United States Patent [19]

Berrie

[11] **3,827,203**

[45] **Aug. 6, 1974**

[54] **PREFABRICATED BUILDING CONSTRUCTION**

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[73] Assignee: **Omnico Systems International, Inc.,** Downey, Calif.

[22] Filed: **Feb. 15, 1972**

[21] Appl. No.: **226,610**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 874,514, Nov. 6, 1969, Pat. No. 3,641,720.

[52] **U.S. Cl.** **52/236,** 52/263, 52/270, 52/285, 52/586

[51] **Int. Cl.** **E04c 2/48,** E04c 3/20

[58] **Field of Search** 52/234, 270, 263, 285, 52/586, 236

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Primary Examiner—Alfred C. Perham

Attorney, Agent, or Firm—Christie, Parker & Hale

[57] **ABSTRACT**

A building construction system employing prefabricated components for high rise construction. The principal components of the system include edge socketed horizontal and vertical panels, two-way horizontal and vertical splines, and four-way vertical column splines. The panels interlock with the splines and column splines by means of complementary protrusions and recesses located in the sockets and spline corners, respectively. A typical floor is completed through erection of the vertical panels engaged in an interlocked relationship by the two-way vertical splines and the four-way vertical column splines, bolted attachment of wall caps, struts and floor beams to the column splines, and assembly of the horizontal panels engaged in an interlocked relationship by two-way horizontal splines which have bolted attachment to the floor beams. Thereafter reinforcing steel bars are placed within the column splines and concrete is poured into the hollow defined by the interior of the column splines.

