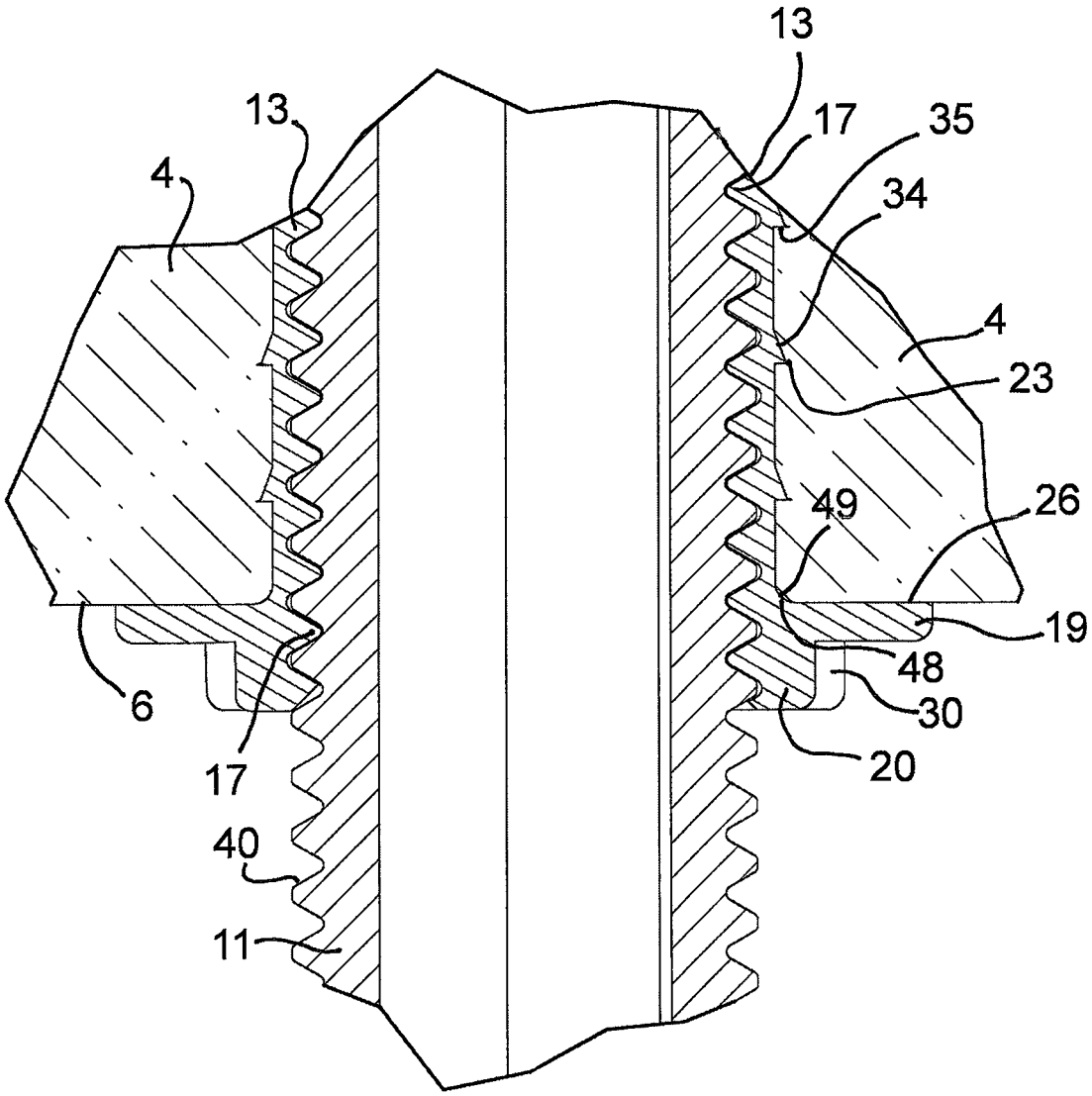


Fig. 3

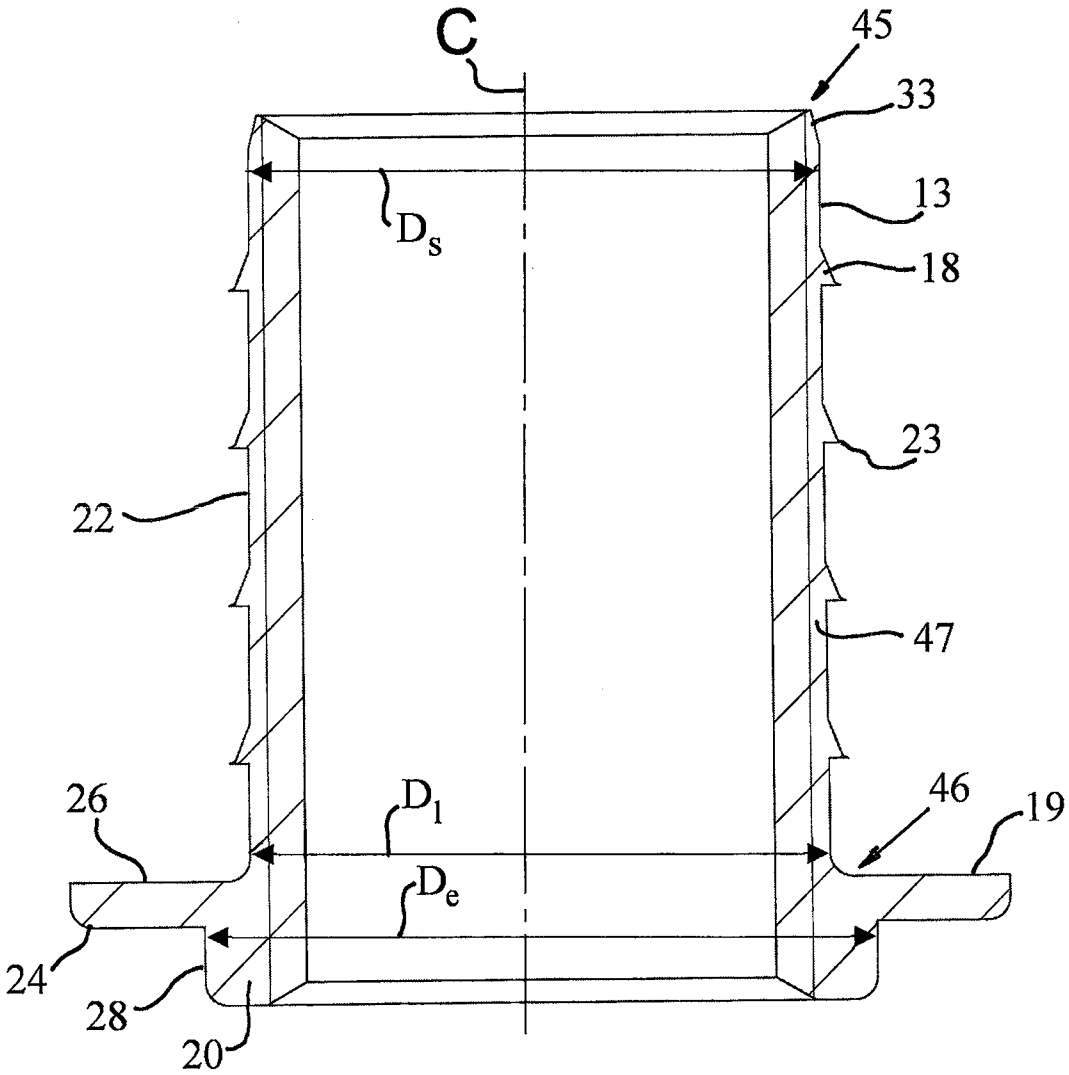


Fig. 4

