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

(11) EP 1 304 431 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
23.04.2003 Bulletin 2003/17

(51) Int Cl.[7]: **E04H 1/00**, E04B 5/38

(21) Application number: **01308911.5**

(22) Date of filing: **19.10.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(71) Applicant: **R. O'Rourke and Son Limited**
Grays, Essex RM20 4YB (GB)

(72) Inventor: **Banks, Colin Richard**
Wouldham Road Grays RM20 4YB Essex (GB)

(74) Representative: **Lamb, Martin John Carstairs**
MARKS & CLERK,
57-60 Lincoln's Inn Fields
London WC2A 3LS (GB)

(54) Constructing a building

(57) In order to provide a method of constructing a building, particularly a permanent multi-storey building, which is flexible in design and has a high quality of finish and structural stability, a design is created by selecting from a plurality of pre-designed building components adapted to be connected together in a plurality of different configurations, a set of selected building components. The design for the building will then show how a pre-designed building components can be combined together in a particular way to form a building. Because the components can be combined together in a plurality of different forms, very flexible designs can be obtained. Finally, a building is constructed according to the design by connecting the components together. Because the components are pre-designed, the process of ordering and constructing them is particularly quick and efficient.

The invention also provides a building constructed according to the method of the invention and an assemblage of pre-designed building components which can be used in the invention.

EP 1 304 431 A1

Description

Introduction

[0001] The present invention relates to methods of designing and constructing a building, an assemblage of components suitable for carrying out the method, and a building constructed by the method.

Prior art

[0002] The methods conventionally employed to construct buildings depend to a large extent on the type of building being constructed. The type of building is in turn determined by a number of factors of which the following are important.

[0003] *Standard or bespoke*- a large number of buildings, including domestic buildings, warehouses, prefabricated buildings and factory units are made to standard designs with limited opportunity for the eventual purchaser to introduce features which they require. If it is important that a building should be tailored to the purchaser's particular needs, the building should be designed from scratch starting with the particular needs of the purchaser. The result is a bespoke building, the design of which is unique.

[0004] *Size* - there are two factors of importance when considering size. One is the overall size of the building itself and the other is the size, number and distribution of rooms within the building. For example, a warehouse may be very large but have a small number of relatively large spaces within it. However, structures such as offices and laboratories may have a relatively large number of small to medium sized rooms. They may also require specialised spaces for staircases, lifts, entrances, car parking and other facilities.

[0005] *Storeys* - another factor to consider is the number of storeys required. Where it is acceptable to dispose all rooms on a single level, the structure may be relatively simple, employing relatively low strength units, as it will only be necessary to support a simple roof. However, in many circumstances, it is necessary to have more than one floor, in order to make maximum use of the ground area available. In such cases, strong and rigid frames must be provided for stability and safety. Such structures are typically made of steel or concrete, or both, out of components which are purpose built and designed for a given a building.

[0006] *Services* - services include gas, water electricity, communications, and air conditioning. In many buildings, such as offices, very complex service systems are required to provide a wide range of services in a safe, reliable and adaptable manner to a wide variety of places.

[0007] *Prefabrication* - some components within a building can be either pre-designed or prefabricated in nature, such as lift equipment, air conditioning, heating and lighting etc. In some standard designs, the entire building or modules within a building such as individual rooms can be prefabricated. However, such systems offer relatively low levels of flexibility or ability to tailor a building to individual needs.

[0008] *Permanent or temporary* - temporary buildings are required only for a limited space of time, after which they are dismantled or removed. It is common in the art to provide temporary buildings as complete prefabricated modules.

[0009] The present invention is particularly concerned with buildings which may be permanent, relatively large, have several storeys or need high levels of flexibility in design in order to meet the needs of individual purchasers. Examples of such buildings include office blocks, laboratory and research facilities, telephone call centres, internet service provider facilities, shops and shopping complexes, factory units and the like.

[0010] Conventionally, the only realistic option for constructing a building of this type has been the bespoke design and construction route. The alternative route of constructing a building from standard modules fails to offer sufficient flexibility to be able to meet individual customers' needs, being only suitable for standard designs or designs with relatively little flexibility. This method is also impractical for example for larger buildings or buildings on several floors. In many cases, prefabricated buildings maintain the appearance of being temporary, whilst many customers will require a properly finished, permanent building.

[0011] However, the bespoke route for designing a building has a number of problems. Primarily, it is very time consuming. Each building has to be designed from scratch. A substantial effort has to be spent on considering how to implement the design. Further, there can be considerable time involved in obtaining permission to build the building from the respective planning authorities and in obtaining approval for example Building Regulations approval or approval from Health and Safety authorities.

[0012] The present invention sets out to provide a method of designing and constructing a building which offers the flexibility, good match to purchaser's needs and quality of finish of a bespoke building construction process, but which can be effected more quickly than the conventional bespoke building process.

[0013] The present inventors have realised that substantial time can be saved if components of the building can be pre-designed in such a way that they can be combined in different ways. The process of constructing a building will then include the step of selecting a set of building components and creating a design which shows how the selected building components can be assembled into a design which meets the purchaser's requirements. Because substantial time and design effort has already been put into designing the building components so that they can be combined in a plurality of different ways, time can be saved in arriving at the eventual design. A highly flexible design can be achieved.

[0014] It is beneficial here to distinguish between building modules, which represent complete rooms or groups of rooms ready for installation on site and building components which cannot on their own define a complete room. Examples of building components include beams, columns, floor units, ceiling units, wall units and foundation units.

[0015] It is known in the art to construct buildings from prefabricated modules by placing a number of modules together. However, it is not known to use a plurality of pre-designed components to design and construct a building by combining selected components in a selected manner.

[0016] The present inventors have realised that a high standard of strength, reliability and quality of finish can be obtained by suitable predesigned components, in particular predesigned major structural components.

[0017] Accordingly, the present invention provides a method of constructing a building, comprising the steps of:

> selecting from a plurality of pre-designed building components adapted to be combined in a plurality of different configurations, a set of selected building components,
> creating a design for the building comprising an indication of how the selected building components are to be combined to form the building, and
> constructing a building according to the design by combining the components together according to the design.

[0018] The present invention further provides a method of designing a, comprising the steps of selecting from a plurality of pre-designed building components adapted to be combined in a plurality of different configurations, a set of selected building components and creating a design for a building comprising an indication as how the selected building components are to be combined to form the building.

[0019] The present invention further provides a building constructed by the method of the invention.

[0020] The present invention yet further provides an assemblage of pre-designed building components which are adapted to be combined in different configurations, from which a set of selected building components can be chosen for constructing a

[0021] The present invention is particularly suitable for the design and construction of multi-storey buildings It has been assumed in the art that such buildings can only be constructed by designing from scratch, because of the great demands of strength and reliability placed upon the major structural members.

[0022] By multi-storey it is meant that there are at least two storeys, suitably comprising at least a ground floor and a first floor in United Kingdom terminology otherwise referred to as a first floor and second floor in United States terminology. Throughout the rest of this document United Kingdom terminology will be used.

[0023] There may be at least one storey above the ground storey. There may be further levels below the ground storey, below ground level. For example, garage spaces may be provided beneath the ground storey.

[0024] There may be a wide range of different types of space on each storey. There may be a large number of small spaces, or a small number of very large spaces, for example open plan offices. There may be a mixture of spaces. There may be a different distribution of spaces on different storeys.

[0025] There may be a plurality of spaces on at least one storey. Preferably, there are a plurality of spaces on more than one storey, and possibly on all storeys of the building.

[0026] For example, there may be at least six spaces, and more preferably at least 10 spaces on at least one storey of the building.

[0027] The building may comprise a plurality of different types of space. These spaces may be selected from meeting rooms, open plan offices, private offices, service rooms, storage rooms, stairwells, lifts, vestibules, conference rooms, waiting rooms, laboratories or other rooms. At least one room may extend through more than one storey, for example to provide an entrance hall for a building.

[0028] In order to provide a design for a building which has adequate strength to support the required number of storeys, there is preferably a framework comprising a plurality of pre-designed major structural members. These major structural members are suitably column members, for extending vertically when constructed and optionally beam members for extending horizontally when constructed. The major structural members may further comprise floor units, comprising substantially planar units for extending substantially horizontally in the complete building, between column members or between beam members. The beam members may extend between column members or they may extend across the ends of floor units. The major structural units may also include ceiling units for extending across the top ends of column members in the constructed building. The major structural members may further include wall members. The major structural members may further include foundation members for supporting floor units and/or column members in the constructed building.

[0029] The major structural members may be made of steel or other metal, concrete, suitably reinforced concrete, most suitably pre-stressed concrete. The major structural members will be pre-designed to allow them to be combined in a plurality of different ways, as will be further discussed below. The major structural members are suitably all load-bearing members.

[0030] The framework may be constructed by defining a standard grid size. For example, columns may be placed in a polygonal pattern, for example square or rectangular, spaced apart by a fixed amount. For example a 9m X 9m square grid may be used. This allows the

columns to be designed to a set diameter, knowing how much load they will be expected to take. This is in contrast to the bespoke building construction method, in which the number and spacing of the columns is first of all designed by the architect and the engineers then decide what size the columns should be in order to bear the loads they will carry.