11 Claims, 7 Drawing Figures

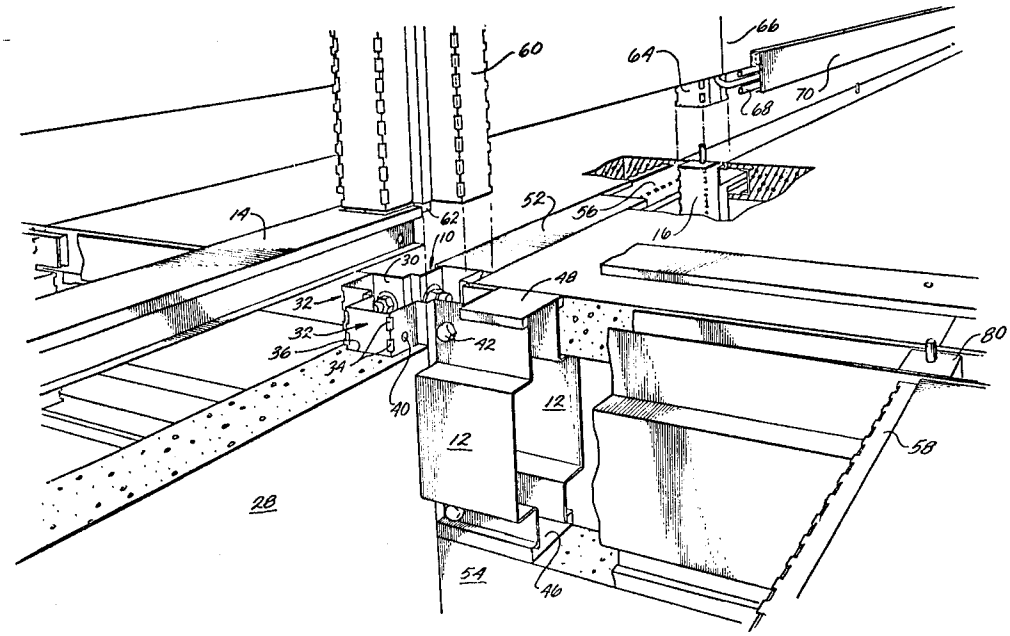
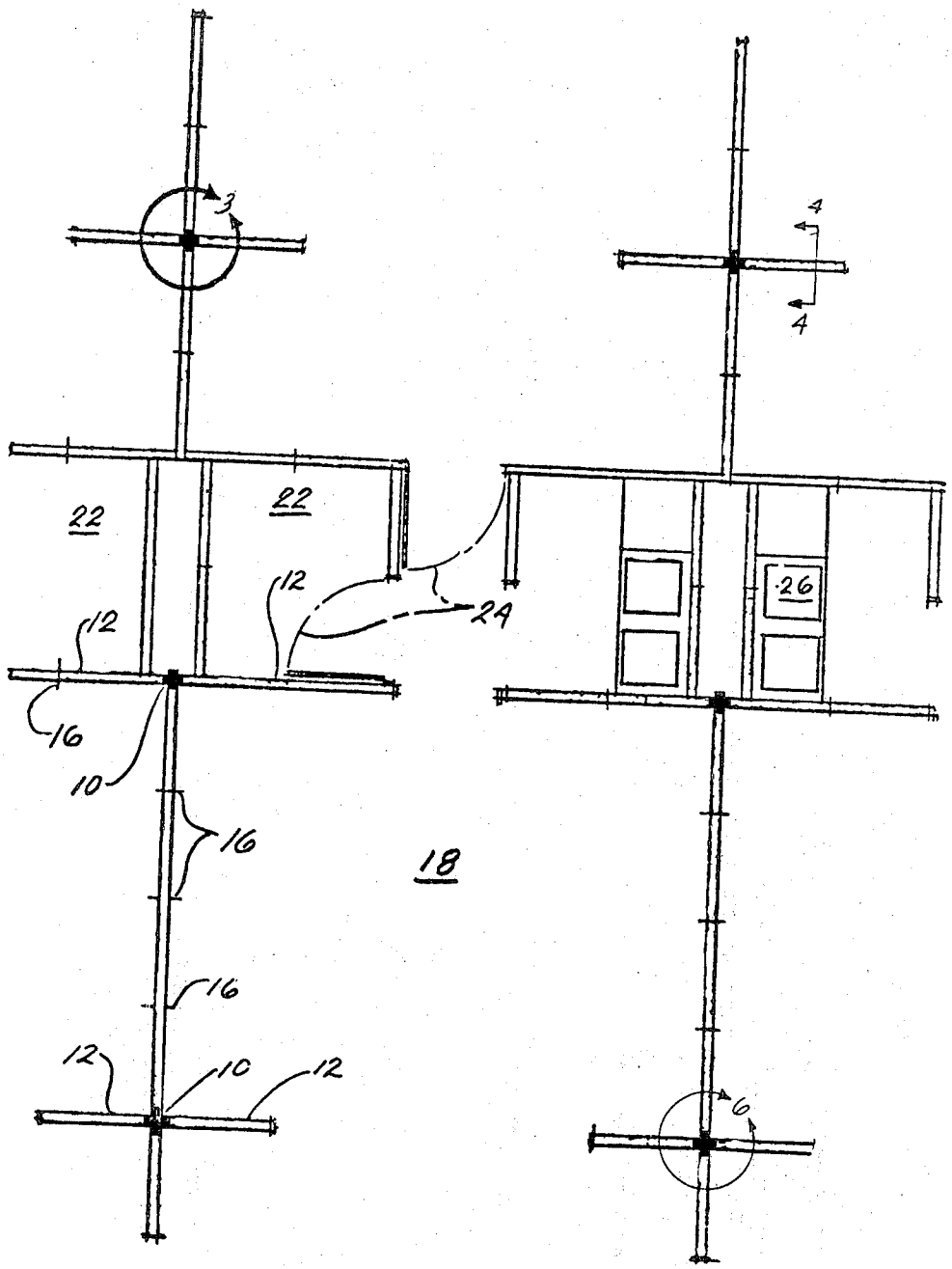


