(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 790 789 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.05.2007 Bulletin 2007/22

(51) Int Cl.:
E04C 2/04 *(2006.01)* ***E04C 2/34*** *(2006.01)*
E04B 5/48 *(2006.01)*

(21) Application number: **05077675.6**

(22) Date of filing: **28.11.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

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(54) **Building system, beam element, column and method**

(57) The present invention provides a building system, comprising at least partially hollow building elements, in which hollow spaces of the building elements connect to one another for the passage of lines. The hollow spaces are accessible via openings in the building elements for fitting or removing the lines. The building elements comprise a beam element, a column, a wall element and/or a floor element. A reinforcement arranged inside the building elements comprises parallel rods, to which supporting elements are attached by at least one a double weld.

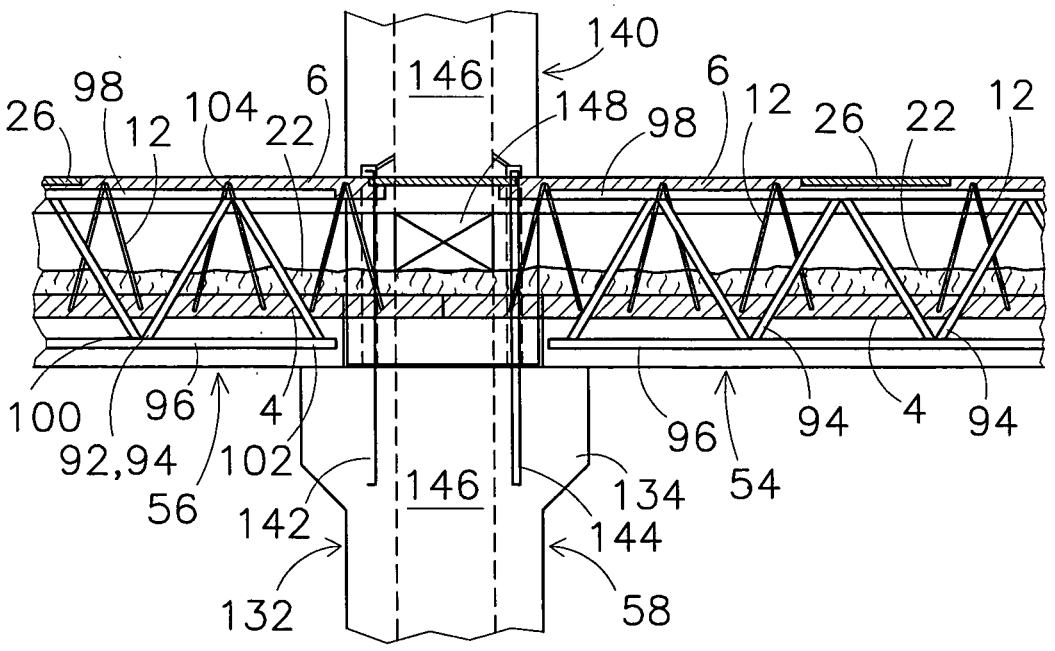

Fig 9

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Description

[0001] The present invention relates to a building system, to a beam element, a column and to a method for constructing a building using a system of this type.

[0002] The building system may comprise all structural components for constructing a building. The system, a building element and/or the method is, for example, used in the construction of houses as well as offices and commercial properties.

[0003] US-4,261,150 discloses a system of wall elements. The elements comprise two parallel concrete slabs which are arranged parallel to one another with an intermediate space in between and are connected to one another by a reinforcement. During building, the wall elements are provided with a support from the outside. Once the elements have been arranged in the desired position and the lines have been installed in the intermediate space, concrete is poured into the intermediate space between the two concrete slabs in order to provide the building elements with the desired strength in order to absorb transverse forces. The lines comprise, for example, electrical wiring, telephone and computer wiring and/or supply and discharge pipes for gas and water.

[0004] The building elements of the known system are relatively light and hollow before the concrete is poured in, resulting in advantages with regard to transport costs. However, the disadvantage of the system is that, like with other buildings having solid walls and floors, fitting or modifying lines retrospectively is labour intensive. Fitting or modifying lines requires walls to be broken open, slots to be cut, holes to be drilled, etc. with the associated nuisance and costs. In the present day and age, where communication means change quickly and the demand for the supply of (electrical) energy is growing constantly, this limited degree of flexibility is a major drawback.

[0005] System ceilings and system floors are also known. Lines, such as sewer lines, wires of a computer network or for air conditioning, are arranged on top of and/or underneath a solid floor. The lines are then hidden from view by means of a system floor or a removable system ceiling. However, fitting the system ceiling is labour intensive as the lines and the system ceiling have to be fitted to the floor. Furthermore, the abovementioned drawbacks with regard to lines having to be led through the floor remain, as cutting, drilling and the like are necessary.

[0006] It is an object of the present invention to provide a system of building elements in which lines, and modifications thereto, can be fitted relatively simply.

[0007] To this end, the invention provides a building system, comprising building elements provided with hollow spaces, in which the hollow spaces of the building elements connect to one another for the passage of lines.

[0008] As a result of the system according to the invention, lines can be fitted and removed more easily. As the building elements are partially hollow, the lines remain accessible after the building works have been completed, so that making modifications retrospectively is less disruptive since breaking and cutting is deviated.

[0009] In one embodiment, the hollow spaces of the building elements are accessible via openings in the building elements for fitting or removing the lines. Modifications or additions in the hollow spaces can thus be made via the openings even after construction work has finished, without the need of breaking and cutting.

[0010] Preferably, the building elements comprise a beam element and/or a column. In addition, the building elements may comprise a wall element and/or a floor element.

[0011] In one embodiment, the building elements comprise an internal reinforcement, which reinforcement comprises at least two rods arranged approximately parallel and connected to one another by a number of supporting elements. Such supporting elements are also known as strut rods. The supporting elements are attached to the rods by means of at least one double weld. The double weld is a strength weld, i.e. a force exerted on the respective supporting element is transferred to the rod via the weld substantially entirely.

[0012] Preferably, the double weld comprises two weld spots which are arranged at opposite sides of an end of the supporting elements.

[0013] If only one weld seam is used, a rod may bend or hinge about the weld seam and may even break away. By using two weld seams, preferably opposite one another on a supporting element when viewed head on, the welds cannot act as a pivot and, at the same time, a stronger connection is achieved. Simultaneous welding of the two seams prevents the supporting element from becoming warped during welding. Simultaneous welding is preferably carried out using a welding robot, which not only welds simultaneously, but also for an equal period and over an equal length of every weld seam. In this manner, identical and strong welded joints are produced which generate as little tension as possible in the rods.

[0014] According to another aspect, the invention provides a beam element for a building system as described above, comprising:

- an elongate beam member;
- a reinforcement provided in the beam member;
- a hollow space extending inside the beam member for arranging lines therein.

[0015] The beam element preferably comprises at least two rods arranged in the beam member and extending in a longitudinal direction of the beam member, and supporting elements which are fitted to a rod by their first end and to another rod by their second end. The entirety made up of rods and supporting elements is also referred to as a zigzag girder.

[0016] In one embodiment, the ends of the supporting elements are attached to the respective rod by means of at least a double weld.

[0017] In one embodiment, the beam member com-

prises a bottom part which is wider than a top part arranged parallel to the bottom part. The bottom part is at least partially wider than the top part in order to provide an edge on which floor parts can be arranged.

[0018] Preferably, the bottom part is a first slab. The top part is preferably a second slab which is arranged parallel to the bottom part. The first and second slabs are separated from one another by the reinforcement and the hollow space. As a result of the solid construction of the reinforcement, the latter is able to absorb forces, thus making the creation of the hollow space between the bottom and top parts possible. The hollow space may even be shaped in such a way that the concrete bottom and top parts are partially separated from one another by just the supporting elements, which are partially free of concrete. The beam element according to the invention is for example capable of spanning a width of 20 m and at the same time supporting a load of around 35 tons.

[0019] According to another aspect, the invention provides a column for a building system according to one of the preceding claims, comprising a support member provided with a hollow space, a reinforcement being arranged inside the support member.

[0020] In one embodiment, an opening is provided in a side wall of the support member in order to make the hollow space accessible.

[0021] Preferably, the column comprises a collar or shoulder which is widened relative to the support member in order to arrange a building element thereon.

[0022] According to another aspect, the invention provides a method, comprising constructing a building from building elements provided with hollow spaces, in which the hollow spaces of the building elements connect to one another for the passage of lines.

[0023] The load-bearing capacity of the reinforcing structure is such that the hollow space in the building elements does not have to be filled with any other material in order to achieve sufficient load-bearing capacity. Thus, any lines in the hollow spaces can be moved, replaced, repaired or added. Likewise, it is possible to add additional connections to lines which have already been installed.

