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(54) Modular wall system

(57) A load bearing wall is formed in a building structure by a number of prefabricated modular reinforced concrete wall panels (1) mounted end to end in an upright orientation on a foundation or floor of the building. Each wall panel (1) has a reinforced concrete body (2). At least one tie bar receiver slot (10) extends upwardly into the body (2) from the bottom edge (5) of the body (2) for

cooperation with and reception of tie bars during wall construction. A grouting duct (25) extends outwardly from an inner end (21) of the slot (10) to a front face (3) of the body (2) to allow back filling of the receiver slot (10) with grout. One or more lifting bars (12) are embedded in the wall panel (1) and project upwardly at a top (6) of the wall panel (1). The lifting bars (12) aid handling and engage with tie bars.

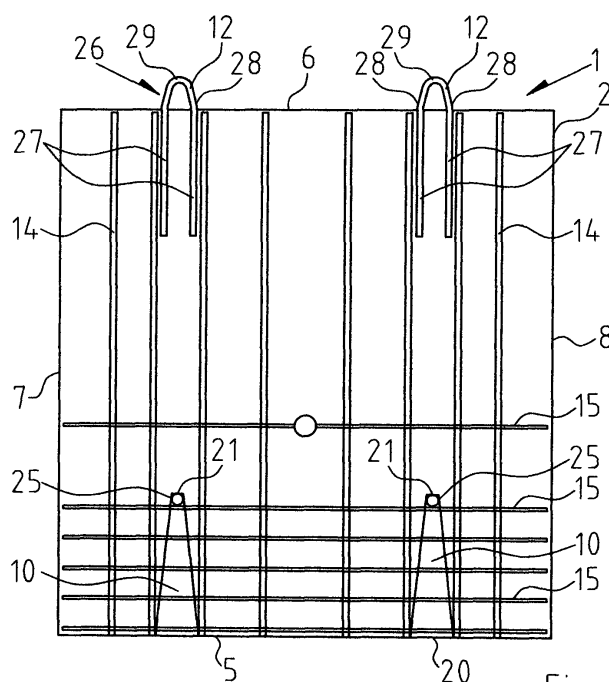


Fig. 1

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Description

Introduction

[0001] The invention relates to prefabricated reinforced concrete wall panels and modular wall constructions.

[0002] The invention is particularly concerned with the manufacture of load-bearing walls in building construction. Such load-bearing walls may be cast in situ. Such a construction is relatively time consuming to manufacture on site. In an alternative arrangement to overcome this problem it is known to provide prefabricated reinforced concrete walls which are manufactured and then transported to the building site and lifted into position. However such wall elements are extremely heavy and unwieldy. They are typically 200mm thick, about 2.6 metres high and may be 4 to 5m long. Because of their size they need to be stored upright and special trucks with custom built mounting frames need to be provided for transporting the wall elements from the manufacturing facility to the building site in which the wall elements are required. On site, the relatively large sizes of such wall elements require large cranes to lift and present problems with manoeuvring the wall elements into position in the building due to the unwieldy size of the wall elements. Apart from these difficulties a large capital cost is required to provide the special A-frames required for storing and transporting the wall elements.

Statements of Invention

[0003] According to the invention there is provided a prefabricated modular reinforced concrete wall panel, including a reinforced concrete body having one or more tie bar receiver slots extending upwardly from a bottom edge of the body into the body for cooperating with and reception of one or more tie bars for supporting the panel in a building structure.

[0004] In one embodiment of the invention each receiver slot is tapered, the receiver slot narrowing between a wide mouth portion at the bottom edge of the body towards a narrow inner end of the slot.

[0005] In a preferred embodiment, the receiver slot extends partially through the body.

[0006] In one embodiment the receiver slot extends to at least 20% of the height of the panel. Typically the receiver slot may extend for between 20 and 35% of the height of the panel. In another embodiment the receiver slot is 500mm deep and preferably is about 700mm deep. In a preferred embodiment the receiver slot has an elongate mouth. This mouth for example may have a width in the order of 200mm.

[0007] In a further embodiment a grouting duct or passageway extends through the body between an inner end of the receiver slot and a face of the panel.

[0008] In another embodiment at least one lifting bar is provided at a top of the body.

[0009] Preferably the lifting bar is in alignment with a receiver slot.

[0010] In another embodiment the lifting bar has an inverted V-shaped loop projecting upwardly from the body. This tapered construction facilitates centring a tie bar with a receiver slot as will be described later.

[0011] In another embodiment the lifting bar is a separate U-shaped piece of metal having a curved top with downwardly depending arms embedded in the body. Preferably said arms are embedded to a distance equal to at least 40 times the diameter of the lifting bar.

[0012] In one construction a single central lifting bar is provided at a top of the body. In another arrangement a pair of spaced-apart lifting bars are provided equi-spaced inwardly from the sides of the panel. Thus the wall panel can be readily easily lifted in an upright position to facilitate construction of a wall.

[0013] In another embodiment a grouting groove is provided along each side edge of the body between a bottom and a top of the body.

[0014] Said grouting groove is inset from front and rear faces of the body and has a depth in the order of 10-15mm, and preferably about 12.5mm.

[0015] In another embodiment the reinforced concrete body has a front face, a rear face, a bottom edge, a top edge and side edges, and has a width of 2.4m. In a preferred embodiment the height of the panel is 2.6m and the panel has a thickness of 200mm. However it will be appreciated that various other heights are possible if required for the wall panel. The thickness could be adjusted also if required for different constructions.

[0016] While the width of the panel could possibly be adjusted also it is desirable that the panel has a maximum width of 2.4m. It may be desirable to provide a number of non-standard panels of less width to make up a wall length which is not an exact multiple of 2.4m.

[0017] In another aspect the invention provides a prefabricated modular reinforced concrete wall panel, including a reinforced concrete body having a front face, a rear face, a bottom edge, a top edge and side edges, wherein the width of the panel between said side edges is 2.4m. In a particularly preferred embodiment the panel has a width of 2.4m, a height of 2.6m and a thickness of 200mm.

[0018] In a further aspect the invention provides a wall construction system for forming a composite wall from a plurality of the wall panels, including mounting a plurality of the wall panels side by side in a row on a floor or foundation support in an upright orientation, engaging upstanding tie bars on said floor or foundation support in the receiver slots in the panels, and filling the receiver slots with grout.

[0019] In another embodiment the system includes mounting each panel on spacer shims mounted between a bottom of each wall panel and the floor or foundation support, sealing the opening between the panel and the floor at each face of the panel, pouring grout through the receiver slots to fill said opening and the receiver slots.

[0020] In a further aspect the invention provides a building construction system including a plurality of the composite walls arranged in parallel with reinforced concrete floor panels spanning between the tops of adjacent walls.

[0021] In a still further aspect the invention provides a process for manufacturing reinforced concrete wall panels of the type described herein, including preparing a casting bed having upstanding side rails spaced-apart by a distance corresponding to the width of the wall panel, mounting a plurality of dividers between the rails at spaced intervals along the bed for sub-dividing the bed into a number of panel sections, the dividers including one or more formers for forming the receiver slot or slots at one end of each panel section, mounting reinforcing elements within each panel section, pouring concrete into each panel section, and curing the concrete to form the wall panels.

[0022] In another embodiment the divider includes lifting bar support means on the opposite side of the divider to the former or formers, mounting a lifting bar on the support means in alignment with a central line of the former.

[0023] In a preferred embodiment the support means comprises a pair of slots in the divider for reception of arms of the lifting bar.

[0024] In another embodiment the process includes mounting a pipe element between an inner end of each former and the bed for forming the grouting duct.

[0025] According to the invention there is provided a prefabricated wall system, including:

a plurality of modular prefabricated reinforced concrete wall panels,

said wall panels being assembled in upright alignment edge to edge in a row to form a composite wall,

a connector means between each pair of adjacent abutting wall panels, said connector means including abutment edges of said adjacent wall panels having an outwardly open channel or slot extending between a bottom and a top of each wall panel, a pair of facing slots defining a cavity between the abutment edges of said pair of wall panels, an upright tie bar extending through said cavity and said cavity being filled with grout.

[0026] In a preferred embodiment the grout is a high strength non-shrink grout.

[0027] In another embodiment the tie bar extends outwardly of the wall panels.

[0028] In another embodiment the tie bar is a steel bar of diameter in the range 20-25mm.

[0029] In a further embodiment the slot is inset from a front face and a rear face of the wall panel.

[0030] In another embodiment the slot is a V-shaped slot in a side edge of the wall panel.

[0031] In another embodiment each panel has a width of about 2.4 metres.

[0032] In another aspect the invention provides a prefabricated modular reinforced concrete wall panel of the type herein described for the wall system of the invention.

Detailed Description of the Invention

[0033] The invention will be more clearly understood by the following description of some embodiments thereof, given by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a sectional elevational view of a reinforced concrete wall panel according to the invention;

Fig. 2 is a sectional end elevation taken along the line A-A of Fig. 1;

Fig. 3 is a sectional view taken along the line B-B of Fig. 1;

Fig. 4 is a sectional view taken along the line C-C of Fig. 1;

Fig. 5 is a perspective view showing a partially constructed building incorporating the wall panels of the invention;

Fig. 6 is a detail perspective view showing portion of the construction in Fig. 5;

Fig. 7 is a perspective view showing portion of a building constructed using the wall panels of the invention;

Fig. 8 is a perspective view of a divider used in a casting bed for forming the wall panels of the invention;

Fig. 9 is a perspective view of the divider, shown from the opposite side;

Fig. 10 is a side sectional view of the divider mounted on a casting bed;

Fig. 11 is a plan view corresponding to Fig. 10 showing the divider mounted on the casting bed;

Fig. 12 is an elevational view showing assembly of wall panels of the invention to form a wall;

Fig. 13 is an end elevational view of the wall assembly shown in Fig. 12;

Fig. 14 is an enlarged elevational view of a floor batten used in the wall assembly;

Fig. 15 is an enlarged detail plan view showing the edge joint between adjacent wall panels in the assembly of Fig. 12;

Fig. 16 is an enlarged detail elevational view of a wall panel side joint batten used in the assembly of Fig. 12;

Fig. 17 is an elevational view of another wall panel of the invention, together with continuity tie bars used in the wall assembly;

Fig. 18 is an underneath plan view of the wall panel shown in Fig. 17;

Fig. 19 is an elevational view of a further wall panel of the invention;

Fig. 20 is an underneath plan view of the wall panel shown in Fig. 19;

Fig. 21 is a perspective view showing another wall system of the invention incorporated in a partially constructed building structure;

Fig. 22 is a plan view of the building structure of Fig. 21;

Fig. 23 is a detail sectional view illustrating mounting of wall panels in the building structure of Fig. 21;

Fig. 24 is a detail, partially cut-away perspective view showing portion of the building structure of Fig. 21 incorporating the wall panels of the invention;

Fig. 25 is a detail perspective view showing portion of the building structure of Fig. 21 incorporating the wall panels of the invention;

Fig. 26 is a detail plan view illustrating a connector between adjacent abutting wall panels of the invention;

Fig. 27 is an elevational view of a modular wall panel forming portion of the wall system of the invention;

Fig. 28 is an end elevational view of the wall panel shown in Fig. 27;

Fig. 29 is a plan view of the wall panel shown in Fig. 27;

Fig. 30 is an elevational view of an end wall panel forming portion of the wall system of the invention;

Fig. 31 is an end elevational view of the wall panel shown in Fig. 30; and

Fig. 32 is a plan view of the wall panel shown in Fig. 30.

