June 2, 1970 D. COMM 3,514,910

MODULAR BUILDING CONSTRUCTION

Filed Feb. 14, 1968 4 Sheets-Sheet 1

Fig. 1

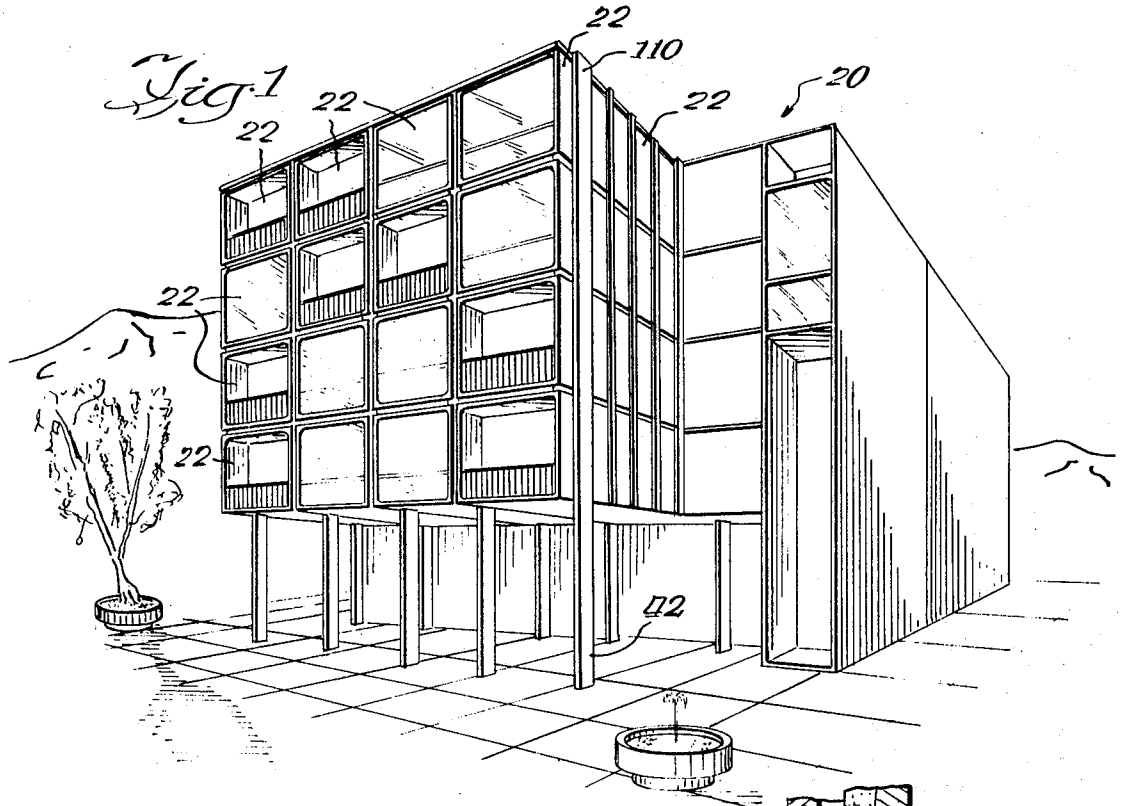


Fig. 4

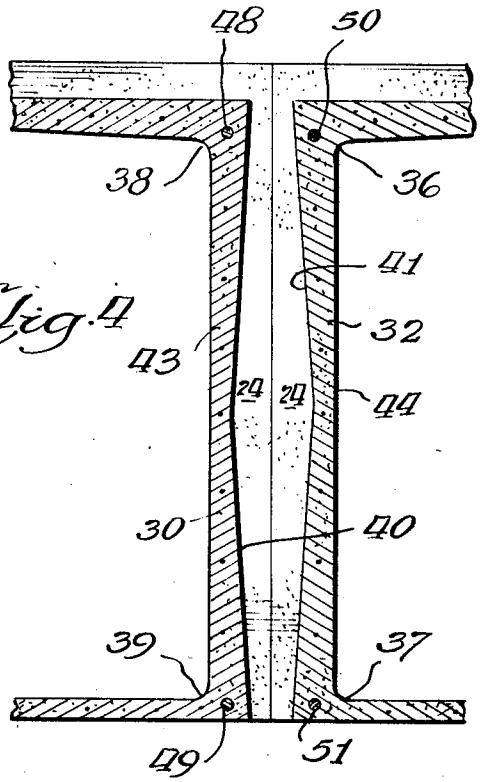
