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(71)(72) Applicant and Inventor: HANSEN, Ib, Hemming [DK/DK]; Ventevej 23, DK-3600 Frederikssund (DK).

(74) Agent: HOFMAN-BANG & BOUTARD; Adelgade 15, DK-1304 Copenhagen K (DK).

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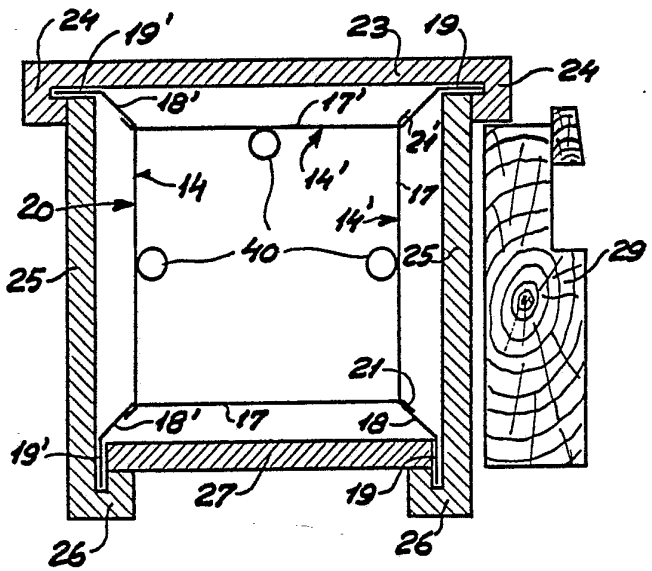
(54) Title: A METHOD OF ERECTING A BUILDING CONSTRUCTION AND A REINFORCING ELEMENT FOR USE IN THE METHOD



(57) Abstract

Load-bearing concrete columns and girders in building constructions are reinforced using sheet-shaped reinforcing elements (14 and 14') which are formed so that they can be stacked, which reduces the cost of storage and transport. The reinforcing elements are moreover formed with edge flaps (19 and 19') which in the finished column extend to or beyond the surface of the column and form readily accesible means to which removable or permanent form elements (25 and 27) or front elements (23) can be secured. The reinforcing elements are also provided with coupling means (21 and 21') which make it easy to assemble them on the building site.

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A method of erecting a building construction and a reinforcing element for use in the method

The invention relates to a method of the type defined in the introductory portion of claim 1.

The German Offenlegungsschrift 28 11 410 discloses a method of this type in which metal sheets bent to form boxes are used as columns and metal sheets bent in U-form are used as girders. In both the columns and the girders the metal sheets thus form a permanent formwork. The building elements may optionally be supplemented with reinforcing bars inserted in the profile cavitites. Compared with formwork and insertion of reinforcing bars in a conventional manner, such a method has the advantage that a complete skeleton of permanent form elements can easily and rapidly be erected by unskilled workmen, and compared to the use of prefabricated columns and girders of reinforced concrete the method is particularly advantageous when there is a great distance between the location where the building elements are made and the location where the building construction is to be erected, because the cost of transporting the heavy concrete columns and girders is very huge in that case.

The object of the invention is to provide a method of the present type which enables further simplification and cheapening in the erection of buildings, in particular at locations involving transport of building elements over long distances. This object is achieved by carrying out the method as defined in the characterizing portion of claim 1 since the circumstance that the reinforcing elements can be interconnected in situ allows them to be constructed so that they can be

stacked, which minimizes their space requirement during transport; and the directly accessible edge flaps of the reinforcing elements permit easy attachment of form or front elements or both to the reinforcing elements.

The embodiment of the method as defined in claim 2 provides an additional simplification of the construction work because the reinforcing elements are also used for securing or supporting formwork and/or front elements.

The invention also concerns reinforcing elements for use in the stated method, and the unique features of a reinforcing element of the invention are disclosed in claim 3.

Two or more reinforcing elements can expediently be assembled by means of such coupling flaps and coupling holes as are stated in claim 4.

Claim 5 defines a particularly expedient embodiment of the reinforcing elements which makes it easy to assemble a box-shaped reinforcement profile with flanges protruding from the corners. Such a profile can consist of four reinforcing elements uniform in pairs, the arrangement of which is stated in claims 6 and 7.

Claim 8 defines another embodiment of the reinforcing element which likewise enables box profiles to be made, as two elements of the stated bype can be assembled by means of two substantially plane sheet elements with coupling flaps at both side edges.

The elements can be interlocked in a simple manner by the arrangement of the reinforcing elements defined in claim 9.

The punched locking and anchoring flaps defined in claims 10 and 11 serve to reinforce the connection between the reinforcing elements and the concrete and to connect the reinforcing elements in a load-bearing construction member, e.g. a column, with the reinforcing elements in an adjacent load-bearing construction member, e.g. a girder; this interconnection can be effected by carrying out the method of the invention as stated in claim 12.

Still another embodiment of the reinforcing element of the invention is defined in claim 13. This construction involves the advantage that all the elements are alike. Great rigidity and stability are obtained in a simple manner by assembling the elements as stated in claim 14.

The invention will be explained more fully below with reference to the drawing, in which.

fig. 1 is a perspective view of a section of the load-bearing structure of a building which can be erected by the method of the invention,

figs. 2 and 3 are likewise perspective views of parts of two embodiments of the reinforcing element of the invention,

fig. 4 is a horizontal section of a column reinforcement made of the reinforcing elements shown in figs. 2 and 3,

fig. 5 is a section of the same elements hinged together in a transport position,

fig. 6 is a horizontal section of the column reinforcement of fig. 4 having applied to it a formwork and front elements,

fig. 7 is a vertical section of a girder reinforcement composed of a third embodiment of the reinforcing element of the invention and applied formwork and front element and connected to a lattice girder and ceiling sheets,

fig. 8 is a vertical view of the upper end of a column reinforcement and the left end of a girder reinforcement and illustrates means for interconnecting the two construction members,

fig. 9 is an enlarged vertical section of two parts of interconnected reinforcing elements,

fig. 10 is a horizontal section of the upper end of a column reinforcement with an inserted assembling member for assembling two column reinforcements end to end,

fig. 11 is a vertical view of a part of the assembling member,

fig. 12 shows a perspective fragmentary view of still another embodiment of two reinforcing elements of the invention, arranged to be coupled together, and

fig. 13 is a perspective view of edge portions of the elements of fig. 12 after assembly.

The building structure shown in fig. 1 comprises a plurality of columns 10 interconnected by longitudinal girders 11 and transverse girders 12. A plurality of lattice girders 13 serving to support a ceiling and a floor are mounted between opposed and transverse girders 12. The columns 10 and the girders 11 and 12 consist of reinforced concrete and may be made in the manner described below.

The reinforcing element shown in fig. 2 is generally designated 14 and is made of a relatively thin, oblong sheet, which preferably but not necessarily consists of iron and is bent along parallel longitudinal bending lines 15 and 16 so as to produce a main part 17, a connecting part 18 and an edge flap 19 perpendicular to the main part 17. Similarly, the reinforcing element 14' shown in fig. 3 has a main part 17', a connecting part 18' and an edge flap 19' and differs from the one shown in fig. 2 only in that the edge flat 19' is parallel with the main part 17' instead of being perpendicular to it.