[0034] Referring to the drawings, and initially to Figs. 1 to 4 thereof there is illustrated a prefabricated modular reinforced concrete wall panel according to the invention indicated generally by the reference numeral 1. The wall panel 1 has a reinforced concrete body 2 having a front face 3, a rear face 4, a bottom edge 5, a top edge 6 and side edges 7, 8 extending between the bottom edge 5 and top edge 6. The width of the panel 1 between said side edges 7, 8 is 2.4m. A pair of spaced-apart tie bar receiver slots 10 extend upwardly from the bottom edge 5 of the body 2 into the body 2 for cooperation with and reception of tie bars as will be described later. A pair of spaced-apart lifting bars 12 project upwardly from the top edge 6.

[0035] The body 2 has a number of vertical reinforcing elements 14 and horizontal reinforcing elements 15 located at spaced intervals within the body 2 as shown in Fig. 1. A grouting groove 16 is provided along each side edge of the body 2 between the bottom 5 and top 6 of the body 2. It will be noted that the grouting groove 16 is inset from the front face 3 and rear face 4 of the body 2 and has a depth in the order of 12.5mm. The width of the groove 16 is about 100mm. The overall width of the body 2 between the front face 3 and the rear face 4 is 200mm. The height of the panel 1 between the bottom 5 and top 6 is 2.6m.

[0036] Each receiver slot 10 is inset 600mm from the side edges 7, 8 of the body 2. It will be noted that the receiver slot 10 is tapered, narrowing between a wide mouth portion 20 at the bottom edge 5 of the body 2 towards a narrow inner end 21 of the receiver slot 10. The receiver slot 10 has a pyramid shape. However two of the sides are elongated so that the width between opposite sides of the receiver slot 10 is 200mm at the mouth and the width between front and back sides of the slot 10 at the mouth is 100mm. At an inner end of the receiver slot 10 a grouting duct 25 extends between the inner end 21 and a front face 3 of the body 2 of the wall panel 1. This is provided for pouring grout into the receiver slot 10 as will be described later.

[0037] Each lifting bar 12 is generally U-shaped having a curved top portion 26 with downwardly depending arms 27 embedded in the body 2 to a distance of about 650mm from the top 6 of the body 2. It will be noted that the curved top 26 has an inverted V-shaped loop with tapered sides 28 and an arcuate tip 29. It will be noted that the lifting bars 12 are in alignment with the receiver slots 10 so that the centre line of the looped head 26 of the lifting bar 12 is coincident with the centre line of the receiver slot 10 directly below it on the body 2 of the panel 1.

[0038] Referring in particular to Figs. 5 to 7, there is shown a wall construction system and building construction system according to other aspects of the invention incorporating the wall panels previously described. To form a composite wall 30 a plurality of the wall panels 1

are mounted side by side in a row on a floor 31 or foundation support in an upright orientation. The receiver slots 10 at a bottom of each wall panel 1 engage upstanding tie bars on the floor 31. To facilitate mounting the wall panels 1 in alignment a guide baton may be fixed to the floor 31 and the wall panels 1 arranged against a straight side edge of the baton to align the wall panels 1 edge to edge along the baton. Typically the wall panels 1 will be mounted on shims which locate between the bottom 5 of each wall panel 1 and the floor 31. The wall panels 1 are supported in the upright position. Another baton or the like might be mounted along the base of the wall panels 1 on the opposite side to the guide baton to close the opening between the bottoms 5 of the wall panels 1 and the floor 31. Liquid grout is then poured through the grouting ducts 25, passing down through the receiver slots 10 filling the opening between the base 5 of each panel 1 and the floor 31 and back filling the receiver slots 10. A number of parallel walls 30 are thus formed as shown in Figs. 5 and 7. Reinforced concrete floor panels 35 are then spanned between tops 6 of walls panels 1 in adjacent parallel walls 30. It will be noted in particular from Fig. 6 that the lifting bars 12 project upwardly between the floor panels 35. A pair of L-shaped tie bars 36 are then inserted through the lifting bars 12 as shown in Fig. 6 with one leg of each tie bar 36 lying flat on top of the floor panel 35 and the other leg extending vertically upwardly. It will be noted that as the head of the lifting bars 12 are tapered inwardly the bars 36 are centred on the lifting bars 12 and hence will be aligned with the centres of receiver slots 10 mounted above the floor panels 35 subsequently to form walls in the next level of the building.

[0039] At this stage also the grouting slots 16 at each side 7, 8 of the panels 1 are filled with grout. A layer 38 of structural screed with mesh is formed above the floor panels 35 to form a floor assembly 39 supported above the walls 30. Upper ends of the upright portions of the tie bars 36 project above a top surface of the floor 39 for cooperation with receiver slots 10 of further wall panels mounted on the floor 39 when constructing another layer of the building.

[0040] Referring now to Figs. 8 to 11 a process for manufacturing reinforced concrete wall panels according to the invention will be described. A casting bed 50 is prepared. The casting bed 50 has upstanding side rails 51 spaced-apart by a distance corresponding to the width of the wall panel 1, in this case 2.4m. A plurality of stop end divider elements 52 are mounted between the rails 51 at spaced intervals along the bed 50 for sub-dividing the bed 50 into a number of panel sections.

[0041] Each divider 52 in this case is of channel section having a base panel 53 with an upstanding front wall 54 and rear wall 55 at opposite sides of the base panel 53. The front wall 54 and rear wall 55 are substantially parallel. Pyramid shaped formers 56 project laterally outwardly from the rear face 55. The shape of these formers 56 corresponds to the receiver slots 10 in the panel 1 described previously. At an inner end of each former 56

is a tubular plastic pipe 58 glued to the bed 50 and pressed tight against an underside of the former 56, the pipe 58 forming the grouting duct 25. During the casting process this pipe 58 also supports the outer end 57 of each former 56 as the pipe 58 seats upstanding on the bed 50. Lifting bar supports are provided on the front wall 54 of the divider 52, in this case formed by pairs of slots 60 extending downwardly from a top edge of the front wall 54. Lower ends 61 of each slot 60 align and centre each lifting bar 12 so that it is in alignment with the associated former 56 on the rear wall 55.

[0042] Reinforcing elements 14, 15 are mounted on the bed 50 between the rails 51 in the configuration shown in Figs. 1 and 2. Concrete is then poured into each panel section and cured to form the wall panels 1. It is particularly preferred to use self-compacting concrete. This gives a very good surface finish. After curing the concrete the dividers 52 are removed starting at one end pulling the formers 56 out of the wall panels 1 and then lifting the wall panels 1 for removal from the bed 50.

[0043] It will be appreciated that while the height of the wall panel 1 described previously is 2.6m, by adjusting the positioning of the dividers 52 on the bed 50 panels of any desired height may be achieved.

[0044] It will be noted that the width of the wall panels 1 is the same as the width of the floor panels 35 and both products can be produced on the one casting bed 50 which is particularly convenient and cost effective from a manufacturing point of view. Further, the size of the wall panel 1 is such that the weight of the wall panel 1 is similar to the weight of a floor panel 35. Thus both panels 1, 35 can be handled by the same lifting equipment on site for example. There is no need for special cranes for example for handling the relatively long conventional pre-cast wall panels.

[0045] It will also be noted that because of its size the wall panel 1 of the invention can be stored on its side without any fear of bending. Also, because of its width it can be transported on its side on conventional trailers in similar fashion to the floor panels 35. There is no need for special frames for carrying the wall panels of the invention. This provides a significant capital cost saving.

[0046] Because the wall panels 1 of the invention can be readily easily stored on their side and stacked, with intervening wooden spacers for example, this facilitates storage and stock piling of this product. It also facilitates ongoing production of the product as there is no limitation imposed by the need for special frames for storing the product. Once the wall panels have been cast they can be removed from the casting bed and stored or transported to a site at which they are used as required.

[0047] It will further be noted that the construction of the lifting bars and receiver slots at a top and at a bottom of the wall panel 1 of the invention facilitates accurate alignment of the reinforcing bars in the construction. The grouting is easy to achieve and provides an excellent finish at a periphery of the wall panels 1. The grouting duct and receiver slot arrangement enables a worker to

cast the grouting in the base portion of the panels whilst standing on the floors on which the panels are standing.

[0048] The lifting bars may be integrally formed with reinforcing elements of the body of the wall panel.

[0049] Assembly of the wall panels 1 is shown in more detail in Figs. 12 to 16. Fig. 12 shows a pair of the wall panels 1 mounted in an upright orientation on the floor 31 or foundation support. The wall panels 1 can be initially supported in the upright orientation by suitable support struts (not shown). Floor battens 70 are fixed to the floor 31 along front and rear bottom edges of the wall panels 1, as shown in Figs. 12 and 13. As can be seen in Fig. 14, each floor batten 70 has a rectangular section timber body 71. Smooth face resilient foam strips 72, 73 are provided along a bottom face and an inner side face respectively of the body 71. In use, these form a seal with the floor 31 and the face of the wall panel 1 with which they engage. Upright side battens 75 are mounted across each edge joint between adjacent wall panels 1 to seal the sides of the joint, as best seen in Fig. 15. Each side batten 75 has a rectangular section timber body 76 with a smooth face resilient foam strip 77 on an inside face of the batten 75 which abuts against the face of the wall panels 1 in use. Three spaced-apart clamp bars 78 extend through the joint and through the side battens 75, clamping the side batten 75 to opposite faces of the wall panels 1 by means of clamps 79 which engage opposite ends of the clamp bar 78. It will be noted that the gap between the edges 7, 8 of the wall panels 1 is 10mm minimum to allow full flow of non-shrink grout. When the battens 70, 75 have been positioned on the wall panels 1, the non-shrink grout can be poured into the gap between the side edges 7, 8 and into the groove 16, thus filling the joint between the two wall panels 1. Also, the non-shrink grout can be poured through the grouting ducts 25 into the receiver slot 10, as previously described.

[0050] It will be noted from Fig. 15 that the joint rebate in each panel 1 is unequal for the reason of de-moulding of side formers on the casting bed 50. It will be noted also that the foam strip 77 projects into the joint where it is not compressed by the panels 1 giving a rebated joint. The foam 72, 73, 77 on the battens 70, 75 prevents leakage of grout when it is initially poured into the joints.

[0051] Referring now to Figs. 17 and 18, another wall panel 80 is shown. This is largely similar to the wall panel described previously and like parts are assigned the same reference numerals. The panel 80 is of narrower width than the panel shown previously. Tie bars 36 are also shown in Fig. 17 to show how continuity is achieved with two bars 36 on each side of the lifting bar 12. Also shown is the engagement of the upright portions of the tie bars 36 with a receiver slot 10 at a bottom of the wall panel 80. Vertical reinforcing bars 14 overlap with lower ends of the lifting bar 12 which are embedded in the wall panel 80 and also overlap with the receiver slot 10 at a bottom of the panel 80.