Fig. 1



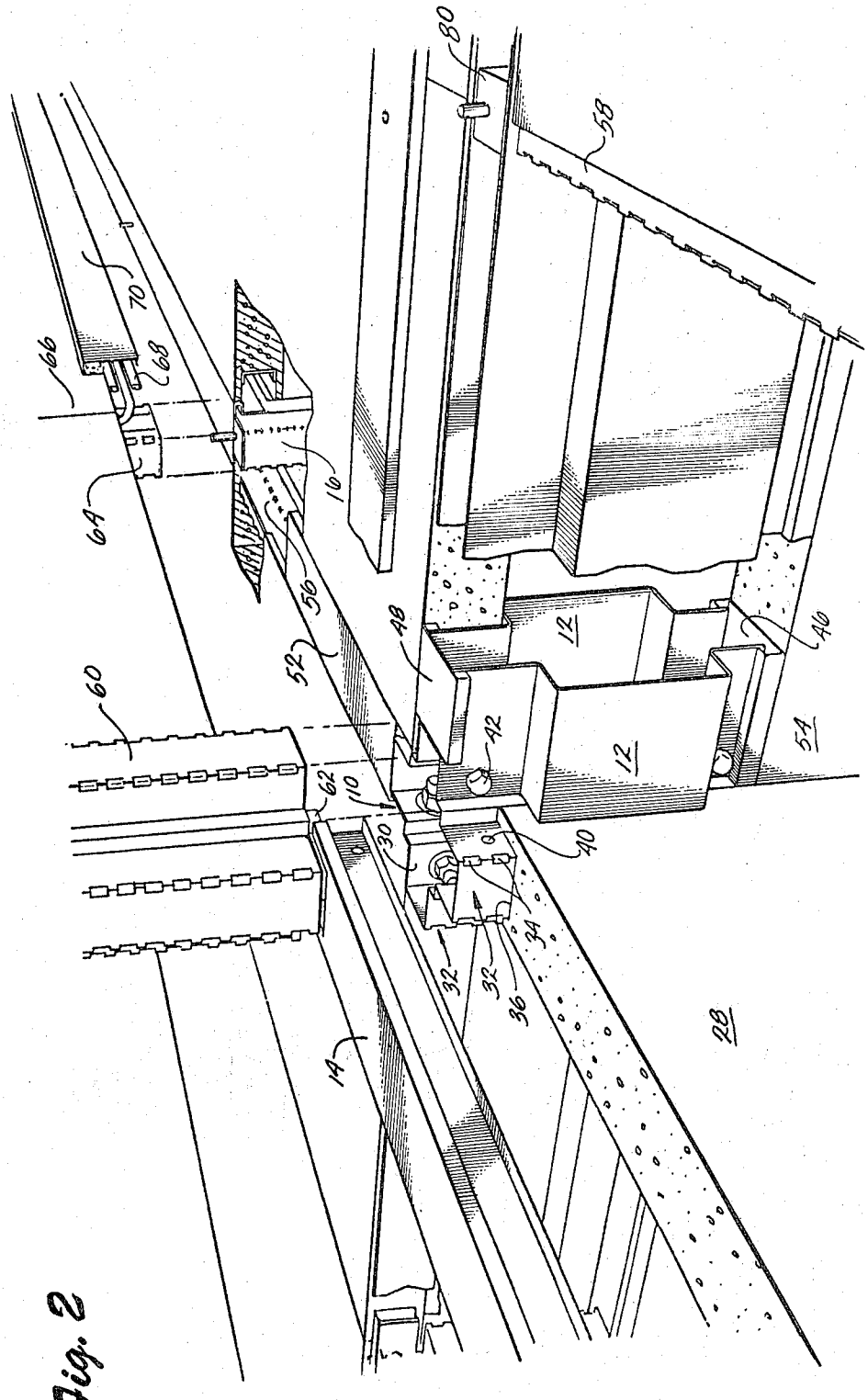

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Fig. 2

Fig. 3

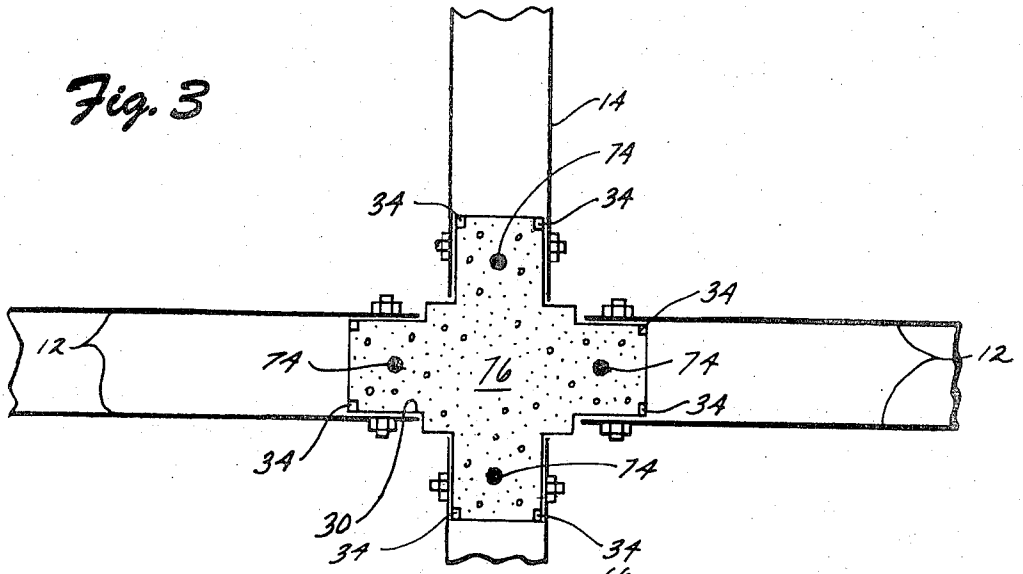

Fig. 4

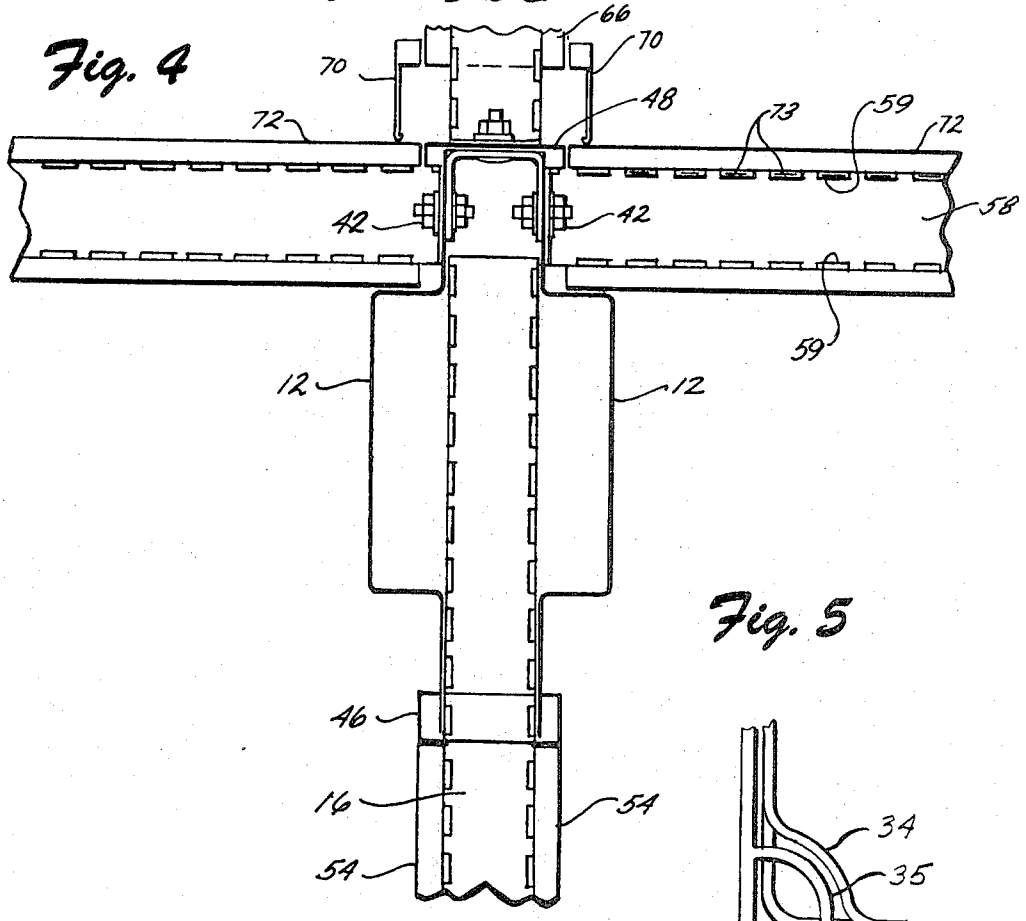

Fig. 5

Fig. 7

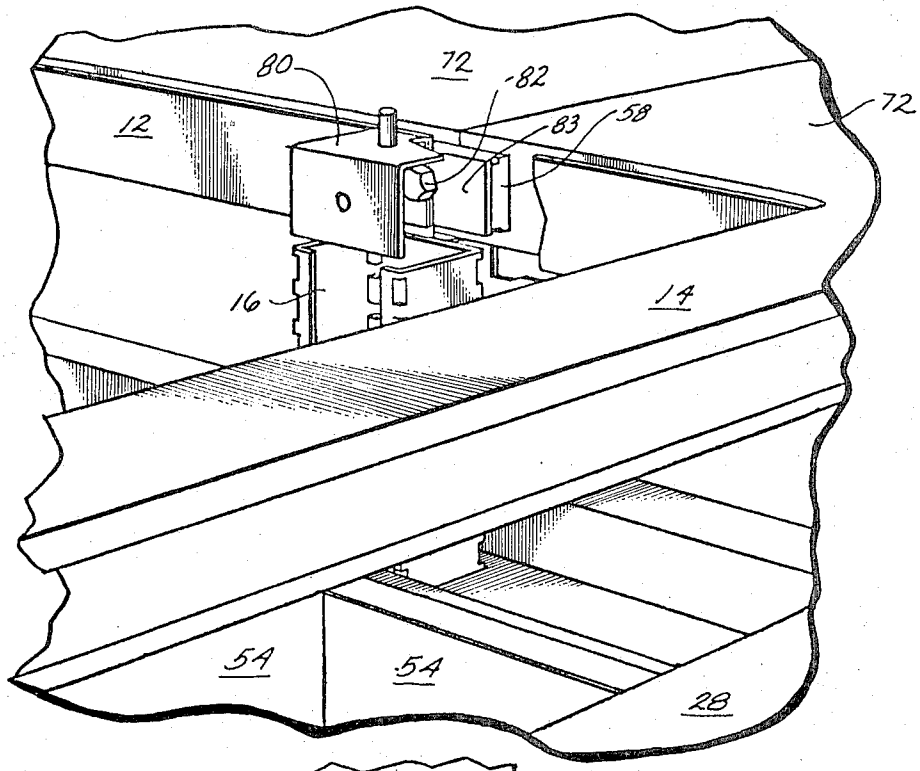
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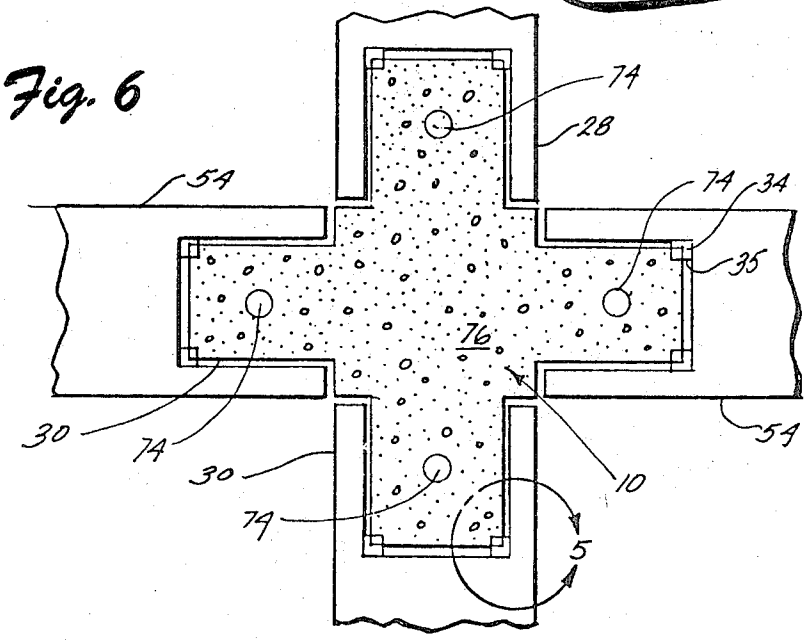
Fig. 6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PREFABRICATED BUILDING CONSTRUCTION

REFERENCES TO RELATED APPLICATIONS

This application is a continuation-in-part of application Ser. No. 874,514 filed Nov. 6, 1969 now U.S. Pat. No. 3,641,720.

BACKGROUND OF THE INVENTION

This invention relates to high rise, prefabricated structures utilizing mechanically interlocked wall and floor panels which are mounted on receiving splines to provide walls, ceilings and floors for the building structures.

