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(54) INTERACTIVE BUILDING MODULE

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Related U.S. Application Data

(63) Continuation-in-part of application No. 11/143,877, filed on Jun. 2, 2005, now abandoned, which is a continuation-in-part of application No. 09/937,278, filed on Mar. 4, 2002, now abandoned, filed as application No. PCT/AU00/00240 on Mar. 23, 2000.

(30) **Foreign Application Priority Data**

Mar. 23, 1999 (AU) PP9408
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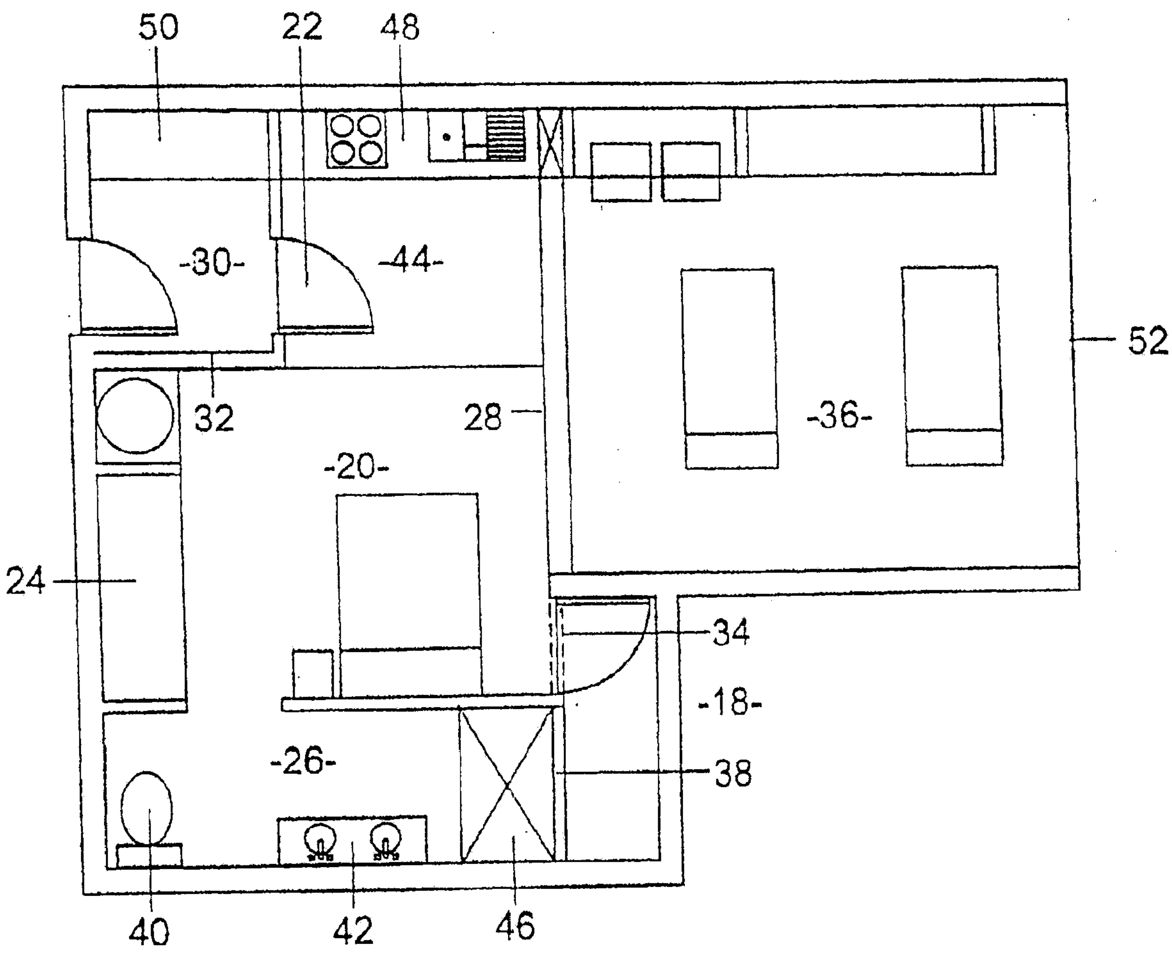
Publication Classification

(51) **Int. Cl.**
E04H 14/00 (2006.01)

(52) **U.S. Cl.** **52/79.1**

(57) **ABSTRACT**

A building module is disclosed which moves between a collapsed configuration, where it is sized and shaped similarly to a standard shipping container, and an erected configuration where it forms a building of greater space. Braced panels are hinged to form walls in the collapsed configuration and floors or ceilings in the erected configuration. The modules may be connected together to form a single storied or multistoried building.



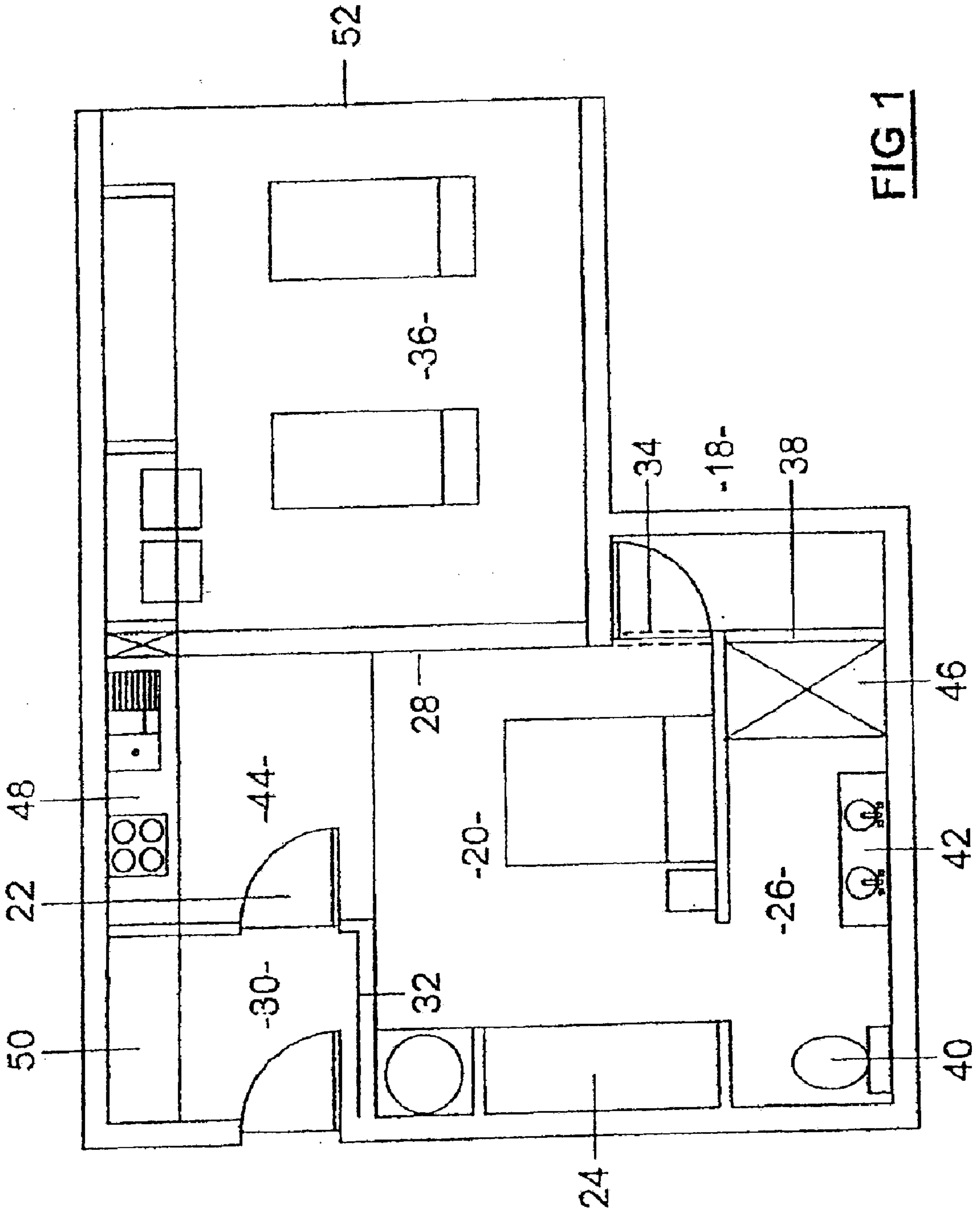


FIG 1

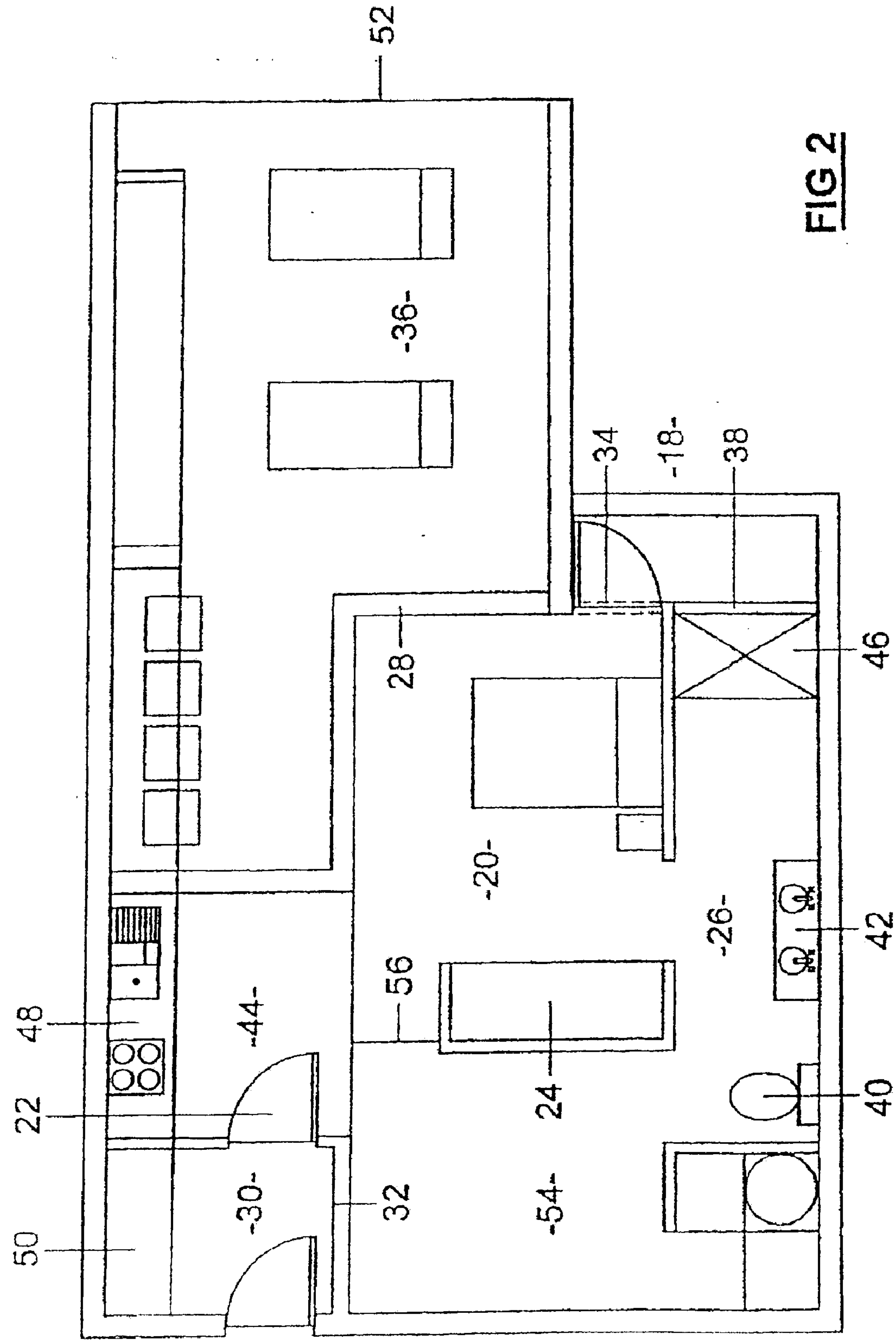


FIG 2

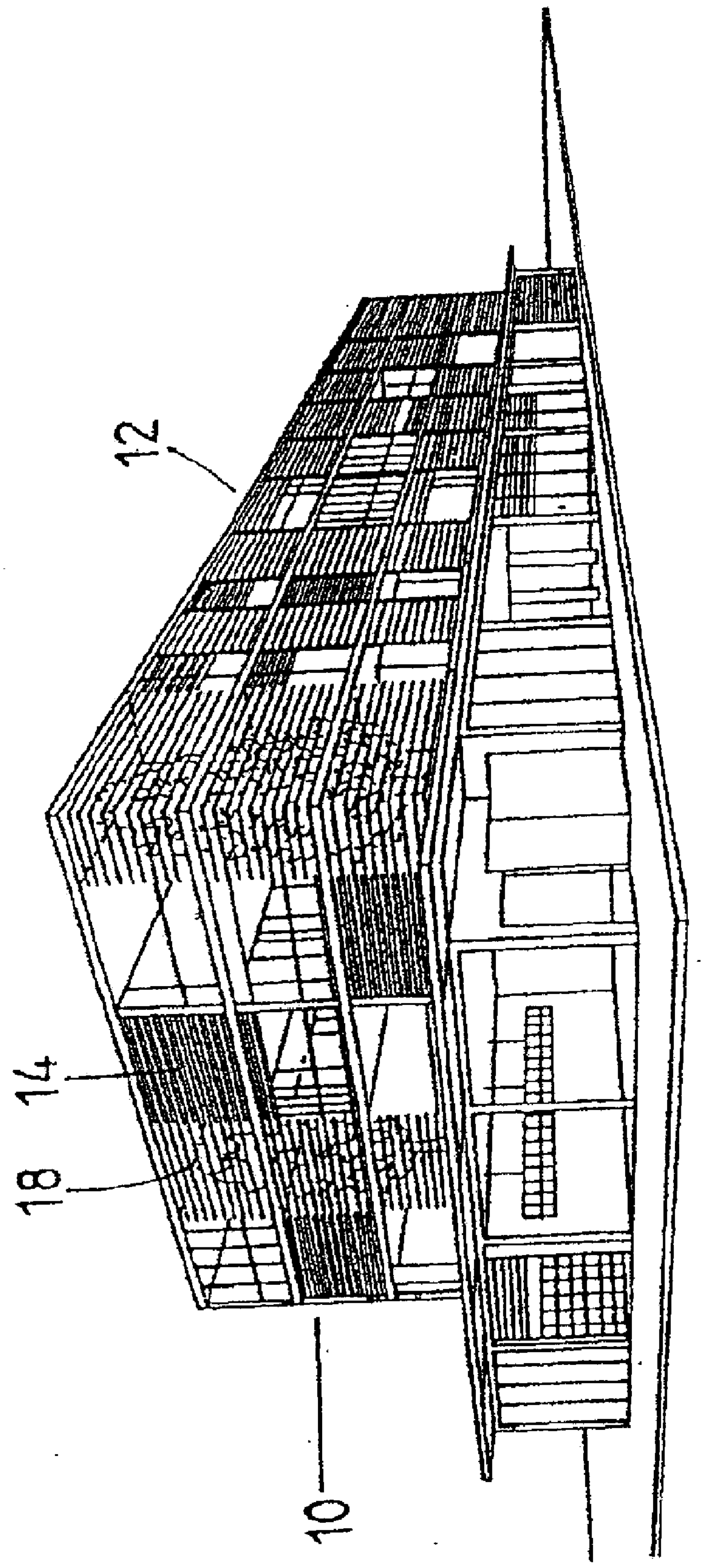


FIG 3

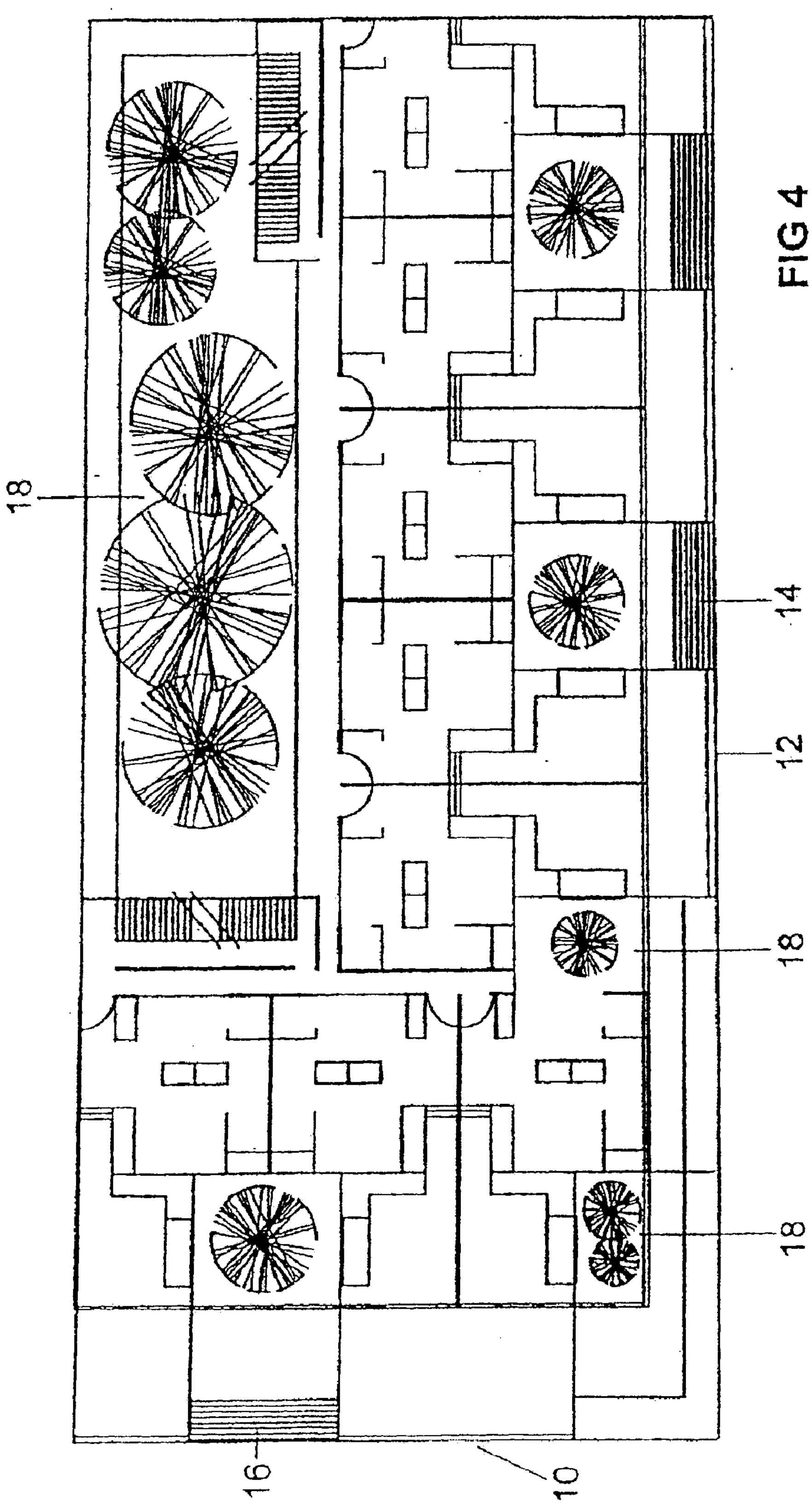
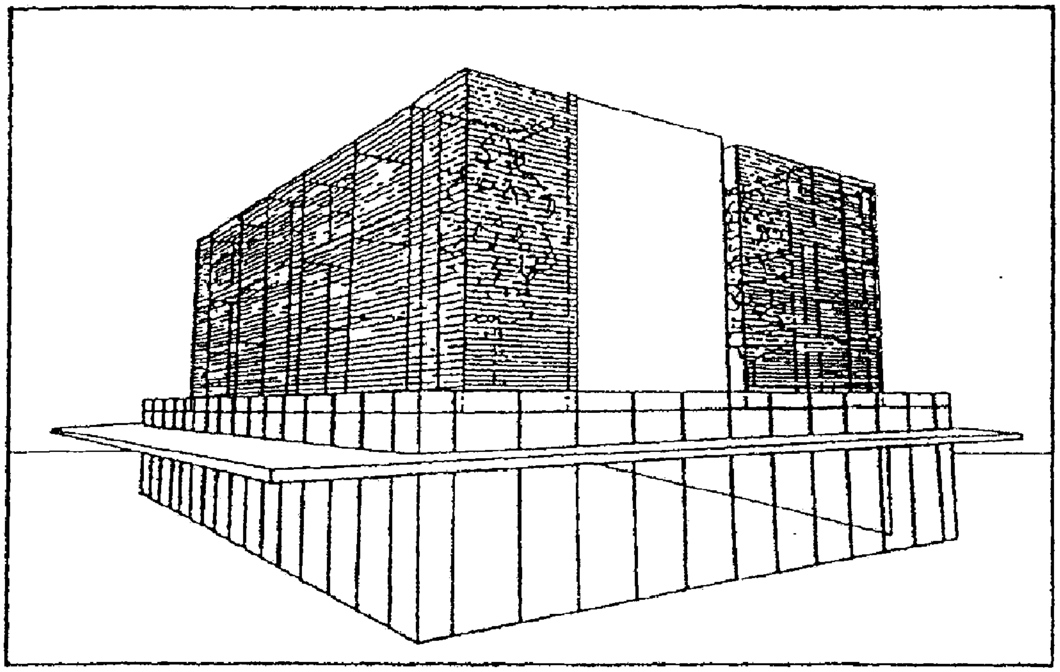
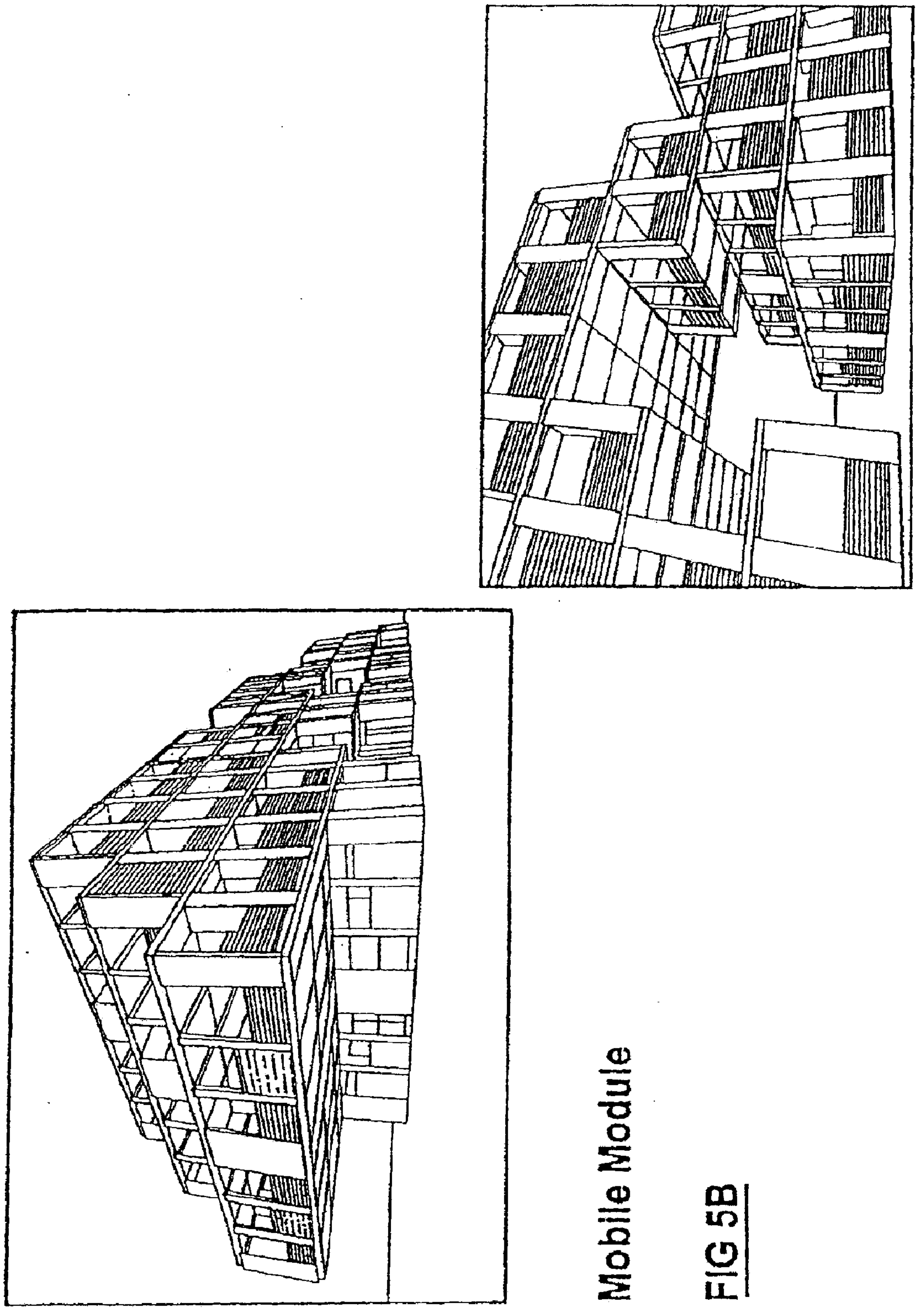


FIG 4



Fixed Module

FIG 5A



Mobile Module

FIG 5B

OFFICE

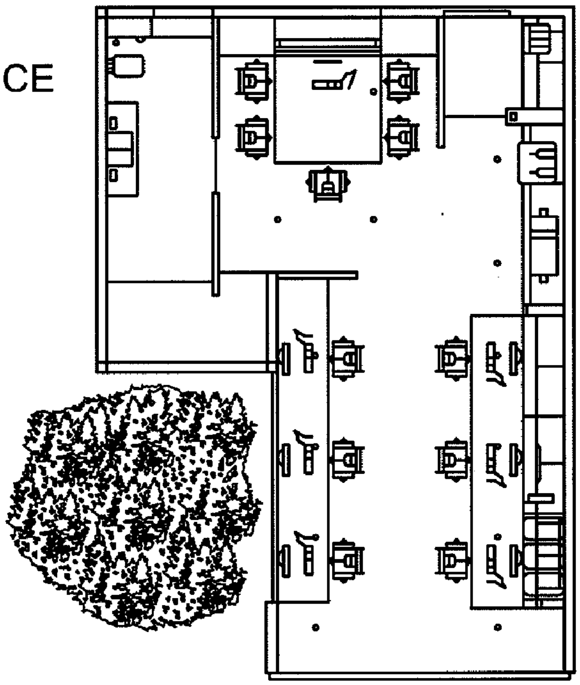


FIG. 7

LIVING ROOM

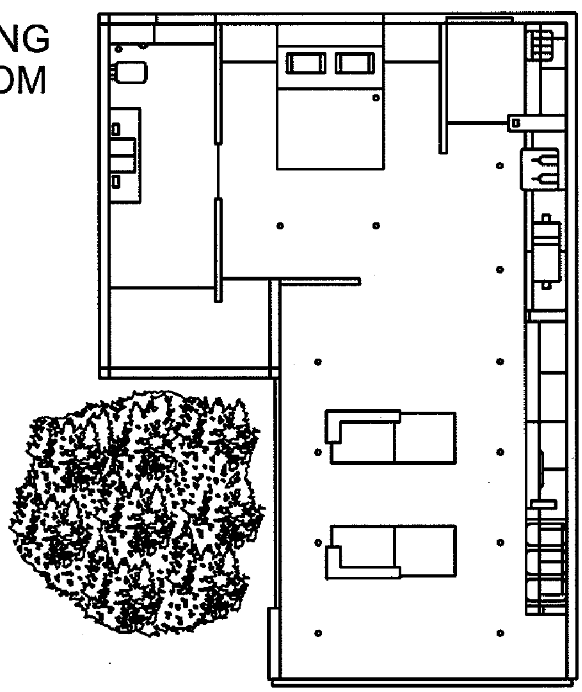


FIG. 6

Schematic Illustration of the Power and Air Conditioning Systems

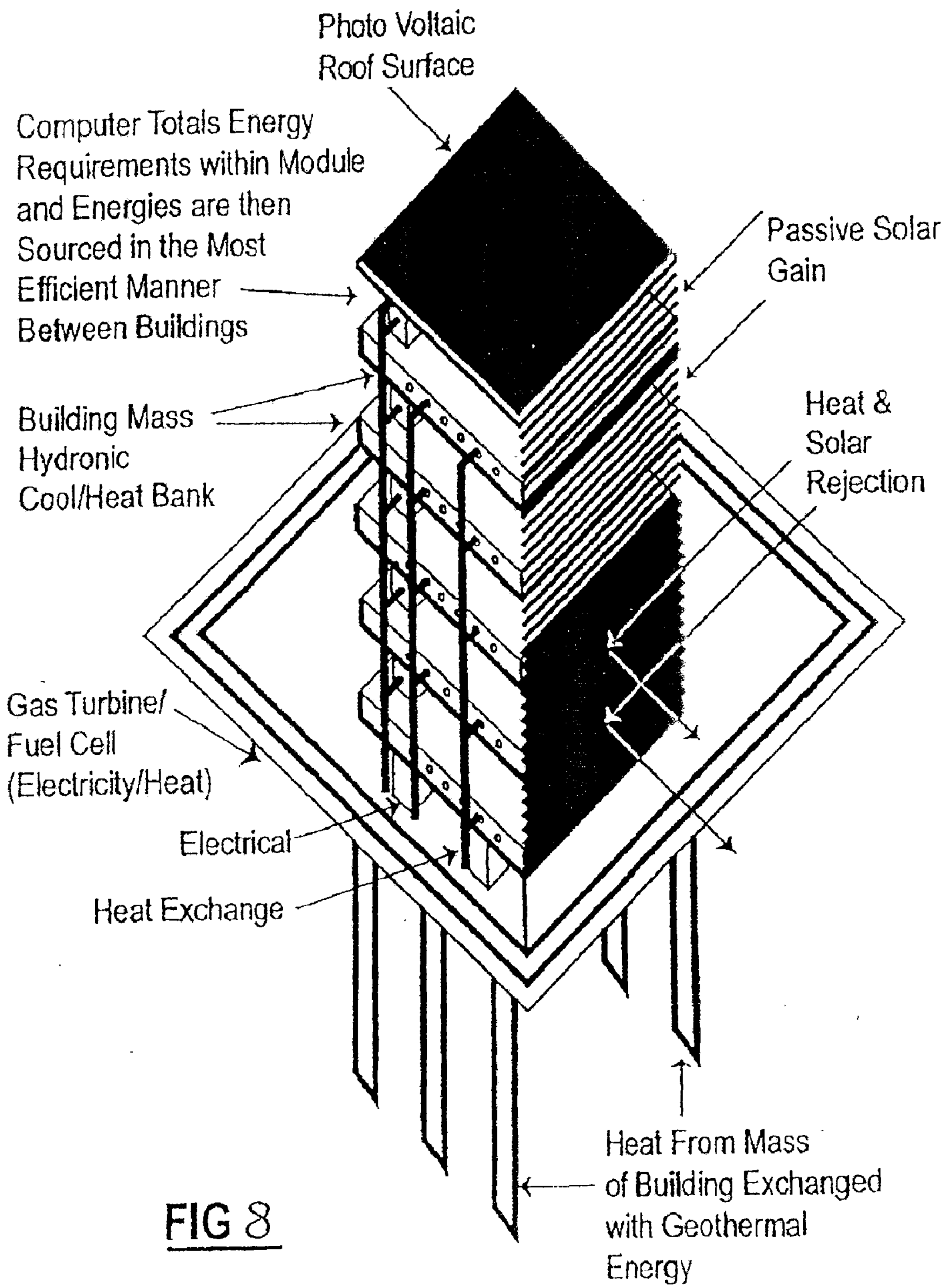


FIG 8

Schematic Illustration of the Natural Air Handling System

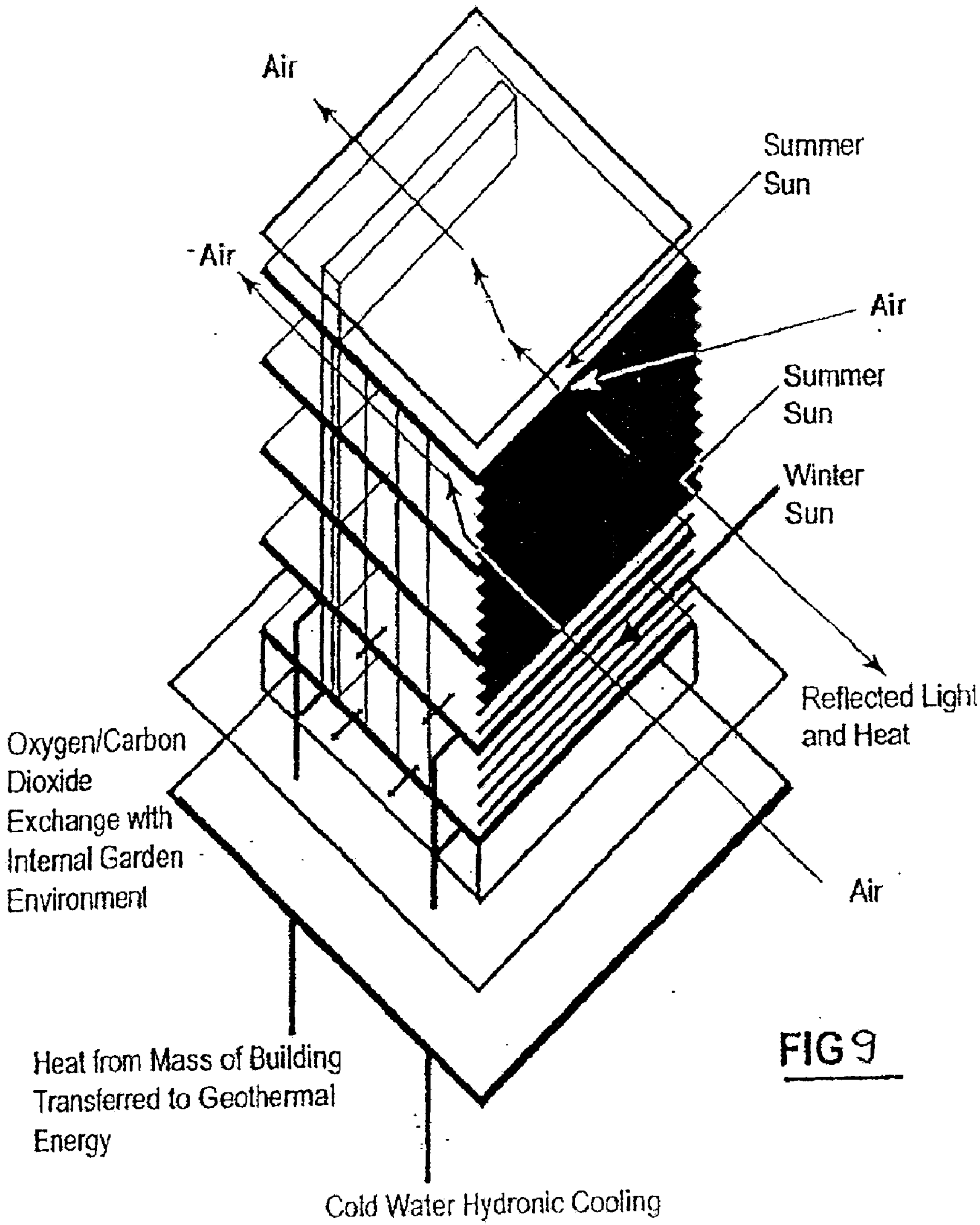
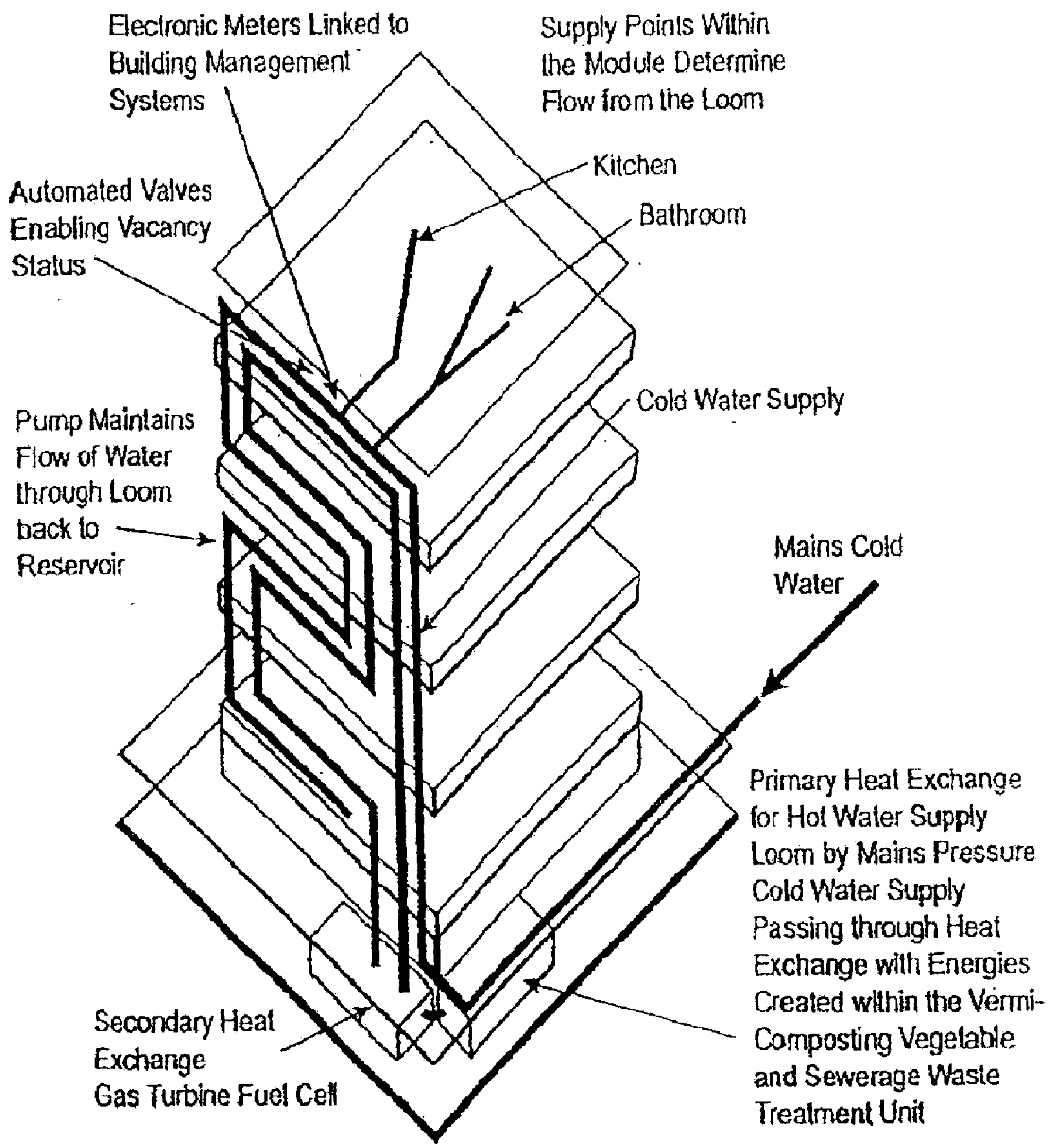


FIG 9

Schematic Illustration of the Hot Water Loom System



A Series of Standardised Ceiling Panels Located Within the Common Area Create Accessible Services Duct for Placement of Hydraulic Electrical and Data Looms. Electrical Meters Switches Valves and Pumps are Networked to the Building Management. Computer which Interactively Process the Data for Efficient Sourcing Supply and for Accounting Purposes.

FIG 10

Schematic Illustration of Water Collection and Reticulated Reuse System

- Automated & Sealed Verm/Composting Unit Separates Solid Wastes From Liquid.
- Waste Materials Are processed by Worms.
- Worm Castings Provide High Bred Fertiliser for Gardens.
- Liquid Waste Undergoes Primary Processing Before it Passes Through an Ozone Filter in Transit to Black Water Storage.
- Pressure Pump Automatically Distributes Black Water.
- Water Used for Gardens and up to a Maximum 70% Re-Use in Toilet Systems.
- Black Water Storage May Also Provide a Supply for Fire Prevention Systems within Buildings.

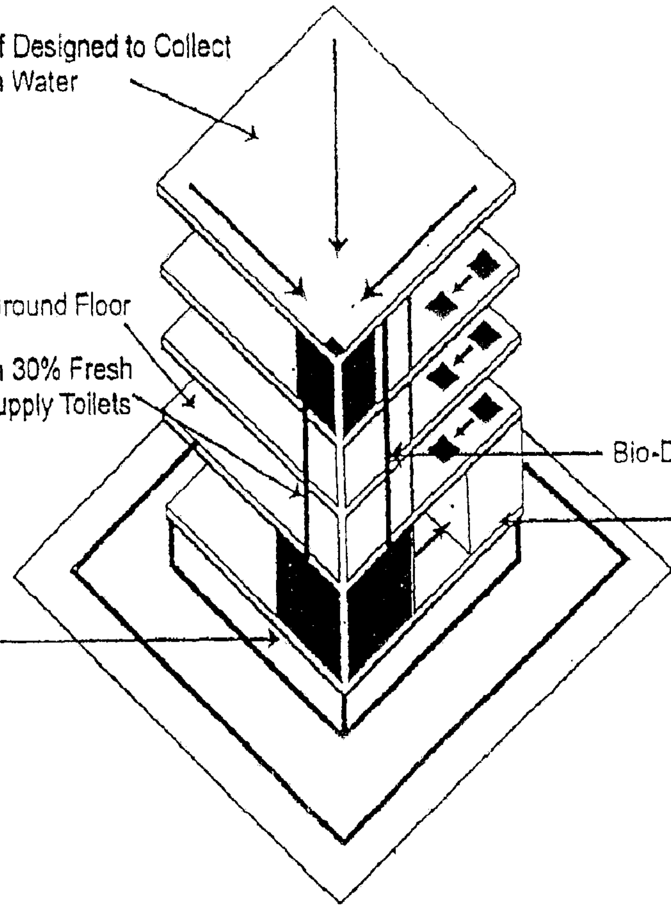


FIG 11

Schematic Illustration of the Closed Loop Air-Conditioning Energy Exchange

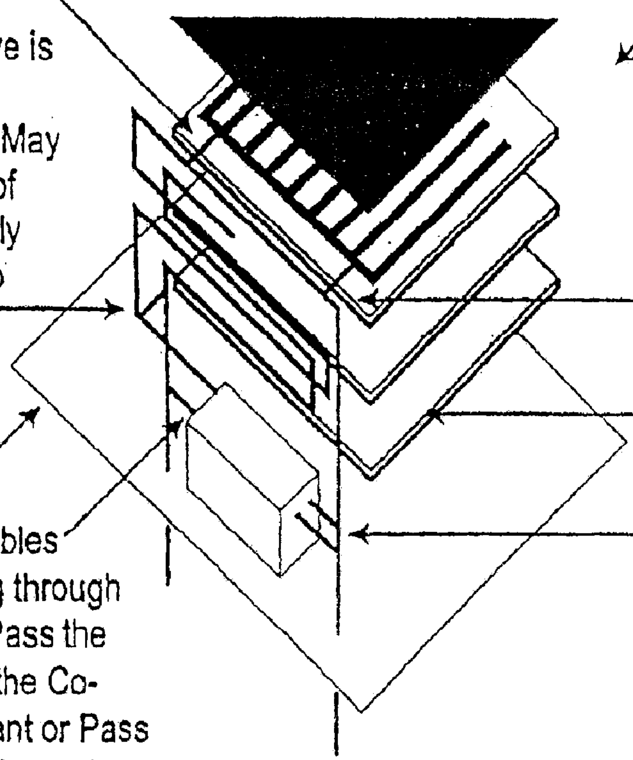


FIG 12

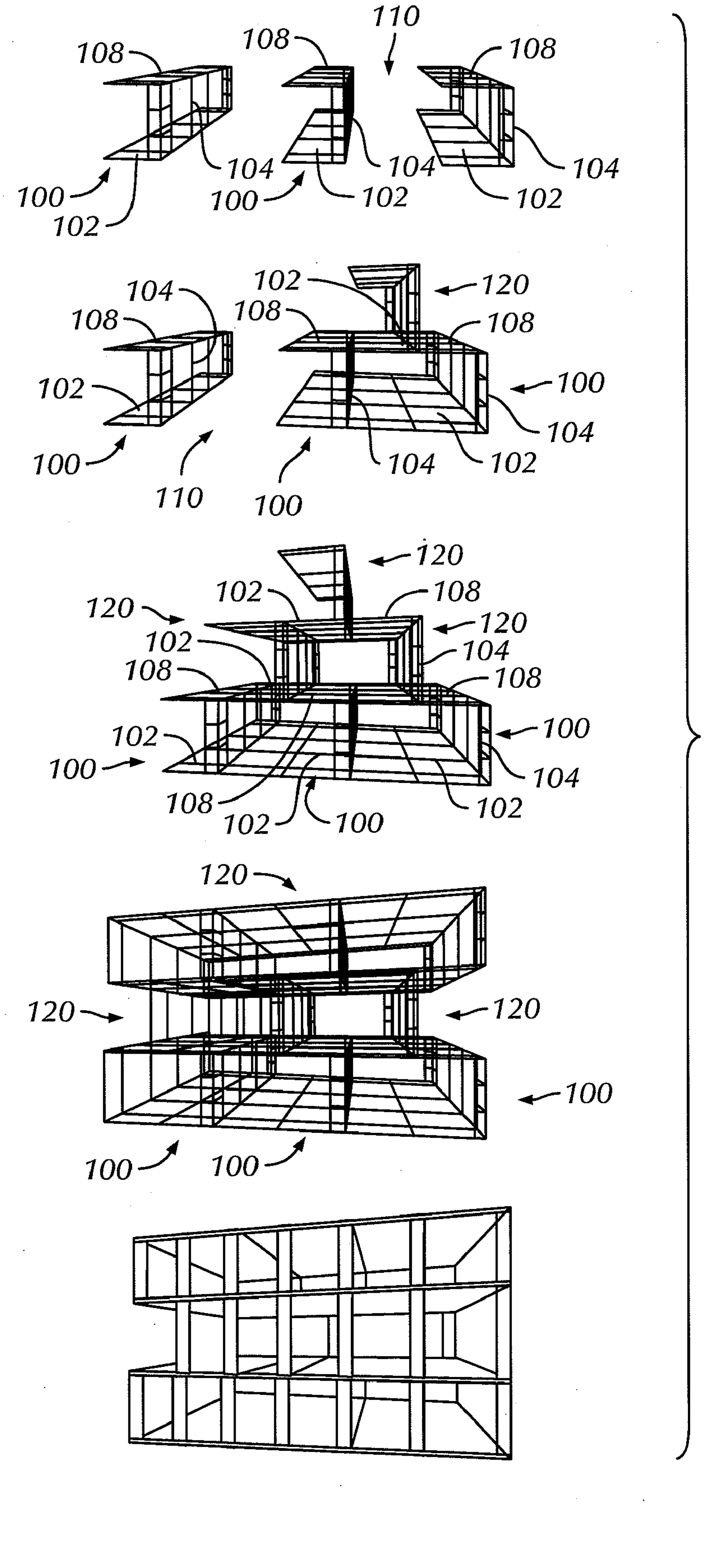

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FIG. 13

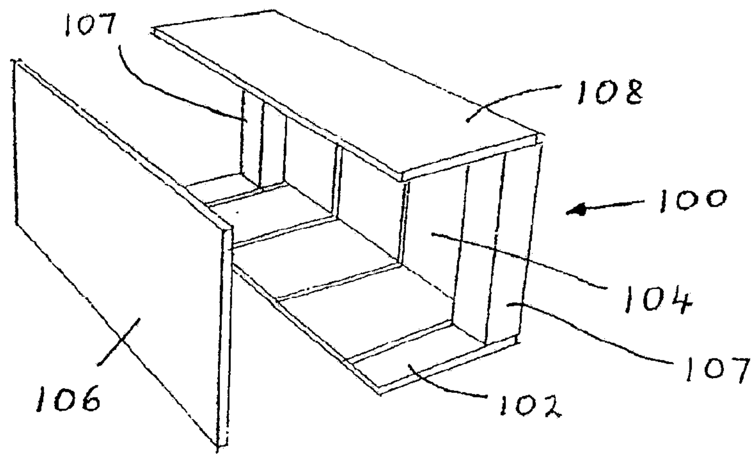


FIG 14 A

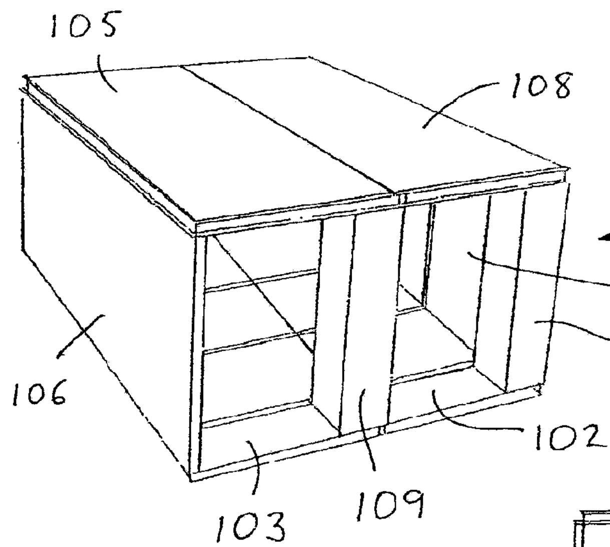


FIG. 14 B

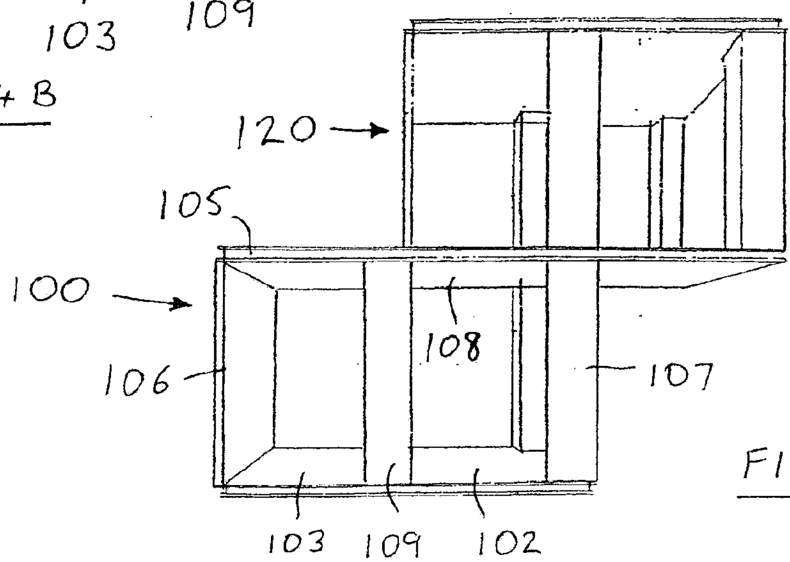


FIG. 14 C

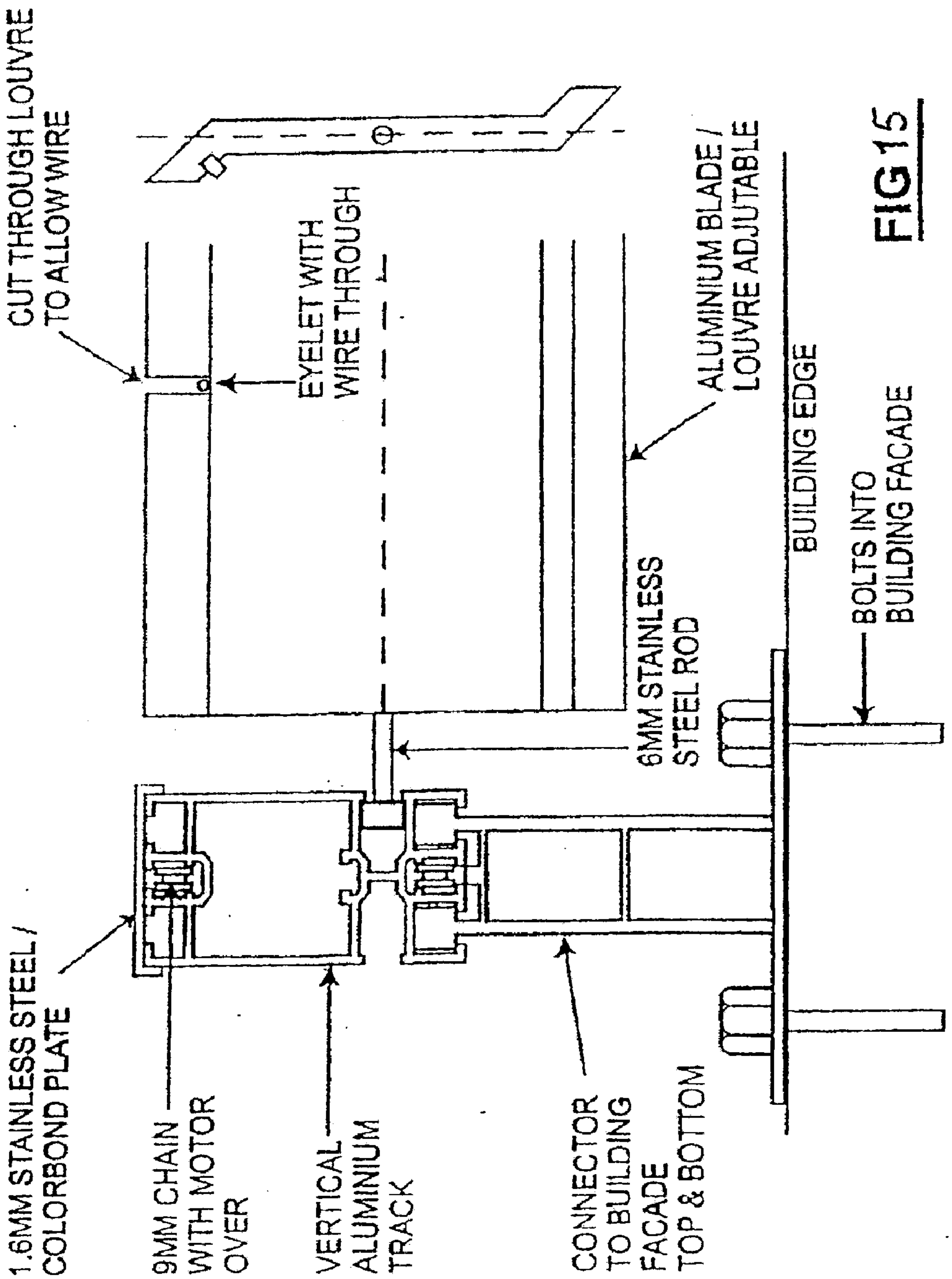

CUT THROUGH LOUVRE
TO ALLOW WIRE
EYELET WITH
WIRE THROUGH
ALUMINIUM BLADE /
LOUVRE ADJUTABLE
BUILDING EDGE
BOLTS INTO
BUILDING FACADE
6MM STAINLESS
STEEL ROD
1.6MM STAINLESS STEEL /
COLORBOND PLATE
9MM CHAIN
WITH MOTOR
OVER
VERTICAL
ALUMINIUM
TRACK
CONNECTOR
TO BUILDING
FACADE
TOP & BOTTOM

FIG 15

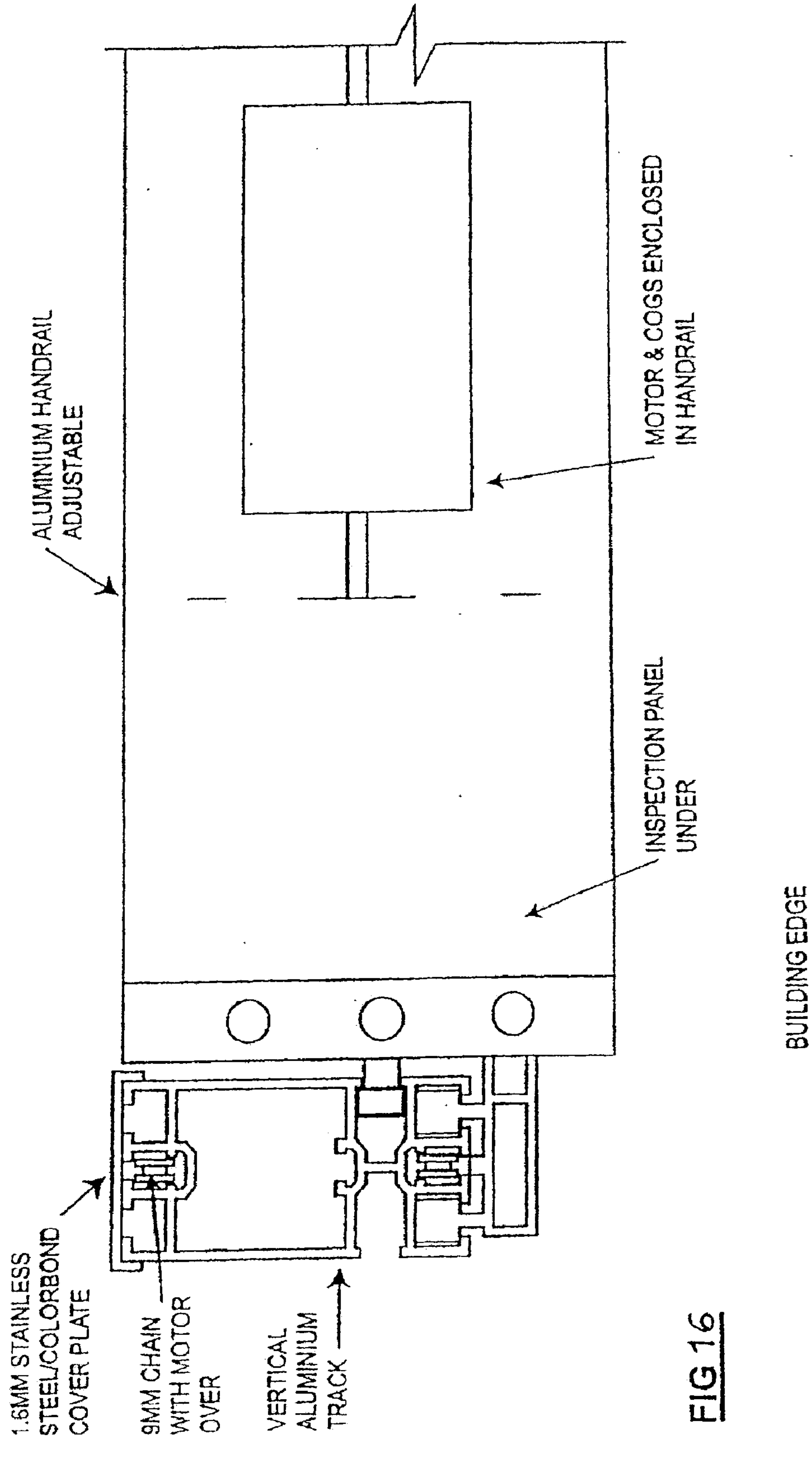

ALUMINIUM HANDRAIL
ADJUSTABLE
MOTOR & COGS ENCLOSED
IN HANDRAIL
INSPECTION PANEL
UNDER
BUILDING EDGE
1.6MM STAINLESS
STEEL/COLORBOND
COVER PLATE
9MM CHAIN
WITH MOTOR
OVER
VERTICAL
ALUMINIUM
TRACK

FIG 16

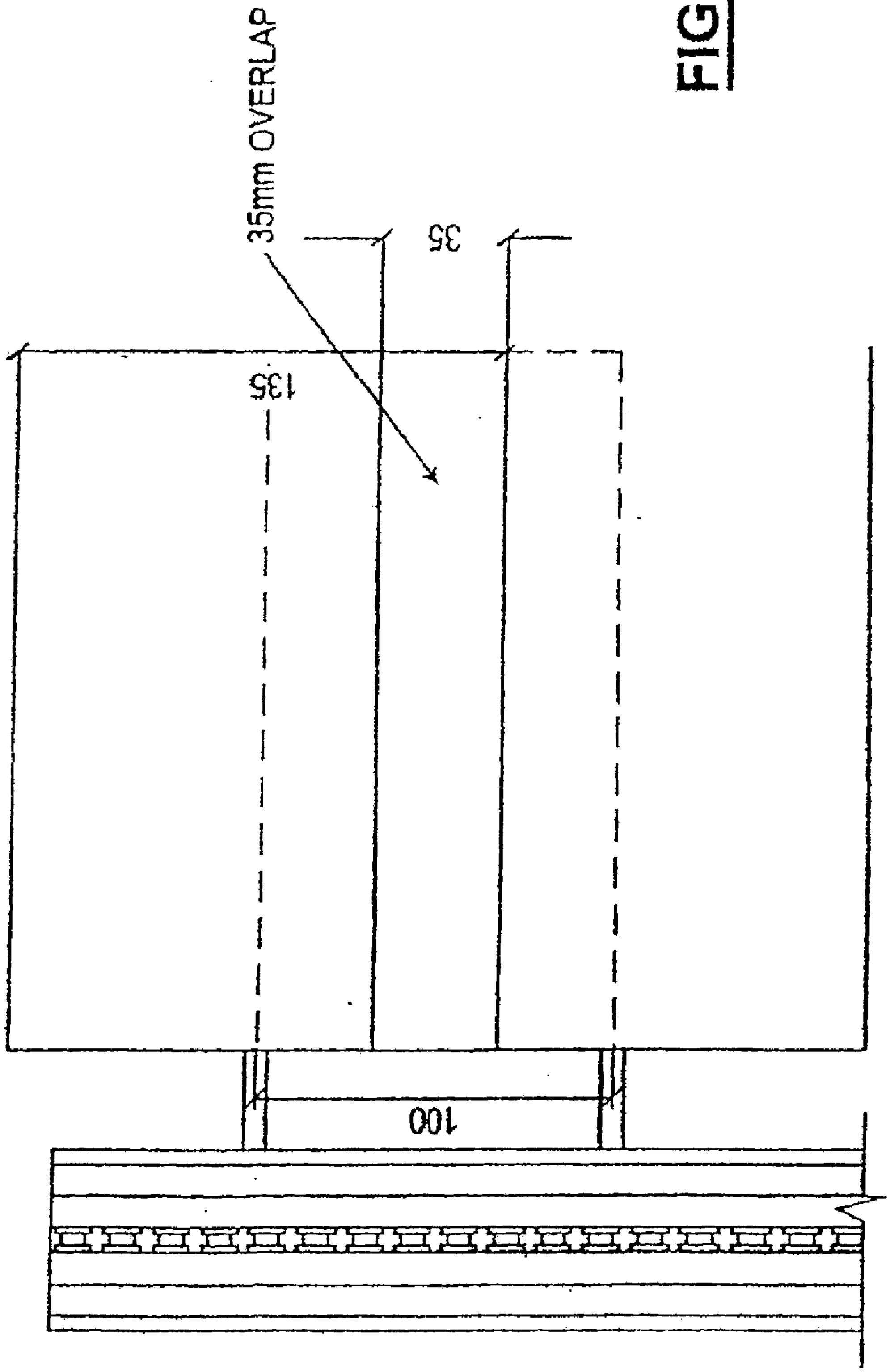


FIG 17

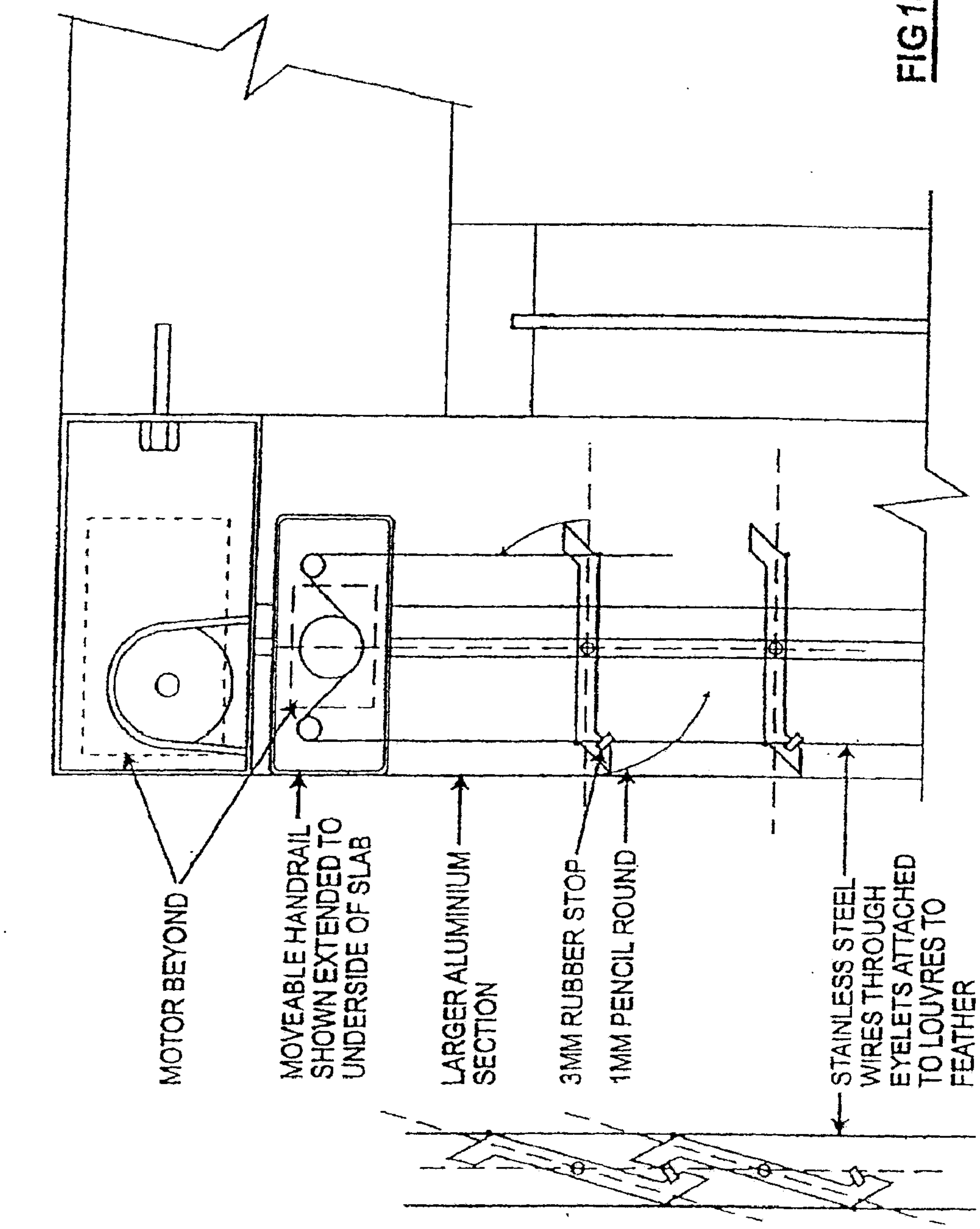

MOTOR BEYOND
MOVEABLE HANDRAIL SHOWN EXTENDED TO UNDERSIDE OF SLAB
LARGER ALUMINIUM SECTION
3MM RUBBER STOP
1MM PENCIL ROUND
STAINLESS STEEL WIRES THROUGH EYELETS ATTACHED TO LOUVRES TO FEATHER

FIG18

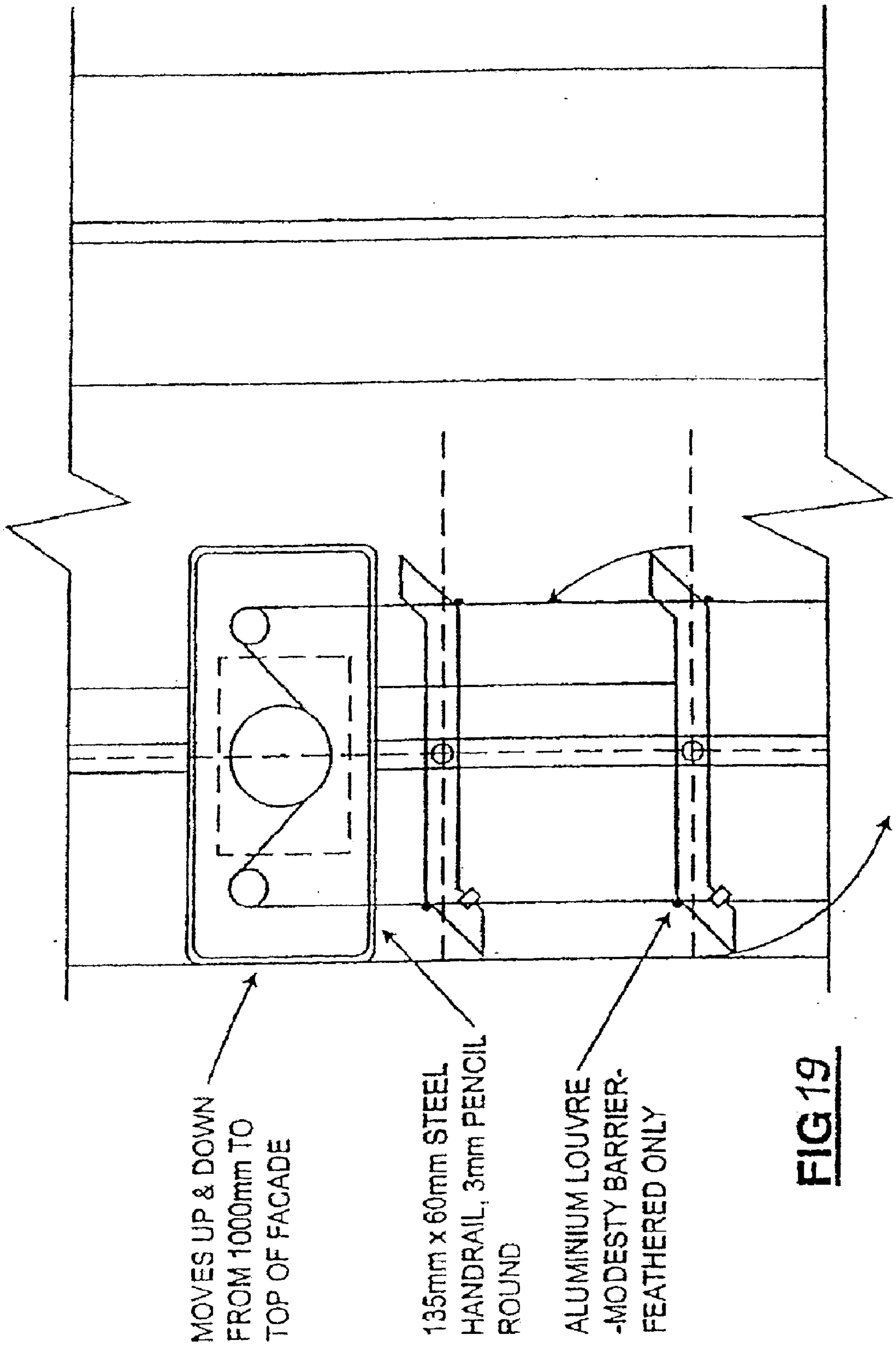

MOVES UP & DOWN
FROM 1000mm TO
TOP OF FACADE
135mm x 60mm STEEL
HANDRAIL, 3mm PENCIL
ROUND
ALUMINIUM LOUVRE
-MODESTY BARRIER-
FEATHERED ONLY

FIG 19

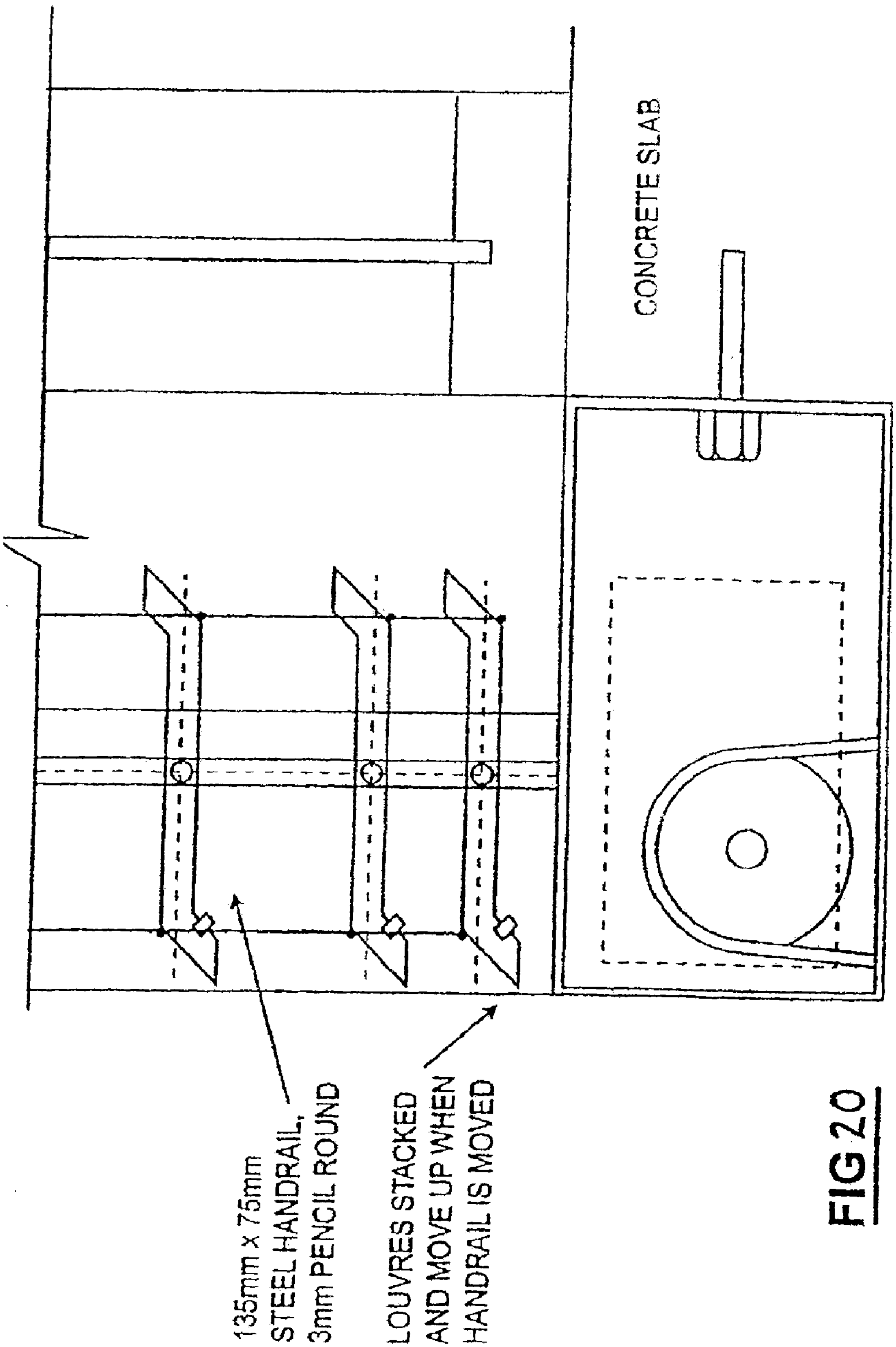

CONCRETE SLAB
135mm x 75mm
STEEL HANDRAIL,
3mm PENCIL ROUND
LOUVRES STACKED
AND MOVE UP WHEN
HANDRAIL IS MOVED

FIG 20

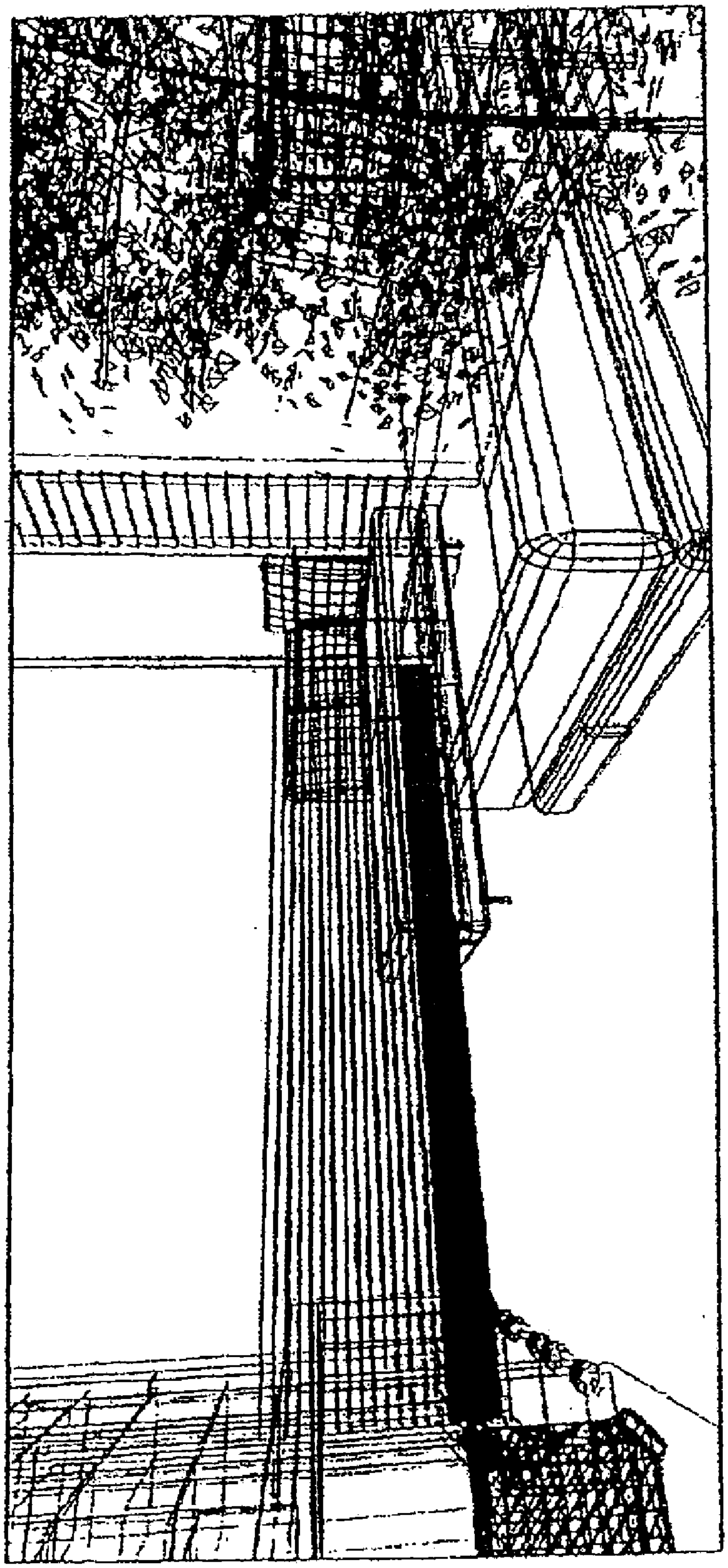


FIG 21

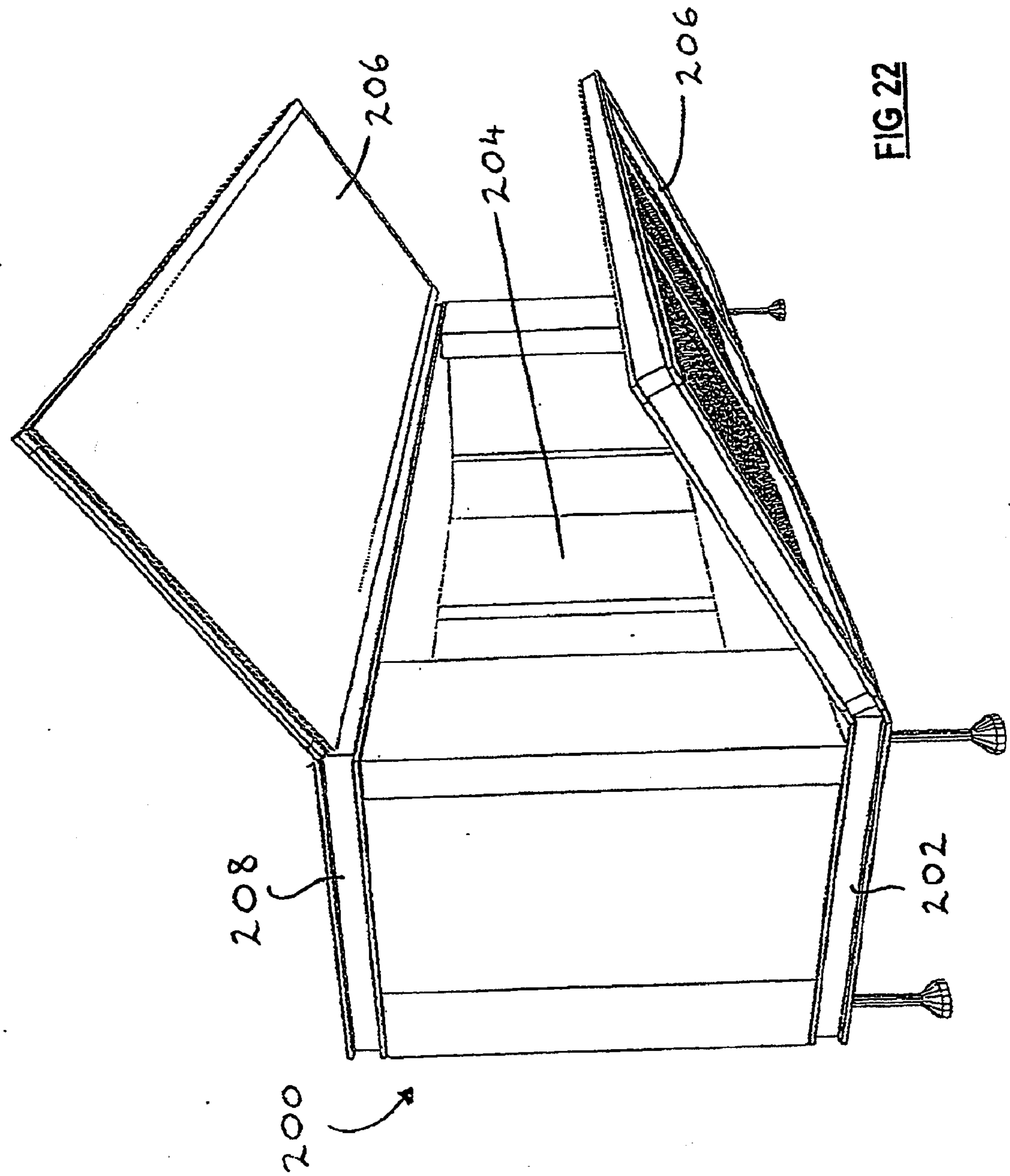


FIG 22

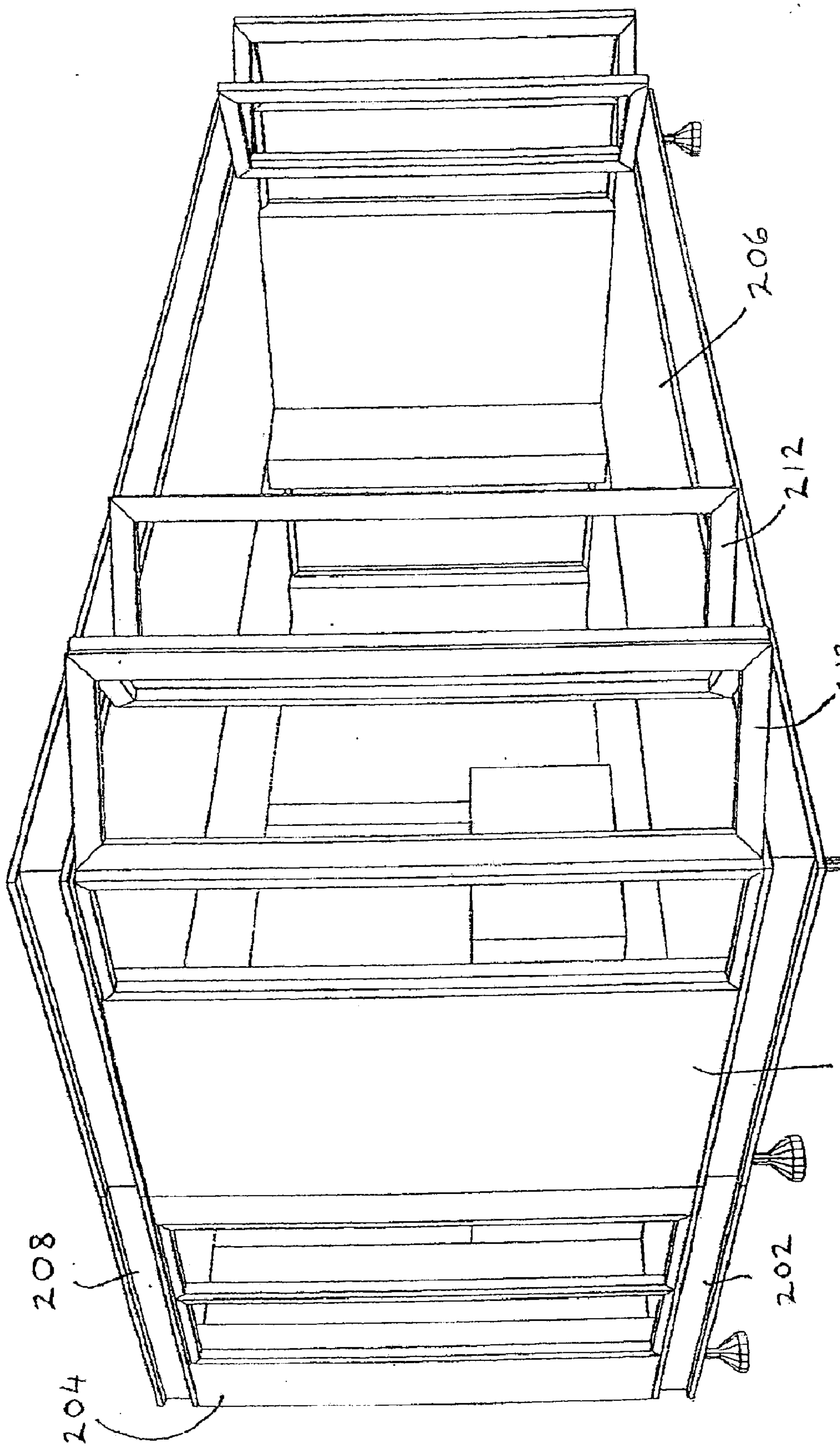
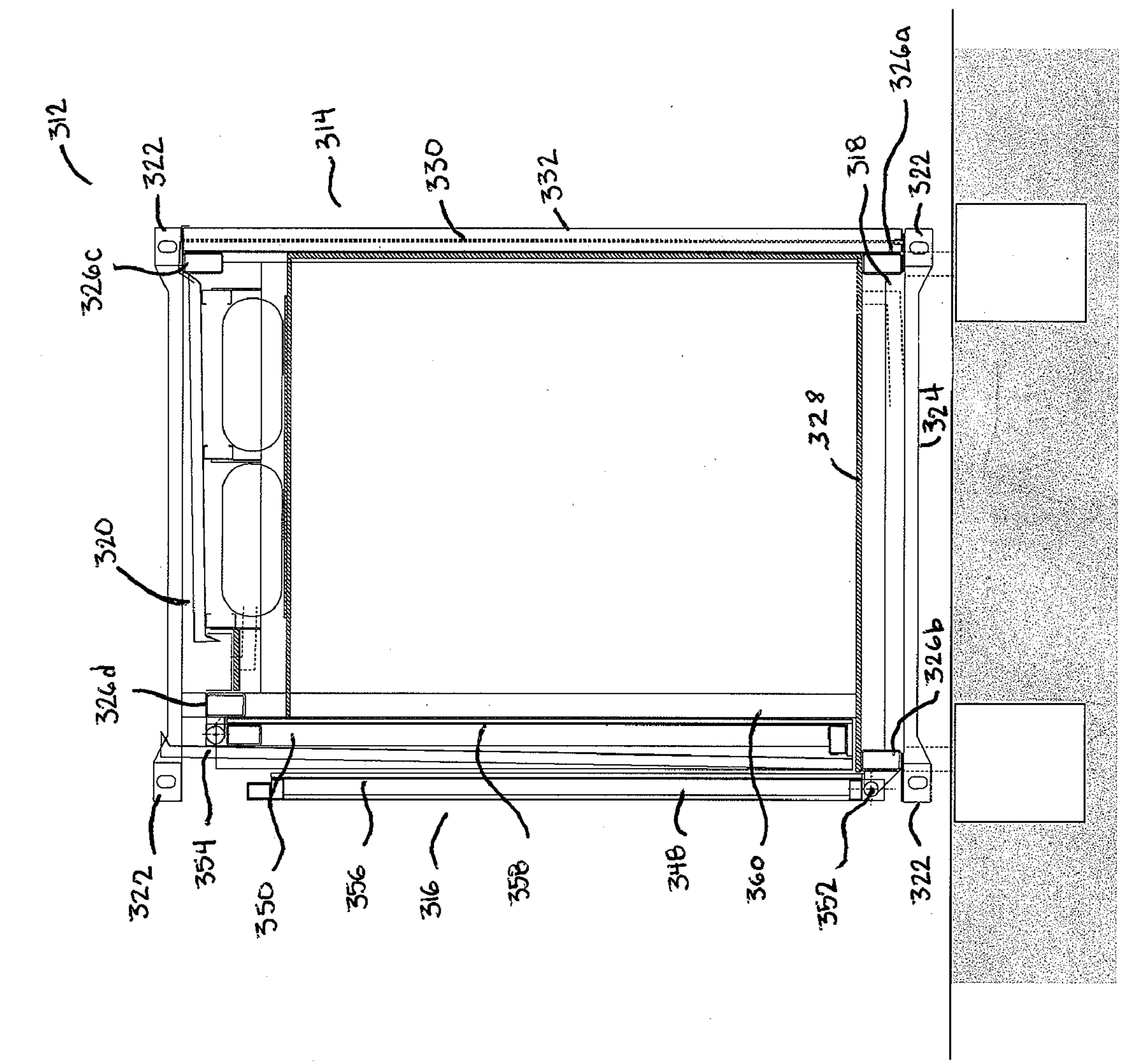


FIG 23

Fig. 24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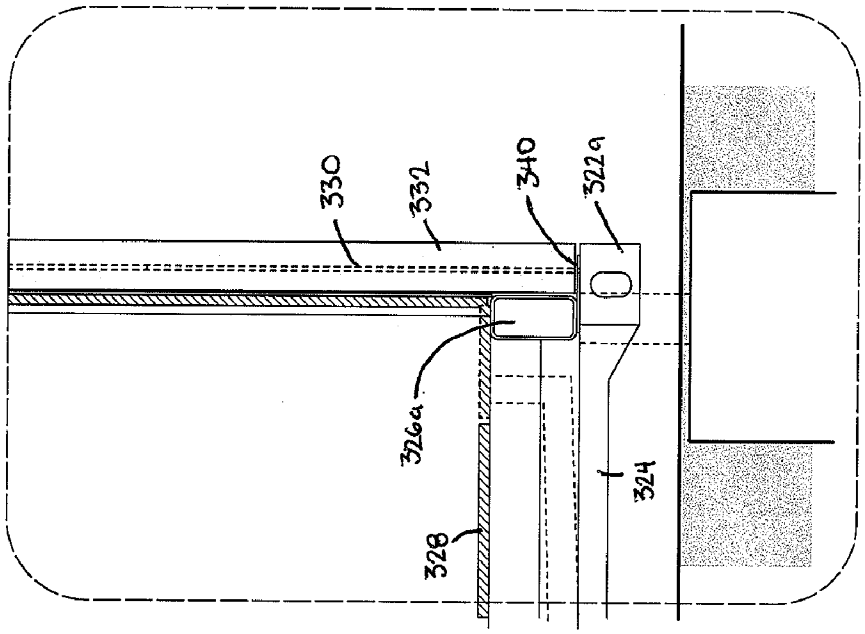
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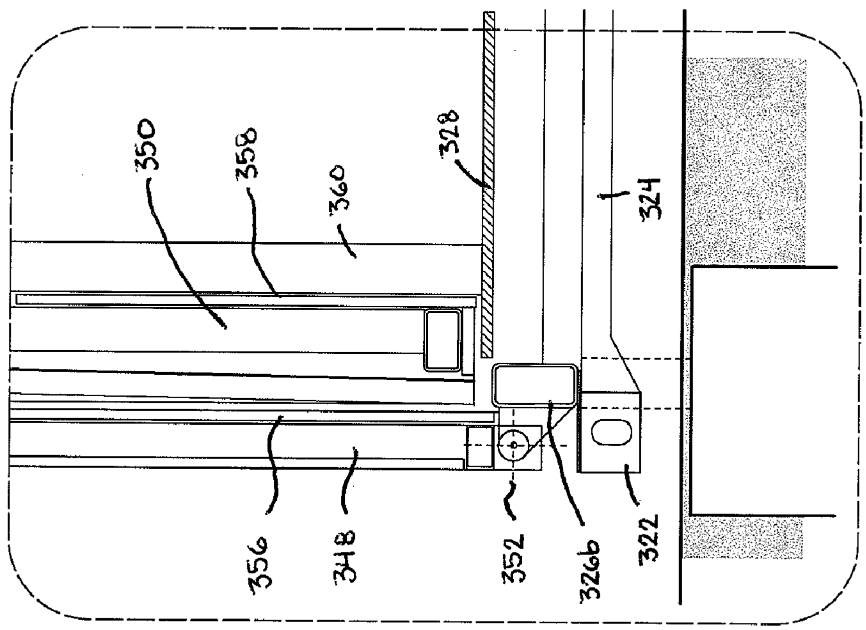
Fig. 26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326b
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Fig. 25

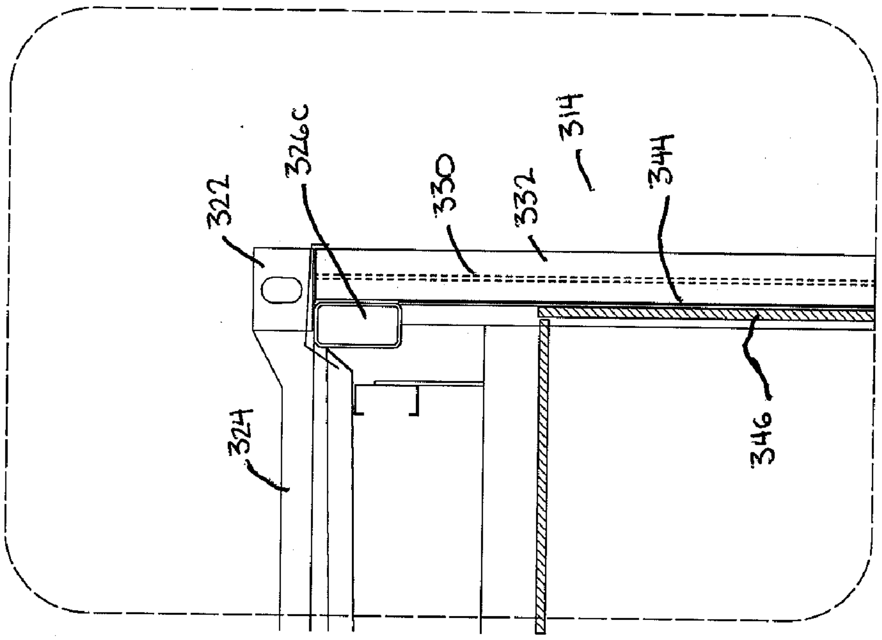


Fig. 28

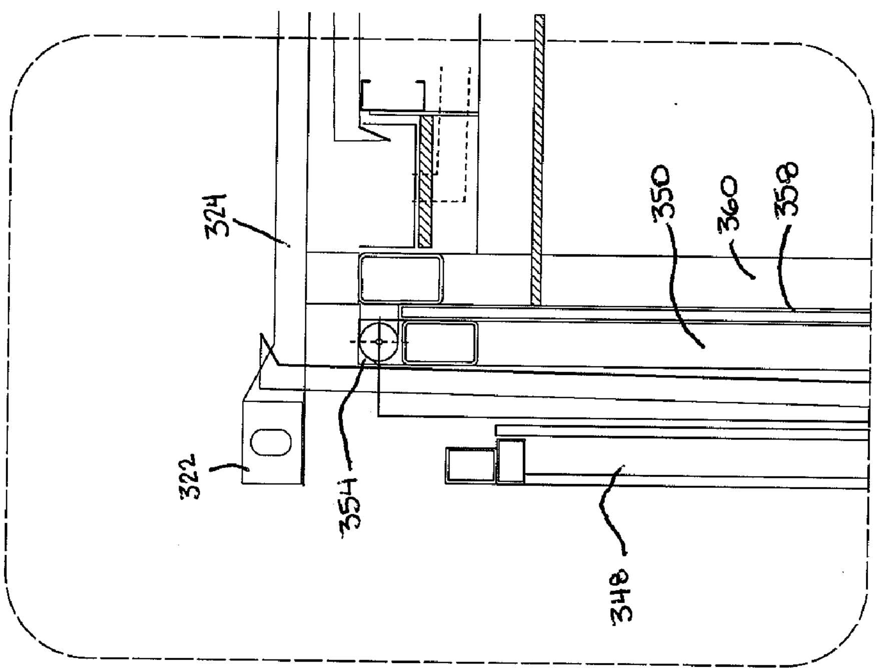


Fig. 27

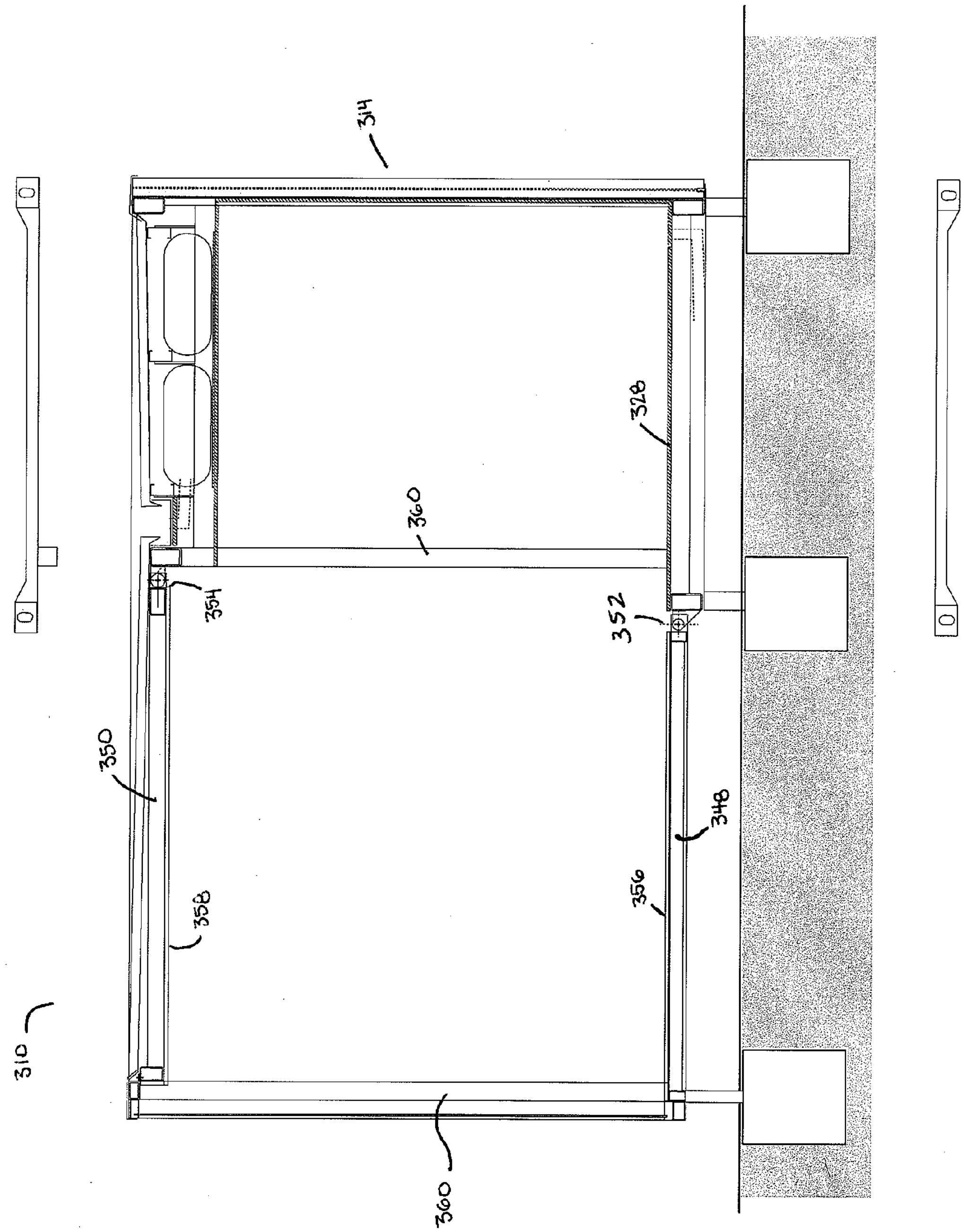


Fig. 29

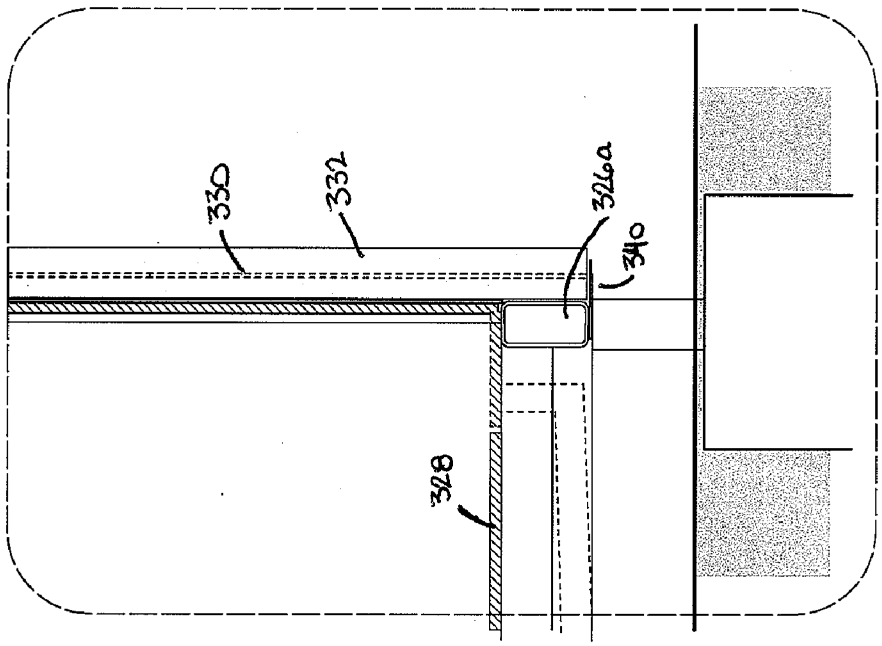


Fig. 31

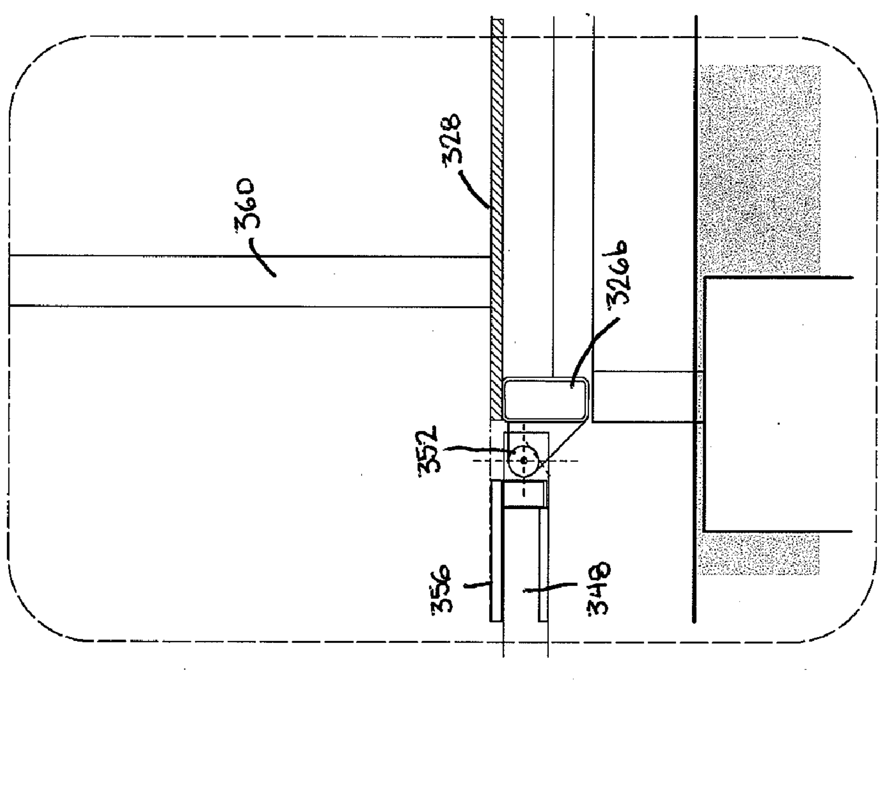


Fig. 30

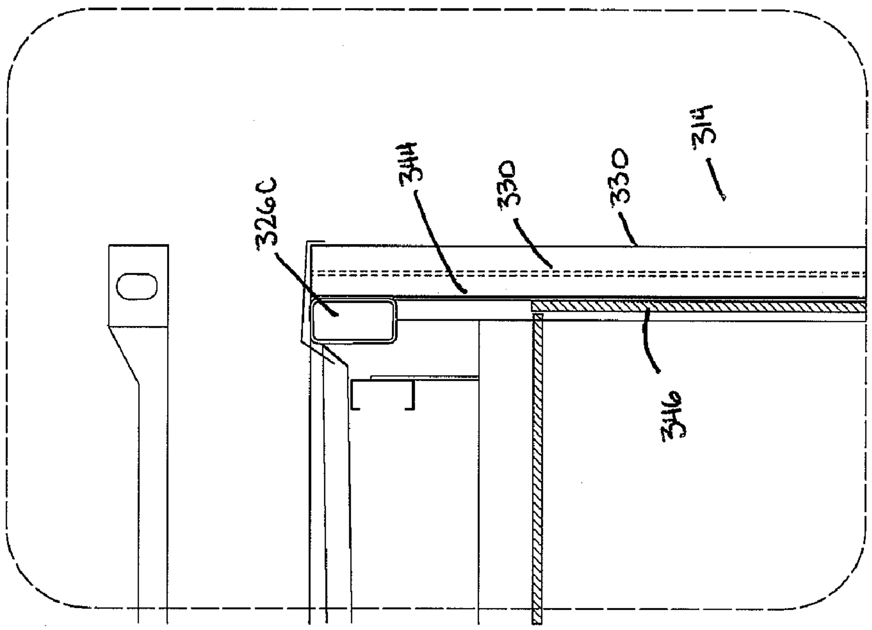


Fig. 33

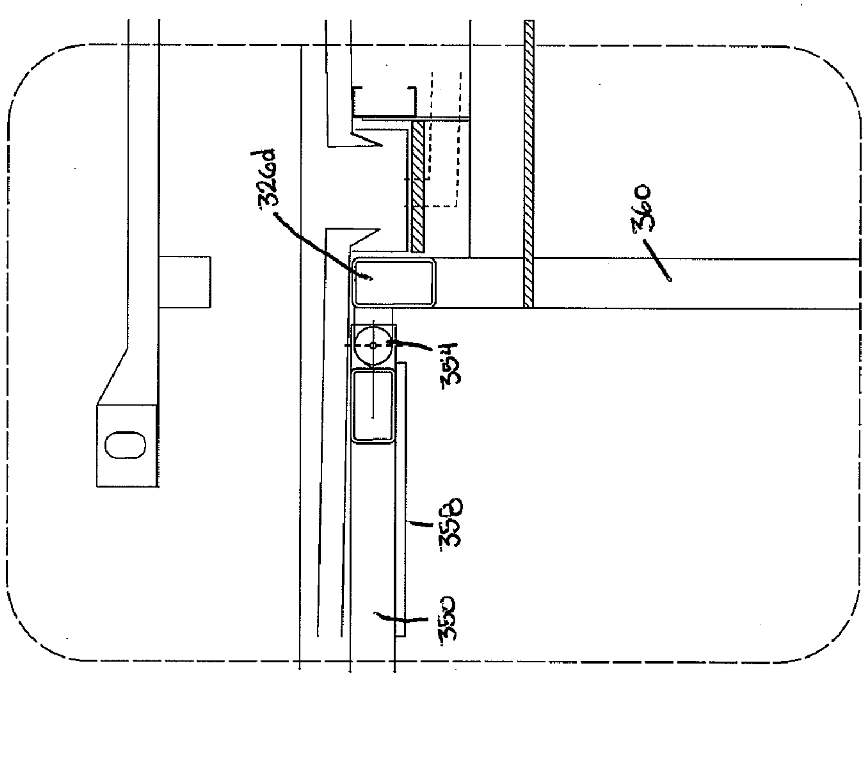


Fig. 32

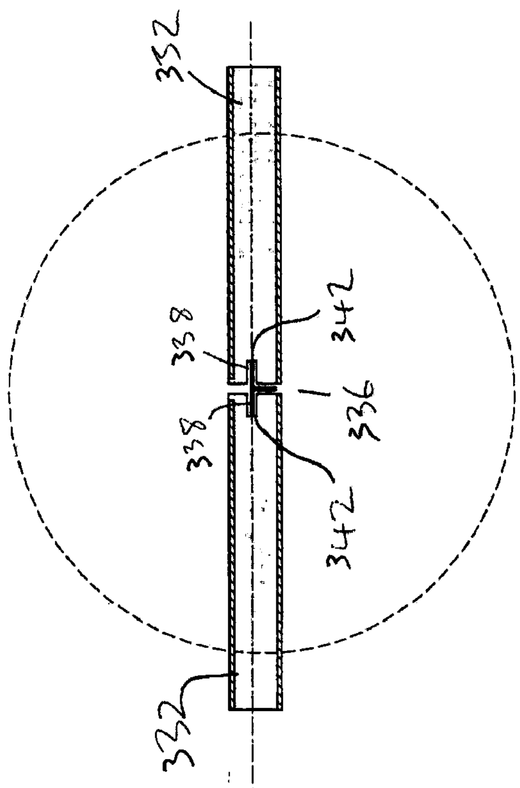


Fig. 35

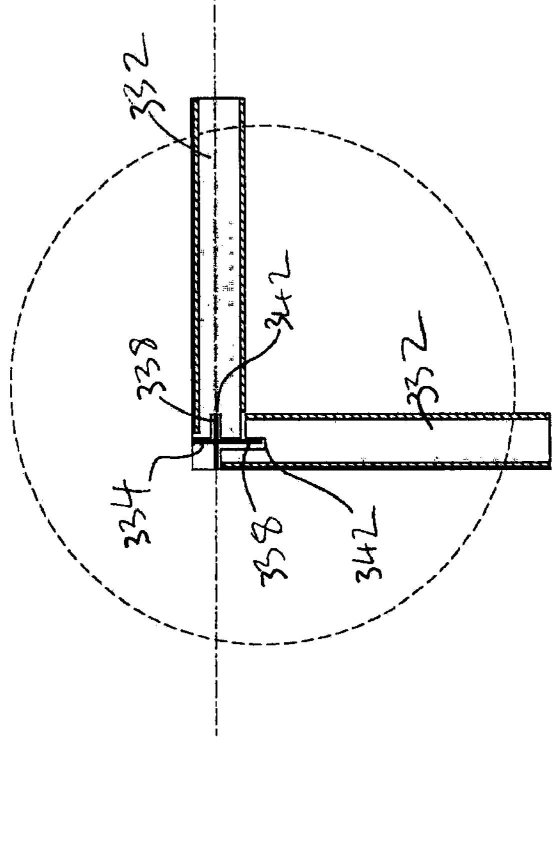


Fig. 34

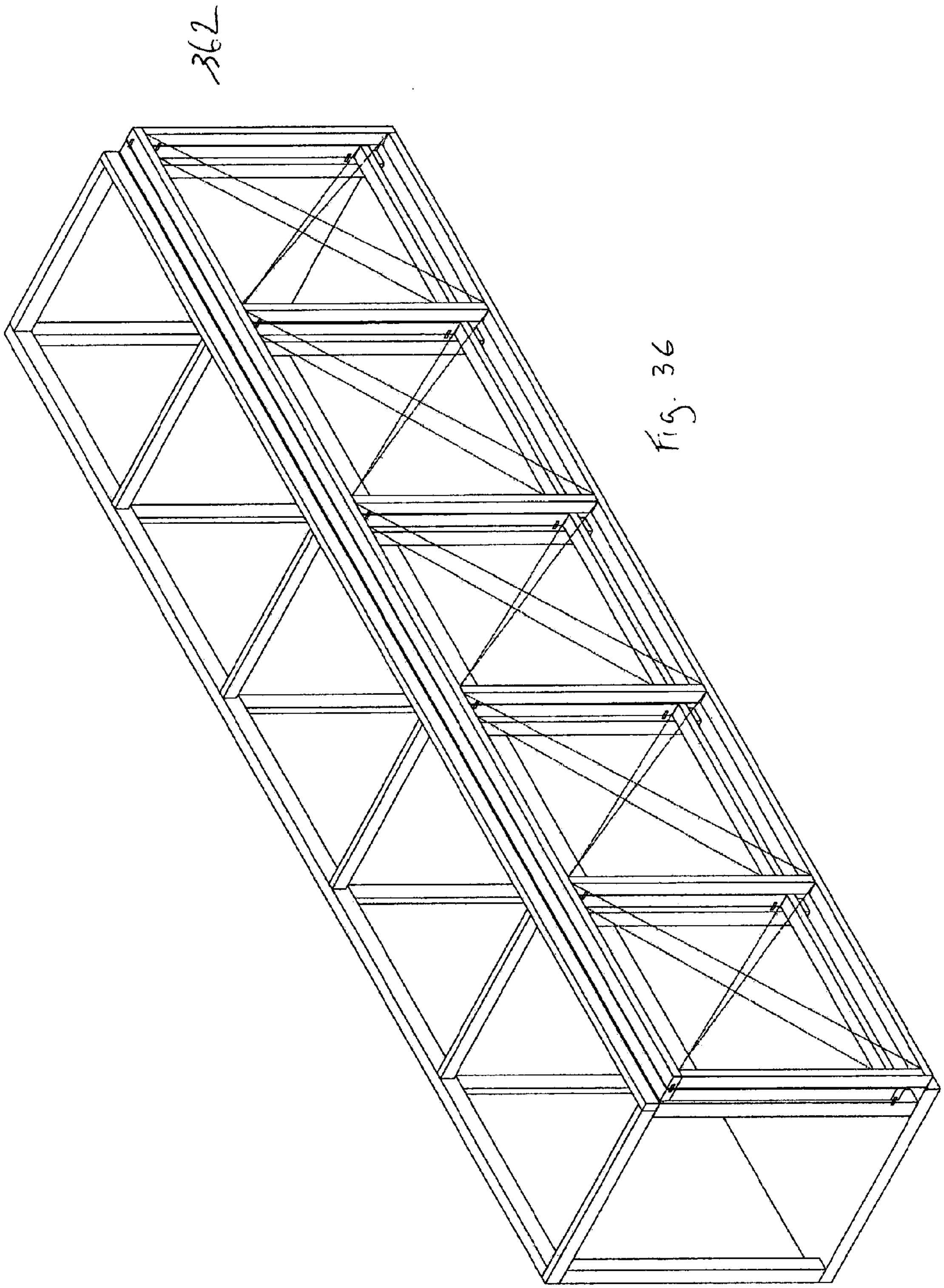


Fig. 36

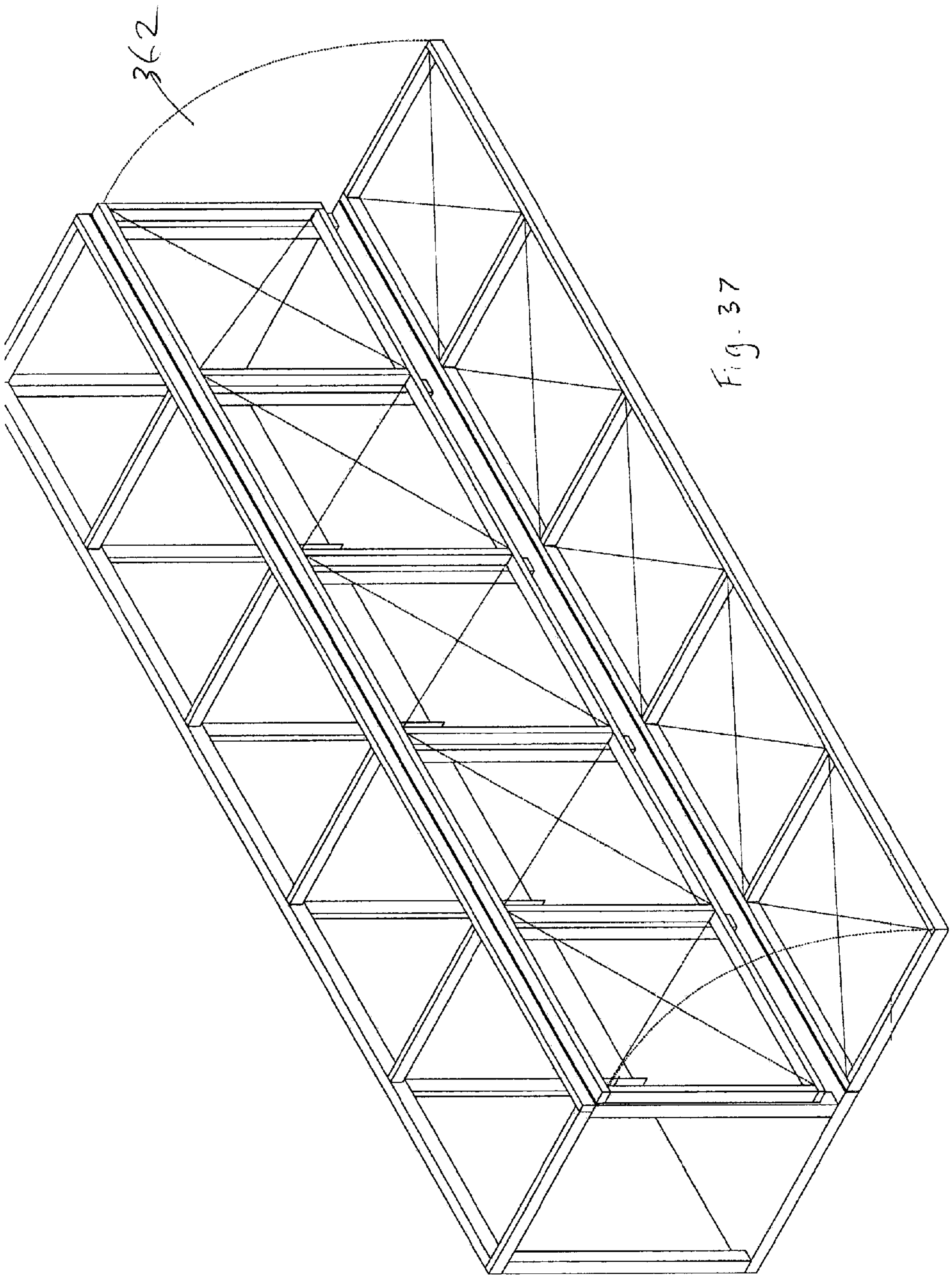
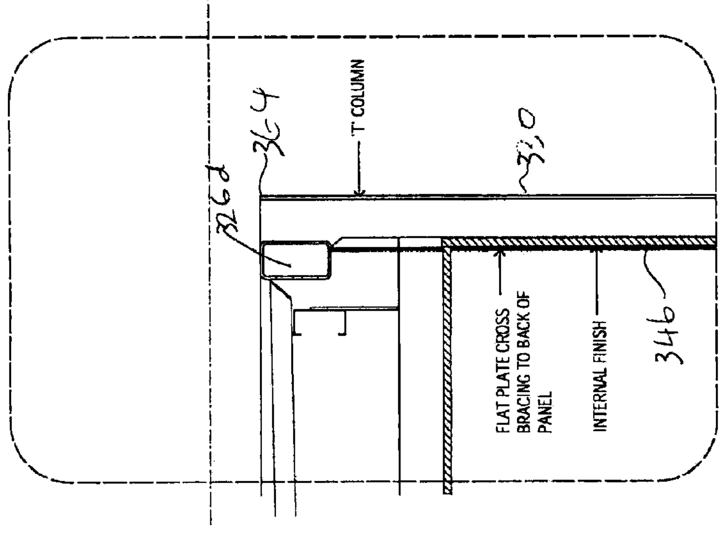
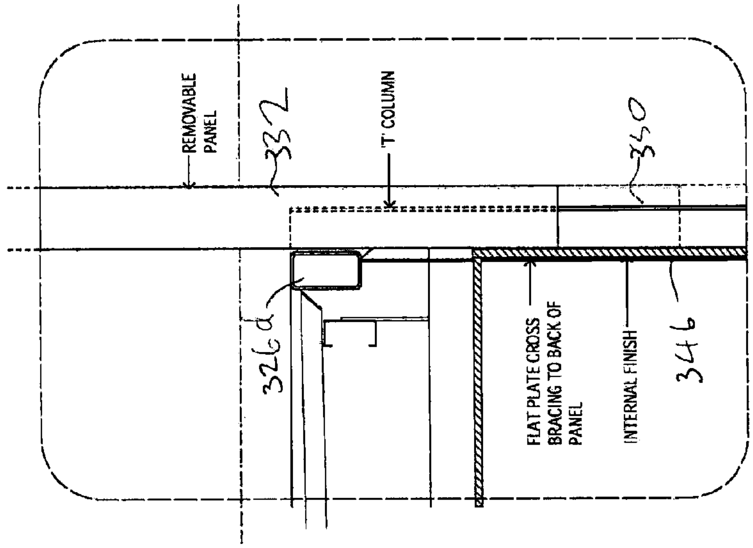


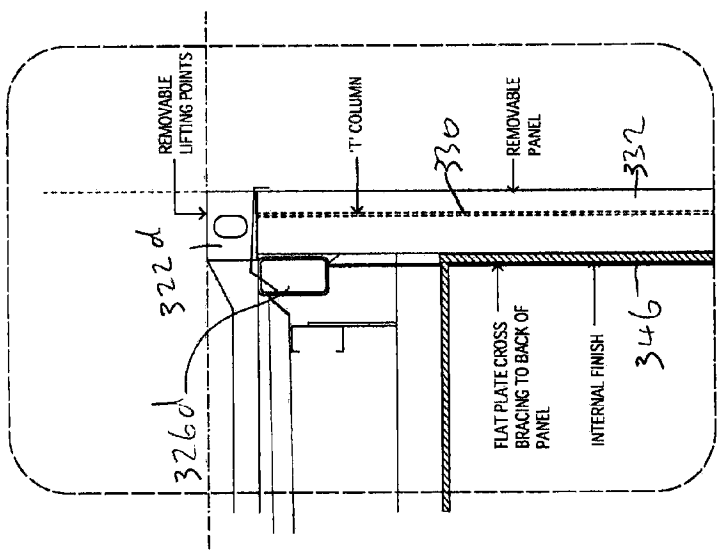
Fig. 37



STEP ONE Fig. 38a



STEP TWO Fig. 38b



STEP THREE Fig. 38c

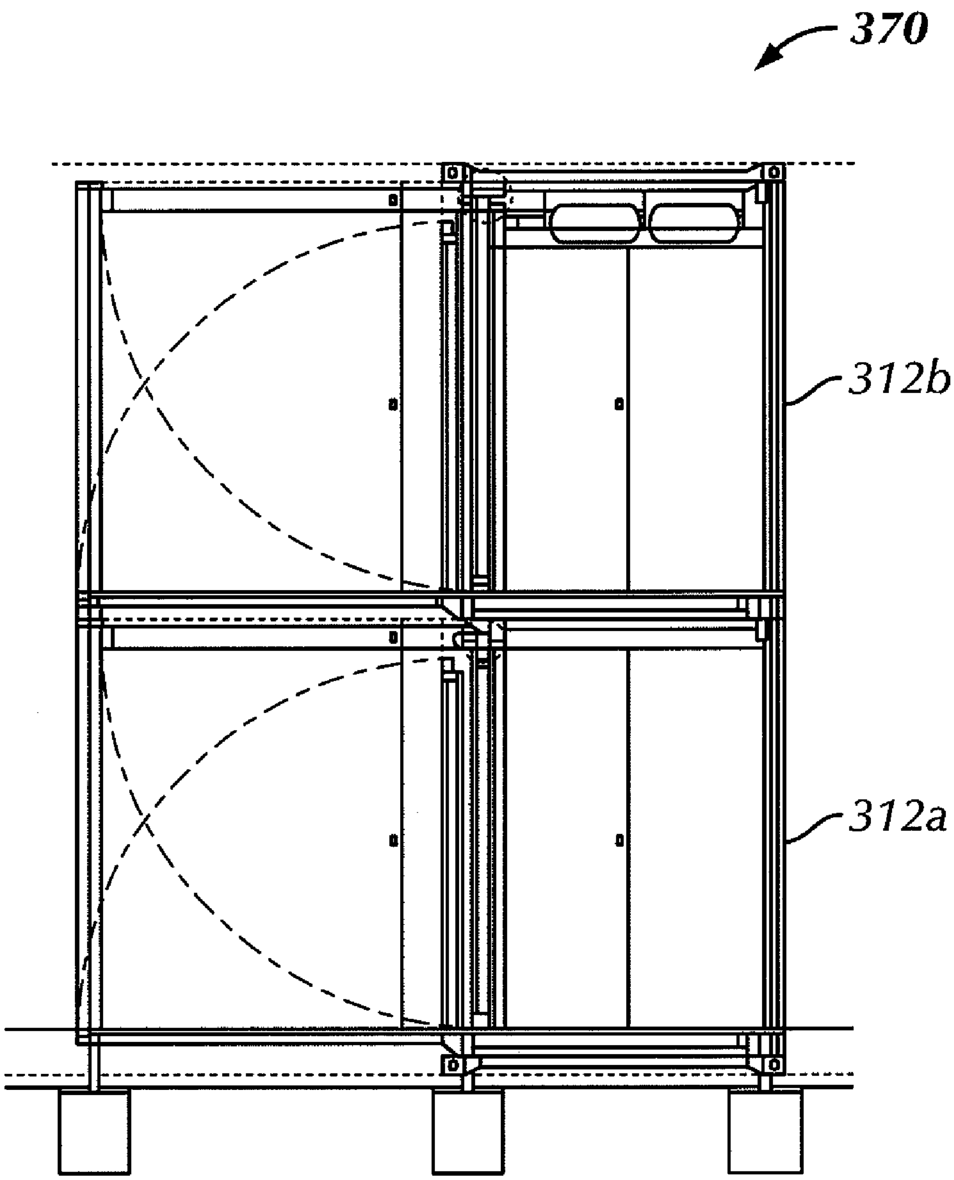


FIG. 39

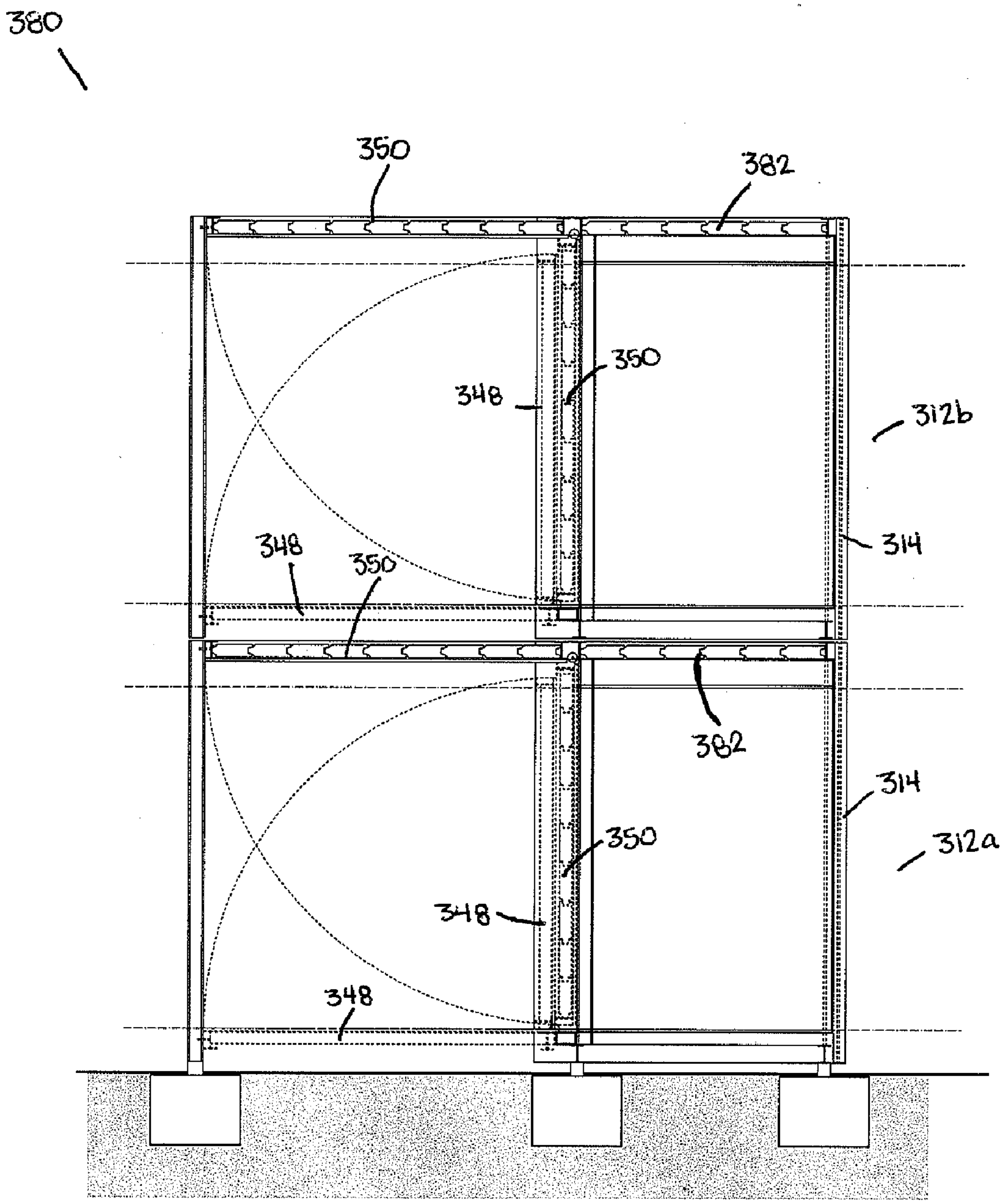


Fig. 40

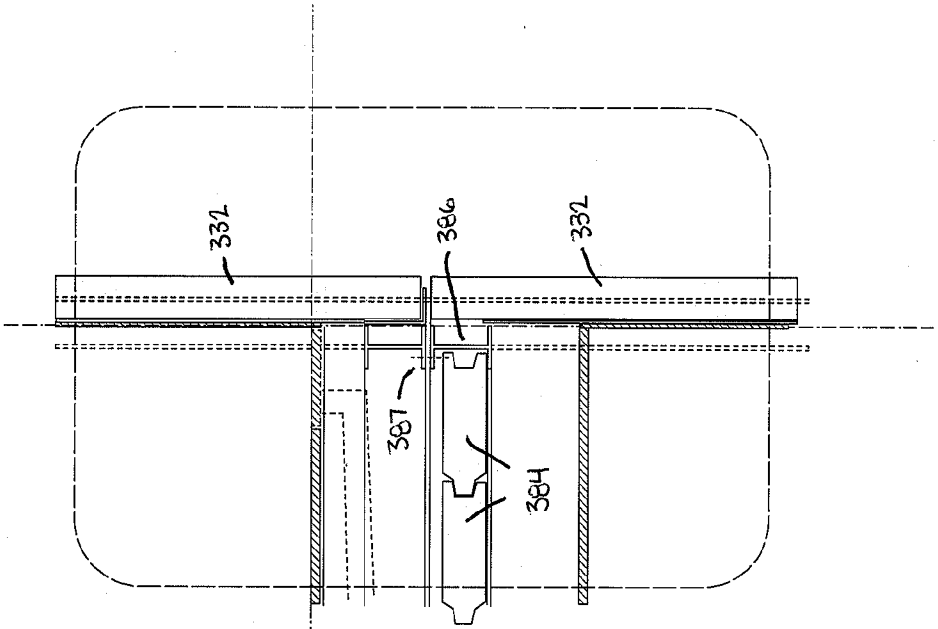


Fig. 42

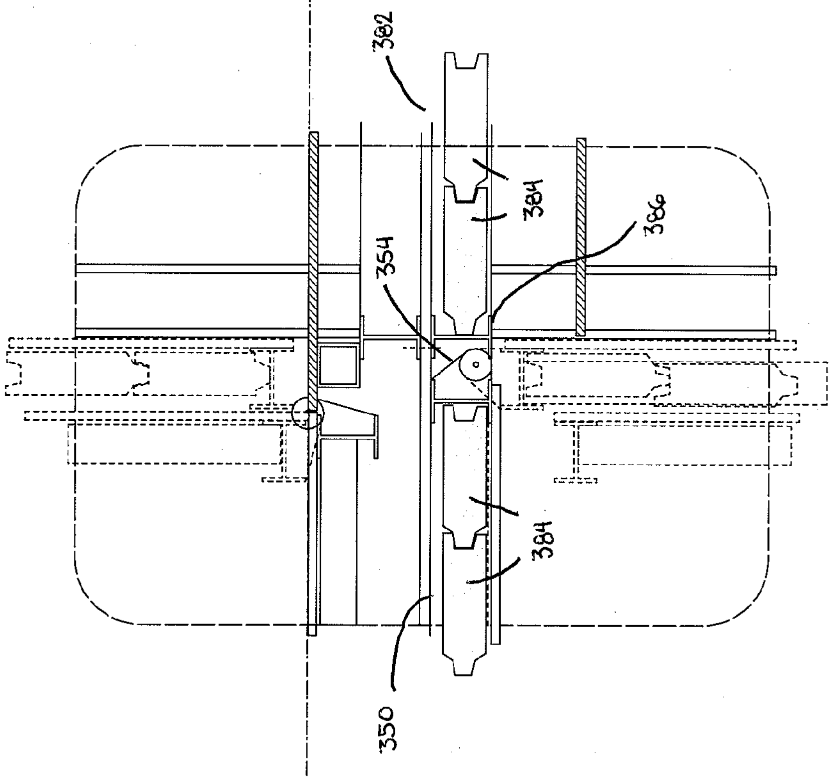


Fig. 41

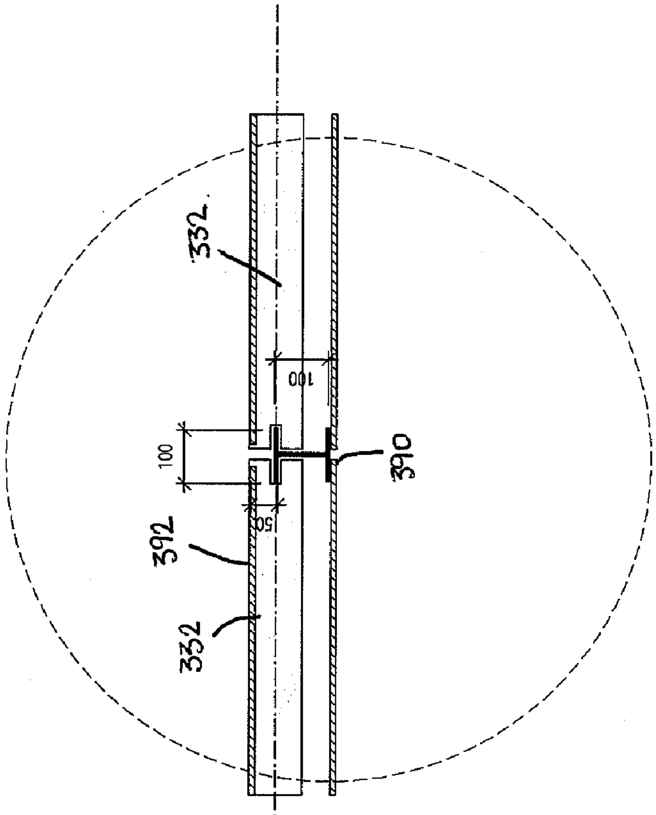


Fig. 44

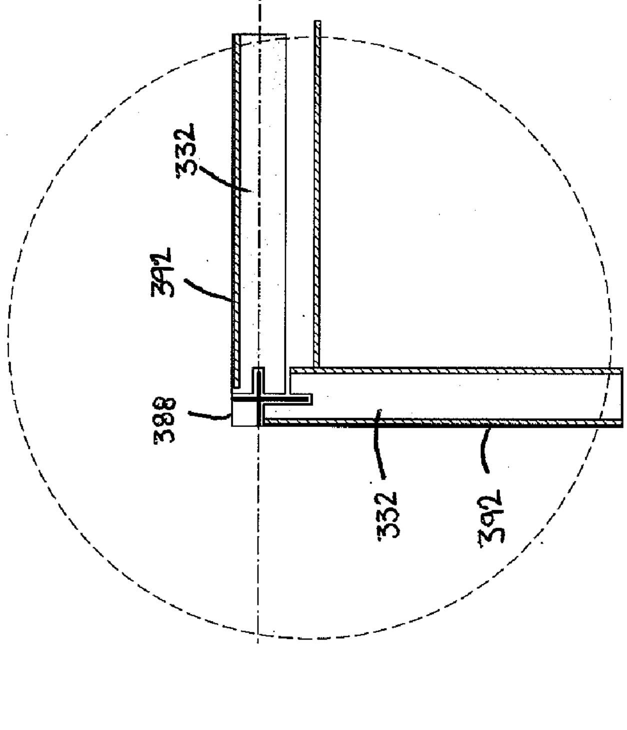


Fig. 43

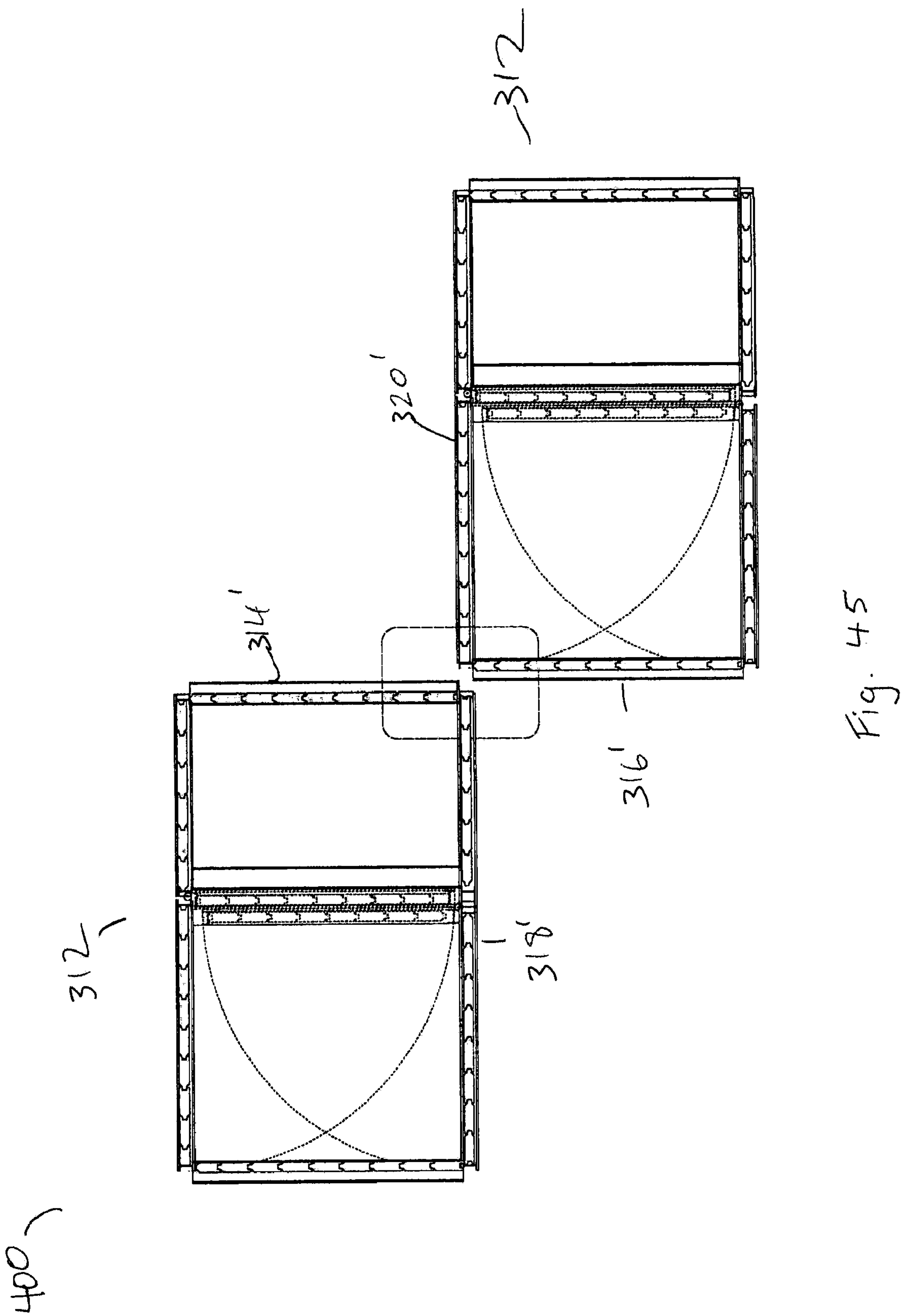

312
320'
314'
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Fig. 45

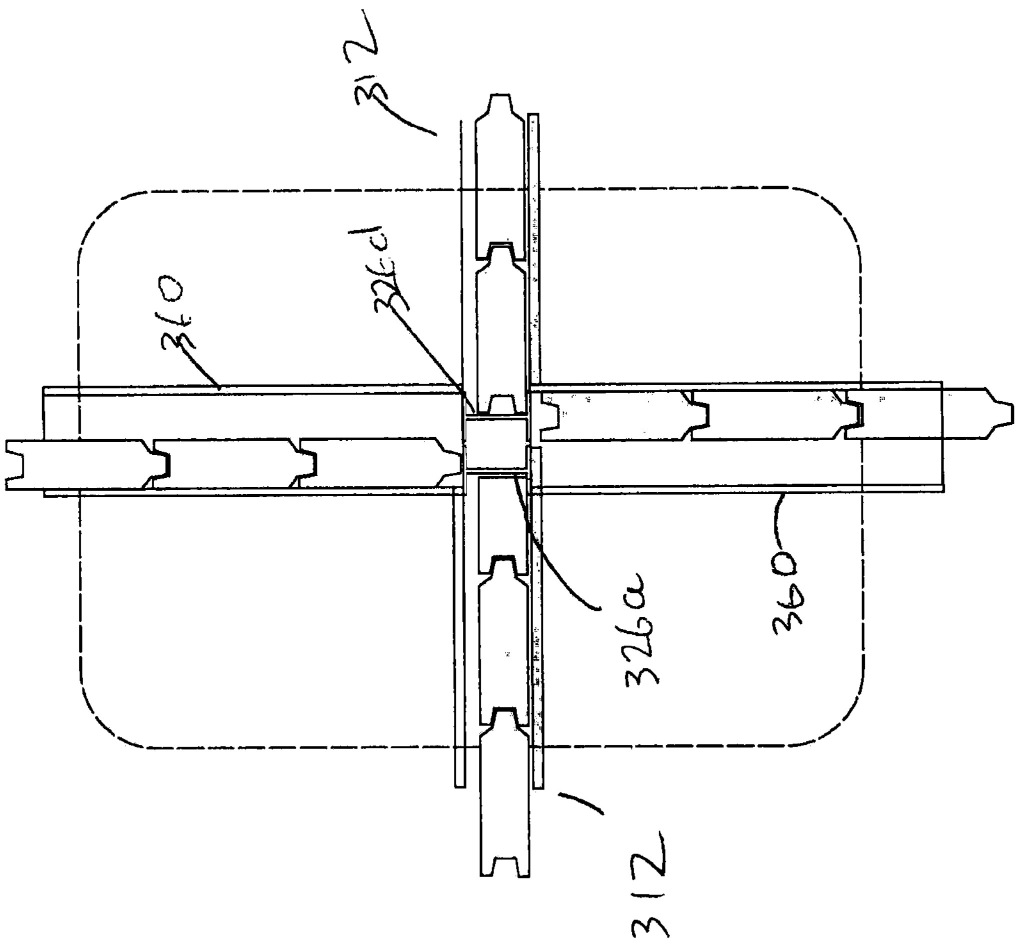

Fig 46

INTERACTIVE BUILDING MODULE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This is a continuation-in-part of, and claims priority to, co-pending application Ser. No. 11/143,877, filed Jun. 2, 2005, which is a continuation-in-part of application Ser. No. 09/937,278, filed Sep. 24, 2002 as a national stage filing under 35 U.S.C. § 371 of PCT/AU00/00240, filed on Mar. 23, 2000, which claims priority to Australian PP 9408, filed Mar. 23, 1999. This application also claims priority to Australian provisional patent application No. 2007902634, filed May 17, 2007.

[0002] The Australian provisional patent application No. 2007902634, the Ser. No. 11/143,877 application, the Ser. No. 09/937,278 application, the PCT/AU00/00240 application, and the Australian PP 9408 application are each incorporated by reference.

FIELD OF THE INVENTION

[0003] This invention relates to interactive building modules and refers particularly, though not exclusively, to interactive building modules capable of flexible multipurpose use and arrangement in various market sectors.

DEFINITIONS

[0004] Throughout this specification reference to a hotel is to be taken as including a reference to a motel and/or serviced apartment. Furthermore, a reference to an office is to be taken as including a reference to a serviced office.

BACKGROUND OF THE INVENTION

[0005] Technological development and subsequent global economic and social change have made employment an important issue. Urban village models aim to foster local employment, training and shopping opportunities for those working in the new service economy, and minimises their travel costs and time. Urban villages encourage small and home-based business solutions. In addition, higher concentrations of residents will help support more of these businesses, which in turn can provide many of the facilities and further infrastructure that addition small businesses need to operate.

[0006] It is becoming evident that the strength of an economy relies not on physical trade but on the movement of ideas and skills. One can thus contemplate the creation of communities, which are more internally focused and truly 'sustainable' in that they bring cause and effect closer together and are more responsive to their members.

[0007] Further potential lies in establishing business frameworks which are supportive of people in local. places and which reflect the nature of these places.

[0008] This potential may be best realised by grouping ownership of such businesses and by extending the concept of "ownership" as widely as possible through organised business systems.

[0009] Increasingly we see cities in an international context. The growth of networking within and between cities and regions is one of the key developments since the advent of the Internet. Emerging alliances and coalitions fostered by the Internet provide a variety of functions: trade, idea exchange, best practice experience, resourcing and promoting local economic and geographic regional development.

[0010] Whilst this networking has been forming naturally, the associated business models are still at a stage of infancy.

[0011] A society which is connected to global information and culture, and which fosters the ideas and skills of its people is a society which will succeed in improving the wellbeing of its people. Further, a society accommodated in well designed more functional buildings, is a more intelligent vision of the future.

[0012] Many methods are known for the construction of buildings. Some methods, such as traditional brick-and-mortar construction, are labour-intensive processes. Other methods, such as tilt-up panel construction, further require the movement of large, heavy building elements using machinery such as cranes. The energy expended during construction and assembly results in high levels of greenhouse emissions.

[0013] Neither of these methods is suitable for the erection of buildings on remote sites. Such sites require a building constructed from readily transportable and easily handled materials, which can be quickly constructed without requiring a large amount of skilled labour. Additionally, it is considered economically desirable to construct buildings in locations where labour is relatively inexpensive, for transport to locations where labour is relatively expensive.

[0014] In response to these needs, and other needs, the concept of a modular building construction has been proposed. A modular building structure allows a building to be constructed from readily transportable components. Being modular, the size and shape of the building can be easily varied using the same components.

SUMMARY OF THE INVENTION

[0015] The inventive concept, in its various aspects, is inspired by the fundamental realisation that use of existing building structures is associated with high capital costs and low utilisation rates. It is also reflects a desire to produce buildings which can be readily transported, including to remote locations.

[0016] Accordingly, the invention, in various aspects, preferably proposes multiple building structures built of modular components, in which the resulting building structures are fabricated for construction involving reduced capital costs, and multi-purpose usage.

[0017] According to one aspect of the invention, there is provided a transportable and stackable modular building unit including a floor panel, side wall panels and a ceiling or roof panel, the panels being arranged and dimensioned to form a shipping container in which the ceiling or roof panel is supported above the floor panel by the side wall panels for transportation by a containerised shipping network, and wherein at least one of the side wall panels of the modular building unit is a movable panel removably or hingedly connected to the floor panel or to the ceiling or roof panel and movable to create additional building space adjacent the space formed by the other panels of said modular building unit. The advantages of such a construction include that building modules can be readily transported using existing infrastructure.

[0018] In one embodiment, the at least one movable panel is removable and utilisable as a structural end wall, a verandah section, a roof section or a floor section to at least partly enclose said additional building space.

[0019] In another embodiment, the at least one movable panel is a side wall panel hingedly connected to the base and/or the top of the unit. The side wall panel may be hingedly connected to the base of the unit so that it can swing downwardly to form an external floor of the additional space. Alternatively, the side wall panel may be hingedly connected to the top of the unit so that it can swing upwardly to form an external roof of the additional building space. In a further embodiment, the side wall panel may have a first hinged section which swings downwardly to form an external floor and a second hinged section which swings upwardly to form an external ceiling of the additional building space.

[0020] Further, one or more additional wall panels or glass facades may be provided to at least partially enclose the additional building space.

[0021] In a further aspect, the volume efficiency of the modular building components can be enhanced by desirably locating those components in favourable configurations.

[0022] In practice, it has been found that the modules may be subject to damage during transportation, installation and use. It is generally not possible to easy replace a damaged portion of a module, and frequently the entire module must be replaced. This can prove a relatively expensive process. Additionally, there is limited flexibility in changing the nature of a module whilst maintaining desired properties, such as the thermal and acoustic properties, of the module. In response to this, in another aspect of the invention, there is provided a transportable, modular building unit for use in a modular building system, the building unit including a supporting structure and surface members, at least one of the surface members being slidable within the supporting structure. The at least one surface member is thus readily changeable as necessary.

[0023] Preferably, the surface members are a floor panel, side wall panels and a roof or ceiling panel, the panels being arranged to form a container in which the ceiling or roof panel is supported above the floor panel by the side wall panels for transportation by a containerised shipping network, a containerised distribution network, or sea transport. More preferably, at least one of the side walls panels and associated supporting structure is a panel hinged to the floor panel or the roof or ceiling panel, and moveable to create additional building space adjacent the space formed by other panels of the modular building unit.

[0024] Preferably, the supporting structure is formed from beams having flanges, such as I-section beams and T-section beams. Also preferably, each panel has a groove about its periphery. The groove is able to locate about flanges of the supporting structure. This allows the supporting structure to be substantially concealed by the surface members.

[0025] According to another aspect of the invention, there is provided a multi-storied building including a plurality of transportable and stackable modular building units, each building unit including a floor panel, side wall panels and a ceiling or roof panel, the panels being arranged and dimensioned to form a shipping container in which the ceiling or roof panel is supported above the floor panel by the side wall panels for transportation by a containerised shipping network, at least one of the side wall panels being a movable panel removably or hingedly connected to at least the floor panel or the ceiling or roof panel and movable to a position in which an additional building space is created adjacent the building unit, and wherein at least one building unit in an upper storey of the building is stacked on at least one of the building units in the storey below.

[0026] In such a building, the external water and energy demands of the building structure may be minimised by the use of water and energy resources appropriate to specific usage demands.

Checkerboard Configuration

[0027] In such a multi-storey building, the volume efficiency of modular building components can be enhanced significantly by providing modules that can be stacked in a "checkerboard" configuration with free spaces between adjacent units on each level to increase the effective volume of resulting modular building structure.

[0028] Further, resources usage by the building structure can be interactively managed in response to demands for resources services and local resource cost and availability.

[0029] Investment in a number of the building structures may be advantageously facilitated by a communal pooling of income associated with the building structures, coupled with the option to sacrifice access to that pool of income in exchange for occupancy of a building structure.

[0030] In order to suit the present and future varying requirements, new real estate concepts advantageously conserve and enhance a community's resources so that the ecological process, on which life depends, is maintained and the total quality of life, now and in the future, will improve. The concept is based upon a contemporary planning view: that a healthy city should consist of numerous nodes: high energy, dense, and interactive urban villages. The historical approach of separating employment areas from residential is no longer necessary or efficient. The concept further develops the sophistication of existing business models, and enables consumers new levels of service and higher margins for manufacturers and service providers.

[0031] The conventional model of the time-share condominium involves mobility of capital paired with mobility of ownership. The concept introduces the notion of mobility of space. Like the mobility of "particles" assembled into space with meaningful variable form, the concept contemplates an increase in productive flow and allows variable use permutations over both virtual and physical existence within a building space. The conventional time-share model is challenged and enhanced by the use of universal spaces capable of variable configurations, creating splicings and mutations over the physical form, leading to a better and more fluid setting for social and economic life.

User Mode Conversion

[0032] A building formed from modular building units is desirably configured between multiple different usage modes over a given period by preferably using standardised fittings which can be used to securely engage and disengage a variety of different components.

Exchange Module

[0033] Further, secure exchange of items with a building structure is advantageously facilitated by a restricted access exchange module to which access can be permitted if appropriate authorisation information is presented matching an authorised access instruction.

Louvre Assembly

[0034] The energy usage and space efficiency of a building structure can be improved by providing a facade having a louvre assembly with a series of articulated louvres able to be retracted to avoid obstruction of a facade. Providing an integrated handrail can avoid the need for a balcony, and can provide greater natural ambient lighting within the structure, minimising artificial lighting requirements.

Preference Configuration

[0035] The building structure can be adapted between a variety of configurations to meet an occupant's or a group of occupants' needs. A building structure can meet those occupants' needs in different ways at different times. Accordingly, it is recognised that it is advantageous to generate preference profiles describing desired configuration options of a building structure, and configuring the building structure between various of those preference profiles as required. It is recognised that this is particularly desirable when different occupants regularly occupy a particular building structure over a period of time, or particular occupants occupy different building structures over a period of time.

Energy Management

[0036] The impact of the energy demands of a building structure can be reduced, and in particular, the dependence on an external source of electrical energy can be reduced by meeting, where possible, energy demands with energy from a source able to generally meet rather than exceed the respective demand. In this way, demand for "expensive" or "high-impact" energy, such as externally sourced electrical energy can be reduced by sacrificing use of such energy for use of "cheaper" or "low-impact" energy where possible. As a consequence, for example, energy generated within the module is generally used in preference to energy sourced externally from the module.

Water Management

[0037] The impact of water consumption in a building structure may be reduced, and in particular, the dependence on an external source of water can be reduced by meeting, where possible, water demands with water from a source generally able to meet rather than exceed the quality requirements for the respective water usage. In this way, demand for "expensive" or "high-impact" water, such as externally sourced water can be reduced by sacrificing use of such water for use of "cheaper" or "low-impact" water where possible. As a consequence, for example, water processed by treatment within the module is generally used in preference to water sourced externally from the module.

Resource Management System

[0038] The resources available to a building module may be interactively and intelligently managed using a networked management system.

Investment

[0039] Investment in building structures or property is advantageously facilitated by a mechanism whereby an investor can have access to income derived from multiple buildings, or exercise, in lieu of access to that income, a right of tenancy in one or more of the multiple buildings. Of course, the right of tenancy is naturally subject to conditions relating to the logistical operation of the occupancy of the multiple buildings, and equitably meeting the rights of all investors.

[0040] Preferably, interactive modules for a building are capable of use as an office, hotel or for residential purposes. Preferably, there is an inter-connected network of buildings, investors, occupiers and business operators. The buildings are preferably located adjacent to areas of high commercial and retail activity and are designed to tap into the existing infrastructure of these centres. A network of inter-connected businesses can therefore be established through the ground level retail areas and some of their upper level modules.

[0041] Preferably, the physical design of the module allows for residential, office, and hotel uses from the same space at any point in time. Transference from one use mode to another may merely require changing and/or moving furniture, and possible reprogramming of certain services such as, for example, telecommunication services. By integrating a rectractable glass wall system and integrated facade system the module may enable further adaption from indoor to outdoor uses.

[0042] Preferably, the design streamlines the daily activities of its occupants, and may also provide them with the ability to live, work and have relaxation in the same geographical area, the same building, or even within the same module. The module may be one standard space and efficient to construct as many of its components may be pre-fabricated. The module may be produced in various design formats suitable for different market sectors.

[0043] Preferably, the modules themselves are durable, and fitted-out with contemporary high performance materials, utilising industrially designed exchangeable components and fittings. By changing the configuration of the fit-out components, the universal spaces created may reach greater levels of utilisation.

[0044] Preferably, integrated computerisation may enable automation and creation of virtual environments with real-time audiovisual communications, financial exchange and personalisation via dynamic IP addressing. For use of the computer functions, an optional hand-held monitor may be available and may further link the occupant with their own module and building group's information, building control and service systems.

[0045] Preferably, the integrated systems architecture of the modules may enable responsive and interactive energy management systems, maximising use of onsite renewable energies together with automated recycling systems. These integrated design techniques incorporating high performance building materials may minimise the impact of greenhouse emissions caused through manufacture, the life-cycle running cost and the reliance on existing service infrastructures, providing short and long term ecological and economic benefits.

[0046] Preferably, the module, like an appliance (connected via the Internet), may enable the occupants more interactive form and function. The systems architecture may enable automated personal profiling of individual requirements, preferences and/or settings. Integrated systems architecture may enable remote monitoring for mental well-being through individual interactions, healthcare and remote diagnostics of all equipment.

[0047] Preferably, automated management systems incorporating reservation procedures, remote vending and yield management via the Internet may enable greater accessibility encouraging the associated benefits of higher occupancy rates, tourism, cultural and information exchange.

BRIEF DESCRIPTION OF DRAWINGS

[0048] FIG. **1** is a perspective view of a smaller interactive module for a building according to the present invention;
[0049] FIG. **2** is a perspective of larger interactive module;
[0050] FIG. **3** is an exterior perspective view of a building according to one embodiment;
[0051] FIG. **4** is an exemplary floor plan of the building of FIG. **3**;
[0052] FIGS. **5**A and **5**B are perspective views of an interactive mobile module for a building of fixed and mobile construction respectively.
[0053] FIGS. **6** and **7** are floor plans of the interior space in the residential mode and office mode respectively.
[0054] FIG. **8** is a schematic illustration of the power and air conditioning systems.
[0055] FIG. **9** is a schematic illustration of the natural air handling system.
[0056] FIG. **10**. is a schematic illustration of the hot water loom system.
[0057] FIG. **11** is a schematic illustration of water collection and reticulated reuse system.
[0058] FIG. **12** is a schematic illustration of a closed-loop air-conditioned energy exchange system.
[0059] FIG. **13** depicts assembly of a plurality of modular building units stacked to form a multi-storied building in a checkerboard configuration.
[0060] FIG. **14** depicts a modular building unit having a removable side wall panel for use in the invention.
[0061] FIG. **15** is a plan view of a typical louvre.
[0062] FIG. **16** is a plan view of an adjustable handrail.
[0063] FIG. **17** is an elevation of a facade system.
[0064] FIG. **18** is a sectional view of the facade system.
[0065] FIG. **19** is a view of a top section of a modesty barrier section of the facade system.
[0066] FIG. **20** is a view of a bottom section of a modesty barrier section of the facade system.
[0067] FIG. **21** is a perspective view of the louvre assembly.
[0068] FIG. **22** is a perspective view of a modular building unit having a side wall panel hingedly connected to the base and/or top of the unit; and
[0069] FIG. **23** is a perspective view of the modular building unit of FIG. **22** with additional wall panels and glass facades.
[0070] FIG. **24** is a cross sectional elevation of a building unit in accordance with another aspect of the present invention, shown in a transportable configuration;
[0071] FIG. **25** is an enlarged cross sectional elevation of a lower rear corner of the building unit of FIG. **24**;
[0072] FIG. **26** is an enlarged cross sectional elevation of a lower front corner of the building unit of FIG. **24**;
[0073] FIG. **27** is an enlarged cross sectional elevation of an upper rear corner of the building unit of FIG. **24**;
[0074] FIG. **28** is an enlarged cross sectional elevation of an upper front corner of the building unit of FIG. **24**;
[0075] FIG. **29** is a cross sectional elevation of a single story building constructed from the building unit of FIG. **24**;
[0076] FIG. **30** is an enlarged cross sectional elevation of an lower rear corner of the building of FIG. **29**;
[0077] FIG. **31** is an enlarged cross sectional elevation of a lower front corner of the building of FIG. **29**;
[0078] FIG. **32** is an enlarged cross sectional elevation of an upper rear corner of the building of FIG. **29**;
[0079] FIG. **33** is an enlarged cross sectional elevation of an upper front corner of the building of FIG. **29**;
[0080] FIG. **34** is a cross sectional plan view of a corner joint within the building unit of FIG. **24**;
[0081] FIG. **35** is a cross sectional plan view of a side joint within the building unit of FIG. **24**;
[0082] FIG. **36** is a perspective of a braced structural truss within the building unit of FIG. **24**, shown in a transportable configuration;
[0083] FIG. **37** is a perspective of the braced structural truss of FIG. **36**, shown in an expanded configuration.
[0084] FIGS. **38***a*-**38***c* show a enlarged cross sectional view of the upper front corner of FIG. **28** during installation of a panel;
[0085] FIG. **39** is a cross sectional elevation of a low-rise building constructed from building units in accordance with an aspect of the present invention;
[0086] FIG. **40** is a cross sectional elevation of a high-rise building constructed from building units in accordance with an aspect of the present invention;
[0087] FIG. **41** is an enlarged cross sectional elevation of an internal level of the building of FIG. **40**;
[0088] FIG. **42** is an enlarged cross sectional elevation of a portion of a side wall of the building of FIG. **40**;
[0089] FIG. **43** is a cross sectional plan view of a corner joint within the building of FIG. **40**;
[0090] FIG. **44** is a cross sectional plan view of a side joint within the building of FIG. **40**;
[0091] FIG. **45** is a cross sectional elevation of a portion of a further high-rise building constructed from units in accordance with an aspect of the present invention, shown during assembly; and
[0092] FIG. **46** is an enlarged cross sectional elevation of the building of FIG. **45**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

1 Introduction

[0093] There are four scenarios of use of a module by users:
  [0094] virtual space
  [0095] serviced office
  [0096] hotel or serviced apartment
  [0097] residential.

[0098] These scenarios are not mutually exclusive, but are broad categories that define the operational and financial properties of the interaction between the individuals and the modules. There may be cases where the use of the space is a hybrid combination of these generic scenarios, for example, when the module is used both as an office and a living space.
[0099] The creation of various internal and external structural forms may be enabled through flexible design solutions. The module's cross-platformed chassis is capable of free-standing installations and may be suited to eco-tourism, rural and third world sectors.
[0100] To first refer to FIGS. **1** to **4** of the drawings, the module carries a high emphasis on environmental design.
[0101] Each major floor of the building has a number of units or modules (see FIG. **4**). In each module the main rooms are located on a raised mezzanine level, providing a reduced ceiling height (e.g. 2.65 m) and, under the floor, a void ideal for plumbing and other building services. The mezzanine area

consists of a main room **20** located off the entry hall **30**. The room **20** is accessible from the hallway **30** by sliding door **32**. The main room **20** has a built-in storage module **24** and a window or door **34** into a controlled garden environment **18**. The room **20** also has a frosted glass wall system **28** which may be partially or fully removed, opening into the main living room/office/bedroom area **36** for further flexibility. The office/bedroom/store **36** may also provide a secure lockable area via lockable door **22** accessible by modular unit holders and not hotel guests.

[0102] Two service areas are provided. Firstly, a bathroom **26** with a full-height window **38** onto a controlled garden environment **18**. The bathroom **26** is minimalist in design, containing industrial fittings, flush-mounted toilet system **40**, single or dual vanity **42**, and a sunken spa bath **46** which may have a shower over. The second service area provided is the security lobby **30** to each module, allowing for efficient interchange with the group's building services network via services shaft **50**, which will have restricted access. The area **50** will house a standard 'interchange' module, consisting of separate, stainless steel removable compartments, accommodating deliveries of building services and rubbish recycling, and so forth. A small but functional stainless kitchen unit **48** is located in hallway **44**, and provides a kitchen galley, which may be closed off and hidden away by simply sliding a cover screen (not shown).

[0103] As shown in FIG. **2**, for the larger interactive module, an extra room **54** is provided for multi-purpose use such as, for example, office, storage, child's bedroom, or the like. The room **54** is closed off from room **20** by sliding wall panels **56**, which may be opened if desired.

[0104] The fixed building module may be designed to provide low and high rise configurations and may be suited towards inner urban and eco-tourism developments. Two modes may be designed, the larger providing an addition room or lockable storage area, enabling storage of personal possessions whilst the remaining spaces within the module and the occupants corresponding shares may be returned to the pooled income environment. This may enable the shareholder greater utilisation of their capital invested in bricks and mortar and enable maintenance of a home base.

[0105] The mobile module may be designed to create high performance cross-platformed building solutions and may increase accessibility to functional building space. The concept may be designed to take advantage of the low economic value of vacant sites within cities and the economies created by mass production manufacturing principles. The cross-platformed structural chassis may form itself into a container for integration into existing road, rail and shipping transport systems. The structural solutions may be engineered to enable stacking such that a six level building may be assembled on-site within a week.

2 Reconfiguration of Components

[0106] The design principle of enabling the same space to be used for different uses over time is not only efficient but it also increases the ability of the property to obtain income. The transference of a module from one use to another may merely require the moving and/or replacement of some or all of the furniture, and possibly the reprogramming or alteration of certain services (eg telecommunications) to suit the requirements of the occupant and/or the use of the module. For example, an office may not require beds, but may require increased telecommunications facilities. This principle also applies to the living space, which can convert to outdoor living space.

[0107] Rapid re-configuration of a module to match the requirements of the customers may be required, and it may be that a module is used in more than one of the generic scenarios in the same twenty-four hour period. For example, it could be used for virtual space for a business meeting in the morning and as a serviced apartment in the evening.

[0108] The module involves mass production of standardised building spaces and streamlining construction systems components as a means of increasing building sophistication and affordability.

[0109] The spaces and their components will be manufactured, with the components being changeable and removable. The components may be manufactured in various colours and materials, enabling various design permutations and consumer choices over generic product. These components are easily fittable and exchangeable.

[0110] The design of the modular space allows the property status, to vary (for example) the modular building may move between the office, hotel and residential sectors of the real estate marketplace) and to provide for combinations of same to be varied with ease.

[0111] The building areas are designed as multipurpose spaces enabling them to move between sectors of the real estate marketplace, for example moving between office hotel and residential sectors of the real estate marketplace.

[0112] The internal fit-out may consist of a range of standard plug-in modular components providing a variety of function and form. The various fittings and accessories may be constructed from a series of standardised plastic injected molded components. The solid plastic components may be durable, easy to maintain, exchangeable, recyclable and may lead to an extended life cycle of stocks over time. The plastic components may be available in a variety of solid and opaque colours and finishes. The systems design may enable consumer choice creating personalised, functional and artistic assembly of a generic and affordable manufactured product.

[0113] Systems design may enable shipping of the sealed container containing the occupants elected range of plug-in components. After erection of the building, the components may then be installed on the outside wall created within the free space.

[0114] FIG. **14**A shows a stackable, transportable modular building unit **100** comprising a floor panel **102**, a fixed side wall panel **104**, a removable side wall panel **106** and a ceiling or roof panel **108**.

[0115] The ceiling or roof panel **108** is supported above the floor panel **102** by fixed side wall panel **104**, and by corner columns **107**, if required. The panels are arranged and dimensioned to form a shipping container which is transportable by a containerised shipping network. During transportation, the removable side wall panel **106** is attached to the floor and ceiling panels **102**, **108** to form the shipping container.

[0116] When the shipping container has been transported to the site where a building is to be constructed, the removable side wall panel **106** may be moved to the position shown in FIG. **14**A to create additional building space adjacent the space formed by the other panels **102**, **104**, **108** of the modular building unit **100**. The additional building space may be at least partially enclosed by additional floor and ceiling panels **103** and **105** respectively, and further columns **109** may be provided for supporting the additional ceiling panel **105** as shown in FIG. **14**B. As shown in FIG. **14**C, a similar stackable modular building unit **120** may be stacked on the modular building unit **110**.

[0117] The removable wall section or panel **106** of the module provides a durable and weatherproof container for ease of transportation. Systems design may enable the removal of this wall panel during erection. Further utilisation of this panel may provide a structural end wall, portico/verandah section, roof and/or ground floor section and may enable establishment of additional free-space.

[0118] Similar systems may provide for assembly of the module in a freestanding environment. In this case, the module's removable wall panel **106** may be replaced with a less structural, dual skin, wall component. The component may be designed to hinge out at floor and/or roof level as shown in FIG. **22**. The insertion of structurally framed modular glass partitions and/or retractable glass facades may allow additional space to be created on-site.

[0119] The system's design may enable assembly of the modules **100** in a checker board configuration as shown in FIG. **13** and may enable the assembly of the modules such that the floor panel **102** of a module **120** on an upper level meets with the roof panel **108** of a module **100** below. The system's design may enable the creation of free space **110** between modules **100** formed from the roof **108**, walls **104**, **106** and floor **102** of adjacent modules. As shown in FIG. **13** the modules **120** on an upper level are stacked on the modules **100** of the below in positions above the free space **100** between the modules **100** so that the floor panels **102** of the modules **120** form ceilings of the free spaces **110**. Streamlined design, engineering and assembly solutions may enable the easy attachments of modules with the ability to place vertical and horizontal floor loading through the building by creating in-series structural solutions.

[0120] The space itself is capable of adapting its use during the course of the day and may adapt from formal to informal residential living. The living area itself may convert to outdoor living space by opening back the glass operable facade and by lowering the external interactive screen allowing direct sunlight and air into the integrated living environment. The space becomes an external private domain and by its orientation with the sun and the external operable screen, the occupant has the option of controlling the ambient lighting levels. In parallel to the systems, the climate control automated screen function allows or rejects solar radiation in the most efficient manner and complements the buildings energy management systems. The glass operable facade allows excellent natural cross ventilation. It also enables the adaptation of the living space to outdoor private space by lowering the interactive facade, creating an external balcony, allowing direct afternoon sunlight into the space.

[0121] The space is designed for extreme flexibility as a means of increasing utilisation of the capital resources tied up in traditional building structures. The space is fitted out with unitised adaptable pre-manufactured components, operable internal walls, a cover screen over the kitchen, fold out bed/meeting room table/desk storage/Japanese den, formal living/day bed. The living space, its furniture and technologies enable adaptation from office to formal and informal residential. The office configuration may be complemented by the addition of a work station and desk components which fit into standardised sockets and fittings in the module.

[0122] The space may be arranged in any combination, for example, the internal walls may be opened, closed or positioned in any setting: the bathroom may be left open to the room adjacent with both rooms having the option of opening and ventilating through the bio-climatic garden void.

3 Checkerboard Configuration

[0123] The structural solutions may be engineered to enable stacking such that a six level building may be assembled on-site within a week.

[0124] The creation of various internal and external structural forms may be enabled through extremely flexible design solutions. The module's chassis is designed with one fixed wall **104** incorporating an integrated structural truss. The remaining walls **106**, floor **102** and ceiling **108** each consist of separately removable, fire-rated panels. This enables the arrangement and possible re-arrangement of internal spaces in both vertical and horizontal amalgamations. The modules cross-platformed chassis may also be capable of freestanding installations and may be suited to tourism, rural or third world sectors.

[0125] As shown in FIG. **13**, the system's design may enable assembly of the modules **100** in a checkerboard such that the floor panel **102** of a module **120** on an upper level meets with the roof panel **108** of a diagonally connected module **100** below. The system's design enables the creation of free space **110** between the modules formed from the roof **108**, walls **104**, **106** and floor **102** of adjacent modules **100**. The system's design may enable shipping of the sealed container containing the occupant's elected range of plug-in components. After erection of the building, the components may then be installed on the outside walls of the space after assembly of the structure.

[0126] The mobile modular structure consists of a structural chassis with an integrated truss in one wall. The floor and ceiling each consist of a series of three separately removable and fire rated panels. The two walls at each end are open and may be fitted with an operable interactive glazing and facade system, or may be fitted with various wall panels or a plug-in front door and exchange module component. The removable wall **106**, running the entire length of the module, is removable and creates a durable and weatherproof container for ease of transportation. The system's design may enable the removal of this wall panel **106**, during erection. Further utilisation of this panel may provide the required in full structural end wall, roof and floor; portico/verandah section, roof and/or ground floor section of the free spaces created during assembly as well as providing weather protection for pedestrian access in and around the building.

[0127] The module's vertical and fire rated service duct enables the incorporation of structural bracing, which combined with the integrated wall truss and the remaining structure to create an integral box chassis. Streamlined design, engineering and assembly solutions may enable the easy attachment of modules with the ability to place vertical and horizontal floor loading through the building by creating in-series structural solutions. The modules separate structure cells may be joined together in series to provide a combined structural solution. This enables the ability to hang or bridge the modules into various formations and urban forms.

[0128] Similar systems may provide for assembly of the module in a freestanding environment. In this case, the module's removable wall panel **106** may be replaced with a less structural, dual skin, wall component. Instead of a removable wall, the component **206** may be designed to hinge out at floor and roof level as shown in FIG. **22**. The insertion of structurally framed modular glass partitions and/or operable glass facades **212** may allow additional space to be created on-site as shown in FIG. **23**.

[0129] The integrated floor and ceiling panels **102** and **108** divide the modules in a horizontal axis and are removable. They also enable linking of the module in vertical and horizontal forms. A plug-in modular staircase component may be added linking the various levels internally within a building.

[0130] Effectively, the modular building might be placed on a site for **10** years. After construction and erection of the building shell, the internal spaces may be progressively configured in accordance with the varying requirements of its occupants at that time or as the occupant's requirements change.

[0131] The structure of the internal spaces may vary in size and form. For example: the size, use and form of internal occupancies in the building may change each year. The solution creates a more fluid flow of occupancy enabling the module to meet the highest commercial levels of demand thereby also reducing vacancy levels.

[0132] A range of plug-in and adaptable components have been designed providing for flexible layout and use configurations. The flexibility of the modules enables designs to be tailored to the varying economic and cultural standards.

[0133] The modules economic life may also be extended by enabling the commercial life cycle to be engineered by building stocks being re-cycled with around the world catering to various economic markets over time.

4 Louvre Assembly

[0134] FIGS. **15** to **21** of the drawings show the module's automated facade may interact with the air conditioning control systems to reduce heat load external to the glass/skin or automatically take advantage of passive solar gain. The interactive and automated facade system may be designed to reduce the capital cost and running expenses of hotel, residential and/or office buildings. The design solution seeks to reduce the need for separate external balconies, facade finishes, handrails, outdoor furniture, and internal blinds.

[0135] The automated operation of the interactive facade enables the systems to take advantage of reflected light thereby reducing dependence on artificial and controls radiation whilst maintaining access to natural ventilation. The invention seeks to enable an occupant private internal space adjacent to the exterior facade to be converted to an outdoor living environment. The handrail may be raised to ceiling height providing an automated and environmentally interactive solar screen by lowering the handrail. The blades are fixed at either side by a guide enabling them to fall and neatly stack below creating a privacy barrier between the unit and the street below. The system may be constructed from metals, plastics or other suitable material.

[0136] The system consists of a series of vertical mullions fixed externally to the building's glass facade. The mullions, made of plastic, aluminium or other material, house a continuous loop chain. The chain returns via a cog or slide at its base and is connected to a cog at its top.

[0137] The mullions fit either side of a window opening. A header box joins the two mullions at the top of the window opening. The box houses a shaft and electric motor linking the cogs and chains within each mullion.

[0138] By connecting a slide bracket to each mullion and the chain, a handrail may be positioned between the two brackets and mullions. A height adjustable handrail is created and is operated by the overhead electric motor. Preset limits prevent the handrail lowering below required regulations.

[0139] The blades themselves are loosely attached into the vertical channel of the mullions at either side of the opening. The fixings and the internal strength of the blades and all connections are designed to meet standard regulations for handrails.

[0140] The blades are connected to the handrail by a series of vertical cables, which enable the raising and lowering of the blades with the handrail and automated adjustment to their pitch. The blades are designed of solid extrusion or plastic injected moldings, to provide strength and durability.

[0141] The height adjustable handrail is hollow and may be made of aluminium, steel, plastic or other materials. A removable panel on the underside provides easy access to an internal electric motor. The motor is designed to drive a continuous shaft, connecting a system of rollers located within the handrail and cables of string or other material, connecting the blades below.

[0142] The shape of the blades has been designed to reduce penetration of rainwater through the screen whilst also providing a light shelf reflecting natural light deeper into the space when open and creating a weather resistant barrier whilst closed. The design of the blades enables convenient over-locking, a rubber seal, running the length of each blade assists with the weather protective qualities of the design and minimises the emittance of noise from the blades rattling against each other.

5 Environmental Control

Ventilation

[0143] Draught free and user automatically controlled natural ventilation provides mechanical cooling and ventilation systems being reduced or redundant.

[0144] Design criteria enabling good natural cross flow of air through the modules and incorporation of warm air chimneys designed to create natural updrafts through non-mechanical means are utilised. Solar chimneys and ventilation stacks enhance the performance of the natural ventilation.

[0145] Effectively, the module occupant may select the desired temperature, climatic condition, ambient lighting levels and air change rates within the space at any time. The Melbourne climate lends itself to the application of natural ventilation for up to 50% of the year.

[0146] Where natural ventilation does not provide adequate comfort conditions a mixed mode or hybrid approach may be adopted. Mixed mode allows for the internal conditions to be maintained by natural ventilation when weather conditions permit with the extreme climatic conditions controlled by the air conditioning.

[0147] The application of high comfort passive air conditioning solutions such as chilled ceilings is a further option.

Air Conditioning

[0148] Each building's rooftop weather station and interactive energy management system, in conjunction with climate control functions of each module's computer, may enable automation of the interactive facade system. The systems operation may enable the rejection of solar heat outside of the buildings operable glass facade or take advantage of passive solar gain and thermal storage within the modules exposed floor. The architecture of the interactive energy management systems may enable increased efficiency. The design configuration may be scaled to provide extremely efficient solutions for larger buildings, and for individual, freestanding, modules/units in either fixed or mobile configurations.

[0149] Air conditioning of the modules may be serviced from geothermal or co-generation heat exchanges of the hydronic air conditioning loom. The building's management systems may analyse available data and may vary the rate by which the cogeneration power and heat source provides energy together with the rate of flow within the looms in order that energies may be distributed efficiently upon demand. The appropriate amount of energy may be sourced and delivered efficiently to each module by a variable flow water loom. A variable speed pump on the supply of water into the loom may ensure a minimum flow and enable exact replacement of lost energy and thereby maintaining a minimum temperature within the loom.

[0150] The energy management systems utilise interactive evaluation and enable the management computer to apply logical reactions in various circumstances. For example, a weather station on the building's roof will emit data regarding external temperature and solar radiation. At the end of a hot day the temperature external to the building may fall. At the appropriate time the rate of fall of temperature, or within a range of temperatures, or at a particular temperature, the systems will stop the cooling cycle and the flow of water within the loom will stop until a call for heating is required. The computer may adjust the interactive facade in order to take advantage of passive solar gain from the afternoon sun enabling storage of energy within the floor.

[0151] As the temperature continues to fall, the computer may change the air conditioning from the cooling to the heating cycle. As the modules climate control systems require heat energy, the system will distribute through the loom, the required volume of both water and energy to service the precise requirement of the module. A temperature sensor at the end of the loom will account for energy loss during the distribution process. The system may also be programmed to vary loom temperature when external temperatures become more extreme.

[0152] The system may enable better response times than may be required for heating the system, and will adjust the heat to flow ratio of the systems management computer. Through co-generation, heat exchange will simply apply more energy to the loom. Flow will be determined by the number of modules requesting heat whilst the loom temperature of the operating system will be increased.

[0153] For hotter climatic conditions, a chiller or other cooling energy source may be added to the loom after primary energy exchange with the buildings geo-thermal loom.

[0154] A variable speed pump and temperature sensor may be located at the end of the air-conditioning supply loop and may ensure that the required temperature within the loom is maintained. The total heating or cooling requirements of modules located on the loom, in conjunction with the interactive building management systems may enable the sourcing of the precise energies to maintain the loom on heating or cooling cycles. An automated T-intersection valve located after the variable speed pump may divert flow within the sealed system via the geo-thermal energy exchange loom, returning directly to the air conditioning loom for distribution. An automated valve and meter will link each modules energy exchange systems with the supply loom, and will account for and regulate flow of hydronic energy from the supply loom to the modules thermal exchange systems. Water will pass through the modules integrated energy exchange system returning by a low-pressure loom to its supply point. The meters will emit data to the management systems for accounting and evaluating the requirements of a module in conjunction with other information received. The automated valve will enable acceptance or rejection of energies from the loom whilst also varying the flow rate independent of the supply loom.

[0155] Accordingly, if the internal and external temperatures of a building remain the same for extended periods, the flow rates might be reduced throughout the system minimising the loss of energy in distribution.

Solar Gain and Solar Rejection

[0156] Solar gains can be controlled through careful consideration of the building materials, glazing types, external shading, orientation, and so forth. The selection of glazing types should be made to limit summer solar heat gain and winter solar heat loss. Double glazing, low E, solar reflective glass and reflective films may be used.

[0157] The northern **10** and western **12** elevations of the building's facades have independently interactive aluminium louvred screens **14**, which can prevent entry of heat from beyond the glass facade **52**. The blades **16** can articulate according to the sun's position over the site and its intensity. The system is linked with the climate control-functions of each module's automation system and each garden environment's independent automation system. The ambient light levels may be set and regulated by the occupant though actuation of the louvred screens **14**.

[0158] Modules having direct frontage to northern and western sunlight in the southern hemisphere may enable indoor living space **36** to be converted by removing the retractable glass wall **52** allowing cross flow of air through the module. Simply by adjusting the angle of the louvres **16** of the louvred screen **14**, or lowering and stacking it, the occupant has the option of allowing direct sunlight into the space **36**. The deletion of separate external space has enabled provision of more spacious living spaces within the module for the same price.

[0159] The general feeling of well being obtained by having garden and trees adjacent to living space cannot be explained. Generally however, the fixed modules will have two or three storey atrium garden voids **18** containing a large trees and other shrubbery. These controlled environments may be protected from the external environment by a sealed glass curtain wall facade, which will also be screened by the attached external louvred facade **14**. Air vents (not shown) at the ceiling and at the base of these voids will enable convectional and evaporative cooling.

[0160] Each module's rooftop weather station, in conjunction with climate control functions of each module's computer, may enable automation of the interactive facade system. The systems operation may enable the rejection of solar heat outside of the buildings operable glass facade or take advantage of passive solar gain and thermal storage within the modules exposed floor. The architecture of the interactive energy management systems may enable increased efficiency. The design configuration may be scaled to provide extremely efficient solutions for larger buildings, and for individual, freestanding, modules/units in either fixed or mobile configurations.

Ambient Lighting

[0161] This prismatic glazing can enhance the performance of daylighting systems restricting direct light from falling on occupants, redirecting it towards the rear of the space where natural lighting availability is lower. Light shelves are also used to provide diffuse natural lighting to circulation spaces, with translucent panels in the floor transferring natural light to below.

[0162] Artificial lighting typically accounts for between 25%-35% of a building's energy usage. Designing a building for effective natural lighting permits the artificial lighting to be switched off for much of the year, which has the added benefit of reducing the amount of heat being generated in a building and which requires removal.

CONCLUSION

[0163] Reductions in a building's typical energy usage of 20% may be expected, if a balance is achieved between the need to reduce heat gains in summer and collect heat in winter. This can be achieved while maintaining acceptable levels of natural lighting.

[0164] The module's automated and interactive climate control systems may be integrated with each module's interactive facade, either taking advantage of passive solar heat in colder climates or minimising solar radiation in warmer situations. Air movement may be provided by design of systems without mechanical means for hygiene and energy conservation (except for exhaust extraction systems).

6 Energy Management System

[0165] The module's interactive energy management systems may run applications of the various systems based upon energy demands of all module's in the building, the climatic conditions, and re-distribute power through the grid between various buildings within the groups' holding, and effectively merging the demand requirements within the community. Additional power may be purchased on a wholesale basis from the local power supply. Consumption costs may be redistributed to module occupants based upon consumption but at discounted rates.

Introduction

[0166] In-house computers located within the module/unit may automatically interact with each individual building services computer and the building groups remotely hosted building management systems via the Internet. The in-house computer may provide automated control and function, and may interact with the buildings automated access control, waste management and energy management systems. Interactive performance with the building's energy management systems may provide more efficient interactions for the sourcing and application of energies based upon actual demand. Further links with the building group's management systems may enable another dimension for the sourcing and application of power between group buildings via the grid.

[0167] The building systems computer may operate the variable flow rate heating and cooling hydronic loom which may source the required energies with co-generation heat exchange via geo-thermal exchange. Similarly, hot water and electricity requirements may also be passed to the building's systems management computer, which may utilise data available to determine, source distribute and account for occupants requirements in the most efficient manner

[0168] Systems design for efficient distribution of hot and cold water to the modules and the provision and distribution of required energies for climate automation integrates the assembly of interactive and networked sensors, variable speed pumps, automated valves and integrated electronic metering. The system design may provide a revolutionary approach to natural resource recovery and distribution systems within buildings.

Power

[0169] The building groups processing computer may be able to more effectively balance power generation potential of the groups buildings at any point in time and reapply the same energies through the power grid in order to better match varying supply and demand levels of various buildings in various geographical locations. This may also minimise the volume of energies purchased by the group during peak supply tariffs.

[0170] Communication from the module's automation computer may enable the building's management computer to maintain current data regarding the building's total energy requirement. In conjunction with data from the building's rooftop weather station and other relevant inputs, the building's management computer may respond to the sourcing and application of energies in the most efficient manner.

[0171] The power generation unit may be used to supplement the power requirements of the building and may be programmed to supplement intake from grid supply during peak periods or provide total self-sufficiency. The systems design may enable a heat source from the building's power generation unit to provide a parallel relationship between the demand requirements of power and heating in sequence. The solar/geothermal solution compliments the overall relationship. The combination may be suitable for extreme and variable climates and may be scaled at any size.

[0172] The collection of solar power during warmer seasons complements the building systems providing energy supply to the air conditioning looms variable pump. During colder months, when the integrated solar collection becomes less effective, the power generation unit may substitute supply and in parallel provide cogeneration energy required meeting the increased heat requirement of the building.

Heating

[0173] An in-floor hydronic heat exchange system is fitted to each module with an instantaneous gas furnace, which may also provide hot water to each module. In larger complexes underground heat exchange, may be added to the system. Generally, the earth will provide a constant temperature (approximately 17 C) which can be boosted in winter and cooled during warmer months. When on automatic the climate control system may gain in efficiency by allowing direct sunlight onto each apartment's floor slab, creating a heat-bank effect when appropriate. When on automatic it may maintain the desired room temperature in an efficient way.

Solar Supply

[0174] Solar power may be collected from an integrated roofing system to compliment electricity supply; a gas fuel cell may provide electricity supply to the building and heat source may be produced as a by-product. The heat may be coupled with a ground water geo-thermal energy exchange system. The by-product energy may be used to heat a water loom providing hydronic floor slab heating and cooling of the modules. The heat source may also be used to run a refrigerated chiller, providing further, secondary water cooling in the geothermal loom and providing cooling to each module hydronic energy exchange.

Water Heating

[0175] Primary heat exchange may be taken from the organic processing, secondary heat. Exchange is provided by the building gas fuel cell. The hot water is then distributed to each module via the continuous hot water loom. Flow rates will be determined by total hot water demand. Automated and networked thermostatic tap values may help minimise water wastage at the supply points.

[0176] Hot water supply requirements of the modules may be serviced from geothermal or co-generation heat exchanges of the hydronic air conditioning loom. Computer automation may vary the rate by which the co-generation power and heat source provides energy based on consumption data provided by the modules control system. The appropriate amount of energy may be sourced and delivered efficiently to each module by a variable flow water loom. An automated pump on the return supply of water may ensure a minimum water temperature before returning to the heat exchange reservoir at mains pressure.

[0177] Hot water supply may be provided to the bathroom and kitchen of each module directly from the water supply loom providing immediate hot water and minimising wastage on delivery. Utilising mains-pressure energy, water may be passed through the primary and secondary heat exchanges. The building's vermiculture waste-processing unit may provide a free-of-charge primary heat recovery source, whilst secondary heat exchange may be provided by the building's co-generation power supply unit.

7 Water Management System

[0178] As shown in the drawings, the domestic cold water supply may be drawn from the authorities main through a back flow prevention device to avoid back contamination.

[0179] Distribution is through either a solar powered booster pump from site storage, or by direct supply from mains, depending upon the building height and the mains supply pressure. Rainwater may be treated by reverse osmosis from solar power to supplement the domestic water supply. Mains supply water may be blended with the treated roof catchment rainwater to reduce the total cost of mains supply water purchase.

[0180] The water may undertake processing within the sealed treatment unit and may then return via ozone filtration to the building's black water storage facility. The water may be distributed by pressure pump to provide 70% supply for re-use through the building toilet systems and in garden watering systems. Roof rain water collection system with a minimum level mains water backup may provide the addition 30% supply of fresh water required to prevent the build up of enzymes within the closed water recycling loop.

[0181] All of the hot water reticulated pipework may be polypropylene or polyethylene that is insulated to restrict heat loss and sound transfer, and gas piping may be nylon and polyethylene.

[0182] Natural gas is used as the heating fuel for hot water heating, as well as air conditioning and space heating. A pre heater may be used on the gas flue to preheat the incoming water supply to the water heater. Gas piping may be nylon and polyethylene.

[0183] The mains pressure hot water supply system may pass water through the primary heat exchange pipes contained within the vermi-composting treatment plant which may be located in the basement of the various buildings.

[0184] As more modules consume hot water from the supply loom, mains pressure may pass water through the primary and secondary heat exchanges. As more energy may be required, the power generation may increase output. The addition of solar integrated roofing may compliment the performance of the systems architecture.

Water Collection

[0185] Rainfall run off from pavement and ground can be stored for re use as wash down, sanitary flushing, irrigation and laundry use after treatment. The treatment would be disinfection and filtration. Rainfall detention on site could also be utilised for fire fighting with an authorities' main supply back up.

[0186] Roof water may be re-used as drinking water provided appropriate filtration and disinfection processes are utilised. Roof water can be used as described after appropriate water treatment has been carried out.

[0187] Irrigation water run off could be collected, filtered and re-used for further irrigation as it is rich in nutrients.

Water Treatment

[0188] A biolytic filter may separate and process the water from sewerage the waste material together with biodegradable waste from the buildings will be converted through the process of vermiculture into worm castings, a hybrid fertiliser which will be vacuum-extracted from the sealed and computer networked processing unit. After processing the black water passes through an ozone sterilisation process to bulk storage in-situ. The water may be applied during the year for garden watering and provide up to 70% supply for re-use in each module toilet system.

[0189] All food scraps and vegetable waste generated by the building may be deposited into the building's vermi composting vegetable and sewerage waste unit. Sewerage and wastewater may enter at the top of the unit. Solid material may automatically be separated from the liquid waste and undergo vermi composting techniques utilising worms in the breakdown of waste matter. The residue worm castings may be automatically vacuum extracted into large bags for distribution on gardens in and around the building. Mains water may pass through a primary heat exchange system integrated into the buildings biodegradable waste processing unit.

Recycle

[0190] All food scraps and vegetable waste generated by the building may be deposited into the building's vermi composting vegetable and sewerage waste unit. Sewerage and biodegradable waste systems may deposit directly into the unit. Solid material may automatically be separated from the liquid waste and undergo vermi composting techniques utilising worms in the breakdown of waste matter. The residue worm castings may be automatically vacuum extracted into large bags for distribution on gardens in and around the buildings.

[0191] The water may undertake processing within the sealed treatment unit then return via ozone filtration to the building's black water storage facility. The water may be distributed by pressure pump to provide garden watering and up to 70% supply for re-use through the building toilet systems. Roof rain water collection system with a minimum level mains backup may provide the addition 30% supply of fresh water required to prevent the build up of enzymes within the closed loop water recycling system.

[0192] Alternative configurations may utilise roof collection as a means of providing a fresh water supply to the module depending upon the availability of quality local supply. The water conservation and re-use systems may reduce building dependence on environmentally damaging water supply, sewerage removal and storm water infrastructures.

CONCLUSION

[0193] The water conservation and re-use systems may reduce building dependence on environmentally damaging water supply, sewerage removal and storm water infrastructures.

[0194] The buildings should conserve less mains water or provide self-sufficient supply and re-use systems and may not require removal of sewerage or storm water drainage off site. The reduced dependence on urban infrastructure will reduce the negative environmental effects of off site power stations, water supply and polluting water disposal systems.

8 Resource Management Systems

[0195] Communication from the module's automation computer may enable the building's management computer to maintain current data regarding the building's total energy requirement. In conjunction with data from the building's rooftop weather station and other relevant inputs, the building may respond to the sourcing and application of energies in the most efficient manner. Further links with the building group's management systems may enable another dimension for the sourcing and application of power between group buildings via the grid.

[0196] Computerised automation of the modules may enable the adoption of computerisation; automation, audio-visual communications, automated vending. Interactive energy management systems as detailed may be incorporated to provide plug-in connection to pre-manufactured and standardised looms enabling easy introduction and scalability of systems design on a modular basis.

[0197] Similarly, hot water and electricity requirements may also be passed to the building's systems management computer which may maintain a continuous total of the requirement of each of the modules.

[0198] A variable speed pump and temperature sensor may be located on the return supply of the closed loop air conditioning loom. The total heating or cooling requirements of modules located on the loom, in conjunction with monitoring change in air temperature outside the building may determine whether the air conditioning energy supply loom is on either the heating or cooling cycle.

[0199] The complex and interactive system integrates the assembly of interactive and networked sensors, variable speed pumps, automated valves and integrated electronic metering. The system design may provide a revolutionary approach to natural resource recovery and distribution systems within buildings.

[0200] The building systems computer will operate the variable flow rate heating and cooling hydronic loom which may source the required energies with cooling energy being sourced via geo-thermal exchange. Geothermal supply in colder climates with secondary heat exchange from the power generation plant in extreme climates the water will return to the heat exchange power generation plant.

[0201] Depending on the temperature of the return supply, it may return directly to the power generation plant. Heating of the individual building modules/units, water will either be sourced from geo-thermal supply for preheating before

9 Communications Infrastructure

[0202] Each module's built in video monitor will provide cable and global satellite television, internet, email, direct communications with building management and provide an easy to use touch screen interface providing access to building services, which may include:

- [0203] meals
- [0204] washing
- [0205] business services
- [0206] groceries
- [0207] dry cleaning
- [0208] rubbish collection.

[0209] The system may also be linked to a built in and electronically projected surround sound compact disc and recordable mini-disk or D. V. D. sound and/or video reproduction system. These services may be varied according to the nature of the use of the module and/or the requirements of the occupant. For example, the telecommunication needs of an office may be greater than for an apartment, but its "entertainment" aspects may be lower. The system may provide points around the module for telephones, printers and computers. In each state there will be a central host site for the all location applications, with all communications between each location and the central host site using a TCP/IP private network connections provided by a system provider with privacy being implemented using encryption.

[0210] At each location host site for a nation there will be a number of platforms implemented that provide an instance of each application for each location.

[0211] All communications at a location will be transported over TCP/IP where possible including television, video, telephony and other audio/visual communications applications.

[0212] Businesses operating from the modules may require the addition security and bandwidth provided by dedicated optical fibre connections-therefore optical fibre cable bundles may be put into the service ducts of buildings where the need is anticipated.

[0213] With the advent of the Internet, and improved communications, it is becoming apparent that our lives exist in physical space, and our mental in cyberspace. The mental space exists of our communications, our information data bases, and our access to information networks and so forth.

[0214] The Internet, the systems design of the module, and the personalised dynamic IP address will enable, (like a personal web site) storage of data and personal communications and module settings which may be lodged into the system, and enable dynamic telephone and video communications anywhere in the world (for the cost of maintaining web site and local phone call).

[0215] The built-in video screen may provide standardised access video communications (via the Internet, globally) and provide general Internet, computer, entertainment and networking interface between in-house computer and building control systems. Systems design may provide for real time download of video information.

[0216] FIG. **22** shows a modular building unit for use in the invention. As in FIG. **16**, the unit **200** has a floor panel **202**, a fixed side wall panel **204**, a movable side wall panel **206** and a ceiling or roof panel **208**. As shown in FIG. **22**, the movable side wall is adapted to be able to be hingedly connected to the remainder of the module at its top and hingedly connected to the floor at the base of the side. In this way one can raise a side, or lower it, to create a floor or roof as the case may be. if two spaced-apart modules do the same thing, extra space is created between them which is useable as general, open space. This may be able to be used as extra living space, office space, a balcony, or the like, as desired.

[0217] By having each module able to "lock in" to modules adjacent to it, above it, and below it, one can erect a structure of such modules in a relatively quick time. Similarly, it is possible to dismantle them relatively quickly so that they are useable for relatively short term occasions such as those described above.

[0218] For the open spaces created by the raising and lowering of walls, the front and rear may be able to be fitted with standard pre-made window units, balcony units, wall units, or the like.

[0219] All wiring is integrated into each module and by merely connecting the wiring to a common loom appropriate electrical connections and telecommunications connections can be made. By using snap-fittings for water reticulation and sewerage again ease of assembly and disassembly is provided. Likewise snap-fittings or other similar engagements can be used for air circulation and air conditioning.

[0220] It is therefore possible to create a building such as a media centre for short-term use for example, such as for Olympic Games in which accommodation is provided for the varying media representatives, offices created for their work to be able to be performed, makeup rooms created for those on television and film media, and even studios created to enable their broadcast to be made. In this way, for example, if the media centre was a sufficient size all of the accommodation, offices, makeup rooms, and studios for a particular television network, for example, could be on one floor or in one area.

10 Module Structure

[0221] Referring to FIGS. **24** to **29**, there is shown a modular building unit **312**. The modular building unit **312** has a front wall **314**, a rear wall **316**, a base **318** and a top **320**.

[0222] The modular building unit **312** has removable lifting and fixing points **322** located both beneath the floor **318** and above the roof **320**. The removable lifting and fixing points **322** are arranged for easy transport of the module **312** by shipping container handling apparatus. As shown in cross section in FIG. **24**, the removable lifting and fixing points **322** may be located on bars **324** which extend from the front wall **314** to the rear wall **316** of the module. Each unit includes a pair of lower front lifting points **322*a*** which may be connected by bars **324** to a pair of lower rear lifting points **322*b***, and a pair of upper front lifting points **322*c*** connected by bars **324** to a pair of upper internal lifting points **322*d***.

[0223] The module **312** has an underneath supporting structure formed by lower front and lower rear beams **326*a***, **326*b***. The beams **326** in this embodiment are rectangular hollow section beams, known as bottom cords.

[0224] A floor panel **328** extends over the underneath supporting structure.

[0225] The module **312** has an upper supporting structure formed by upper front and upper rear beams **326*c***, **326*d***. These beams **326** are parallel to the beams **326** of the underneath supporting structure, and are known as top cords.

[0226] The front wall **314** extends between the lower and upper front beams **326*a***, **326*c***, and is located to the front of these beams **326**. The front wall **314** is formed by a supporting structure having at least two track members **330** and at least one surface member, being a panel **332**.

[0227] In a preferred embodiment, as shown in the drawings, the supporting structure of the front wall **314** has two corner track members **334** defining the vertical edges of the front wall **314** and an intermediate track member **336** positioned midway between the corner track members **334**. The front wall **314** is thus divided into two equal portions.

[0228] The track members **330** are elongate, and each include at least one panel supporting flange **338**. Corner track members **334**, as shown in FIG. **34**, are t-shaped, with two panel supporting flanges **338** located perpendicular to each other. Intermediate track members **336**, as shown in FIG. **35**, are T-shaped, with two panel supporting flanges **338** aligned with each other.

[0229] The track members **330** each extend upwardly from a base plate **340**. The base plate **340** extends outwardly from a lower surface of the lower front beam **326*a***

[0230] Each panel **332** has parallel grooves **342** on vertical sides thereof. The grooves **342** are positioned to engage with panel supporting flanges **338** of the track members **330**. A panel **332** can thus be slid vertically between a corner track member **334** and the intermediate track member **336**, with the respective flanges locating within grooves of the panel.

[0231] Flat plate cross bracing **344** extends between the lower front beam **326*a*** and the upper front beam **326*c***, internally of the front wall **314**. An internal wall finish **346** can be fixed to the bracing **344**, extending upwardly from the floor panel **328**. The bracing **344** is then concealed. It will be appreciated that other forms of bracing can be used as desired.

[0232] The rear wall **316** is formed from two hinged portions, a first hinged portion **348** and a second hinged portion **350**. A lower hinge **352** extends along the lower rear beam **326*b***, and an upper hinge **354** extends along the upper rear beam **326*d***.

[0233] The first hinged portion **348** is connected to the lower hinge **352**, and is arranged to be moveable between a transportable configuration, wherein the first hinged portion **348** is substantially vertical, and an extended configuration wherein the first hinged portion is substantially horizontal. The first hinged portion **348** includes a surface panel **356**, which is within the module **312** in the transportable configuration and which provides an extension of the floor panel **328** when in the extended configuration.

[0234] The second hinged portion **350** is connected to the upper hinge **354**, and is arranged to be moveable between a transportable configuration, wherein the second hinged portion **350** is substantially vertical, and an extended configuration wherein the second hinged portion **350** is substantially horizontal. The second hinged portion **340** includes a ceiling panel **358**, which is within the module **312** in the transportable configuration and which provides a ceiling above the surface panel **356** when in the extended configuration.

[0235] The lower hinge **352** is laterally offset from the upper hinge **354**, such that in the transportable configuration the second hinged portion **350** is within the first hinged portion **348**.

[0236] The unit **312** is further strengthened by vertical columns **360** at either side of the rear wall **316**.

[0237] In the extended configuration, the modular building unit **312** forms a single story building **310** as shown in FIGS. **29** to **33**. In this configuration the second hinged portion **350** is maintained in position above the first hinged portion **348** by the hinges **352**, **354** on one side and by an additional pair of vertical columns **360** at the rear. This building **310** can then be joined to other similar buildings **310** to form a larger structure having distinct rooms. The building **310** may also have additional side walls added to it, constructed in a similar fashion to the front wall **314**.

[0238] In a preferred form of the invention, each of the first and second hinged portions **348**, **350** include braced structural trusses **362** about their respective hinges **352**, **354**. Examples of such trusses are shown in FIGS. **36** and **37**. The inclusion of the structural trusses increases the rigidity and torsional stability of the modular building unit **312** during transportation.

[0239] The trusses **362** are preferably fixed to the walls of the building unit **312** at plurality of locations, in order to provide sufficient structural integrity.

[0240] It will be appreciated that, although the building unit **312** has been described with a single wall **316** capable of moving into an expanded configuration, it will be possible to have a building unit with several such hinged portions on different walls.

[0241] Similarly, although the sliding panel arrangement has been described with reference to a single front wall **314**, it will be appreciated that the arrangement can be readily applied to all other walls of the building unit. It will also be appreciated that the arrangement may be adapted to the floors and ceiling or roof panels.

[0242] FIGS. **38***a* to **38***c* show the insertion of a panel **332** over tracks **330**. As can be seen in FIG. **38***a*, when a panel **332** is not in position then the track **330** has an outer end **364** at its topmost point which is exposed. A panel **332** can then be located about the flanges **338** of the track **330**, and slid downwardly. When the panel **332** is located in its final position, as shown in FIG. **38***c*, the removable lifting points **322** can be located above it.

[0243] It will be appreciated that the nature of the grooves **342** in the panels **332** allow the panels **332** to substantially cover the tracks **330**, such that the tracks **330** are not visible from the exterior of the unit **312**. This provides a visually clean appearance, whilst also reducing exposure of the track members **330** to external elements.

[0244] A low rise building **370**, in this case having two levels, is shown in FIG. **39**. The low rise building **370** is constructed from two building units **312**, one mounted on top of the other. The upper and lower building units **312***a*, **312***b* are differentiated by the presence of roof mounted structures, such as water tanks and guttering, above the upper building unit **312***b*.

[0245] A portion of a high rise building **380** is shown in FIGS. **40** to **44**. The high rise building **380** is constructed from building units **312** substantially as above described. The principal difference is in the second hinged portion **350**, and an associated separating portion **382** to replace the top **320** of the unit **312**.

[0246] In the high rise building **380**, the second hinged portion **350** provides acoustic separation between levels of the building. As such, the simple arrangement provided in the single story building **312** and low rise building **370** may not be sufficient.

[0247] Instead, the levels of the building **380** are separated by an insulating material. In the embodiment of the drawings, the insulating material is formed by modular, pre-fabricated planks **384**. Alternatively, the insulating material may be panels or in-situ formed material. The insulating material is typically aerated concrete, providing acoustic separation and fire resistance between levels. Other materials may be used.

[0248] Rather than the units **312** being bordered by rectangular hollow sectioned beams **326**, in the high rise building **380** I-beams **386** and C-section beams are used. These provide mounting points within which the planks **384** or other insulation material can be mounted. In particular, the planks **384** or other insulation material can be located in the reveals of the I-beams **386** and C-section beams. The lower beams **326***a*, **326***b* of an upper module **312** can be connected to the upper beams **326***c*, **326***d* by suitable fixing means **387**. Usefully, this fixing means **387** can be installed from within a unit **312** during assembly of the building **380**.

[0249] Additionally, it may be necessary to mount the front wall panels **332** away from the internal wall finish **346** to enhance fire resistance properties. Examples of suitable track members **388**, **390** are shown in FIGS. **43** and **44**. In this example the front wall panels **332** are further clad by metal sheeting **392**, although it will be appreciated that other cladding may be used.

[0250] In the construction of multi-level buildings, the use of slidable panels **332** as described above allows for the ready replacement of a damaged panel during construction of a building. In this way delays to construction are minimised.

[0251] It will be appreciated that planks **384** or other insulating materials with desirable acoustic properties and fire-separation properties may be used in the construction of internal dividing walls within the buildings **370**, **380**.

[0252] A further embodiment of a high-rise building **400** is shown in FIGS. **45** and **46**. The construction of the building **400** is similar to that of the high-rise building **380** of FIG. **40**, however units **312** are offset on alternate levels. In this way the top **320'** of a unit **312** provides a floor for the space above. The base **318'** provides a ceiling for a space below. The outermost face **332'** of the walls **314'**, **316'** provides internal wall faces for adjacent spaces on either side of the unit **312**.

[0253] The units **312** are assembled in a 'checkerboard' configuration, with unit-sized spaces on each side of each unit **312**. The spaces function as rooms, with each side of the spaces bordered by units **312**. In this way the volume of a building **400** may be virtually double the combined volume of its units **312** in their extended state. As the units **312** in their extended state have a volume more than double than that in their transportable state, the volume of the building **400** is virtually four-fold the sum of the volumes of the units in their transportable configuration.

[0254] In the building **400**, strength is created by mounting the lower front beam **326***a* of an upper unit **312** horizontally next the upper rear front beam **326***d* of a lower unit **312**. Both beams **326***a*, **326***d* can thus be supported by a single column **60**. This arrangement is shown in FIG. **46**.

[0255] In a further desirable embodiment, building units **312** may be fitted with location signalling devices within their structure. In the event of a unit **312** being misappropriated, the location signalling device can be deployed to assist recovery of the unit. The location signalling device may be arranged to interact with a global positioning or other satellite. The units or components thereof may also be catalogued with unique identification numbers or other identification devices to dissuade theft.

[0256] Modifications and variations as would be apparent to a skilled addressee are deemed to be within the scope of the present invention.

1. A transportable and stackable modular building unit including a floor panel, side wall panels and a ceiling or roof panel, said panels being arranged and dimensioned to form a shipping container in which the ceiling or roof panel is supported above the floor panel by the side wall panels for transportation by a containerised shipping network, and wherein at least one of the side wall panels of the modular building unit is a moveable panel removably or hingedly connected to the floor panel or the ceiling or roof panel and moveable to create additional building space adjacent the space formed by the other panels of said modular building unit.

2. A modular building unit as claimed in claim **1**, wherein the at least one movable panel is removable and utilizable as a structural end wall, a verandah section, a roof section or a floor section to at least partly enclose said additional building space.

3. A modular building unit according to claim **1** wherein the at least one movable panel is a side wall panel hingedly connected to the base and/or the top of the unit.

4. A modular building unit as claimed in claim **3**, wherein the at least one movable panel is a side wall panel hingedly connected to the floor panel of the unit so that it can swing downwardly to form an external floor of said additional building space.

5. A modular building unit as claimed in claim **3**, wherein the at least one movable panel is a side wall panel hingedly connected to the ceiling or roof panel of the unit so that it can swing upwardly to form an external roof of said additional building space.

6. A modular building unit as claimed in claim **3**, wherein the at least one movable panel is a side wall panel having a first hinged section which swings downwardly to form an external floor, and a second hinged section which swings upwardly to form an external roof of said additional building space.

7. A modular building unit as claimed in claim **1**, wherein one or more additional wall panels and glass facades are provided to at least partially enclose said additional building space.

8. A multi-storied building including a plurality of transportable and stackable modular building units, each building unit including a floor panel, side wall panels and a ceiling or roof panel, the panels being arranged and dimensioned to form a shipping container in which the ceiling or roof panel is supported above the floor panel by the side wall panels for transportation by a containerised shipping network, at least one of the side wall panels being a movable panel removably or hingedly connected to at least the floor panel or the ceiling or roof panel and movable to a position in which an additional building space is created adjacent the building unit, and wherein at least one building unit in an upper storey of the building is stacked on at least one of the building units in the storey below.

9. A building according to claim **8** wherein the at least one movable panel is a side wall panel hingedly connected to the base and/or the top of the unit.

10. A building according to claim **9** wherein the movable panel of at least one of the building units is hinged to the floor panel of the unit and movable to a position in which it forms a floor of said additional building space.

11. A building according to claim **9** wherein the movable panel of at least one of the building units is hinged to the roof panel of the unit and movable to a position in which it forms a ceiling or roof of said additional building space.

12. A building according to claim **8** comprising first and second modular building units on at least one storey of the building that are arranged with a free space between said building units and comprising a further building unit stacked on said first and second building units above said free space so that the floor panel of said further building unit forms a ceiling of the free space between said first and second building units.

13. A multi-storied building according to claim **12** wherein a plurality of the modular units on a plurality of levels are stacked in a checkerboard configuration with free spaces between the adjacent units on each level.

14. A multi-storied building according to claim **8** wherein the movable panel is removable and is utilised as an end wall, roof or floor section of said additional building space.

15. A building according to claim **8** wherein additional wall panels and glass facades are provided for said additional building space.

16. A transportable, modular building unit for use in a modular building system, the building unit including a supporting structure and surface members, at least one of the surface members being slidable within the supporting structure.

17. A building unit as claimed in claim **16**, wherein the surface members are a floor panel, side wall panels and a roof or ceiling panel, the panels being arranged to form a container in which the ceiling or roof panel is supported above the floor panel by the side wall panels for transportation by a containerised shipping network, a containerised distribution network or sea transport.

18. A building unit as claimed in claim **17**, wherein at least one of the side walls panels and associated supporting structure is a panel hinged to the floor panel or the roof or ceiling panel, and moveable to create additional building space adjacent to the space formed by other panels of the modular building unit.

19. A building unit as claimed in claim **16**, wherein the supporting structure is formed from beams having flanges, such as I-section beams and T-section beams.

20. A building unit as claimed in claim **19**, wherein at least one panel has a groove about its periphery, the groove being able to locate about flanges of the supporting structure.

21. A building unit as claimed in claim **19**, wherein the supporting structure includes bracing located within the surface members.

22. A transportable, modular building unit for use in a modular building system, the building unit including supporting structure and surface members, the surface members being a floor panel, side wall panels and a roof or ceiling panel, the panels being arranged to form a container in which the ceiling or roof panel is supported above the floor panel by the side wall panels for transportation by a containerised shipping network, a containerised distribution network or sea transport, wherein at least one of the side walls panels and associated supporting structure is a panel hinged to the floor panel or the roof or ceiling panel, and moveable to create additional building space adjacent the space formed by other panels of the modular building unit, the hinged panel including braced structural trusses.

23. A transportable, modular building unit for use in a modular building system, the building unit including a supporting structure and surface members, the surface members being a floor panel, side wall panels and a roof or ceiling panel, the panels being arranged to form a container in which the ceiling or roof panel is supported above the floor panel by the side wall panels for transportation by a containerised shipping network, a containerised distribution network or sea transport, the unit including removable lifting and fixing points.

24. A transportable, modular building unit for use in a modular building system, the building unit including a supporting structure and surface members, the surface members being a floor panel, side wall panels and a roof or ceiling panel, the panels being arranged to form a container in which the ceiling or roof panel is supported above the floor panel by the side wall panels for transportation by a containerised shipping network, a containerised distribution network or sea transport, the unit including location signalling devices within its structure.

25. A transportable, modular building unit for use in a modular building system, the building unit including a supporting structure and surface members, the surface members being a floor panel, side wall panels and a roof or ceiling panel, the panels being arranged to form a container in which the ceiling or roof panel is supported above the floor panel by the side wall panels for transportation by a containerised shipping network, a containerised distribution network or sea transport, the unit or components thereof including a unique identification number or other identification devices.

26. A transportable, modular building unit for use in a modular building system, the building unit including a supporting structure and surface members, the surface members being a floor panel, side wall panels and a roof or ceiling panel, the panels being arranged to form a container in which the ceiling or roof panel is supported above the floor panel by the side wall panels for transportation by a containerised shipping network, a containerised distribution network or sea transport, the supporting structure including I-beams or C-section beams, wherein an insulating material having desirable fire-separation and acoustic properties can be located within the reveals of the beams.

27. A building unit as claimed in claim **18**, wherein at least one of the hinged panels includes I-beams or C-section beams which provide for insulating material having desirable fire-separation and acoustic properties within their reveals.

28. A building constructed from units according to claim **16**

29. A multi-story building constructed from units according to claim **16**, wherein vertically adjacent units each have a supporting structure including upper and lower beams, and wherein the upper beams of a lower unit are connected to the lower beams of an upper unit by a fixing means.

30. A multi-story building as claimed in claim **29**, wherein the fixing means can be attached from within a unit.

31. A multi-story building as claimed in claim **29**, wherein the beams are connected horizontally, the units being arranged in a checkerboard fashion.

32. A building as claimed in claim **29**, wherein the units are separated by insulating material.

33. A building as claimed in claim **32** wherein the insulating material is aerated concrete.

34. A building as claimed in claim **32**, wherein the insulating material is supplied as modular planks or panels.

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