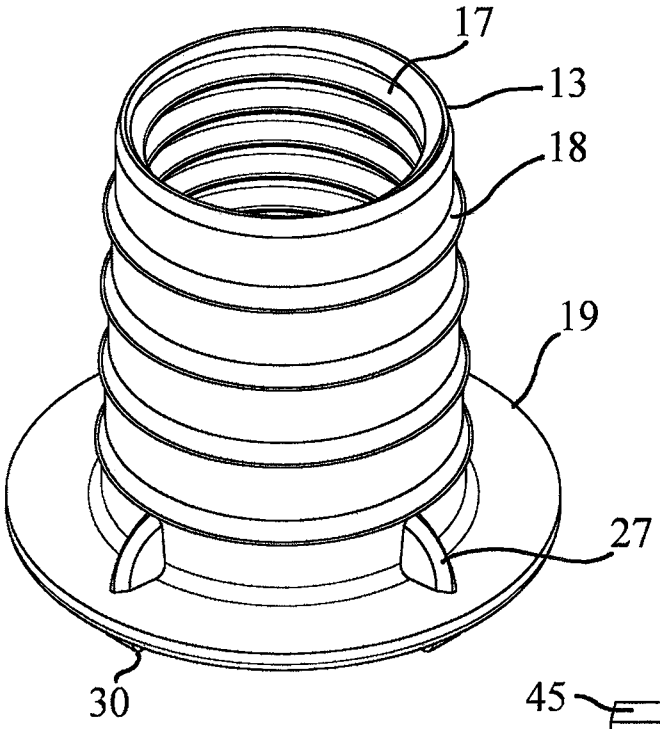


Fig. 5

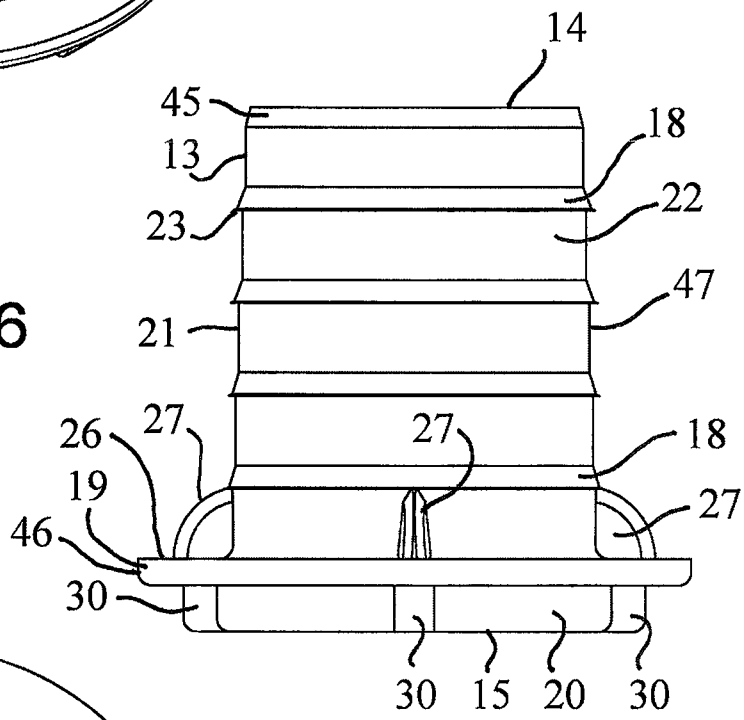


Fig. 6

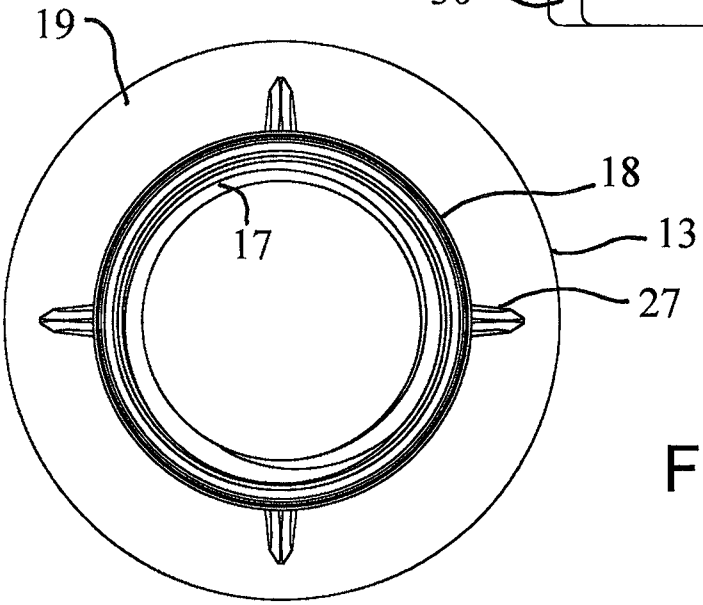