[0024] The abovedescribed building elements are rigid and have a large load-bearing capacity. The metal used for the reinforcement is preferably steel and in particular reinforcing steel. Furthermore, it is preferable for the supporting elements and/or the rods to be tubular, thereby further increasing the strength of the reinforcement.

[0025] Further advantages and characteristics of the present invention will be explained in greater detail below with reference to the attached drawings, in which:

Fig. 1 shows a sectional view of a building element according to the present invention;
Fig. 2 shows a side view, partially in section, of a wall and a floor element according to the present invention;
Fig. 3 shows a sectional view of a floor element according to the present invention;
Fig. 4 shows a sectional view of a wall and a floor element according to the present invention;
Fig. 5 shows a sectional view of a floor and a wall element which are connected to one another;
Fig. 6 shows a floor element according to the present invention, in which an intermediate space between concrete slabs of the floor element is accessible from below;
Fig. 7 shows a top view of an embodiment of a system according to the present invention, comprising a column, beam elements and floor elements arranged thereon;
Fig. 8 shows a perspective view of a first embodiment of a beam element according to the invention;
Fig. 9 shows a section of the system of Fig. 7 along the line B-B;
Fig. 10 shows a section of the system of Fig. 7 along the line A-A;
Fig. 11 shows a top view of a column according to the present invention;
Fig. 12 shows a view of a floor comprising floor elements according to the present invention;
Fig. 13 shows a view of a floor comprising floor elements according to the present invention;
Fig. 14 shows an embodiment of a floor element and a wall element according to the present invention;
Fig. 15 shows a section of the system of Fig. 7 along the line B-B in another embodiment;
Fig. 16 shows a section of the system of Fig. 7 along the line A-A in the embodiment of Fig. 15;
Fig. 17 shows a perspective view of a rod and a supporting element with a double weld according to the present invention;
Fig. 18 shows a diagrammatic view of the double weld of Fig. 17;
Fig. 19 shows a diagrammatic representation of a first step for the production of a building element according to the present invention;
Fig. 20 shows a diagrammatic representation of a second step for the production of a building element according to the present invention;
Fig. 21 shows a diagrammatic representation of a first step for the production of a beam element according to the present invention;
Fig. 22 shows a diagrammatic representation of a second step for the production of a beam element according to the present invention;
Fig. 23 shows a view of an embodiment of a concrete column according to the present invention;
Fig. 24 shows a longitudinal section of a column according to the present invention during a first production step; and
Fig. 25 shows a longitudinal section of a column according to the present invention after a further production step.

[0026] Fig. 1 shows a building element 2 which com-

prises a first concrete slab 4 and a second concrete slab 6. Along a part of the length of the concrete slab, the second concrete slab 6 has a smaller width than the first concrete slab 4, the width being in the plane of the paper. The length of the first concrete slab 4 may be equal to the length of the second concrete slab 6 or one of the two lengths may be less than the length of the other slab, depending on the application and the chosen design. A metal load-bearing structure is arranged between the first and the second concrete slab 4, 6. The building element comprises a first supporting element 8a and a second supporting element 8b. The supporting elements 8a and 8b are at an angle with respect to one another for the purpose of structural rigidity and strength.

[0027] If desired, a building element 2 may comprise more supporting elements, for example depending on the desired width of the building element 2, a minimum weight to be supported or a span to be bridged.

[0028] Fig. 2 shows a floor element 8 with two slabs 4, 6. Rods 10a, 10b are arranged inside the slabs in the longitudinal direction. The rods 10a, 10b are connected to one another by supporting elements 12a, 12b, 12c, etc. Adjacent supporting elements 12, such as 12a and 12b, together with one of the rods 10a, 10b, form a triangle. The triangle's geometry is determined on the basis of a height of the building element and a desired strength.

[0029] One end of the floor element in Fig. 2 rests on a wall 14. The floor element is supported at at least one other position. Preferably, the floor element is supported at a position where one or two supporting elements 12 are connected to the rod 10b. Thus, the transverse force is transferred to a support of the floor element, such as the wall or the wall element to which the floor element is affixed.

[0030] The configuration, shown in Fig. 2, of the rods 10a, 10b and the supporting elements 12 in the shape of adjacent triangles was chosen for reasons of structural strength and rigidity which are associated with a triangular configuration of this type. Other configurations are also possible, as long as the strength of the structure remains sufficient.

[0031] The supporting elements 12 are welded to the rods 10. For added structural strength, one end of each supporting element 12 is welded in at least two spots, or along two seams, to a rod 10a, 10b. Optionally, more than two welding spots may be used. The one weld may, for example, be executed on a first side of the respective end, while the second weld is executed on a second side situated opposite the first side. When a supporting element 12 is welded in one spot or along one seam, the supporting element 12 may become deformed, thus making welding along the second seam or to the opposite rod difficult, if not impossible. Furthermore, undesirable stresses may occur in the building element. Preferably, the supporting elements are welded simultaneously to a rod 10a, 10b at the two spots or along the two seams. In this case it is advantageous if this welding is carried out by an automatic welding device since such a device produces two (or more) substantially identical welds, as a result of which stresses in the respective materials are further reduced. Deformation of the supporting elements 12 is prevented further by simultaneously producing a total of four welds at two ends of the supporting elements 12. Thus, it is possible to produce flat building elements of sufficient strength.

[0032] Fig. 3 shows a third embodiment of a floor element comprising a plurality of building elements 2. The floor element of Fig. 3 comprises concrete slabs 6 which are connected by means of a load-bearing structure to concrete slabs 4 which are arranged in parallel. The load-bearing structure comprises two or more supporting elements 20a, 20b, 20c. The use of a plurality of supporting elements results in a greater load-bearing capacity and/or greater rigidity. Thus, wider and/or longer concrete slabs 4, 6 can be used. Also, a load-bearing structure of this type can be used in order to enable a floor element to bear larger loads.

[0033] The floor element from Fig. 3 comprises adjacent building elements 2. The concrete slabs 4 form a continuous surface. This continuous surface may, as illustrated, be located at the bottom and act as a ceiling, but may also be located on any other side, depending on the use.

[0034] Openings between the concrete slabs 6 are covered with a covering panel 26. The covering panel 26 can be made from any material, depending on the desired strength and use. The covering panels 26 and the concrete slabs 6 together form a surface, the covering panels, if desired, being removable in order to access the space between the concrete layer 22 and the concrete slabs 6.

[0035] A concrete layer 22 is arranged in the space between the two concrete slabs 4, 6, on the concrete slabs 4. The concrete layer 22 comprises a reinforcement 24 above a joint between adjoining building elements 2. The concrete layer 22 ensures a diaphragm action in the building where it is fitted, as a result of which the floor element is reinforced. Diaphragm action ensures that the floor acts as a unit in transferring forces onto the walls of the building, without the components of the floor moving with respect to each other. Floor parts can also be secured to one another using bolts, as is described in more detail below. Incidentally, depending on the use, the space between the concrete slabs 4, 6 may be partially or completely filled with concrete, cellular concrete or another material, for example a sound- or vibration-dampening material and/or a thermal insulation material.

[0036] There is a space between the concrete layer 22 on one side and the concrete slabs 6 and the covering panels 26 on the other side for installing electrical cables 29 and other lines 30. The covering panels 26 have been fitted so as to be removable and replaceable, so that the lines 29, 30 are easily accessible. In case of malfunctions, new lines and/or pipes can easily be installed in the gap by removing a covering panel 26. In Fig. 3, the electrical cables 29 are connected to an electrical junction box 28,

which is arranged in a concrete slab 4.

[0037] Depending on the construction of the load-bearing structure, the materials used and the form of the supporting elements 12, 20 and the girders 10, 24, etc., the building elements 2 can bridge spans of for example approximately 20 metres.

[0038] Fig. 4 shows a floor element comprising a building element 2. The floor element is connected to a wall element 42 according to the present invention. The building element 2 comprises a first concrete slab 4 and a second concrete slab 6, the first concrete slab 4 being wider than the second concrete slab 6. As a result of the first concrete slab 4 being wider than the second concrete slab 6, the floor element is arranged on the supporting wall structure of slab 44 by means of the protruding part of slab 4.

[0039] In the embodiment shown in Fig. 4, the first concrete slab 4 rests on a first concrete slab 44 of the wall element 42. The second concrete slab 46 may be higher than the first concrete slab 44, namely such that the end side of the second concrete slab 46 is level with the top of the first concrete slab 4 of the floor element 2.

[0040] It can be seen from Fig. 4 that an intermediate space between the first slab 4 and the second slab 6 is greater than a space between slab 44 and slab 46. Such a difference in dimensions is not required but only depends on the desired strength. All dimensions of the building elements may be selected to be different, depending on function and desired strength and space and other parameters.