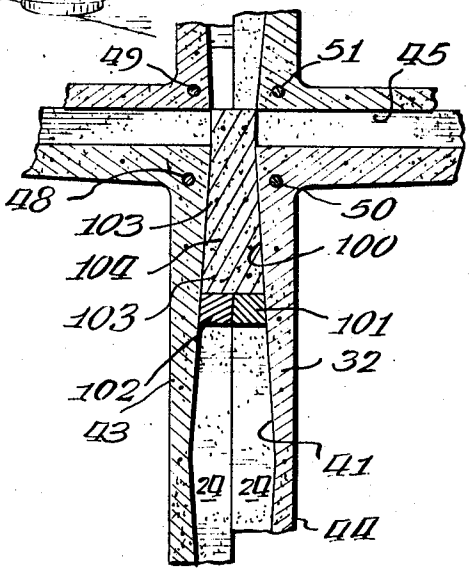


Fig. 9



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MODULAR BUILDING CONSTRUCTION

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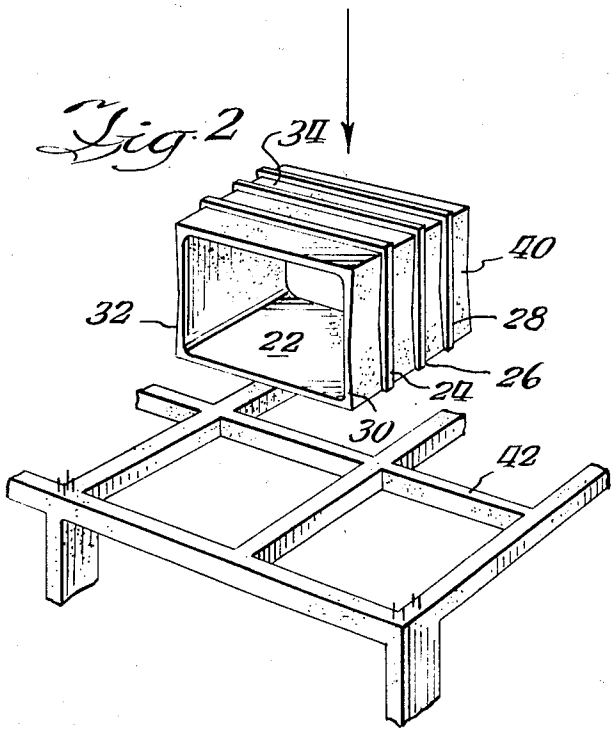
Fig. 2



