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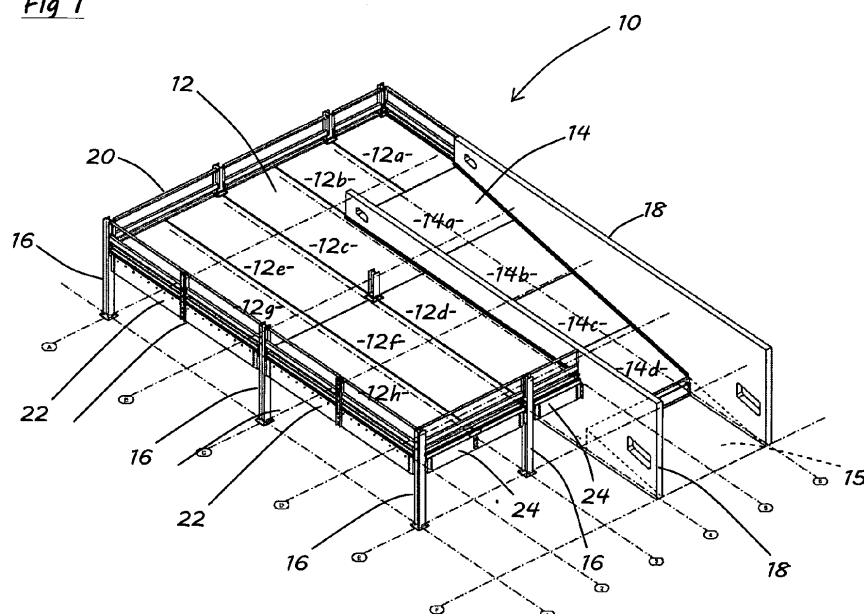
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(54) **A building with built-in drainage**

(57) A multi-storey car park building (10) on a rectilinear grid has an elevated floor (12) accessed by a ramp (14). The floor (12) comprises a plurality of rectangular flooring panels (12a to 12h) carried on columns (16) positioned at selected intersections of the grid lines. The panels (12a to 12h) are secured to longitudinal and lateral glulam beams (22, 24) extending between and secured to the columns (16). The panels (12a to 12h) are laid (and appropriately dimensioned) with gaps between them

both longitudinally and laterally to allow rain or other liquid to drain from the floor (12), and drains extend both longitudinally and laterally along and under each gap to carry this liquid away. The longitudinal and lateral drains are respectively carried by the longitudinal and lateral beams (22, 24) to extend along and under the gaps between the flooring panels, below and not secured to the flooring panels. The building may be constructed from a modular construction system and extended in modular fashion horizontally and vertically.

Fig 1



Description

[0001] This invention concerns buildings having a plurality of floors, particularly but not necessarily exclusively multi-storey car parks (also known as parking structures or parking garages) and mezzanine structures with built-in drainage.

[0002] Multi-storey car parks and like structures commonly comprise a rectilinear framework carrying a plurality of substantially horizontal decking units put together to form individual floors, with ramps providing access from one floor to another. Commonly the framework is of steel and/or concrete and the decking units conventionally comprise concrete slabs precast or cast *in situ*. Care is needed to prevent water and materials such as oil, fuel and salts contained in it from penetrating joints between decking units (to cause corrosion) and leaking through the joints (to damage vehicles parked on lower floors). To this end the joints are usually sealed and the deck assembly may be covered with a waterproof membrane. However such seals and membranes have a limited ability to cope with structural movements and thermal changes, and as a result cracks often appear in the vicinity of joints.

[0003] Various attempts have been previously made to provide a building such as a multi-storey car park with built-in drainage, and two such may be considered briefly here.

[0004] US6397539 (Kimura) describes a building having floor panels and gutters that overlap with and interconnect with connecting portions. However the gutters and the connecting portions are integrated with the floor panels, which adds complication and cost and also requires (as stated in Kimura) that repairs require a plurality of floor panels can be lifted.

[0005] JP7166731 (Wakamoto) concerns an upper floor of a (typically) two-storey parking lot. The floor is formed of modular flooring panels laid on horizontal H-section beams which are in turn supported by vertical columns. Each flooring panel has a facing plate secured to a frame comprising side pieces with stiffening members between them. The facing plate is somewhat shorter than the frame in both length and thickness so that there are gaps between the facing plates at both the ends and the sides when the flooring panels are laid in place. The side pieces of adjacent flooring panels are spaced apart and connected together by means of the connector which is cut away to provide a channel-shaped seat for a longitudinally extending gutter in the space between the sides of adjacent flooring panels. The sides of the facing plates are turned down into the gutter and ends of the side pieces are cut away so that abutting ends form an arcuate seat for a laterally extending drain, into which the gutters discharge. However, both the gutter and the drain are located between and secured to the flooring panels.

[0006] Other previous arrangements in which drainage elements are incorporated within and secured to the floor

structure are shown in JP6136980 (Nagai), JP2009030345 (Nippon Rittai), JP2005048555 (Sasaki) and US2004020136 (Hauck).

[0007] It is an object of the present invention to improve and simplify drainage in multi-storey car parks and the like.

[0008] Thus according to a first aspect of the invention there is provided a building comprising a floor elevated on a framework having a plurality of vertical columns spaced apart longitudinally and laterally in a regular array and a plurality of longitudinal and lateral beams secured to the columns and extending horizontally therebetween, wherein the floor comprises a plurality of flooring panels carried by the beams and each having first sides and second sides and being laid to form the floor with first sides separated by longitudinal gaps extending in a first direction and second sides separated by lateral gaps extending in a second direction, a plurality of longitudinal drains, a plurality of lateral drains and interconnection means connecting the longitudinal drains to the lateral drains, whereby liquid is drained from the floor, **characterised in that** the longitudinal and lateral drains are respectively carried by the longitudinal and lateral beams to extend along and under the gaps, below and not secured to the flooring panels.

[0009] By having the drains carried by the beams, below the flooring panels and not secured to them, the invention provides a substantial improvement over previously known arrangements for drainage in multi-storey car parks and the like, because the flooring panels may be lifted for repair or replacement or for under-floor access without having to disconnect or dismantle any drainage. This contrasts with prior arrangements in which - as expressly stated in Kimura, for instance - it is necessary to lift a plurality of flooring panels whenever repair or servicing is required. Similarly, in previous systems having drainage elements incorporated with a floor structure, it is necessary to reconnect or reconstruct the drainage after lifting a flooring element, and those skilled in the art will appreciate that reconnection or reconstruction of drainage often results in leaks. In addition, the invention allows the form of the flooring elements to be simpler and therefore cheaper.

[0010] The first and second sides of the flooring panels are preferably mutually orthogonal.

[0011] Preferably each gap between flooring panels is narrower than the drain under it.

[0012] The interconnection means may be carried by at least some of the columns and comprise a drainage collar and a downpipe extending down the carrying columns.

[0013] At least some of said beams may be formed with a convex surface to which the flooring panels are secured, whereby the flooring panels are cambered to facilitate drainage of water towards sides thereof.

[0014] It is preferred that the flooring panels and the beams be formed of engineered wood.