[0041] In addition to the rods 10, supporting elements 12, concrete layer 22 and lines 30 already shown in the previous figures, Fig. 4 shows a reinforcement 24 which provides a connection between the concrete layer 22 and the first concrete slab 44 of the wall element 42. The reinforcement 24 provides an anchoring between the floor element 2 and the wall element 42. The lines 30 in the floor element are connected to the lines 30 in the wall element 42 by means of a coupling piece 31. A coupling piece 31 is optional, but facilitates installation of the lines 30.

[0042] The space between the concrete slabs 44, 46 of the wall element 42 may remain empty, except for the lines 30 installed therein. Likewise, this space can at least partially be filled with material, for example sound insulation, thermal insulation material, sand or concrete, depending on the desired properties of the wall.

[0043] Fig. 5 shows another embodiment of a connection between a wall and a floor element according to the present invention. A first concrete slab 4 rests on a wall element 42A, while a second, relatively small concrete slab 6 above it forms part of a floor. A filling material 22, for example concrete, is disposed in a first wall element 42A.

[0044] A second wall element 42B is arranged on the first wall element 42A. The second wall element 42B comprises two concrete slabs 44, 46, which are of equal height. The second wall element 42B is likewise filled with a material 48. Preferably, the filling material 48 is the same as the filling material 22 with which the first wall element 42A is filled and the material 48 provides a connection to the filling material 22. Although this has not been shown, a reinforcement material may be arranged in the filling material 22, 48 in order to further reinforce the connection. The filling by means of filling material is optional.

[0045] Fig. 6 shows a further embodiment of a building element according to the present invention. The building element acts as a floor element. The floor element comprises a first concrete slab 4 which forms a continuous floor surface with the adjacent building elements. The building element furthermore comprises two concrete slabs 6a and 6b which are each connected separately by means of a load-bearing structure comprising supporting elements 20 to the first concrete slab 4. The concrete slabs 6a and 6b form a ceiling for a storey running beneath the building elements. Covering panels 26 close the openings between slabs 6a and 6b. The covering panels 26 are removable so that lines 30 are easily accessible. Connections for the lines 30 are provided in the covering panels 26, as well as for example an electrical junction box 28.

[0046] In order to provide a structure with diaphragm action, see above, a cover layer 32 may be provided on the slabs 4 of the floor element. In addition, a reinforcement may be arranged in the cover layer 32.

[0047] Above, building elements are described for forming at least partially hollow floor and/or wall elements. In the intermediate space between the building elements, lines can be arranged. The intermediate spaces are accessible via openings, so that modifications can be made to the lines retrospectively. In this case, crushing, cutting or similarly radical actions can be dispensed with.

[0048] In addition to floors and walls, a building constructed using the abovementioned building elements generally also comprises beam elements and columns. The supporting columns are arranged at angular points of the floor elements and are placed in an upright position, at right angles to the floor element. The beam elements extend from column to column. Floor elements are arranged on protruding edges of the beam elements. The beam elements also provide additional strength, as a result of which taller or narrower buildings can be constructed.

[0049] Known supporting beams and columns are made of solid concrete. Any reinforcement arranged therein is fitted under tension, as described above, as a result of which the reinforcement is too weak to absorb transverse forces on its own. By applying concrete around the reinforcement, the transverse forces are absorbed by the solid concrete, i.e. the concrete around the supporting elements prevents buckling of the supporting elements. With known columns and beam elements, the lines are therefore embedded in concrete. Thus, chases have to be cut if modifications are to be made.

[0050] The present invention provides a beam element and a column which are provided with a hollow space in which lines can be arranged. The hollow spaces of the beam elements and the columns preferably connect to the intermediate space of the wall and floor elements via openings in side walls of the columns, so that the unit provides a complete system for the passage of lines. Even after the building has been completed, the hollow spaces are accessible so that modifications can be made.

[0051] Fig. 7 shows a system which includes hollow columns and beam elements in addition to floor and wall elements. The system comprises floor parts 50 which consist of floor elements 2 as described above. The floor parts partially rest on a beam element 54 by their outermost edges 52. The beam element 54 and a second beam element 56 rest on a column 58 by one of their ends. The beam element 56, like the beam element 54, comprises a top part 60 which is at least partially narrower than a wider bottom part 62. The floor parts 50 are supported by the edge of the bottom part which protrudes relative to the top part 60. The protruding edge is indicated on the right-hand side of Fig. 7 by means of a dashed line.

[0052] Fig. 8 shows an embodiment of a beam element 54 according to the present invention. The beam element comprises a top part 60 and a bottom part 62. The bottom part comprises a first slab and the top part comprises a second slab. The first and the second slabs are preferably made of concrete. The first and second slabs are furthermore parallel to one another and are connected to one another by means of a reinforcement. The reinforcement comprises rods which are embedded in the concrete of the slabs, and are therefore not visible in the figure, as well as supporting elements 92, 94. The supporting elements 92, 94 are arranged in pairs in the longitudinal direction of the beam element. As the supporting elements are optionally arranged at an angle to one another, transverse forces, in the plane of the top part 60, are more readily absorbed.

[0053] The supporting elements 92, 94 are welded to rods 96, 98 by means of the abovedescribed welding method (Fig. 9). The locations of the welds are denoted by spots 100, 102, 104. By applying the abovedescribed welding method, the reinforcement is able to absorb transverse forces more readily. In addition, the fact that the supporting elements are partially embedded in the concrete has proved to be advantageous. The supporting elements are further strengthened by partially embedding them in a poured layer of concrete 22, which is also provided in the hollow space of the floor parts 50. The buckling length of the supporting elements is thus only approximately half the length of the section of the supporting elements which is free from concrete.

[0054] Fig. 9 shows a column 58 of the system according to the invention. The column comprises an upright longitudinal support member 132. One end of the support member is provided with a widening shoulder part or support 134 on which the beam elements 54, 56 are arranged (see also Fig. 7). The beam elements 54, 56 comprise a top and a bottom part which are separated by a hollow space, as described with reference to Fig. 8. Floor elements 50 according to Figs. 1 to 6 are arranged on the edges of the component 62 of the beam elements. The hollow space of the beam element 54, 56 is in communication with the hollow space of the floor elements so that lines can be lead through.

[0055] A second column 140 arranged on the shoulder part forms an upper storey. The second column 140 is anchored in the lower column 58 by means of an internal reinforcement 142, 144.

[0056] The columns 58 and 140 are partially hollow. In the embodiment shown, the columns are provided with en elongate hollow space 146 over their entire length. At a location which adjoins the hollow spaces in the beam elements 54, 56 or in floor elements 50, the second column 140 is provided with an opening 148. The opening 148 extends from the hollow space 146 through the side wall of the column to the outer side of the column. Optionally, several openings 148 are provided in the side wall of the column in suitable locations.

[0057] The cross section shown in Fig. 10, which is at right angles to the cross section shown in Fig. 9, shows floor parts 50 arranged on the bottom section 62 of the beam element 54. In the embodiment of Fig. 10, the reinforcement of the beam element 54 also comprises rods 166, 168 arranged in the width direction of the beam element. The rods 166, 168 connect the rods 96 and 98, respectively. The supporting elements 92, 94 are arranged in parallel planes which are at right angles to the drawing. The supporting elements are connected to the rods 96, 98 according to the welding method described above.

[0058] Fig. 11 shows the column 58, which is, for example, approximately square in top view. The hollow space 146 arranged in the centre of the column 58 is also approximately square. Reinforcement rods 142, 144 are likewise shown.

[0059] In another embodiment of the system, illustrated in the figures up to 16, the building elements are connected to one another by means of bolts. Furthermore, similar parts are denoted by the same reference numerals.

[0060] Fig. 12 shows a floor comprising floor elements 2. The floor element comprises a slab 4 and a narrower slab 6. The intermediate space between slabs 6 is filled by a lid 26. The reinforcement of the floor elements comprises rods 10 which are connected by supporting elements 12. The floor elements 2 are connected to one another by a removable coupling 202, instead of with a poured concrete layer 22 as in Fig. 3. The coupling comprises a part 200 anchored in the slabs 4. The parts 200 of the respective slabs 4 are connected to one another by means of a suitable connecting piece.

[0061] The detachable coupling of the building elements which is described below in more detail has the

advantage that the building elements can be reused, i.e. if a building has to be demolished, the couplings can be detached and the building parts can be removed intact. The building elements can then be used in the construction of a new building, thus preventing debris and reducing the demand for material.

