United States Patent [19]

Weese

[11] **3,831,332**

[45] **Aug. 27, 1974**

[54] **MODULAR BUILDING CONSTRUCTION SYSTEM USING SEGMENTED COLUMN ASSEMBLY**

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[22] Filed: **Aug. 18, 1972**

[21] Appl. No.: **281,706**

[52] **U.S. Cl.** **52/236,** 52/586

[51] **Int. Cl.** **E04h 1/04,** E04h 9/06

[58] **Field of Search** ..... 52/263, 285, 250, 421, 52/275, 427, 583, 586, 753 C, 753 D, 753 K, 234, 236, 79

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Attorney, Agent, or Firm—Johnson, Dienner, Emrich, Verbeck & Wagner

[57] **ABSTRACT**

The present invention relates to a system of constructing floors of a building by joining together a plurality of box-shaped modular room units horizontally and vertically. The modular units are interconnected by means of assembling together a plurality of column segment attached to the modular units. A tubular body portion of the column segments are assembled together in a vertical stacked aligned relationship and thereafter the tubular body portions are coupled together by using a tension bar threaded through their axial opening.

9 Claims, 12 Drawing Figures

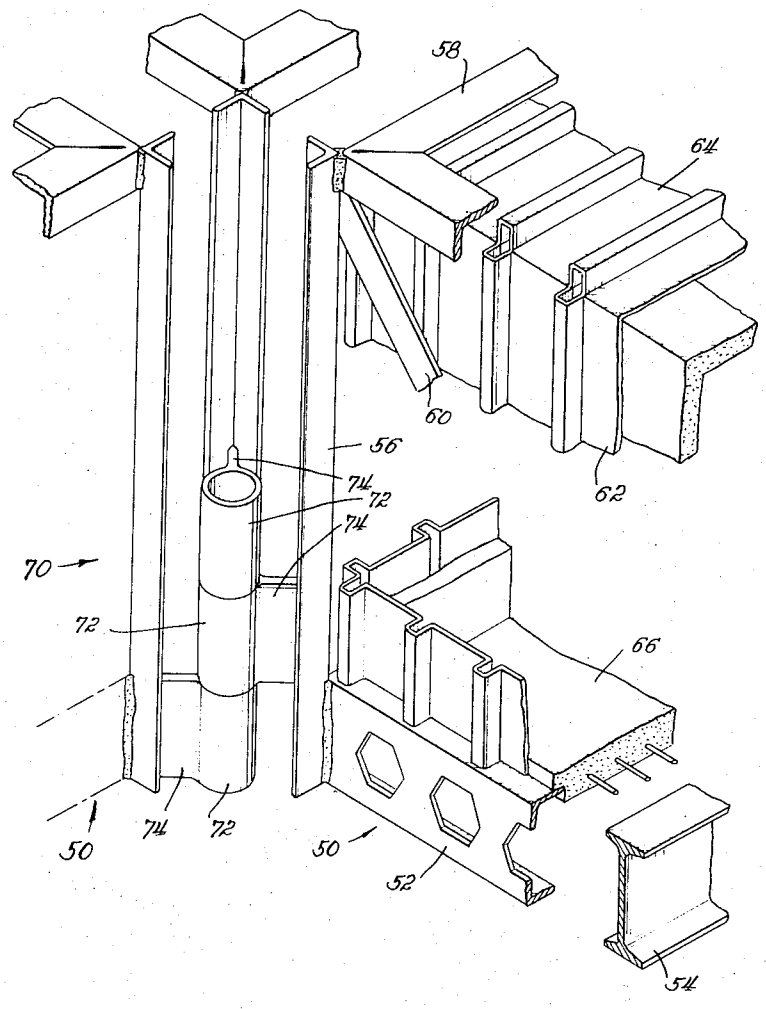


Fig. 1

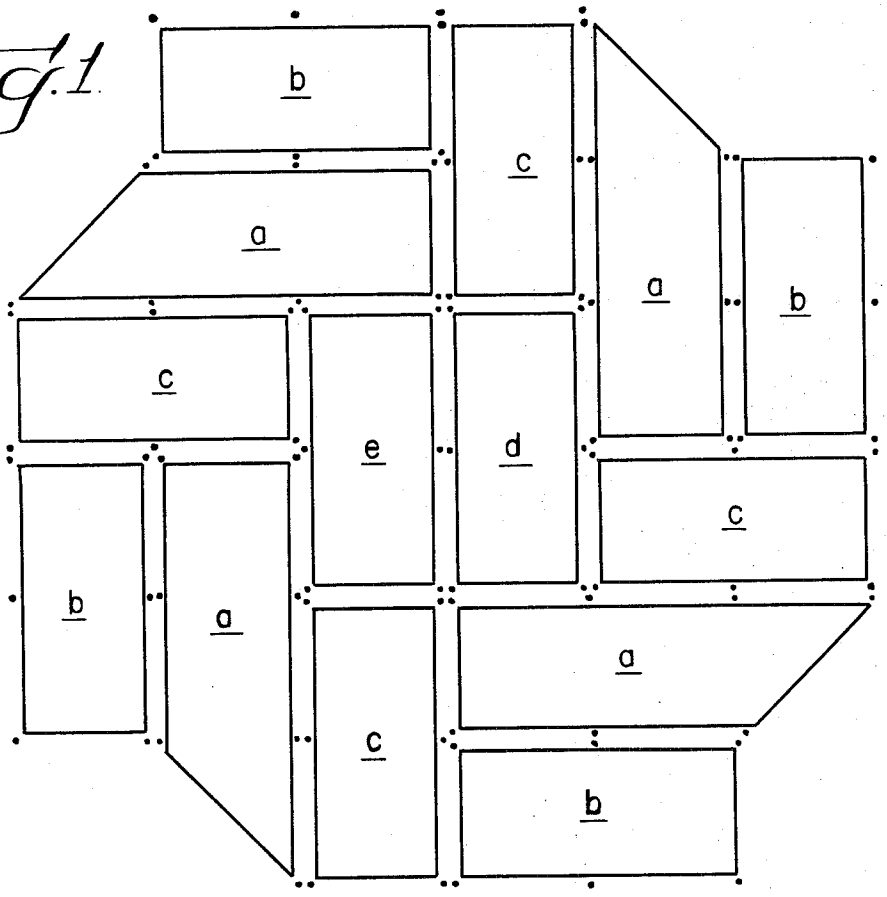


Fig. 2

MODULAR UNIT	EACH FLOOR NO.		
a	4	TYPICAL ROOMS AND STUB CORRIDORS	
b	4		
c	4		
d	1	ELEVATORS & STAIRS PASSENGER-SERVICE & LOBBY	
e	1		

Fig. 3

SEGMENTS	•	••	⁘	⁙
CONTACTS	1	2	3	4
UNITS	8	21	10	2

Fig. 4.

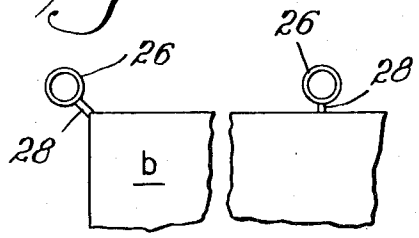


Fig. 5.

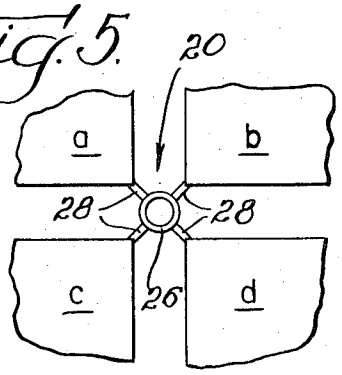


Fig. 7.

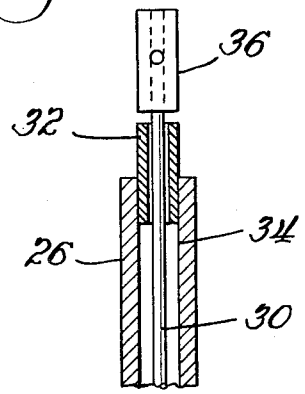


Fig. 6.