The present invention utilizes the interlocked spline and panel prefabricated building system disclosed in U.S. Pat. No. 3,641,720 in a system to be utilized in the construction of multiple story buildings.

SUMMARY OF THE INVENTION

A basic component of the new building construction system according to the present invention is a concrete filled, four-way column spline having recesses located in the outwardly facing edges of each of the four spline sections of the column. Prefabricated panels defining walls extending away from the columns in four directions engage with the spline sections of the column and intermediate stud splines located between each panel by means of protrusions located in the corners of sockets which extend along the vertical edges of the panels. Mechanical joining of the remaining elements of the system, such as floor beams, floor struts, wall caps and beam caps to the column and stud splines, plus the emplacement of floor panels, provide the basic elements for the construction of a multiple story building according to the present invention.

The result is a strong, lightweight, quickly assembled multiple story building construction system. Significant reductions in weight of the building structure are achieved because the structure of the present invention does not require that the columns of the building be capable of withstanding the external loads on a typical building due to wind and other stresses. Such loads are now transmitted to the foundation by the interlocking cooperation of the column splines, stud splines and wall panels of the present invention, referred to herein as the shearlock system of prefabricated construction. This unique cooperation has the effect of transmitting such loads through the structure as planar forces separated into increments corresponding in number to the number of interlocked protrusions and recesses of the engaged splines and panels.