[0031] The method of the invention is suitably used to create a permanent building. By permanent, it is meant that at least some of the major structural members are joined together by permanent joints. Such permanent joints may be formed by suitable known processes for constructing permanent joints, for example by bolting or by fixing by adhesive or by cementitious material such as grout, mortar or cement. It is particularly preferred that, at least some of the major structural members are permanently joined to foundation units.

[0032] The building components are designed to be combined together in a plurality of different configurations. For example, the building components may be provided with mechanical connections which allow other building components to be connected to them. Alternatively, where one or both of the building components is cast in concrete, the building components may be connected together by casting them in such a way that they are connected together when the concrete is cured. This is particularly suitable when constructing at least some building components in situ, as described below.

[0033] A major structural unit may be constructed according to a predesigned form and then assembled at the building site after construction of the major structural unit. Alternatively, it may be constructed on site to a standard design.

[0034] For example, where major structural members are constructed from cast concrete, casting may be conducted before constructing the building or it may be conducted in situ while constructing the building. In order to allow a standard design of cast structural units, pre-designed moulds for the major structural members may be produced and used.

[0035] In a preferred embodiment, floor units of the building are cast in situ. Preferably, the floor units are cast in situ with edge defining units, for example beam members. The beam members may be pre-cast. The floor units are preferably constructed according to a standard design. They are preferably constructed to a standard design using standard mould parts which are placed in situ in the building process.

[0036] In a particularly preferred embodiment, a plurality of column members (preferably pre-cast column members) are erected at a building site, following which pre-designed pre-constructed mould parts for defining pre-designed floor units are placed in position at the heads of the columns, following which concrete is poured into the mould parts to prepare a concrete flooring unit joining the heads of the columns. Preferably, pre-designed reinforcing units, for example reinforcing bars may be placed at the heads of the columns prior to casting of the floor units. Pre-designed coupler members or moulds for defining coupler members may be provided for coupling to additional columns on tops of the heads of the erected columns.

[0037] The construction of floor units may further include the step of placing pre-constructed or pre-designed beam units along the outer periphery of the floor units for defining the edges thereof.

[0038] In a preferred embodiment, the floor units are constructed of post tensioned concrete, in which a plurality of tensionable reinforcing members slideably received in conduit members are placed in the mould before casting the floor unit in such a way that the ends of the tensionable reinforcing units extend beyond the periphery of the floor units to be constructed. After the concrete for forming the floor units is cast, whilst it is curing, the tensionable units may be placed under tension and anchored at each end with respect to the floor units, thereby placing the floor unit under compression and reinforcing it.

[0039] The design may include a core unit. The core unit may be constructed of steel. The core unit can be constructed according to a standard design or a design selected from a plurality of standard designs. The core unit preferably comprises a frame work constructed of concrete or steel. The core unit may comprise spaces for the following:

Lift units
Stairways
Toilets
Cloakrooms
Uptakes/Downtakes for air conditioning and services.

[0040] In a preferred embodiment, the building according to the present invention is constructed by the following steps:

a) foundations are constructed from pre-designed or pre-constructed units as described below.

b) a floor unit is pre-constructed in situ by casting concrete using pre-designed mould members, across the tops of the foundation units.

c) the core unit is assembled on the floor unit to the required member of storeys.

d) columns for the ground storey are assembled on the floor unit in a pattern around the core unit.

e) a further floor unit is constructed across the heads of the columns of the ground storey and adjoining the core unit.

f) a plurality of columns for the first storey are placed in position on the further floor unit, and in a pattern

around the core unit.

g) a further floor unit is constructed on the plurality of columns of the first storey

h) this process may be repeated until the complete framework of the building is constructed.

[0041] The foundations of the building may be constructed from pre-designed units. They may be pre-constructed or they may be constructed in situ to a pre-designed pattern or they may be constructed in situ to a pattern which is designed for the building in question.

[0042] The pre-designed building components may include, in addition to the major structural members, other components, selected for example from:

Wall units. wall units may be relatively thick exterior wall units or relatively thin interior wall units. They may be constructed of any suitable material, for example concrete, metal, fibreglass, thermoplastic material, wood, glass or any combinations of these.

Exterior facing material or cladding. This defines the outer surface of the building, giving a distinctive and pleasing appearance. The cladding material may comprise metal, glass, bricks, tiles (natural or glazed) or other suitable materials or combinations of such materials.

Roof systems. These may be constructed of any suitable material, for example concrete, metal, glass or composite structures comprising a combination of these materials, as is known in the art. Similar cladding materials may be used as for the exterior-facing wall as discussed above.

Raised flooring systems, as are well known in the art.

Suspended ceiling systems, as are well known in the art.

Air conditioning systems which may be located within wall spaces, ducts, raised flooring systems or suspended ceiling systems.

Lighting units as are well known in the art

Standard machinery, such as lifts, moving staircases or the like

Stair constructions, for example straight stairs, dog-leg stairs or spiral stairs.

Sunshading and solar control systems, as are well known in the art

Toilet cubicle designs as are well known in the art

Single storey height service ducts comprising spaces for services such as heating, air-conditioning, electrical services, power, communications etc. or comprising such services in situ. The service ducts may be designed as units extending through a single storey. The design may require a plurality of such units to be placed end to end through the required number of storeys.

Plumbing systems, for example for toilets, washrooms, water drainage from roofs etc. These building components may be installed once the framework of the building has been completed as described above.

Each building component, whether a major structural element or other building component may be pre-designed by specifying one or more of the following features:

1) The overall dimension of the respective components may be specified. Suitably, an individual component may be available in the range of different sizes.

2) The shape of the component may be specified. Again, a plurality of different shapes may be available.

3) Connecting means may be designed for each component to allow it to be connected to other building component in a standard manner.

4) The quality of the component may be specified such that it falls within given tolerances. For example, the weight, strength or other quality data may be specified.

[0043] The method of designing a building according to the present invention will preferably include a first step in which the customer's requirements are assessed. For example, the proposed location of the building may first of all be studied, to determine the space available, the nature of the foundations required, existing service provision etc. Then the space requirements of the customer will be assessed, for example total floor area required, number of floors, number and selection of room spaces. At this stage, a plurality of building components can be selected which will define a framework, outlining the shape of the design of the building. In selecting the building components, it is necessary to specify the size of individual components required, optionally the shape and the number of each individual type of component. The design will also indicate how the individual components are to be combined.

[0044] This design can then be submitted to the customer for comments and, if possible, approval. As soon

as approval is received from the purchaser an order may be placed for the individual components. No intermediate step of designing the components needs to be taken, as the design of the components is already fixed, This represent a substantial saving in time for the overall construction of the building.

[0045] In a preferred embodiment of the method, the design is constructed as a three dimensional computer generated model. Suitable software for doing this is available under the title AutoCAD ADT (trade mark). The resulting model can be displayed on the screen of an ordinary apparatus such as personal computer allowing the building to be viewed from a number of views, including internal views, in response to control inputs by a user of the software.

[0046] In a preferred embodiment, the pre-designed components are individually three dimensionally modelled in the computer-generated system so that the computer-generated model accurately represents the process of constructing a building. The design may be created using electronic data handlings means, for example at least one personal computer. The design may be stored by any suitable storage means, for example hard disk, floppy disk, random access memory of a computer or other suitable means. Copies of the design may be printed onto paper for the purposes of records or for use in the construction of the building. The electronic design apparatus may comprise dedicated hardware or programmable hardware. In order to configure the programmable device to operate the design method, suitable programme code can be provided to the device using any conventional carrier medium, e.g. a floppy disk, CD-ROM, tape device or programmable logic device for a transient carrier medium e.g. electrical, optical, microwave or radio frequency signal.

[0047] The present invention will be further described by way of example with reference to the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS.

[0048]

Figure 1 is a flow chart showing the steps involved in a prior art bespoke process for constructing a building.

Figure 2 is a flow chart showing a prior art process for constructing a prefabricated building.

Figure 3 is a flow chart showing the steps involved in constructing a building according to the present invention.

Figures 4 to 10 show steps involved in the construction of a building in an embodiment of process the present invention.

Figures 11 to 14 show various designs of components for use in the invention.

DETAILED DESCRIPTION OF THE DRAWINGS.

The Prior Art

[0049] There are two known ways of constructing buildings in the prior art, the bespoke route and prefabrication route.

[0050] In the bespoke route, which is shown schematically in figure 1, the prime contractor, who may be represented by a single company or a group of companies including architects, builders, contractors etc. first of all assesses the purchaser's requirements in step 101. As a result of this assessment, a design is produced in step 102 which is then checked with the purchaser in step 103. When a design which meets the purchaser's requirements has been arrived at, regulatory approval, such as planning permission and safety approval is obtained in step 104.

[0051] In the next step 105, the detailed method of construction of the building is determined. In particular, the size, design and method of construction of each part of the building is assessed according to conventional techniques. For example, it may be necessary to determine the number and the size of columns to support a given floor area. An estimate of the loading on the floor area is obtained, from which the size and strength of the supporting columns required can be calculated. It may be necessary to involve the sub-contractor who will construct parts of the building in the design of components in order to arrive at a complete detailed design (step 108 and 105). Once the detailed design has been determined, construction can begin, for example commencing with preparation of the site (step 106) and placing orders for the necessary components (step 107). Sometimes, the sub-contractor will perform the design of the components at this stage.

[0052] Finally the building is constructed in step 109 from components constructed by the sub-contractor in step 110.

[0053] The whole process can be quite lengthy, particularly in steps 101-105 where a great deal of work has to be done in obtaining approval from the purchaser, from regulatory bodies and determining suitable methods of construction.