[0062] The detachable coupling is preferably formed by nuts and bolts. The bolts 204, if desired provided with anchors 206, are embedded in the concrete of slabs 4 (Fig. 13). The bolts are coupled by a plate 208 and nuts 210 are provided on the ends of the bolts.

[0063] In a similar manner, floor parts can be connected to a wall, as shown in Fig. 14. A bolt 216, provided with a cramp iron, is embedded in a panel 212 of a wall 214. A hole is provided on an edge of slab 4 of the floor element, through which the bolt protruding from the panel 212 extends. At the bottom of another panel 218 of the wall, a hole 220 is provided. Via the hole 220, a nut 222 is fitted in order to fixedly attach the parts of the entire unit to one another.

[0064] As shown in Fig. 15, the column 58, for example, comprises bolts 230, 232, embedded in a similar manner and protruding from the top end of the column. The ends of the beams 54, 56 comprise holes 234, 236, into which holes nuts 238, 240 can be fitted on the bolts in order to bolt the beam elements to the column. At one top end of the column 58, a metal strip 242 is provided over part of the periphery, which strip lies approximately at the top of the column. A corresponding metal strip 244 is provided at the bottom end of the column 140. The columns 58 and 140 are connected to one another by welding edges of the strips 242, 244 together. The strip 242 is anchored in the column 58 by embedded cramp irons 246, 248.

[0065] Fig. 16 shows another view of the system of Fig. 15 and, in addition shows that floor elements 50 are bolted to the embedded bolts 254, 256 by means of nuts 250, 252.

[0066] Fig. 17 shows the double weld according to the invention. Supporting element 258 is attached to rod 260 by applying a weld 264, 266 at the end 262 of the supporting element on two opposite sides.

[0067] Fig. 18 shows that the joint surface of the welds 264, 266 is greater than or equal in size to the surface of the supporting element 258. Thus, a strong coupling is achieved, in which the forces exerted on the supporting element are completely passed on to the rod 260.

[0068] Fig. 19 shows a first manufacturing stage of a floor or wall element 2. First, the slab 6, provided with reinforcement 10, 12 is cast in a first shuttering 280. As shown in Fig. 20, the entire unit is turned over once the concrete has set. Then, slab 4 is cast in shuttering 282.

[0069] A first manufacturing stage for producing a beam element according to the invention, as shown in Fig. 21, comprises casting the top part 60 in a shuttering 290. The reinforcement 294, comprising rods 166, 168 and supporting elements 92, 94 is also embedded. After setting, the entire unit is turned over in a second manufacturing stage, as shown in Fig. 22. Then, the component 62 is cast in a second shuttering 292.

[0070] The beam element may, for example, be produced as shown in Figs. 21 and 22. The concrete top part 90 is cast in a shuttering containing the reinforcement and any pipes or blocks for creating openings (Fig. 21). The entire unit of set top part 90 and reinforcement is turned 180 degrees about a longitudinal axis and placed on the open side of the shuttering of the bottom part 88. Then, the bottom part 90 is cast (Fig. 22). This manufacturing method has the advantage that the top and bottom of the beam element are clean when the shuttering has been removed.

[0071] The column may comprise an opening 190 in a side wall of the support member 132, as shown in Fig. 23, similar to the opening 148 in Fig. 9. Lines arranged in the hollow space of the column 146 are accessible through the opening 190. In the opening 190, connections are provided for example, such as sockets. The opening 190 may optionally be provided with a door in order to render the lines arranged inside the column invisible, if the opening 190 is arranged in a visible spot, for example at hip or eye level from the floor.

[0072] The hollow column can be produced by pouring concrete in two parts into a shuttering, see Figs. 24 and 25. The hollow space 146 inside the column can be produced by, for example, arranging an elongated sheath, tube or a block made of polystyrene foam in the shuttering before pouring the concrete. In addition, the desired reinforcement 191 is arranged in the shuttering before the pouring. As shown in Fig. 24, a first part having three walls 192, 194, 196 is poured first. Once said walls have set sufficiently, the entire unit is turned 180 degrees about the longitudinal axis in a second stage, following which a last wall 198 is cast in a shuttering (Fig. 25).

[0073] It is likewise possible to cast the column in a shuttering in a vertical position, the hollow space being produced by a tube arranged in the shuttering.

[0074] The present invention provides a complete system for the construction. The beam elements act as beam binders where two floor parts meet and a passage for lines is nevertheless required. The beam element comprises one or more hollow spaces for the passage of lines at virtually the same level as openings or hollow spaces in the floor parts.

[0075] As concrete beams are normally solid, the transverse forces occurring when the floor parts are being installed are absorbed by the concrete. With the beam element according to the present invention, it appears that the transverse forces can be absorbed by the zigzag arrangement of the supporting elements. The concrete which would normally absorb the transverse forces can be omitted with the beam element according to the invention in order to provide openings, since the reinforcement, inter alia as a result of the welding method used, is sufficiently strong to absorb the transverse forces. The openings or spaces may be connected to spaces in floors and walls.

[0076] The beam elements are coupled to the floor el-

ements. The coupling can, for example, be achieved by the following two methods: 1) The beam elements are coupled to the floor elements by a cramp iron which is provided at the first end in the beam element and at the second end in the poured concrete layer 22; 2) the beam elements are coupled to the floor elements by a mechanical coupling made of steel.

[0077] If the supporting elements of the zigzag-shaped girder arranged in the building elements have relatively large diameters, for example a diameter greater than 20 mm, the supporting elements 170 can be arranged at right angles to the rods 166, 168, see for example Fig. 11. An inclined coupling of the supporting elements relative to the rods, see Fig. 8, is more stable in the top part 90 of the beam element. The top part 90 of the beam element forms the pressure zone and is subjected to a buckling load.

[0078] The top of the beam element may be arranged so as to be level with the top of adjoining floor elements. Optionally, a finishing layer 84 (see Fig. 8) may be added on top. The finishing layer may for example serve to compensate for relatively large tolerances.

[0079] In one practical embodiment of the building elements, the supporting elements of the reinforcement have a diameter of 16 mm or more. Both ends of the supporting elements are attached to the rods by means of double welds in order to avoid prestressing the supporting elements.

[0080] In one practical embodiment, the beam element can, for example, span widths of 5 m to 20 m. The beam element shown in Fig. 8 or 9, for example, has a total height of approximately 60 cm to 80 cm. The supporting elements 92, 94 of the reinforcement have a diameter of 20 mm or more, for example of approximately 28 mm. Both ends of the supporting elements are attached to the rods 96, 98 by means of double welds to avoid prestressing the supporting elements.

[0081] The supporting elements and the rods of the reinforcement are made of high-performance steel, such as torsteel, reinforcing steel or constructional steel.

[0082] One practical embodiment of a column according to the invention may, for example, have a length or height of 7 to 8 m, which is sufficient for two storeys of a building. The column, for example, in plan view forms a square with sides of approximately 800 mm. The opening in the centre is for example a square with sides of 400 mm. The column may be subjected to a maximum load of approximately 280 tons. The bottom part 88 of the beam element laterally protrudes, for example, about 200 mm relative to the top part 90.

[0083] The building elements according to the present invention are suitable for use in buildings where the configuration of lines changes relatively often. Examples include hospitals, where electrical equipment is often moved around and furthermore conduits for air treatment, oxygen and the like have to be accessible near each bed. The present invention provides advantages for offices with regard to modifying and adding electrical equipment which is required at each workstation. More and more air treatment is being applied in this connection. Due to hollow spaces in the building elements which are connected to one another and which are accessible even after construction work has finished, it remains possible to modify the lines relatively quickly and with relatively little disruption. A system comprising building elements according to the present invention, for example, makes cable ducts on the walls redundant.

[0084] The present invention is not restricted to the above embodiments, to which many modifications can be made without departing from the scope of the attached claims.

Claims

1. Building system, comprising building elements provided with hollow spaces, in which the hollow spaces of the building elements connect to one another for the passage of lines.

2. Building system according to claim 1, in which the hollow spaces of the building elements are accessible via openings in the building elements for fitting or removing the lines.

3. Building system according to claim 1 or 2, in which the building elements comprise a beam element and/or a column.

4. Building system according to one of the preceding claims, in which the building elements comprise a wall element and/or a floor element.

5. Building system according to one of the preceding claims, in which the building elements comprise an internal reinforcement, which reinforcement comprises at least two rods arranged approximately parallel and connected to one another by a number of supporting elements, the supporting elements being attached to the rods by means of at least a double weld.

6. Building system according to claim 5, in which the double weld comprises two weld spots which are arranged at opposite sides of an end of the supporting elements.

7. Beam element for a building system according to one of the preceding claims, comprising:

   - an elongate beam member;
   - a reinforcement provided in the beam member; and
   - a hollow space extending inside the beam member for arranging lines therein.