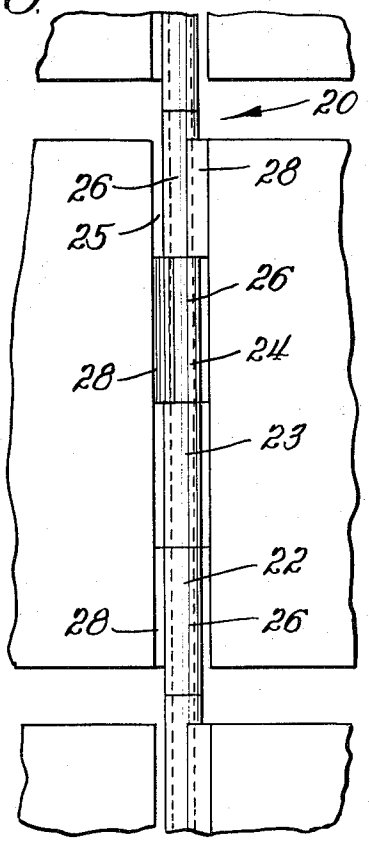
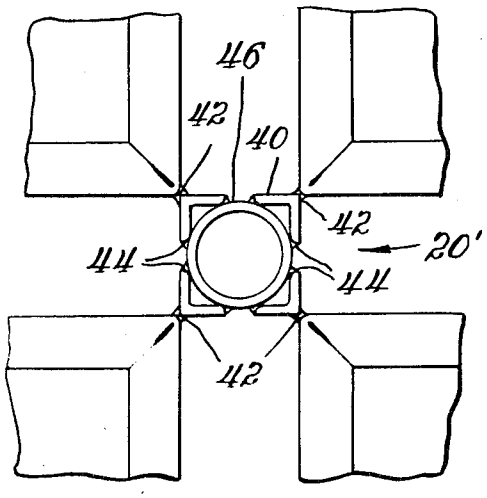


Fig. 8.