[0054] Figure 2 shows a prior art prefabrication route for a construction of buildings.

[0055] In this route, in step 201 the prime contractor designs a module for a building which represents a complete space which can be used on its own design. Once the design has been prepared, the method of construction is determined in step 202 which may involve liaison with sub-contractors who will design the components, in step 203.

[0056] In step 204, the sub-contractor may obtain regulatory approval for components, for example from the point of view of safety. Similarly, approval may be obtained for the entire building module.

[0057] As the modules are made to a standard a de-

sign, they can be constructed in advance in step 205 and stored in step 206 for use at a later date.

[0058] When a purchaser desires to construct a building of this type, they will make an order for the standard type of or building module from the prime contractor, setting out their basic requirements in step 206. Simultaneously, regulatory approval for the project may be sought in step 207, for example, planning permission. Once planning permission is obtained, construction commences by preparing the site (step 208) and ordering modules (step 209). Modules are delivered by the sub-contractor (step 210) allowing a building to be constructed (step 211)

[0059] While the prefabrication route can be quicker than the bespoke route for constructing a building, the resulting building is likely to be rather inflexible in design, being unable to meet the full requirements of most purchasers. Further, buildings constructed by this route tend to have a rather temporary appearance, reducing their value and desirability.

[0060] Figure 3 sets out a method of constructing a building according to the present invention. In this method, a building contractor, for example a prime contractor, designs a range of components of standard designs. The components are designed so that they can be assembled together in a number of different ways using standard techniques. This will be described further below. The step of designing the components (step 301) can be conducted if necessary with the assistance of a sub-contractor who will make the components (step 302).

[0061] A first benefit of the present invention is that the components, once designed, can be submitted for various types of regulatory approval, for example safety testing, before they are required for constructing a building (step 303). In this way, large amount of regulatory approval can be obtained in advance of the procedure for constructing an individual building

[0062] The procedure for constructing an individual building starts with step 304. In step 304, the purchaser's requirements are assessed.

[0063] Requirements may be assessed, for example, by the use of questionnaire or similar instrument, indicating a number of headings under which the purchaser's requirements are to be assessed. For example, the designer will need to know the overall floor area, number, distribution and size of spaces within the building, general shape of the building, aspect (for example facing south or east), number of storeys, number of individual tenancies within the building to be accommodated, and desired external appearance (for example cladding materials to be used). Further, the purchaser can define certain types of equipment which are preferred. For example, if the purchaser requires pumped water heating or cooling arrangements, these can be specified at this stage.

[0064] Further, a description of the land on which the building is to be constructed is obtained.

[0065] At this stage, a single design or a small number of different designs for buildings meeting the purchaser's requirements may be established in step 305.

[0066] The designs produced at this stage will be outline designs.

[0067] In each design, the building will be designed by first of all determining the floor area required and the number of storeys available. A floor plan is then proposed. The floor plan is realised on a standard grid. For example, the grid may comprise a plurality of 9m by 9m squares on each floor.

[0068] After determining the floor plan, the location of a core structure is determined. The core structure will include a lift shaft or shafts, stairs (optionally) and toilets (optionally). The number of toilets required may be calculated as a function of the floor area provided on each storey. Once the size and position of the core is determined, the positioning of support columns for the floors is determined. The spacing between the columns or the between the columns and the core structure may be set at a standard figure, for example on a 9m x 9m grid.

[0069] After the configuration of the floor around the core structure is determined, the position and appearance of other components such as wall units, cladding, roof systems, raised flooring systems, suspended ceilings system, air conditioning systems, lighting units, lift machinery and other staircases may be determined. The result is an outline plan of a building defined entirely in terms of standard components.

[0070] The process uses the same engineering principles as are used in the prior art, and is not described in detail. However, as the structure is constructed according to a standard size grid from standard components, the sizes of the building components, can be specified at a very early stage in the design process, or selected from a small range of standard sizes. This will simplify the design, ordering and sourcing of building components.

[0071] A plurality of different designs constructed on the same principles may be proposed to the purchaser in step 306

[0072] The purchaser then selects the preferred design. The purchaser then may propose amendments or alterations, whereupon the process returns to step 305 and any amendments necessary are made.

[0073] When the outline plan is approved by the purchaser, regulatory approval, for example, planning permission, can be sought. (step 307). As noted above, regulatory approval for matters such as safety and building quality can be speeded up by the fact that a very large member of the components may be of a standard form which have already individually been approved.

[0074] Once regulatory approval is obtained (step 307) a detailed design may be prepared. The detailed design is prepared, largely for the benefit of the constructors of the building, setting out in detail the positions, dimensions and connections of components. Once the detailed design is prepared (step 309), prep-

aration of the site can commence (step 310) and components can be ordered (step 311). As the components are of a standard design, no time need be taken in determining the size or design of the components - they can simply be constructed upon request (step 312).

[0075] Construction of the building will then commence (step 313)

A method of constructing a particular embodiment of a building according to the present invention will be described further with reference to figures 4-10 below.

[0076] In a first step shown in figure 4, foundations are constructed using pre-designed foundations units, 400. These foundation units 400 are cast in situ. There are relatively large foundations units 401 whose purpose will be explained further below. The other foundation units are constructed to various standard sizes.

[0077] The sizes and the spacing of the foundation units 400 can be specified relatively easy, because it will be known exactly how much load each will be expected to bear because the designs of floor unit, columns etc to be supported by them are standard. Further, because the sizes of the foundation units 400 are known in advance, the foundation excavations can be designed and carried out relatively simply.

[0078] In the next step, a floor unit 501 is constructed on top of the foundation units, as shown in figure 5. The floor unit 501 is cast in situ, using a plurality of standard shaped formers which are placed in position between the foundation units 400 and 401 and around the edges thereof. The floor unit 501 may be constructed of prestressed, post-stressed or other reinforced concrete. A pair of extensions 502 are provided, whose function will be described further below.

[0079] In the next step, as shown in figure 6 a core structure 601 is constructed on the floor unit 501. The core structure is composed of a lattice work steel structure of a standard design. The core structure 601 rests above the large foundation units 401 which are designed to bear the weight of the steel core structure.

[0080] The floor unit 501 may be cast in a number of steps for convenience, as is well known in the art.

[0081] In a fourth step, as shown in figure 7, a plurality of columns 701 are erected at predetermined grid positions on the floor unit 501 surrounding the core unit 601.

[0082] The columns 701 are constructed on a 9m by 9m-square grid.

[0083] In a fifth step, also shown in figure 7, a plurality of pre-designed beam units 702 are placed in connection with the heads of the column units 701 which are located at the periphery of the floor unit 501. A re-entrant structure of 703 is formed, whose function will be described further below.

[0084] In a sixth step shown in figure 8, a second floor unit 801 is constructed connecting the heads of the columns and the beams 702, except in the re-entrant portion 703. The second floor unit 801 is constructed up to the edge of the core structure 601, but not extending into it. The second floor unit 801 may be constructed by a process similar to the first floor unit 501.

[0085] In seventh and eighth steps shown in figure 9, a second set of columns 901 is constructed on top of the second floor unit 801, aligned with the heads of the first set of columns 701. Subsequently, a third floor unit 902 is cast in position on top of the heads of columns 901, up to the edge of the core structure 601.

[0086] The third floor unit 902 extends across the top of re-entrant structure 703. In this way, the re-entrant structure 703 forms an entrance hall-way extending through two storeys of the buildings. However, the third floor unit 902 includes an opening 903 to let light down from upper storeys to lower storeys.

[0087] In a tenth step, as shown in figure 10, a third set of columns 1001 are constructed on the third floor unit 902, aligned with the heads of the second set of columns 901. A third set of beams 1002 are placed in contact with the heads of the third set of columns 1001 along the periphery of the building. Finally, a fourth floor unit 1004 is constructed across the heads of the columns 1001, between the beams 1002, and extending up to the edge of the core unit 601. The fourth floor unit 1004 further includes an opening 1005 coinciding with opening 903 to passlight to lower parts of the building.

[0088] In an eleventh step (not shown) a further set of columns can be constructed on top of the fourth floor unit 1004 for supporting a roof structure (not shown).

[0089] In further steps, other building components can be placed in position in the building.

[0090] These further building elements will include the followng:

- window units and cladding for closing the outside of the building
- a roof structure as described above
- lifts, extending through a lift shaft formed within the core unit 601
- services, such as air conditioning, communications and electrical power supply and
- internal wall units and internal raised floor structures and suspended ceilings.

[0091] Figure 11 is a schematic cross section through a pair of columns extending between three floor units.

[0092] Each of the columns 1101 and 1102 is constructed according to a standard design.

[0093] In this case, the standard design is of a circular cross section and has a fixed pattern of reinforcing bars 1103 located within the column, including a central reinforcing bar 1104. The bar 1104 projects at the bottom of the column 1101, but stops short of the top of the column, which includes a hollow sleeve 1109 as described below. The bar 1104 projects at either end of the column 1102. The columns are shown broken in the middle to indicate that they are not necessarily in scale with respect of figure 11.

[0094] The concrete from which the columns 1101 and 1102 are formed may be of any suitable design for

a load bearing concrete material. It may be cured under special conditions.

[0095] One of the advantages of the standard design of the columns 1102 and 1101 is that they may be manufactured off site and cured under controlled conditions, to improve strength.