Fig. 7

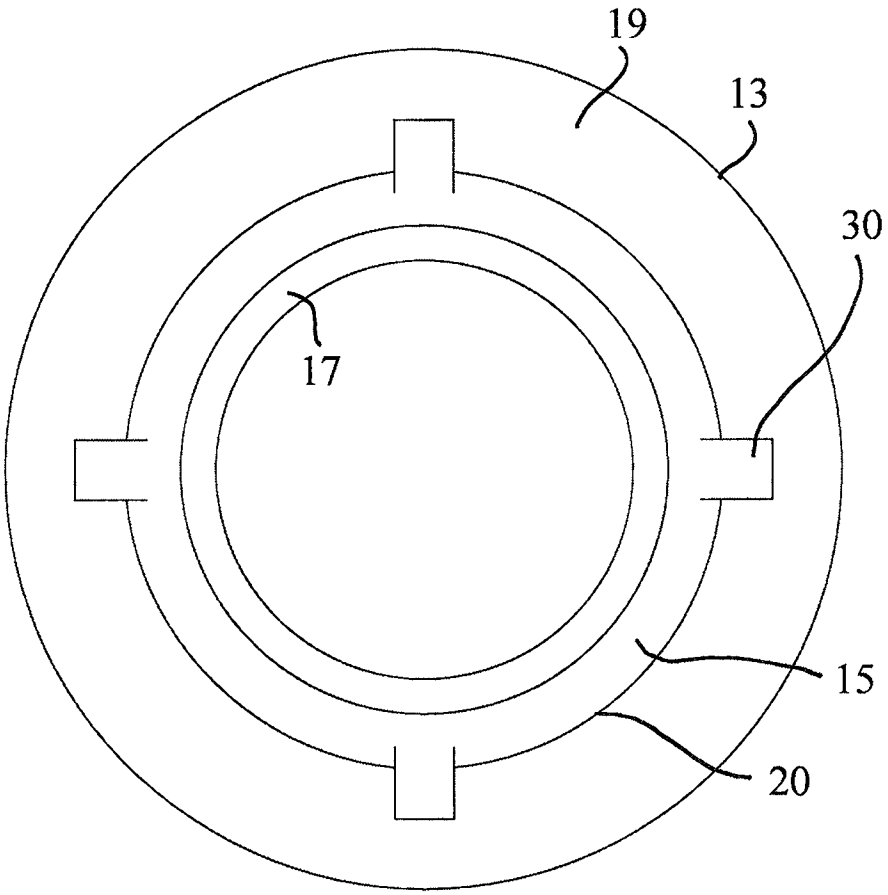


Fig. 8

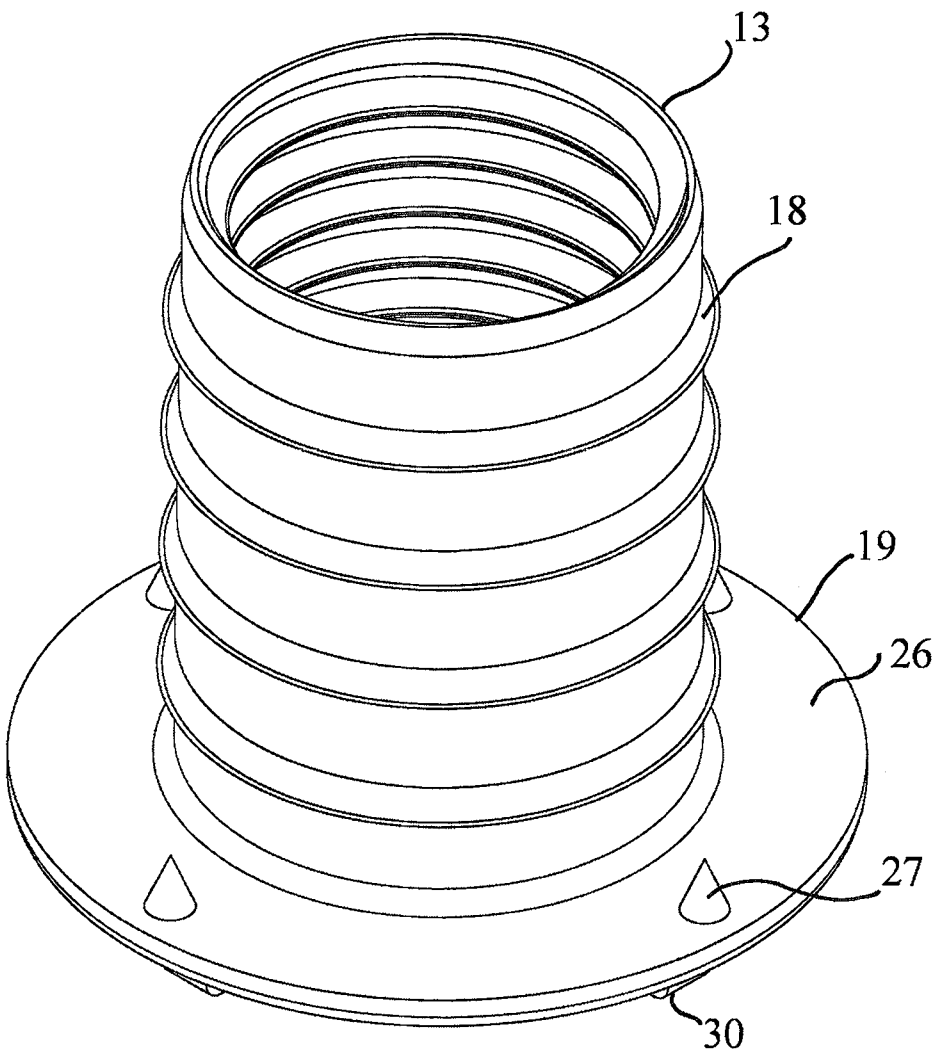


Fig. 9