8. Beam element according to claim 7, in which the reinforcement comprises:

    - at least two rods; and
    - supporting elements which are fitted to a rod by their first end and to another rod by their second end.

9. Beam element according to claim 8, in which the ends of the supporting elements are attached to the respective rod by means of at least one double weld.

10. Beam element according to one of claims 7-9, in which the beam element comprises a bottom part which is wider than a top part arranged parallel on the bottom part.

11. Beam element according to claim 10, in which the bottom part is a first slab, and in which the top part is a second slab which is arranged parallel to the bottom part and is separated from the first slab by the reinforcement and the hollow space.

12. Column for a building system according to one of the preceding claims, comprising a support member provided with a hollow space, a reinforcement being arranged inside the support member.

13. Column according to claim 12, in which an opening is provided in a side wall of the support member, which opening extends from the hollow space to the outer side of the column in order to make the hollow space accessible.

14. Column according to claim 12 or 13, comprising a shoulder which is widened relative to the support member in order to arrange a building element thereon.

15. Method comprising constructing a building from building elements provided with hollow spaces, in which the hollow spaces of the building elements connect to one another for the passage of lines.

16. Method according to claim 15, comprising building elements substantially according to one of claims 1-14.

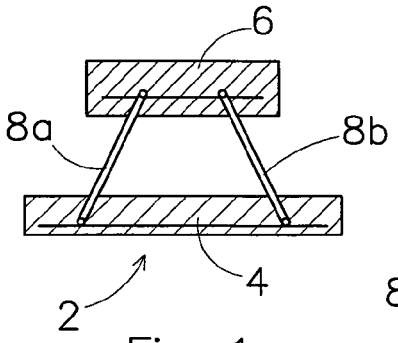


Fig 1

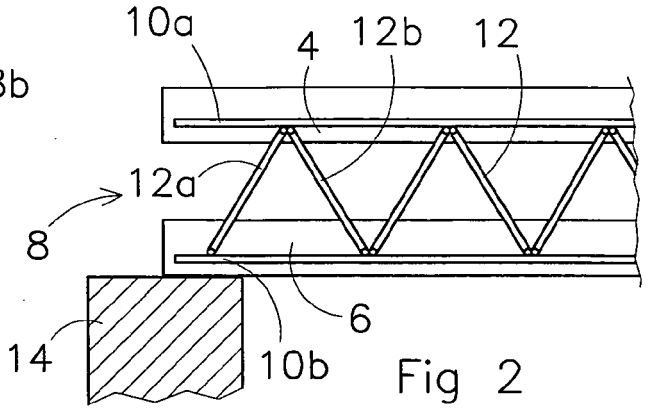
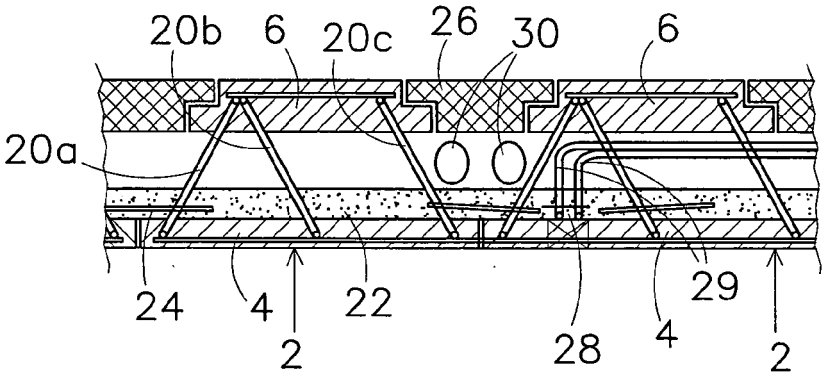


Fig 2



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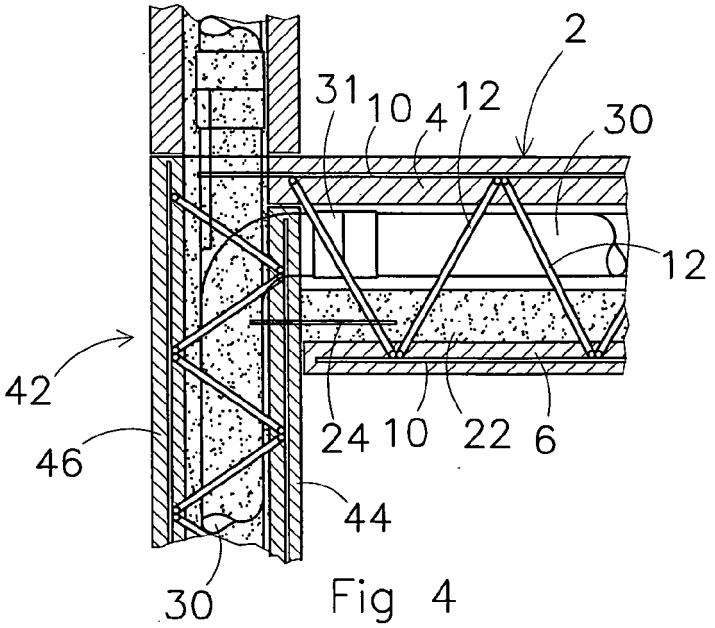


Fig 4

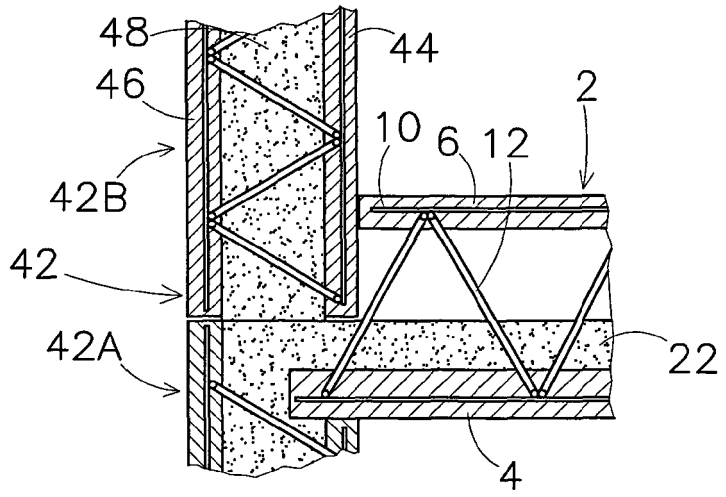


Fig 5

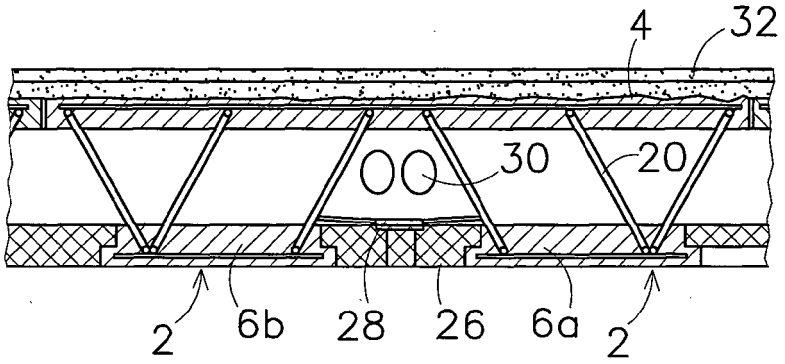
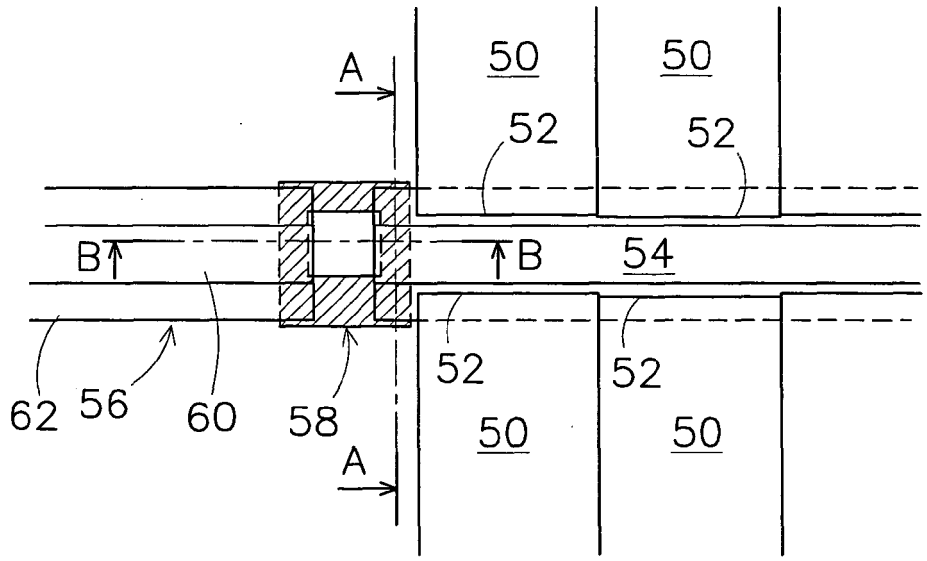


