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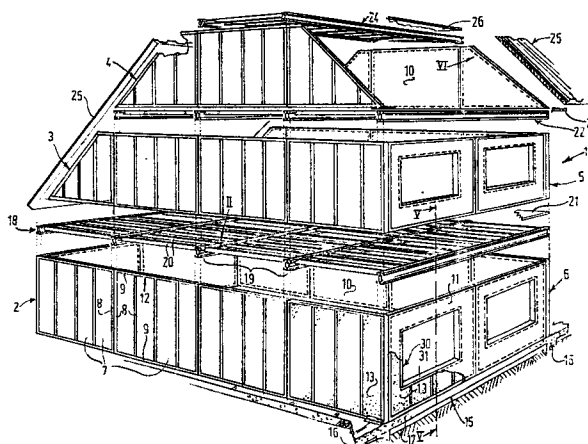
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Building, wall sections and profiles for the same.

A building (1) comprising walls (2-6) consisting of frameworks (12) of horizontal (9) and vertical (8) posts provided at least on one side with plates (10, 11) ensuring resistance to deformation and span elements disposed on said walls such as floor beams (19) or rafters (93). Each wall is composed of separate sections (7) having at least one circumferential framework (12) of cold-rolled steel plate profiles, adjacent sections being mounted to one another by their vertical peripheral posts (8) and the span elements (19) being disposed above the vertical peripheral posts (8).



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BUILDING, WALL SECTIONS AND PROFILES  
FOR THE SAME.

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The invention relates to a building comprising walls constructed from frameworks of horizontal and vertical posts provided on at least one side with plates imparting resistance to deformation and span elements disposed on the walls such als floor beams or rafters.

Such a building may be a building constructed in accordance with the wood skeleton building method. In the wood skeleton building method all supporting and non-supporting elements above the foundation, that is to say, the walls, the floors and the roof are made from wood with the exception of any coating and insulating materials. The skeleton of the walls comprises horizontal and vertical posts of standarized dimensions, which are joined by simple nail joints. The resistance to deformation of the building is obtained by the plates arranged on the frameworks and, of course, by the bond of the walls with one another. A conventional mode of construction consists in that the storey floor is disposed on the erected walls of the first floor, then the storey walls

are disposed on the storey floor and on these storey walls are again arranged the storey floors for the higher storey or the rafters.

The wood skeleton building method has several  
5 important advantages. One particularly important advantage is that this method usually does not impose any limitation on the designer and that any desired construction can be carried into effect by this method. However, the building height is usually limited to three or four storeys. In addition, a  
10 building constructed by the wood skeleton building method is relatively cheap and a high insulating value can be obtained in a simple manner. A further advantage is that such a building has materially lower weight than a building of bricks or concrete. Owing to these advantages buildings are  
15 frequently erected in accordance with the wood skeleton building method in the U.S.A. and in Canada. In other countries too this method is progressing, since the highly increased building costs result in a growing interest in building methods by which high-grade buildings can be made,  
20 but which involve reasonable costs.

The object of the present invention is to provide a building constructed by a system which combines the most important advantages of the wood building method with the actual industrial possibilities.

25 In a building of the kind set forth in the preamble this is achieved by composing each wall of separate sections having at least one circumferential framework of cold-rolled steel plate profiles, adjacent sections being mounted in contact with one another by the vertical peripheral posts and  
30 the span elements being disposed above the vertical peripheral posts. Cold-rolled steel plate profiles have low weight in accordance with the advantages of the wood skeleton building. Whereas in the wood skeleton building the wall absorbs vertical loads throughout the length, the greater  
35 rigidity of cold-rolled steel plate profiles permit of erecting the walls in sections, whose vertical peripheral posts exclusively absorb vertical forces. Consequently inside each section door or window openings can be quite freely made with-

out the need for providing lintels laterally deflecting the vertical load.

It has surprisingly been found that practically without detracting from the full freedom of design any  
5 desired construction can be carried into effect when the sections in inner and outer walls have each a length lying in a range including: a complete module size, half the module size and the full and half module size minus once or twice respectively the thickness of the section. Therefore the  
10 industrial manufacture of at least the frameworks for the sections becomes interesting in view of the comparatively small number of different sections. For any building no or only very few specific sections need be made. For example, when the building to be erected has an inclined roof only few  
15 sections having an inclined side are required.

Preferably during manufacture the posts are provided at equal intervals with perforations for passing conduits and fastening means. The sections are delivered on the building site provided with outer plates or as the case may be, with a  
20 temporary strut so that after the erection of the walls and the floors of the building the conduits can be arranged in place in a very simple manner. Subsequently the inner plates are mounted.

An advantageous construction is obtained when the  
25 horizontal peripheral posts have a U-section profile and the vertical peripheral posts have an open-box profile, the width of the open-box profile corresponding to the inner distance between the limbs of the U-profile. In this way the vertical peripheral posts can be fitted by their ends in the hori-  
30 zontal peripheral posts and in this structure the vertical posts may be very thin whilst maintaining sufficient rigidity.

The horizontal and vertical posts may be advantageously interconnected by a known cold-riveting method  
35 which is a very fast method requiring little effort. According to the invention the vertical peripheral posts are provided for this purpose in their side faces with depressions around the perforations for the passage of rivets passed

through corresponding perforations in the horizontal peripheral posts. When the rivets are clamped, the material of the horizontal peripheral posts is slightly drawn inwardly into the depression of the vertical peripheral post concerned. Thus the head of the rivet can be drawn inside the plane of the framework so that the plates can be smoothly mounted on the framework.

Preferably the span elements are made from cold-rolled steel plate profiles. As stated above, they are relatively rigid in reasonable sizes so that the distance between two neighbouring span elements may be large. Since the span elements are disposed above the vertical peripheral posts of the sections, these sections may consequently have a large module size. This applies in particular when in accordance with the invention the floor comprises girders being formed by two identical, substantially U-shaped profiles mounted web to web, the webs comprising each a profile part re-entrant in the direction towards the associated limbs. The re-entrant profile parts thus constitute a long cavity in the mounted state of the two identical profiles matching high rigidity with very low weight.