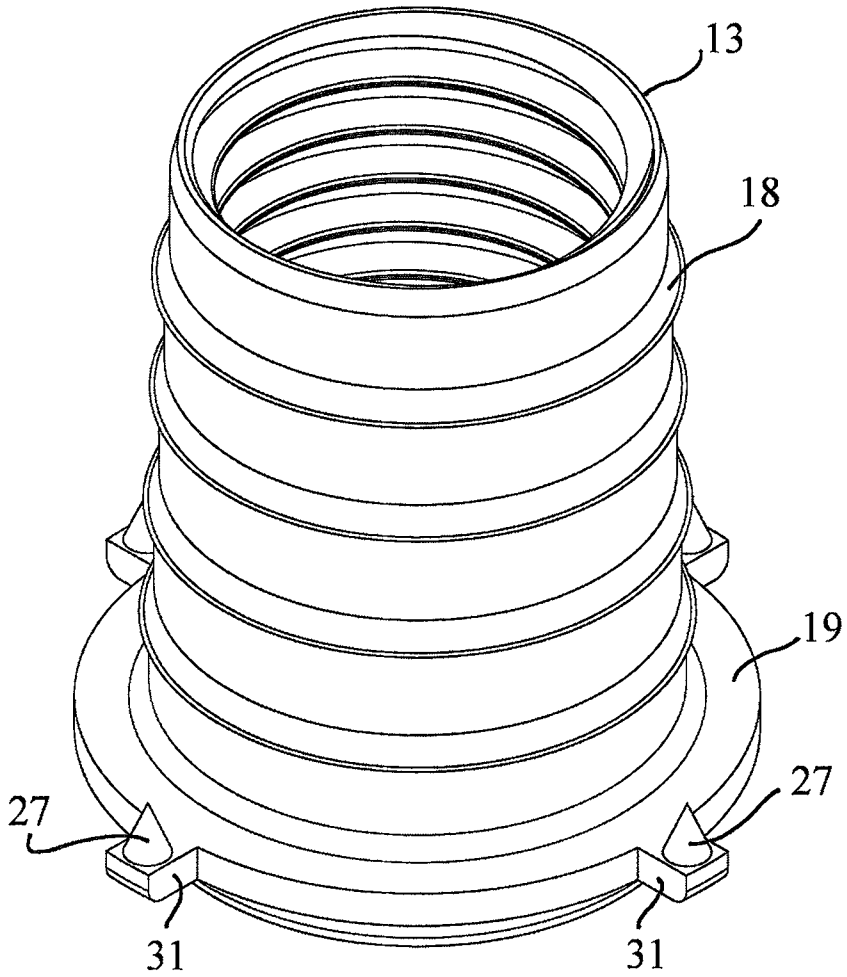


Fig. 10

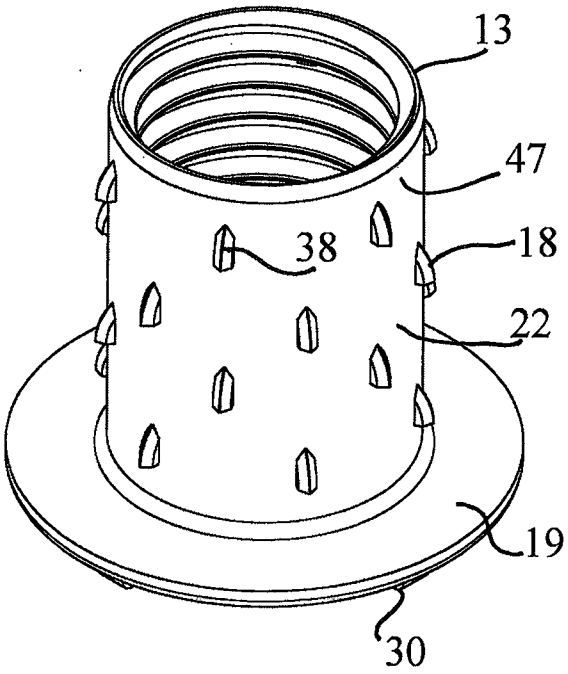


Fig. 11

