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## (54) Wall and roof assemblies

(57) A sub-structure for retaining sheet material forming an outer surface of a building (such as a wall or roof) in spaced relation to an underlying structure comprises a supporting member and a bracket. The supporting member is longitudinally extensive and the sheet material is attached to the support member by suitable fixings. The support member is mounted on the brackets which are fixed to the underlying structure and serve to space the support member from the underlying structure. The support member is mounted on the brackets by a "snap-on" latching action, during which at least part of it is resiliently deformed.

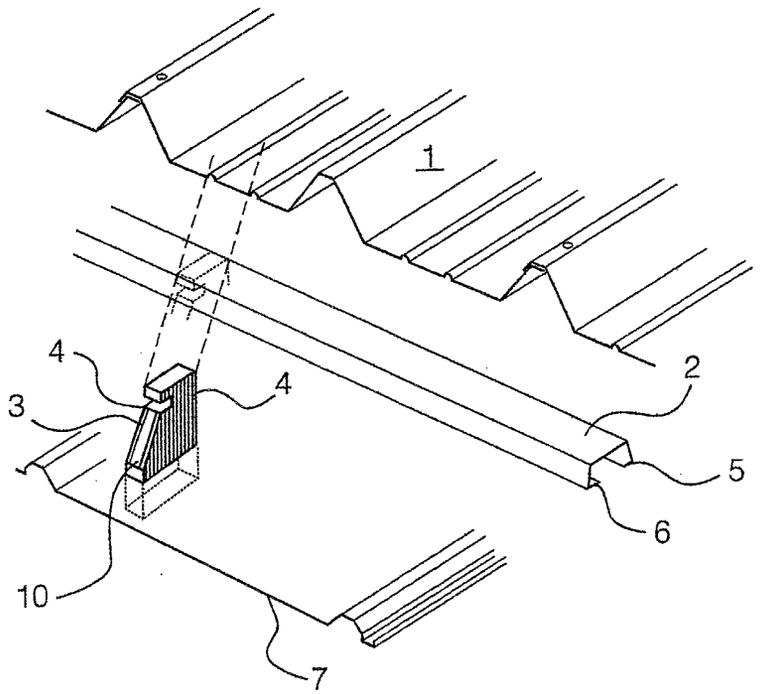


Fig. 2

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## Description

**[0001]** The present invention relates to wall and roof structures and sub-structures. In particular, the invention relates to sub-structures by means of which a new outer roof or wall surface may be supported in spaced apart relation to an existing roof or wall, or other suitable underlying structures (such as joists formerly supporting a replaced roof). The invention relates in particular to support members to which the outer roof or wall surface is attached and to brackets by means of which the support members are attached in spaced relation to the underlying structure.

**[0002]** The refurbishment of roofs or walls of existing buildings may be achieved by providing a supporting grid over the existing wall or roof to which a new wall or roof outer surface is attached. The supporting grid must be attached to an existing structural element of the building such as an existing wall or existing roof joists and brackets are provided so that the supporting grid is in spaced relation to the existing structure. For new buildings the supporting grid is simply attached to suitable structural elements of the building. One advantage of mounting the new roof or wall membrane in spaced relation to the underlying structure is that, provided a lining membrane or the like is provided at the inner side, a void is created which can be filled with suitable insulating material.

**[0003]** GB 2 148 975 describes one form of such a structure in which a bracket is located in a generally "C" shaped support member by a twist and lock action. A disadvantage of the system described in GB 2 148 975 is that in use the bracket may be caused to rotate so that it becomes loose and allows movement of the new roof/wall structure.

**[0004]** Another system, described in GB 2 240 558 tries to overcome this disadvantage by providing the bracket with tongue portions which engage parts of the support member to prevent rotation of the bracket.