[0096] At the base, there is a floor unit 1105 corresponding to the first floor unit 501.

[0097] Whilst the floor unit 1105 is being formed, a connector unit 106 was cast into the floor unit for receiving the base of the column 1101 and the reinforcing rod 1104 projecting from the bottom of the column.

[0098] At the tops of the columns 1101 and 1102, further reinforcing bars 1107 extend laterally, as will be described further below.

[0099] Once the floor unit 1105 is cured, column 1101 can be placed in position with its reinforcing rod 1104 received in the connector 1106.

[0100] Subsequently, a second floor unit 1108 can be formed by a standard procedure on top of the head of the column 1101.

[0101] In order to form the floor unit 1108, formers (not shown) may be placed around the head of column 1101 providing a trough of a required depth, into which concrete for forming the floor unit 1108 can be poured. Reinforcement units can be included in the floor unit 1108 in a manner known in the art. These reinforcement units can overlap or be united with the reinforcing bars 1107 projecting from the top of the column 1101.

[0102] However, the concrete forming the floor unit 1108 is excluded from the sleeve 1109. Accordingly, a socket extending into the floor unit and into the head of the column 1101 is formed.

[0103] Once the material of the floor unit 1108 is cured, the second column 1102 can be placed in position with the base resting on a suitable bearing pad 1110 and the reinforcing bar 1104 projecting into the sleeve 1109 of the lower column 1101.

[0104] Subsequently, a roof unit 1111 can be formed on top of the head of the second column 1102 in a manner similar to the floor 1108. In this case, however, no sleeve protecting the reinforcing bar 1104 is used, so that the reinforcing bar 1104 is incorporated into the roof unit 1111.

[0105] Figure 12 is a detailed view, at larger scale of the sleeve 1109 shown in figure 11. It can be seen that it comprises a generally cylindrical metal sleeve of internal diameter greater than the diameter of the reinforcing rods 1104, so that these rods can be received within it. A small bearing member 1112 may be provided between the ends of the reinforcing rods 1104.

[0106] Figure 13 is an end view, at smaller scale, of the column 1101 or 1102, showing the reinforcing bars 1107 protecting there from in a cruciform pattern for forming a strong connection with the floor unit 1108 or roof unit 1111.

[0107] Figures 14 and 15 show alternative designs of the base (figure 14) and head (15) of the columns 1101 and 1102, showing the pattern of the reinforcing bars within the column. This type of head or base is particularly suitable for use for internal columns.

[0108] The present invention has been described above by way of example only, and modifications can be made within the spirit of the invention, which extends to equivalents of the features described. The invention also consists in any individual features described or implicit herein or shown or implicit in the drawings or any combinations of any such features or any generalisation of any such features or combination.

Claims

1. A method of constructing a building, comprising the steps of:

   selecting from a plurality of pre-designed building components adapted to be combined in a plurality of different configurations, a set of selected building components,
   creating a design for the building comprising an indication of how the selected building components are to be combined to form the building, and
   constructing a building according to the design by combining the components together.

2. A method according to Claim 1, wherein the building is a multi-storey building.

3. A method according to Claim 1 or 2, wherein the building components comprise major structural members selected from the group consisting of columns, floor units, ceiling units, beam units, foundation units and wall units.

4. A method according to Claim 3, wherein the major structural members are pre-constructed according to a pre-determined design or constructed in situ according to a pre-determined design.

5. A building according to Claim 4, wherein the step of constructing the building comprises the step of erecting a plurality of column members at a building site, placing pre-designed pre-constructed mould parts for defining pre-designed floor units at the heads of the columns, and pouring concrete into the mould parts to prepare a concrete flooring unit joining the heads of the columns.

6. A method according to any preceding claim, wherein the building is a permanent building.

7. A method of designing a building,
   comprising the steps of selecting from a plurality of pre-designed building components adapted to be

combined in a plurality of different configurations, a set of selected building components and creating a design for a building comprising an indication as how the selected building components are to be combined to form the building.

8. A building constructed by the method according to any of claims 1 to 6.

9. An assemblage of pre-designed building components which are adapted to be combined in different configurations, from which assemblage a set of selected building components can be chosen for constructing a building .