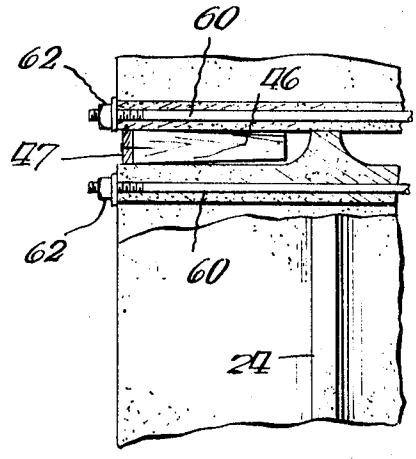
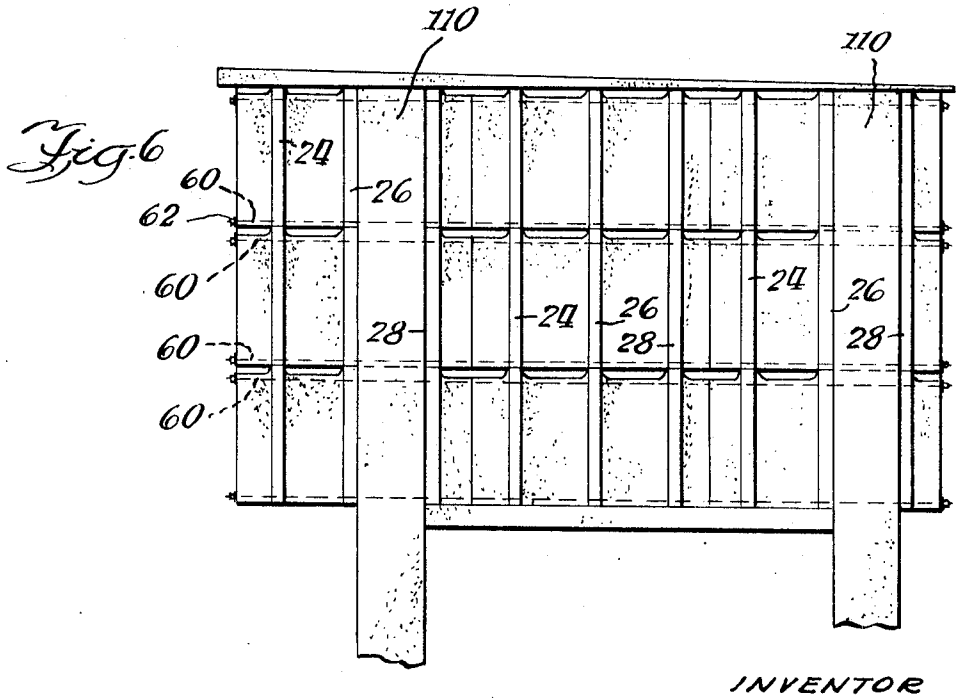


Fig. 7

Fig. 6



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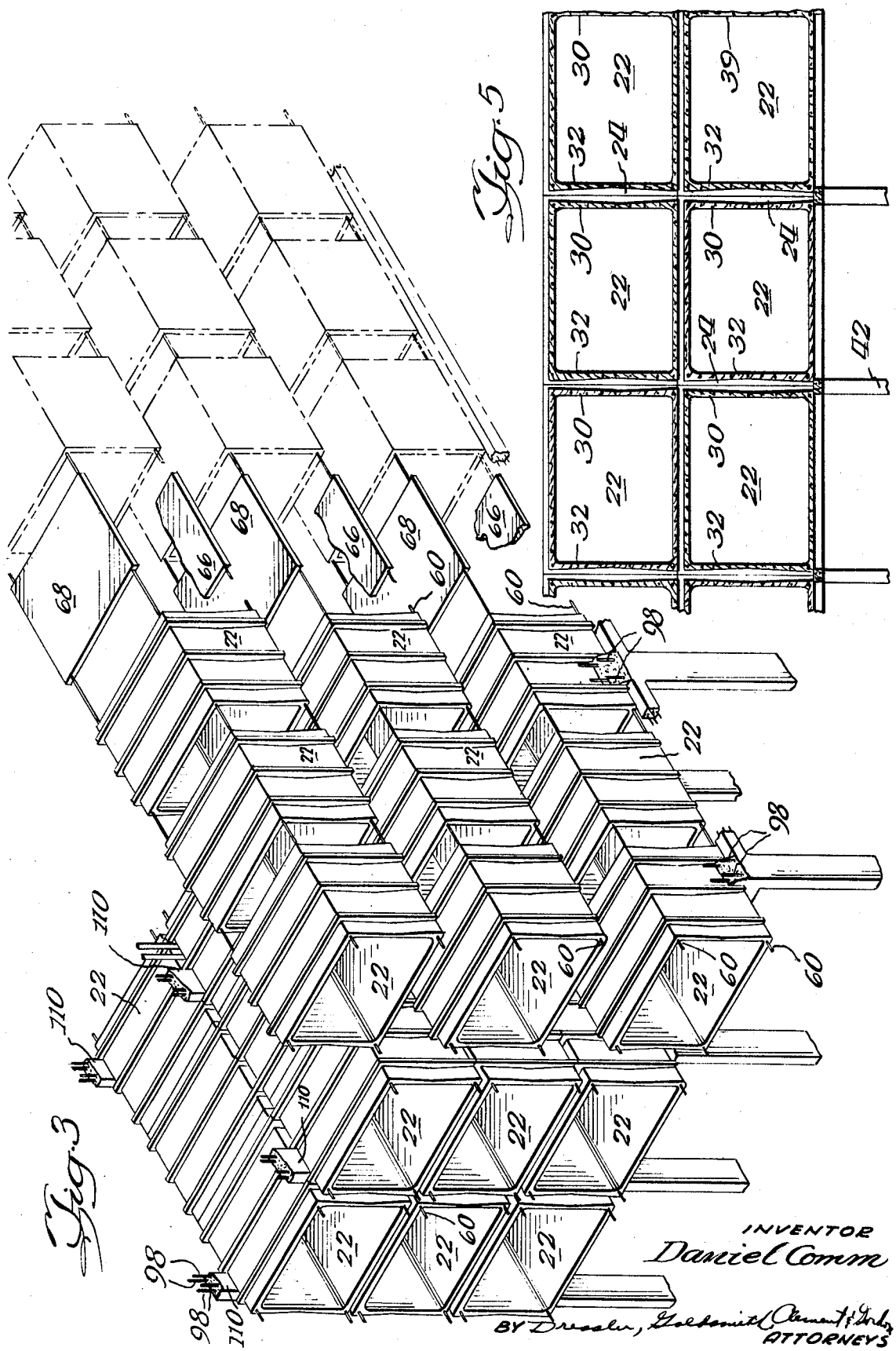
MODULAR BUILDING CONSTRUCTION