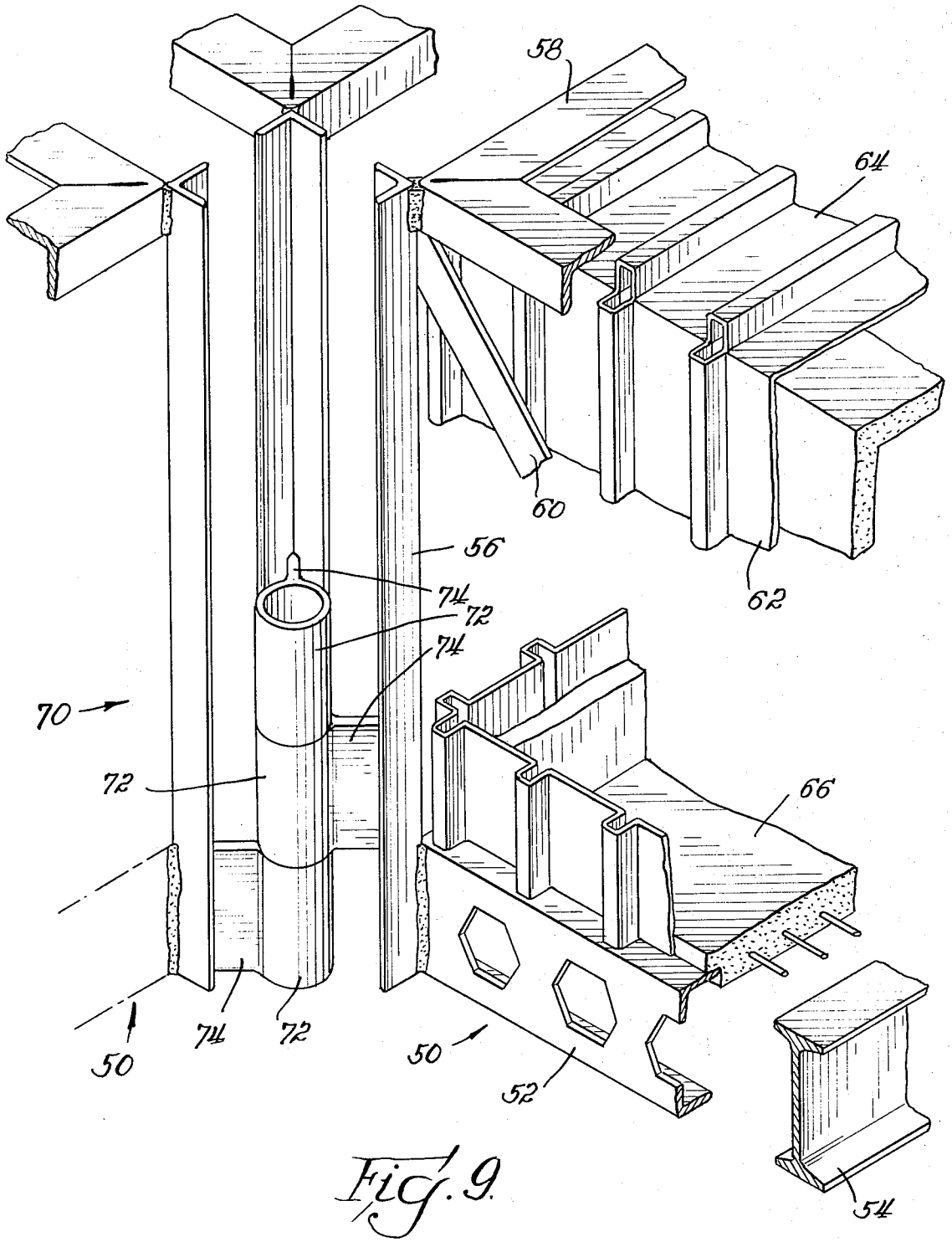


Fig. 9

FIG. 10