Fig 6



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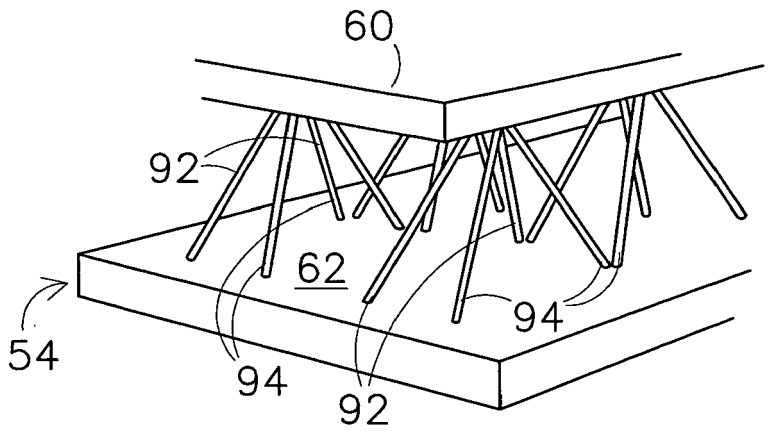
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Fig 8

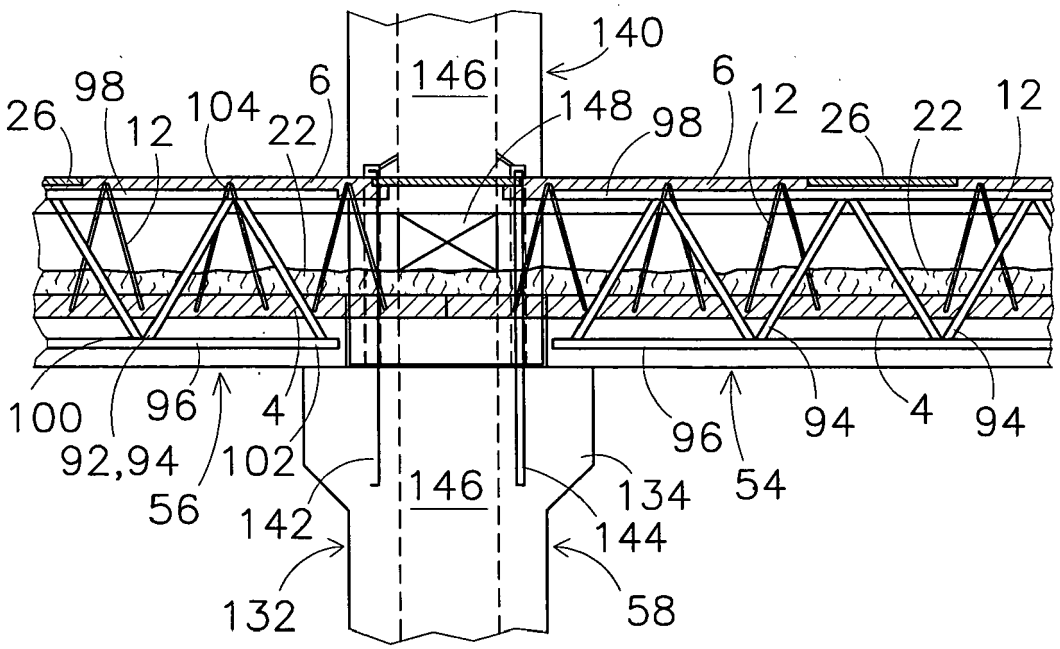
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Fig 9

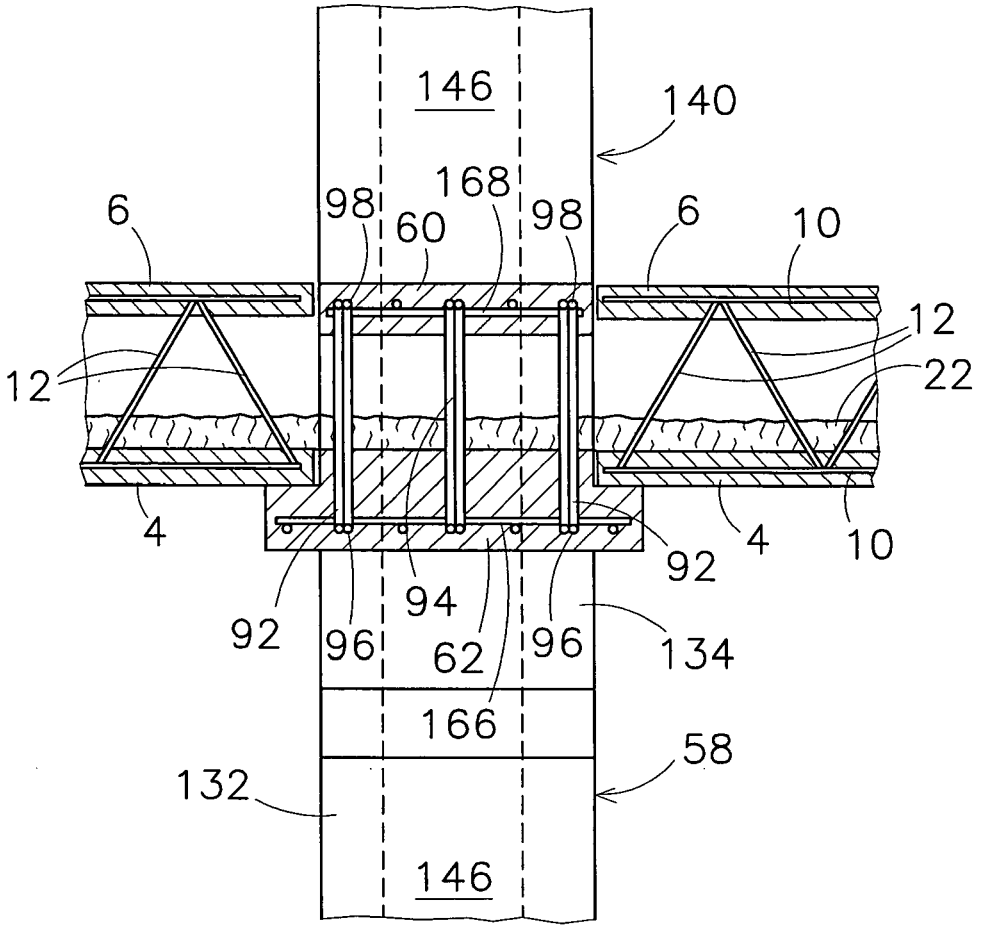
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Fig 10

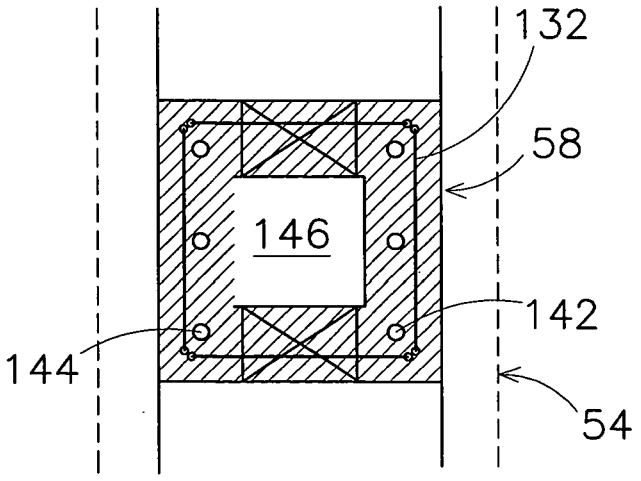
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Fig 11

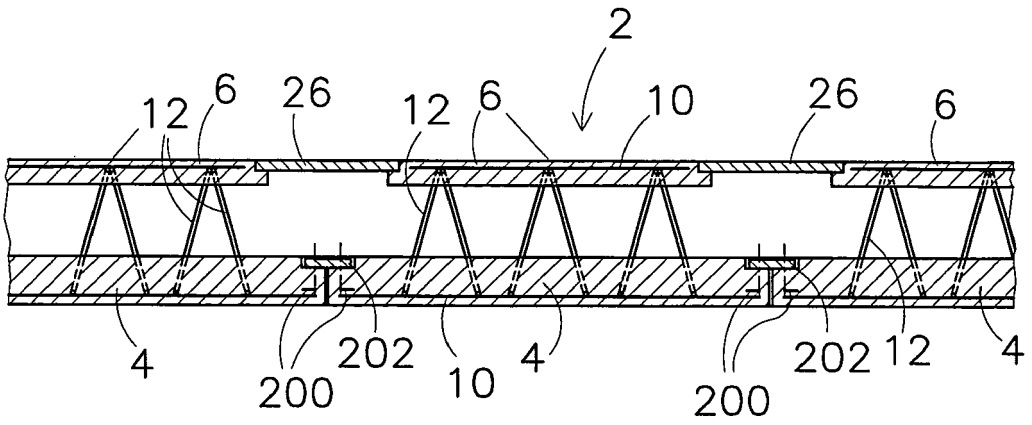
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Fig 12