As in the wood skeleton construction the building according to the invention may be provided with any desired outer coating, for example, bricks, natural stone, plaster and so on. Preferably the outer coating is formed by asbestos-cement boards or a similar material. In order to ensure satisfactory resistance to fire the plates on the inner side of the building are preferably gypsum boards.

A suitable thickness for the sections is, for example, 10 cms. By filling out the sections in accordance with the invention with mineral wool a very satisfactory thermal and sound insulation of the building can be obtained.

The invention furthermore relates to and provides wall sections for use in a building embodying the invention. Such a wall section comprises at least one peripheral framework of cold-rolled steel plate profiles and a deformation-resisting element such as plates or a strut. A strut is used



The building 1 comprises walls, for example, a ground floor wall 2, a storey wall 3, a loft wall 4 and front walls 5 and 6 at the first floor and the ground floor respectively. These walls 2 to 6 are formed by vertical posts 8 and horizontal posts 9. According to the invention each wall is constructed from separate sections 7 having a circumferential framework 12 of cold-rolled steel plate profiles so that adjacent sections 7 are mounted to one another by the vertical peripheral posts 8. In order to obtain the deformation-resistance required for a wall the sections are provided on at least one side with plates, for example, an inner plate 10 and/or an outer plate 11.

The ground floor walls such as 2 and 6 are erected on a foundation 15 consisting of foundation beams 16, which may be arranged on piles, and a system floor 17 of known type arranged between the foundation beams.

When the building 1 is erected, first the ground floor walls are first formed from the sections 7. Subsequently the storey floor 8 is arranged on the ground floor walls. According to the invention the storey floor comprises girders 19, between which joists 20 are arranged. The girders 19 are disposed on the sections 7 of the walls above the vertical peripheral posts thereof. Consequently not any vertical effort is exerted on the upper horizontal peripheral post of each section. On the floor beams 19,20 is then arranged a floor slab 21. The floor slabs 21 are preferably made from multi-plywood; they also contribute to the deformation resistance of the construction.

When the storey floor 18 is arranged in place, the wall sections 7 for the first-floor walls such as 3 and 5 are erected on the storey floor that is to say on the slabs 21. On these first-floor walls is placed a loft floor 22 in the same manner as the first floor 18. The loft floor 22 is also provided with floor slabs 23.

On the loft floor 22 are erected the loft walls such as 4 and thereon is placed a flat roof 24, which also consists of girders and joists, said roof having a structure corresponding with that of the storey floor 18 and the loft

floor 22 and thus also being provided with slabs 26.

The roof plates 25 for the inclined roof faces are arranged in a manner to be described more fully hereinafter.

Since in accordance with the invention only the  
5 vertical peripheral posts absorb vertical load, there is full freedom in designing the wall between the two vertical peripheral posts of a section 7. As is shown in Fig. 1, it is therefore possible to provide a window 30 in a section without the need for further precautions such as lintels and the  
10 like by connecting a window profile 31 with the vertical intermediate posts and by providing the inner and outer plates with a recess. As a matter course, apart from windows doors and other openings can be provided. In the window opening 30 a window frame can be mounted as is shown in Fig.  
15 5.

Fig. 2 shows that in accordance with the invention perforations 32 are provided at equal intervals in the posts of the sections 7. The girders 19 also have perforations 32 at equal intervals. These perforations can be effectively  
20 made prior to cold-rolling of the profiles. The perforations 32 serve to pass conduits through the walls and the floor construction. For passing a synthetic resin conduit 33 first a socket 34 is arranged in the perforation 32. Other conduits such as the conduit 35 may be directly passed through the  
25 perforation concerned.

Fig. 2 furthermore shows that the horizontal posts of each section 7 are formed by C-section profiles and the vertical posts 8 by open-box profiles. The width of the open-box profile 8 corresponds to the distance between the limbs  
30 of the horizontal posts 9 so that the vertical posts can fit in the horizontal posts. The posts 8 of two adjacent sections 7 are interconnected, for example, by a cold rivet joint. The girder 19 shown disposed on the vertical peripheral posts 8 is formed by two identical, substantially U-shaped profiles  
35 mounted web-to-web. The webs each have a profiled part re-entrant in the direction of the associated limbs so that in the composed state a hollow cylinder 28 is formed. The girder thus constructed has a very high rigidity and an indifferent

behaviour to buckling. The webs of the profiles 27 may again be interconnected by a cold rivet joint. On the side face of the girder 19 are arranged a number of profile parts 36 on which the joists 20 are mounted. As is shown, the joists preferably have an open-box profile. The profile parts 36 are fastened with the aid of rivets 37 to the girder 19. The holes for the rivets as well as the perforations 32 for passing ducts are provided in an operation preceding the profile formation of the material. The horizontally extending upper limb of the profile part 36 has a bore through which extends a bolt 39 which is engaged in the screwthread of a clamping piece 38. When mounting the joist 20 the clamping piece 38 is turned for about one quarter stroke with respect to the position shown in Fig. 3 and the bolt 39 is tightened so that the inwardly folded limbs of the profile of the joist 20 are clamped tight between the clamping piece 38 and the upper limb of the profile part 36. Since the holes for the rivet 37 are previously accurately positioned in the girder 19, the upper face of the joist 20 will lie on the same level as the upper face of the girder 19 without the need for further means. At its front end the joist 20 has a recess 40 so that it can engage the girder 19 in the manner shown in Fig. 2. The ceiling plates 45 are suspended in known manner by means of hangers 46 to the joists 20. It is thus possible to arrange an insulation blanket of mineral wool on the entire surface of the ceiling and hence right below the girders. It is thus ensured that in the event of fire the girders will not become too hot soon which would result in sagging. This effect could give rise to warping of the side-walls due to sagging girders. In order to prevent the insulation blanket from disengaging when the ceiling boards are collapsing, it is fastened to the joists 20.