[0052] Figs. 19 and 20 show another wall panel 90 of narrow width, in this case 900mm, as opposed to the

width of 1200mm for the panel 80. Parts similar to those described previously are assigned the same reference numerals. A number of the panels 80, 90 may be cast at the same time on the casting bed with a suitable divider element between the panels 80, 90.

[0053] Referring now to Figs. 21 to 32 of the drawings there is illustrated portion of a building indicated generally by the reference numeral 100 incorporating a prefabricated wall system according to another embodiment of the invention indicated generally by the reference numeral 102. In Fig. 21 two spaced-apart upright parallel composite wall assemblies 102 are shown extending upwardly from ground level 103 and forming load-bearing supports for a composite floor assembly 104.

[0054] Each composite wall assembly 102 comprises a number of wall panels 106, 107 assembled in upright alignment edge to edge in a row with connector means indicated generally by the reference numeral 108 between each pair of adjacent abutting wall panels 106, 107.

[0055] As best seen in Fig. 26 the connector means includes abutment edges 110 of each pair of adjacent abutting wall panels 107 having an outwardly open channel or slot 111 extending between a bottom and a top of each wall panel 106, 107. A pair of facing slots 111 define a cavity 112 between the abutment edges of said pair of wall panels 107. An upright tie bar 114 extends through said cavity 112 and the cavity 112 is filled with a high strength non-shrink grout 115 material.

[0056] As can be seen in the drawings the tie bar 114 extends upwardly of the wall panels 106, 107 for keying with the cavity 112 formed by wall panels 106, 107 in a composite wall formed above the floor 104. The tie bar 114 is typically a steel bar of 25mm diameter.

[0057] In this case the slot 111 is shown as being V-shaped section. Each slot 111 is inset from a front face 118 and a rear face 119 of the panel 107. In this case the inset distance X is 40mm, the overall depth of the panels 106, 107 between the front face 118 and rear face 119 being 200mm. It will also be noted that a narrow gap 120 of about 5mm is left between abutting end faces 110 of the panels 106, 107 on assembly.

[0058] Each panel 106, 107 has a width of about 2.4 metres, height of about 2.6 metres and are 200mm deep. Thus they can be readily easily handled and placed in position on site.

[0059] Figs. 27 to 29 show the wall panels 107 with double female connector slots 111 at each side. Figs. 30 to 32 show an end wall panel 106 which is only provided with a single female connector slot 111 extending along one side edge. Inset from the opposite side edge a through hole 124 is provided extending between a bottom and a top of the panel 106 for reception of a tie bar 114 as shown in Fig. 24.

[0060] Each panel 107 has a front face 118, a rear face 119, a bottom face 127, a top face 128 and side faces 129. The end wall panel 106 is of similar construction to the standard intermediate wall panel 107 although it may

be of narrower width than the 2.4 metres of the standard wall panel 107. Figs. 21 to 25 show the building construction in which a number of the wall panels 106, 107 are assembled abutting in line to form the wall assemblies 102 on the ground 103. Floor panels 130 span between adjacent wall assemblies 102. Free outer ends of the wall panels 130 rest on top of the top face 128 of the wall panels 107 as shown in Figs. 24 and 25.

[0061] As can be seen in Figs. 24 and 25 the tie bar 114 projects upwardly from the wall panels 107, extending upwardly above the floor panels 130 also. U-shaped tie bars 132 are positioned about the tie bar 114 as shown. A layer 134 of structural screed with mesh is formed above the floor panels 130 covering the U-shaped tie bars 132 as shown particularly in Figs. 21 and 23 to form the floor assembly 104.

[0062] The invention is not limited to the embodiments hereinbefore described which may be varied in both construction and detail within the scope of the appended claims.

Claims

1. A prefabricated modular reinforced concrete wall panel (1), including a reinforced concrete body (2), **characterised in that** one or more tie bar receiver slots (10) extends upwardly from a bottom edge (5) of the body (2) into the body (2) for cooperating with and reception of one or more tie bars (36) for supporting the panel (1) in a building structure (30).
2. A wall panel (1) as claimed in claim 1, wherein each receiver slot (10) is tapered, the receiver slot (10) narrowing between a wide mouth portion at the bottom edge of the body towards a narrow inner end (21) of the slot (10).
3. A wall panel (1) as claimed in claim 1 or claim 2, wherein the receiver slot (10) extends to at least 20% of the height of the panel.
4. A wall panel (1) as claimed in claim 3, wherein the receiver slot (10) extends for between 20 and 35% of the height of the panel.
5. A wall panel (1) as claimed in any preceding claim, wherein a grouting duct (25) or passageway extends through the body (2) between an inner end (21) of the receiver slot (10) and a face (3) of the panel (1).
6. A wall panel (1) as claimed in any preceding claim, wherein at least one lifting bar (12) is provided at a top (6) of the body (2).
7. A wall panel (1) as claimed in claim 6, wherein the lifting bar (12) is in alignment with a receiver slot (10).
8. A wall panel (1) as claimed in claim 6 or claim 7, wherein the lifting bar (12) has an inverted V-shaped loop projecting upwardly from the body (2).
9. A wall panel (1) as claimed in any of claims 6 to 8, wherein the lifting bar (12) is a separate U-shaped piece of metal having a curved top with downwardly depending arms (27) embedded in the body (2).
10. A wall panel (1) as claimed in claim 9, wherein the arms (27) are embedded to a distance equal to at least 40 times the diameter of the lifting bar (12).
11. A wall panel (80) as claimed in any of claims 6 to 10 wherein a single central lifting bar (12) is provided at a top of the body (2).
12. A wall panel (1) as claimed in any of claims 6 to 10 wherein a pair of spaced-apart lifting bars (12) are provided equi-spaced inwardly from the sides (7, 8) of the panel (1).
13. A wall panel (1) as claimed in any preceding claim wherein a grouting groove (16) is provided along each side edge (7, 8) of the body (2) between a bottom (5) and a top (6) of the body (2).
14. A wall panel (1) as claimed in claim 13, wherein said grouting groove (16) is inset from front (3) and rear faces (4) of the body (2) and has a depth in the order of 10-15mm.
15. A wall panel (1) as claimed in any preceding claim, wherein the reinforced concrete body (2) has a front face (3), a rear face (4), a bottom edge (5), a top edge (6) and side edges (7, 8), and has a width of 2.4m.
16. A wall panel (1) as claimed in any preceding claim, wherein the height of the panel is 2.6m and the panel (1) has a thickness of 200mm.
17. A wall construction system for forming a composite wall from a plurality of the wall panels as claimed in any preceding claim, including mounting a plurality of the wall panels side by side in a row on a floor or foundation support in an upright orientation, engaging upstanding tie bars on said floor or foundation support in the receiver slots in the panels, and filling the receiver slots with grout.
18. A wall construction system as claimed in claim 17, wherein the system includes mounting each panel on spacer shims mounted between a bottom of each wall panel and the floor or foundation support, sealing the opening between the panel and the floor at each face of the panel, pouring grout through the receiver slots to fill said opening and the receiver

slots.

19. A building construction system including a plurality of the composite walls as claimed in claim 17 or claim 18, arranged in parallel with reinforced concrete floor panels spanning between the tops of adjacent walls. 5

20. A process for manufacturing reinforced concrete wall panels as claimed in any of claims 1 to 16, including preparing a casting bed having upstanding side rails spaced-apart by a distance corresponding to the width of the wall panel, mounting a plurality of dividers between the rails at spaced intervals along the bed for sub-dividing the bed into a number of panel sections, the dividers including one or more formers for forming the receiver slot or slots at one end of each panel section, mounting reinforcing elements within each panel section, pouring concrete into each panel section, and curing the concrete to form the wall panels. 10
15
20

21. A process as claimed in claim 20, wherein the divider includes lifting bar support means on the opposite side of the divider to the former or formers, mounting a lifting bar on the support means in alignment with a central line of the former. 25

22. A process as claimed in claim 21, wherein the support means comprises a pair of slots in the divider for reception of arms of the lifting bar. 30

23. A process as claimed in any of claims 20 to 22 wherein the process includes mounting a pipe element between an inner end of each former and the bed for forming the grouting duct. 35

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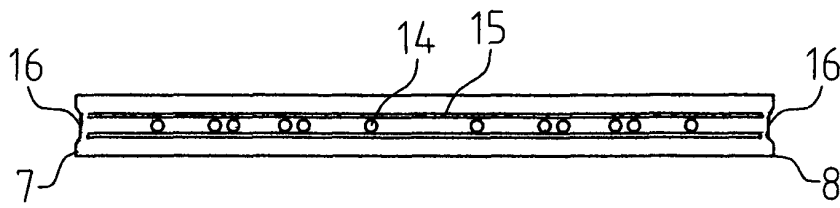