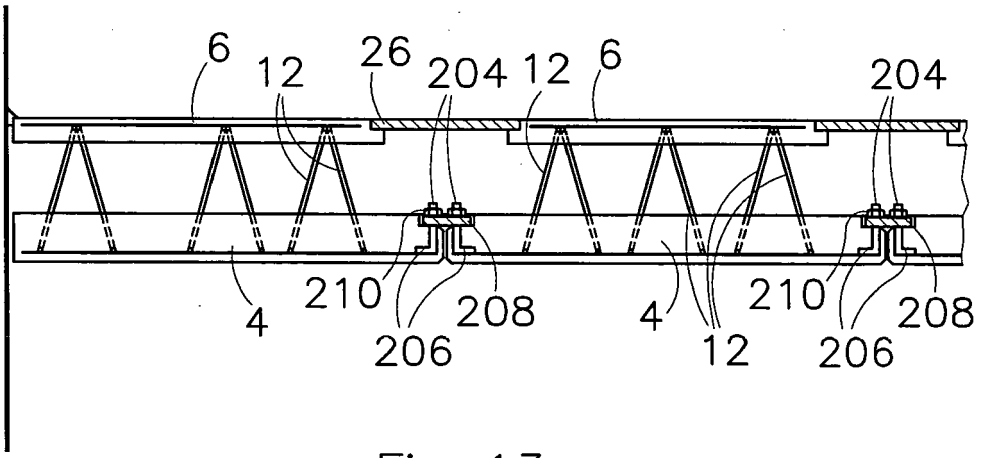
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Fig 13

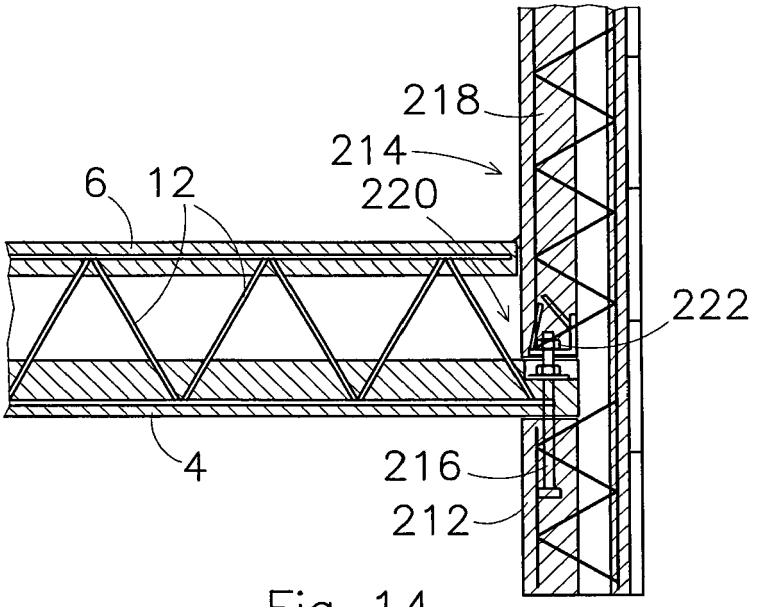
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Fig 14

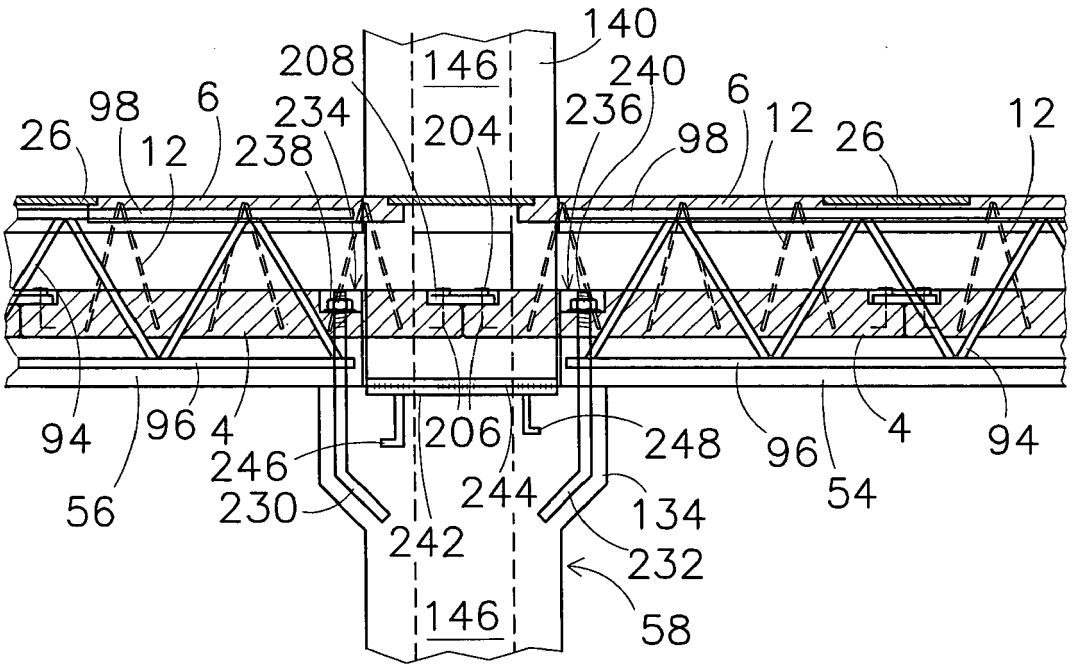
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Fig 15