**[0005]** In both the system of GB 2 148 975 and that of GB 2 240 558 it is necessary to insert the bracket into an end of the support member and then to slide the bracket along the support member until it is in its desired use position. The bracket is then rotated until it engages the support member and it is locked in its position of use. Systems of this sort have two particular disadvantages. Firstly, it is often a requirement to position the brackets in very specific locations. For example, a new roof structure is often mounted over an existing roof structure which has a corrugated profile. In this case, the brackets must be mounted in the support member so that in use they sit in the valleys of the corrugated profile. As there may be many brackets for each support member, accurate location of all the brackets is difficult and it can also be difficult to adjust the position of a wrongly located bracket. Secondly, the brackets are not secured to the underlying structure until after they have been located in the support member and the support member has been placed in position. Thus, the support member interferes with access to the bracket for inserting and tightening fixings (usually self-tapping screws) which is inconvenient and does not promote secure and accurate fixing of the brackets.

**[0006]** The present invention seeks to overcome the above disadvantages. In particular, by means of the present invention it is possible to mount the brackets in the desired locations on the underlying structure and subsequently to mount the support member on the brackets. Thus, the brackets can easily and accurately be attached at desired locations on the underlying structure, and access for the bracket fixing is not hindered by the presence of the support member.

**[0007]** Accordingly, a first aspect of the present invention provides a sub-structure for retaining sheet material forming an outer surface of a building in spaced relation to an underlying structure, said sub-structure comprising:

(i) a longitudinally extensive support member having a support surface to which said sheet material is attached in use, and first and second legs depending from respective side edges of said support surface, said support surface and said legs defining a hollow interior of the support member, and

(ii) a bracket including a first portion which is secured in use to the underlying structure and a second portion which lies in use substantially within the hollow interior of the support member and which co-operates with the support member to retain the support member on the bracket, wherein at least one of said legs is resiliently deformable from a rest condition to a condition in which said legs are spaced further apart, and said second portion of the bracket has first and second oppositely disposed side edges which lie in use adjacent the respective inner surfaces of said legs, at least part of said second portion being so sized and shaped that said at least one resiliently deformable leg is deformed away from the rest condition as the support member is mounted on the bracket.

**[0008]** In a preferred embodiment of this aspect of the invention, a free end of one of said legs includes an engagement formation and the respective side edge of the second portion of the bracket includes a recess which co-operates with said engagement formation to retain the support member on the bracket.

**[0009]** In a particularly preferred variation of this embodiment, the free ends of each of said legs include an engagement formation and the respective side edge of the second portion of the bracket each include a recess which co-operates with an engagement formation of a respective leg to retain the support member on the bracket.

**[0010]** In a particularly preferred arrangement the engagement formation(s) and the recess(es) co-operate

by a latching engagement. In this way, the support member is particularly securely located on the bracket(s).

**[0011]** In a further preferred arrangement, at least part of the engagement formation(s) enters the recess(es) to an extent that the support member adopts substantially its rest configuration when mounted on the bracket in the use position.

**[0012]** In an especially preferred embodiment of the invention, at least one of the side surfaces of the bracket includes a portion having a convex profile whereby said second portion is so sized and shaped that said at least one resiliently deformable leg is deformed away from the rest condition as the support member is mounted on the bracket.

**[0013]** Preferably in this embodiment, the second portion of the bracket comprises a substantially straight top edge which lies in use proximate the undersurface of the support surface of the support member, the portion having a convex profile depending from one end of said top edge, and an arcuate portion leading from the other end of said top edge to the other of said side edges.

**[0014]** According to a second aspect of the invention, there is provided a bracket for co-operation with a support member in a sub-structure for retaining sheet material forming an outer surface of a building in spaced relation to an underlying structure, the bracket comprising:

a lower, first, portion including a foot which contacts the underlying structure in use and by means of which the bracket is secured in use to the underlying structure, and

an upper, second, portion including a substantially straight top edge oppositely disposed from said foot, oppositely disposed side edges depending from said top edge, each side edge including an inwardly directed recess and at least one of said side edges including a portion, extending from said top edge to an upper limit of said recess, having an outwardly convex profile.