As stated above, the inner plates 10,45 are preferably gypsum plates, which are also satisfactorily resistant to fire. In the walls separating houses, one of which is shown in Fig. 2 and two adjacent walls are shown in Fig. 4, double plates may be arranged on the inner side rather than the plates on the cavity side. In this way the

resistance to collapsing of the walls is appreciably raised. After the ceiling 45 is arranged, a finishing fillet 48 is mounted.

Between the inner plates 10 and the framework 12 of the section 7 is sandwiched a moist-inhibiting foil 14.

Fig. 4 shows that between two opposite storey floors, in the cavity between two separating walls an insulation 49 is arranged. This insulation serves to prevent fire from passing to the adjacent house through said interspace. Above at the wall, where the roof plate 25 is lying on the section concerned there is also provided the insulation 50. Otherwise it is apparent that the storey wall 3 is disposed on the floor slab 21 of the storey floor.

In the window opening 30 a window frame 54 is mounted on the boundary of the profile 31. The window frame 54 is milled from a material in a manner such that a ridge 60 is formed, which covers the outer plate 11. On the inner side a finishing fillet 55 is provided.

In order to avoid cold bridges insulation tape of synthetic foam may be arranged between the outer plates 11 and the framework 12 of the section concerned. This tape 52 not only reduces transfer of heat but also limits sound transmission. The tape is applied to the posts at least near the areas where the plates are fastened. This is shown in detail in Fig. 10.

Between the outer plates 11 of the superposed wall sections 7 a plate 53 is arranged for bridging the interspace caused by the storey floor.

Fig. 6 shows the construction in the area of the ridge of the roof. On the normal section 7 and the triangular section 64 of the loft wall 4 is disposed in known manner a girder 19. To the girder 19 and the joist 20 connected with the former is fastened a plate 26. Above the girder 19 a triangular profile 61 is fastened around the plate 26. On the upright side of the triangular profile 61 is arranged a filling piece 62. The roof plate 25, which is formed in this embodiment by two relatively spaced aluminium plates with polyurethane foam sandwiched between, is fastened to the tri-

angular profile 61. Near the loft floor 22 and the storey floor 18 are arranged profiles corresponding with the triangular profile 61 on which the roof plates 25 are lying. For finishing purposes a covering profile 63 is provided and in known manner several layers of roofing material 65 are arranged on the resultant construction.

The building shown in the Figures represents only one potential design. As stated above, the construction embodying the invention has the advantage that the freedom of design is hardly limited. Owing to the systematics of the structure a highly economic building method is obtained.

According to an important aspect of the invention the sections and the inner and outer walls have each a length lying in a range including a full module size, half a module size and a full and half a module size minus once or twice the thickness of the section. Sections having lengths in this range are shown in Fig. 8. The section 71 shown has a length equal to half a module size 76. The section 70 has a length equal to a full module size, that is to say, twice half the module size 76. With regard to commercially available sizes of sheet materials an appropriate module size is 2.50 ms. The section 70 has four interspaces between vertical posts 8 so that the interspace between two neighbouring posts is each time 60 cms in this module size.

The section 73 has a length equal to half the module size 76 minus once the thickness of a section. This size is designated by 77. The section 72 has a length equal to a full module size minus the wall thickness. Also section 75 has a length 78 equal to half the module size minus twice the wall thickness and the section 74 has a length equal to the full module size minus twice the wall thickness. By means of this range of sections 70 to 75 substantially any structural problem can be solved. This is illustrated in Fig. 9 from which it is apparent that for a square room having an outer size equal to half the module size the sections 71, 73 and 75 are sufficient.

For further illustration Fig. 7 shows a sectional plan view of the ground floor of the building 1, in which the

various sections are designated by the reference numerals of Fig. 8. It should be noted that the door openings are each arranged inside a section so that the sections extend on both sides of the door openings.

5 It will be obvious that by using sections having lengths in the range mentioned above the great advantage is obtained that a building 1 as shown in Fig. 1 can be erected by an exceptionally small number of different objects. For this building apart from the sections of said range six tri-  
10 angular sections 64 of the same size are employed. By including also these triangular sections 64 in the system the system becomes substantially universal.

As described in the foregoing the sections, in order to have the required resistance to deformation, have to  
15 be provided during transport with at least one stiffening element, for example, a plate or a strut. It is particularly interesting to provide the sections to be used in the outer walls previously with the outer plates so that the building is closed within a very short time. In those cases in which  
20 it is more effective to mount the plates afterwards, which may apply in particular to the inner walls, the sections can be transported and erected whilst being provided with a temporary strut. In Fig. 8 these temporary struts are indicated by broken lines 80.

25 Fig. 10 shows further details of the manner in which the frameworks 12 of the sections are mounted. As described above the vertical profiles 8 are preferably formed by open-box profiles and the horizontal posts 9 preferably by U-profiles. The vertical posts 8 have around the holes 85  
30 depressions 86. When a horizontal post 9 is connected with a vertical post 8 by means of a rivet 87, the material of the horizontal post 9 is drawn inwardly into the depression 86 during the riveting operation, preferably a cold riveting operation so that a depression is also formed in the material  
35 of the post 9. Thus the head of the bolt 87 will lie within the side face of the framework. As is shown the strut 80 is preferably fastened temporarily with the aid of a plate screw 89. When the framework is set up the strut 80 can be rapidly

removed by loosening the screws 89.

Prior to mounting the plates 11 the insulation tape 52 is applied in the manner described above. The plates 11 are preferably fastened also with the aid of plate screws 90. 5 These plate screws may effectively be of the self-fixing type.

It should be noted that in Fig. 10 the wall thicknesses of the profiles are represented on an exaggerated scale. It has been found that for a building 1 as shown in 10 Fig. 1 a thickness of the material of the profiles 8 and 9 of about 1.5 mms is sufficient.

Apart from the building 1 described above the system embodying the invention permits of erecting any other building. The building shown in Figs. 11 and 12 (92) also 15 comprises walls composed of the sections 7 described in the foregoing. On the walls above the vertical peripheral posts of the sections are disposed rafters 93 instead of girders 19. The rafters 93 are formed by open-box profiles 94 and 95. The head plate 96 is fastened by means of rivets 97. The 20 posts 91 are inserted into the open side of the profiles and fixed in place by rivets. In the longitudinal direction girders 98 are arranged across the rafters 93. These girders 98 are preferably fastened to the rafters 93 in the manner corresponding to the fastening mode of the joists 20 to the 25 girders 19. The girders 98 also have an open-box profile and clamped to the rafters by means of a clamping plate 99 in which a screwthreaded bolt 100 is engaged. On the girders 98 is arranged a roofing plate in known manner.