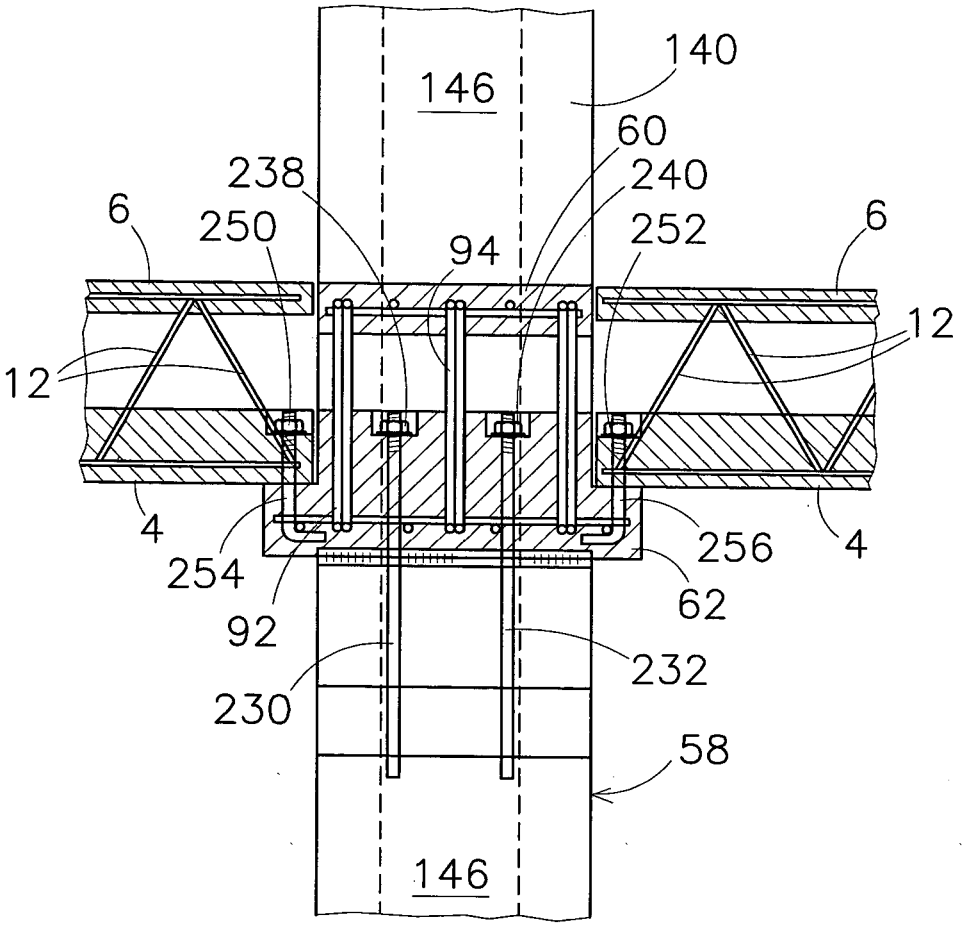


Fig 16

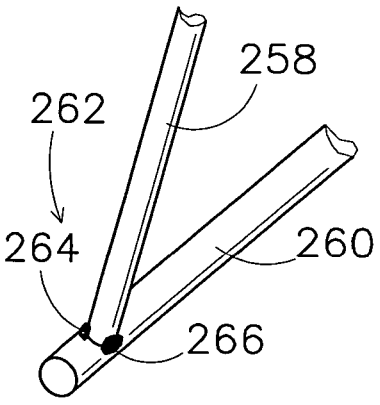


Fig 17

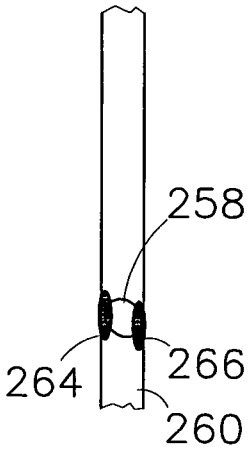


Fig 18

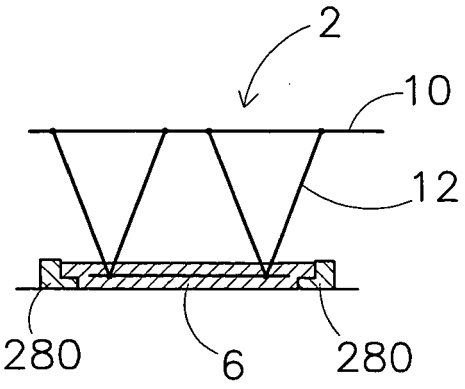


Fig 19

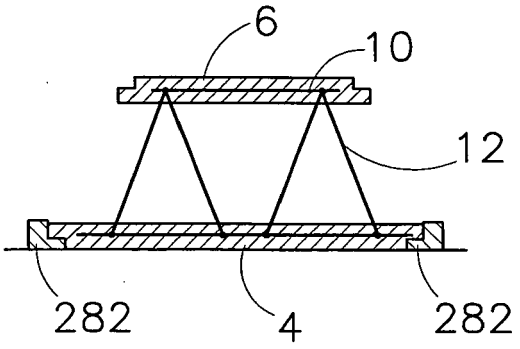


Fig 20

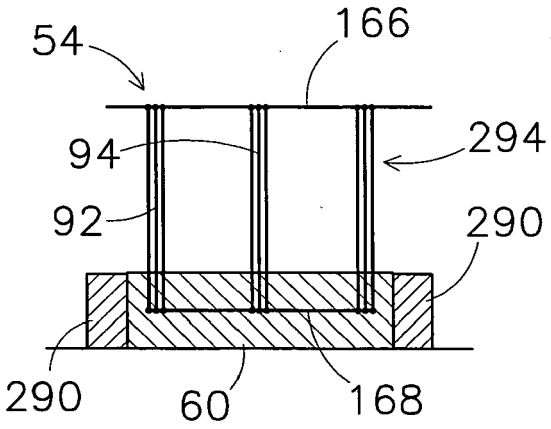
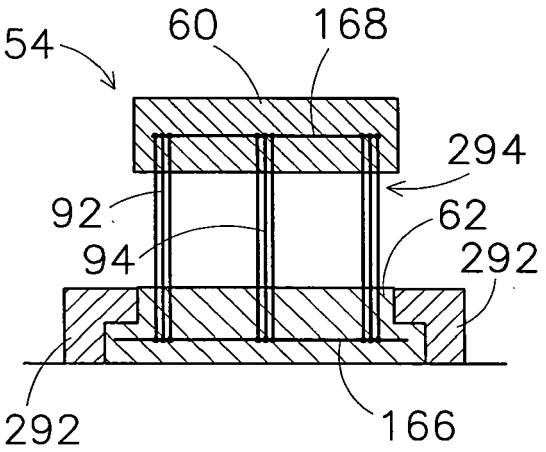


Fig 21



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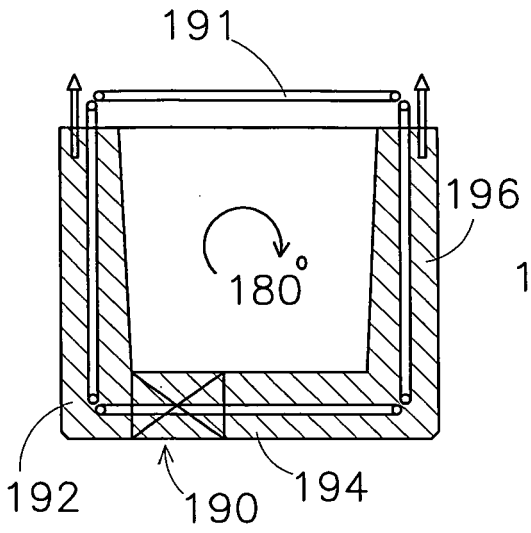

Fig 24

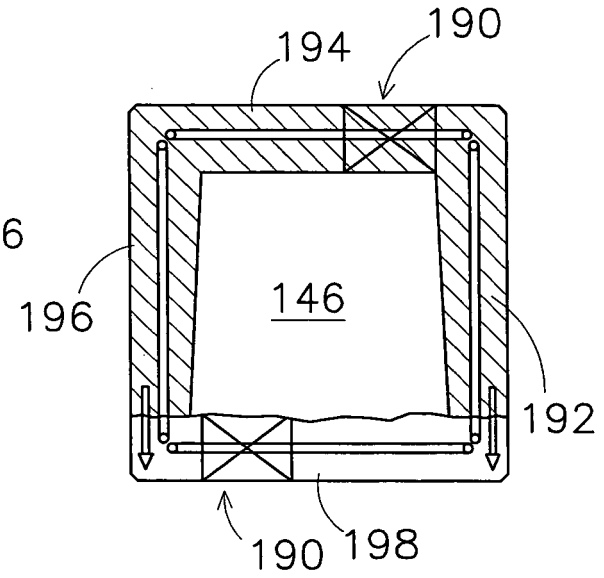

Fig 25

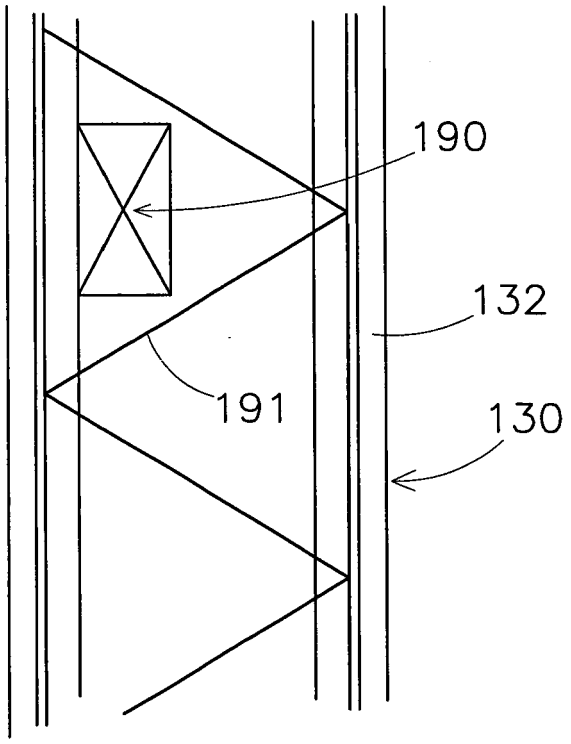

Fig 23

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 07 7675

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 44 34 499 A (AINEDTER) 28 March 1996 (1996-03-28)	1-11,15, 16	INV. E04C2/04
Y	* column 2, line 19 - line 23 * * column 3, line 3 - line 14 * * column 4, line 27 - line 32; figures 1,3,4,6,7,9-11 *	3	E04C2/34 E04B5/48
X	DE 23 24 224 A (SILBERKUHL) 5 December 1974 (1974-12-05)	12-14	
Y	* page 7, line 7 - page 8, line 31; claims 8,10; figures 1-4,6 *	3	
A		16	

TECHNICAL FIELDS SEARCHED (IPC)

E04C
E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	30 May 2006	Mysliwetz, W

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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P : intermediate document

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D : document cited in the application
L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 07 7675

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30-05-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4434499 A	28-03-1996	NONE	
DE 2324224 A	05-12-1974	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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