Fig 1

Prior Art - Bespoke

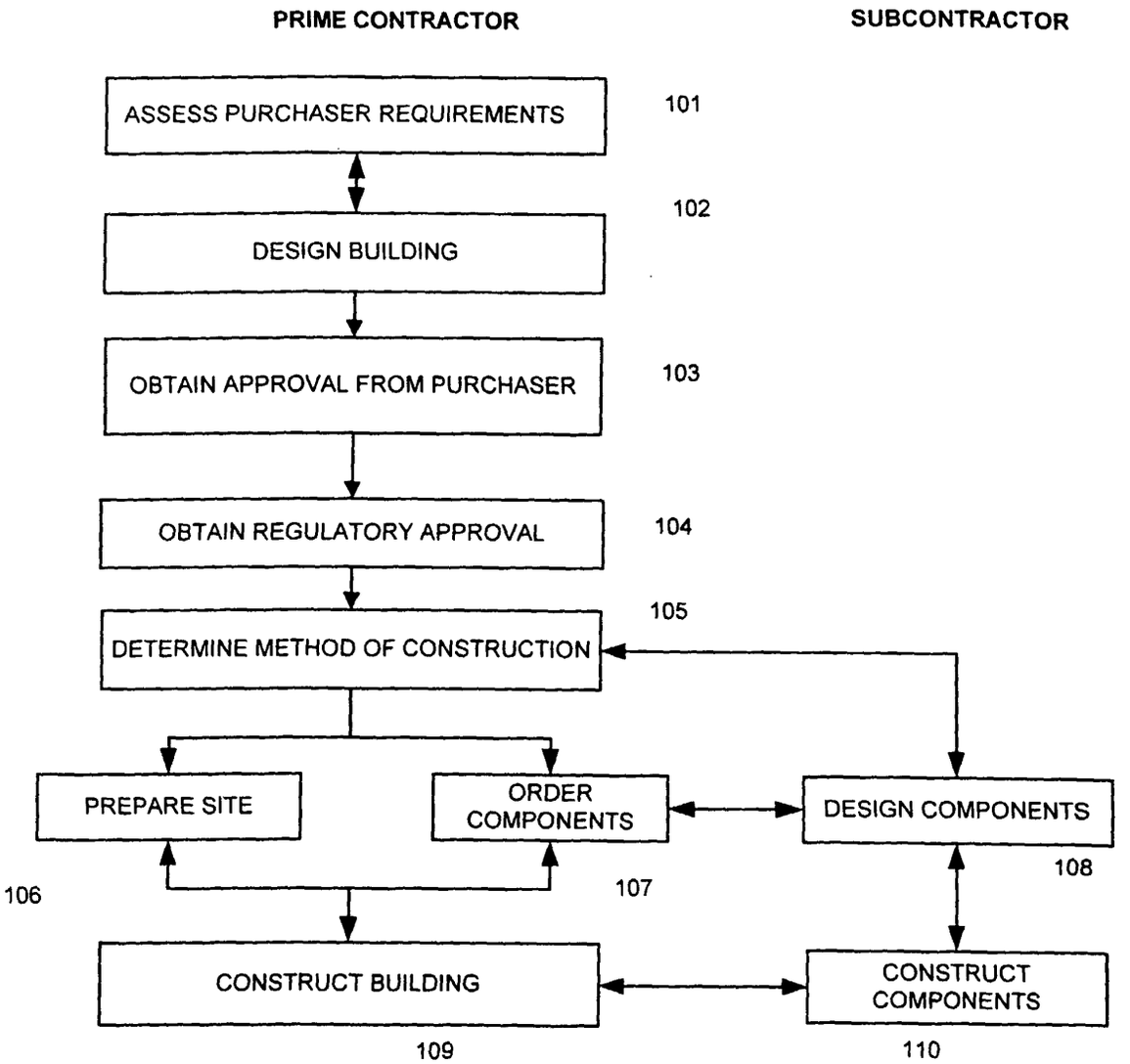


Fig 2

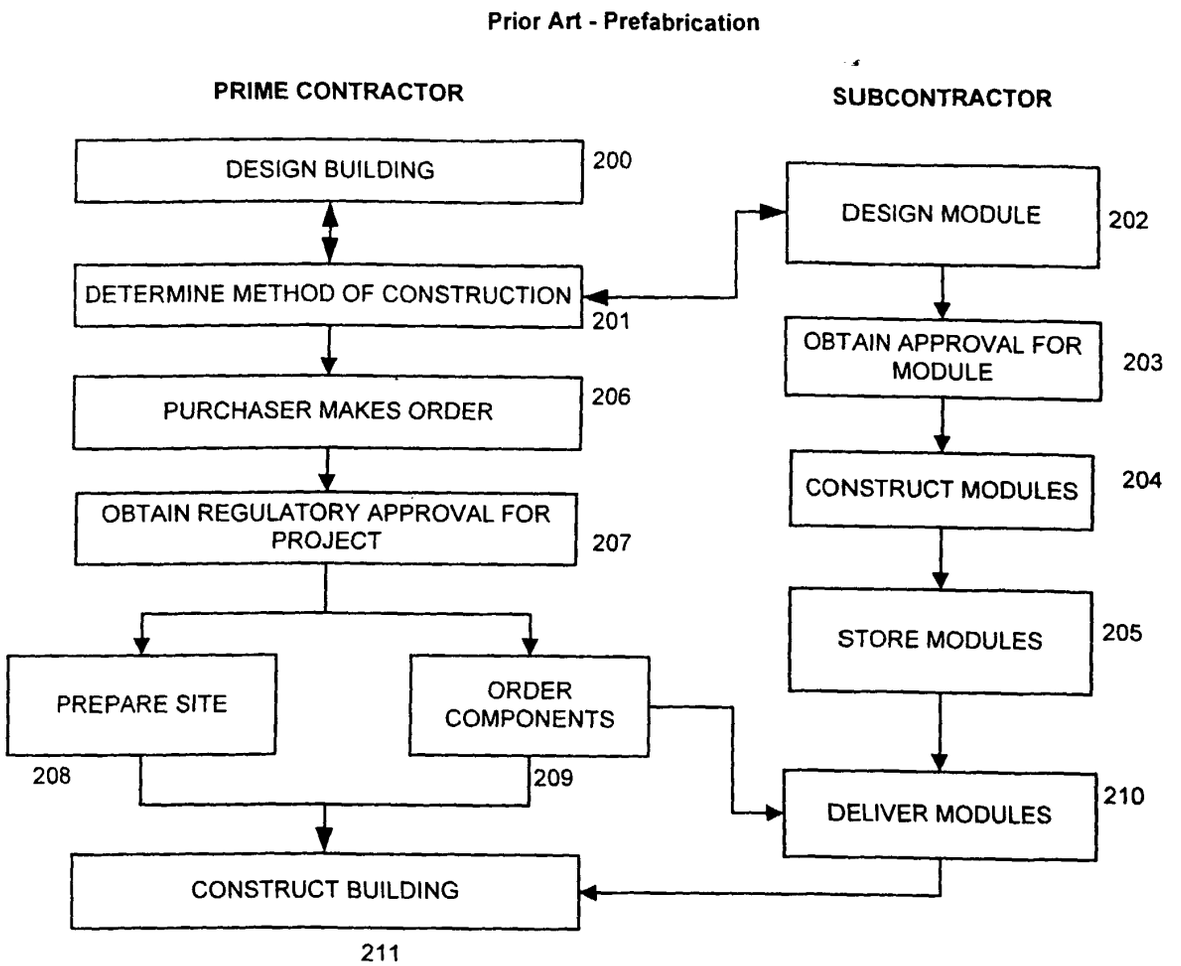
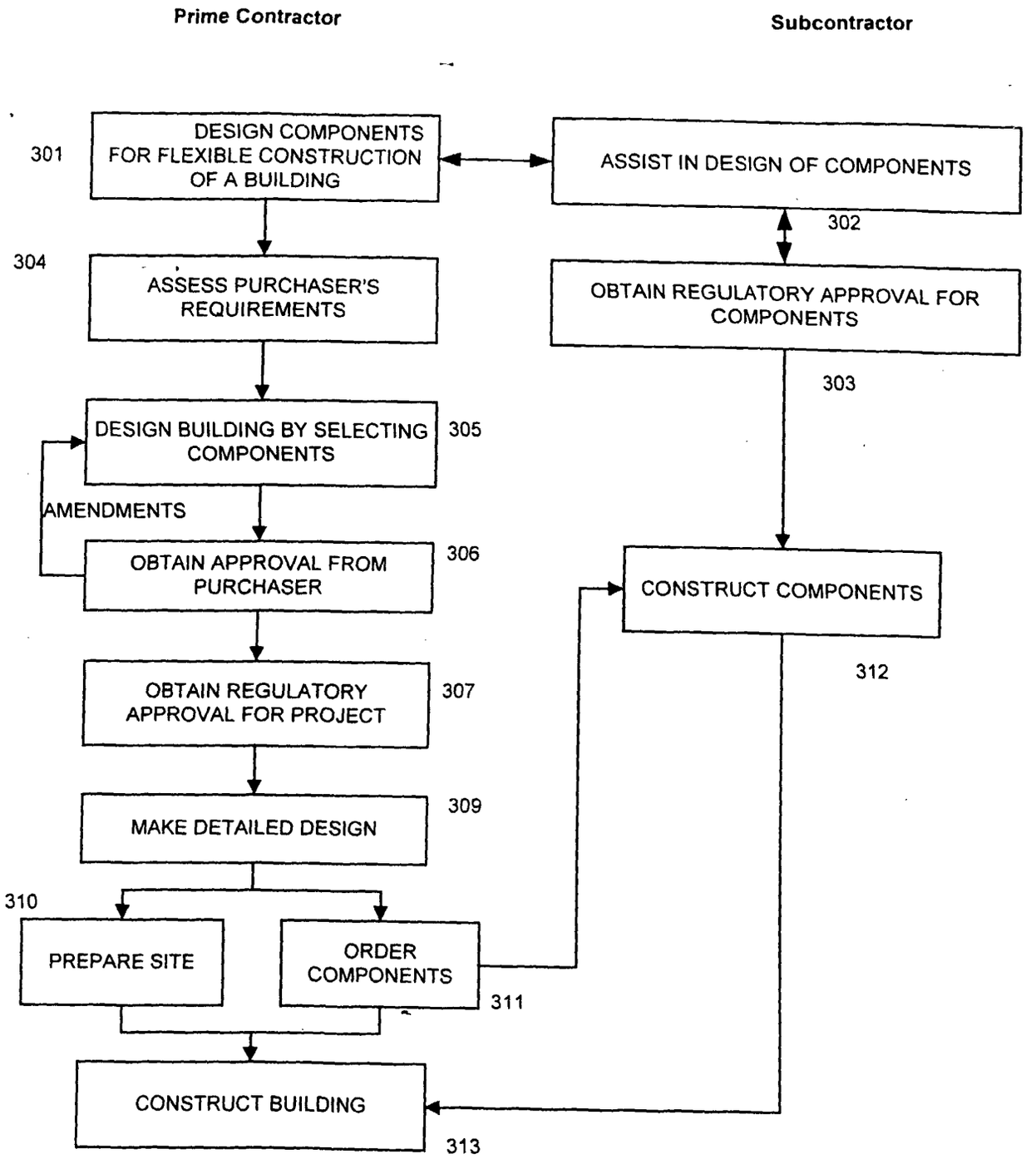

Prior Art - Prefabrication
PRIME CONTRACTOR
SUBCONTRACTOR
DESIGN BUILDING
200
DESIGN MODULE
202
DETERMINE METHOD OF CONSTRUCTION
201
OBTAIN APPROVAL FOR MODULE
203
PURCHASER MAKES ORDER
206
CONSTRUCT MODULES
204
OBTAIN REGULATORY APPROVAL FOR PROJECT
207
STORE MODULES
205
PREPARE SITE
208
ORDER COMPONENTS
209
DELIVER MODULES
210
CONSTRUCT BUILDING
211