A building 92 of the kind shown in Figs. 11 and 12 30 may very effectively serve as a temporary dwelling or as a barn, a shed or the like.

Owing to the far-reaching system design the various elements can be effectively manufactured on an industrial scale which results in that at relatively low costs any 35 desired building can be constructed in small or large numbers without markedly affecting the freedom of design.

## C L A I M S

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1. A building (1) comprising walls (2-7) consisting of frameworks (12) of horizontal (9) and vertical (8) posts provided at least on one side with plates (10, 11) ensuring resistance to deformation and span elements disposed on said  
5 walls such as floor beams (19) or rafters (93) characterized in that each wall is composed of separate sections (7) having at least one circumferential framework (12) of cold-rolled steel plate profiles, adjacent sections being mounted to one another by their vertical peripheral posts (8) and the span  
10 elements (19) being disposed above the vertical peripheral posts (8).

2. A building as claimed in Claim 1 characterized in that the sections (7) in the inner and outer walls have each a length lying in a range including a full module size, half  
15 a module size and a full and half a module size minus once or twice the thickness of the section respectively (fig. 8).

3. A building as claimed in Claim 1 or 2 characterized in that the posts (8) have perforations (32, 85) at equal intervals for passing conduits (33, 35) and

fastening means (37, 87).

4. A building as claimed in anyone of the preceding Claims characterized in that the horizontal peripheral posts (7) have a U-profile and the vertical peripheral posts (8) an open-box profile, the width of the open-box profile corresponding to the inner distance between the limbs of the U-profile.

5. A building as claimed in Claim 4 characterized in that the vertical peripheral posts (8) have, in their side faces, depressions (86) around the perforation (85) for passing rivets (87) passed through registering perforations in the horizontal peripheral posts (9).

6. A building as claimed in anyone of the preceding Claims characterized in that the span elements are made from cold-rolled steel plate profiles.

7. A building as claimed in Claim 6 characterized in that the floor beams comprise girders (19) disposed on the walls and joists (20) arranged between adjacent girders and in that the girders are formed by two identical, substantially U-shaped profiles (27) mounted web-to-web, the webs having each a profile part re-entrant in the direction of the associated limbs.

8. A building as claimed in anyone of the preceding Claims characterized in that the plates (10) of the inner walls are formed by gypsum plates.

9. A building as claimed in anyone of the preceding Claims characterized in that the outer wall plates (11) are formed by plates of asbestos-cement or a similar material.

10. A building as claimed in anyone of the preceding Claims characterized in that plates (22, 23) formed by multi-plywood slabs are arranged on the floor beams.

11. A building as claimed in anyone of the preceding Claims characterized in that each framework is mainly filled out with mineral wool (13).

12. A building as claimed in anyone of the preceding Claims characterized in that the separation walls of two houses having a cavity (51) between them comprise sections having plates exclusively on the side of the house.

13. A building as claimed in Claim 12 characterized in that the plates of the separation wall sections are double plates (fig. 4).

14. A wall section for use in a building as claimed  
5 in anyone of the preceding Claims comprising at least one circumferential framework of cold-rolled steel plate profiles and a form-stiffening element for example plates or a strut.

15. A cold-rolled steel plate profile apparently  
intended for use in a wall section or a building as claimed  
10 in anyone of the preceding Claims.