With a view to assembling two reinforcing elements 14 and two reinforcing elements 14' so as to provide a box-shaped reinforcement 20 as shown in fig. 4, the elements are provided with coupling means, partly in form of hook-like coupling flaps 21 on the free edge of the main part 17 or 17', partly in form of oblong holes 22 and 22' disposed along the bending line 15 and 15', respectively, and serving to receive the coupling flaps 21' and 21. The coupling flaps 21 and 21' on three of the reinforcing elements, marked a, b, and c in figs. 4 and 5, are bent as shown clearly in fig. 4 so as to engage, in the assembled reinforcement, the connecting part 18 or 18' of the adjacent

element. Thus, during transport and storage it is possible to hinge the four elements together so that they are disposed in substantially the same plane, as shown in fig. 5, To allow the elements to be hooked together to form the reinforcement shown in fig. 4, it is necessary that the coupling flaps 21 on the fourth element marked d are coplanar with the main part 17 of the element as shown in fig. 5 and with broken lines in fig. 4 and are bent only after the elements have been assembled.

An outwardly bent stop flap 22a and 22'a is left in at least one of the coupling holes 22 and 22', as shown by broken lines as far as the lower hole is concerned; this stop flap has such a length that after a hook-like coupling flap has been inserted in the hole, the flap can snap into it and ensure that the hook cannot be retracted from the hole again.

In fig. 6 a reinforcement of the type shown in fig. 4 is shown with applied formwork, which on the front side consists of a front element 23, e.g. of wood, concrete or bricks, which has cross-sectionally hook-like side edge parts 24 gripping around the edge flaps 19 and 19' on two of the reinforcing elements 14 and 14'. The front element 23 may optionally be attached to the edge flaps by means of pins or screws (not shown) which from the rear side of the hook-like side edge parts are passed through holes in these and in the edge flaps.

On the two sides perpendicular to the front side are shown two form elements 25 which may be removable or permanent and engage with one end side edge their respective ones of the two edge flaps 19 and 19', which

are partly encircled by the edge hooks of the front element, and grip their respective ones of the other edge flaps 19 and 19' by a cross-sectionally hook-like edge part 26 at the other side edge. A form sheet 27 is mounted on the fourth side whose side edge parts engage respective end edge faces of the hook-like edge parts 26. The form elements, too, can consist of any suitable material and can be attached to the edge flaps of the reinforcement in any suitable manner.

Fig. 6 also shows a front element in the form of a window frame 29 on one side perpendicular to the front element 23. It will be seen that front elements and permanent and removable form elements can be combined in many different ways.

Finally, fig. 6 shows extra reinforcing elements 40 in the channel defined by the reinforcing elements 14 and 14'. These additional elements 30 may optionally be conduits for electric wires or water supply pipes or the like.

The girder reinforcement of fig. 7 is generally designated 30 and is composed of two uniform, but oppositely directed reinforcing elements 31, which each have a main part 32 merging at their side edges into inclined connecting parts 33 and 34, respectively, which in turn merge at their outer extremeties into edge flaps 35 and 36, respectively, one 35 of which is parallel with and the other 36 is perpendicular to the main part 32. Each main part 32 is with oblong holes (not shown) along the side edges to receive coupling flaps 37 on two reinforcing sheets 38 and 38', which interconnect the two reinforcing elements 31. The

coupling flaps 37 on one one sheet 38 are pre-bent as shown, i.e. before mounting, and the same applies to the coupling flaps on one side edge of the other sheet 38', whereas the coupling flaps on the other side edge of this sheet can only be bent after the reinforcing elements have been assembled.

The girder reinforcement 30 is mounted on a column reinforcement 20 shown by broken lines, and a form element 41 is applied to its underside and a front or form element 39 is applied on one vertical side thereof. At the other vertical side the reinforcement 30 is connected to a lattice girder 42 incorporating two horizontal bars 43 and 44 with hook-like end parts 43a and 44a passed through holes in the main part 32 of the adjacent reinforcing element 31. The latrice girder 42 has moreover a top rail 45 capable of supporting a floor 46, and a strip 48 is secured to the lower, horizontal rod 44 by means of a bracket 47; the strip 48 extends in parallel with the girder reinforcement 30 and rests on the cross-sectionally L-shaped edge part 49 of a ceiling sheet 50. This edge part 49 extends across the cross-sectionally hook-like side edge part of the form element 41 and downwardly towards the edge flap 36 of the reinforcing element. The ceiling sheet 50 also serves as a formwork.

Fig. 8 shown a fragmentary view of a column reinforcement 20 like the one shown in fig. 6 and one end of a girder reinforcement 30 like the one shown in fig. 7 which are to be interconnected. With this end in view the main part 17, the connector part 18 and the edge flap 19 of the reinforcing element 17 in the column reinforcement 20 facing the girder end and the connect-

ing part 18 and the edge flap 19 of the adjacent reinforcing element 17 are removed over a distance corresponding to the vertical extent of the main parts 32 of the girder reinforcement 30; the spacing between the main parts 32 are adapted so that they can be inserted between and engage the inner sides of the main parts 17 and 17' of the column reinforcement which are parallel with the girder. Similarly, the sheets 38, the connecting parts 33 and the edge flaps 35 of the girder reinforcement are removed over a distance corresponding to the width of the main parts 17 and 17' of the column reinforcement.

The main parts of the reinforcing elements and optionally also their connecting parts are formed with horizontal rows of punched and slightly outwardly bent, trapezoidal locking and anchoring flaps 51 and 52, the flaps 51 extending vertically and the flaps 52 horizontally. These flaps serve to ensure a good and strong connection between the reinforcement and the concrete which is to be poured into the cavitites defined by the formwork, and to assemble two reinforcing assemblies in the manner described below.

Prior to assembling, the horizontal flaps 52 on all the faces of the two reinforcing assemblies which are to engage each other, are knocked or pressed into the plane of the main parts in question 17, 17' and 32. Assembling is effected by passing the girder reinforcement end from above down between the column reinforcement main parts 17 and 17' so that, as shown in fig. 9, the vertical flaps 51 on the girder reinforcement extend obliquely down into the holes 53 in the column reinforcement left by the vertical flaps 51 of the column reinforcement. This produces a clamp-

ing effect urging the two main parts together. The parts can be assembled in this manner because the reinforcing elements have a relatively small thickness, e.g. 1.5 mm, and the four sheet parts which are to be assembled in pairs can therefore yield sufficiently for the girder reinforcement parts 32, in spite of the protruding flaps 51, to be passed down between the column reinforcement parts 17 and 17'. When the two sets of reinforcing parts are placed in position with respect to each other in this manner their horizontal slits 52 are disposed opposite each other as shown in fig. 9, and the assembling operation is concluded by knocking at least some of the flaps 52 in the column reinforcement into the holes 54 left by the corresponding flaps in the girder reinforcement, so that these flaps, too, are instrumental in ensuring good anchoring of the reinforcement in the concrete.

When two girders are to be connected to the same column from their respective sides, each of the girder reinforcements can only extend over half of the main parts of the column reinforcement which are parallel with the girders.