Fig 3 The Invention



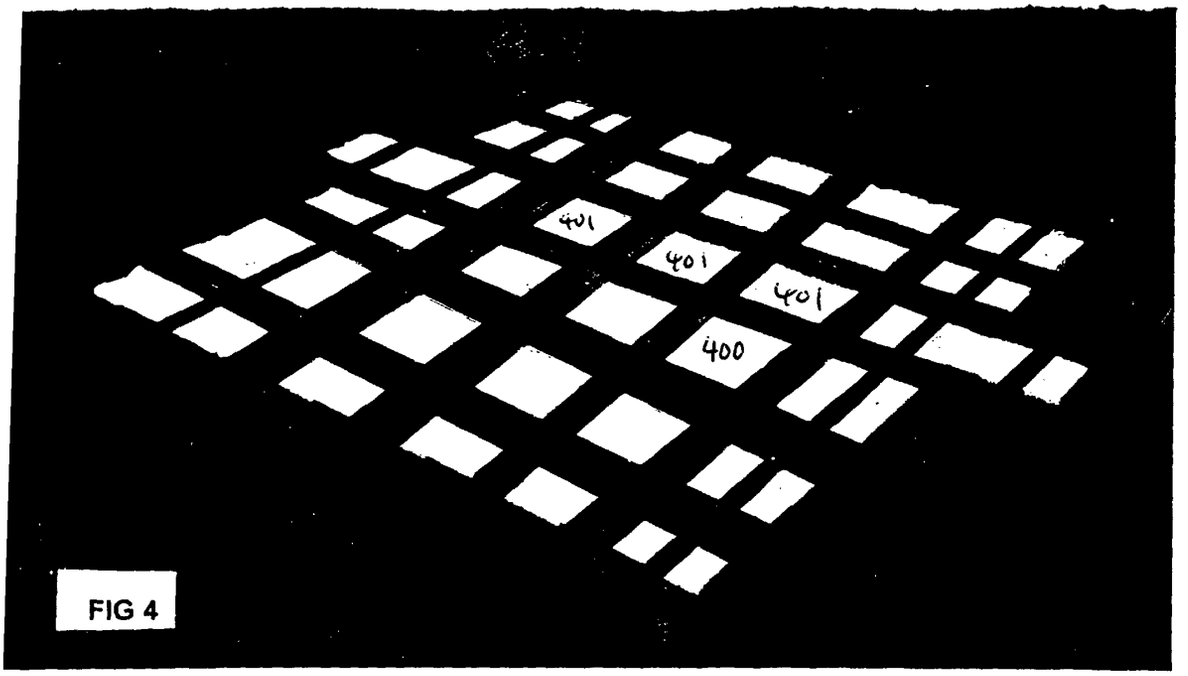


FIG 4

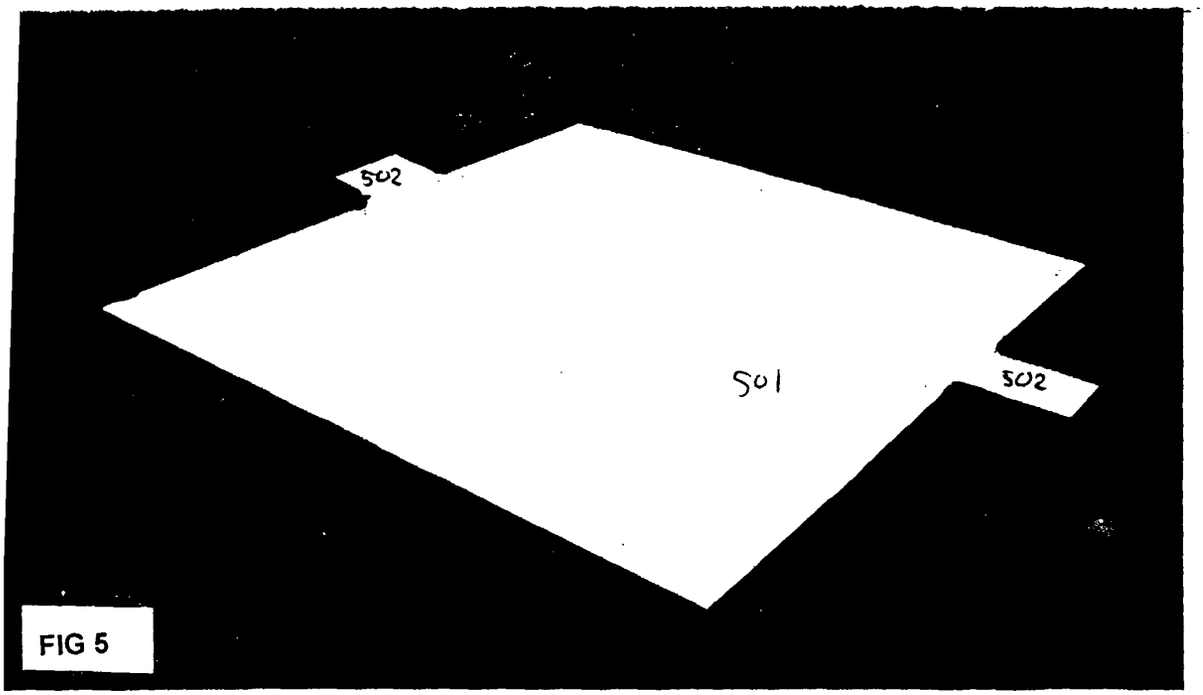


FIG 5

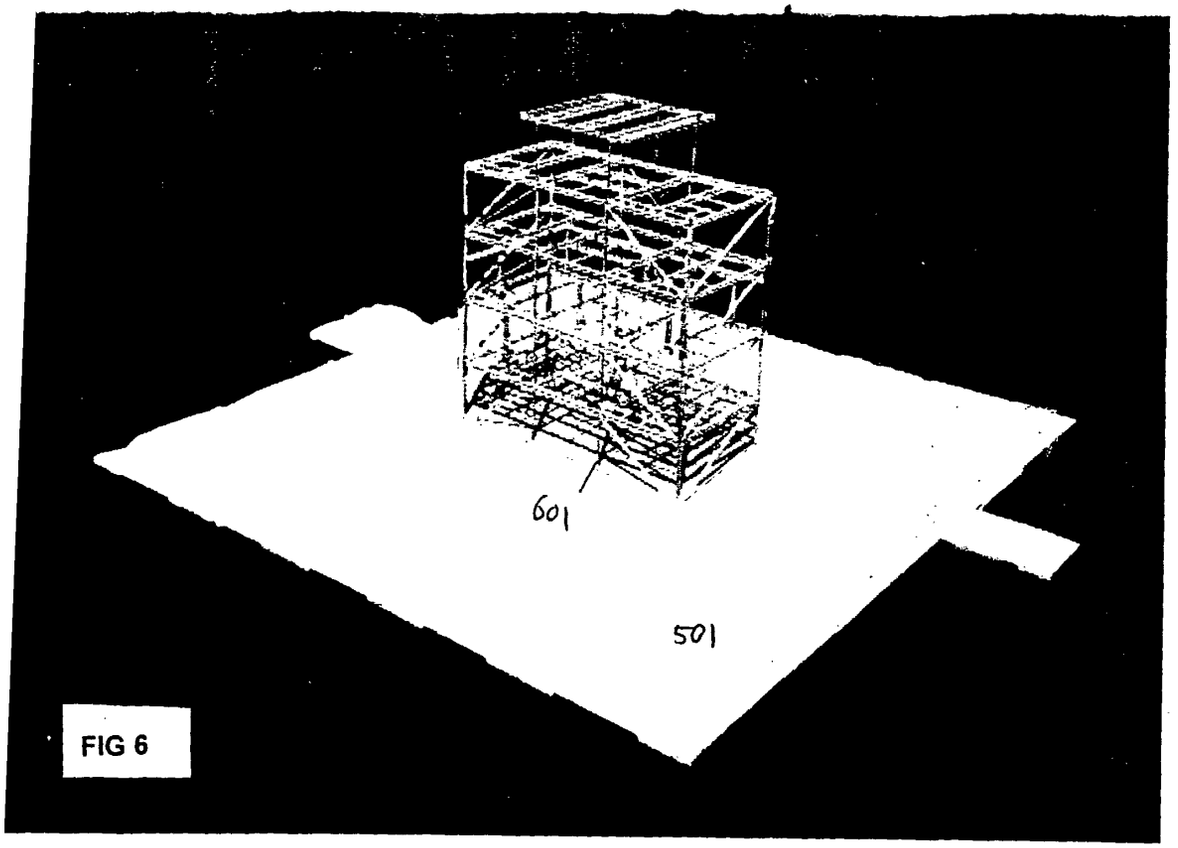


FIG 6

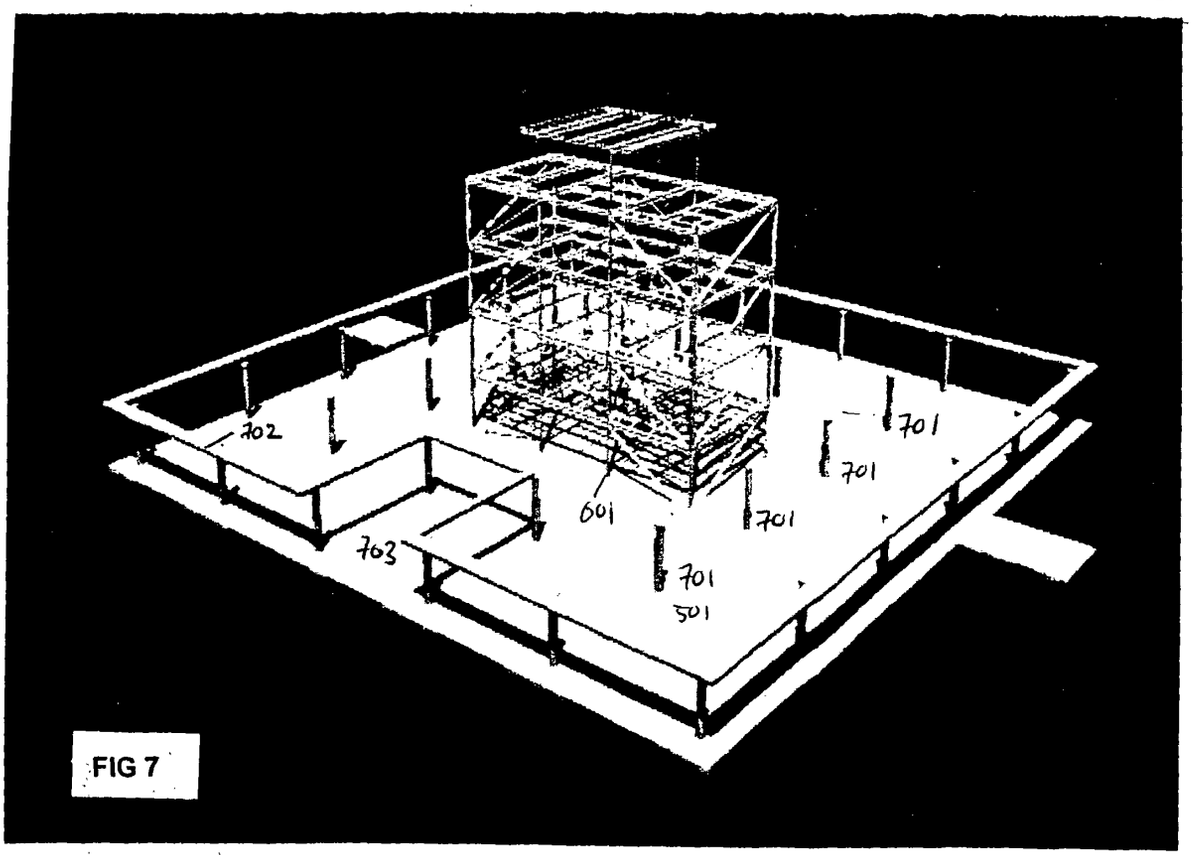


FIG 7

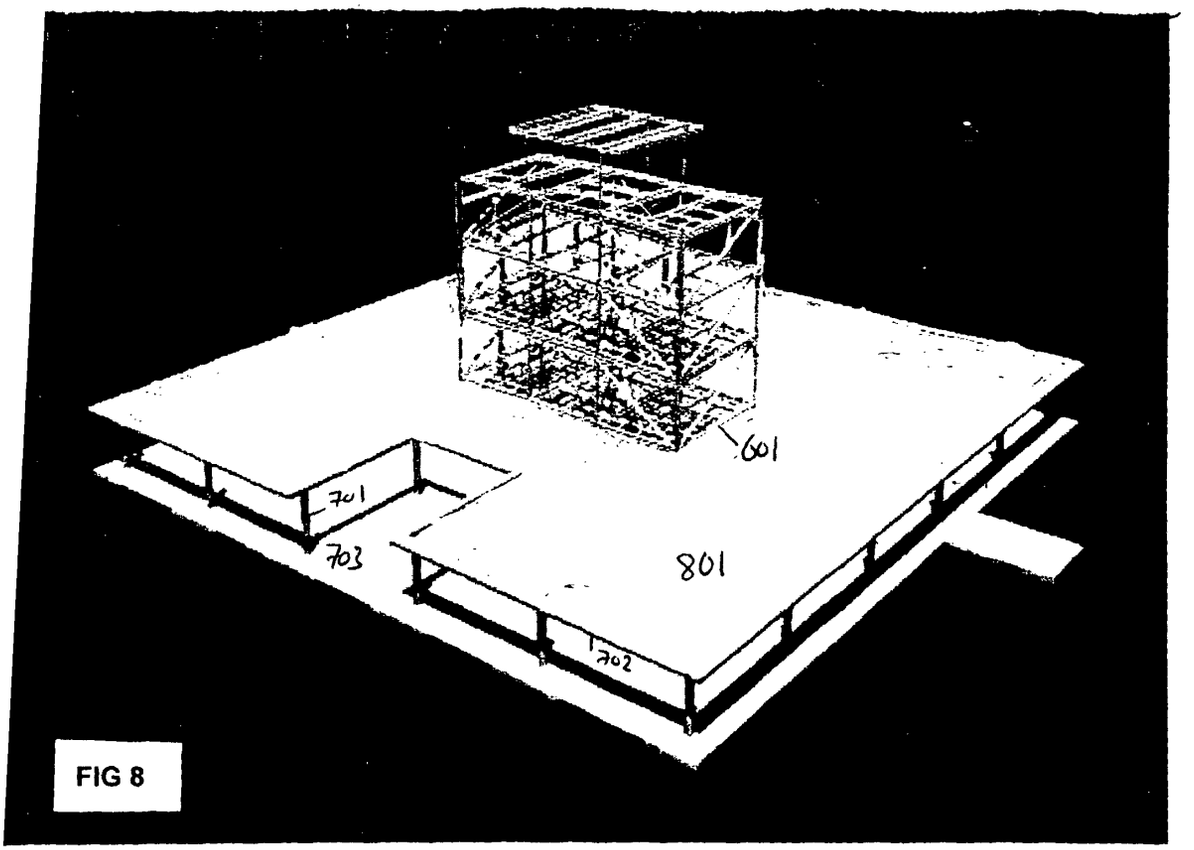


FIG 8

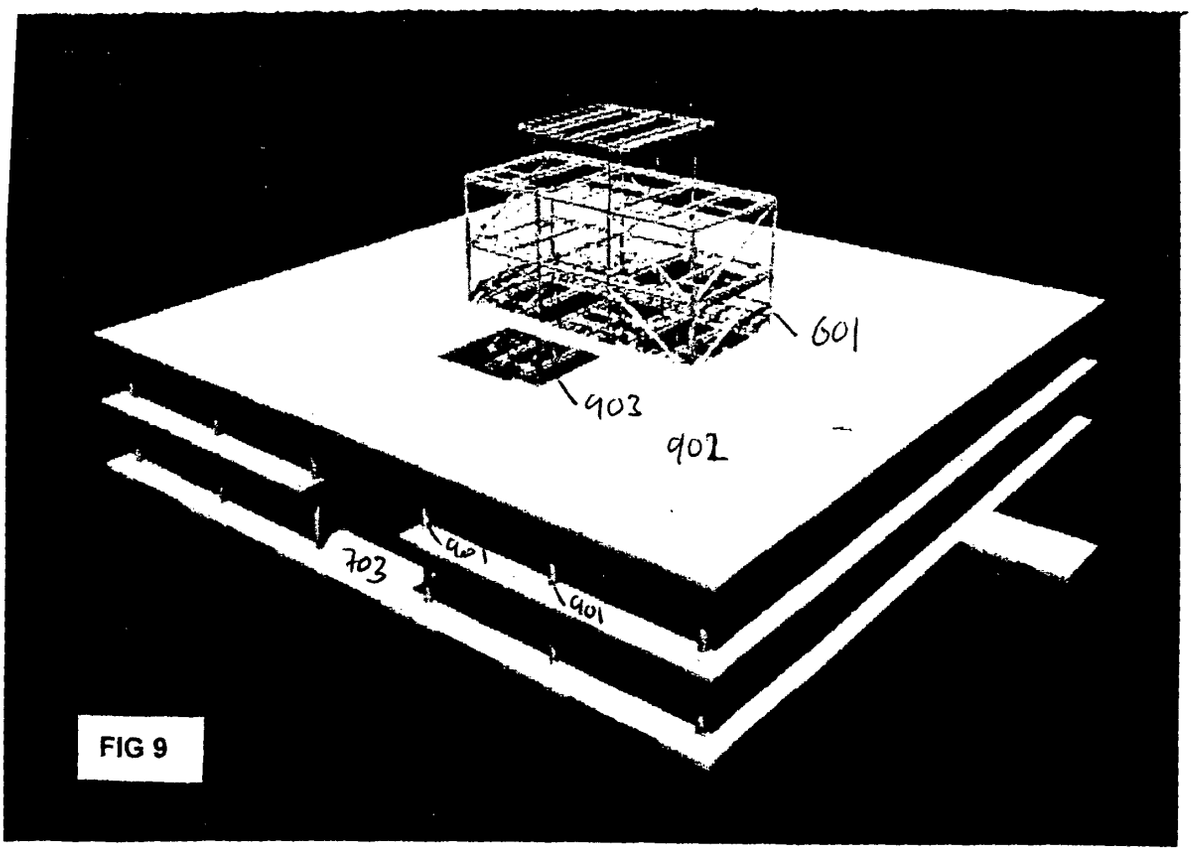


FIG 9

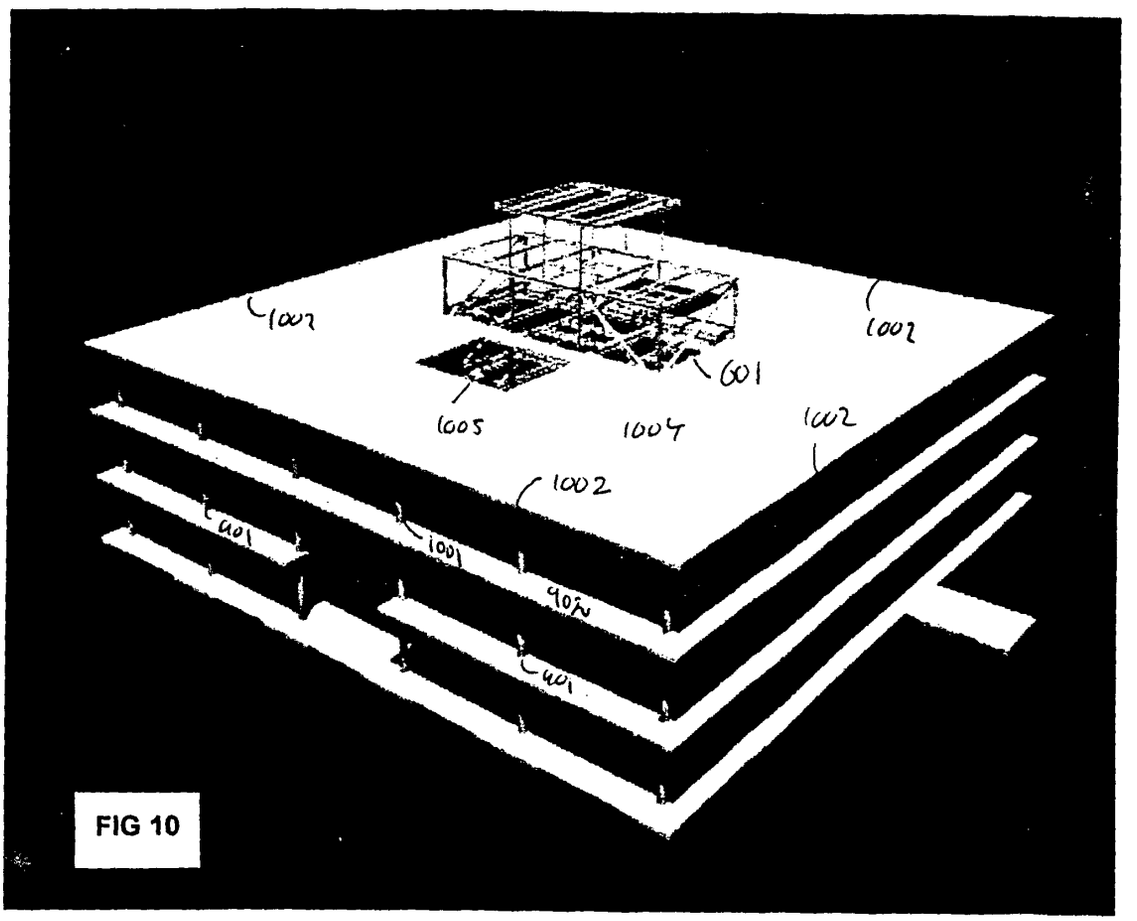


FIG 10

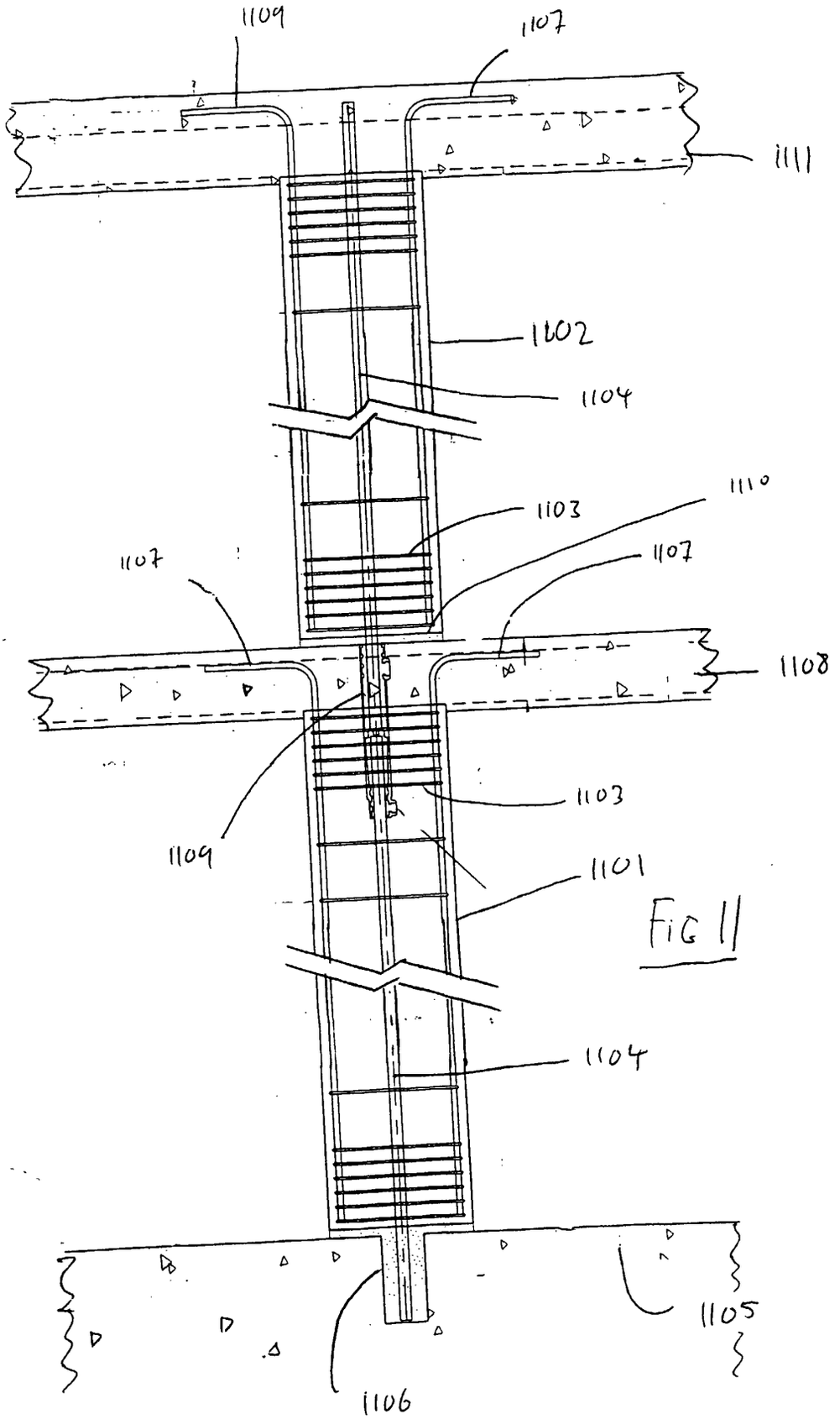

1109
1107
1111
1102
1104
1110
1103
1107
1107
1108
1103
1109
1101
1104
1105
1106

Fig 11

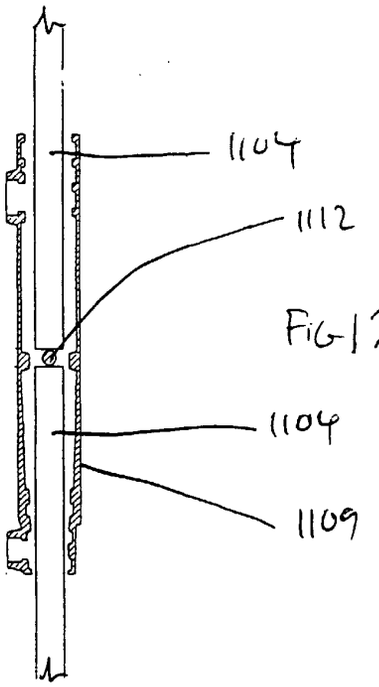


Fig 12

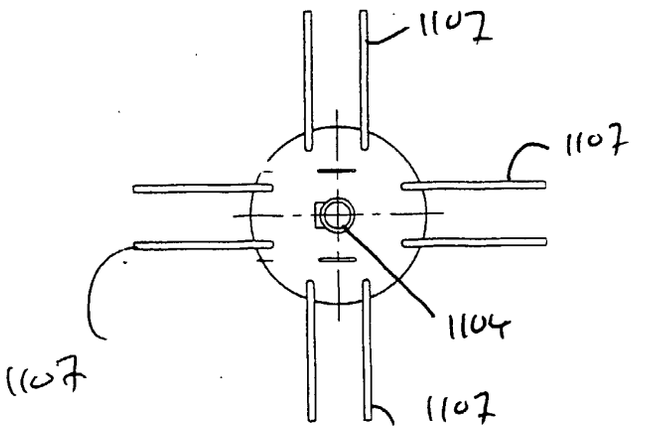


Fig 13

Fig 14

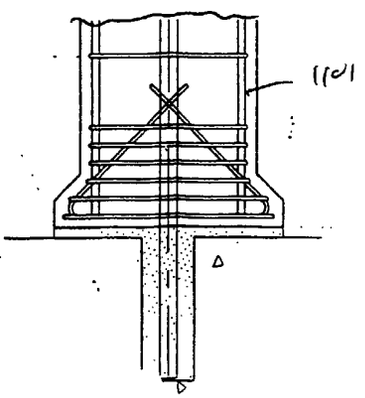
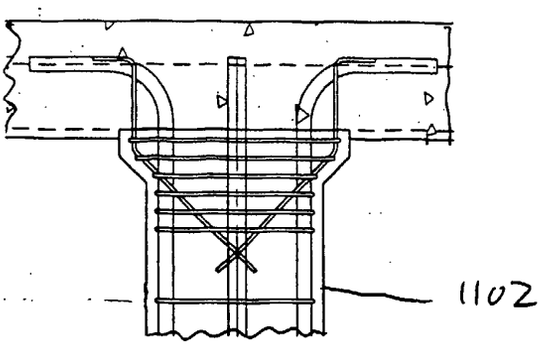


Fig 15