[0015] The longitudinal drains may be formed of a rigid

material and configured and arranged to resist a load upon the overlying flooring panels, and the lateral drains may be formed of a resilient material and configured and resiliently engaged with the overlying flooring panels so as to provide a water-resistant seal therewith.

[0016] The building may comprise a multi-storey car park having a plurality of said floors with the drains configured and arranged to prevent liquid falling from one floor to a floor below. Such a car park may also comprise one or more ramps for cars to pass from one floor to another, with the or each ramp comprising a plurality of ramp panels laid with gaps between their sides and drains underlying said gaps.

[0017] According to a second aspect of the invention there is provided a modular construction system for constructing a building as above and comprising said columns, beams, flooring panels and drains, **characterised in that** the drainage elements are so dimensioned and the flooring panels are so dimensioned relative to the spacing of the columns that the width of the gaps is less than the width of the drainage elements.

[0018] Each flooring panel is so dimensioned as to provide an integral number of car parking bays of a standard size according to local regulations.

[0019] Each flooring panel may include utility services interconnectable between adjacent panels.

[0020] According to a third aspect of the invention there is provided a method of constructing a building from a modular construction system as above **characterised in that** said method comprises positioning the columns vertically and spaced apart longitudinally and laterally in a rectilinear array, securing the beams to the columns to form a rectangular framework, securing the flooring panels to the beams with their sides spaced apart to form gaps, and securing the drains to the beams to extending along and under the gaps to drain liquid from the floor.

[0021] Other aspects of the invention will be apparent from the following description, which is made by way of example only with reference to the accompanying schematic drawings in which -

Figure 1 is an isometric view of a multi-storey car park building illustrative of the invention constructed on a rectilinear grid and having an elevated floor and a ramp;

Figures 2 to 4 show elevations of the building of Figure 1 respectively at grid line A, grid line 1 and grid line E;

Figure 5 shows in plan view columns and longitudinal and lateral beams of the building of Figure 1;

Figure 6 illustrates in plan view a connection between beams and a typical column at grid point C3; Figure 7 illustrates in plan view a connection between beams away from a column;

Figures 8 to 10 are sections of the building of Figure 1 respectively at grid line 5, grid line 3 and grid line 2 and particularly illustrating flooring panels of the building;

Figure 11 illustrates part of a flooring panel in side elevation;

Figure 12 is an isometric view illustrating the construction of a flooring panel;

Figure 13 shows drainage of the building of Figure 1 in plan view;

Figure 14 illustrates in plan view the drainage arrangement around a typical column at grid point C3 where drains interconnect;

Figure 15 is an isometric view of the drainage arrangement at grid point C3;

Figure 16 is an isometric view of the drainage arrangement where drains interconnect away from a column;

Figure 17 is a vertical section illustrating a longitudinal beam, a drainage element and flooring panels;

Figure 18 is a vertical section illustrating a lateral beam, a drainage element and flooring panels; and

Figure 19 is a vertical section illustrating drainage across the ramp of the building of Figure 1.

[0022] Referring first to Figures 1 to 4 these show a building indicated generally at 10 constructed on a rectilinear grid indicated by longitudinal grid lines 1 to 6 and lateral grid lines A to E. As illustrated, the lateral grid lines 1 to 6 are spaced apart by 4000 mm and the longitudinal grid lines A to E are spaced apart by 2400 mm. (Flooring panels of the invention may be dimensioned to suit locally recommended sizes for parking bays. In the UK the minimum standard size recommended by local authorities is 4800mm long by 2400mm wide, but it will be understood that the invention may accommodate different sizes, for instance where other countries have different recommendations).

[0023] The building 10 has an elevated floor 12 accessed by a ramp 14. The floor 12 comprises a plurality of rectangular flooring panels 12a to 12h - to be described in more detail hereinafter - carried on columns 16 positioned at selected intersections of the grid lines, ie in the illustrative building 10 at grid points A1, A3, A5, A6, C1, C3, E1 and E3. The columns 16 are standard H-section steel columns of the kind known as universal columns UC 254x254x73, although it will be understood that other columns may be used.

[0024] The ramp 14 comprises a plurality of ramp flooring panels 14a to 14d supported between shear walls 18 of engineered wood (in the present embodiment, although other possible arrangements will be evident to those skilled in the art) and is completed at its lower end by a concrete approach 15 formed *in situ*. The floor 12 is bounded by a crash barrier 20.

[0025] The floor 12 is secured to longitudinal beams 22 and lateral beams 24 extending between and secured to the columns 16. The beams 22 and 24 are formed of glued laminated timber, commonly known as glulam, although beams of different engineered wood or other materials may be used. In the illustrative building 10 the longitudinal beams 22 are 690x240 glulam GL32c beams

and the lateral beams 24 are 600x200 glulam GL24c beams.

[0026] The building 10 is illustrative of the invention. In comparison with the arrangement shown in Figure 1 the building may be (a) extended both longitudinally and laterally in modular fashion to accommodate multiple parking bays on a floor 12 and (b) extended vertically - eg to form a multi-storey car park - by the addition of more floors, and additional access ramps arranged in a fashion that will be understood by those skilled in the art. Thus for use as a car park a building of the general form shown in Figure 1 may have lateral grid lines spaced apart by 16000 mm rather than the 8000 mm of the illustrative building 10. Similarly a building of the general form shown in Figure 1 but extended vertically as for use as a multi-storey car park may have columns of different size or configuration. The longitudinal and lateral beams of the building 10 may be differently dimensioned or of some material other than glulam (or even, in some arrangements, be omitted altogether, as will be explained later herein). And other features of the building 10 may also be varied.

[0027] The arrangement of columns 16 and beams 22, 24 is shown more clearly in Figure 5, which also shows lateral beams 26 that support the flooring panels of the ramp 14 and are standard H-section S275JR steel beams.

[0028] The way in which the longitudinal beams 22 and the lateral beams 24 are secured to a central column 16 (ie a column at grid point C3, within the grid rather than at its edge) can be seen in Figure 6. A flitch plate 28 is secured in the proximal end of each beam 22, 24 by gluing and bolting in well-known fashion. Four orthogonally arranged fin plates 30, one corresponding to each flitch plate 28, are welded to the column 16. Then the flitch plates 28 are bolted to the corresponding fin plates 30. The beams 22, 24 are centred with respect to the grid lines 1 to 6 and A to E. The fin plates 30 for the longitudinal beams 22 are centred with respect to the longitudinal grid lines 1 to 6 and the fin plates for the lateral beams 24 are offset. The beams 22, 24 are secured to columns 16 at the edge of the grid in similar fashion, but with only a three-way connection rather than a four-way connection.

[0029] The longitudinal beam 22 and lateral beams 24 also intersect away from the columns 16, ie in the illustrative building 10 at grid points A4, A2, C2 and E2. The way in which they are connected together at grid point C2 can be seen in Figure 7. The longitudinal beams 22 terminate at grid points such as C2 whereas the lateral beams 24 are continuous therethrough. At a grid point such as C2 a flitch plate 32 is secured in the proximal end of each longitudinal beam 22 by gluing and bolting in well-known fashion. Two welded steel tees 34 are bolted to the lateral beam 24 on the sides thereof which face the terminal ends of the longitudinal beams 22. Then the flitch plates 32 are bolted to the corresponding tees 34. The beams 22 and 24 are connected together at grid points on the edge of the grid in similar fashion, but with

only a single tee (on the appropriate side) rather than two.