Filed Feb. 14, 1968 4 Sheets-Sheet 3



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MODULAR BUILDING CONSTRUCTION

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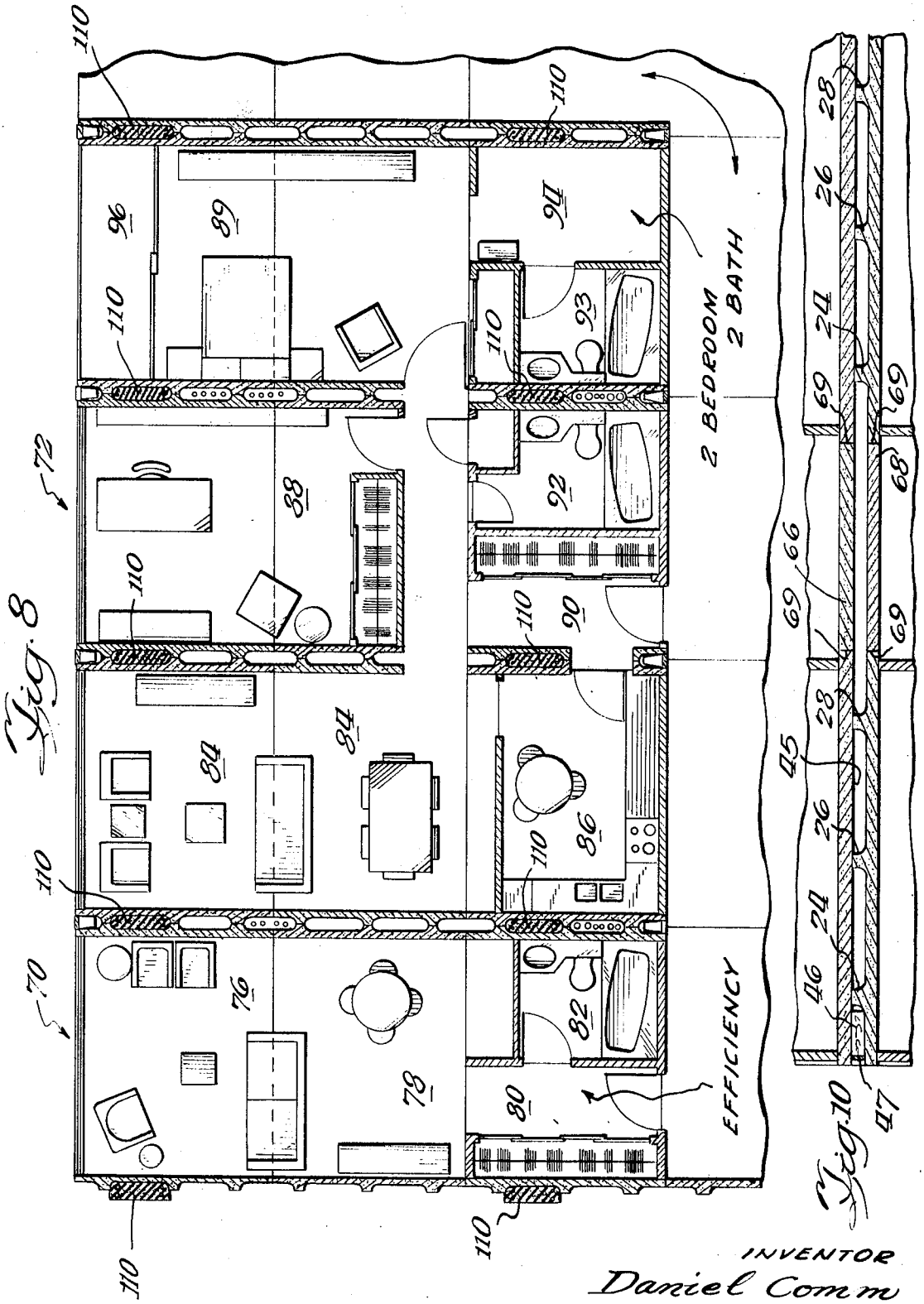