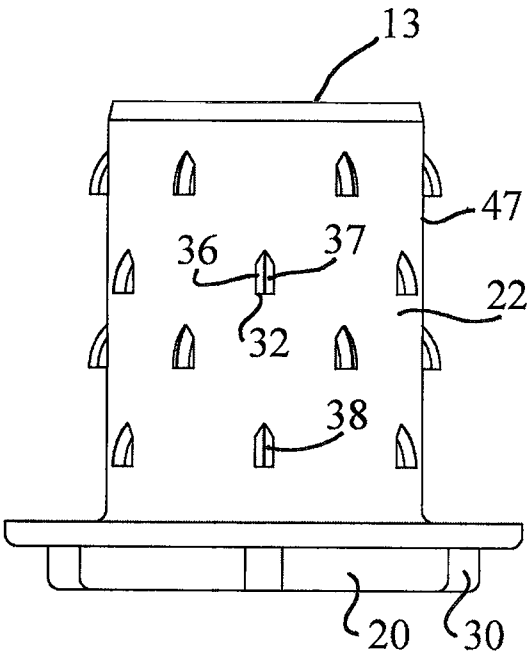


Fig. 12

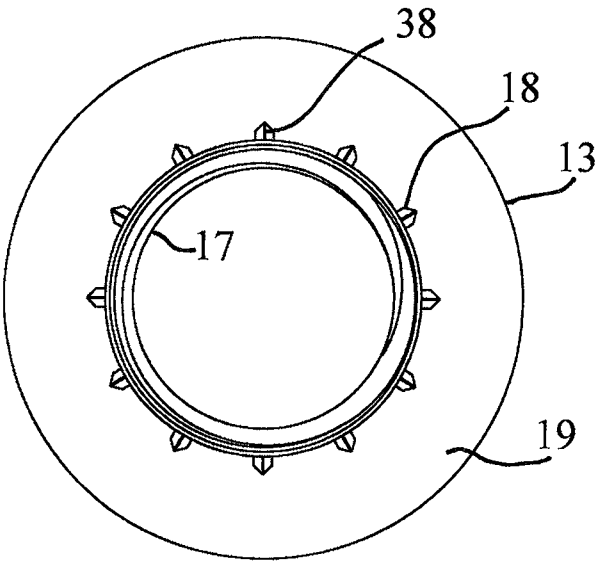
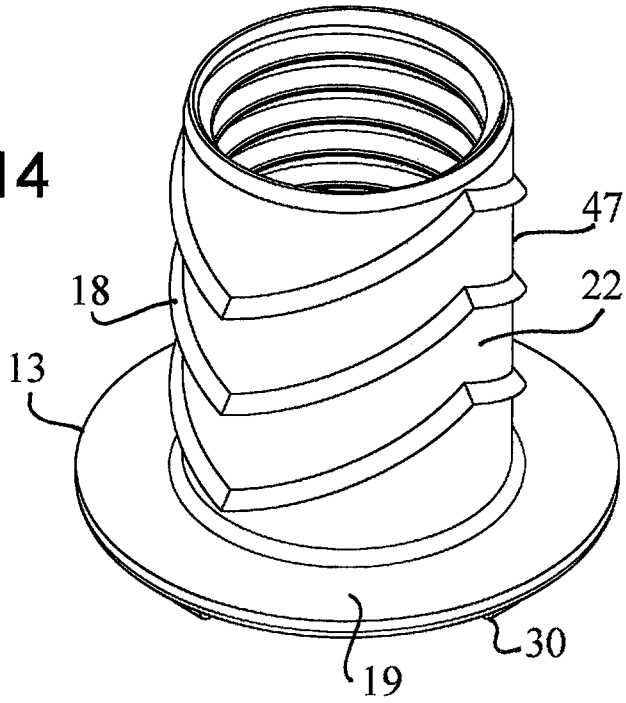