Fig. 3

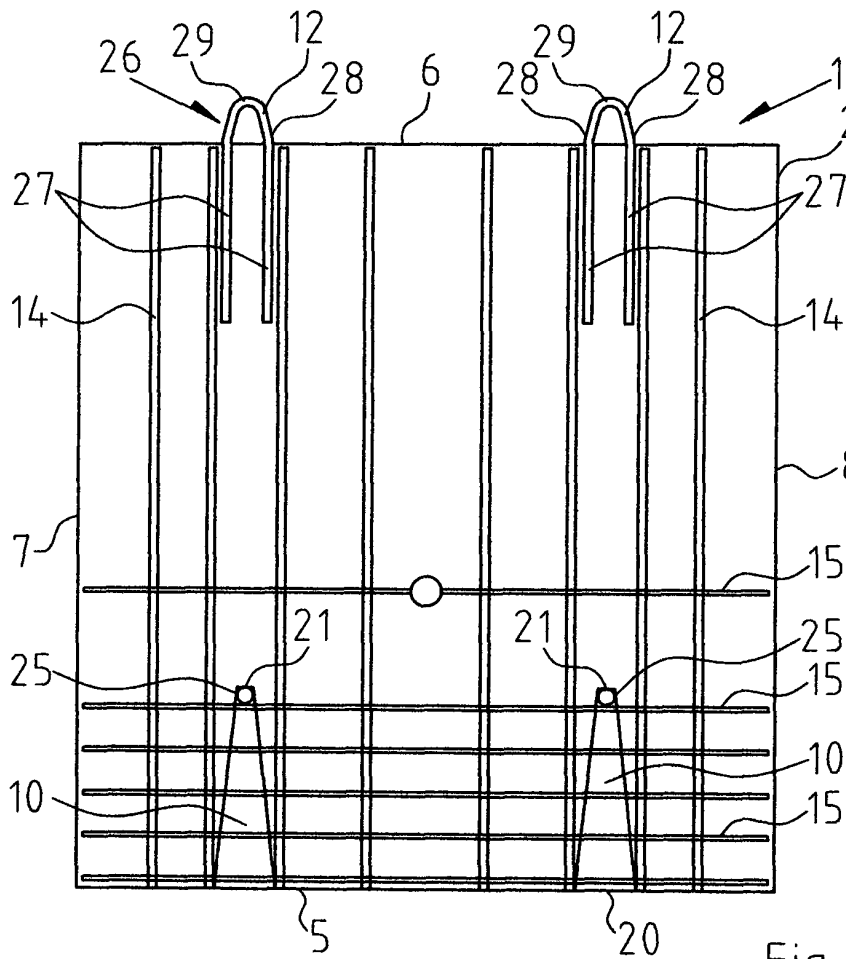


Fig. 1

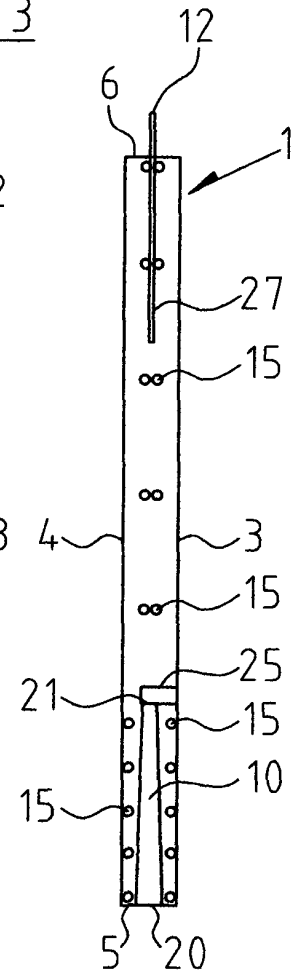


Fig. 2

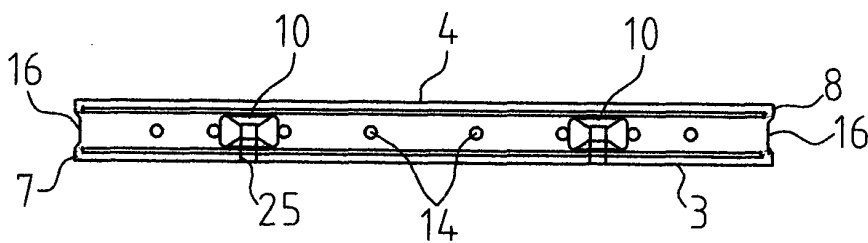


Fig. 4

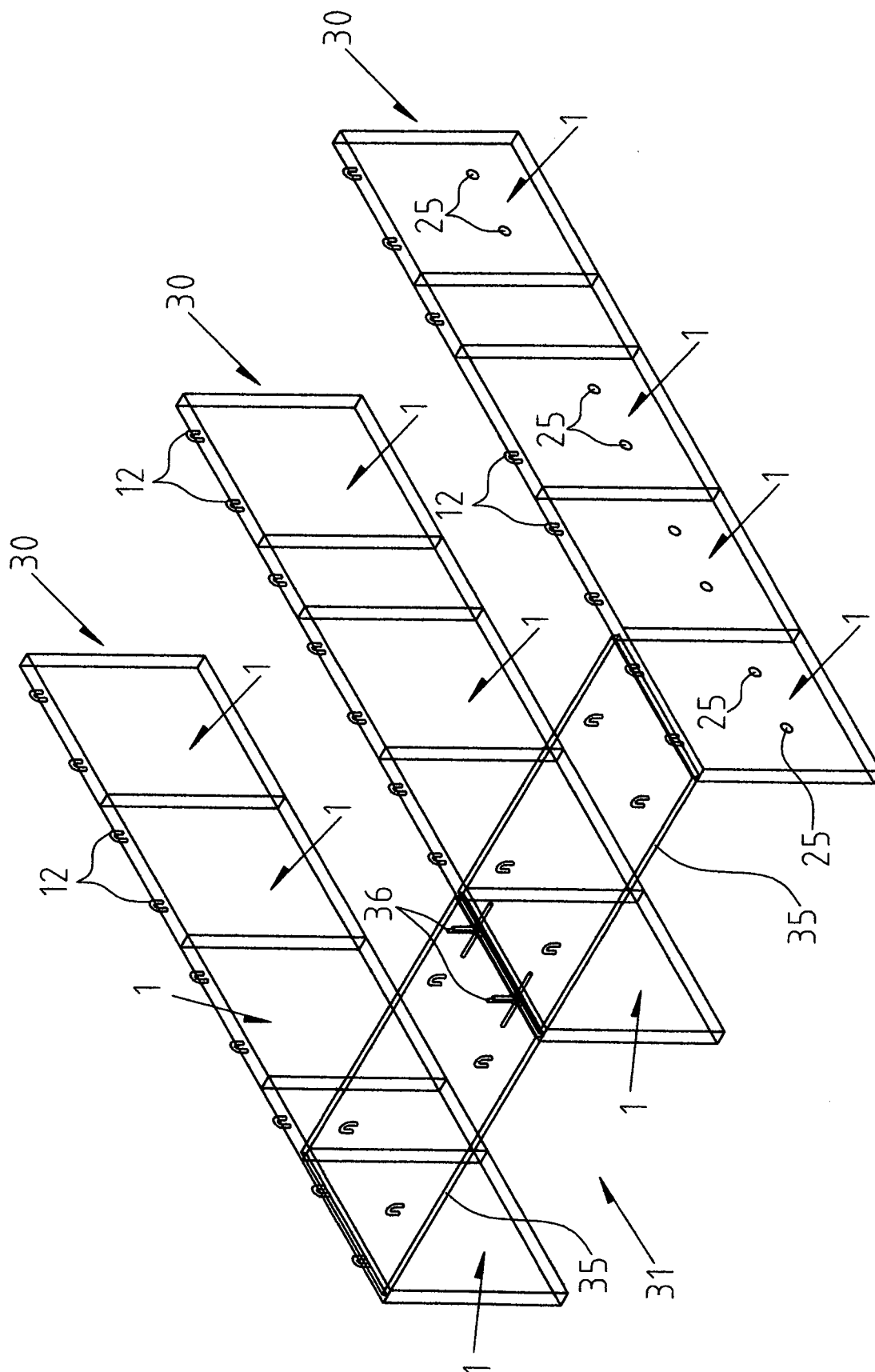


Fig. 5