[0030] The floor 12 of the illustrative building 10 will now be described with reference to Figures 8 to 12.

[0031] The floor 12 is made up of a plurality of rectangular flooring panels 12a to 12h secured to the longitudinal and lateral beams 22, 24. In the illustrative building 10 most of these flooring panels are nominally 8000 mm long (ie in the longitudinal direction) and 2400 mm wide (ie in the lateral direction), corresponding to the dimensions of the grid, although the panels 12a and 12b at the top of the ramp 14 have a nominal length of only 4000 mm. It will be understood however that the invention is not limited to such dimensions; and for use as a car park, for instance, the flooring panels may be 16000 mm long or otherwise configured to fit a selected grid pattern.

[0032] The flooring panels 12a to 12h are all of similar construction, illustrated by Figures 11 and 12. Each comprises a frame 36 of 47x185 mm timber comprising a pair of side pieces 38 (which in use extend longitudinally) bridged by a plurality of transverse joists 40 secured at their ends to the side pieces 38. A sheet 42 of 30 mm timber ply is secured to the upper face of the frame 36 to provide a deck. A sheet 44 of 15 mm fire board is secured to the under face of the frame 36 to provide a soffit.

[0033] The flooring panels 12a to 12h are not laid tightly side to side but rather are laid (and appropriately dimensioned) with gaps between them both longitudinally and laterally as will be described in more detail later herein.

[0034] The ramp flooring panels 14a to 14d have a construction generally similar to that of the flooring panels 12a to 12h but with certain differences of detail that will also be described later herein.

[0035] As is well known, the floors of multi-storey car parks get wet, particular from rainfall and blown-in rain, and this water needs to be drained away to avoid damage to the structure and hazards such as ice formation. In addition, cars in the car park may drop fluids such as fuel and oil which is damaging to car bodywork, and such fluids also needs to be drained away along with the water, to avoid damage to cars parked on lower floors. Accordingly the illustrative building 10 is furnished with comprehensive drainage extending along and under the aforementioned gaps between the flooring panels. As shown in Figure 13 this drainage comprises both longitudinal drainage elements 50 and lateral drainage elements 52, and in addition lateral gutters 54 under the ramp 14 (Figure 1) which will be described separately.

[0036] As shown in Figure 14 longitudinal drainage elements 50 extend along tops of the longitudinal beams 22 and lateral drainage elements 52 extend along tops of the lateral beams 24, and at columns 16 they are coupled to a generally rectangular drainage collar 55 formed in two-parts from galvanised steel. (Other materials may be used).

[0037] The arrangement at grid point C3, and certain other details, can be seen in Figure 15. The drainage collar 55 extends around the column 16. (It is formed in

two parts to avoid having to fit it by sliding it down the column 16). On two opposed sides the drainage collar 55 is cut away to receive proximal ends of the two adjacent longitudinal drainage elements 50, which are formed of ethylene propylene diene monomer (EPDM) rubber. On its other two opposed sides the drainage collar 55 is cut away to receive proximal ends of the two adjacent lateral drainage elements 52, which are formed of precast concrete. On these two sides, and within the H-section of the column 16, the drainage collar 55 is coupled to two down pipes 56 (Figure 14) whereby water and other liquid is carried away. It will be understood that in a multi-storey building a down pipe 56 may discharge into a drainage collar 55 below it. It will also be understood that the down pipe(s) may be replaced by other arrangements: for instance the column 16 itself may be formed to channel liquid downward.

[0038] EPDM rubber is a resilient material and its use to form the longitudinal drainage elements 50 serves two purposes as follows. First, when the flooring panels 12a etc are secured to the longitudinal beams 22 the longitudinal drainage elements 50 are compressed and thereby form seals, beneath the flooring panels, to prevent leakage of drained liquids. And second the EPDM drainage elements conform to the upper faces of the longitudinal beams 22, which are cambered to facilitate drainage. (The flooring panels 12a etc, as previously described, extending longitudinally and with lateral joists, similarly conform to the camber when secured to the longitudinal beams 22. Those skilled in the art will appreciate that the provision of a camber is advantageous in comparison with the conventional provision of a sloping floor, typically with a fall of 1 in 60, which creates constructional problems by creating different levels at different mounting points).

[0039] Precast concrete is a rigid material and thus the lateral drainage elements 52 resist deformation of the flooring panels 12a etc above them, so that cars are safely carried.

[0040] The intersection between longitudinal and lateral drainage elements is illustrated by Figure 16. As shown therein the (rigid) lateral drainage element 52 includes a mid-section 52a recessed to receive the (resiliently deformable) longitudinal drainage element 50.

[0041] Figure 17 shows a cross section through a lateral beam 24, looking towards a column 16 at a central grid point C3. Timber bearers 60 extending along the length of the longitudinal beams 22 and parallel to their upper faces are secured to the beams 22 and screwed to joists 40 (see also Figure 11) of overlying adjacent flooring panels 12e and 12f, which are thereby supported by and secured to the longitudinal beams 22.

[0042] As can be seen from Figure 17, and to be understood from the foregoing description, the flooring panels 12e, 12f are separated by a gap 62, which extends laterally along the line of the beam 24. The width d of the gap 62 is 10 mm. The precast concrete drainage element 50 is carried by the lateral beam 24 and extends along

and under the gap 62 to receive liquid draining through it. To this end the drainage element 50 is formed with a lengthways channel 50a and an upwardly extending neck portion bridging the gap 62 and engaged on each side thereof with the underside of the deck sheets 42 of the flooring panels 12c and 12e. By this means liquid draining through the gap 62 discharges into and is carried away by the channel 50a. The drainage element 50 is little narrower than the nominal 200 mm width of the lateral beam 24 which carries it, and the channel 50a occupies a substantial part of its cross section.

[0043] Figure 17 also shows bolts 64 whereby the flitch plates 28 are secured within the ends of the longitudinal beams 22 (the uppermost of which bolts 64 are counter-sunk) and the bolts 66 whereby the flitch plates 28 are in turn secured to the fin plates 30, as described above with reference to Figure 6.

[0044] Although not shown in Figure 17 (for simplicity of illustration) there is a compressible seal between the deck sheets 42 and the drainage element.

[0045] Figure 18 shows a cross section through a longitudinal beam 22 supporting two adjacent flooring panels 12h and 12f by means of timber bearers 60 screwed to the joists 40. The soffits 44 (see also Figure 12) terminate just short of the bearers 60 and (although not shown in Figure 18) there are bearing pads between the bearers 60 and the joists 40 to which they are screwed.