Fig. 13

Fig. 14



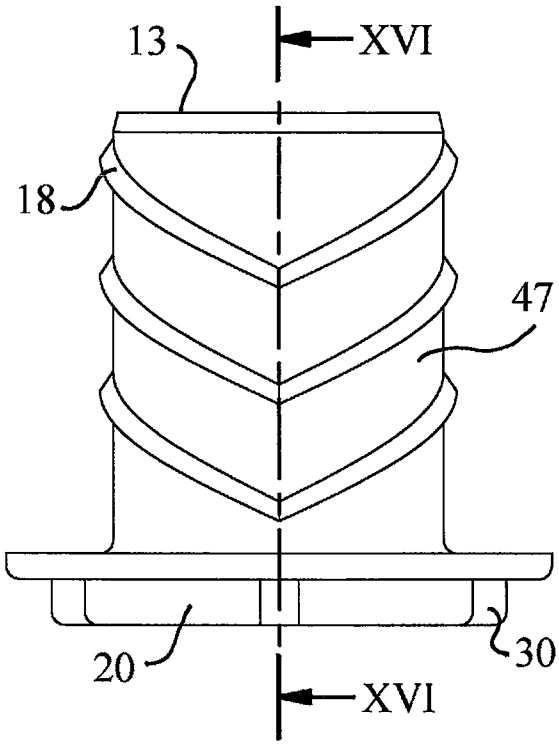


Fig. 15

Fig. 16

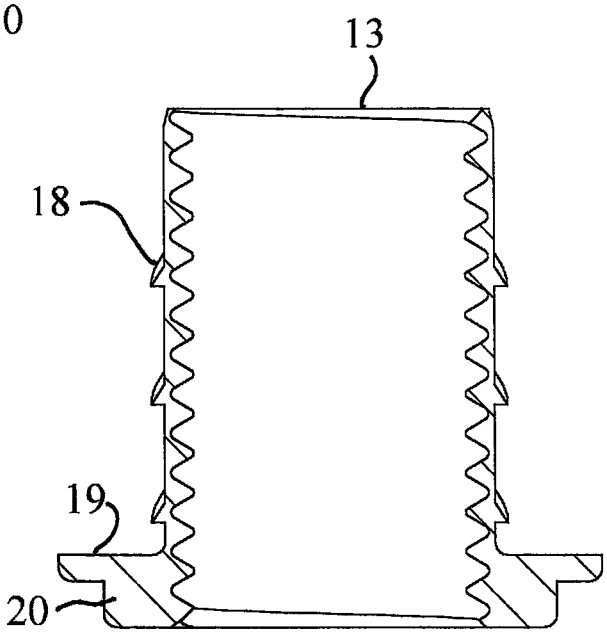
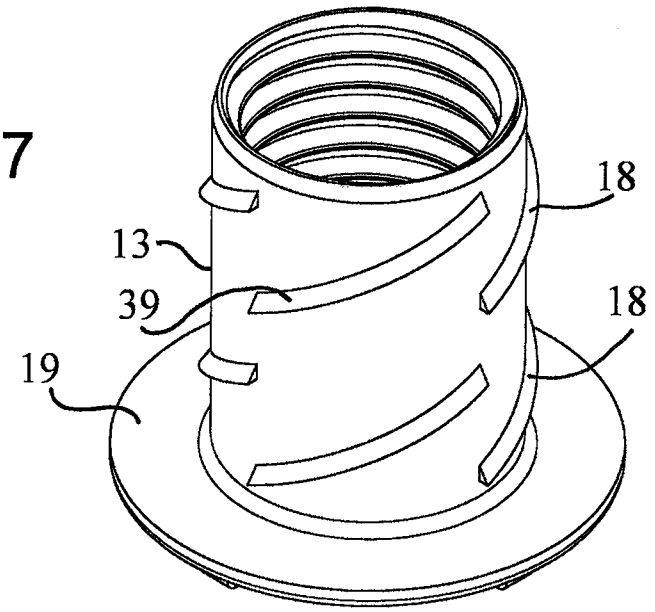


Fig. 17



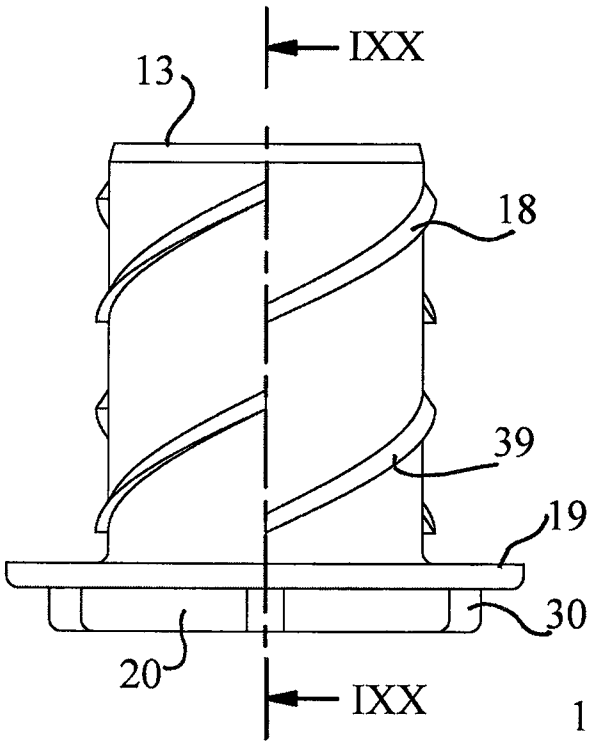
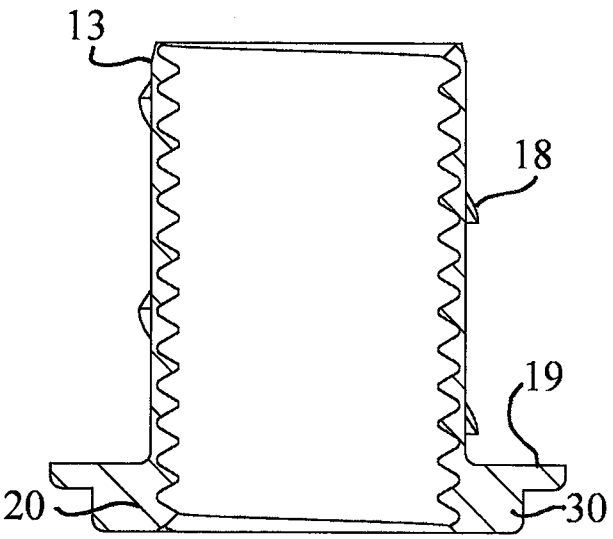


Fig. 18

Fig. 19



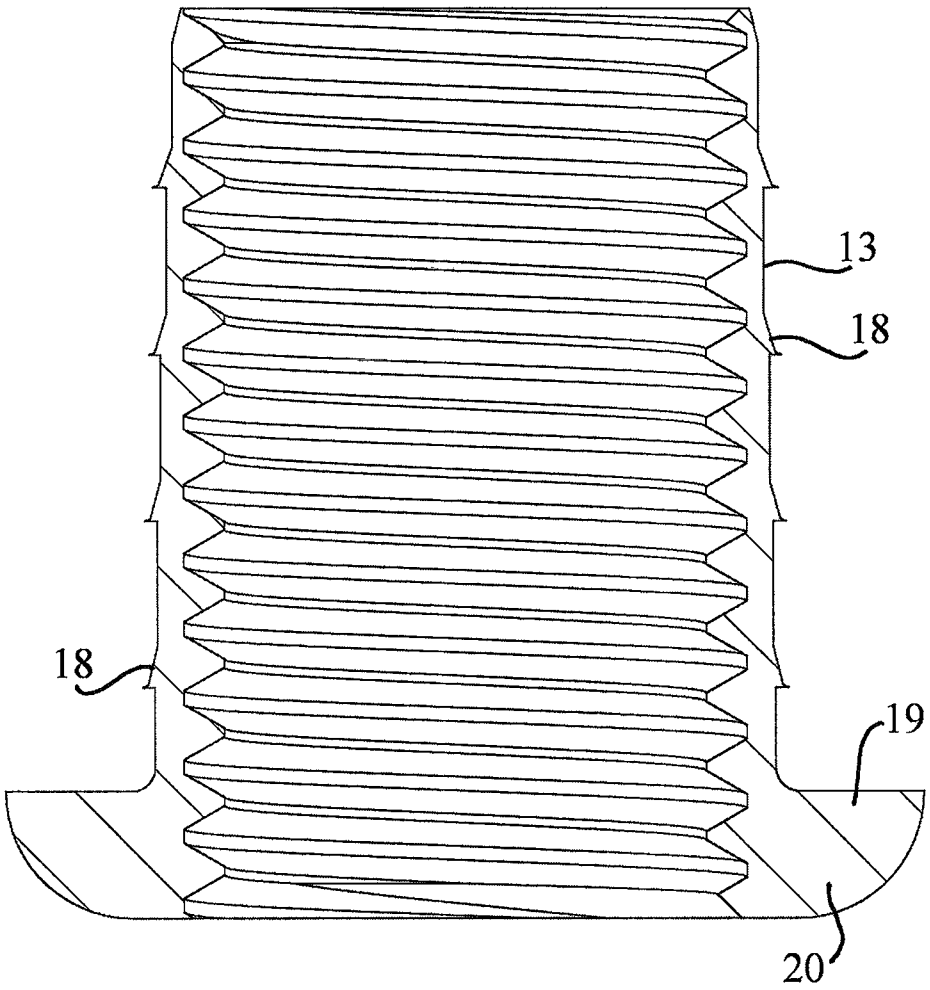


Fig. 20

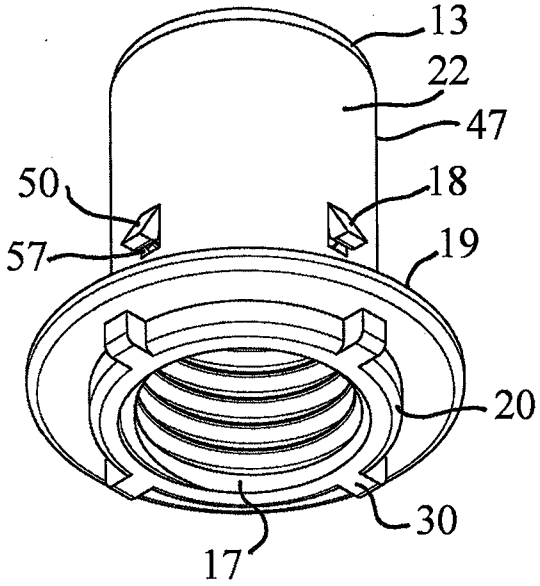


Fig. 21

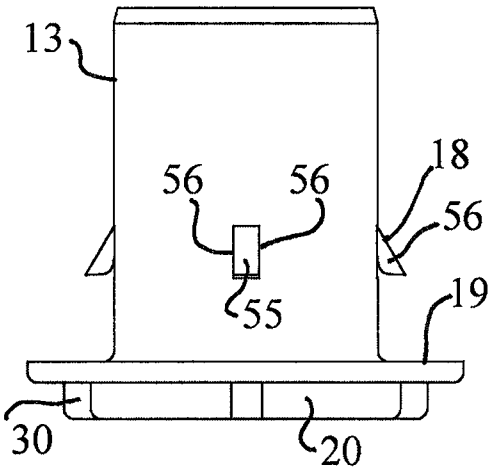


Fig. 22

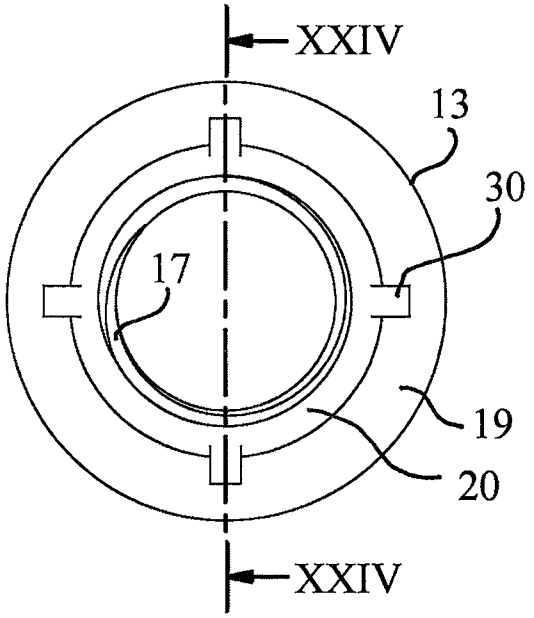


Fig. 23

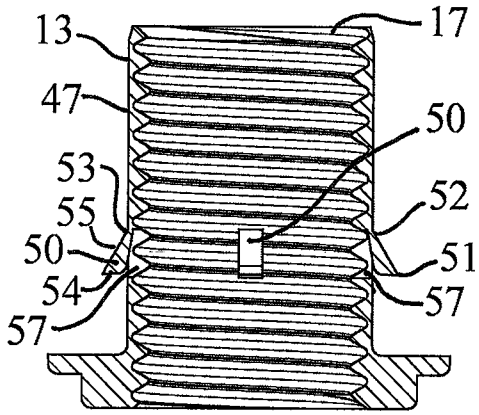


Fig. 24

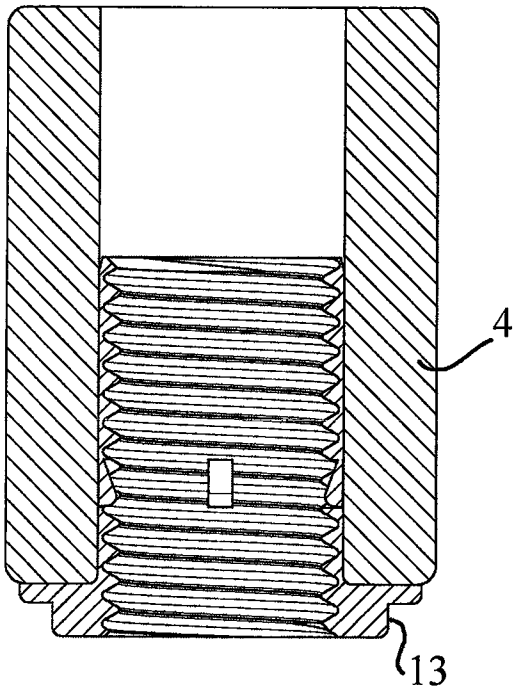


Fig. 25

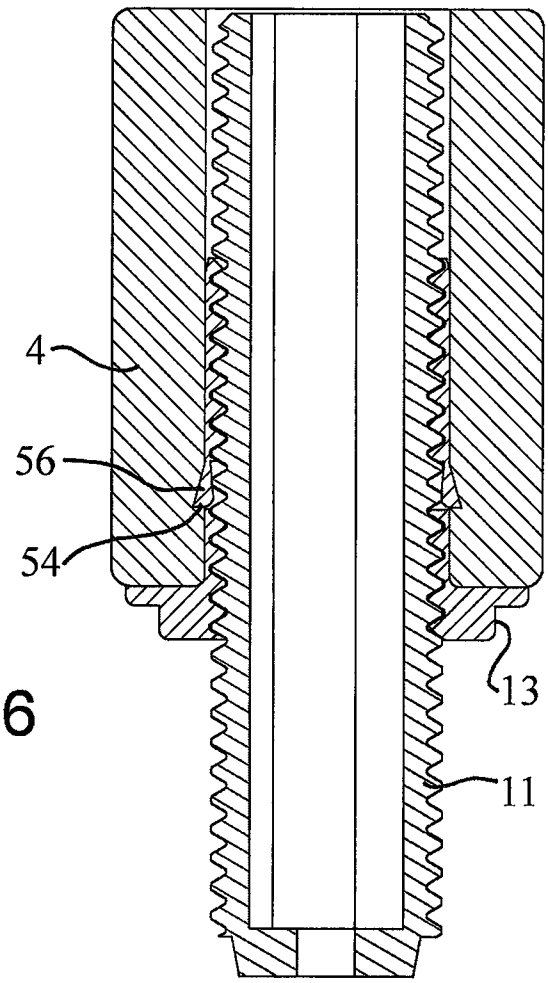


Fig. 26

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2010/000145

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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:E04B, E04F

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2003035028 A (BRIDGESTONE CORP), 7 February 2003 (2003-02-07); (abstract) Retrieved from: PAJ database; Original document: figures 1,10; details 2,3,5,6,7,10,13,101	1-18
A	EP 0482266 A1 (FUKUVI CHEM IND CO LTD), 29 April 1992 (1992-04-29); abstract; column 3, line 19 - line 25; figure 3; details 26,28	1-18
A	EP 0199560 A2 (WESTERING HOMES LTD), 29 October 1986 (1986-10-29); figures 1,3; detail 5	3, 11
A	WO 9726424 A1 (BLOM KENT ET AL), 24 July 1997 (1997-07-24); abstract; detail 1	1-18
A	SE 508986 C2 (LIVRE BO), 23 November 1998 (1998-11-23); abstract; figure 2; detail 12	3
A	JP 2144935 U (..), 10 December 1990 (1990-12-10); figures 3,4	1-18

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
19-08-2010	20-08-2010
Name and mailing address of the ISA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Authorized officer Örjan Nylund Telephone No. + 46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2010/000145

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 2243102 A1 (BRENDLE KURT), 18 April 1974 (1974-04-18); figure 1; detail 5	1-18
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A	US 5511760 A1 (KAMBARA GORO), 30 April 1996 (1996-04-30); abstract; figure 1B	1-18
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Continuation of: second sheet

International Patent Classification (IPC)

E04F 15/024 (2006.01)
E04B 5/48 (2006.01)

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Cited literature, if any, will be enclosed in paper form.

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