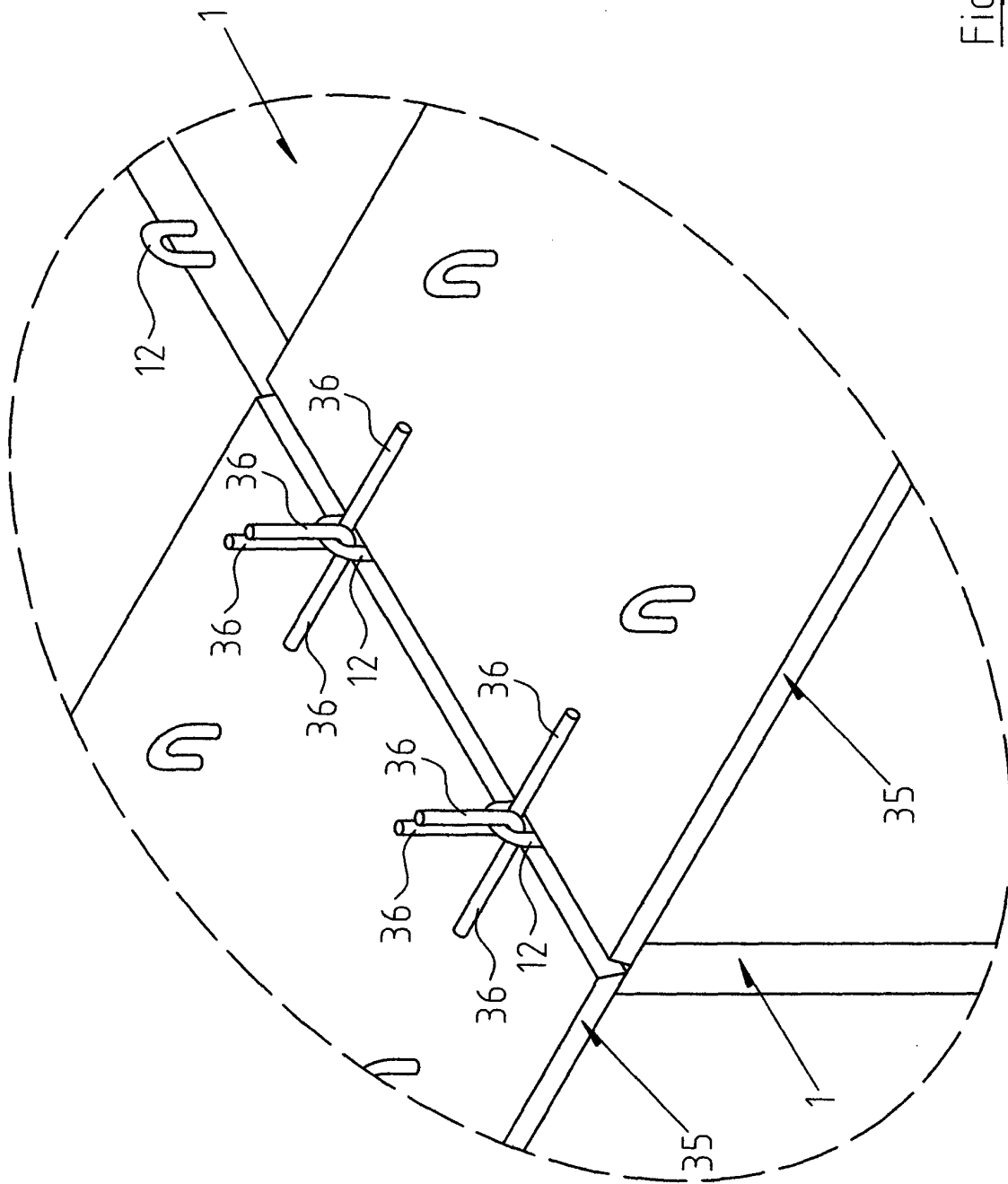


Fig. 6

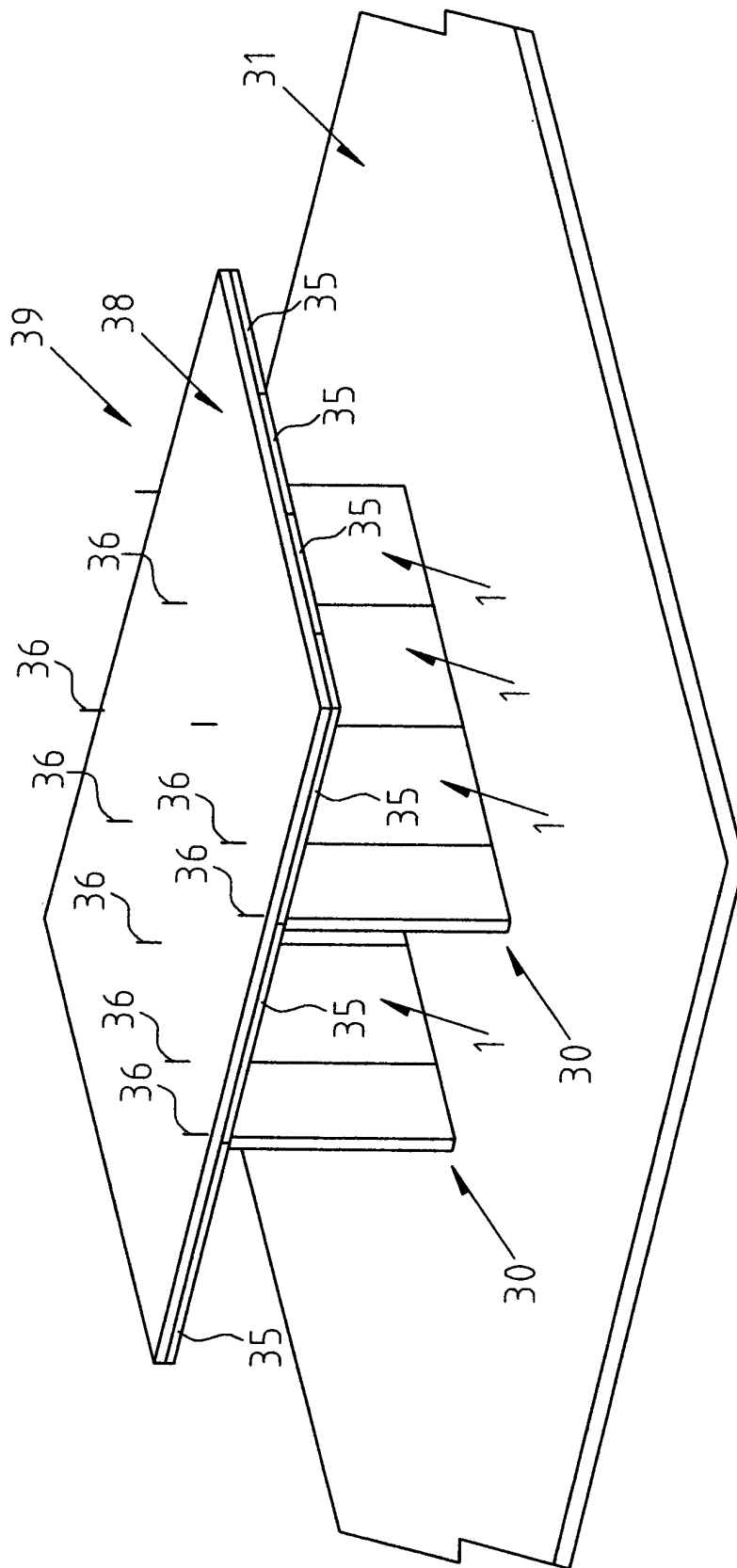


Fig. 7

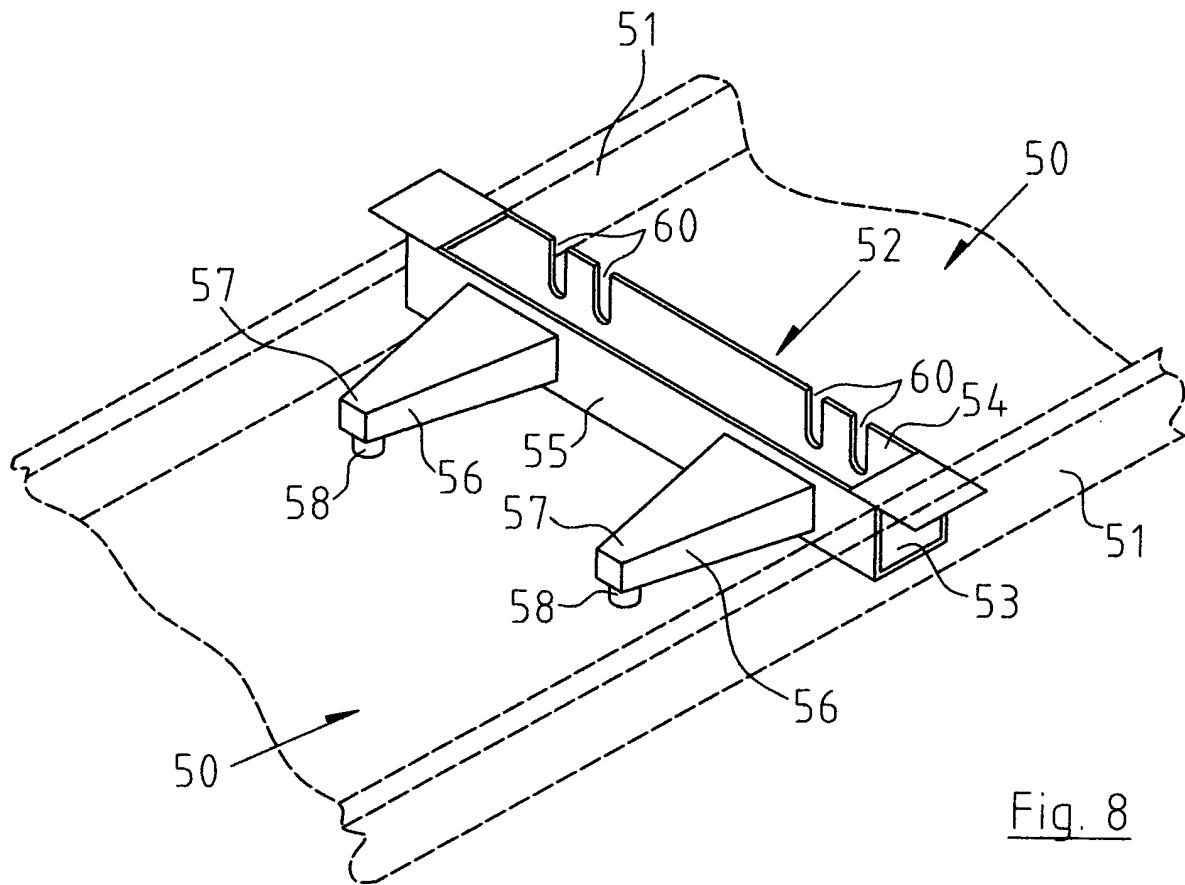


Fig. 8

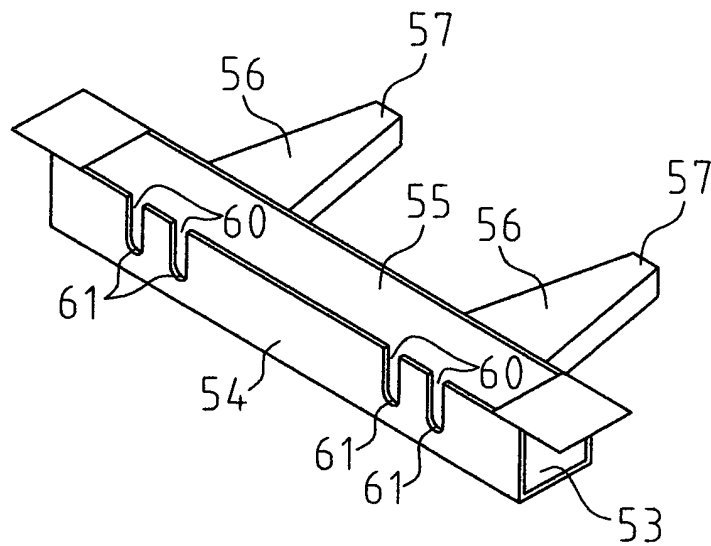


Fig. 9

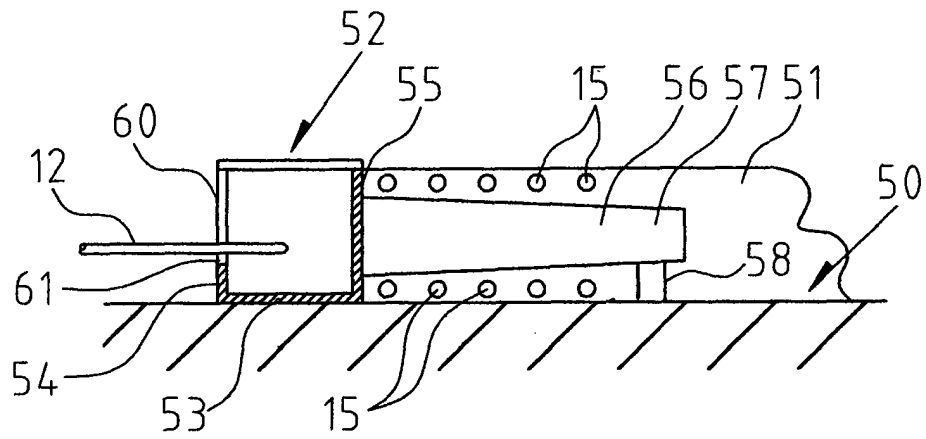