[0046] There is a gap 68 between the adjacent flooring panels 12h and 12f and the EPDM lateral drainage element 52 carried by the longitudinal beam 22 extends along and under this gap 68 to receive liquid draining through it. The drainage element 52 has a cross section comprising two walls compressed (by the screw connection between the bearers 60 and the joists 40) against the underside of the flooring deck sheets 42 to provide a watertight seal each side of the gap 68. The width d of the gap 68 is 10 mm and the walls of the drainage element 52 have a widthways separation greater than this, although the overall width of the drainage element 52 is somewhat less than the nominal 200 mm width of the longitudinal beam 22 that carries it. The drainage element 52 also comprises a lengthwise ridge between the walls which extends upwards within the gap 68 and divides the drainage element 52 into two channels.

[0047] Comparing Figures 17 and 18 (which are of similar scale) it can be seen that the cross sectional area of the channel 50a in the longitudinal drainage element 22 is substantially greater than the combined area of the two channels in the lateral drainage element 52. This gives the longitudinal drainage element 50 substantially greater carrying capacity, to allow the lateral drainage element 52 to drain into it. Also, the longitudinal drainage element 50 is dimensioned and otherwise configured and arranged to avoid its becoming blocked by detritus in the draining liquid.

[0048] At the top and the bottom of the ramp 14 are laterally extending precast concrete drainage elements underlying gaps in the floor 12, like the lateral drainage

elements 52 but formed on one side (in a manner which will be readily understood by those skilled in the art) to accommodate the slope of the ramp 14. Between top and bottom of the ramp gaps between adjacent ramp flooring panels are underlaid by transverse gutters. Figure 19 illustrates this. Adjacent ramp flooring panels 14a and 14b supported at their sides by a laterally extending H-section steel beam 70 are laid so that their sides are separated by a gap 72. Rain or other liquid on the ramp 14 drains through the gap 72 and is carried away by a transverse gutter 74.

[0049] Those skilled in the art will now appreciate that the present invention offers particular benefit in providing effective drainage both longitudinally and laterally and that the key to its effectiveness lies in the gaps between flooring panels, which are left open to allow liquid on a floor to drain through and underlaid by coextensive drainage elements arranged to carry the liquid away. As well as being effective this drainage arrangement saves time and cost, and eases construction management, because there is no need for specialists on site to apply seals to joints between flooring panels as is conventional. Further, ongoing maintenance costs are reduced because there are no sealed joints requiring repair.

[0050] Also, inasmuch as a building embodying the invention may be constructed largely of wood, the invention offers the benefit of near carbon-neutral construction.

[0051] The invention may be used in the construction of multi-storey car parks, where carbon-neutrality may be of particular interest in offsetting carbon emissions from cars. However it will be understood that the invention is not limited to the construction of car parks. It may, for instance, be used to construct a mezzanine floor in, say, a supermarket, to deal with spills without unduly inconveniencing customers.

[0052] Other modifications and adaptations may be made. For instance, whilst a modular arrangement as described herein is likely to be of most general use, the principle of two-way underfloor drainage could be applied to non-modular structures. Also, whereas the invention has been described and illustrated in relation to a structure with rectangular modules, it might be applied to structures of other form such as a floor with triangular tessellations and hence three-way drainage. (In this regard, for the avoidance of doubt, the terms longitudinal and lateral as used herein should not be deemed restricted either to drainage in only two directions nor to mutually orthogonal drainage elements). The beams of the structure may be carried by means other than the flitch plate arrangement described, for instance by brackets or trusses secured to or part of the columns. Further, whilst the illustrative building described herein has flooring panels carried on separate beams, it should be understood that the flooring panels themselves may be configured and arranged to be self-supporting between columns or the like. To provide electrical or other services through the building the floor panels may conveniently include lines, pipes etc with standard connectors at the sides of the panels

for assembling a network that does not require special fitting or commissioning, ie a network of the kind commonly known as "plug-and-play". The flooring panels may also be pre-marked to indicate parking bays, traffic directions and so forth.

Claims

1. A building comprising a floor (12) elevated on a framework having a plurality of vertical columns (16) spaced apart longitudinally and laterally in a regular array and a plurality of longitudinal and lateral beams (22, 24) secured to the columns (16) and extending horizontally therebetween, wherein the floor comprises a plurality of flooring panels (12a - 12h) carried by the beams (22, 24) and each having first sides and second sides and being laid to form the floor with first sides separated by longitudinal gaps (68) extending in a first direction and second sides separated by lateral gaps (62) extending in a second direction, a plurality of longitudinal drains (50), a plurality of lateral drains (52) and interconnection means (55) connecting the longitudinal drains (50) to the lateral drains (52), whereby liquid is drained from the floor, **characterised in that** the longitudinal and lateral drains (50, 52) are respectively carried by the longitudinal and lateral beams (22, 24) to extend along and under the gaps (68, 62), below and not secured to the flooring panels (12a - 12h).
2. A building as claimed in Claim 1 **characterised in that** said first and second sides are mutually orthogonal.
3. A building as claimed in Claim 1 or Claim 2 **characterised in that** each said gap (68/62) is narrower than the drain (50/52) under it.
4. A building as claimed in any preceding claim **characterised in that** the interconnection means (55) is carried by columns (16) and comprises a drainage collar and a downpipe (56) extending down the column (16) that carries the interconnection means (55).
5. A building as claimed in any preceding claim **characterised in that** at least some of said beams are formed with a convex surface to which the flooring panels (12a - 12h) are secured, whereby said flooring panels (12a - 12h) are cambered to facilitate drainage of water towards sides thereof.
6. A building floor as claimed in any preceding claim **characterised in that** the flooring panels (12a - 12h) and the beams (22, 24) are formed of engineered wood.

7. A building as claimed in any preceding claim **characterised in that** the longitudinal drains (50) are formed of a rigid material and configured and arranged to resist a load upon the overlying flooring panels (12a -12h). 5

8. A building as claimed in any preceding claim **characterised in that** the lateral drains (52) are formed of a resilient material and configured and resiliently engaged with the overlying flooring panels (12a - 12h) so as to provide a water-resistant seal therewith. 10

9. A building as claimed in any preceding claim **characterised in that** said building comprises a multi-storey car park having a plurality of said floors and the drains (50, 52) are configured and arranged to prevent liquid falling from one floor to a floor below. 15