The invention provides a prefabricated building structure comprising prefabricated wall panels having outwardly facing grooved sockets in the longitudinal edges thereof and a plurality of protrusions located in spaced relation longitudinally of said sockets. Column splines are located at spaced intervals within the exterior walls of the structure and the wall panels extend away from the column splines to define the wall lines of the structure interior. Stud splines are located intermediately of the column in the wall lines for supporting adjacent wall panels and a plurality of protrusion receiving recesses are located in spaced relation longitudinally of the columns and stud splines, said recesses being transversely telescoped about said protrusions whereby when assembled said stud splines and column splines are interlocked with said groove sockets against relative longitudinal movement to provide for the transmission of bending, tilting deflecting and rotational forces to the foundation of the structure upon application of such forces thereto.

In a typical structure utilizing the system of the present invention, it is contemplated that the first level of the building will be poured, reinforced concrete defining the basic outline of the building and providing the foundation therefor. Erected on top of the foundation is the first floor of the building system according to the present invention. Bolted to the foundation in sequential progression by means of bolts embedded in the foundation and mounting plates welded to the column spline base are the four-way column splines of the present invention. Base flashings or sills are also attached to the foundation to define the wall lines. After the sills are leveled vertical panels and vertical two-way splines are positioned sequentially along with the column splines, the various wall caps, struts and floor beams are secured in position, the horizontal panels are positioned with the horizontal two-way splines to complete the erection of the floor. The floor beams are attached at the top of the column splines in a "floating" relationship with respect to the wall panels located directly below the beams to prevent cumulative loading.

As a last step in the assembly of each floor of the structure, once the panels and all the other elements constituting the complete floor construction are secured to the column splines, steel reinforcing bars are placed in the hollow defined by the interior of the column spline steel skin. Concrete is thereafter poured into the interior of the column spline to complete its construction. Predetermined lengths of steel reinforcing bars are left extending above the floor level to provide a lapped point of attachment for the column splines of the next level of the structure.

The advantage of the structure according to the present invention is that the column acts as a static conductor of lateral loads to the foundation. In a building according to the present invention the columns do not react to bending or rotational forces. By elimination of the need for columns to withstand deflection and bending forces, and carry only vertical loads, significant reductions in the size and weight of the column materials are achieved.

The advantages are both a reduction in foundation costs and the remaining structural components of the building which are supported by the foundation. Moreover, the structure of the present invention is characterized by quick and efficient erection, making possible a significant reduction in the terms of construction. It is anticipated that a considerable reduction in the cost per square foot enclosed within the exterior walls of the structure is possible, when utilizing the system of the present invention in comparison to conventional on-site construction methods.

DESCRIPTION OF THE DRAWING

The foregoing and other advantages of the present invention will be better understood by reference to the following figures, wherein:

FIG. 1 is a layout of a typical floor in a multiple story structure utilizing the construction system of the present invention;

FIG. 2 is a perspective view of a typical floor detail illustrating the column spline of the present invention during construction;

FIG. 3 is a sectional view taken through the structure at the top of the column spline as indicated at lines 3—3 of FIG. 1;

FIG. 4 is a sectional view taken along the lines 4—4 of FIG. 1;

FIG. 5 is an enlarged view taken along lines 5—5 of FIG. 6 illustrating the detailed relationship of the interlocking panel protrusions and spline recess;

FIG. 6 is a sectional view taken through the vertical panels and column spline of the structure as indicated at lines 6—6 of FIG. 1; and

FIG. 7 is a perspective view of a typical floor detail illustrating the assembly of the vertical splines located along the floor beams.

DESCRIPTION OF A SPECIFIC EMBODIMENT

A floor plan of a typical floor utilizing the building construction system of the present system is shown in FIG. 1. The system includes filled column splines **10** and floor beams **12** extending in opposite directions from the column splines. The column splines **10** are spaced according to the spacing of foundation footings or columns which support the building and are attached thereto by means of base plates welded to the base of the column splines which base plates are in turn bolted to the foundation. Extending at right angles to the floor beams **12** are struts **14** which are also mechanically attached to the column splines. Together the floor beams and struts define the wall lines of the floor plan. Located at spaced intervals, the spacing corresponding to the width of the typical shearlock panel described in more detail in the parent application are stud splines **16,** indicated schematically as transverse lines extending across the schematic lines defining the floor beams and struts. The floor plan shown in FIG. **1** is typical of a conventional multiple story dwelling and includes room enclosures **18,** balconies **20,** stairwells **22,** doorways **24** and enclosures for utility lines and the like **26.**