The assembling member shown in figs. 10 and 11 and serving to connect two column reinforcements 20 end to end consists of a sheet cross member 55 with four radial arms 56 of a length corresponding to half the distance between two opposed main parts 17 and 17' of the reinforcement 20. These arms are along the outer edges formed with angularly shaped projections 57 which, as seen from the centre of the sheet cross member in fig. 10, all point to the left.

Assembling is effected by passing the sheet cross member 55 a distance corresponding to half its height down in the lower column reinforcement 20 sutstantially in the angular position shown by broken lines in fig. 10 and then turning it counterclockwise so that the angular projections engage the central vertical row of holes left by the punched locking and anchoring flaps 52 in the reinforcing main parts 17 and 17', and the sheet cross member is caused to assume the position shown by full lines in fig. 10. The sheet cross member can optionally be secured using wedge means (not shown), or the locking and anchoring flaps 52 disposed opposite the angular projections may be knocked behind them to prevent the projections from turning back again.

When the sheet cross member 55 has thus been secured in the upper end of the lower column reinforcement, the lower end of the upper column can be passed down over the upper half of the sheet cross member in an angular position with respect to it, corresponding to the one shown in fig. 10. Then the upper column reinforcement can be placed in position by turning it clockwise with the same result as described in the foregoing, and the reinforcement and sheet cross member may be fixed likewise as described.

Fig. 12 shows the upper ends of two elongate, uniform reinforcing elements consisting of sheets 61 with weight-saving holes 62. The sheet has at one side edge a plurality of coupling flaps which each have an inner part 63 forming an angle of about 45° with the sheet and an outer part 64 which forms an angle of about 45° with the inner part and is thus substantially perpendicular to the sheet. The sheet 61 has along its other

side edge an edge flange bent to the same side as the flaps 63, 64; this edge flange has an inner part 65 forming an angle of about 45° with the sheet and an outer part 66 substantially parallel with the sheet. At the transition between the two parts 65 and 66, the edge flange is formed with oblong holes 67 to receive the outer parts 64 of the coupling flaps 63, 64 on an adjacent reinforcing element; and holes 68 are provided in the sheet opposite each of these holes 67 and disposed adjacent to the edge flange, to receive the inner part 63 of the coupling flaps.

The coupling of two such reinforcing elements at right angles is effected by passing the coupling flaps 63, 64 of one element first through the holes 68 and then the holes 67 of the other element, as shown in fig. 13. Following this operation the outer end parts of the flaps are twisted, as shown for one of them in fig. 13, to provide a very rigid and stable structure.

The shown and described details of the reinforcing elements of the invention can be modified in many ways within the scope of the invention. For example, the reinforcing elements might be in the form of a sheet cross member of a type similar to the assembling member 55 which is shown in figs. 10 and 11, where the angular projections are shaped and dimensioned so as to form edge flaps. It is also possible to interconnect girders and columns by means of bolts and screws, and in that case the locking and anchoring flaps might optionally be omitted. However, in all circumstances it will be expedient to form the reinforcing elements with anchoring flaps due to the connection between the elements and the concrete. This also applies to the structures shown in figs. 2-7

even though for simplicity the flaps are not shown in these figures. Instead of the above-mentioned sheet cross member the assembling member may be a sheet cylinder or a sheet prism with punched flaps which upon turning of the cylinder or the prism engage the holes left by the locking and anchoring flaps of the reinforcing elements.

Patent Claims:

1. A method of erecting a building construction whose load-bearing structure consists of reinforced concrete columns and girders, c h a r a c t e r i z e d by primarily erecting a structure of reinforcing elements made of a sheet material and formed with coupling means serving to assemble the reinforcing elements to form a self-supporting structure, and then providing at least the reinforcing elements on at least two sides with a permanent or removable formwork, and filling the spaces defined by the formwork with concrete or similar casting material.

2. A method according to claim 1, c h a r a c t e r i z e d by the use of reinforcing elements having edge flaps of such a shape that they will be disposed at or near the surface of the finished column or girder and form fastening or supporting means for the permanent or removable formwork and/or front elements.

3. A reinforcing element for use in the method according to claim 1 or 2, c h a r a c t e r i z e d in that it is in the form of an oblong sheet formed with coupling means to connect one or more adjacent reinforcing elements.

4. A reinforcing element according to claim 3, c h a r a c t e r i z e d in that the coupling means are flaps and holes.

5. A reinforcing element according to claim 4, c h a r a c t e r i z e d in that it has a main part connected to one or more edge flaps through a connecting

part which forms an angle with both the main part and the edge flap or flaps, and that the coupling holes are disposed at the transition between the main part and the connecting part.

6. A reinforcing element according to claim 5, c h a r a c t e r i z e d in that the main part is substantially parallel with the edge flap or flaps.

7. A reinforcing element according to claim 5, c h a r a c t e r i z e d in that the main part is substantially perpendicular to the edge flap or flaps.

8. A reinforcing element according to claim 4 with one or more edge flaps at both side edges, c h a r a c t e r i z e d in that it has a main part which is substantially parallel with the edge flap or flaps at one side edge and is substantially perpendicular to the edge flap or flaps at the other side edge, and which is connected to the edge flaps through inclined connecting parts, and that the coupling holes are disposed along the transitions between the main part and the connecting parts.

9. A reinforcing element according to claims 3 and 5, c h a r a c t e r i z e d in that the coupling flaps are hook-like.

10. A reinforcing element according to any of claims 5-9, c h a r a c t e r i z e d in that the locking and anchoring flaps are punched in the main part.

11. A reinforcing element according to claim 10, c h a r a c t e r i z e d in that it has two sets of locking and anchoring flaps disposed perpendicularly to

each other, and that one set of flaps at the ends of the element is coplanar with the main part.

12. A method according to claim 1 of erecting a building construction using reinforcing elements according to claim 11, c h a r a c t e r i z e d by assembling two mutually perpendicular reinforcing elements by causing one set of locking and anchoring flaps on one element to engage the holes left by the other set of locking and anchoring flaps on the other element, and that at least some of the locking and anchoring flaps coplanar with the main part of the first element are then knocked into holes in the other element.

13. A reinforcing element according to claim 4, c h a r a c t e r i z e d in that the coupling flaps extend from one side edge of the sheet, forming an angle therewith and having an end part which forms an angle with the inner part, and the opposite side edge has an edge flange bent to the same side as the coupling flaps so that the outer part of the edge flange is substantially parallel with the sheet and is connected to it through an inclined part forming substantially the same angle with the sheet as the inner part of the coupling flaps, said sheet being formed with coupling holes along the inclined flange part and the edge flange at the transition between the inclined part and the outer part, the latter ones of the coupling holes being oblong to receive their respective parts of the coupling flaps on an adjacent reinforcing element.

14. A method according to claim 1 of erecting a building construction using reinforcing elements according to claim 13, c h a r a c t e r i z e d in that upon being passed through the coupling holes in an adjacent

reinforcing element, the outer end parts of the coupling flaps are twisted to lock the flaps in the holes.