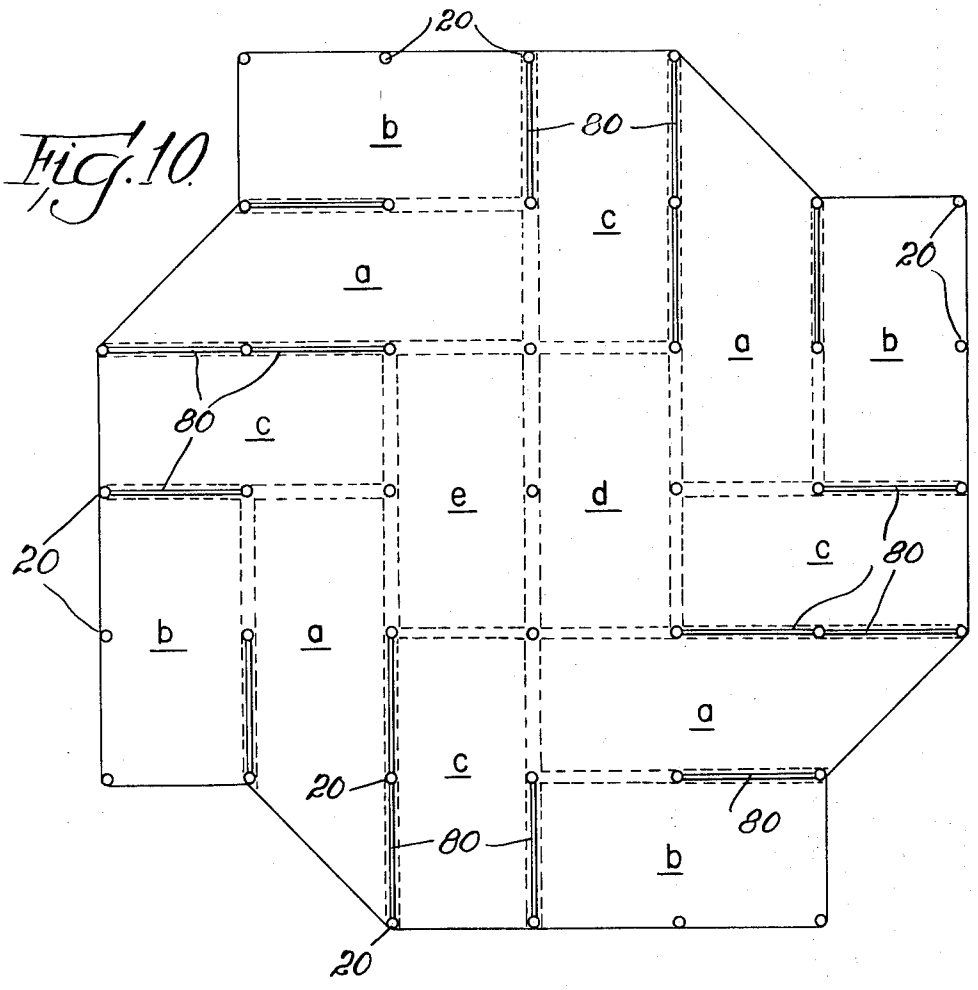
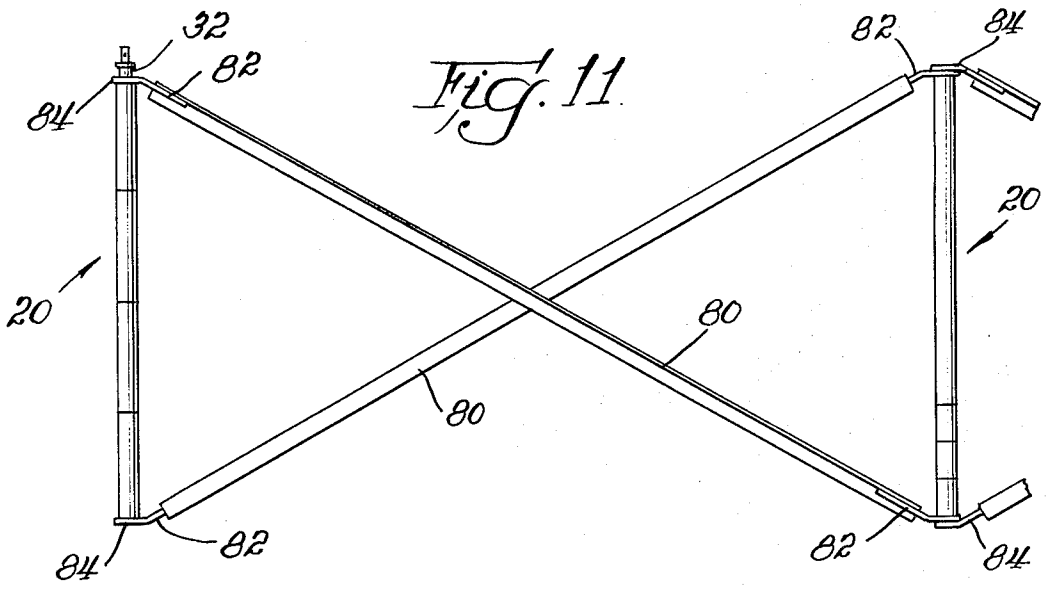