Fig. 10

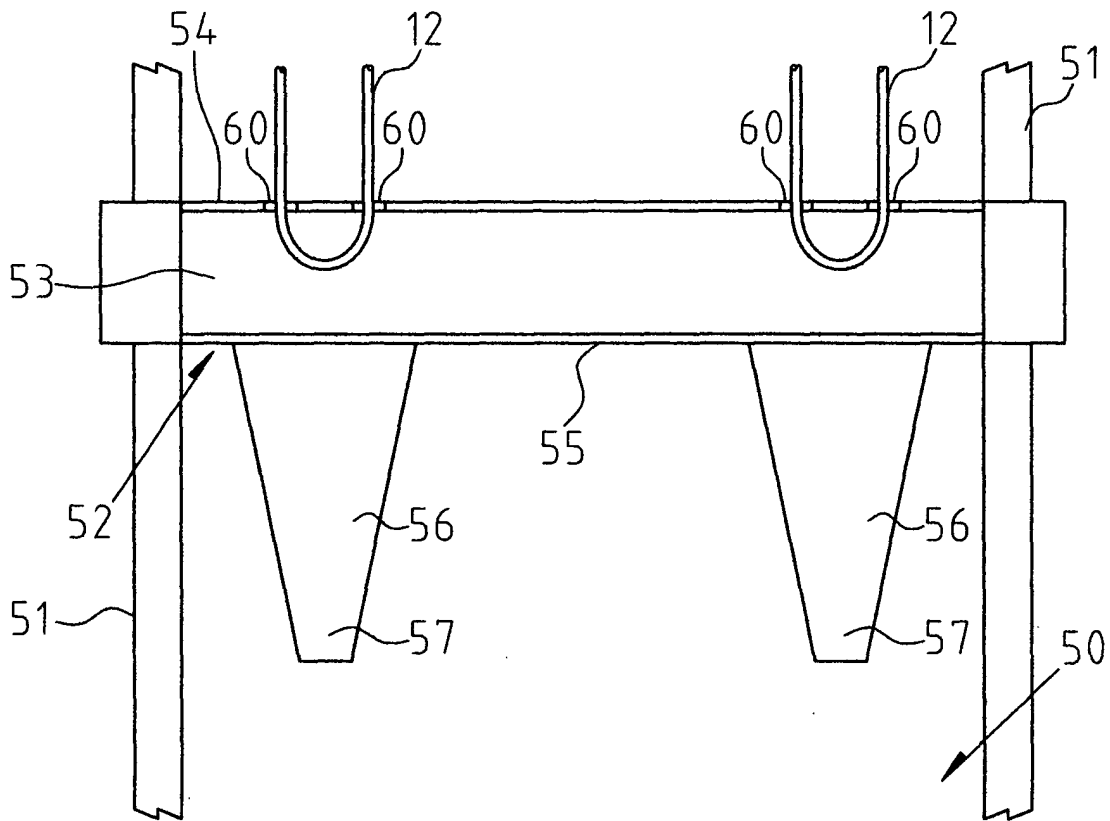


Fig. 11

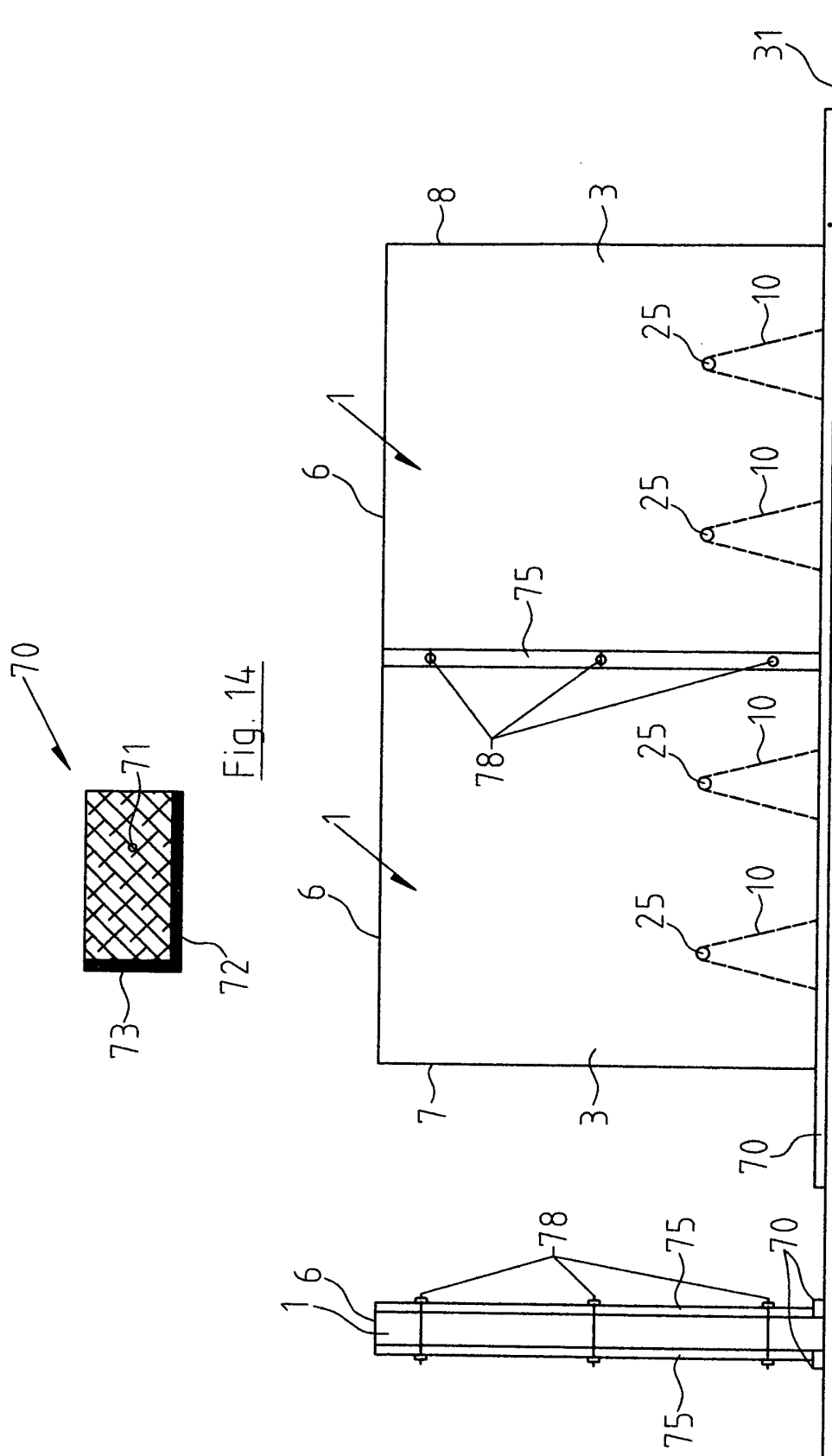


Fig. 12

Fig. 13

Fig. 14

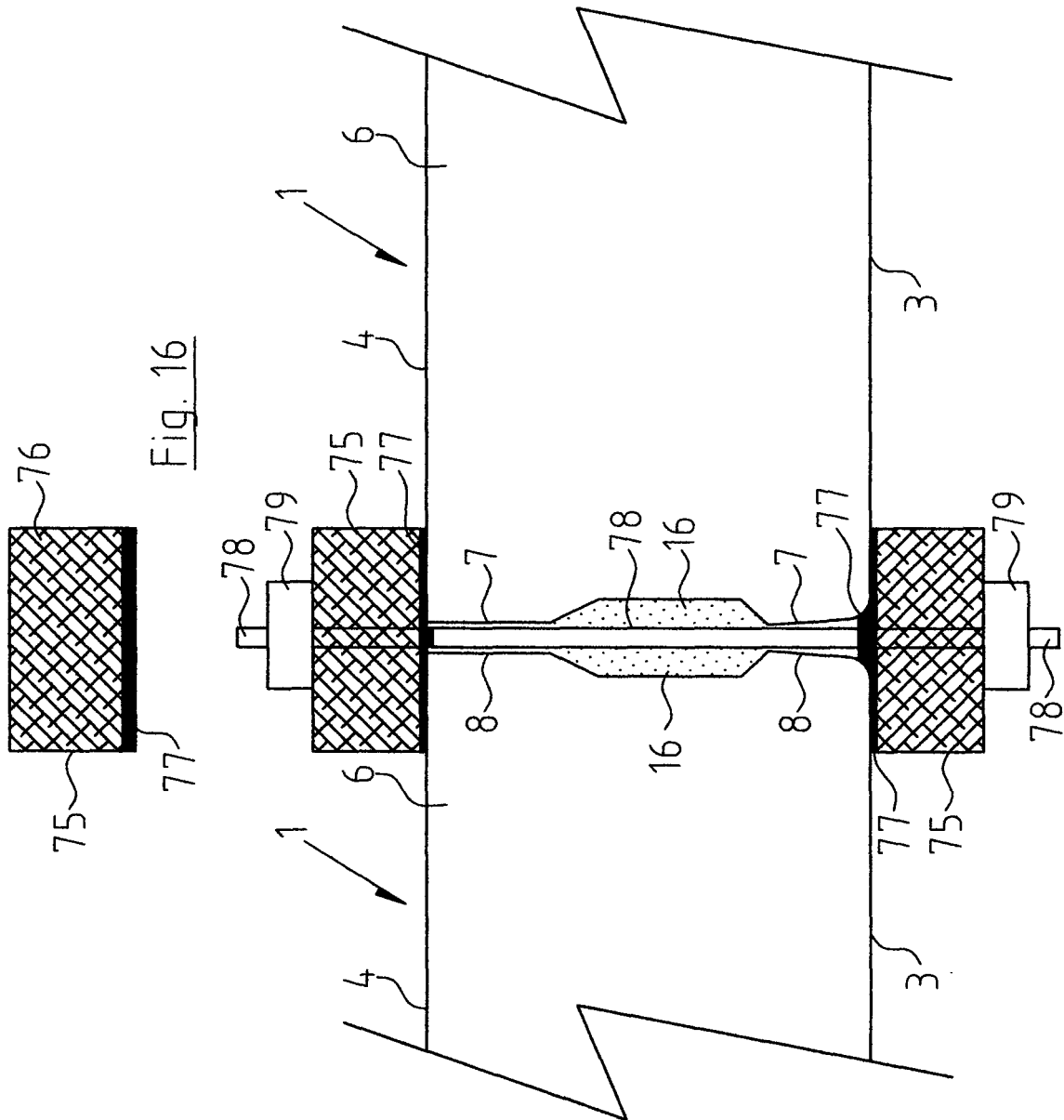
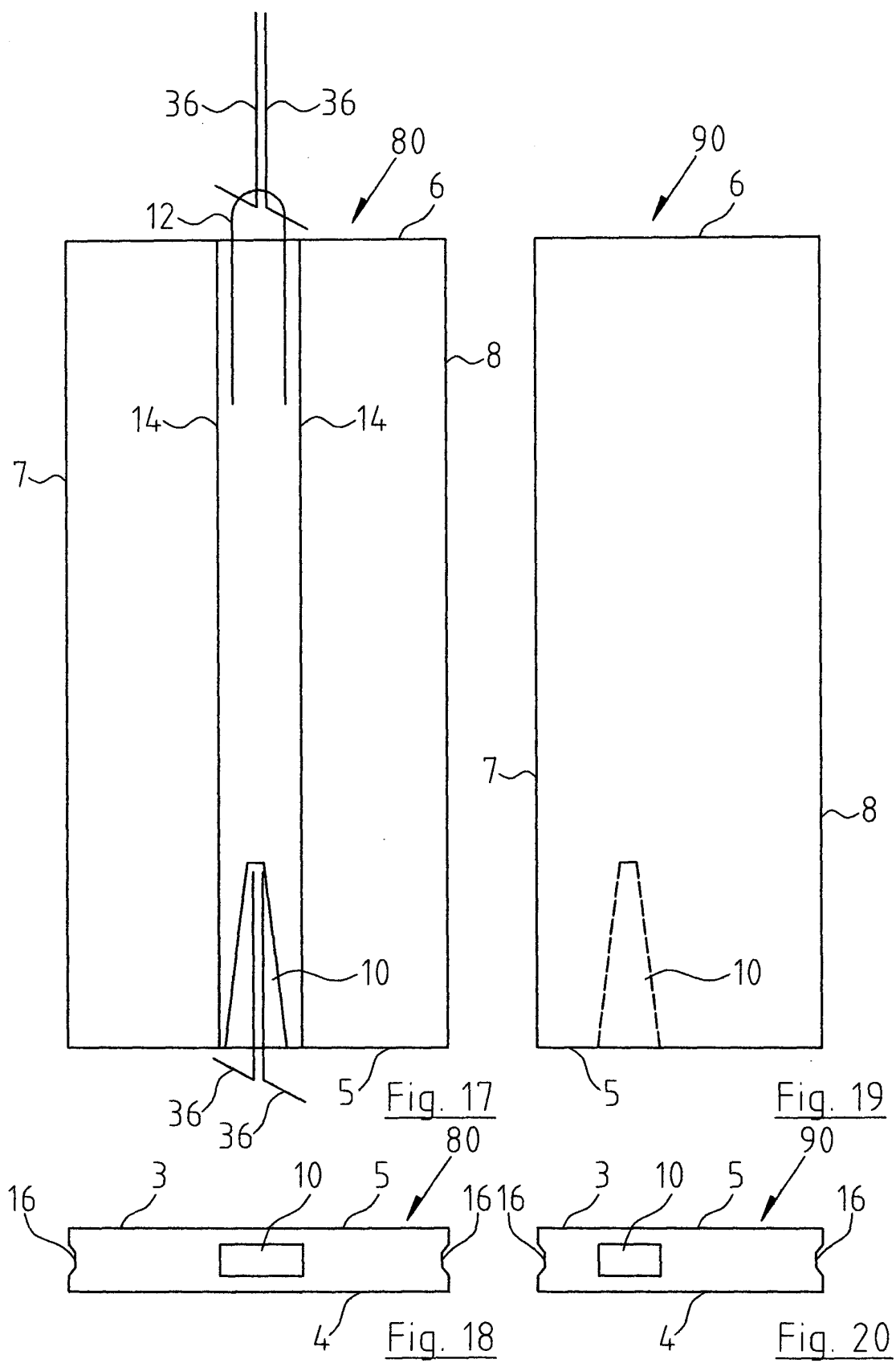