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 30 8911

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 953 697 A (JANDL PATENTHOLDING KEG A) 3 November 1999 (1999-11-03) * the whole document *	1-4,6-9	E04H1/00 E04B5/38
X	FR 2 551 122 A (DAVID JEAN) 1 March 1985 (1985-03-01) * the whole document *	1-4,6-9	
Y		5	
Y	FR 2 333 109 A (GEN BATIMENT) 24 June 1977 (1977-06-24) * the whole document *	5	
X	GB 1 433 825 A (BUDAPEST MUSZAKI EGYETEM BETON;EMEXPORT FOVALLALKOZO VALLALAT) 28 April 1976 (1976-04-28) * the whole document *	1-4,6-9	
X	GB 2 182 689 A (AL REEDY AL SAYED SAMI MOHAMMA) 20 May 1987 (1987-05-20) * the whole document *	1,3,4, 6-9	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			E04H E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 February 2002	Delzor, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 30 8911

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

05-02-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0953697 A	03-11-1999	AT 3661 U1	26-06-2000
		AT 3823 U1	25-08-2000
		EP 0953697 A2	03-11-1999
FR 2551122 A	01-03-1985	FR 2550256 A1	08-02-1985
		FR 2551122 A2	01-03-1985
		FR 2551121 A2	01-03-1985
		FR 2558876 A2	02-08-1985
FR 2333109 A	24-06-1977	FR 2333109 A1	24-06-1977
GB 1433825 A	28-04-1976	HU 173309 B	28-04-1979
		DD 105643 A1	05-05-1974
		IT 1025010 B	10-08-1978
GB 2182689 A	20-05-1987	NONE	

EPO FORM P0459

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