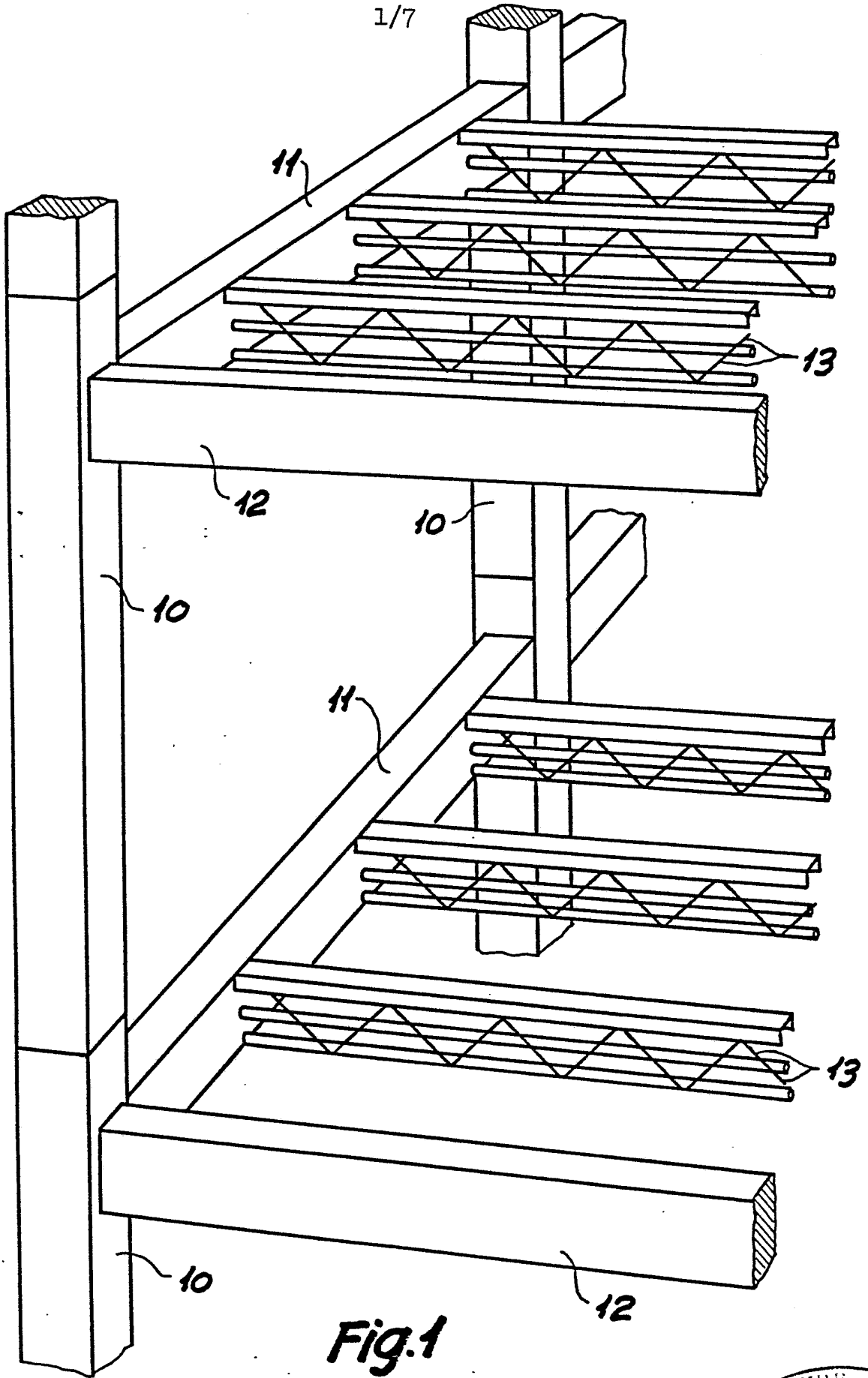

Fig.1

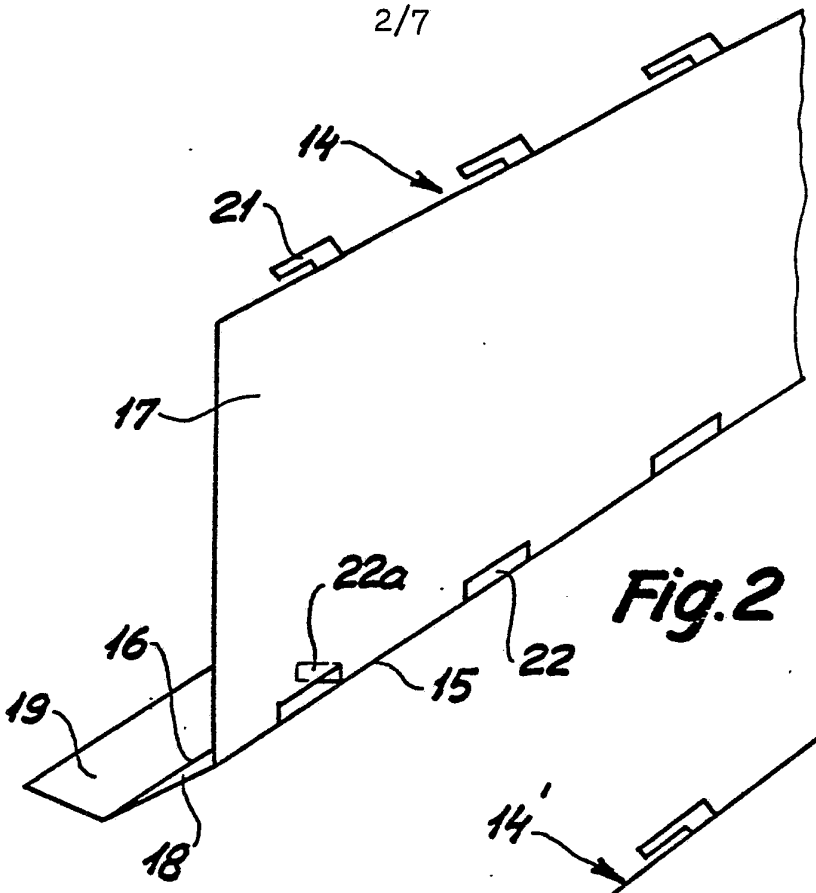

Fig.2

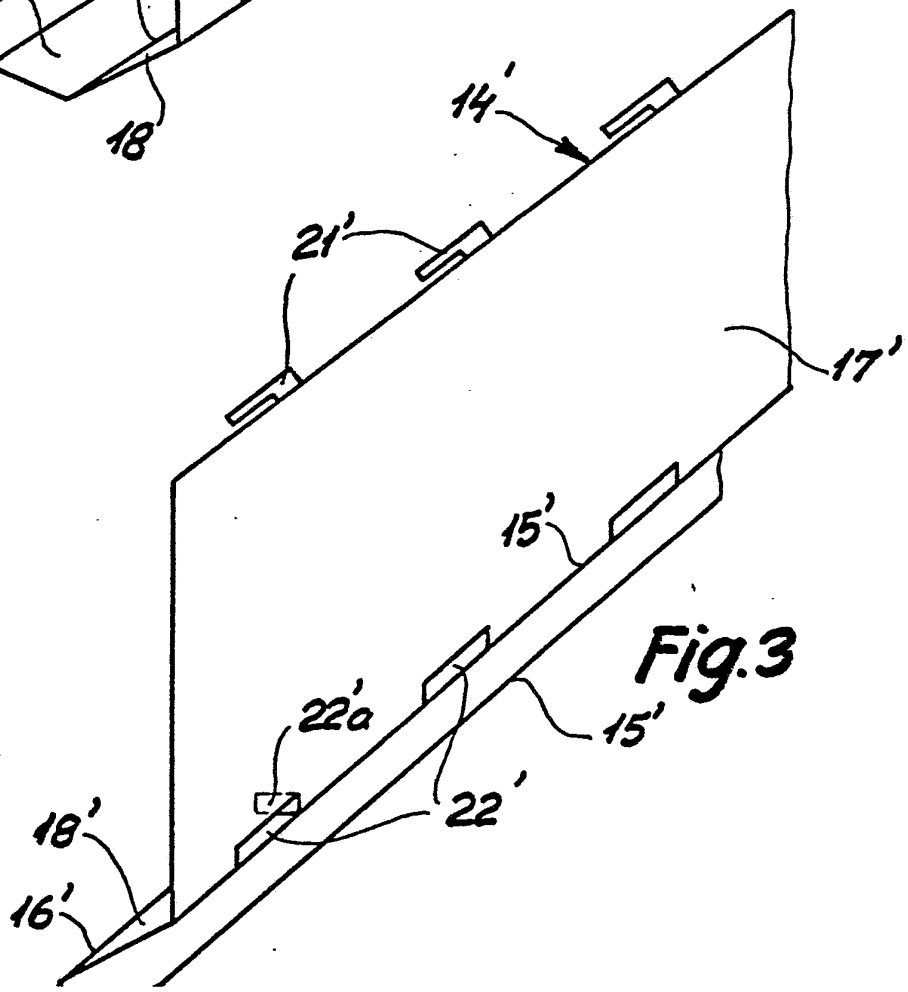

Fig.3

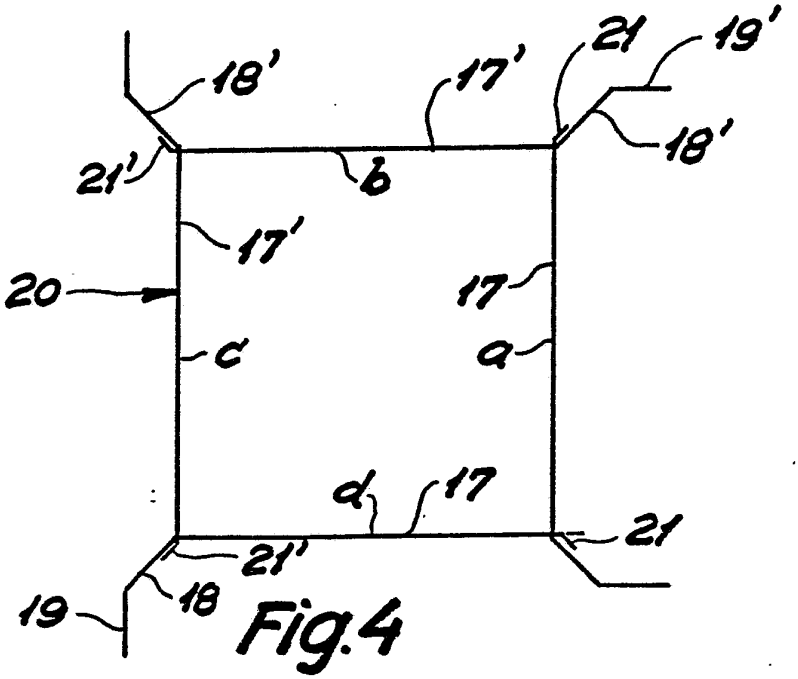

Fig.4

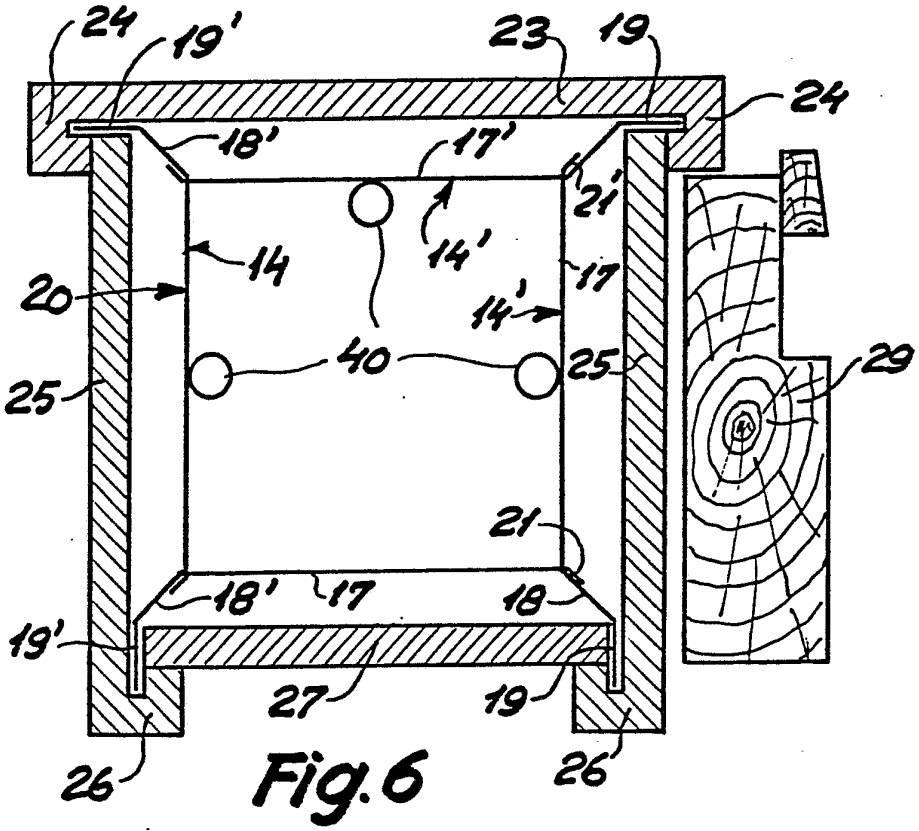

Fig.6

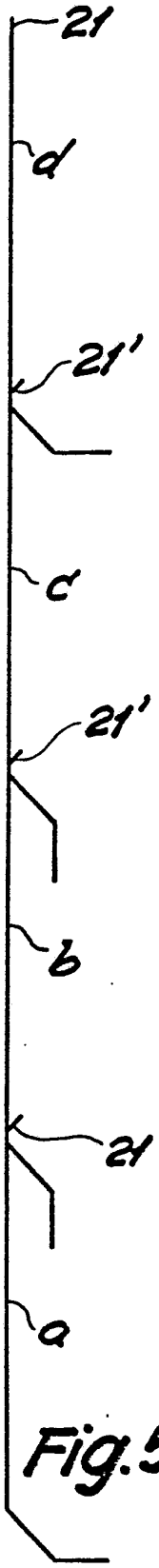

Fig.5

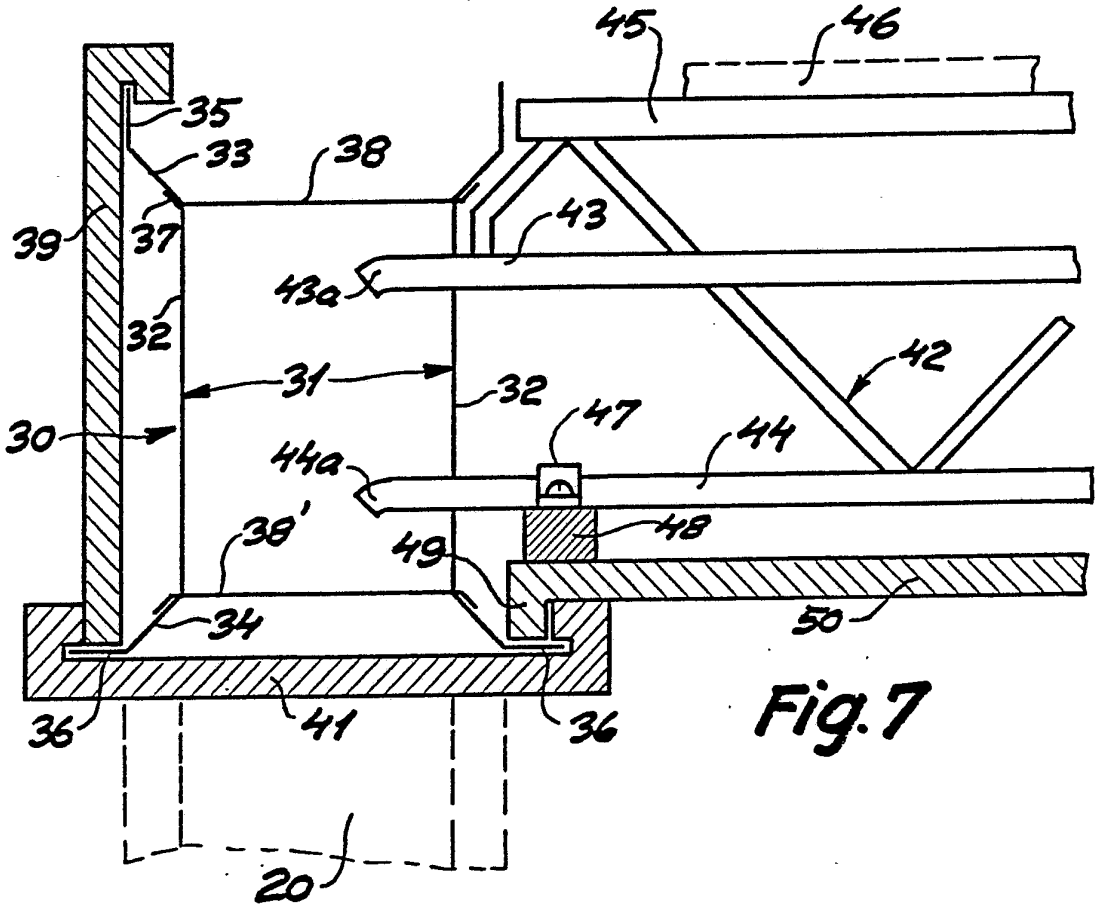

Fig.7

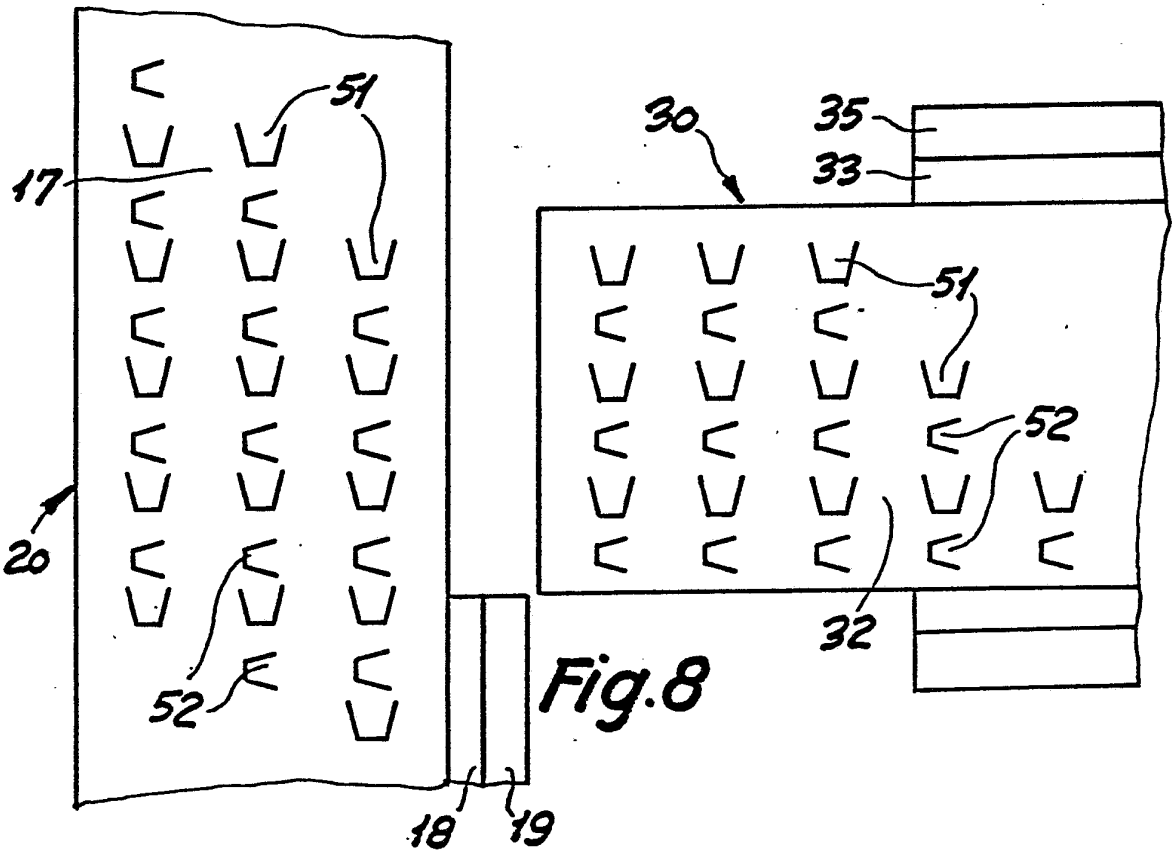