Fig. 8

Fig. 10

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3,514,910

MODULAR BUILDING CONSTRUCTION

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Int. Cl. E04b 1/348; E04c 3/34
U.S. Cl. 52—79 12 Claims

ABSTRACT OF THE DISCLOSURE

A building constructed from a number of prefabricated modules. Each of the modules has solid spacing ribs on its outer surface, which ribs cooperate with similar ribs on adjacent modules to define a series of spaces between adjacent modules. The modules are stacked and arranged according to a predetermined building plan, and selected spaces defined by adjacent sets of cooperating spacing ribs are filled with poured concrete to form support columns for the building.

This invention relates to a building construction in which a number of building modules are arranged to form the structure.

ADVANTAGES OF THIS INVENTION

There are numerous advantages to a system in which prefabricated building modules are arranged to form a building structure. For example, conventional building structures require the erection of forms, the insertion of reinforcing steel and the pouring of concrete to construct the building framework at the site. The modular construction of the present invention requires only a basic support underlying the entire building, and a conventional building framework is not required or used.

Additionally, the modular building construction of the present invention obviates the problem of damage to mechanical facilities which often occurs with prior art reinforced concrete systems. For example, in prior art systems, piping, conduit and duct work are generally installed in the concrete forms before the concrete is poured. Often these components will be damaged during the pouring of the concrete, and in order to repair the damage after pouring, it is necessary to tear up the concrete. In contrast, as is described below, with the modular building construction of the present invention, the mechanical facilities are installed after the modules are in place. In this manner, alterations or repairs to mechanical facilities are simplified and can be made without tearing up the concrete.

Furthermore, in accordance with the illustrative embodiment of the present invention, the modules are cast of concrete so that all interior surfaces are completely finished. Hence, there is no need to apply plaster or other wall surfacing to the interior walls of the modules. Such modules are fireproof, and the arrangement of the modules according to the present invention provides excellent soundproof qualities.

In the illustrative embodiment, some of the modules are the size of a small room so that they can be finished and equipped as a complete room unit subsequent to casting thereof. Thus, these modules can be assembled at the site without need to install additional interior equipment. The only remaining installation required is the connecting of mechanical facilities.

Various other advantages of the modular building construction of the present invention will become apparent from the following description thereof.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a building comprising a number of prefabricated building modules having a horizontal wall member and at least two opposing, vertically disposed side walls. Each of the modules has solid spacing means extending outwardly from the exterior surface of at least one of the opposing side walls to provide space between the sides of adjacent modules. The solid spacing means of each module is in contact with the adjacent module to define chases for receiving a flowable, hardenable material, such as concrete. A flowable, hardenable material fills some but not all of the chases to connect adjacent modules to each other and to provide support columns for the building.