20
b
80
c
a
20
a
b
80
c
e
d
20
b
a
c
80
a
20
c
80
80
b
20

FIG. 11


32
82
84
82
84
20
20
80
80
84
82
82
84

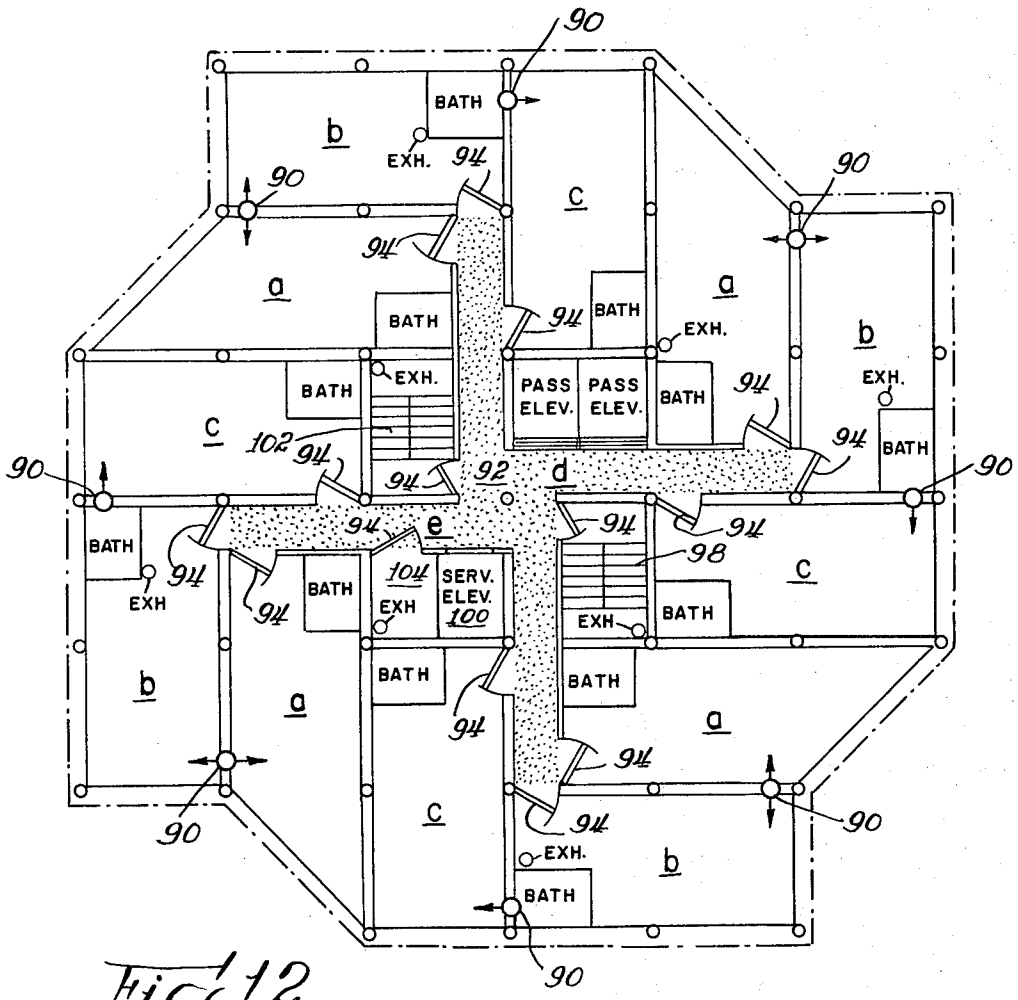

90
BATH
b
EXH.
94
c
a
PASS ELEV.
PASS ELEV.
102
92
d
e
98
SERV. ELEV.
100
104

Fig. 12.

MODULAR BUILDING CONSTRUCTION SYSTEM USING SEGMENTED COLUMN ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates to a system for interconnecting box-shaped modular units to form a building having one or more stories.

This invention is designed to provide a new and novel system for constructing a building using box-shaped modular units. One object of this invention is to provide a construction system that can be erected quickly and permits dry construction of high rise buildings.

SUMMARY OF THE INVENTION

My invention is directed to a support column assembly for joining together a plurality of box-shaped modular units to form a single or multistory building. The support column assembly is composed of a plurality of column segments assembled together in a vertical stacked aligned relationship. Each of the column segments comprises a tubular body portion and an attachment means radially extending from the tubular body portion for connection with the corners or outside wall areas of one of the modular units. The tubular segments are held under compression by means of a tension rod threaded through their center opening.

DESCRIPTION OF DRAWINGS

For a better understanding of this invention, reference may be made to the accompanying drawings, in which:

FIG. **1** is a plan view of a plurality of modular units which are connected together by means of a segmented column structure embodying the principles of my invention;

FIG. **2** is a chart for a typical floor plan of a high rise hotel indicating the number of modular units used in FIG. **1**;

FIG. **3** contains a chart explaining the use of the dot symbol shown in FIG. **1**;

FIG. **4** is a plan view showing two column segments attached to the corner and side of one of the modular units;

FIG. **5** is a plan view showing the interconnection of four corners of box-shaped modular units using the segmented column structure emobdying the principles of my invention;

FIG. **6** is a side view of FIG. **5**;

FIG. **7** is a sectional view showing the top of the segmented column structure embodying the principles of my invention;

FIG. **8** is a top plan view showing the modified version of the segmented column structure embodying the principles of my invention interconnecting four corners of box-shaped modular units;

FIG. **9** is a front perspective view showing a segmented column structure embodying the principles of my invention interconnecting three corners of box-shaped modular units which are made from an all steel frame construction;

FIG. **10** is a top plan view identical to FIG. **1** wherein cross bracing has been added to strengthen the building structure;

FIG. **11** is a side elevational view showing the cross bracing used between adjacent segmented column structures embodying the principles of my invention; and

FIG. **12** is a typical floor plan for a high rise hotel in which corridors and service facilities have been added to the floor plan of FIG. **1**.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to FIG. **1**, there is shown a plan view of a plurality of modular room units labeled a through e which are connected together by means of a segmented column structure having one, two, three or four connection points. The segmented column structure which is illustrated in FIGS. **4** through **9** embodies the principles of my invention and is generally designated by the reference numeral **20**. The modular units a-e are preferably of a one-story height which when assembled together using my invention will provide either a one story building, or a high rise structure by stacking the modular units vertically to form multiple floor levels.