**[0015]** Preferably the bracket further comprises an arcuate portion extending from said top edge to the upper limit of said recess on the side edge not including the portion having an outwardly convex profile.

**[0016]** A third aspect of the present invention provides a method of forming the sub-structure according to the first aspect of the invention comprising mounting a desired number of brackets at appropriate locations on the underlying structure, placing the support member over the brackets and urging the support member into its position of use whereby the at least one resiliently deformable leg of the support member is resiliently deformed from its rest condition as the second portion of the bracket enters the hollow interior of the support member.

**[0017]** Preferably, in their use position, the brackets and the support member are engaged by a "snap-fit" action such that the legs of the support member engage the bracket by a latching action.

**[0018]** For a better understanding of the invention, and to show how the same may be carried into effect, reference is made, by way of example only, to the following drawings, in which:

Figure 1 is a section through a prior art cavity wall assembly in accordance with the structure described in GB 2 148 975;

Figure 2 is an exploded view of the prior art section shown in Figure 1;

Figure 3 is a part sectional view of a prior art roof sub-structure as described in GB 2 240 558;

Figure 4 is a plan view of part of a bracket in accordance with the present invention;

Figure 5 is a transverse section through a support member for co-operation with the bracket of Figure 4, in accordance with the present invention; and

Figure 6 is a transverse section through an alternative support member.

**[0019]** Referring now to Figures 1 and 2, in the prior art assembly the outer surface of the wall comprises sheet material 1 in the form of a series overlapping corrugated panels.

**[0020]** The panels of sheet material 1 are mounted on a C-section supporting member 2 which in turn is mounted on brackets 3. The brackets 3 are provided with slots 4 into which lips 5,6 of support member 2 are inserted (by a twisting of the bracket 3) to lock the bracket 3 in the support member 2. The sheet material 1 is secured to the brackets 3 by means of self tapping screws (not illustrated). The assembly of Figures 1 and 2 is also provided with a lining 7 of sheet material, thereby to define a cavity 8 between the sheet material 1 and the lining 7. The lining 7 is attached to the underlying structure 9 of the building. The brackets 3 are attached at 10 (by self tapping screws) to the underlying structure 9. Although illustrated in Figures 1 and 2 with respect to wall cladding, structures of this type are also suitable for new or replacement roofing structures.

**[0021]** Figure 3 shows another prior art structure comprising a bracket 30 and a support member 31. Sheet material 32 is attached to the top surface 33 of support member 31. The bracket 30 is mounted on underlying structure 34 by means of a foot 35. A liner 36 is disposed on the underlying structure 34 and passes between the bracket 30 and the underlying structure 34. The bracket 30 includes tongues 37, 38 and slots 39, 40 which co-operate with recesses 41, 42 formed in the support member 31 to retain the support member 31 on the bracket 30. Elements 43, 44 (which project out of the plane of the paper) act to prevent rotation of bracket 30

in support member 31.

**[0022]** In both constructions illustrated in Figures 1 to 3 it is a particular disadvantage that the brackets must first be set in position in the support member before the support member (with the brackets attached) is placed in its location of use. It is often the case, especially, for example, when covering an underlying surface such as an old wall or roof with a corrugated profile, that the brackets must be disposed (with respect to the underlying structure) in specific locations, with limited margin for error. Such specific locations may, for example, be the valleys in the corrugated profile of the underlying structure, or the location of particular elements of the underlying structure capable of supporting the new sheet material outer surface via the brackets. It can be difficult to locate the brackets in the correct location in the support member and, if the brackets are found to be in the wrong position when the support member is offered to the underlying structure, it can be difficult to adjust their position. Furthermore, the support member can often obstruct access to the fixing point for attaching the brackets to the underlying structure. The present invention seeks to overcome these deficiencies.

**[0023]** Figures 4 and 5 illustrate respectively a part of a bracket 50 and a support member 70, in accordance with the present invention. Only the upper part of the bracket is shown in Figure 4. The lower part of the bracket (not illustrated) by means of which it is attached to the underlying structure may be formed as known from the prior art. For example one or more feet may be formed at the base of the bracket extending generally perpendicularly with respect to the main portion of the bracket, these feet including one or more holes for fixings such as self tapping screws.

**[0024]** The bracket 50 includes a top edge 51 which is generally straight and side edges generally indicated at 52 and 53. Recesses 54 and 55 are formed in side edges 52 and 53 respectively. The bracket 50 is preferably formed from steel (especially galvanized steel) or may be formed from other suitable material having the required characteristics of strength and rigidity. The bracket may be formed from a web of steel material having a thickness of between 1mm and 5mm, preferably about 3mm.

**[0025]** The support member 70 is illustrated in transverse cross-section and extends along a major axis perpendicular to the plane of the paper. The length of a given support member will depend on the particular circumstances of its use, but may be several metres. The support member 70 includes a support surface 71 to which, in use, the sheet material forming the (new) outer surface of the building is attached. The sheet material will often take the form of rolled metal sheets, such as of steel or aluminium. These sheets can be formed with a corrugated or ridged profile and adjacent sheets will normally overlap and, ideally be provided with inter-engaging means to hold the sheets together to form a single surface. Other sheet materials can also be used, such as suitably strong and durable plastics materials. A lining material, for example a waterproof lining material, co-extensive with the sheet material, may be placed between the support surface 71 and the sheet material. The support surface 71 may be formed with a number of ribs which may be longitudinal, transverse, or in other directions. These ribs may serve to increase the rigidity of the support surface and it has been suggested that the resistance to being pulled out of a fixing of particular thread diameter may be improved by the presence of the ribs. However, this advantage is only likely to be achieved when the fixing passes through a valley between the ribs and such precision in location of the fixing may not be possible where, for example, the ribs on the support surface 71 are obscured by a liner. Depending from the respective edges of the support surface 71 are legs 72, 73 which are as illustrated preferably of unequal length, although this need not necessarily be so. The free ends 74, 75 of the legs 72, 73 are provided with engagement formations 76, 77 which preferably extend continuously along the length of the support member 70. The engagement formations 76, 75 are formed as lips or hooks depending from the respective legs 72, 73. The support member 70 is preferably made from steel, especially galvanized steel, having a thickness of from 0.5 to 5mm, especially about 1mm to 2mm, particularly about 1,25mm. Other materials may be used provided that they are suitable for fixing the sheet material and meet other requirements outlined below.

**[0026]** The bracket 50 includes a portion 56 of the side edge 52 having an outwardly convex profile 57. The portion 56 in the embodiment illustrated depends from the top edge 51 and terminates at the upper limit 58 of recess 54. The portion 56 is illustrated in Figure 4 as having a smoothly progressive convexly curved surface, and this is the preferred arrangement as it provides the easiest mounting of the support member 70 on the bracket 50. However, other convex profiles may be suitable, such as a more steeply curved surface, or two plane surfaces extending respectively from the top edge 51 and the upper limit 58 of recess 54 and meeting at an apex, provided only that the support member 70 can be mounted on the bracket 50 by means of a reasonable force applied to cause resilient deformation of the support member 70, as described below. A portion 59 of the side edge 53 between the top edge 51 and the recess 55 has a generally arcuate shape.

**[0027]** The leg 72 of support member 70 is resiliently deformable from the rest condition illustrated in Figure 5 generally in the direction indicated by arrow A. The spacing d between the free end 74 of leg 72 and leg 73 is thereby increased. When the leg 72 is no longer subjected to the force causing the deformation, the leg 72 returns resiliently to the rest condition illustrated in Figure 5. If desired, the leg 73 may be resiliently deformable and the support surface 71 may also be capable of some resilient deformation.

**[0028]** In use of the sub-structure of the invention

(comprising the bracket(s) and the support member(s), the brackets are first secured in the desired locations on the underlying structure. In this context, the underlying structure may be an existing wall or roof, or other suitable structural frameworks or elements of a building. The brackets may be secured by suitable fixings such as self tapping screws, or may be fixed to the underlying structure by means of an adhesive. When the required number of brackets has been fixed in position, the support member is placed loosely over the brackets so that the upper portions of the brackets 50 begin to enter the hollow region 78 of the support member 70 defined by the legs 72, 73 and support surface 71. The brackets 50 are initially prevented from fully entering the hollow region 78 of the support member 71 because the width of the bracket 30 in the area including the convexly profiled region 57 is greater than the spacing d of the support member. A force is then applied to the support member 70, usually to the support surface 71, to urge the support member 70 further onto the brackets 50. The leg 72 of the support member 70, and possibly other parts of the support member 70, are caused to deform resiliently so that the spacing d is increased. In this way, the free ends 74, 75 of the legs 72,73 can slide over the convexly profiled surface 57 and arcuate surface 59 respectively so that the upper portions of bracket 30 enter further into hollow region 78. As the support member 70 reaches its final use position with respect to the brackets 50 the engagement formations 76, 77 enter the respective recesses 54, 55 so that the support member 70 resiliently returns to its rest condition with a "snap" action. The engagement formations 76, 77 co-operate with the upper edges 58, 60 of the recesses 54, 55 in a latching action to retain the support member 70 securely on the brackets 50.

**[0029]** The support member 70 should have a sufficient resistance to resilient deformation so that a substantial force is required to urge the support member 70 into engagement with the brackets 50. In this way, the support member 70 is securely retained on the brackets 50 because a large force is required in order to overcome the resistance to deformation of the support member 70 and to urge it out of engagement with the brackets 50. In order to urge the support member 70 into engagement with a given bracket 50, a minimum force of approximately 600N, more especially 1000N should be required. The required force will, of course, be determined by factors such as the material used to form the support member 70, the thickness of the material and the degree of deformation which is required.

**[0030]** Figure 6 illustrates a variation of the support member 70 in which the engagement formation 77 is replaced by a protrusion or knee 79 formed in the leg 73.

## Claims

**1.** A sub-structure for retaining sheet material forming an outer surface of a building in spaced relation to an underlying structure, said sub-structure comprising:

(i) a longitudinally extensive support member having a support surface to which said sheet material is attached in use, and first and second legs depending from respective side edges of said support surface and each having a free end distal from the support surface, said support surface and said legs defining a hollow interior of the support member, and
(ii) a bracket including a first portion which is secured in use to the underlying structure and a second portion which lies in use substantially within the hollow interior of the support member and which co-operates with the support member to retain the support member on the bracket, wherein

at least one of said legs is resiliently deformable from a rest condition to a condition in which said legs are spaced further apart, and said second portion of the bracket has first and second oppositely disposed side edges which lie in use adjacent the respective inner surfaces of said legs, at least part of said second portion being so sized and shaped that said at least one resiliently deformable leg is deformed away from the rest condition as the support member is mounted on the bracket.

**2.** A sub-structure as claimed in Claim 1 wherein a free end of one of said legs includes an engagement formation and the respective side edge of the second portion of the bracket includes a recess which co-operates with said engagement formation to retain the support member on the bracket.

**3.** A sub-structure as claimed in Claim 1 wherein the free ends of each of said legs include an engagement formation and the respective side edges of the second portion of the bracket each include a recess which co-operates with an engagement formation of a respective leg to retain the support member on the bracket.

**4.** A sub-structure as claimed in Claim 2 or 3 wherein the engagement formation(s) and the recess(es) co-operate by a latching engagement.

**5.** A sub-structure as claimed in Claim 2, 3 or 4 wherein at least part of the engagement formation(s) enters the recesses to an extent that the support member adopts substantially its rest configuration when mounted on the bracket in the use position.

**6.** A sub-structure as claimed in any preceding claim wherein at least one of the side surfaces of the

bracket includes a portion having a convex profile whereby said second portion is so sized and shaped that said at least one resiliently deformable leg is deformed away from the rest condition as the support member is mounted on the bracket.

**7.** A sub-structure according to Claim 6 wherein the second portion of the bracket comprises a substantially straight top edge which lies in use proximate the undersurface of the support surface of the support member, the portion having a convex profile depending from one end of said top edge, and an arcuate portion leading from the other end of said top edge to the other of said side edges.

**8.** A bracket for co-operation with a support member in a sub-structure for retaining sheet material forming an outer surface of a building in spaced relation to an underlying structure, the bracket comprising:

a lower, first, portion including a foot which contacts the underlying structure in use and by means of which the bracket is secured in use to the underlying structure, and
an upper, second, portion including a substantially straight top edge oppositely disposed from said foot, oppositely disposed side edges depending from said top edge, each side edge including an inwardly directed recess and at least one of said side edges including a portion, extending from said top edge to an upper limit of said recess, having an outwardly convex profile.

**9.** A bracket as claimed in Claim 8 further comprising an arcuate portion extending from said top edge to the upper limit of said recess on the side edge not including the portion having an outwardly convex profile.

**10.** A method of forming the sub-structure of any of Claims 1 to 7 comprising mounting a desired number of brackets at appropriate locations on the underlying structure, placing the support member over the brackets and urging the support member into its position of use whereby the at least one resiliently deformable leg of the support member is resiliently deformed from its rest condition as the second portion of the bracket enters the hollow interior of the support member.

**11.** A method as claimed in Claim 9 wherein in their use position, the brackets and the support member are engaged by a "snap-fit" action such that the legs of the support member engage the bracket by a latching action.

**12.** A sub-structure as claimed in Claim 1 including a bracket as claimed in Claim 7 or Claim 8.

**13.** A building including a sub-structure as claimed in any of Claims 1 to 7 or 12.

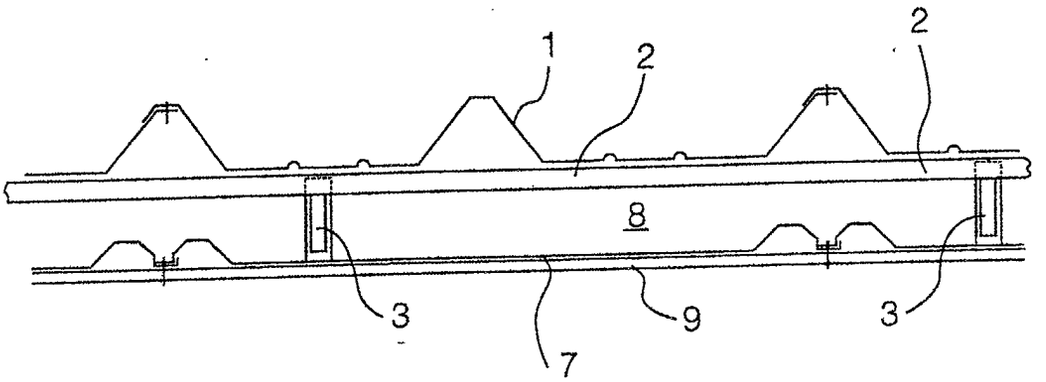


Fig. 1

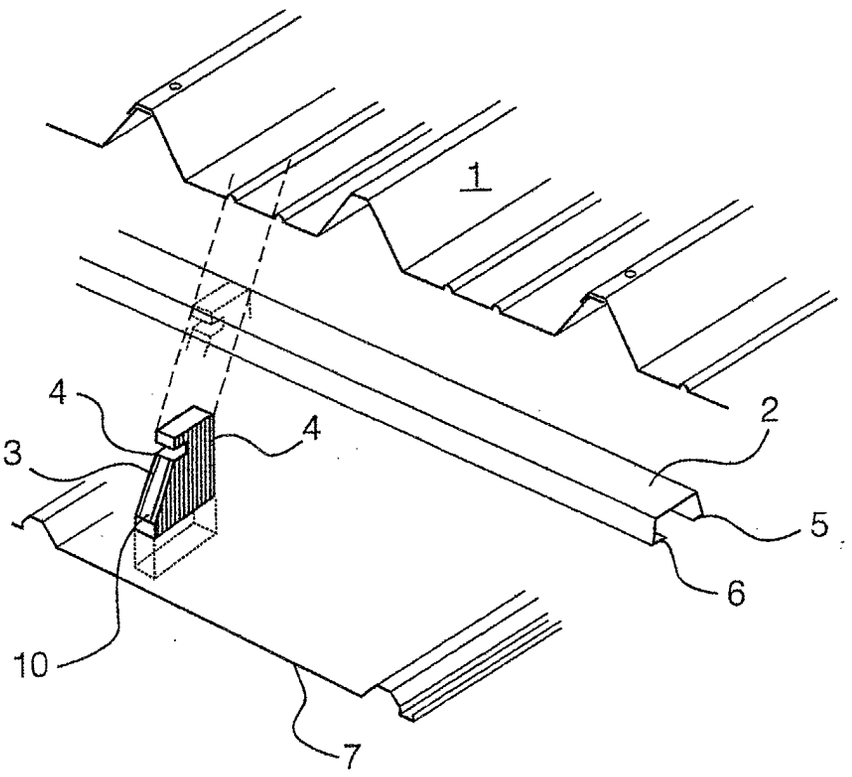


Fig. 2

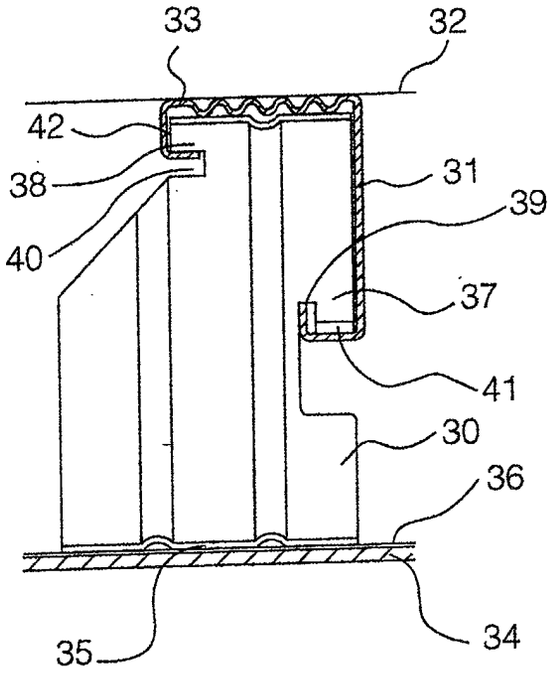


Fig. 3

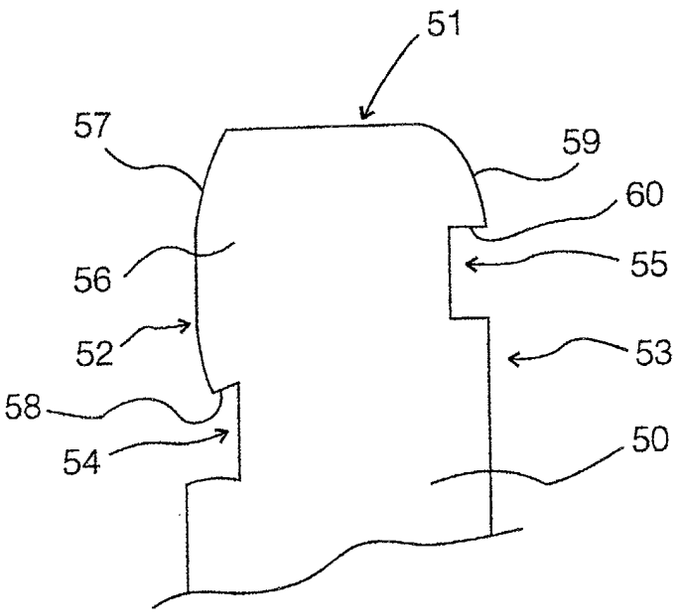


Fig. 4

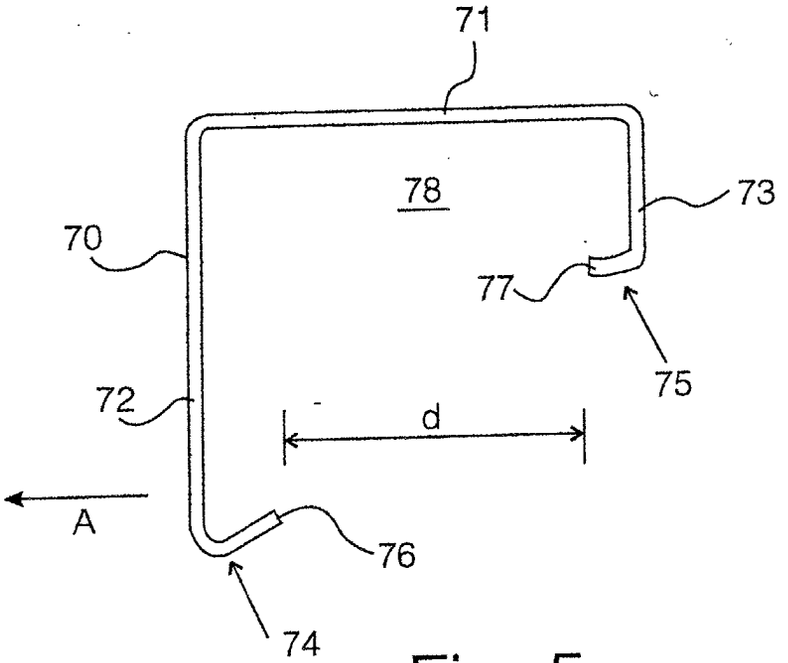


Fig. 5

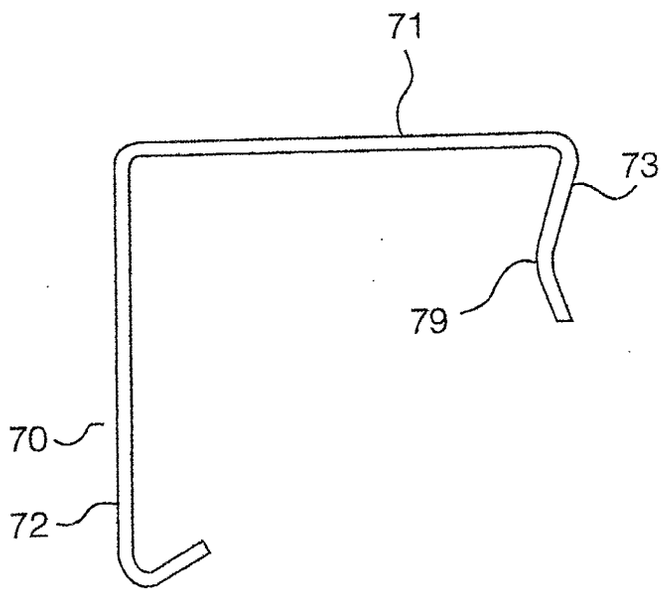


Fig. 6

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# EUROPEAN SEARCH REPORT

Application Number
EP 01 30 9456

## 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.7) |
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

E04D
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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 19 March 2002 | Demeester, J |

CATEGORY OF CITED DOCUMENTS

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 30 9456

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