Fig. 15



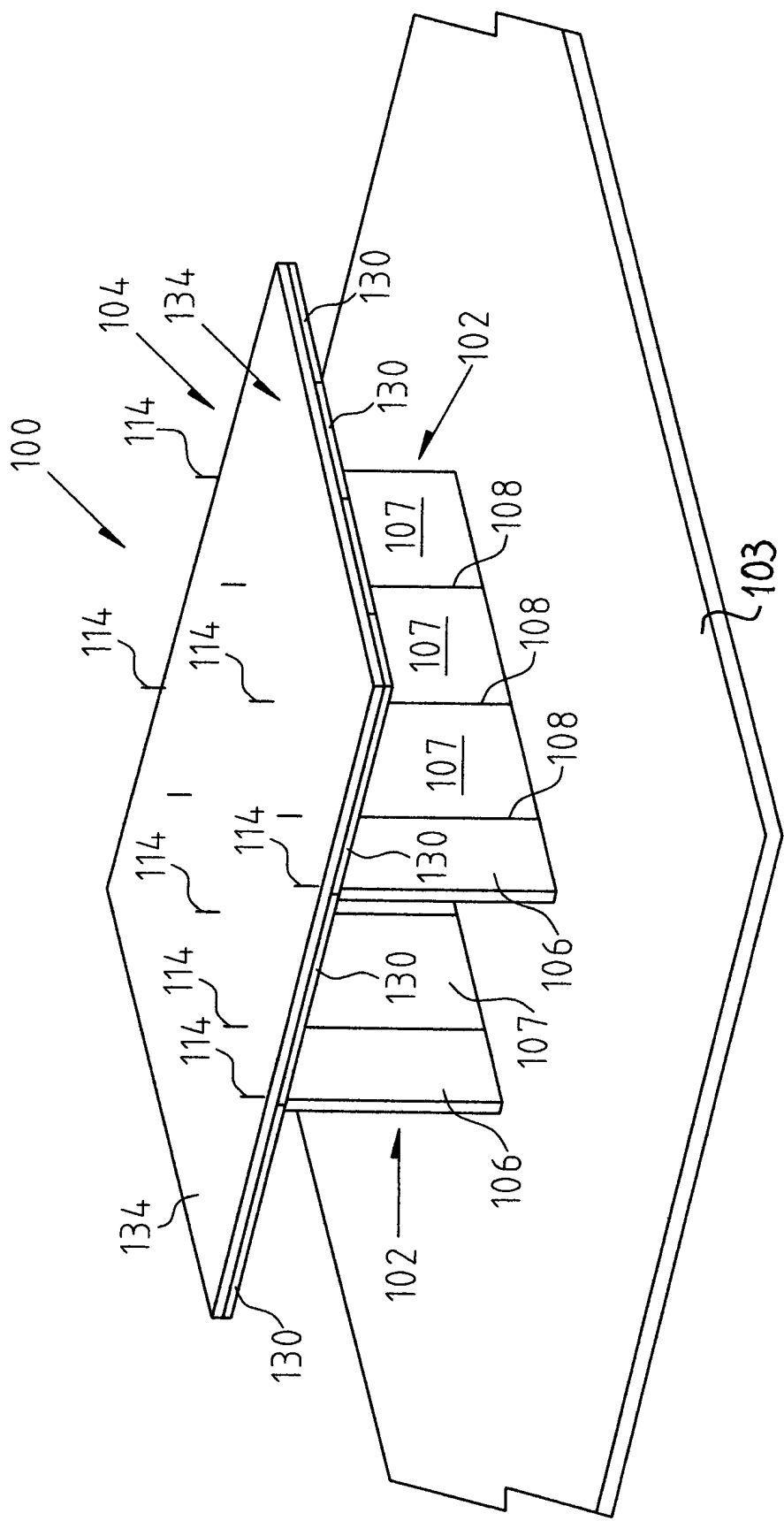


Fig. 21

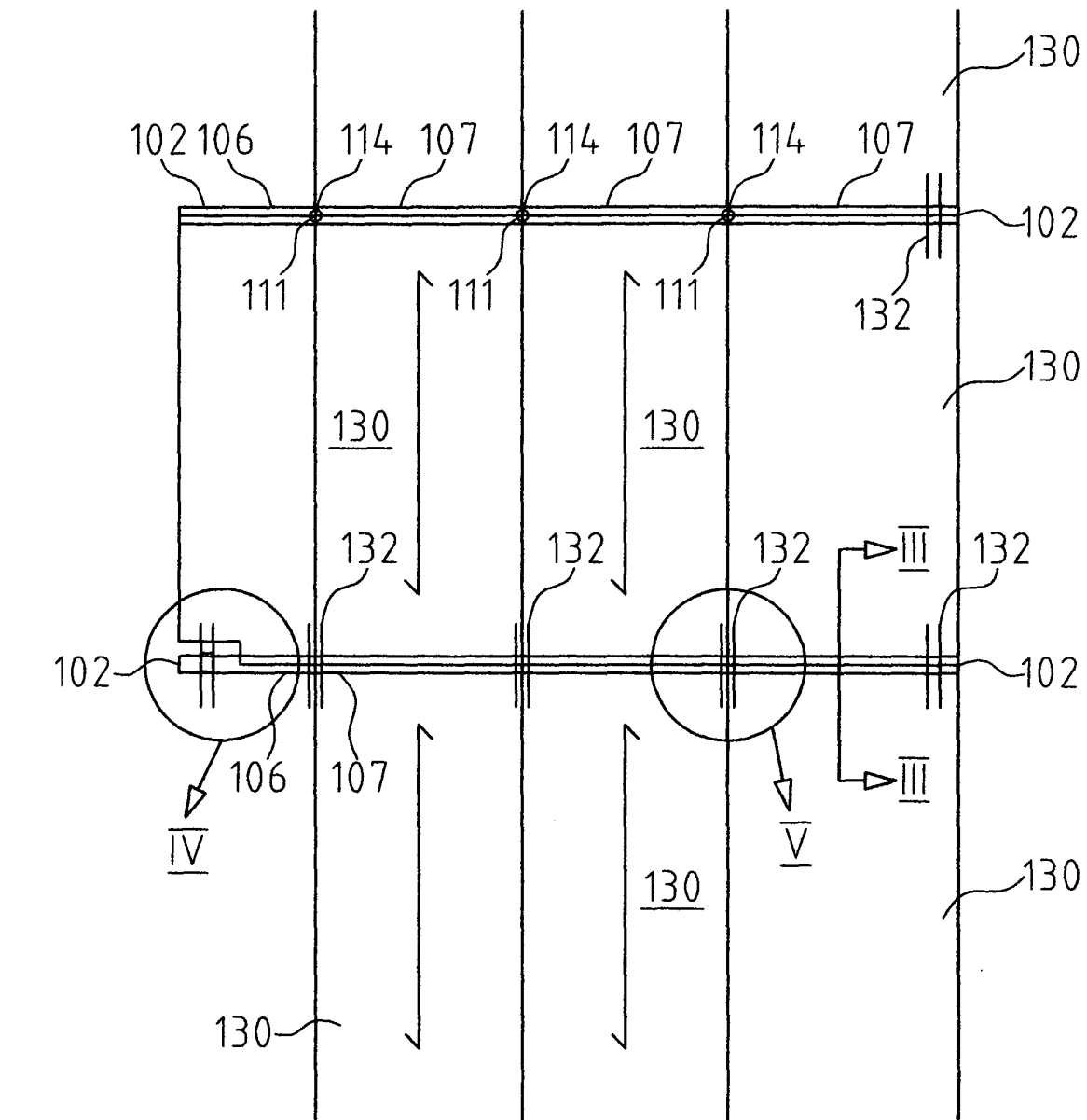


Fig. 22

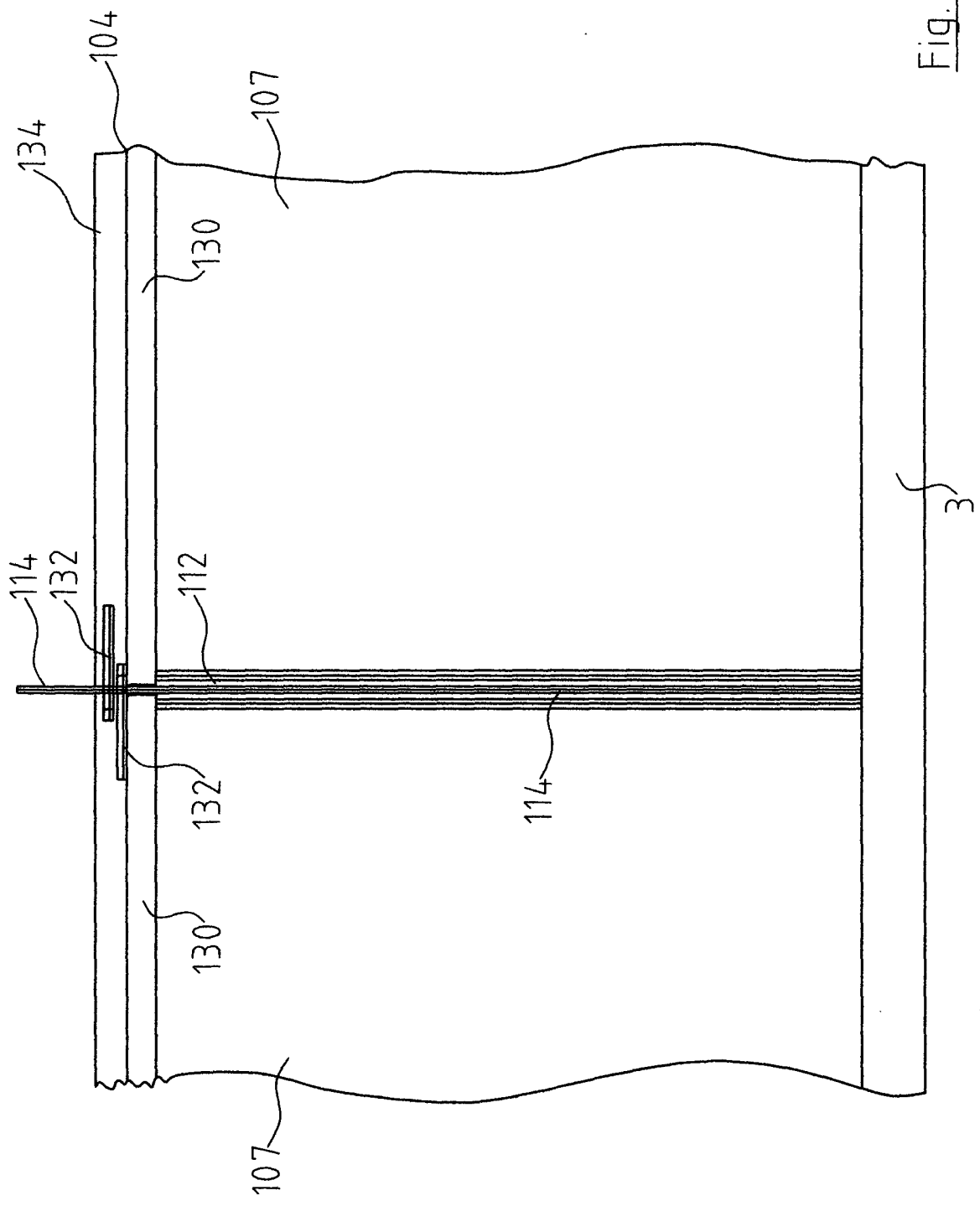