There is shown in FIGS. **5** and **6** a segmented column structure **20** having four column segments **22** through **25** for interconnecting the adjacent corners of modular units a through d, respectively. Each of the column segments **22–25** are identical in construction and comprise a tubular body portion **26** and an integral radial plate portion **28**. The outer edge of the radial plate portion **28** is fastened along the corner of the associated modular unit as by welding. A tension rod **30** extends downwardly through the column segments (FIG. **7**) and is secured at both ends of the column in order to hold the column together. Referring to FIG. **7** there is shown the upper end of segmented column structure **20** in which a centering sleeve **32** is slipped over the upper end of tension rod **30** and fits snugly in the upper end of the central opening **34** of the vertical column. A sleeve nut **36** is screwed on the upper threaded end of the tension bar **30**. The lower end of the segmented column structure would similarly employ a centering sleeve and sleeve nut. To strengthen the segmented column structure **20**, its center opening **30** is preferably filled with grout.

As is apparent from FIG. **6**, the segmented column structure **20** serves the additional function of structurally interconnecting the modular units which overlie and underlie the four modular units A, B, C and D. In those instances in which less than four contacts are needed, it is preferred to insert additional tubular members without radial plates to bring the total number of segments up to four and thereby provide a continuous column segment which may be tied together by the tension bar **30** and grouted. Thus, for example, if only three connections were necessary as represented by the three dots in FIG. **1**, one additional column segment without a radial plate would be added. Likewise where only two segments are required, two additional column segments would be added.

Once the modular units are connected together in a manner such as depicted in FIG. **1**, the rooms, corridors and service facilities are added. For example, on the FIG. **2** chart there is a suggested usage of the modular construction of FIG. **1**. According to the FIG. **2** chart, modular units *a*, *b* and *c*, which are each four in number, would be completed as hotel rooms and stub corridors, and modular units *d* and *e*, which are each one in number, would be completed as elevators, stairwells, and a lobby. FIG. **3** contains a chart explaining the use of the dot symbols in FIG. **1**, in which a single dot represents the need for a column support structure having one segment with a radial plate. Similarly, two

dots represent the use of a column support structure wherein two of the column segments have radial support plates and so forth. The third line in FIG. 3 sets forth the total number of each type of column support structure needed to make the FIG. 1 structure. It is noted that those column support structures used on the outer surface of the FIG. 1 building structure require only one radial support plate to provide a means for fastening a facing around the building, and is pictorially represented in FIG. 4.

FIG. 8 shows a modified version of a column support structure 20' in which the radial plate portions are substituted by four right-angled bars 40. The corner 42 of each right-angled bar 40 is welded to the adjacent corner of the modular unit and its two outer edges 44 are welded to the tubular body portion 46. Otherwise, the segmented column structure 20' is identical to that shown in FIGS. 4 through 6.

FIG. 9 depicts the use of the segmented column structure used in an all-steel building which is particularly adaptable to low rise construction. In FIG. 9, three all-steel modular units 50 are shown connected together by the segmented column structure 70. Each of these modular units 50 has an all-steel construction comprising an edge beam 52, joist 54, vertical support beam 56, a top plate 58 and diagonal box braces 60 the beams and top plate forming a metallic corner trim for the unit. Metal siding 62 and ceiling 64 which are integrally formed and a flooring 66 such as gypsum plank are assembled together to form a room or corridor. The segmented column structure 70 is substantially identical to that shown in FIGS. 4 through 6 except that only three column segments 72 having radial attachment plates 74 are employed since there are only three modular units to be connected. To complete the segmented columns, a fourth segment having no attached radial plate would be added.