The spacing means in the illustrative embodiment of the invention comprise ribs having the same lateral location on respective sides of modules. When modules are placed vertically, one above the other, the contacting ribs of adjacent modules will form continuous vertical chases for receiving the flowable, hardenable material.

The use of support columns formed by pouring a flowable, hardenable material in selected chases defined between adjacent modules is unique and offers a modern structure with much air space between adjacent modules. Hence, ready access between adjacent modules is provided so that it is not necessary to drill through a thick wall if a service connection is subsequently necessary between the modules. In contrast, prior art prefabricated systems such as disclosed in U.S. Pat. No. 3,331,170 and French Pat. No. 1,269,080 require that concrete be poured to fill all air spaces between adjacent modules. In such prior art systems the modules must be relatively close to each other—otherwise the amount of concrete required to fill all air spaces would be very large and prohibitively expensive. The relative closeness of adjacent modules of such prior art systems does not allow much space for mechanical facilities, and in addition limits the soundproofing qualities of the structure.

In the illustrative embodiment, the exterior surfaces of the opposing sides of the modules are bevelled with respect to a vertical plane. This expedient achieves a positive mechanical purchase between the modules and the hardened material between adjacent modules, and makes it possible to provide the hardened material in only selected chases between adjacent modules.

THE DRAWINGS

A more detailed explanation of the invention is provided in the following description and claims, and is illustrated in the accompanying drawings, in which:

FIG. 1 is a perspective view of a building constructed in accordance with the principles of the present invention;

FIG. 2 is a fragmentary perspective view of a single module about to be positioned on a base structure;

FIG. 3 is an isometric view, partially exploded and partially in phantom, of a portion of the building of FIG. 1;

FIG. 4 is an enlarged fragmentary end elevation of a pair of building modules in position adjacent each other;

FIG. 5 is a fragmentary end elevation of a number of building modules after they have been arranged and stacked to form a portion of a building structure;

FIG. 6 is a side elevation of a building construction with the modules in place;

FIG. 7 is an enlarged fragmentary side elevation, taken partially in section, of a portion of the building construction of FIG. 6;

FIG. 8 is a top sectional view of a portion of one floor of a building of FIG. 1;

FIG. 9 is an enlarged fragmentary end elevation of four adjacent modules in position with respect to each other with a transverse beam being utilized; and

FIG. 10 is an enlarged fragmentary side elevation of a floor and ceiling connection according to the principles of the present invention.

DESCRIPTION OF SPECIFIC EMBODIMENT

The building **20** illustrated in FIG. 1 is formed of a number of modules **22** which are stacked vertically and aligned horizontally. Each of these modules **22** is formed of pre-cast reinforced concrete and has solid spacing ribs **24**, **26** and **28** (best seen in FIGS. 4–6) integrally cast therewith and extending outwardly from the side walls **30**, **32** and top wall **34**. The spacing ribs of each module have the same lateral location on respective side walls **30** and **32** and on top wall **34**. In this manner, spacing ribs of adjacent modules can be placed in contact with each other and vertical chases will be formed between adjacent modules. Such chases provide air space to achieve soundproofing qualities and also within selected chases there is poured concrete which, when hardened, provides support columns **110** for the structure.

The internal corners **36**, **37**, **38** and **39** are coved to achieve maximum strength. The external surfaces **40** and **41** of side walls **30** nd **32** are bevelled with respect to a vertical plane (surface **41** being bevelled upwardly and outwardly), as shown most clearly in FIG. 4. This expedient is useful to provide a positive mechanical purchase when the concrete is poured between the side walls of adjacent modules.

In the illustrative embodiment, the spacing ribs on the top wall **34** of the modules contact the exterior surface of the bottom wall, i.e., the flat undersurface **45**, of the module directly thereabove. The air spaces between vertically adjacent modules provide excellent soundproofing qualities and mechanical facilities can be provided in both the vertical and horiontal chases formed between adjacent modules. If desired, concrete may be poured to fill some of the horizontal chases and thus form horizontal beams extending between and supported by vertical support columns formed in vertical chases located on opposite sides of a given module, which horizontal beams provide additional lateral stability for the vertical columns and, when the beams are in direct contact with the flat undersurfaces **45** of the modules immediately above, help to support those vertically adjacent modules. As shown in FIG. 7, inserts **46** are provided to close the openings defined by vertically adjacent modules. Trim **47** is connected to the otherwise exposed ends of inserts **46** at the building facade, to provide an attractive appearance.