Additional details of the relationship of the various components of the system according to the present invention are shown in the perspective view of FIG. **2** and the enlarged detail views of FIGS. **3** and **4** taken at the location of detail area **3** and along lines **4—4** respectively, of FIG. **1.** The exploded perspective view of FIG. **2** illustrates an assembly of components of the system of the present invention at intermediate floor level of a multiple story building. As shown therein, a four-way column spline **10** which has been attached to the foundation or a lower column spline (not shown) at its opposite end, has its upper end extending a predetermined distance beyond the top of the wall panels **28** which are attached thereto. At this point in the construction the column spline is a hollow steel skin **30** defining four spline sections **32** which extend outwardly from the center of the column at righ angles to each other. Recesses **34** are provided extending longitudinally along each corner of the spline sections for receiving and complementing with interlocking bosses or protrusions (not shown) extending longitudinally along the corners of groove sockets **36** located along the edge of each wall panel. The details of the spline-recesses and groove-protrusions assembly and transverse interlock are set forth in U.S. Pat. No. 3,641,720 of which this application is a continuation-in-part.

Two-way stud splines **16** are likewise secured into position along the wall lines at spacings corresponding to panel widths. Slotted mounting plates in the base of the stud splines permit the horizontal or transverse movement of the stud spline to effect the interlocking engagement of panels and splines during the sequential emplacement of each wall panel. The wall panels **28, 54** are then sequentially emplaced in interlocking relationship with the vertical four-way column splines and two-way stud splines.

In the next step floor beams **12** are bolted to the column splines along their top and bottom edges, as shown at **42** and **44** of FIG. **2.** A channel-shaped wall cap **46** receives and overlaps the bottom edges of the floor beams in a telescoping relationship to permit the flexing of the floor beams under load. A channel-shaped wall cap **48** is similarly positioned at the top of beams **38** and is apertured to provide the means for bolting attachment to intermediate stud splines **50.**

Also bolted to the column splines **10** and resting upon wall panels **28** are struts **14** which extend away from the column spline in a direction transverse to the floor beams. The struts **14** are also arranged so as to engage the spline sections **32** of column spline **10** to which they are attached.

Subsequent to the attachment of the floor beams horizontal floor splines **56** and **58** are attached to the floor beams as the floor panels are sequentially assembled. The floor beams provide the basic support structure for the floor panels **72.** The mechanism of attachment and interlocking of the floor panels is the same shearlock system as is employed in the wall panels of the system. After the wall and floor panels are in place and the floor of the building defined thereby is squared off, reinforcing steel bars **74** are placed in each of the column spline sections and secured to the "rebar" in the column spline located immediately below. The interior of the column is filled with concrete **76** to provide the strength in compression to support the live and dead load of the building.

Erection of the next floor of the building is then begun by emplacing the next column spline **60** on its supporting column spline **10.** Registration of this column with respect to its supporting column is obtained by telescoping guides **62** provided in the corners bridging adjacent column spline sections. Likewise, intermediate stud splines **64** are placed on the struts and beam caps and attached to lower supporting stud splines. Wall panels **66** of the next floor are attached to the column splines **60** and stud splines **64** a predetermined distance above the top of the floor struts and beam caps to provide the space for running utility lines **68.** A base trim strip **70** is utilized to screen and house the utility lines.

The enlarged view of FIG. **3** is a horizontal section through a completed column spline **10** and further illustrates the manner in which floor beams **12** and struts **14** are bolted to the column spline. Reinforcing steel rods or bars **74** extend vertically through each spline section of the column spline in the concrete fill **76** which has been poured into the column spline interior. In the enlarged view of FIG. **6,** wall panels **28, 54** are shown in interlocked relationship with their associated spline section; protrusions **35** in the corners of the

panel sockets being engaged in recesses 34 in the edges of the spline sections. (FIG. 5)

The telescoping or floating relationship of the floor beams 12 relative to the wall panels 54 is further illustrated in FIG. 4, a section view along lines 4—4 of FIG. 1. The beams 12 extend between the column splines of structure with their ends bolted at 42, 44 to the column splines. Under load the beams flex and bend intermediate their ends. The floating, overlapping relation of beam cap 48 and wall cap 46 and the beams 12 permit the beams to telescope between the cap members absorbing the load without transmitting the load forces to the wall panels 54 located below the beam. FIG. 4 also illustrates the interlocked relationship of the floor splines 58 and floor panels 72 with protrusions or bosses 73 in the floor panel sockets engaging in recesses 59 in the edges of the floor splines.

The elevation of the base of the wall panels 66 of the next level or story of the structure relative to floor panels 72 is seen in FIG. 4. Base trim strip 70 is secured in position at the base of panels 66 and defines a conduit or enclosure 78 through which electrical, telephone or other utility lines are run.