Additional structural support can be obtained by interconnecting adjacent segmented column structures 20 by means of cross bracing as depicted in FIG. 11. As diagramatically represented in FIG. 10, the cross bracing is provided between adjacent segmented column structures 20 which have no openings through their common wall area. Diagonal braces 80 include connectors 82 extending from their opposite ends with a circular collar portion 84 that fits over the centering sleeve 32.

Referring now to FIG. 12, there is shown a typical floor plan for one of the floors of a high rise hotel constructed in accordance with the principles of my invention and having a plurality of modular units *a* through *e* connected together horizontally and vertically as diagrammatically depicted in FIG. 1. Comparing FIGS. 1 and 12, it can be seen that modular units a, b and c are used as hotel rooms having a partitioned bathroom added to each room and vertically extending heat and cooling ducts 90 installed in the space between adjacent rooms. A criss-cross shaped corridor 92 is formed in the center of modular units *e* and *d* and extends through the rear portion of modular units *a*. Doors 94 are provided off this corridor and for each room. Two passenger elevators 96 and a stair way 98 are formed in modular unit d, and a service elevator 100 and stairway 102, and a storage area 104 are installed in modular unit *e*.

I claim:

1. The combination of a central support column and a plurality of room unit arrays, each array comprising hollow rectangular box-shaped precast concrete modular room units superposed relative to each other to form a multiple story building and with vertical corners in vertical alignment, said arrays being aligned adjacent each other on four sides of said vertical central support column for joining together said plurality of box-shaped modular units, said central support column being vertically disposed between adjacent vertical corners of said modular units, and comprising a plurality of column segments assembled together in a vertical stacked aligned relationship of a quantity at least equal in number to the number of said modular units, said column segments each including a tubular body portion and attachment means radially extending from said body portion for connection with the adjacent corner of a corresponding one of said modular units, means for coupling said column segments together, and a filling of grout filling the space between said connected adjacent modular units and surrounding said column.

2. The combination as defined in claim 1, wherein said coupling means comprises a tension bar extending through the center of said tubular body portions for variable tensioning thereof.

3. The combination as defined in claim 1, wherein said attachment means comprises a radial plate portion integrally formed with said tubular body portion.

4. The combination as defined in claim 1, further comprising grout infilling the axial opening of said tubular body portions.

5. The combination as defined in claim 1, wherein said attachment means comprises a right-angled bar secured lengthwise on said tubular body portion along its two lateral edges.

6. In combination a first horizontal array of hollow substantially rectangular modular room building units each having vertical and horizontal enclosing walls, at least two of which walls per unit are disposed with respect to each other at a vertical right dihedral angle to form a vertical corner, each of said units having metallic corner trim forming at least one vertical corner of each unit, said one vertical corner of each adjacent unit being disposed adjacent to, but spaced from, other similar corners of said first array, a second horizontal array of hollow substantially rectangular modular building units, substantially like the aforesaid first array, superposed upon and vertically registering with said first array and having corresponding vertical corners formed with metallic trim, and means providing vertical and horizontal connection between the trim of adjacent corners of the respective units.

7. The combination of claim 6 wherein the means providing vertical and horizontal connection between said adjacent corner trim of the respective units comprises a tubular metallic member disposed substantially equidistantly from the adjacent corners of the units between which it is located and having radial connections to the corner trim of adjacent units.

8. The combination of claim 6 wherein the space between adjacent units and surrounding said tubular metallic member is filled with concrete.

9. In a modular building structure, the combination of two or more arrays of vertically aligned hollow rectangular box-like room modules assembled horizontally into two or more floors of a building, a first array comprising a plurality of room units which are rectangular

except for some exposed outer sides, said rectangular portions of said room units for each floor being assembled with planar spaces between them, said planar spaces being disposed at right angles to each other in three dimensions, and means spatially separating the units from each other but structurally joining them together, said units having metallic trim on at least the four bottom and four top corners of each of said modules; a second array of room modules similar to the aforesaid array superposed on the first array, the vertical walls of the modules, of each of the arrays which face each other, being spaced from each other by a filling of concrete; and vertically extending metallic connecting means disposed in the space between adjacent vertical walls of both layers of modules and being bonded to and connecting the metallic trim on adjacent modules.

* * * * *