10. A building as claimed in Claim 9 **characterised in that** said building comprises one or more ramps (14) for cars to pass from one floor to another and the or each ramp comprises a plurality of ramp panels (14a - 14d) laid with gaps between their sides and drains (54) underlying said gaps. 20
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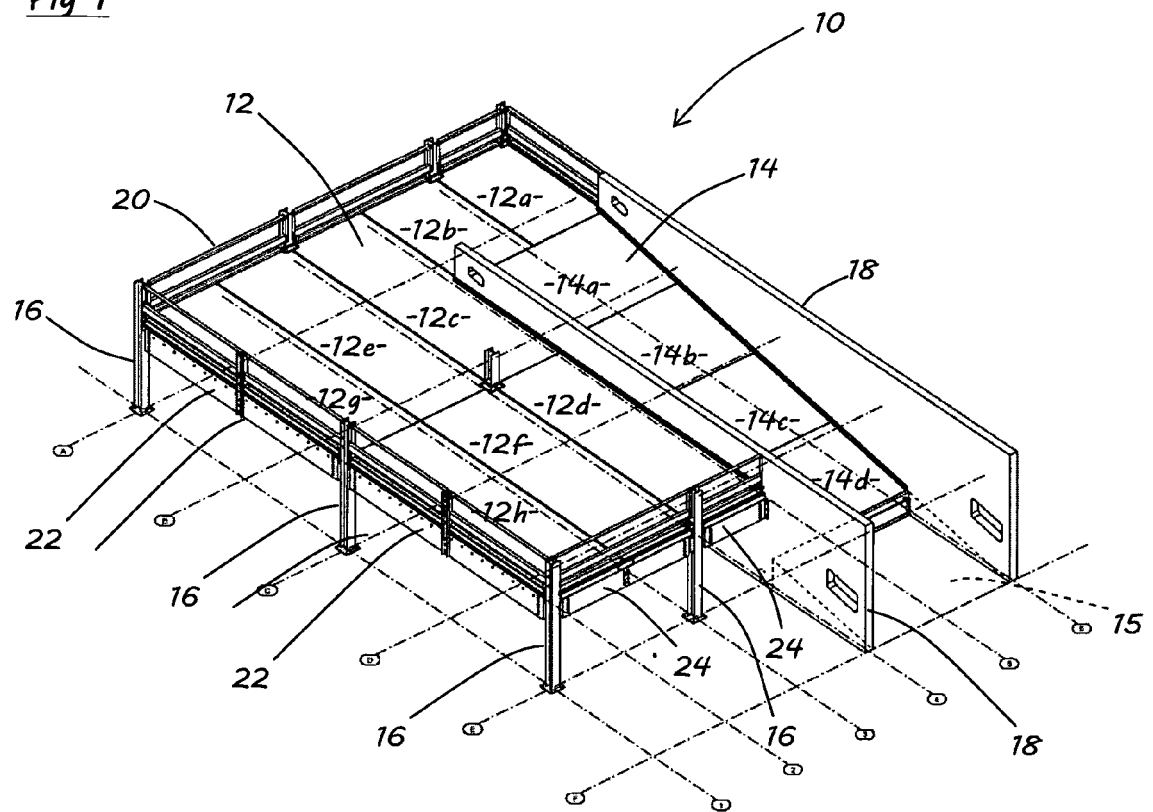
11. A modular construction system for constructing a building as claimed in Claim 9 or Claim 10 and comprising said columns, beams, flooring panels and drains, **characterised in that** the drainage elements are so dimensioned and the flooring panels are so dimensioned relative to the spacing of the columns that the width d of the gaps is less than the width of the drainage elements. 30
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12. A modular construction system as claimed in Claim 21 **characterised in that** each flooring panel is so dimensioned as to provide an integral number of car parking bays of standard size. 40

13. A modular construction system as claimed in Claim 11 or Claim 12 **characterised in that** each flooring panel includes utility services interconnectable between adjacent panels. 45

14. A method of constructing a building from a modular construction system as claimed in any of Claims 11 to 13 **characterised in that** said method comprises positioning the columns vertically and spaced apart longitudinally and laterally in a rectilinear array, securing the beams to the columns to form a rectangular framework, securing the flooring panels to the beams with their sides spaced apart to form gaps, and securing the drains to the beams to extending along and under the gaps to drain liquid from the floor. 50
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Fig 1



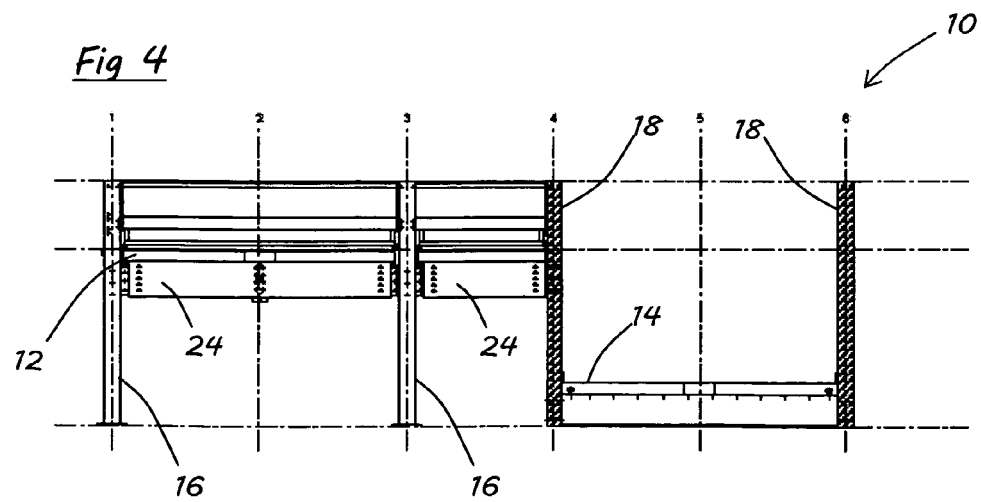
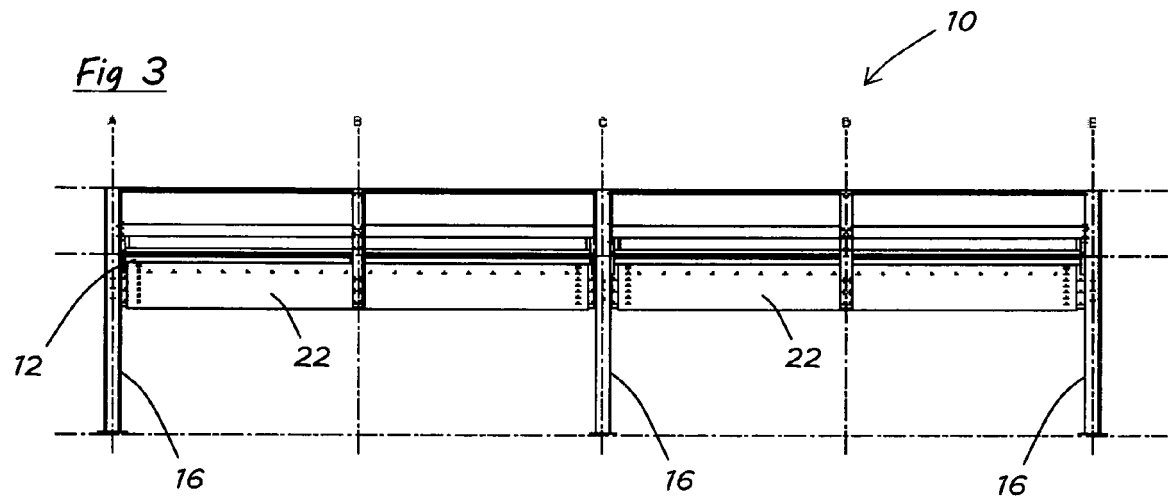
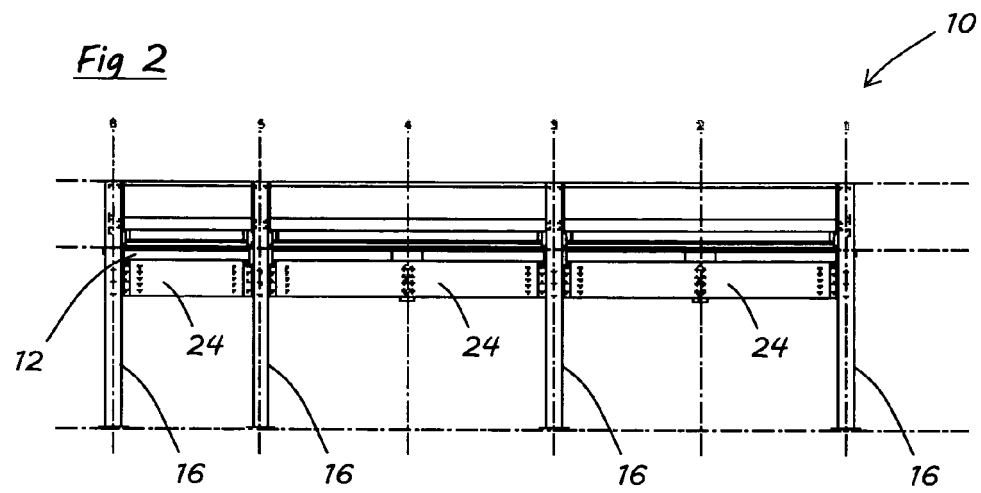