As best seen in FIGS. 4 and 9, the walls of each module define four apertures **48**, **49**, **50** and **51** which extend the entire length of the module, and are preferably located near the corners formed by adjoining walls of the module. These apertures are provided in a manner so that when the modules are aligned end to end, the apertures defined by one module will register with the apertures defined by the adjacent modules, thereby providing openings for tie rods **60** (see FIG. 6) connecting end to end modules to each other. Nuts **62** are screwed onto the ends of the tie rods to retain them within the apertures. Such tie rods provide additional support for the structure.

Where a hallway is desired, floor planks **66** and ceiling planks **68** may be inserted as shown most clearly in FIGS. 3 and 10. The floor and ceiling planks also define apertures for receiving the tie rods **60**, and the ends **69** of the planks are cemented to the ends of the contacting modules (FIG. 10).

A typical floor plan is illustrated in FIG. 8, in which twelve modules are aligned to provide an efficiency apartment **70** and a two-bedroom apartment **72**. The efficiency apartment **70** includes a living room-sleeping area **76**, a dining room-kitchen **78**, an entrance hall **80** and a bathroom **82**. The two-bedroom apartment **72** includes a living room-dining room area **84**, a kitchen **86**, two bedrooms **88**, **89**, an entrance hall **90**, two bathrooms **92**, **93** a large walk-in closet **94** and a balcony **96**.

The modular units are formed by pouring concrete into molds in which are positioned the necessary reinforcing steel rods. After the modular units are formed, certain special components, including kitchen and bathroom cabinets, counter tops, plumbing fixtures, heating and air-conditioning systems, windows and doors, ceramic tile, lighting fixtures, etc., are installed. The module can now be shipped to the site of construction and it can be placed in a predetermined position with all of the interior fixtures already in place.

The construction of the building commences with the preparation of the underlying support structure **42**, as shown most clearly in FIG. 2. In the embodiment shown, structure **42** is poured in monolithic form. The first module is then set in place, and any mechanical facilities which are to be connected to the first unit or adjoining units are set in place. Reinforcing steel **98** is set in the areas in which structural columns will be provided. In some instances, transverse horizontal beams are required. To this end, some of the modules are formed with sections of the spacing ribs omitted, as shown in FIG. 9. In this manner, when two rows of adjacent modules have been aligned, mold members **101** and **102** are placed in opening **100** at the bottom thereof, reinforcing rods **103** are placed in the opening, and concrete is poured in the opening to provide transverse horizontal beams **104** that extend between and are supported by vertical support columns formed in vertical chases between horizontally adjacent modules. To facilitate placement of the mold members, member **101** may be trapezoidal in cross section and member **102** may be a parallelogram in cross section. They may be formed of any suitable fire-proof material.

Once the first unit is set in place, adjacent units are then set around it. Concrete is thereupon poured in the areas where reinforcing has previously been installed, to form support columns **110** (best seen in FIGS. 1, 3 and 6). Additional units are subsequently added, as called for in the plans.

As a specific example, in the illustrated embodiment of the invention, the modules are twelve feet wide by eight feet high by ten feet deep. These dimensions can of course be varied without departing from the invention. In the illustrative embodiment, each module is pre-cast of reinforced concrete as a single monolithic unit. Such construction provides excellent fireproof quality and production efficiency.

It is to be understood that the embodiment shown is for illustrative purposes only, and many modifications or substitutions may be made without departing from the spirit and scope of the present invention.