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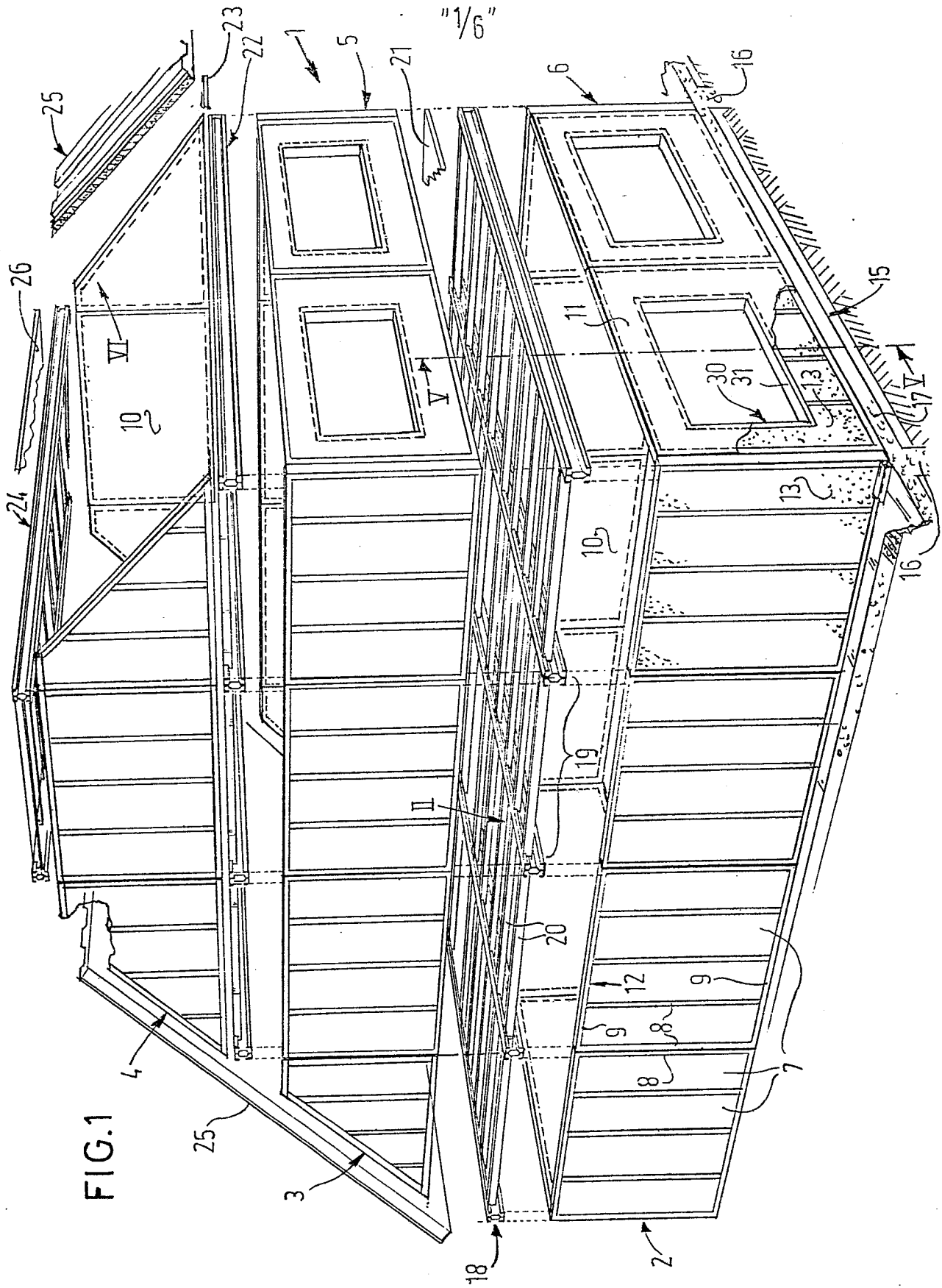
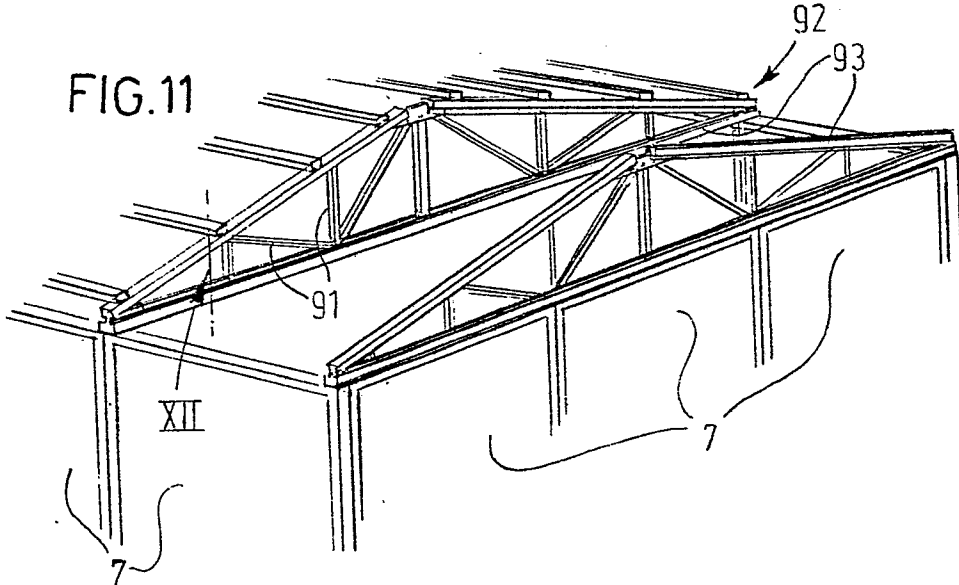
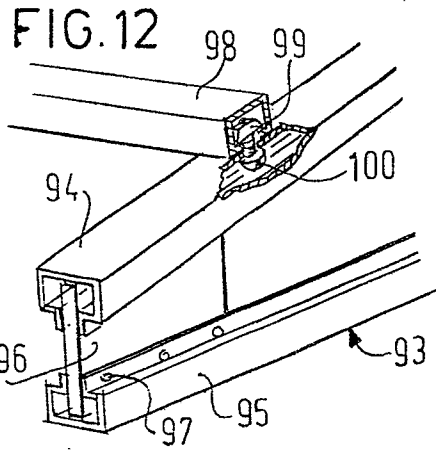
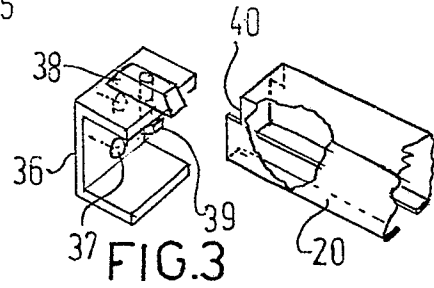
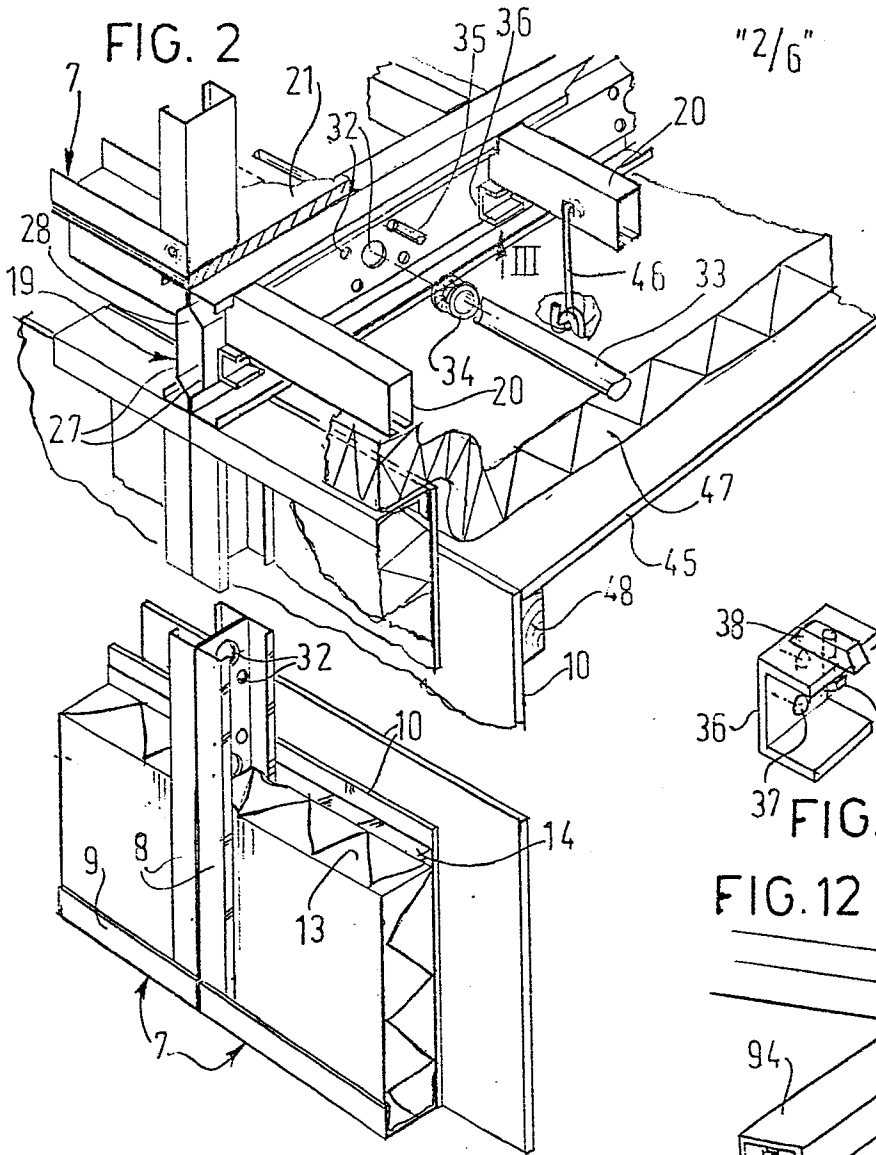
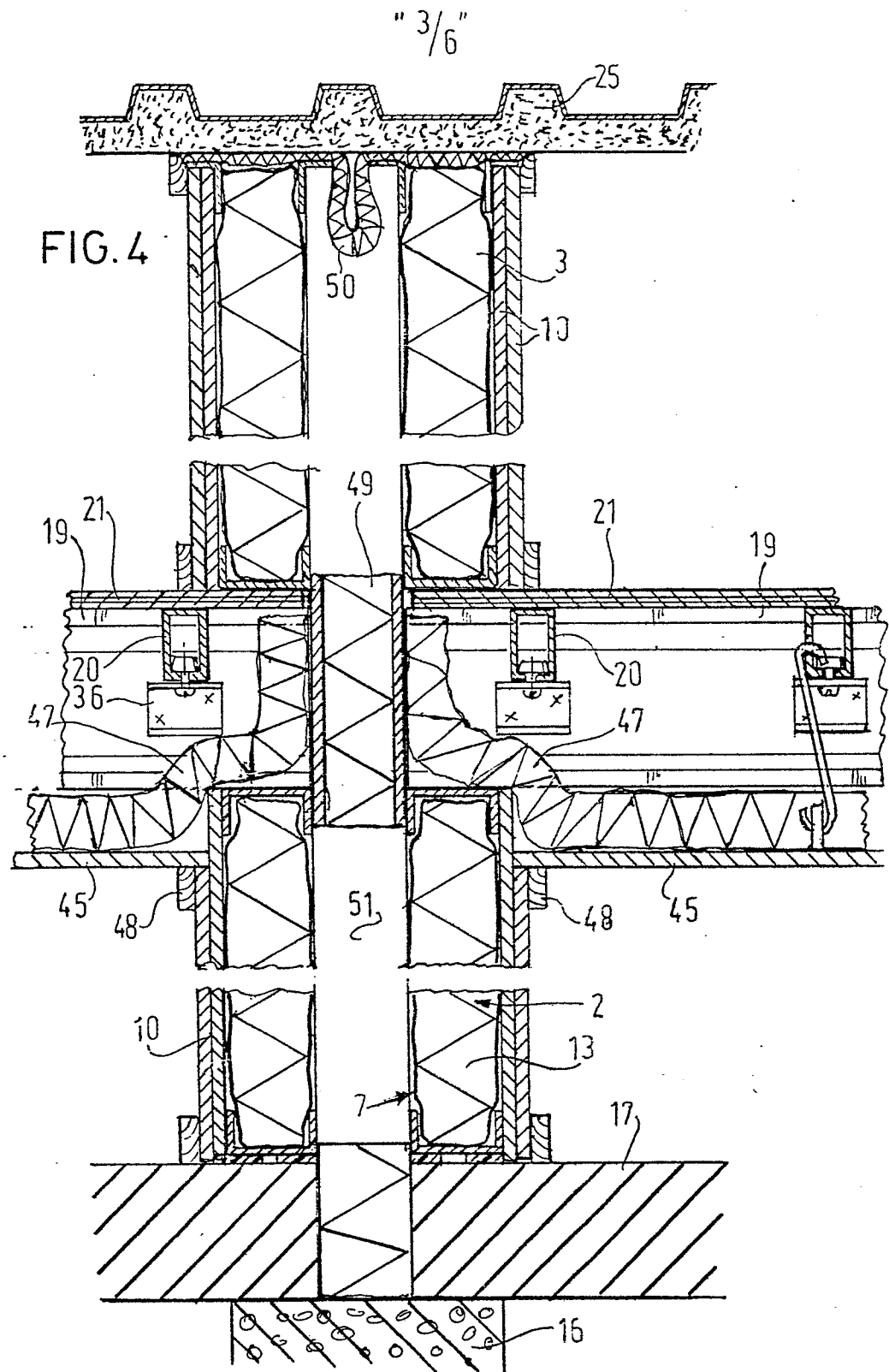


FIG. 1

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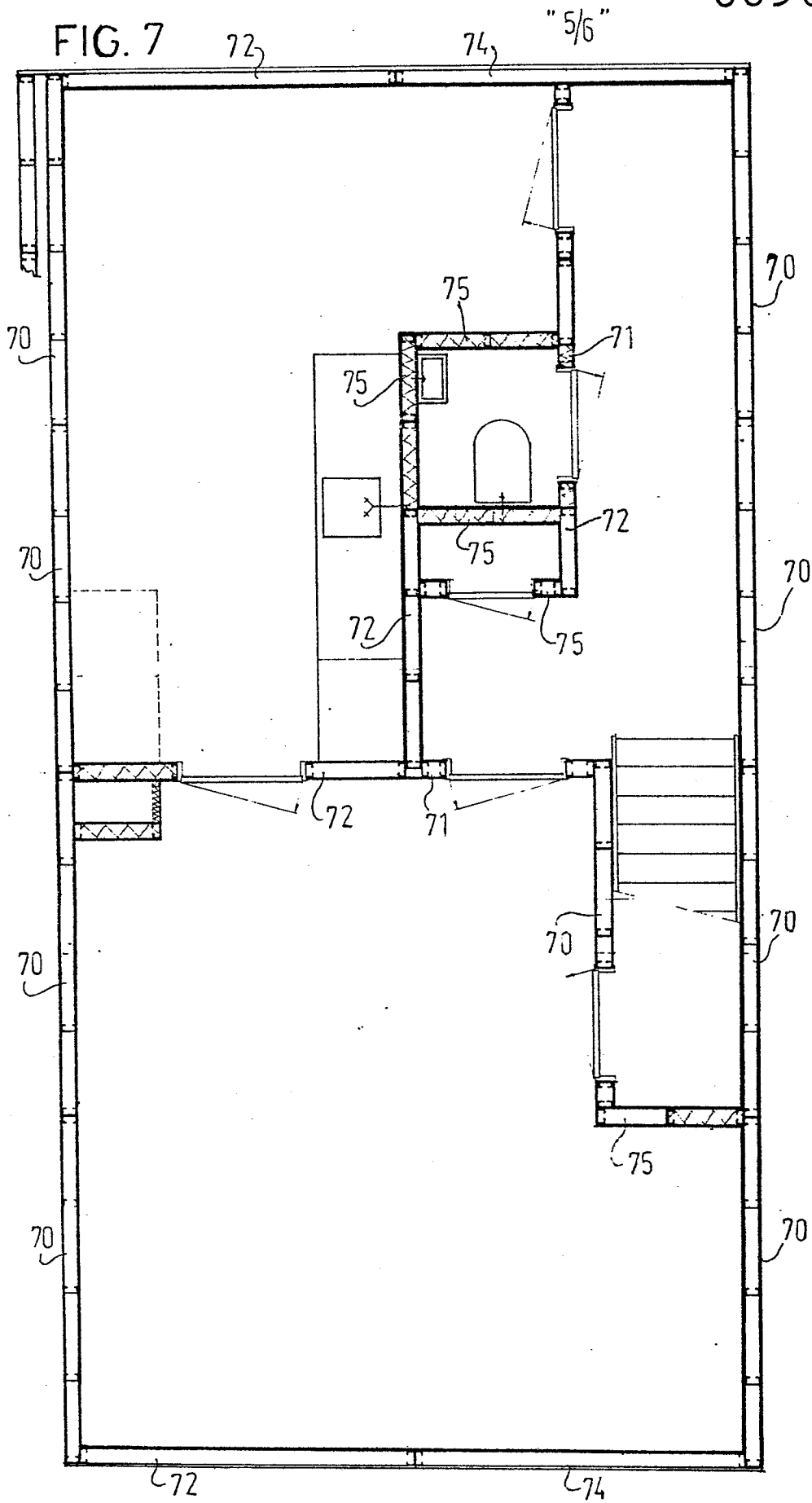




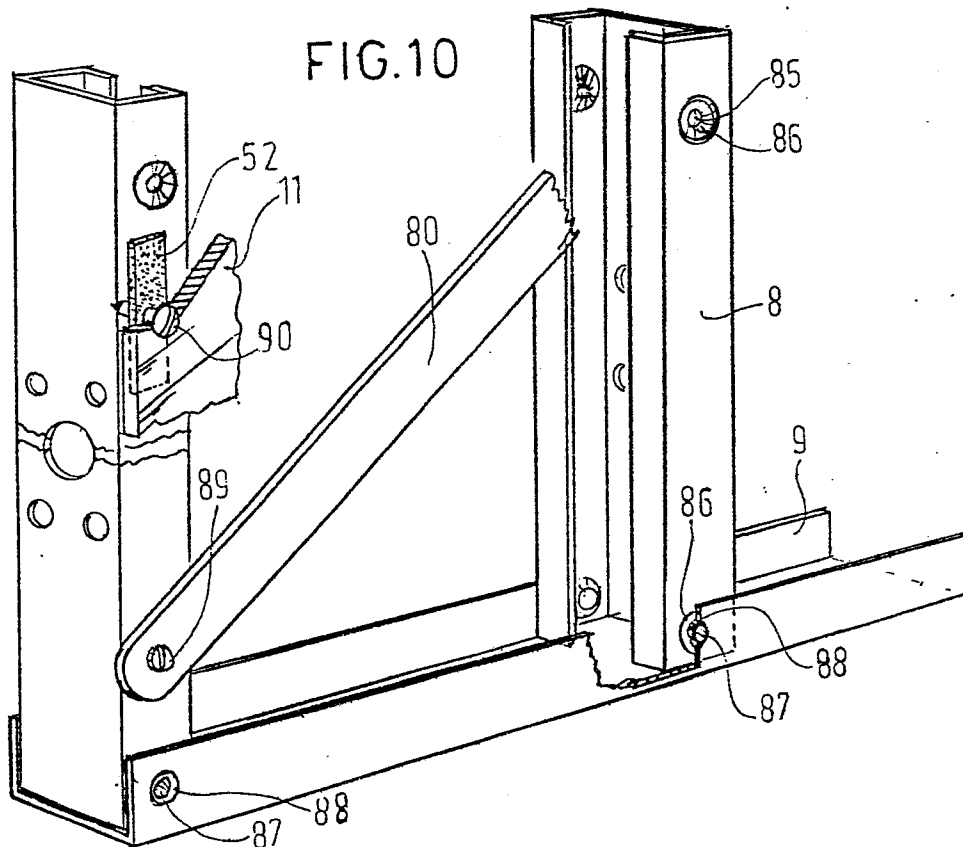
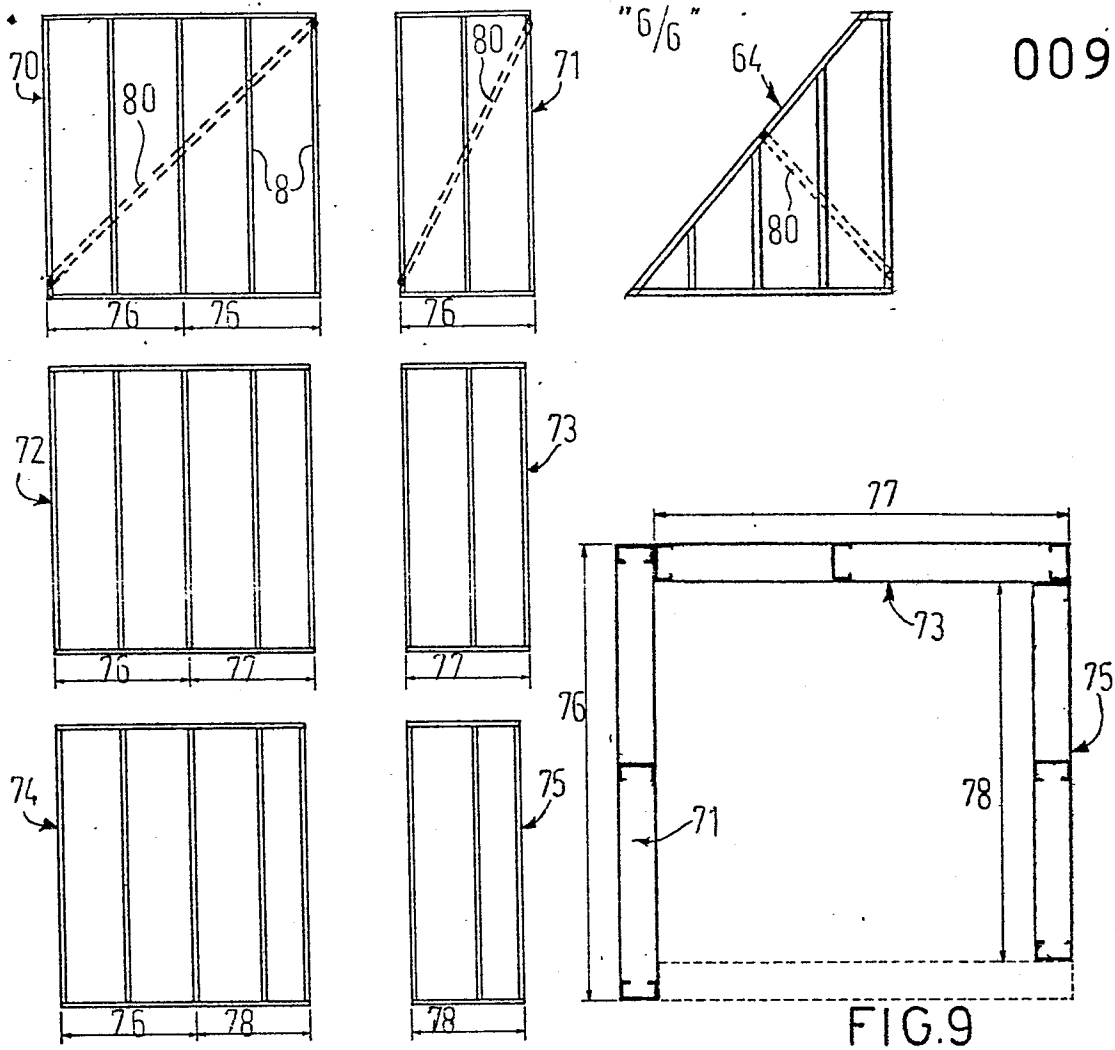


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FIG. 7



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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. <sup>3</sup> )
X	US-A-2 073 781 (S. CALAFATI)  * Page 1, left-hand column, line 16 - right-hand column, line 3; page 2, left-hand column, lines 31-67; page 3, right-hand column, line 33 - page 5, left-hand column, line 37 *	1-4, 6, 7, 12, 14, 15	E 04 B 1/08
Y	* Page 5, right-hand column, line 74 - page 6, left-hand column, line 44; page 7, right-hand column, lines 40-50; figures 2-7, 11-12, 25-27, 29 *	8-11	
Y	--- BOUWERELD, vol. 67, no. 15, 9th April 1971, pages 44-45, Deetinchem, NL. "Woningen als bouwpakket" * Page 44, left-hand column *	8, 11	TECHNICAL FIELDS SEARCHED (Int. Cl. <sup>3</sup> )  E 04 B
Y	--- FR-A-1 528 620 (T. CONSTANTINIDIS) * Page 2, left-hand column, line 49 - right-hand column, line 16; page 3, right-hand column, lines 11-23; figures 1, 2, 4 *	9	
Y	--- US-A-4 161 089 (OMANSKY) * Column 2, line 33 - column 3, line 38; figures 1, 2, 5, 7 *	10	
	--- -/-		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 23-06-1983	Examiner DIJKSTRA G.
CATEGORY OF CITED DOCUMENTS		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	
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		& : member of the same patent family, corresponding document	

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EUROPEAN SEARCH REPORT

0090473

Application Number

EP 83 20 0437

DOCUMENTS CONSIDERED TO BE RELEVANT		Page 2	
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
A	US-A-2 356 309 (GARBE) * Page 1, left-hand column, line 29 - right-hand column, line 32; page 2, left-hand column, line 46 - right-hand column, line 27; figures 1-3 *	7	US-A-2 356 309
A	FR-A-2 486 565 (LACOSTE)		FR-A-2 486 565
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 23-06-1983	Examiner DIJKSTRA G.
<b>CATEGORY OF CITED DOCUMENTS</b> 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	

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