Fig 5

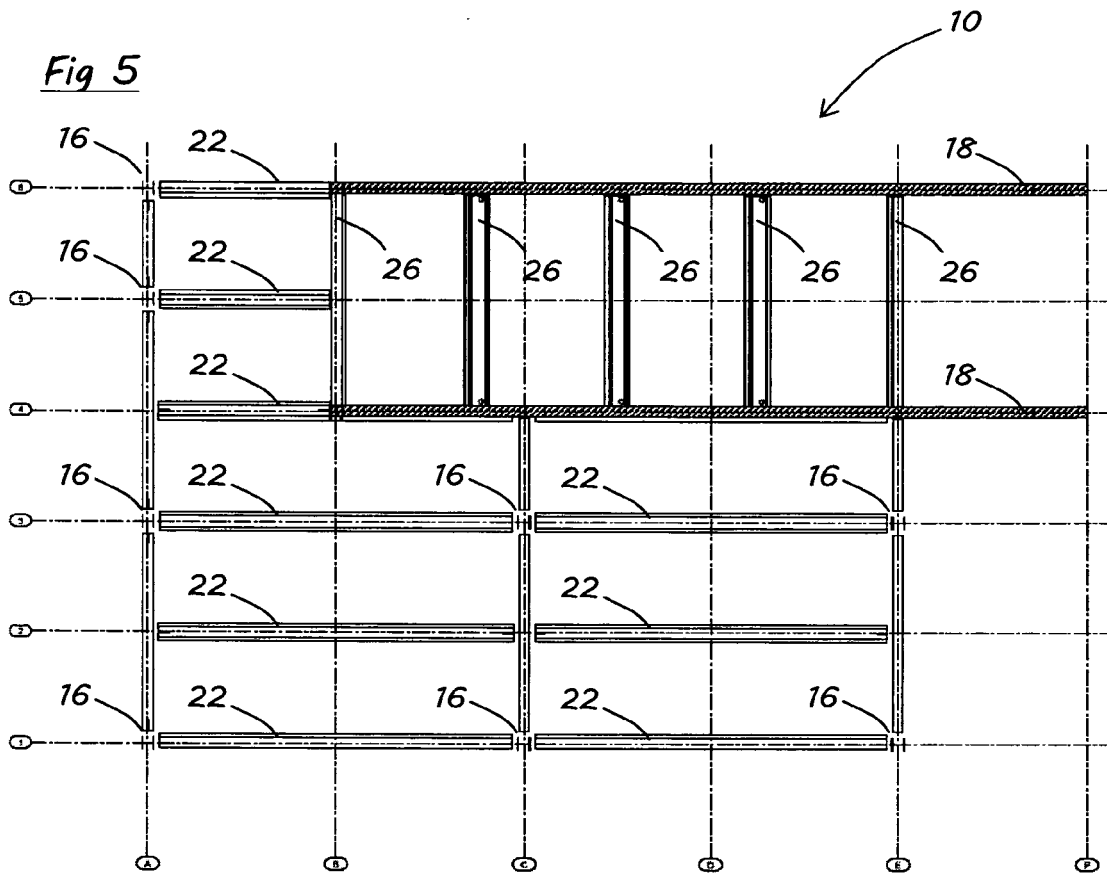


Fig 6

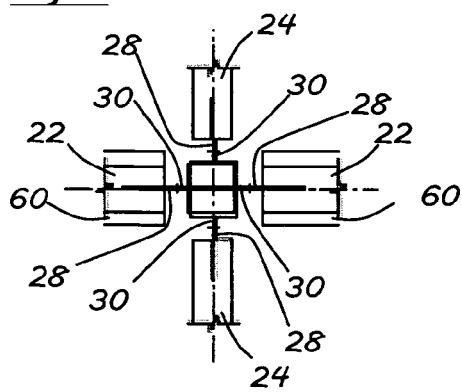


Fig 7

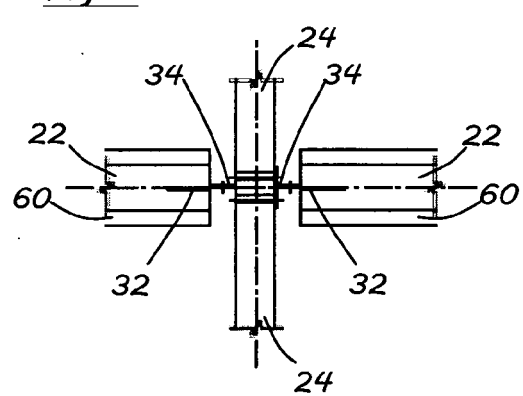


Fig 8

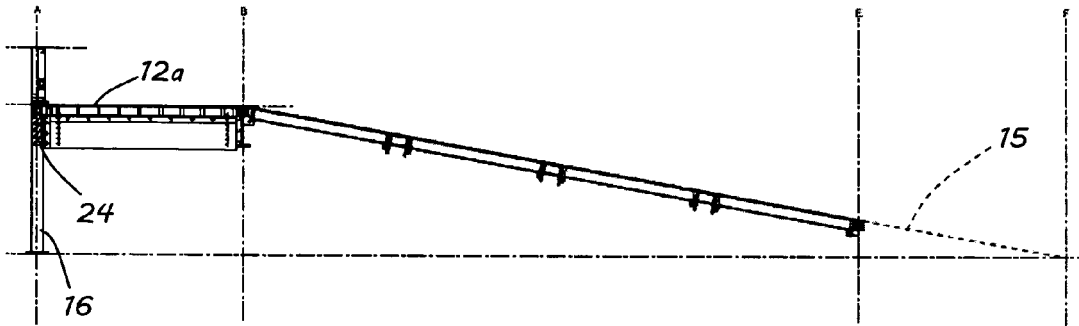


Fig 9

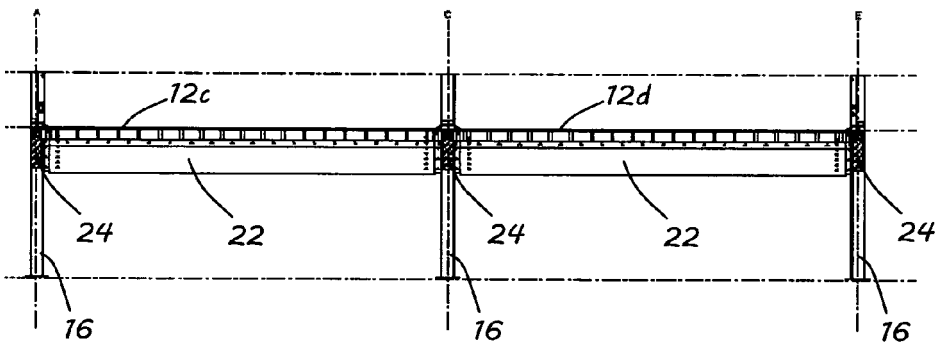


Fig 10

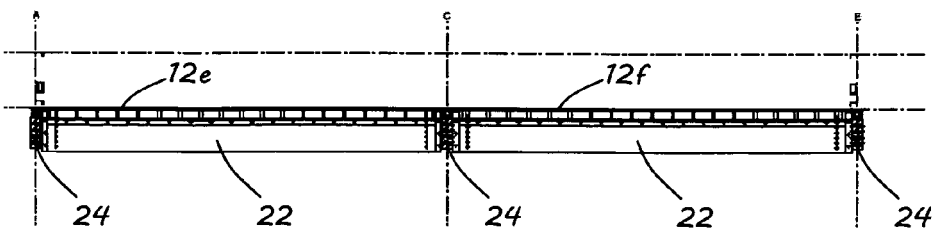


Fig 11

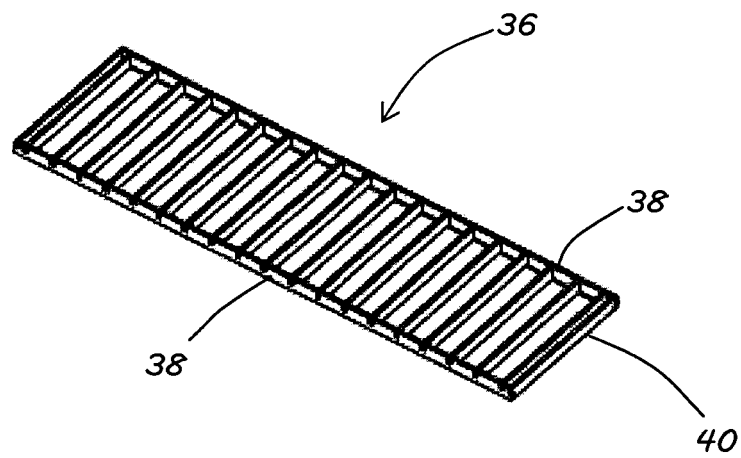


Fig 12

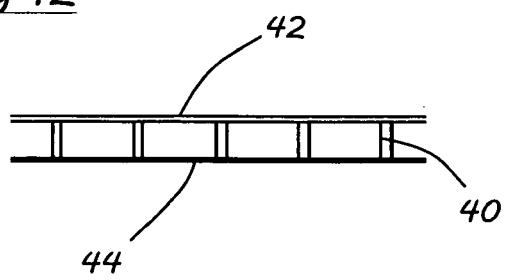


Fig 13

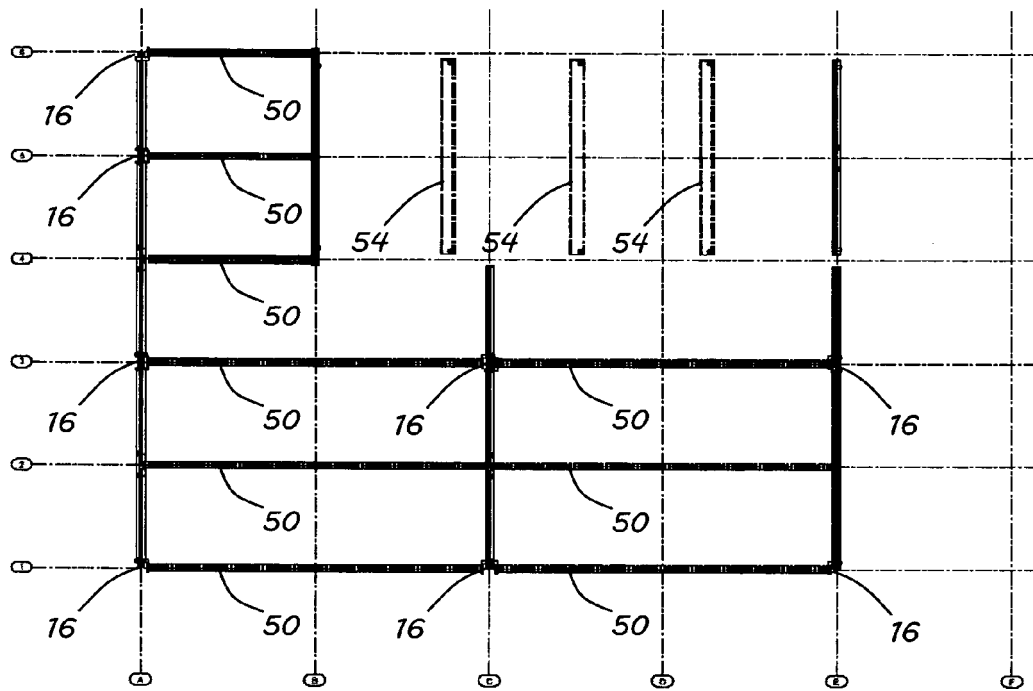


Fig 14

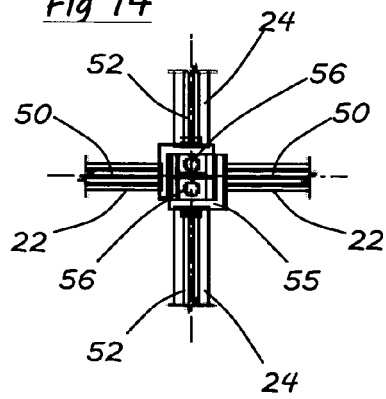


Fig 15

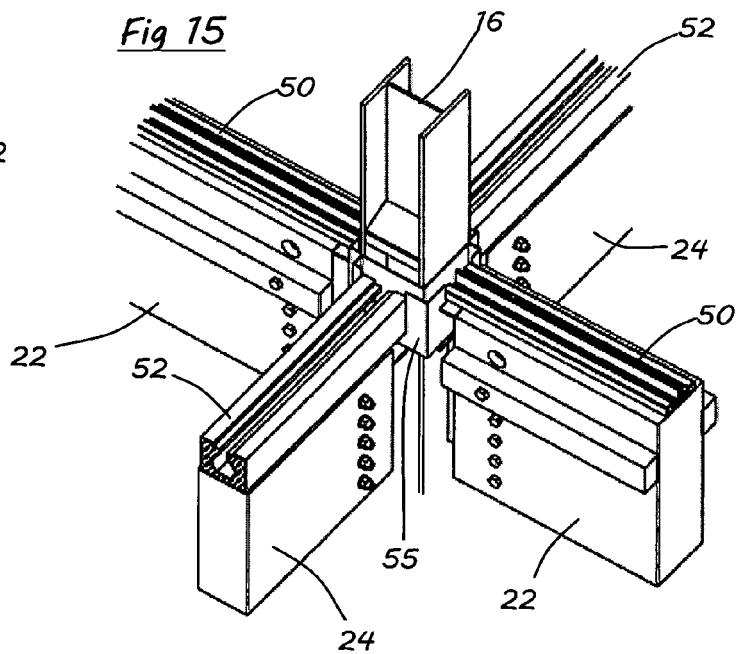


Fig 16

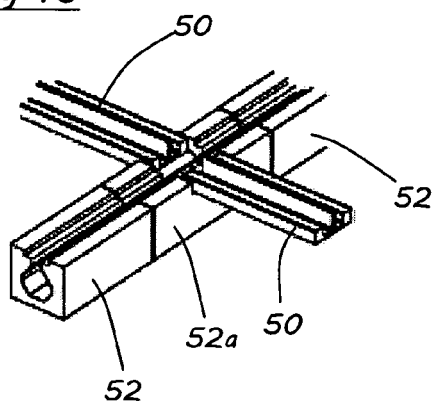


Fig 17

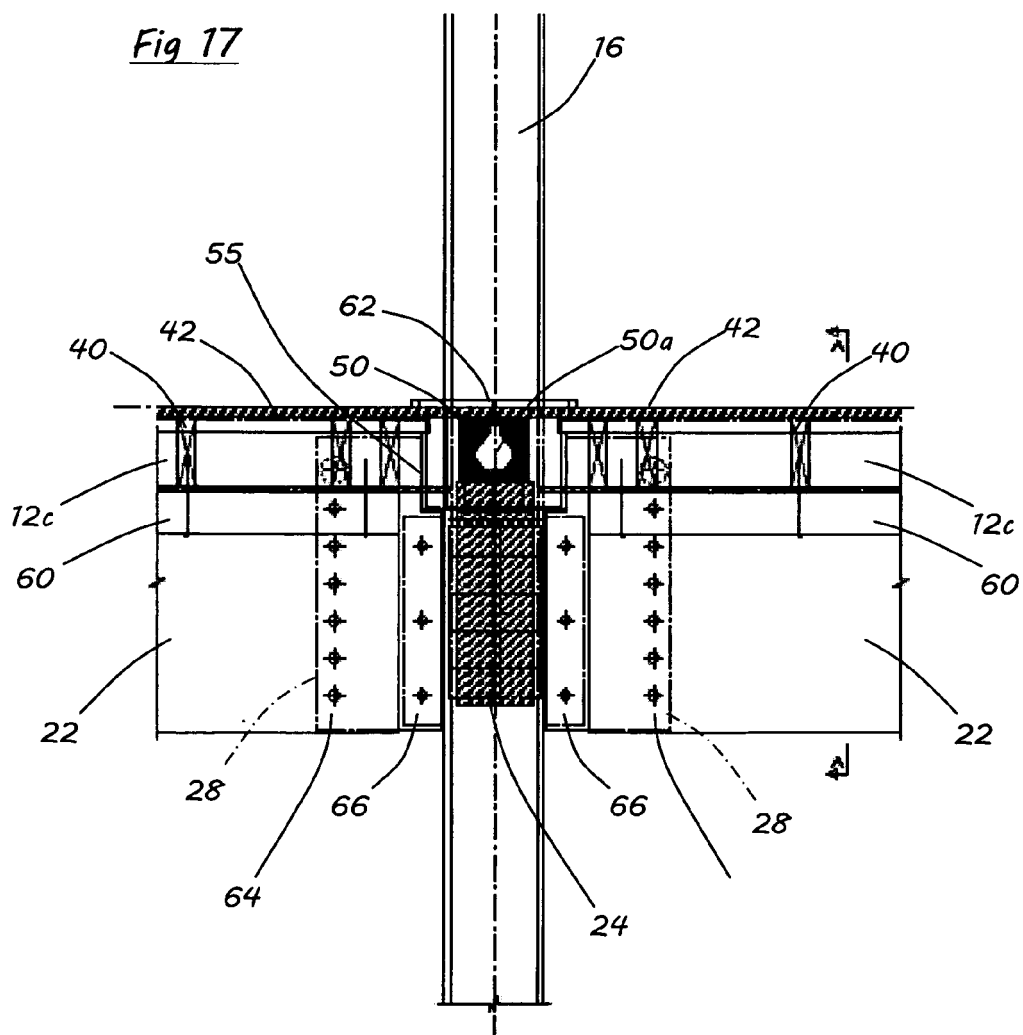


Fig 18

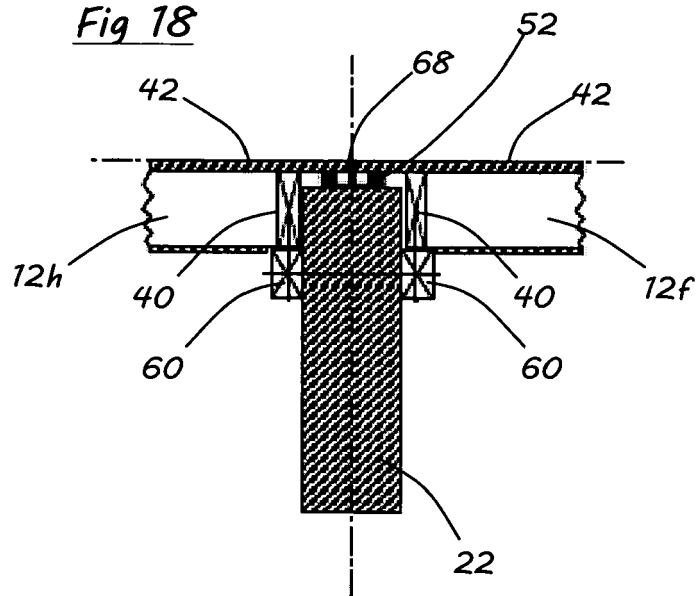
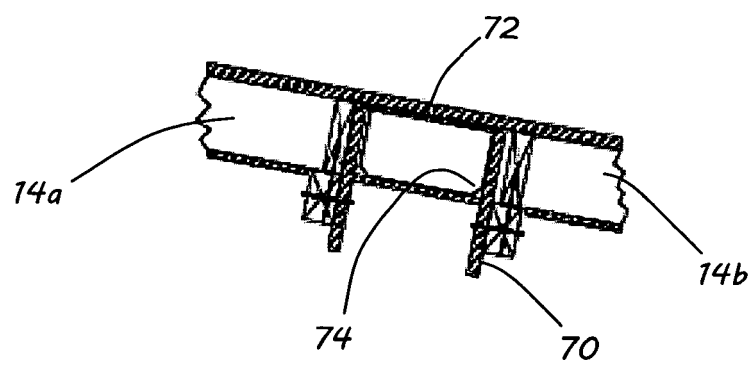


Fig 19



REFERENCES CITED IN THE DESCRIPTION

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