What is claimed is:

1. A building which comprises: a gridwork of horizontal beams extending throughout the area underlying said building; means for supporting said gridwork upon the ground; a plurality of horizontal rows of prefabricated building modules at each of a plurality of floor levels in said building, each of said prefabricated building modules having a horizontal wall member and at least two opposing, vertically disposed side walls, said horizontal wall member and vertical side walls enclosing habitable space therebetween, the bottom rows of said prefabricated building modules being supported at the first floor level by said gridwork of horizontal beams, modules at all floor levels having solid spacing means extending outwardly from the exterior surface of at least one of said opposing side walls to provide spaces between the side walls of all building modules and the immediately adjacent modules in all of said horizontal rows, solid spacing means on modules in each of said horizontal rows being in contact with adjacent modules to define vertical chases that extend continuously from the bottom to the top of said building, some of said continuous vertical

chases being filled with a flowable, hardenable material to form vertical support columns rising from said gridwork to the top of the building, the remainder of said continuous vertical chases being devoid of said flowable, hardenable material, selected ones of said latter chases containing utility lines for servicing said building; and a plurality of horizontal beams extending between and supported by said vertical support columns at each floor level of the building above said first floor level to provide additional lateral stability for said vertical columns.

2. The building of claim 1 in which all said prefabricated building modules in said building have solid spacing means as there described extending outwardly from the exterior surface of at least one of their said opposing side walls.

3. The building of claim 1 in which some of said prefabricated building modules in said building have solid spacing means as there described extending outwardly from the exterior surfaces of both their said opposing side walls.

4. The building of claim 1 in which all said prefabricated building modules in said building have said solid spacing means extending outwardly from the exterior surfaces of both their said opposing side walls.

5. The building of claim 4 in which each of said solid spacing means is in contact with the solid spacing means of adjacent prefabricated building modules to define said vertical chases.

6. The building of claim 1 in which each of said prefabricated building modules has a bottom wall and a top wall.

7. The building of claim 6 in which each of said top walls on said prefabricated building modules carries solid spacing means to provide horizontally extending chases between the top of said module and the vertically adjacent module immediately above it, said horizontal chases extending continuously from one side of said building to the other, some of said horizontal chases containing said flowable, hardenable material to form horizontal beams extending between and supported by said vertical support columns, and the remainder of said horizontal chases being devoid of said flowable, hardenable material.

8. The building of claim 7 in which said solid spacing means on each top wall of said prefabricated building modules is in contact with the exterior surface of the bottom wall of the vertically adjacent module immediately above it and the continuously extending horizontal chase defined thereby is completely filled with said flowable, hardenable material to form a horizontal beam that is in contact with and helps to support said vertically adjacent module.

9. The building of claim 1 in which sections of said solid spacing means are omitted, and mold means extending from the exterior surface of the side wall of one of said building modules to the exterior surface of the side wall of the adjacent module is positioned at the bottom of the spaces where said sections of the spacing means are omitted, to form a chase extending continuously through said spaces from one side of the building to the other, said horizontally extending chase being filled with said flowable, hardenable material to form a horizontal beam extending between and supported by said vertical support columns.

10. The building of claim 1 in which said flowable, hardenable material is poured concrete and said concrete is reinforced with steel reinforcing rods.

11. The building of claim 1 in which each of said prefabricated building modules has a plurality of tie rods extending from one end of said module into a horizontally adjacent module.

12. The building of claim 1 in which at least a portion of the exterior surface of each of said opposing side walls of all said prefabricated building modules is bevelled upwardly and outwardly with respect to a vertical plane, to provide a positive mechanical purchase between said side walls and the vertical support columns formed of flowable, hardenable material.

References Cited

UNITED STATES PATENTS

1,421,278	6/1922	Matthews	52—429
2,882,712	4/1959	Carlson	52—429
1,900,457	3/1933	Miller	52—437
2,009,217	7/1935	Barnhart	52—437
3,260,025	7/1966	Van Der Lely	52—228
3,287,865	11/1966	Lockman	52—79
3,292,327	12/1966	Van Der Lely	52—79
3,331,170	7/1967	Lowe	52—79
3,377,755	4/1968	Stacky	52—79

FOREIGN PATENTS

120,609	12/1945	Australia.
269,000	1964	Australia.
722,341	1965	Canada.
120,024	1901	Germany.

HENRY C. SUTHERLAND, Primary Examiner

U.S. Cl. X.R.

52—228, 236, 438