Fig.8

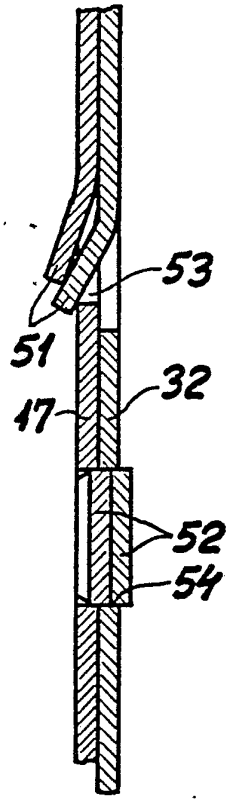

Fig.9

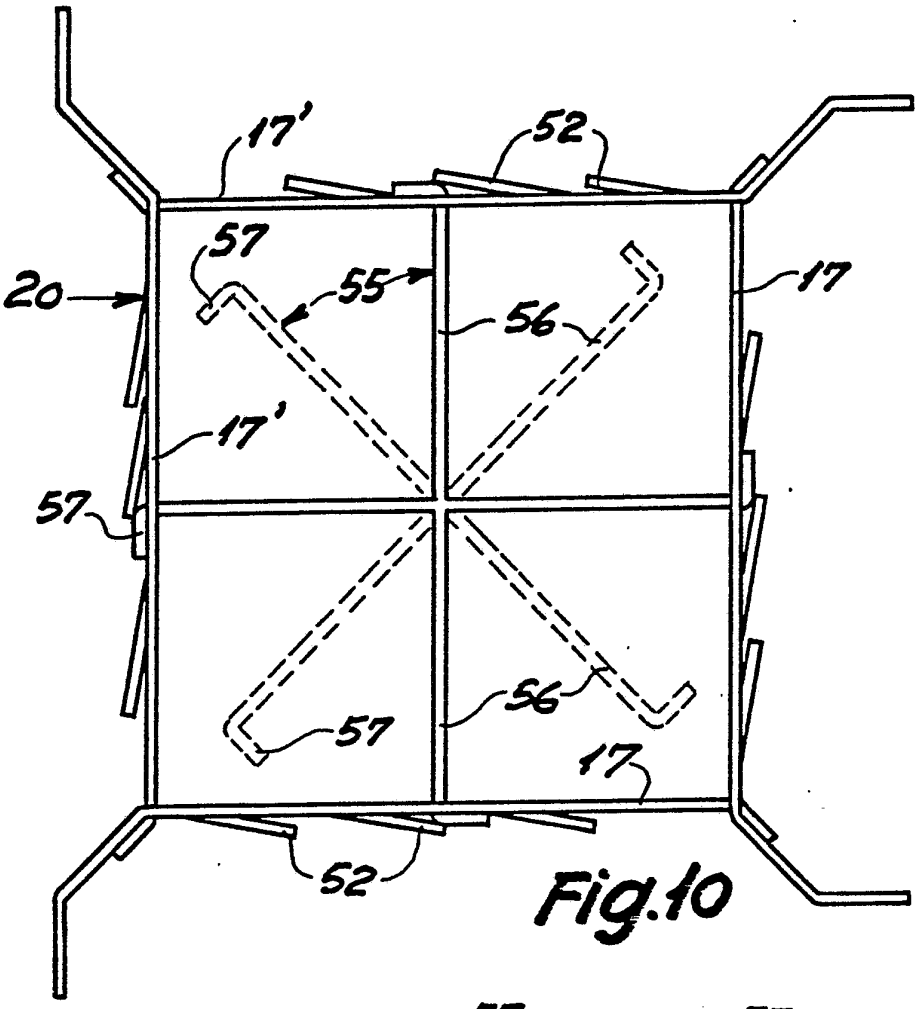

Fig.10

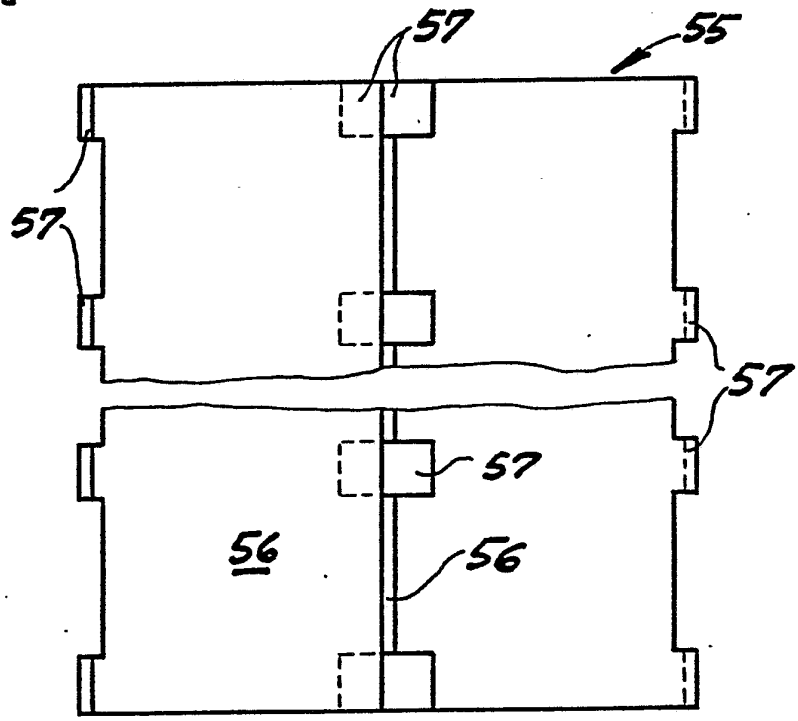

Fig.11

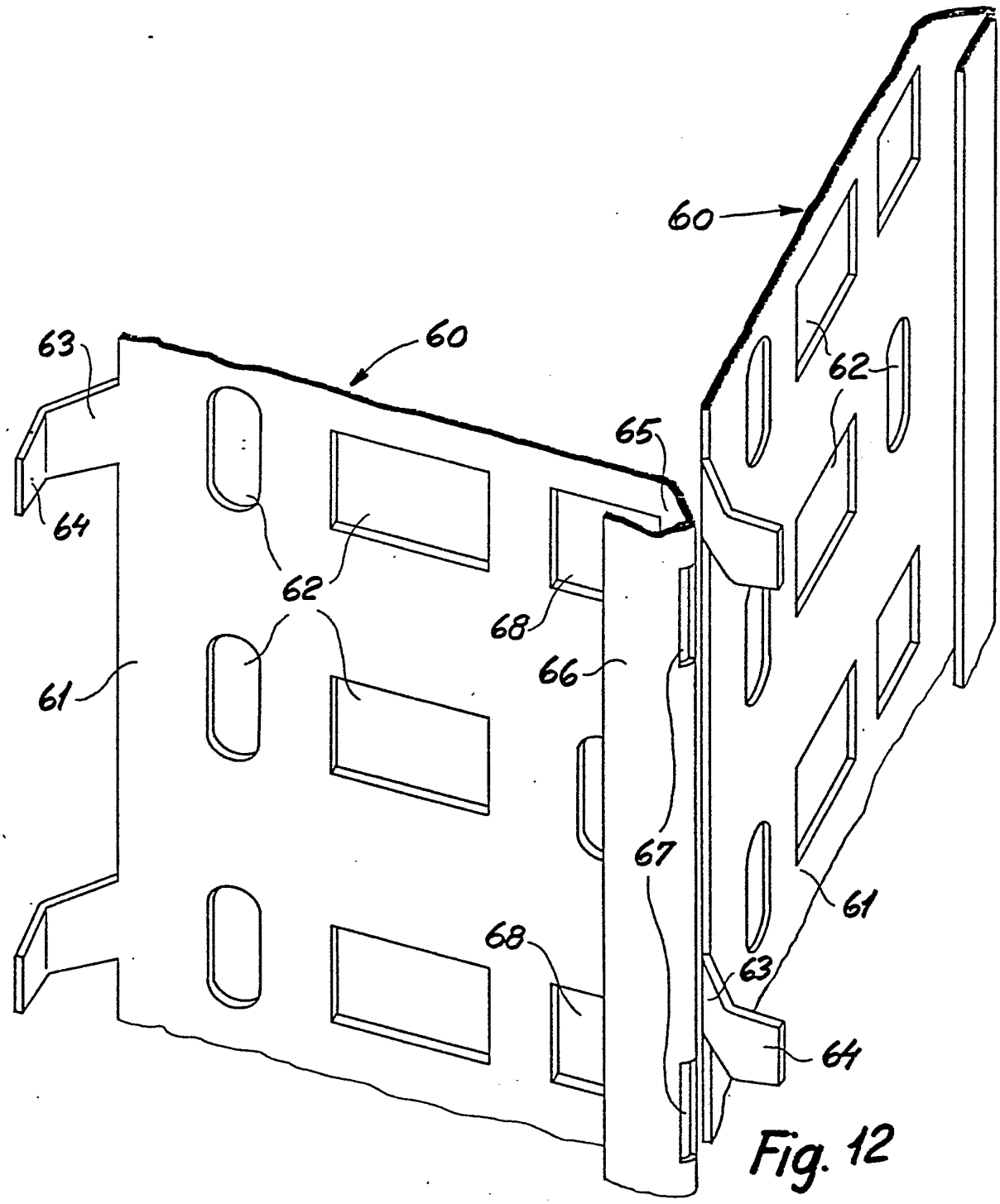

Fig. 12

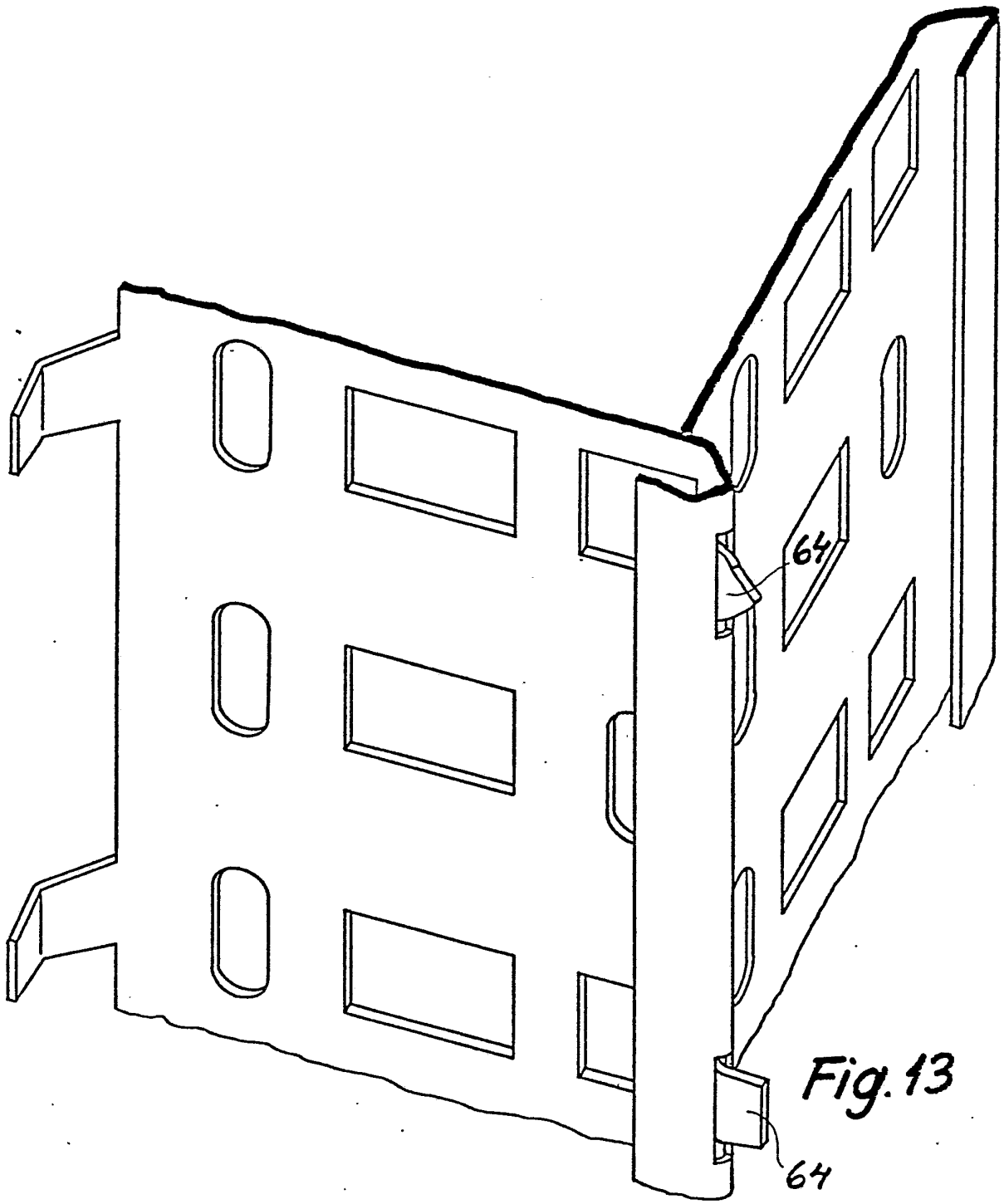

Fig. 13

INTERNATIONAL SEARCH REPORT

International Application No PCT/DK82/00106

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [2]

According to International Patent Classification (IPC) or to both National Classification and IPC [3]

E 04 B 1/16, E 04 C 5/00

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC 3	E 04 B 1/16-21,30,2/84,86, E 04 C 3/20,22,293,294,30,34,38, 44, E 04 C 5/00,01,06,065, E 04 G 11/00,02,13/00-04
US Cl	52:250-252,633,634,650,659-676,730,731

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [5]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category [6]	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
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A	DE, A1, 2 811 410 (PEITZ JUN. JOSEF) 12 October 1978	
Y	DE, A1, 2 931 162 (HUDO-WERK KG ET AL) 5 February 1981	1, 2, 3
Y	DE, A1, 3 029 993 (ARBED S.A.) 26 February 1981	1, 2, 3
A	US, A, 1 794 079 (KELLETT WP) 24 February 1931	
Y	US, A, 3 134 468 (TOTI AJ ET AL) 26 May 1964	1, 2, 3
A	NO, C, 35 007 (AGNESS CARL O) 6 June 1922	3, 4

[6] Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [1]	Date of Mailing of this International Search Report [2]
1983-01-12	1983 -02- 07
International Searching Authority [1]	**Signature of Authorized Officer [20]**
Swedish Patent Office	Ingemar Hedlund