Fig. 23

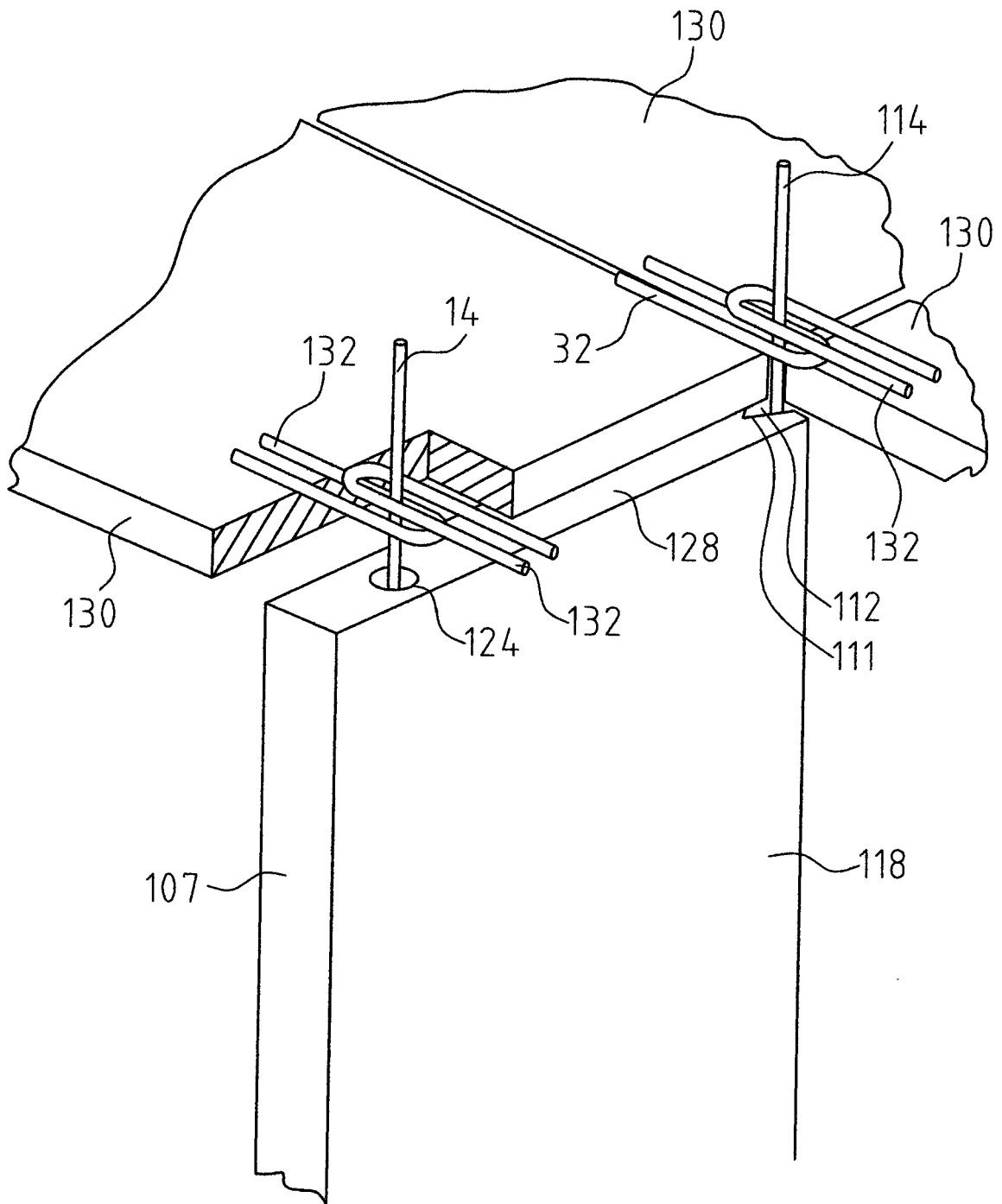


Fig. 24

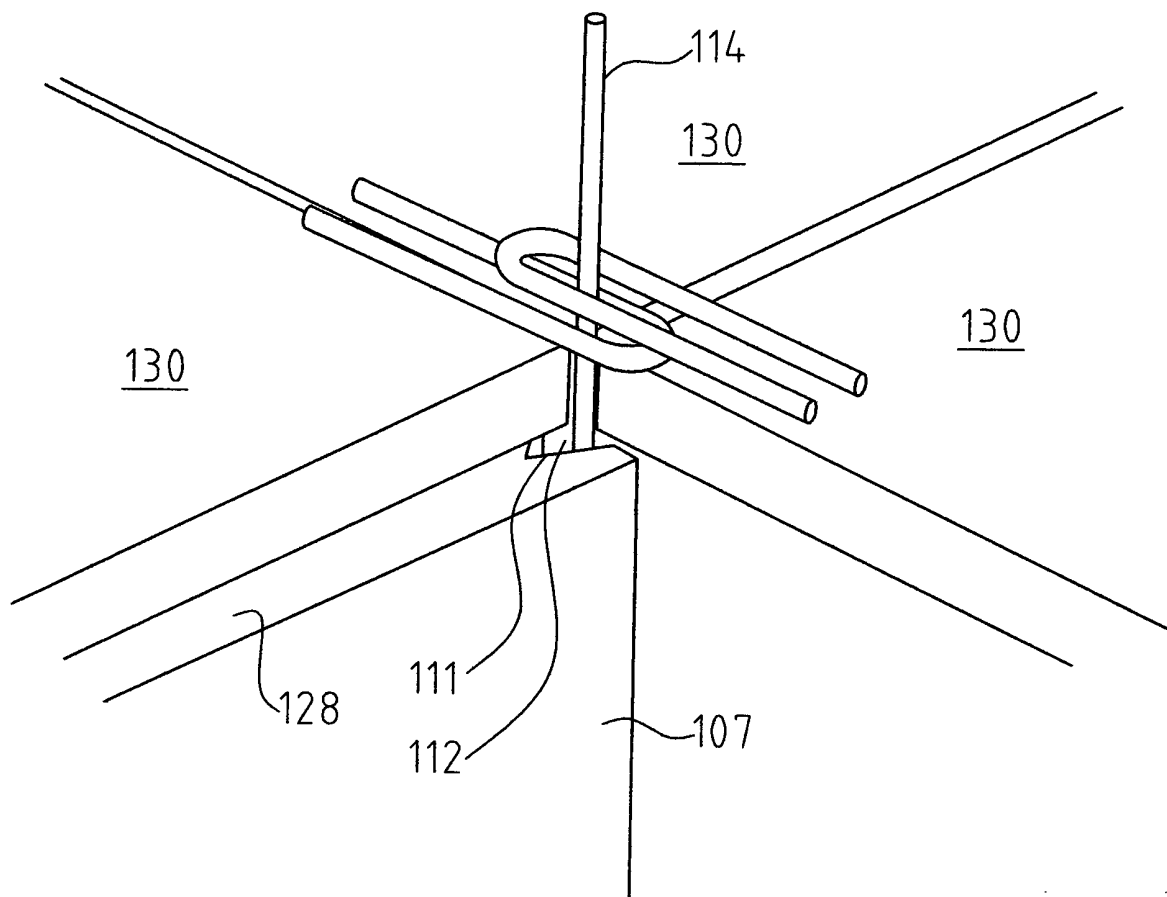


Fig. 25

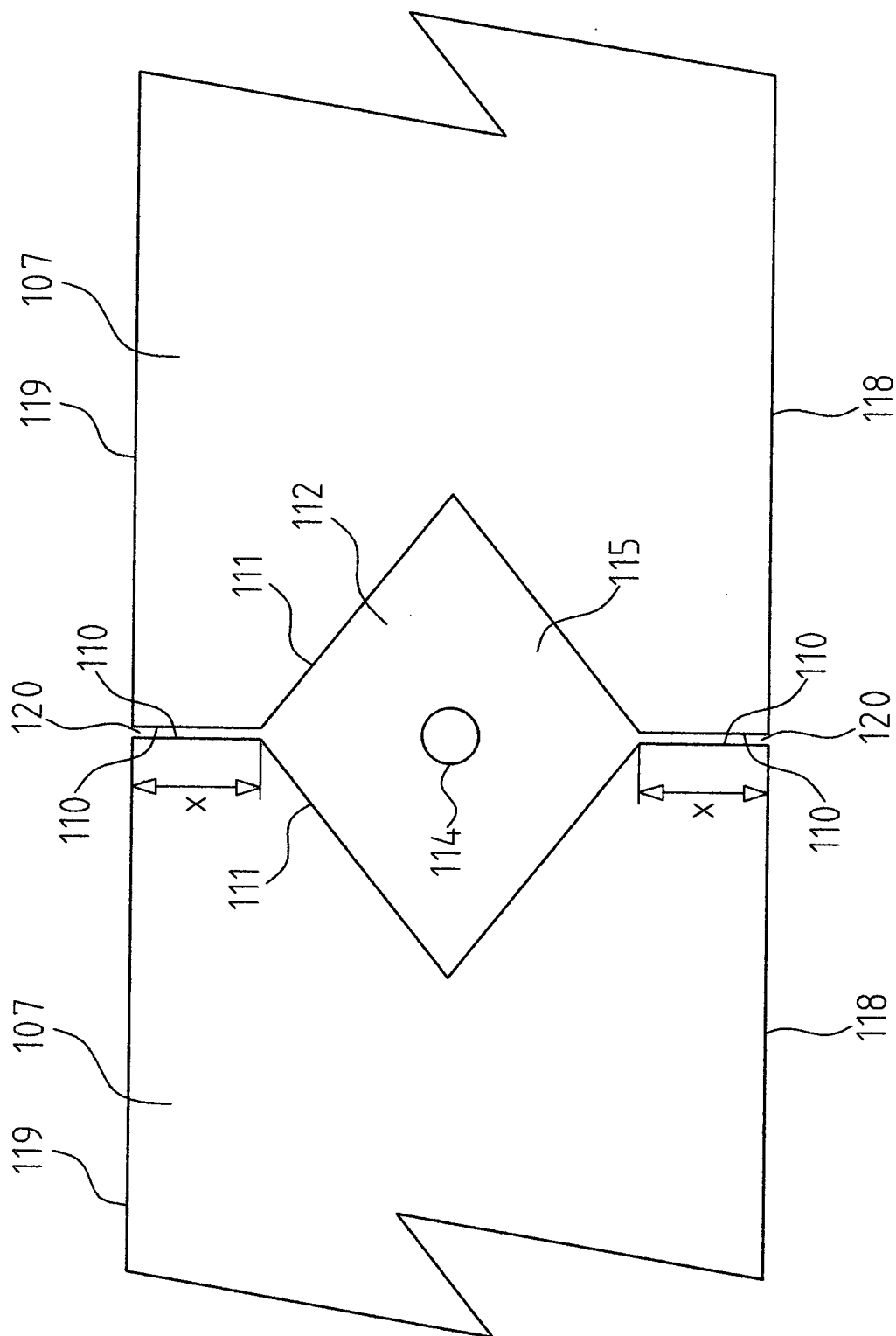


Fig. 26

