



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 0 795 658 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.09.1997 Bulletin 1997/38

(51) Int. Cl.⁶: **E04D 3/35**, E04D 3/36,
E04D 13/16

(21) Application number: **97200690.2**

(22) Date of filing: **07.03.1997**

(84) Designated Contracting States:
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
NL PT SE**

(30) Priority: **11.03.1996 NL 1002565**
29.05.1996 NL 1003222
31.01.1997 NL 1005144

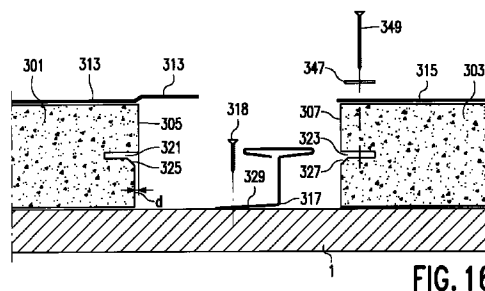
(71) Applicant: **L.B. Benedict Beheer B.V.**
5211 NS 's-Hertogenbosch (NL)

(72) Inventor: **Benedict, Leonard Bert**
2387 Baarle Hertog (BE)

(74) Representative: **Van Weele, Paul Johannes Frits**
Octrooibureau Los en Stigter B.V.,
Weteringschans 96
1017 XS Amsterdam (NL)

(54) **Roof covering system, as well as a method for covering a roof using a roof covering system**

(57) A roof covering system to be mounted on a roof construction (1) is provided with insulation plates (301,303), rainproof covering material (313,315) and fastening means (317) for fastening the insulation plates (301,303) onto the roof construction (1), which fastening means (317) engage the insulation plates (301,303) from the side (305,307). The fastening elements (317) have resilience properties, resiliently pressing the insulation plates (301,303) after the fastening elements (317) have been fastened to the roof construction (1) onto the roof construction. Covering a roof with the aid of a roof converting system according to the invention may be realised by successively placing roof elements and insulation plates and finally finishing the covering material to be rainproof.



EP 0 795 658 A1

Description

In the first place the invention relates to a roof covering system in accordance with the preamble of claim 1. In addition, the invention relates to a method of covering a roof using a roof covering system in accordance with the invention.

A roof covering system of the above kind is known, for instance, from DE-OS-1 709 005. Such systems are usually used for flat or lightly sloping roofs. With some roof covering systems of this kind the insulation plates are placed loosely onto the roof construction, after which the rainproof covering material which may, for instance, constitute strips of bituminous material or a similar material but on a plastic base, is applied over the insulation plates and suitably joined together to be rainproof by, for instance, applying strips over the seams and subsequently melting the bituminous material with the aid of a burner for rainproof fusion of the strips. To avoid the loose roof covering being damaged by external forces, for example by the wind, a layer of gravel is applied onto the rainproof covering material which serves as ballast and because of its weight functions as additional means of securing the insulation plates on the roof construction. With the known roof covering system the application of ballast is actually not necessary as mechanical fastening means are used.

Using loose insulation plates which are held in place only by means of fastening elements, provides a roof with great ecological advantages because there is no fusion between the roof construction and the insulation plates and in addition there are few and easily removable other parts. Thus the roof can be easily and quickly dismantled, having few different materials and parts, which preferably are joined together as little as possible. The absence of a gravel layer or other means of pressing-on may, however, cause problems, because it is not always certain that the insulation plates are in fact resting on the roof construction. Wind and expansion/shrinkage may result in play and cause noises and possibly damage to the roof.

The object of the invention is the removal of these problems and is characterized in claim 1. This embodiment ensures that the insulation plates rest on the roof construction while retaining the advantages described above.

To obtain the resilience, fastening may basically be effectuated in various ways. One preferred embodiment is determined by claim 2. As will be further elucidated, in this embodiment the required resilience is obtained in a very simple manner without any additional parts. The angle between the first part of the fastening element and the second part will perforce be about 90° so that during mounting the fastening element has to undergo a certain deformation. This deformation constitutes a resilient load on the insulation plates, pressing them against the roof construction under some prestress.

An embodiment of the invention in accordance with claim 3 is of interest. This embodiment allows quick and

efficient work with large elements which are supplied in one piece.

The insulation plates of the roof covering system according to the invention comprise a rainproof covering material. This covering material extends about 15 cm past the insulation material at one of the sides and at the front surface, to allow the rainproof covering material to be fastened with a flap over an adjacent insulation plate. In some cases the rear surface of the insulation plate also requires such a flap of rainproof covering material, for instance when a connection is required to an already existing roof covering or when locally an edge finishing is required, etc. In this respect the embodiment of claim 4 is of importance. By this embodiment an overlap can be created at the rear side of an insulation plate by breaking off a piece of insulation material at the groove. The width of this block of insulation material that may be broken off may, for instance, be 150 mm.

The embodiment of claim 5 is of importance for avoiding that due to thermal effects undesirable stress occurs in the roof covering system or that play develops between the fastening elements and insulation plates. As mentioned before, play is preferably to be prevented because due to the changing roof load ensuing from wind and vorticity around a building, it can cause movement of the insulation plates resulting in damage and undesirable noises.

The good insulating properties of the roof covering according to the invention and the fact that there are no parts passing through the roof, make an economic embodiment according to claim 6 possible.

Claim 7 relates to a very important embodiment of the invention, ensuring that each insulation plate at both sides is tied to the roof by means of one or more fastening elements.

A very important embodiment of the invention is reported in claim 8. Experience has shown the fastening elements of the indicated form to have a number of important advantages. The fastening element may be manufactured by existing techniques without much effort by starting with a flat metal strip and bending it a few times. When it is used for a roof construction, this kind of fastening element has cross parts which are at their top side flat and extend to both sides, parallel to the roof construction. A fastening element of this kind has proved to be of particular importance for mounting the insulation plates on the roof construction free of play and preferably under a certain prestress. This is desirable in view of the roof loads occurring from wind and the like, as well as in view of the thermic influence on the dimensions of the roof construction, the insulation plates, the fastening elements, etc. The free edge of each of the two cross parts is suitably rounded off, thereby assisting with the insertion of the cross parts into the appropriate recesses at the side of the insulation plate.

Claim 9 concerns an embodiment with, for instance, the advantage that when applying the fasten-

ing element to the roof construction, no hindrance is experienced from a sideways extending second part. Because of this the first part may be less wide.

The embodiment according to claim 10 is important with respect to easy, correct placing of the insulation plates on the roof construction. Every unevenness on the roof construction and every deviation from a completely flat roof construction will lead to deformation of the insulation plate. In the embodiment of claim 10 the correct placing of an insulation plate up against an already placed insulation plate is assisted by the presence of a slanting guiding surface, so that the respective part of the fastening element already placed on the roof construction, is guided into the groove.

If the fastening of the insulation plates on a roof construction with the aid of the fastening elements of the invention is found to be insufficiently effective, for instance when the roofs of buildings are subject to especially strong winds, as with buildings situated near the coast, it is advantageous to apply the embodiment of claim 11. Generally the fastening elements of the invention extend to about half the height of the insulation plate. The additional fastening element extends to the top of the insulation plate and is mechanically coupled to the fastening element positioned under it. In this manner the fastening elements together with the additional fastening elements form combined fastening elements providing a connection between the top of the insulation plates and the roof construction to which they are fastened.

The employment of the embodiment according to claim 12, however, is a simple method of guaranteeing an absolutely waterproof finish.

With the roof covering system according to the invention an excellent thermal insulation may be realized. In this respect the application of the embodiment according to claim 13 is of importance. This embodiment guarantees that in spite of the thickness of the fastening elements, the part of the insulation plates extending above the fastening elements are in direct contact with each other, thus abutting without play. In this way no gaps running from the roof construction through to the rain proof material, can occur.

In addition to the invention relating to a roof covering system, it relates in the second place to a method of covering a roof with the aid of a roof covering system as already discussed above. This second aspect of the invention is characterized by the steps described in claim 14.

By using this method a quick and efficient method is created for covering roofs while always being able to work in an easily accessible spot, and covering a roof amounts to the execution of a number of repetitive operations, namely alternately placing a roof element and adjacent thereto subsequently mounting the fastening elements on the roof construction. After the entire roof has thus been provided with roof covering, the covering material is subsequently rainproofed. If at a later stage the roof covering is to be removed again, the above-

mentioned steps can quickly and simply be carried out in reverse order while, as demonstrated above, the greatest advantage is that a total separation exists between the fastening materials on the one hand and the rest of the roof covering material on the other hand.

Claim 15 relates to an interesting embodiment of the method according to the invention. As mentioned earlier, fusion of the covering flap may be carried out with the aid of mechanical and even automated mechanical means; these will be briefly discussed below.

A third aspect of the invention is described in claim 16 and relates to a fastening element pertaining to a roof covering system according to the invention and which is suitable for a method according to the invention. Such fastening means may be developed, manufactured and brought on the market in the form of separate components by specialized companies. They may be made from any suitable material such as metal and/or plastic, for instance by means of extrusion, injection moulding, bending plate material, punching and bending etc.

Appropriate application of the invention affords a roof covering system having ecological and technical advantages not only during placing and during its mechanical life, but also when, after perhaps many years, the roof covering system is removed. For ecological reasons ever more import is attached to systems employed in the building industry which during demolition will entail the least possible environmental burden. This means that "demolition-friendly" constructions and systems must be strived for. In this respect it is of importance that the smallest possible quantities of materials are used, that they are in themselves the least possible burden to the environment, that the smallest possible variety is used, that they can be easily separated by kind during demolition, and can easily be removed, and that after demolition they are reusable in an unchanged or little-changed form, in other words, that they are damaged as little as possible during demolition or, if reuse is out of the question, that they can be recycled.

The roof covering system according to the invention is "demolition-friendly". It consists of few elements which elements may easily be removed and separated. In practice the demolition of the roof covering of a system according to the invention will amount to cutting through the covering material, pulling the thus formed strips from the insulation plates, the removal of the fastening elements and taking away the insulation plates. Neither the covering material nor the insulation plates comprise foreign parts. With a steel roof construction as often used in buildings of public utilities the fastening element may be left in place to be disposed of together with the steel roof construction. The insulation plates may be reused, if desired lying loose in a roof covering system where ballast is used. The covering material also, or at least parts thereof, may be reused, the important point being that this material has no drillings. As the material may be relatively thin, the environmental bur-

den is in any case much smaller than with the known thicker material, this applies also to recycling and even to destruction by burning.

Correct implementation, especially with regard to the height of the fastening elements avoids heat loss via the roof covering system according to the invention. Heat loss due to thermal conductivity via the roof to the fastening elements and via these to the environment is a liability, particularly when the fastening elements are of metal and are placed on a metal roof as often happens with buildings of public utilities. Surprisingly it has been shown that the height of the fastening elements, which depends on the material of the insulation plates, may be chosen such that while retaining excellent effectiveness of the roof covering system, heat loss attributable to the fastening elements may be avoided completely. Calculations have shown that even in detrimental conditions and when using metal fastening elements on a metal roof, no heat loss attributable to the fastening elements will occur if the height of the fastening element is not more than about 45 to 50 percent of the thickness of the insulation plates. By means of experimentation it is possible to always choose the appropriate dimensions for the fastening elements in combination with a particular kind of insulation plates, such that irrespective of the roof construction on which the roof covering system is to be placed, there will substantially be no heat loss attributable to the fastening elements. The importance of this embodiment is that the diverging positioning of the various parts of the fastening element's cross parts allows the insulation plates to be mounted resiliently with no play in the recesses of the insulation plates.

The invention will now be elucidated purely for illustrative purposes with reference to some of the embodiments shown in the drawings which are in no way limitative and in which:

Figure 1 shows a perspective view of an integrated roof element comprising several insulation plates and a strip of covering material fused therewith as well as a number of interacting fastening elements, Figure 2 shows a cross-section through several integrated roof elements of the kind shown in Fig. 1, placed adjacent to each other on a roof construction with fastening means of a different embodiment,

Figure 3 shows a cross-section similar to the one in Fig. 2 having fastening means of another embodiment, showing also a different fastening means applied at a side of a roof element which is situated at the edge,

Figure 4 shows a cross-section similar to the one in Fig. 3 in which fastening means of a further embodiment are applied,

Figures 5-9 are enlarged cross-sections of the fastening elements as used with the roof covering system shown in Figs. 2 to 4,

Figures 10 to 12 show cross-sections similar to

those of Figs. 2 to 4 but in different embodiments, Figures 13 to 14 are cross-sections similar to those of Figs. 5 to 9 of fastening elements as used with the roof covering systems shown in Figs. 10 to 12, Figure 15 shows part of a roof construction with two partial insulation plates placed on the roof construction, a fastening element placed between the insulation plates with a number of nails positioned to be driven through the fastening element into the roof construction,

Fig. 16 is a cross-section of the whole as shown in Fig. 15, showing also an additional fastening element above one of the insulation plates, as well as a nail in a position where it will be driven through a part of an insulation plate and through the additional fastening element to couple the additional fastening element with the fastening element thereunder,

Fig. 17 is a cross-section showing again all the different parts visible in Fig. 16, but now in the situation where they are fastened to each other,

Figure 18 is a cross-section similar to the one in Fig. 17 of an embodiment of a roof covering system in which so-called rebate plates are used,

Figure 19 is an enlarged cross-section of the fastening element as used with the roof covering system shown in Figs. 1 to 3, and

Figure 20 is an enlarged cross-section of an additional fastening element of another embodiment.

Corresponding parts in the various Figures carry the same reference number.

Figure 1 shows a roof covering system according to the invention comprising a roof construction 1, see Figs. 2 to 4, insulation plates 3 having a top surface 5, a bottom surface 7, sides 9 and 11, a front surface 13 and a rear surface 15. The insulation plates 3 are provided with a rainproof covering material which may, for instance, be a strip of bituminous covering material which is as such known. Further fastening means 19 and 21 are shown. The fastening means shown in Fig. 1 comprise fastening elements 19 having a first part 23 for placing on and fastening to the roof construction 1 and a second part 25 for fastening to the sides 9 of the insulation plates 3, at a position between the insulation plates' top surface 5 and the bottom surface 7. The fastening profile 19 is provided with holes 27 in the first and second parts 23 and 25 respectively of the fastening profile. The fastening profiles are attached to the roof construction by screws 21 which are screwed into the roof construction through the holes 27 present in the first part 23. The insulation plates 3 are attached by the vertical parts 25 of the fastening profile 19 by inserting screws 21 through the holes present in the side. This is done in an alternating fashion, with the in-between holes 27 being provided beforehand with screws 21 pointing in the other direction.

The insulation plate 3 is resiliently pressed onto the roof construction by having the second part 25 of the

fastening element 19 form an angle with the first part 23 of more than 90°. When screwing in the screws 21 a deformation takes place producing the desired press-on force. Said angle involves only a few degrees and is not perceptible in the drawing. This same property of the fastening part is applied to the other various embodiments shown in the drawing.

As the insulation plates 3 are made from a relatively soft material, the screws can easily be pushed into the material. Thus, when an adjoining roof element is pushed against the fastening profile 19 it is also automatically attached to the fastening profile 19. As can be clearly seen in Fig. 1, the second part 25 of the fastening profile 19 is attached to the side 9 of the insulation plates at a location between the insulation plate's top surface 5 and the bottom surface 7. This makes the fastening means suitable for insulation plates 3 having different thicknesses.

The cross-sections in Figs. 2, 3 and 4 show insulation plates 29, 30 and 31 respectively having different shapes.

The insulation plate 29 shown in Fig. 2 has a top surface 33 and a bottom surface 35 as well as a left-hand side 37 and a right-hand side 39. In Figs. 3 and 4 said surfaces are also provided with reference numbers.

With the roof covering systems according to Figs. 2 to 4, the sides of the insulation plates shown in cross-section are provided with recesses. For instance, in Fig. 2 the left-hand side of the insulation plate 29 is provided with a recess 57. In Figs. 3 and 4 the insulation plates 30 and 31 respectively are provided with recesses 59 and 61 respectively both at the left-hand side 45 and 53 respectively and at the right-hand side 47 and 55 respectively. The insulation plates 29 in Fig. 2 are provided with a recess at only one side, whereas the insulation plates 30 and 31 respectively in Figs. 3 and 4 are provided with recesses in both sides. This kind of recesses may extend over the whole length of the insulation plates and consequently over the whole length of a roof element which is, however, not necessary; the recesses may also be provided locally in the otherwise smooth sides.

The fastening elements placed between the respective insulation plates shown in Figs 2 to 4, carry the reference numbers 63, 65 and 67 respectively. Figs. 3 and 4 also show at the right-hand side of the roof covering system special edge fastening elements with the reference numbers 69 and 71 respectively.

Below first the embodiment of the invention shown mainly in Fig. 2 will be discussed. For an enlarged cross-section of the fastening element 63 only, see Fig. 5. As mentioned before, the insulation plates 29 are provided at the left-hand side 37 with a recess 57. At the right-hand side the insulation plates 29 are provided with correspondingly shaped extending parts 73. These are shaped such that they fit into the recesses 57 leaving a little play. The extending parts 73 may again extend over the whole length of the insulation plates and consequently the roof element or may, if desired, only

be present locally. Due to the recesses 57 at the one side and the extending parts 73 at the other side, the insulation plates 29 engage, forming a tongue and groove joint. The connecting elements 63 (see also Fig. 5) are shaped such that they fit into place between adjacent insulation plates. To this end the connecting element 63 is provided with a complementary part 75 interacting with the insulation plates 29 to be placed on both sides of the fastening element. To this end the complementary part 75 fits around the (in the drawing) right-hand side of a recess 57 and around the (in the drawing) left-hand side of an extending part 73. The fastening element 63 comprises in essence a first part 77 consisting of a roof fastening part which serves to be fastened to the roof construction 1 at a location next to an insulation plate 29 which was placed earlier and under an insulation plate 29 to be placed subsequently and adjacent thereto. The second part 79 of the fastening elements 63 comprises a part connected roughly at right angles to the first part 77, having a length which is less than the thickness T2 of the insulation plates 29.

Similarly, the fastening element 65 which is used in the embodiment of the invention shown in Fig. 3, comprises a first part 81 and a second part 83. The insulation plates 31 are at both sides provided with similar recesses 59 and the fastening means 65 are provided with complementary parts 85 and 87 extending on both sides at the top of the second part 83. The first part 81 is again suitable for fastening to the roof construction 1 next to an insulation plate 31 placed earlier and under and adjacent to an insulation plate 31 to be placed subsequently. The length L3 of the second part 83 is again less than the thickness T4 of the insulation plate 31. The right-hand side of the insulation plate 31 at the far right in Fig. 3 is the insulation plate fastened by means of the profile 69 shown in Fig. 7 which corresponds broadly speaking with the profile 65 shown in Fig. 6, however, without one of the complementary parts. It comprises a first part 89 and a second part 91 as well as at its top side a single complementary part 93.

After the above comprehensive description of the embodiments shown in Figs. 1-3, the embodiment of Fig. 4 will be described only briefly. The complementary parts in this embodiment consist of a tube 99 containing insulation material 101. This insulation material strengthens the tube 99 in particular against indentation, but it also prevents the possible formation of a cold spot between the insulation plates 33 shown in Fig. 4. The connecting element 71 is again formed by an element that could be considered to be a modification of the connecting element 67, and will therefore not be discussed in detail. It has a first part 103, a second part 105 as well as a tube 107 filled with insulation material 109.

All the fastening elements shown consist of lengths of a fastening profile whose first part can be riveted mechanically. Figs. 2, 3 and 4 show rivets indicated by reference number 111.

The various fastening profiles may be manufac-

tured from any suitable material such as plastics or a metal. Profiles such as the fastening elements 19, 63, 65 and 69 are, for instance, suitable for manufacture by plastics or aluminium extrusion. The profiles of the fastening elements 19, 63, 67, 69 and 71 can, for instance, be suitably manufactured by bending strip material such as galvanized steel strip. The profiles may, for instance, be supplied in standard lengths and used whole or may, on site or elsewhere, be cut or sawn into connecting elements of a useful length.

More particularly with reference to Fig. 1 and further Figs. 2 to 4, the embodiments of the invention shown involve roof elements 113 connected into one whole, comprising a number of insulation plates 3 or, if desired, one single long insulation plate 3, suitably fused with the strip-like covering material 17, for instance a known, somewhat flexible bituminous strip-like material or a similar material on a plastic base. With each roof element 113 a certain length of the covering material 17 extends across, past one of the sides (in Fig. 3 side 11) providing a covering flap 115. At the other sides of the roof element 113 the covering material comes just to the respective side or the front and rear surface. However, a covering flap may also conceivably be formed at one or more of the latter-mentioned surfaces. The covering flaps 115 of the adjacently placed roof elements 113 have a certain amount of overlap over the covering material of the adjacent roof element. All of the fastening means described above will after application be completely covered by the covering flaps 11.

This property of the invention allows a covering material 17 to be used with a thickness of not more than 5 mm at the most and preferably with a thickness of between 2.5 and 4 mm.

For convenience's sake the method according to the invention of covering a roof with the aid of a roof covering system of the above-described kind will now be discussed with reference to Fig. 4 only. The method comprises the following steps: first insulation plates 31 are suitably joined by means of adhesion to the covering material 17 to form integrated roof elements. The integrated roof elements are placed on the roof construction 1 by successively placing these adjacent to each other onto the roof while after each placement of a roof element the required fastening elements 67 are placed against its free side 53, which fastening elements 67 are then fastened to the roof construction 1 with the aid of the nails 111 or by some other suitable means such as, for instance, by adhesion. Subsequently a next roof element is pushed against the side 53 of the previously placed roof element, against the fastening elements 67 already fastened to the roof, etc., in such a manner that always alternately integrated roof elements and fastening elements are mounted on the roof. Finally the covering material 17 is finished to be rainproof. In the embodiment shown, the roof elements are joined together to form an integrated rainproof insulated roof covering by means of thermally fusing the covering flaps

115 of the one roof element to the top side of the covering material 17 of the other, adjacent roof element. To this end it is convenient to use a device that can move either power driven or non-power driven over the roof elements, which device is provided with means to locally slightly lift the covering flap to be fused, and is provided with a flat burner that is able to slide under the thus lifted covering flap in order to heat the material of the covering flap as well as the covering material underneath to precisely the right melting temperature. In addition the device is provided with a press-on roller which firmly presses together the roof element parts rendered soft and sticky by heating. The rate at which such a device moves over the roof, the gas supply of the burner and the type of gas used are adapted to each other such that an optimal rainproof fastening is attained at the highest possible rate of movement and consequently productivity of the device. Such a device may be automotive and up to a point may operate completely automatically.

Figs. 3 and 4 show how a right-hand side of a roof covering 47 or 55 is fastened by means of an adapted fastening element 69 or 71 respectively. For fastening a left-hand side (not shown) another fastening element (not shown) is required. These fastening elements entail simple modifications of the fastening elements 69 and 71 in the sense that the respective complementary parts interacting with the recesses 59 and 61 are located at the right-hand side, instead of (in the drawing) at the left-hand side. The fastening element 63 (see Figs. 2 and 5) may be used unaltered both with a free left-hand side as a free right-hand side of a roof covering.

Figs. 10, 11 and 12 show further embodiments which will be discussed only briefly. The fastening means are shown separately in Figs. 13, 14 and 15.

In Figs. 10, 11 and 12 the roof construction underneath carries reference number 1.

The insulation plates 201 shown in Fig. 10 are provided in their side 221 with a recess 243 and in their side 219 with a corresponding ridge 255 fitting into the recess 243. As can be seen in the drawing, the recess 243 has an undercut with the result, that the corresponding ridge cannot simply be placed into the recess by a translative mutual movement of two insulation plates. In this embodiment the ridge 255 must therefore be fitted into the recess of the insulation plate already placed on the roof construction by means of a tilting movement. Special with this embodiment is, that due to the undercut a coupling is realized between the adjacent insulation plates which is completely independent of the fastening of the insulation plate by means of the fastening element. In this embodiment the fastening element used is a fastening element 231 (see also Fig. 13), comprising a first part 235 for fastening on the roof construction in addition to a vertical upright second part 239 which at about half its height is bent, forming between the bent part and the rest of the part an angle of roughly 120°. This angle is of no further importance and may,

depending on the circumstances, be varied. The bent part forms a complementary part 249 fitting into the bottom part of recess 243 (see Fig. 10).

The embodiment of Fig. 11 resembles the preceding embodiment of Fig. 10, except that the recess 245 in the insulation plates does not have an undercut and is in this case roughly shaped like a right-angled triangle. The insulation plate's 203 side 223 is provided with a corresponding ridge 257 fitting into the recess 245 at the side 225. By designing the insulation plates like this, it is again possible to push the plates against each other by mutual translation. The presence of the ridge 257 in the recess 245 prevents also that one of the adjacent insulation plates can move vertically in relation to its neighbouring plate. The fastening element 231 is the same as in Fig. 11, but may also differ, especially in regard of the dimensions of the different parts and the angle between the complementary part 249 and the rest of the part 239.

In the embodiment according to Fig. 12, the insulation plates 205 are coupled together by means of a fastening element 233 which in this case consists of two separate parts, 233A and 233B, mounted on top of each other. The first part 233A consists of a part 237 and another part 241 with the top part 251 forming a complementary part fitting into a recess 259 at the side 229 of an insulation plate 205. This complementary part 251 runs substantially parallel with the first part 237 of the fastening element. It is made from a resilient metal or plastic material, and comprises a bottom part 251A with a part 251B bent back over it at 261. Near the bend 261 both parts 251A and 251B are provided with indentations 263. The second complementary part 253 consists of a moulding having a cross-section shaped like a round-topped cone with connected to it a flat moulding 267 placed between the parts 251A and 251B. The latter being inserted at the open side and pushed between the resilient parts 251A and 251B past the indentations 263 between which it is clamped by spring pressure. The flat moulding 267 is locally provided with notches 269 to accommodate the indentations 263, so that after insertion, the complementary part 253 with respect to the part 233A of the fastening element, is locked by means of the indentations 263. The whole part 253 consisting of the rounded cone-shaped profiled moulding 265 together with the connected flat moulding 267, may be made entirely from recycled plastic, for instance, recycled polyethylene.

As can be seen in Fig. 12, the profiled moulding 265 fits into the recess 247 of the side 227 of the insulation plate 205. Special in this embodiment is, that before part 233B is applied to part 233A, the first part 237 of the fastening element is easily accessible from above to fasten the fastening element onto the roof construction 1. Only then is part 233B pushed between the parts 251A and 251B and secured by means of the indentations 263 being snapped and locked in the recess 269, and is the next insulation plate 205 pushed against the side of the roof element 205 just previously placed

against the fastening element consisting of the two parts 233A and 233B, fastened to the roof construction.

Fig. 15 shows a roof construction 1 with two insulation plates 301 and 303 to be fastened thereto with their sides 305 and 307 respectively facing each other and having front surfaces 309 and 311 respectively. To the insulation plates 301 and 303 a layer of covering material 313 and 315 respectively is affixed. There are also fastening means in the form of a fastening element 317 and nails 318 for fixing the fastening element 317 to the roof construction 1.

The fastening element 317, hereafter also to be referred to as fastening profile is dimensioned, especially with respect to height, such that effectively no heat loss attributable to the fastening profile 317, occurs.

The sides 305 and 307 of the insulation plates are provided with recesses 321 and 323 respectively, substantially forming of a horizontal groove opening out at the respective side of the insulation plate. Where the groove opens out, the underside of the opening of the groove is bevelled to form a guiding surface 325 and 327 respectively, to guide the corresponding complementary part (still to be discussed) of the fastening profile 317 into the groove. If desired, such a guiding surface may be provided at the top side of the groove.

The construction of the fastening construction 317 will now be discussed with reference, in particular, to Fig. 19. This fastening element comprises a first part 329 to be placed for fastening onto a roof construction 1. The second part serves to fasten the sides 305 and 307 of the insulation plates somewhere between the bottom surface and the top surface of the insulation plates. The complementary parts of the fastening profile 317 which are to be fitted into the recesses 321 and 323, consist of cross parts 333 and 335 extending at least nearly parallel to the first part 329. The first part 329 and the second part 331, and of the parts 333 and 335 consist of parts made of a single, multi-bent metal strip, for instance thin galvanized steel plate. The cross parts 333 and 335 each consist of two parts of the strip, 333a, 333b and 335a, 335b respectively, which run nearly parallel at a short distance from each other. The strip is bent such that the free edges 333c and 335c of each of the two cross parts 333 and 335 respectively, have a rounded transition between the parts 333a, 333b and 335a, 335b respectively.

The rounded transitions 333c and 335c at the sides of the fastening profile 317 and also the presence of bevels 325 and 327 at the sides of each insulation plate, facilitate the insertion of the fastening profile correctly into the recesses 321 and 323, even when the roof construction 1 is not entirely flat or when the roof locally exhibits unevennesses. The roundings, together with the bevels provide a sort of locating effect, facilitating the mounting of the roof covering system. In addition, this prevents possible damage which could result from the cross parts of fastening profiles exhibiting sharp edges and not immediately and properly being inserted into the relatively fragile insulation plates.

As is clearly and even with gross exaggeration shown, particularly in Figs. 16 and 19, there is some divergence between the parts 333a and 333b running at a short distance from each other, said divergence beginning at the rounded transition 333c. The same applies for the parts 335a, 335b, which also diverge from each other starting from the rounded transition 335c. The appropriate design and the appropriate measure of divergence can ensure that after the cross parts have been fitted into the corresponding recesses of the insulation plates, see Fig. 17, the cross parts are resiliently in contact with the parts around the recesses of the insulation plates so that there is no play between the cross parts and at least one of the walls of the recesses in the insulation plates.

The first part 329 of the fastening profile 317 forms an angle α greater than 90° , for instance between 91° and 92° , with the vertical body part 337 of the second part 331. When the nails 318 are driven through the first part 329, the angle causes a downward force to be exerted via the body part 337 of the fastening profile on to the cross part 335, which at that moment is already placed in the groove 323 of the insulation plate 303. In addition, it causes the cross part 333c to come under an angle such that when the insulation plate 301 is abutted and the cross part 333c enters the recess 321, a downward force is also exerted onto the insulation plate 301. In this respect the resilience of the material from which the fastening profile 317 is made is obviously of importance.

The above measures allow the insulation plates to be fastened without play and under some prestress on the roof construction, so that undesirable play and rattling are effectively prevented.

Near their rear surfaces 343 and 345, the insulation plates 301 and 303 are provided with a groove 339 and 341 respectively, extending across their width from the bottom surface to near the top surface. These grooves are located at a distance from said rear surfaces, respectively the front surfaces 309 and 311, which distance corresponds with the distance being bridged by the overlapping parts 313a and 315a of the rainproof material 313 and 315 respectively. By breaking off the piece of insulation material between the groove 339 or 341 respectively and the corresponding rear surfaces, it is possible to also provide an overlap of rainproof material at the respective side of the insulation plate. As mentioned earlier, this may be of importance for certain places of the roof covering.

As shown in Figs. 16 and 17, the fastening means for fastening the insulation plates onto the roof construction may also comprise additional fastening elements. Fig. 16 shows a first part 347 for placing on the top surface of the insulation plate 303 and a second part in the form of a long nail 349 which serves for the mechanical coupling of the additional fastening element to the fastening element 317. Fig. 17 shows the coupled situation. The first part 347 may comprise a ring or plate but may also comprise a strip extending parallel to the

recess 323 of the insulation plate 303. The nail 349 may be driven through the insulation plate 303 and through the cross part 335 of the fastening profile 317 with the aid of a suitable machine. In the situation shown in Fig. 17 the pin 349 is inserted through both parts 335a and 335b of the cross part 335. In this way the top of the insulation plate 303 is indirectly coupled with the roof construction 1. As can be seen in Fig. 17, the overlap 313b formed by the rainproof material 313 at the side 305 may be placed over the first part 347 of the additional fastening elements and the head of the nail 349, so that the watertightness of the rainproof covering of the roof covering system will continue to be ensured.

Fig. 18 very much resembles Fig. 17 and will therefore be discussed only briefly. The two insulation plates 351 and 353 are so-called rebate plates which in themselves are known, whose sides are provided over their width and over part of their height, with protruding complementary rebate parts 351S and 353S respectively, so that the rebate part 351S of the insulation plate 351 abuts to the complementary rebate part 353S of the adjacent insulation plate 353. The fastening element again consists of the same fastening profile 317 from Figs. 1 to 4. This fastening element is provided below the rebate part 353S of the insulation plate 353 and next to the complementary rebate part 351S of the insulation plate 351. The drawing shows clearly that the invention is equally applicable with the known so-called rebate plates. The fastening element 317 may, with respect to dimensions, particularly the dimensions of the cross parts 333 and 335, be adjusted, which may be of particular importance when the rebate parts are relatively broad. The rebate part of the insulation plate 351 may also be situated above the rebate part 353S instead of under it as shown in the drawing.

The insulation plates 301 and 303 (Fig. 15) are provided with several compensation grooves 346 situated at a distance from each other, distributed over the breadth of the insulation plates and extending from the bottom surface to near the top surface for the compensation of thermically determined changes in the dimensions of the insulation plates. Fig. 15 shows a single such groove in each of the insulation plates 301 and 303. This kind of grooves has, at least almost, the same shape as the grooves 339 and 341. There are several such grooves provided over the length of the insulation plates, which is not shown in the drawing.

To accommodate the thickness of the fastening profile 317, a space is provided locally between the abutting insulation plates 301 and 303 by means of slightly receding the side 305 of the insulation plate 301 (see in particular Fig. 16) over a height which is adapted to the fastening profile 317. The receding embodiment may be attained by milling part of the side 305 nearest the roof construction over the indicated distance d. Fig. 17 shows how by this measure some space is created under the cross part 333 of the fastening profile 317, between the body part 337 of the fastening profile and the side 305 of the insulation plate 301. Above the cross

parts 333 and 335, however, the insulation plates abut without play. See in this connection also Figs. 10 to 12 where the same measure is taken. In this way the heat loss is kept to a minimum as there is no open connection between the roof construction 1 and the top of the insulation plates 301 and 303.

Also of importance is in this respect the chosen arrangement of the fastening element 317 which abuts play-free against the insulation plate 353 (Figs. 16 to 18). Thus the amount of play 365 is to be found at the side of the insulation plate 351 and is enclosed between the first part 329 of the fastening part 317, the body part 337 and the cross part 333. The space 365 is, however, in contact with the space between the parts 333A, 333B, 335A and 335B. This can optionally also be prevented by interchanging the cross parts 333 and 335, thus in this sense altering the embodiment of the fastening element 317. Such an embodiment prevents ventilation in cross direction. This ventilation may be desirable or indeed undesirable, depending on the circumstances.

The additional fastening element 355 of Fig. 20 consists just like the fastening element 317 of Fig. 19, of a profile made from a multi-bent metal strip. This provides a body part 357, an upper flange 359 and, extending at the bottom of the body part, at some distance from each other, parallel to the upper flange 359, two parts 361 and 363. These latter parts are fitted into the recess 323 of the insulation plate 303 so that the upper flange 359 comes to rest on the rainproof material 315. Only now the cross part 335 of the fastening profile 317 is applied such that it is located between the parts 361 and 363 of the additional fastening element 355. In this manner the fastening profile 317 and the additional fastening element 355 are mechanically coupled with each other. Optionally, one can also drive a nail, such as the nail 349, from the top through the flange 359 and through the two parts 361 and 363 of the additional fastening element and through the two parts 335a and 335b of the cross part 335 of the fastening element 317.

The fact that the invention has been discussed with reference to the drawing in relation to a limited number of embodiments, does not mean that the invention is limited to the embodiments given. It is, for instance, possible not to use fastening profiles but separate fastening elements which may be manufactured by means of plastic injection moulding or from metal, or separate fastening elements supplied in the form of loose components, manufactured by punching from plate material. Further, in the fastening element 19 of Fig. 1, the screws 21 for coupling the fastening elements with the neighbouring insulation plates could be omitted if, for instance, the second part 25 of the fastening element is provided with pointed parts extending outward at both sides, forming an integral part of the fastening element. The fastening elements can be fixed to the roof construction in any appropriate manner, for instance by using glue, adhesive strips, separate fastening brackets, etc. After the above extensive description the expert

will be able to envisage many other embodiments.

To obtain the desired resilience properties, the fastening elements may be embodied in numerous ways. For instance, fastening elements made from plate material may locally be provided with slits so that resilient tongues are created. It is also possible to use additional resilient elements such as tension and/or compression springs of all conceivable kinds which are applied between parts of the fastening means which, in relation to each other are somewhat movable. Although the drawings show only a few embodiments, the expert will be able to apply many alternatives having the same function, namely that of resiliently pressing the insulation plates against the roof construction by means of the fastening element.

Claims

1. A roof covering system comprising:

insulation plates to be mounted on a roof construction, which insulation plates have top and bottom surfaces, sides and a front and rear surface;
rainproof covering material to be applied to the insulation plates; as well as
fastening means for fastening the insulation plates onto the roof construction;

wherein the fastening means comprise fastening elements having a first part to be placed on and connected to the roof construction and having a second part for fastening a side of an insulation plate at a location between the top surface and the bottom surface of the insulation plate and wherein the sides of the insulation plates are provided with recesses and the fastening elements are provided with a complementary part fitting into the recesses, **characterized** in that the fastening elements have resilient properties and that after their being fastened onto the roof construction, the insulation plates press resiliently onto the roof construction.

2. A roof covering system according to claim 1, **characterized** in that the second part of the fastening element forms an angle (α) greater than 90° with the first part of the fastening element.

3. A roof covering system according to claim 1, **characterized** in that

the insulation plates and the covering material are connected to form integrated roof elements,
with each roof element the covering material extends across, past one of the sides over a certain distance, thus providing a covering flap, the covering flap of a roof element covers the

covering material of an adjacent roof element over a certain distance,

the fastening means, when in position, are located completely under the covering flap and that the roof elements each comprise a number of insulation plates covered by a continuous strip of covering material.

4. A roof covering system according to claim 1, **characterized** in that the insulation plates, at least near one of the surfaces including the front surface and the rear surface, are provided with a groove extending over the breadth of the insulation plate and extending from the bottom surface to near the top surface.

5. A roof covering system according to claim 1, **characterized** in that the insulation plates are provided with several compensation grooves situated at a distance from each other, distributed over the breadth of the insulation plates and extending from the bottom surface to near the top surface for the compensation of thermally determined changes in the dimensions of the insulation plates.

6. A roof covering system according to claim 1, **characterized** in that the covering material has a thickness of 5 mm at the most and preferably has a thickness of between 2.5 and 4 mm.

7. A roof covering system according to claim 1, **characterized** in that

the fastening elements are provided at both sides with complementary parts interacting with the insulation plates to be placed on both sides of the fastening element and that the complementary parts of the fastening elements substantially comprise cross parts extending almost parallel to the first part.

8. A roof covering system according to claim 5, **characterized** in that

the first and the second part as well as the cross parts consist of parts made of a single, multi-bent metal strip, each of said cross parts comprises two parts of the strip, which run nearly parallel at a short distance from each other, the free edges of each of the two cross parts constitute a rounded transition between the parts of the strip running at a short distance from each other and that in at least one of the cross parts said two parts running at a short distance from each other diverge somewhat in relation to each other, the divergence beginning at the rounded transition.

9. A roof covering system according to claim 1, **characterized** in that the second part of the fastening element comprises a separate part which can easily be coupled manually to the remainders of the part.

10. A roof covering system according to claim 1, **characterized** in that

the recesses in the sides of the insulation plates substantially constitute a horizontal groove, opening out at the side of the insulation plate and

that where the groove opens out, at least one side of the groove opening is bevelled to form a guiding surface to guide the fastening element's complementary part during its insertion into the groove.

11. A roof covering system according to claim 1, **characterized** in that the fastening means comprise additional fastening elements having a first part to be placed on the top surface of the insulation plate and a second part for the mechanical coupling of said additional fastening element to said fastening element.

12. A roof covering system according to claim 11, **characterized** in that the first part is located underneath the overlap of rainproof material of an adjacent insulation plate.

13. A roof covering system according to claim 1, **characterized** in that at least one of the sides of the insulation plates is provided with a slight recession over a height which is adapted to the fastening means, in order to locally provide a space between the abutting neighbouring insulation plates, to accommodate the thickness of the fastening element.

14. A method of covering a roof with the aid of a roof covering system according to one or more of the preceding claims, **characterized** in that the method comprises the following steps:

joining the insulation plates and the covering material by means of adhesion to form integrated roof elements;

placing the integrated roof elements on the roof construction by successively placing these adjacent to each other onto the roof while after each placement of a roof element the required number of fastening elements are placed against its free side, which fastening element(s) is/are then fastened to the roof construction, subsequently a next roof element is pushed against the side of the previously placed roof element, against the fastening ele-

ment(s) already fastened to the roof construction, etc., and
finishing the covering material to be rainproof.

15. A method according to claim 14 for a roof covering system according to claims 12 or 13, **characterized** in that the roof elements are joined together to form an integrated rainproof insulated roof covering by means of thermally fusing the covering flap of the one roof element to the covering material of the adjacent other roof element.
16. A fastening element clearly belonging to a roof covering system according to claims 1 to 12 and being suitable for a method according to either one of claims 13 and 14.

20

25

30

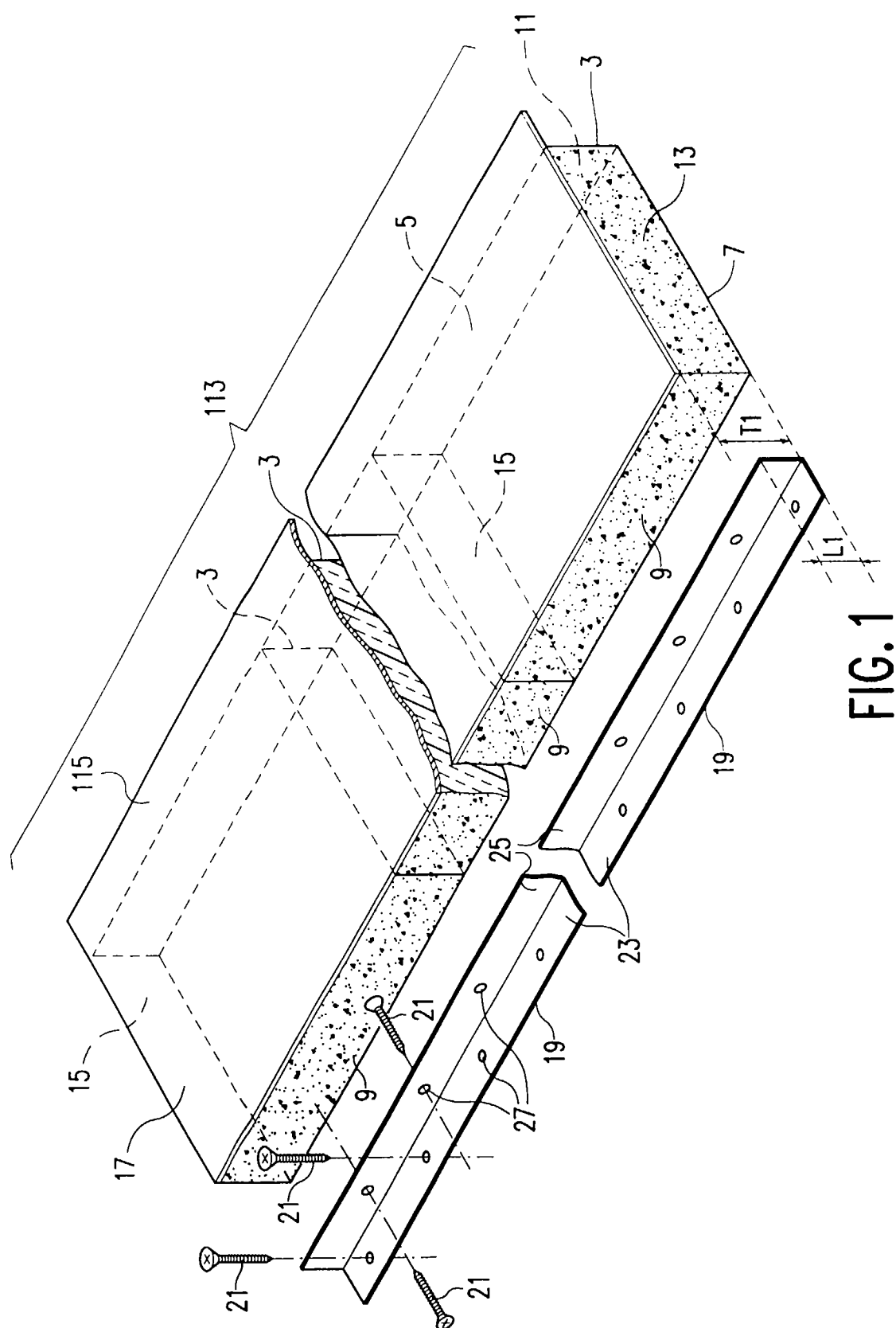
35

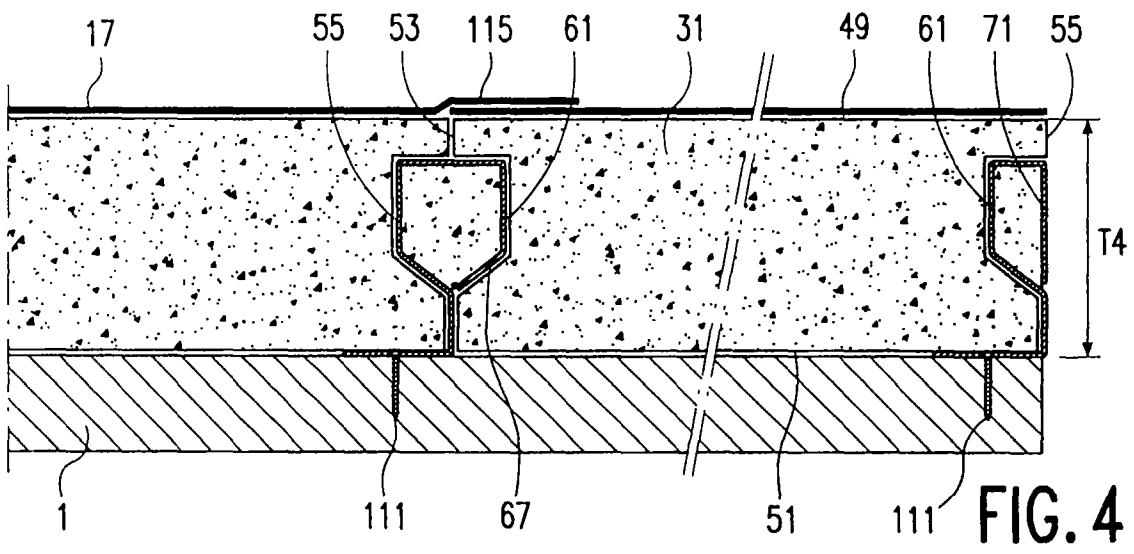
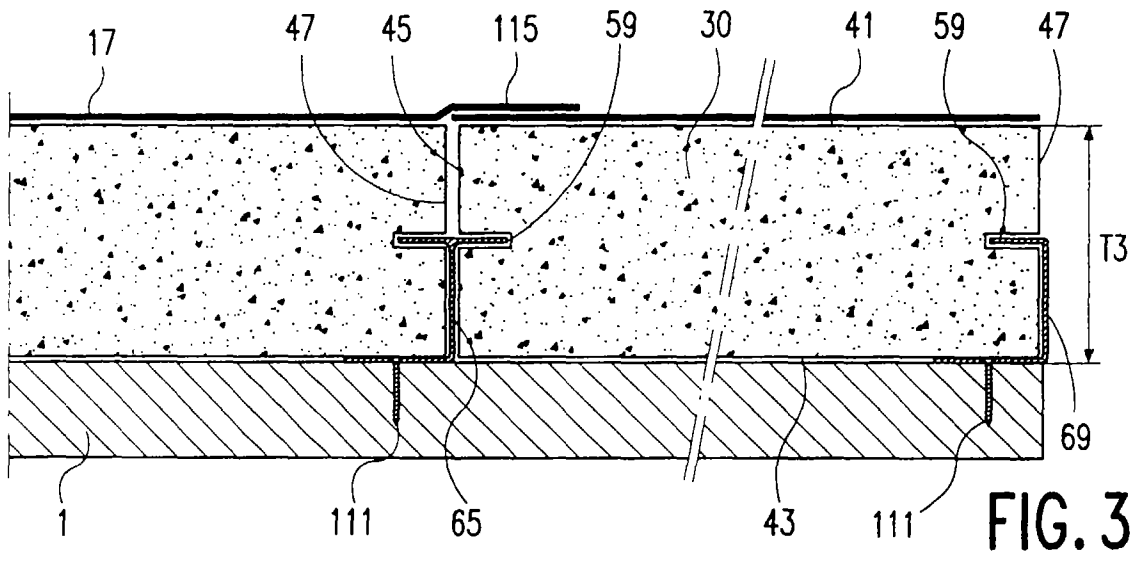
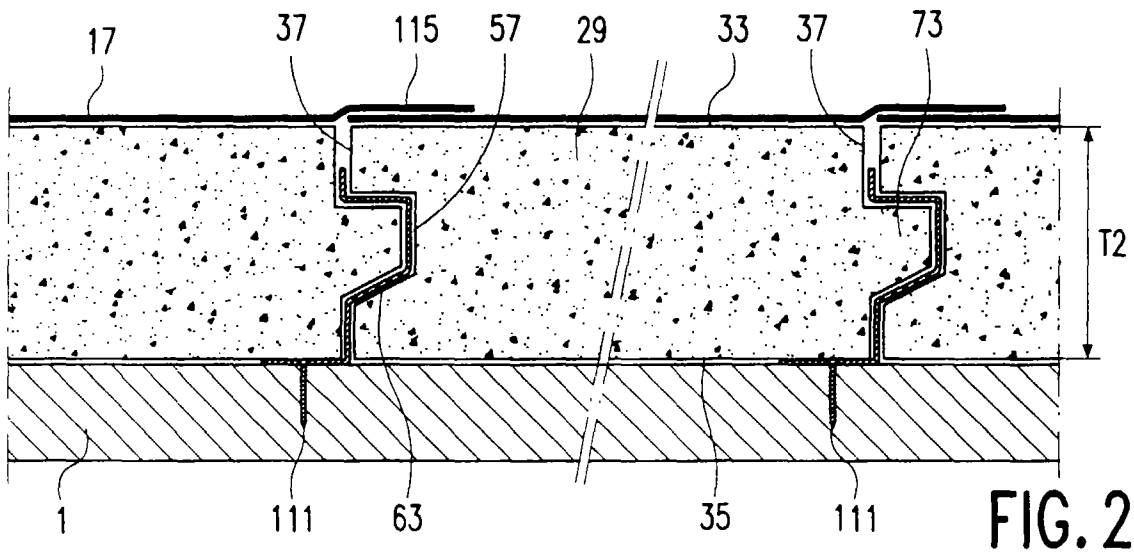
40

45

50

55





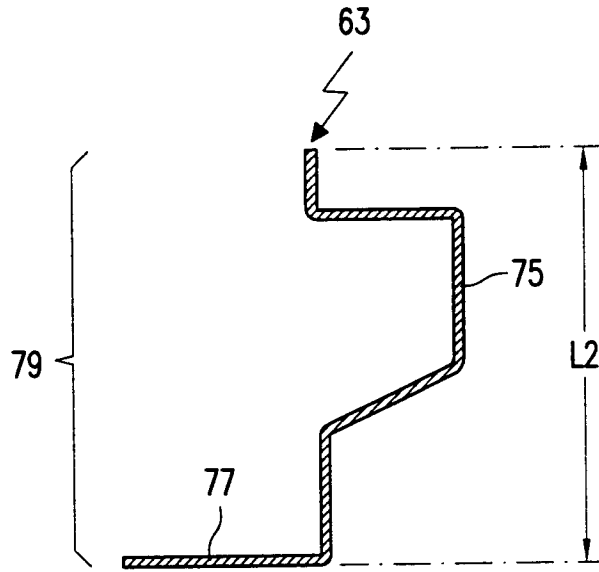


FIG. 5

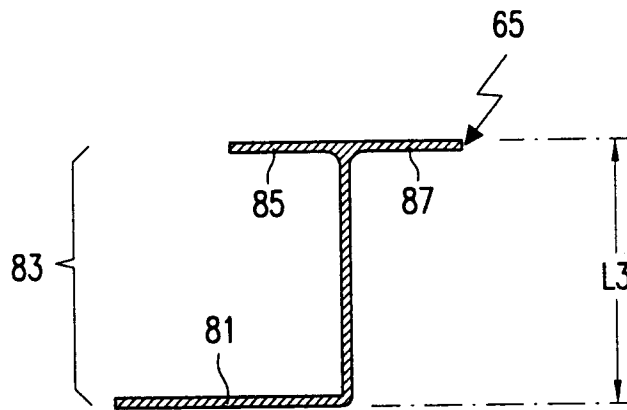


FIG. 6

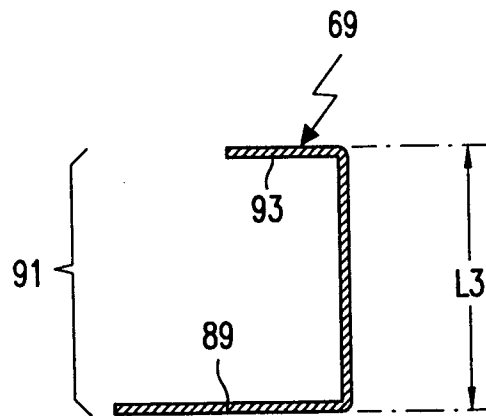


FIG. 7

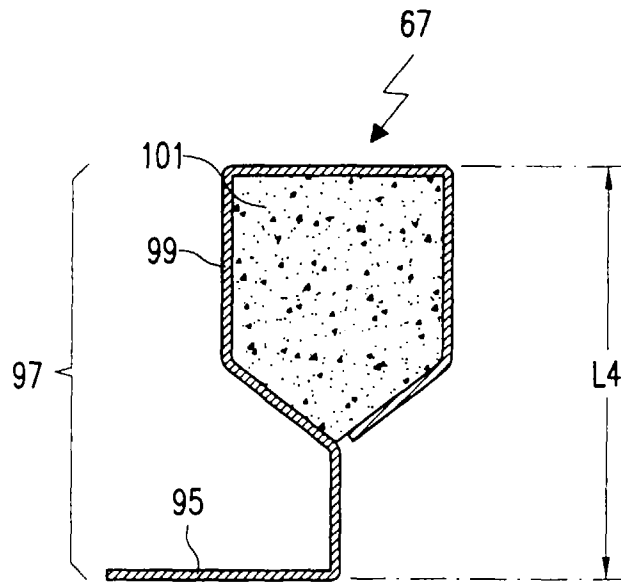


FIG. 8

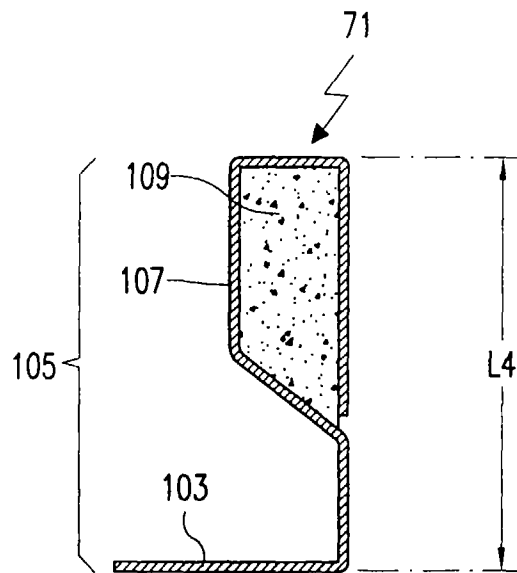
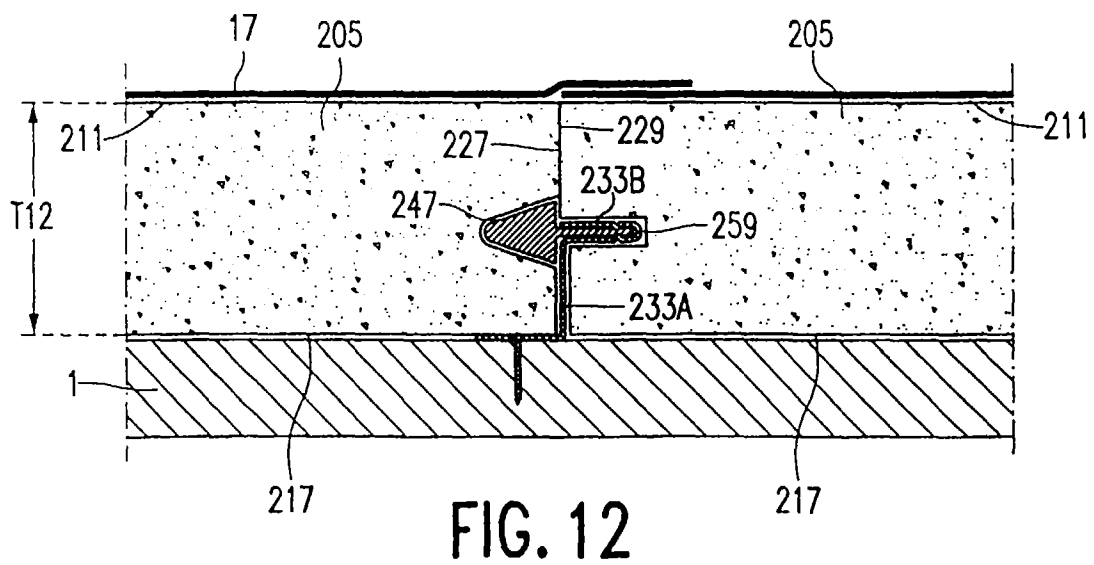
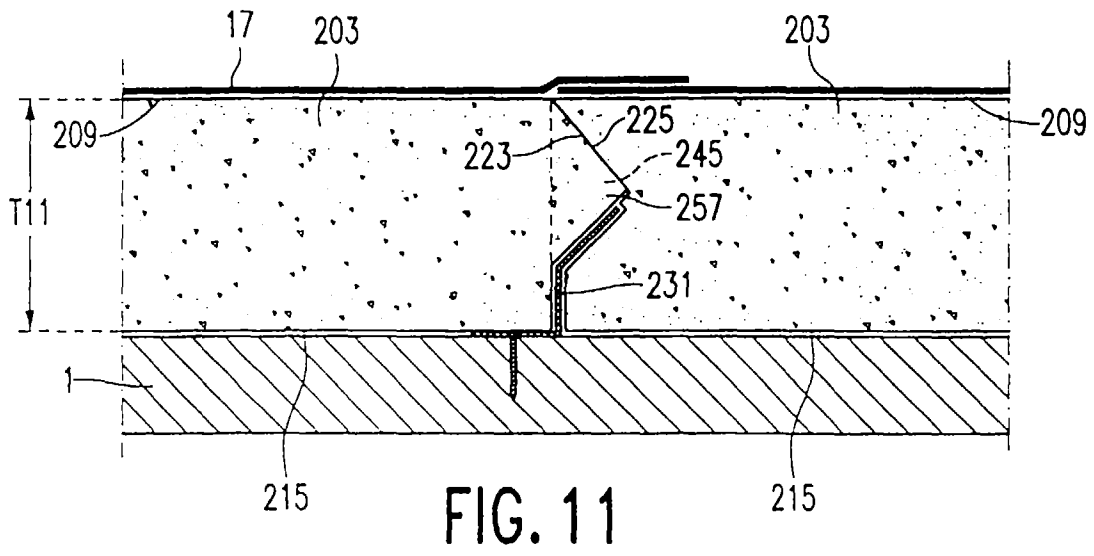
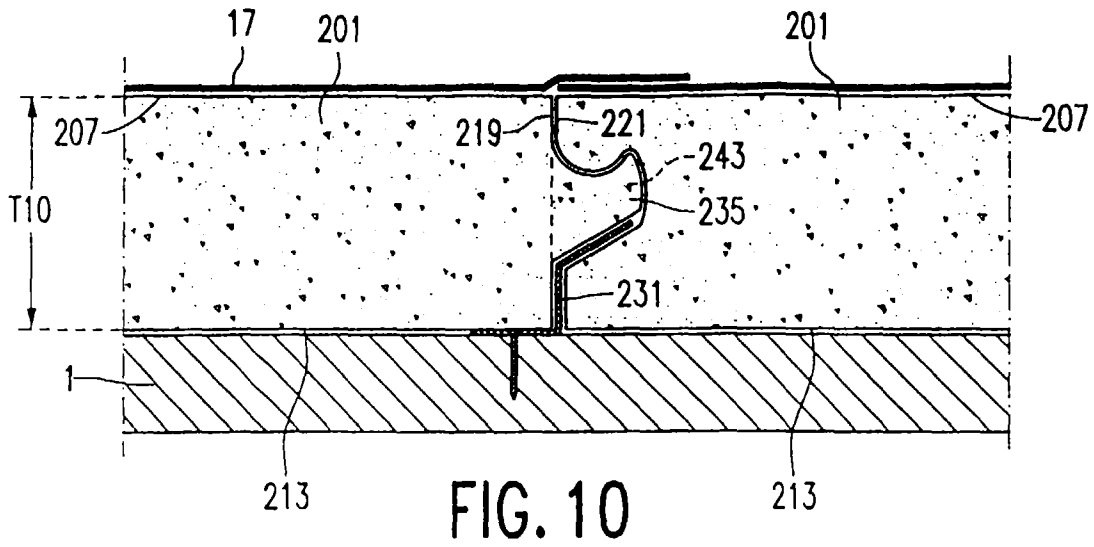


FIG. 9



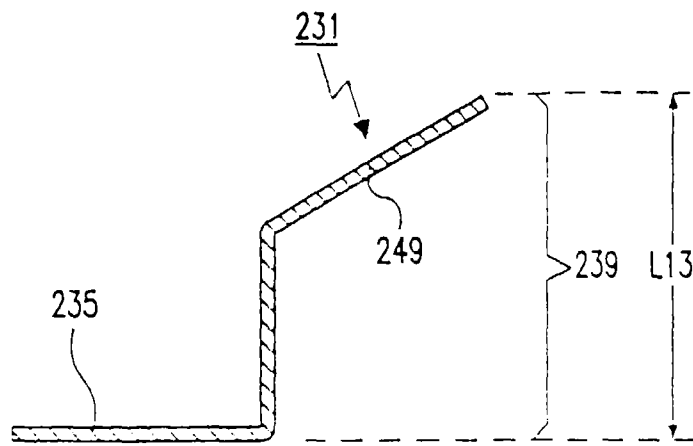


FIG. 13

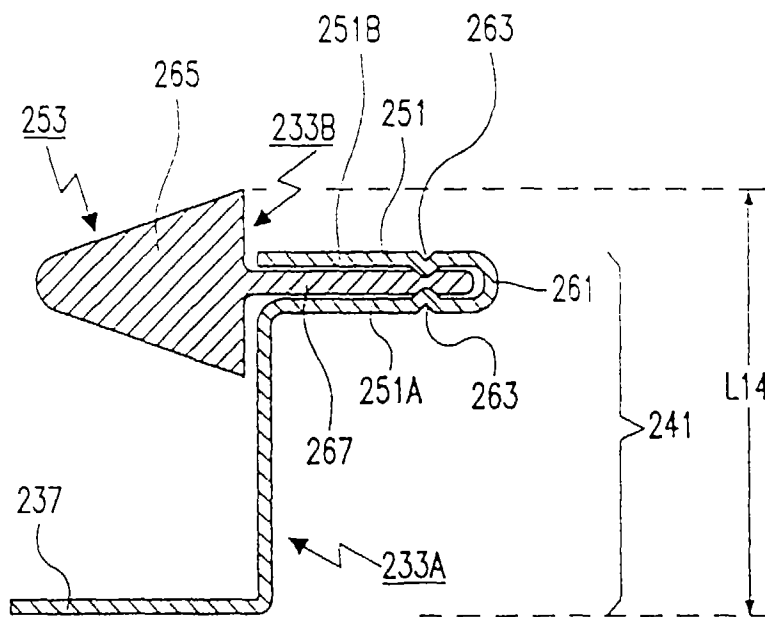


FIG. 14

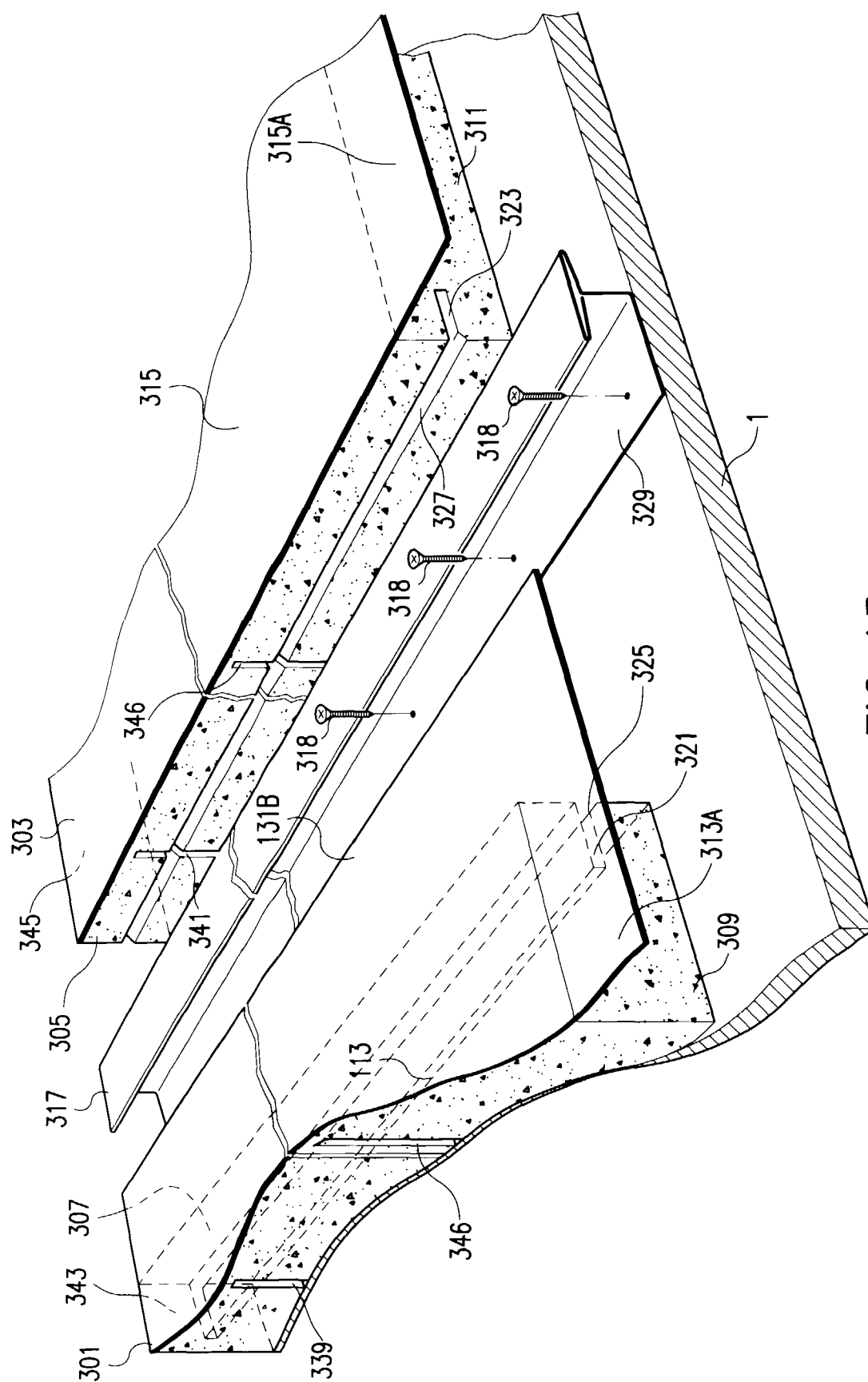


FIG. 15

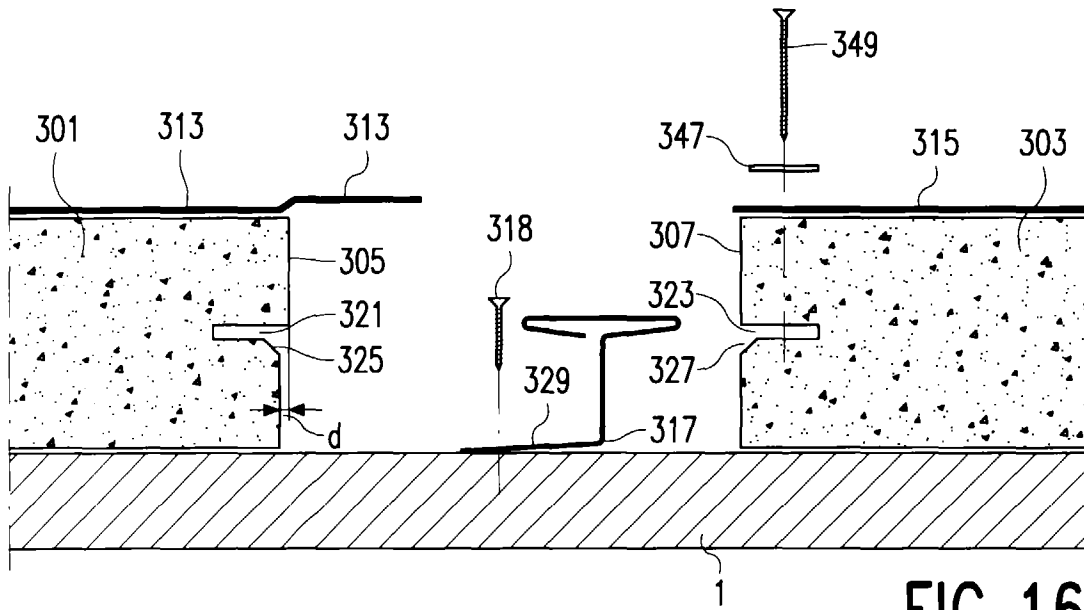


FIG. 16

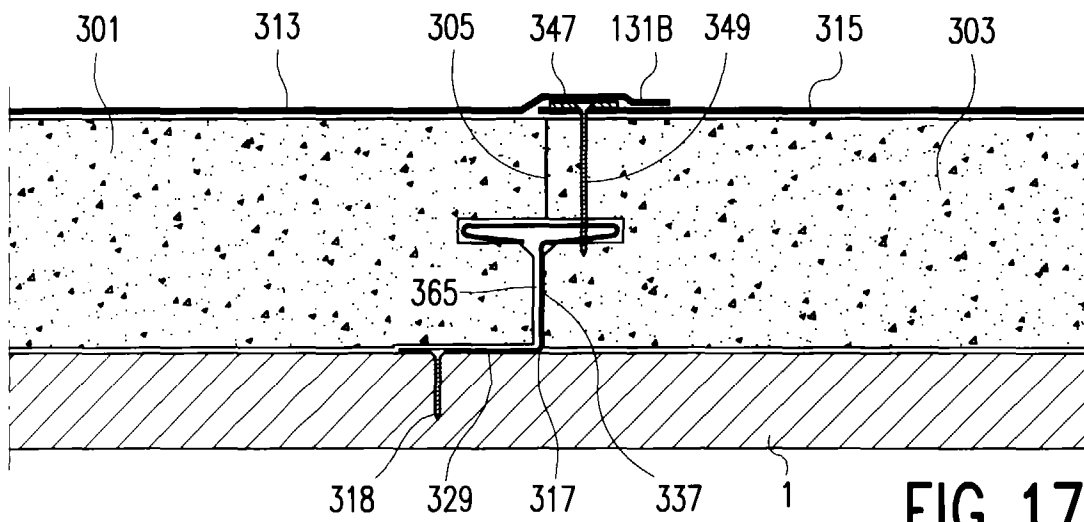


FIG. 17

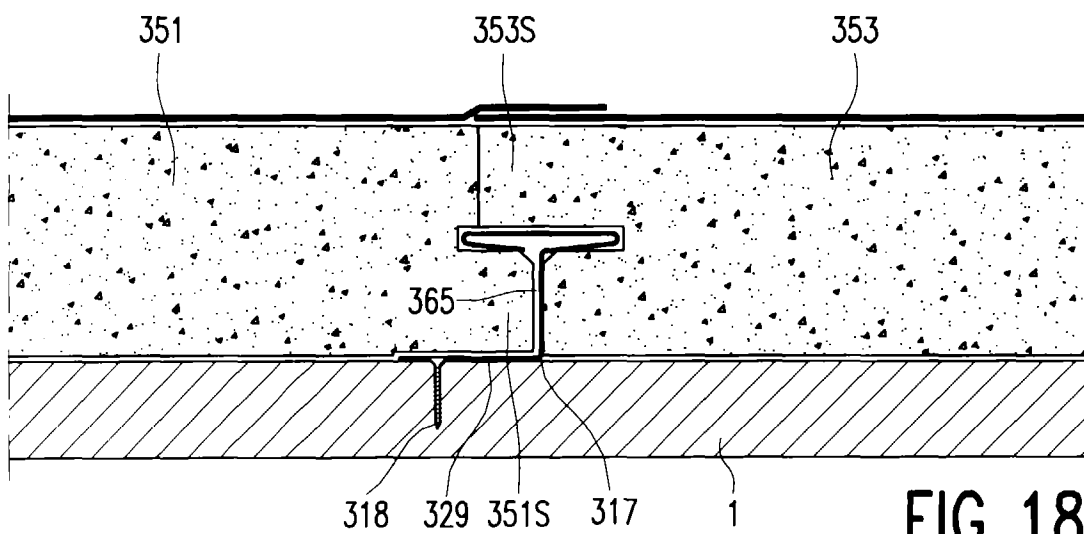


FIG. 18

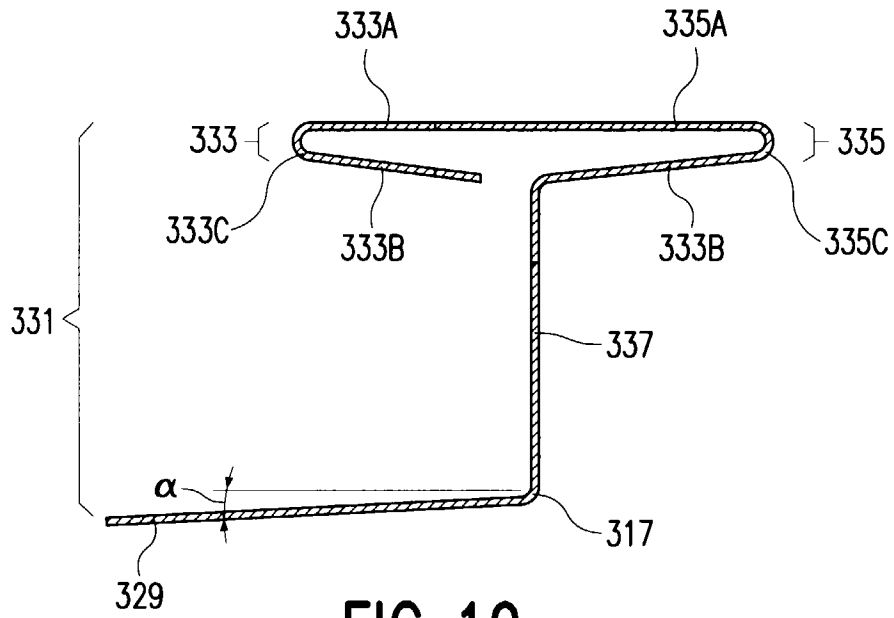


FIG. 19

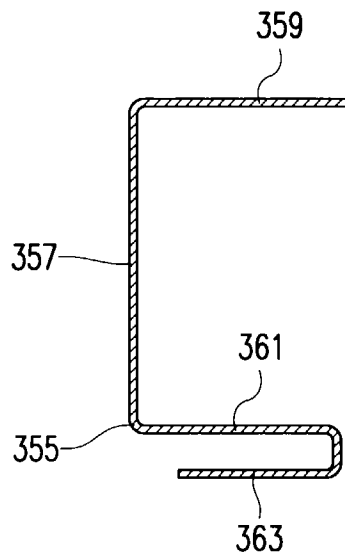


FIG. 20



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 20 0690

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	NL 7 308 365 A (DYNAMIT NOBLE AG) * page 3, line 8 - page 3, line 14 * * page 3, line 27 - page 4, line 2 * * page 5, line 10 - page 5, line 28 * * page 9, line 15 - page 10, line 5 * * page 10, line 10 - page 10, line 16 * * page 10, line 28 - page 10, line 36 * * figures 1,3,5 *	1,3,6-8, 10,13-16	E04D3/35 E04D3/36 E04D13/16
Y A	GB 2 136 471 A (ISOTEC AG) * page 1, line 66 - page 1, line 79 * * page 1, line 106 - page 1, line 119 * * page 2, line 27 - page 2, line 60 * * page 3, line 46 - page 3, line 110 * * figures 1-4 *	1,3,7, 14,16 8,11,12	
P,Y	NL 1 002 564 C (ESPACE HOLDING) * the whole document *	1,3,6-8, 10,13-16	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	DE 88 08 063 U (UNIDEK BOUWELEMENTEN) * page 6, paragraph 2 * * figure 1 *	1,7,8,16	E04D E04B
A	GB 1 120 983 A (THERMACOUST LTD) * page 1, line 80 - page 2, line 25 * * figures 1,2 *	1,10,13, 16	
A	DE 88 04 855 U (LINZMEIER) -----		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 17 June 1997	Examiner Hendrickx, X
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)