At intervals corresponding to the location of the two-way vertical splines in the wall lines defined by the floor beams, vertical spline support clips 80 are located between the floor beams 12 and are bolted to the top of the beams at 82. End plates provided on the two-way horizontal splines for supporting the floor panels are also bolted at 82 to the side of beam 12 opposite clip 80. In this manner the vertical splines of the floor above which are bolted to the top of clip 80 are supported by the clips and floor beams without transmitting any loading to the two-way vertical stud spline located immediately beneath clip 80. The clips 80 and stud splines 16 also act to stay or maintain the spacing between the floor beams 12 which bracket the clips and splines.

In addition to the advantages inherent in the system of the present invention by virtue of reduced cost of material, such lighter weight components when assembled are also less subject so seismic forces because of their reduced mass, making use of such structures in earthquake-prone areas desirable.

1. A prefabricated building structure system suitable for multi-story construction comprising:

a plurality of columns, said columns having at least three splines extending away from said columns, each of said splines having a plurality of protrusion-receiving recesses locted in spaced relation longitudinally of the spline;

prefabricated wall panels having outwardly facing groove sockets in the longitudinal edges thereof, said sockets having a plurality of protrusions located in spaced relation longitudinally thereof;

stud splines located intermediately of the column splines in wall lines for supporting said wall panels, said stud splines having a plurality of protrusion-receiving recesses located in spaced relation longitudinally thereof; the groove sockets of said wall panels being engaged with said column splines and stud splines with said spline recesses being transversely telescoped about the panel socket protrusions:

floor beams engaged with said columns;

floor struts engaged with said columns in an orientation transverse to said floor beams;

floor splines positioned between said floor beams parallel to said floor struts, said floor splines having a plurality of protrusion-receiving recesses located in spaced relation longitudinally thereof; and

prefabricated floor panels having outwardly facing groove sockets in the longitudinal edges thereof, said sockets having a plurality of protrusions located in spaced relation longitudinally thereof with the floor panel sockets being engaged with said floor splines, with said floor spline recesses being transversely telescoped about said floor panel socket protrusions whereby said columns, stud splines, wall panels, floor struts, and floor beams are interlocked to provide for the transmission of bending, tilting, deflecting, and rotational forces to the foundation of the structure upon application of such forces thereto.

2. A system according to claim 1 wherein the columns are hollow steel enclosures filled with reinforced compression-resistant material during erection of the structure.

3. A system according to claim 2 wherein the columns include means for registering said column with columns to be located above and below said column.

4. A system according to claim 3 including wall caps to be disposed over the wall panels and below the floor beams and beam caps located above the floor beams, said wall caps and said beam caps being secured to said columns in a floating, telescoping relationship with respect to the floor beams.

5. A system according to claim 1 wherein said columns are four-way columns having the configuration of a cross in cross-section.

6. A system according to claim 5 including base plate means attached at one end of the lowest columns of said structure, said base plate means being mechanically securable to said foundation.

7. A system according to claim 6 including sill means to be located between the columns mounted on said foundation, said sill means being adjustable for leveling the wall panels supported thereby.

8. A system according to claim 7 wherein the floor beams define a shoulder located a predetermined distance below the floor level for providing support for floor panels disposed thereon.

9. In a prefabricated building structure having a plurality of prefabricated panels having outwardly facing groove sockets in the longitudinal edges of said panels, a plurality of protrusions located in spaced relation longitudinally of said groove sockets, stud splines having a plurality of protrusion-receiving recesses located in spaced relation longitudinally of the stud splines, aaid recesses being transversely telescoped about said protrusions to interlock the panels and splines, the improvement which comprises:

a column fabricated of a rigid material comprising a hollow enclosure having a central core and four arms extending away from said core and compression-resistant material located within the enclsoure, each of said arms being perpendicular to adjacent arms and each arm having a plurality of protrusion-receiving recesses located in spaced relation longitudinally thereof, said recessess being located and engaged with corresponding longitudinally extending protrusions located in the edge-located longitudinal sockets of the wall panels which are engaged with the column, and

means for registering said column with said columns to be disposed above and below said column to enable the erection of a multi-story structure.

10. A column according to claim **9** wherein said column is fabricated of a steel material and the compression-resistant material includes reinforcing means located within the material.

11. A column according to claim **10,** wherein said arms have square corners at the exterior side thereof, one each of said parallel line of recesses being located in each of said corners.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,827,203 Dated August 6, 1974

Inventor(s) Robert W. Berrie

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 6, line 62, before "protrusion-receiving" insert the phrase --parallel lines of--

line 65, before "protrusions" insert --parallel lines of--

Signed and sealed this 5th day of november 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents