Sept. 29, 1970 I. MEZES 3,530,626

CONCRETE PRE-FABRICATED SPACE FRAME STUCTURE

Filed Dec. 23, 1968 5 Sheets-Sheet 1

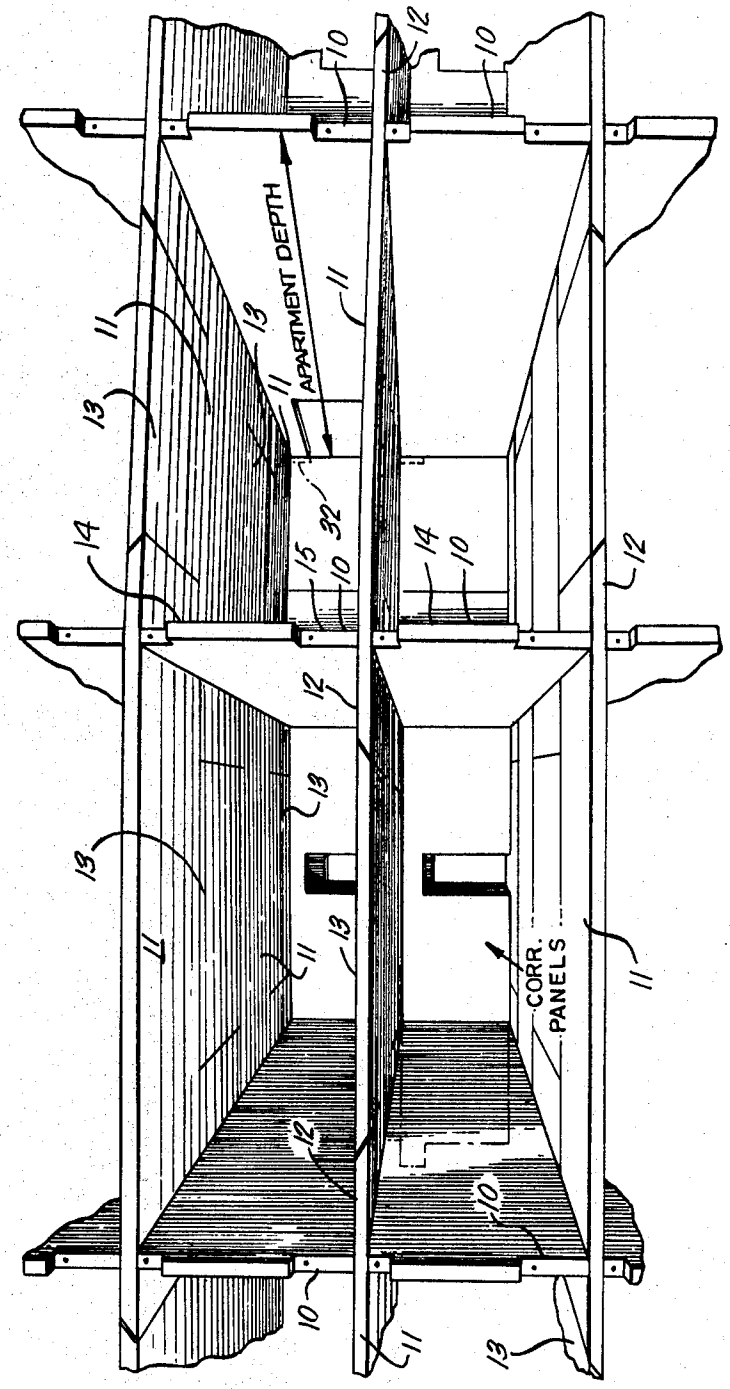


FIG. 1

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CONCRETE PRE-FABRICATED SPACE FRAME STUCTURE

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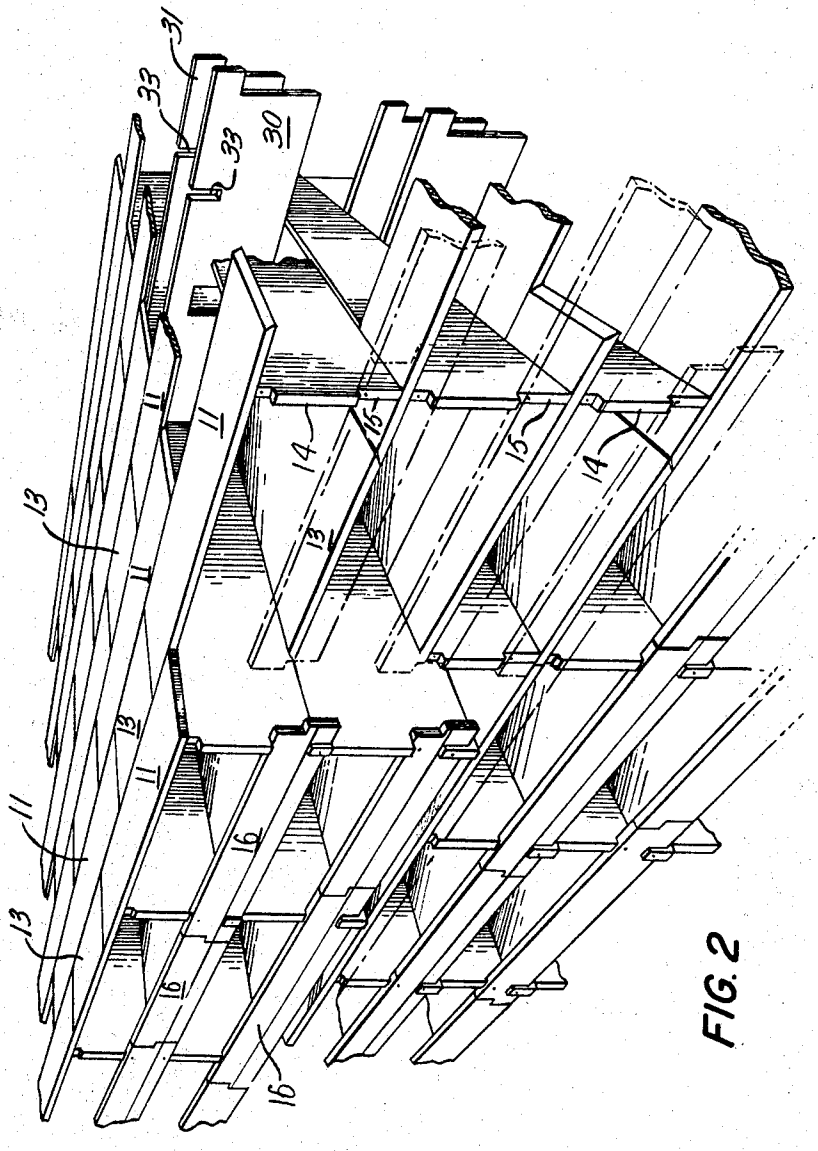


FIG. 2

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CONCRETE PRE-FABRICATED SPACE FRAME STUCTURE

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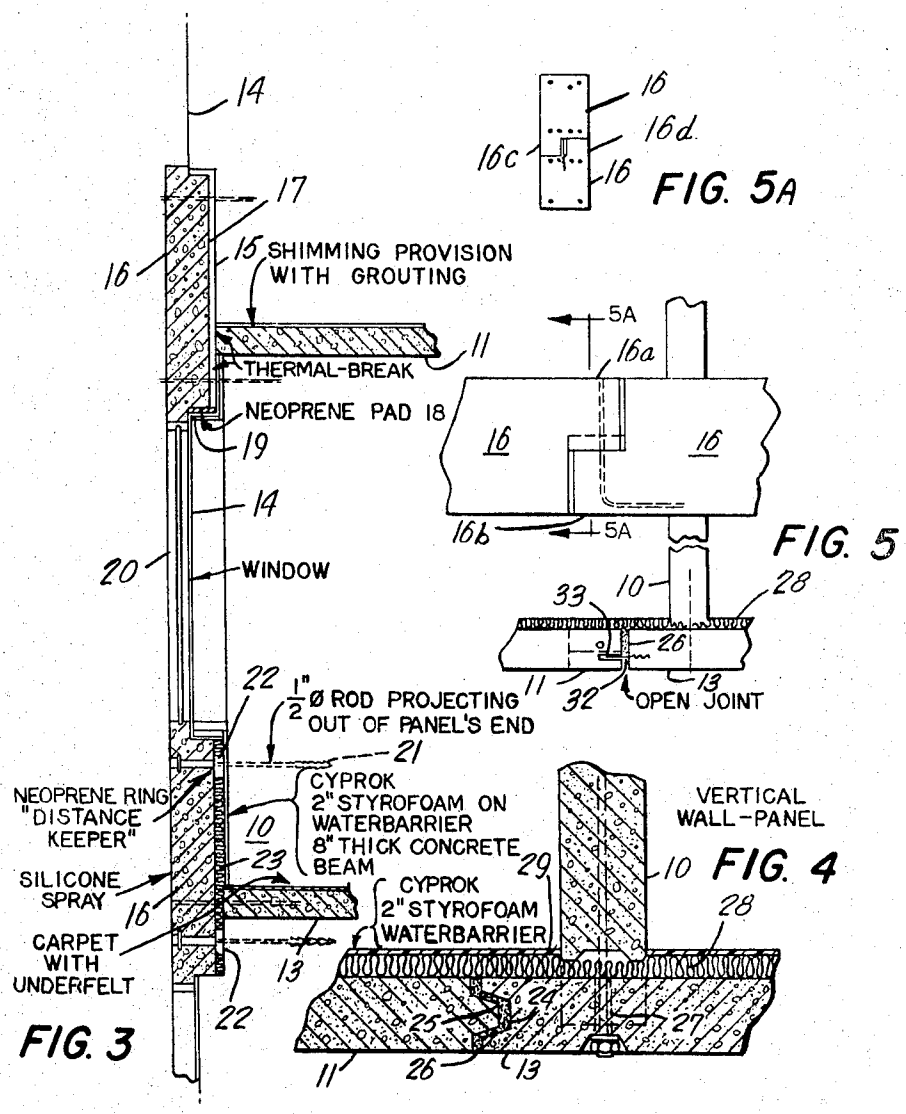


FIG. 3

FIG. 4

FIG. 5A

FIG. 5

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CONCRETE PRE-FABRICATED SPACE FRAME STUCTURE

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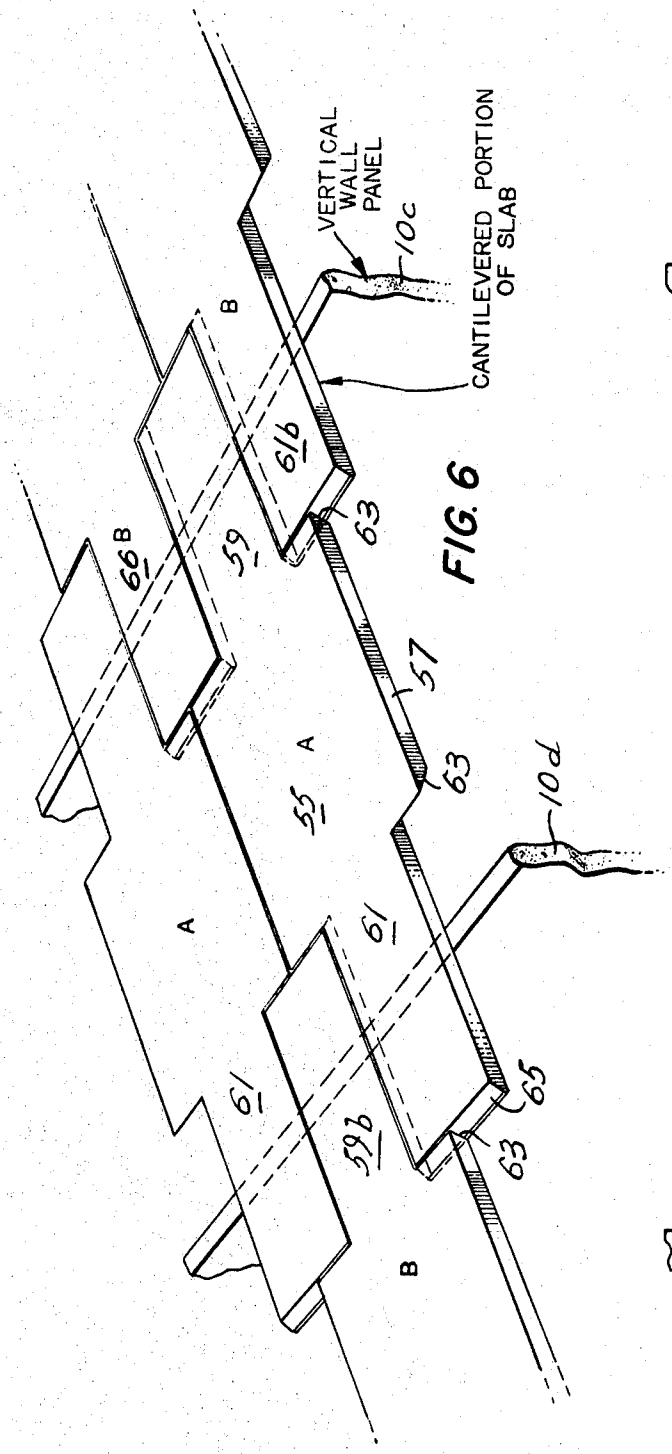


FIG. 6

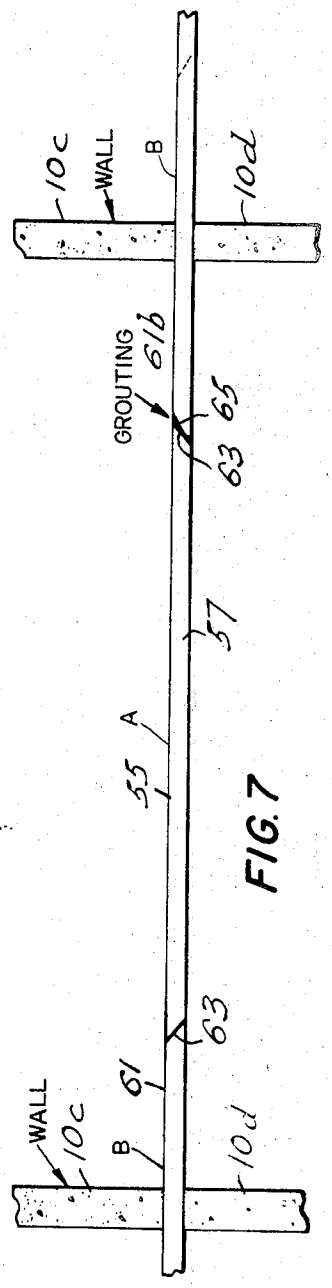


FIG. 7

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CONCRETE PRE-FABRICATED SPACE FRAME STUCTURE

Filed Dec. 23, 1968 5 Sheets-Sheet 5

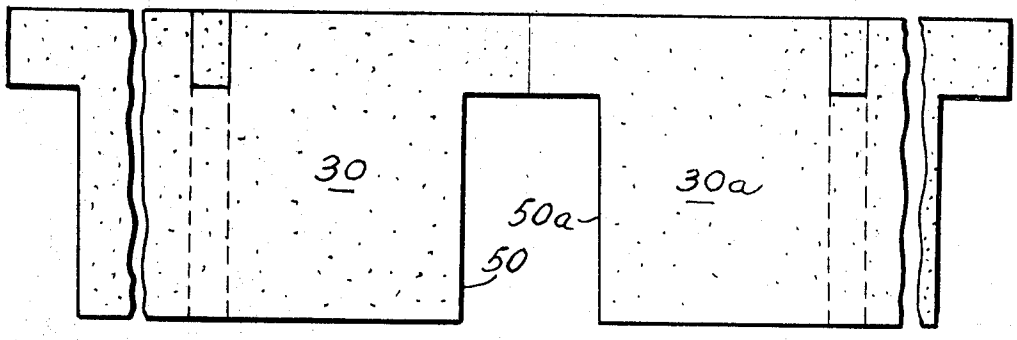


FIG. 8

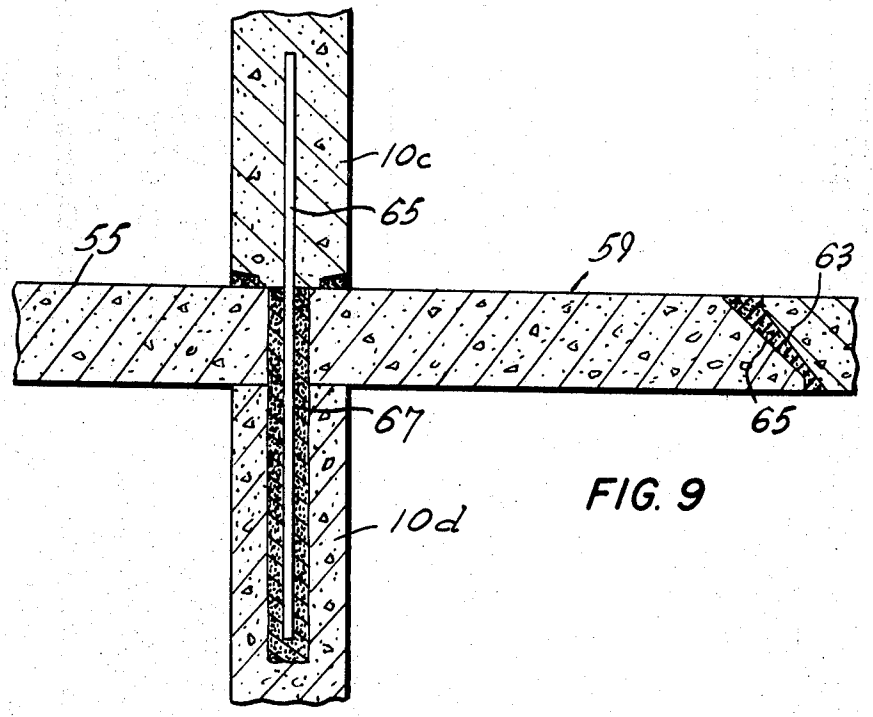


FIG. 9

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United States Patent Office 3,530,626
Patented Sept. 29, 1970

3,530,626

CONCRETE PRE-FABRICATED SPACE FRAME STRUCTURE

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Continuation-in-part of application Ser. No. 624,304, Mar. 20, 1967. This application Dec. 23, 1968, Ser. No. 785,888
Int. Cl. E04h 1/04; E04b 5/02
U.S. Cl. 52—204 4 Claims

ABSTRACT OF THE DISCLOSURE

A concrete pre-fabricated space frame structure includes a number of vertically arranged, reinforced concrete, load bearing wall panels spaced apart at the desired width of the bay or room that is to be formed between these wall panels. The floors of the building are formed by floor elements or slabs supported on the load bearing walls.

This is a continuation-in-part application of U.S. patent application S.N. 624,304, filed Mar. 20, 1967 now abandoned.

This invention relates to a concrete pre-fabricated space frame structure.

In accordance with the present invention, there is provided a concrete pre-fabricated space frame structure including a plurality of spaced-apart, vertical wall panels, and a plurality of horizontal elements forming floors, the panels and elements together forming bays or rooms, the floor elements including a first type of element the length of which is greater than the spacing between adjacent wall panels and arranged in cooperation with two panels in such manner that each element of the first type spans the space between the two cooperating panels and projects beyond both these panels to form cantilevered portions, and elements of a second type the length of which is less than the spacing between adjacent wall panels, elements of the second type having their ends supported by cantilevered portions of two elements of the first type.

In a further embodiment of the present invention, the floor elements comprise a plurality of identical elements having a first central portion of predetermined width and longitudinally extending tongue portions of substantially half the width of the central portion, the tongue portions extend from each end of the central portion so that when the floor elements are laid, each floor element is fully supported by two spaced-apart parallel vertical wall panels and the tongues of abutting floor elements interlock with each other and with adjacent floor elements.

It is also a further aspect of the present invention to provide wall panels having cut-out ends such that the adjacent abutting end-to-end wall panel defines a door opening between the panels.

A further aspect of the present invention is to provide a connecting system for connecting the vertically disposed wall panels in relation to each other.

The invention will now be described in greater detail with reference to the accompanying drawings in which:

FIG. 1 is a view of a building incorporating a space frame structure in accordance with the present invention with one end wall of the building omitted to show the internal construction.

FIG. 2 is a perspective view of the structure of FIG. 1 and shows additional detail,

FIG. 3 is a vertical section through an outside wall of the building of FIG. 2,

FIG. 4 is a vertical cross section showing one form of joint between two horizontal structural elements,

FIG. 5 is an alternative form of the structure shown in FIG. 4 and also shows a parapet beam,

FIG. 5a is a section on the line A—A of FIG. 5,

FIG. 6 is a perspective view of the floor elements according to one aspect of the invention,

FIG. 7 is an elevation view of the floor elements shown in FIG. 6 in relation to the supporting wall panels,

FIG. 8 is an elevation view of the end-to-end abutting corridor wall panels, and

FIG. 9 is an enlarged sectional view taken vertically through two vertically disposed wall panels in relation to a floor panel, showing the connecting means between the wall panels.

Referring firstly to FIG. 1, the illustrated structure includes a plurality of vertically arranged, reinforced concrete, load bearing wall panels **10** which are spaced apart at the desired width of the bay or room that is to be formed therebetween. The floors of the building are formed by floor elements or slabs of two different types. The first elements, referenced **11**, have a horizontal length greater than the spacing between adjacent panels **10** so that each element **11** forms the floor of one bay and projects for a certain distance, for example, four feet, beyond the two walls **10** with which it cooperates. These projecting portions have been referenced **12** in FIG. 1. The other floor elements are referenced **13** in FIG. 1 and it will be noted that these are of a width less than the distance between each pair of wall panels **10**. The edges of the elements **13** are supported by the edges of the cantilevered portions **12** and the details of the interlock between the edges of the elements **14** and the cantilevered portions **12** will be described hereinafter.

As will be seen from FIG. 1, each element **11** and **13** has a width which is far less than the length of the panels **10**. In the illustrated embodiment, the width of each element **11** and **13** is approximately one-quarter the length of the panel **10** so that four elements **11** and **13** must be placed side by side to form a floor structure equal in length to the length of the panel **10**. It will also clearly be seen from FIG. 1 that the part of the uppermost floor or roof to the left of the center wall panels **10** is composed of elements **11**, **13**, **11** and **13** whereas the floor to the right of the center wall panels **10** is composed of elements **13**, **11**, **13** and **11**. Thus in adjacent bays, the floor elements are "out of step." Furthermore, it should be noted that each element **11** is is vertically above and below an element **13** so that taking any vertical line through the building elements **11** and **13** are encountered alternatively.

If reference is made to the respective view illustrated in FIG. 2, a number of elements **11** and **13** forming the roof of the structure have been referenced and it is believed that the check-board pattern in which these elements are arranged will be clearly apparent from that figure.

Also illustrated in FIG. 2 is the manner in which the front or outside wall of the building is constructed. Each panel **10** is cast with a protruding tongue **14** at one end thereof. When a pair of panels **10** are arranged, as illustrated in FIG. 1, one above the other, this gives rise to a notch **15** which extends both above and below one of the floors of the structure. Parapet beams **16**, illustrated in FIG. 2, are seated in these grooves **15** as will now be explained in detail with reference to FIG. 3. Each parapet beam **16** is separated from the floor element **11** and wall panels **10** by a thermal gap **17** and rests, via a neoprene pad **18**, on the horizontal upper surface **19** of the tongue **14** immediately therebetween. Windows **20** are suitably secured between adjacent parapet beams **16**. The beams **16** are secured to the wall panels **10** by means of bolts **21** passing through the beams **16** and grouted into suitable bores in the panels **10**. Neoprene rings **22** are located between the beams **16** and the adjacent panels **10** and surround the bolts **21**, these rings act as spacers

to prevent the beams **16** touching the panels **10**. Suitable waterproofing and insulating material generally indicated at **23** is provided in the gaps between the beams **16** and the panels **10**.

A number of parapet beams **16** are placed end to end to traverse the entire width of the building. These beams interlock as illustrated in FIGS. 5 and 5*a*. Adjacent beams **16** have upper and lower, horizontally projecting tongues **16***a* and **16***b* which interlock with one another, and also have downwardly projecting and upwardly projecting tonges **16***c* and **16***d* (FIG. 5*a*) which also interlock with one another.

The floor elements **11** and **13** can be secured to one another along their edges in any desired manner. As illustrated in FIG. 4, the element **13** has a groove **24** running along the edge thereof and the element **11** has a tongue **25** shaped to conform to the shape of the groove **24**. The tongue and groove connection thus constituted is filled with a suitable sealing compound generally indicated at **26**.

In this figure, the connection between the panel **10** and the element **13** is also indicated, this being by means of vertical bolts **27** passing through the element **13** and being grouted into the panel **10**. A water barrier material **28** is provided between the panel **10** and the element **13** and extends completely across the upper surface of the elements **11** and **13** thus forming a suitable barrier between elements **11** and **13** and the floor covering indicated generally at **29**.

Reverting now to FIG. 2, structural corridor elements **30** and **31** have been illustrated, these running across the structure parallel to the parapet beams **16**. The connection between the panels **10** and the corridor elements **30** and **31** is as follows. Each panel **10** has a projecting tongue **32**, best seen in FIG. 1 to the right of the center wall **10**, which projects into a slot **33** in one of the corridor elements **30** or **31**.

The structure of the present invention results in every constructive "bay" or "room" of the structure being braced horizontally, in an almost monolithic manner, although built from pre-fabricated slabs.

Parapet beams **16** are structural members and serve to "tie" the wall panels **10**. The arrangement of the parapet beams as described is such that only alternate parapet beams, considered both horizontally and vertically, are bolted to the panels **10** by the bolts **21**, the other beams being "loose" and held in place by the bolted beams **16** via the above described tongue arrangement (FIG. 5*a*). For example, in FIG. 5*a*, if the beam **16** including the tongue **16***c* is secured to the panels **10**, the interlock between the tongues **16***c* and **16***d* prevents any movement of the other beam **16** illustrated in that figure.

The modified structure of FIG. 5 for connecting two elements **11** and **13** includes a "weather-bar" **32** which is a 16 gauge copper sheet cast in the element **13** and projecting from the edge thereof. The element **11** is provided with a groove **33** which receives the projecting part of the bar **13**. Parts of the structure of FIG. 5 which have a counterpart in FIG. 4 are referenced accordingly.

The entire structure illustrated reduces thermal movements of the exposed elements and minimizes the possibility of damage being caused by stresses created due to thermal expansion.

To take up the effects of wind loading it is possible to arrange certain vertical panels **10**, for example those at the left and right hand ends of the building as illustrated in FIG. 2, perpendicularly to the illustrated panels **10**.

The resulting structure is a self-reinforced pre-fabricated, concrete, load-bearing, system, built on a strict geometrical modular idea, with a built-in flexibility capable of providing bays of diverse size within one block if necessary, and using the same standard elements.

The corridor wall panels **30** and **31** are formed with a cut-away portion **50** which corresponds to approximately half an opening for a doorway. It can be seen in FIG. 8, that when two panels **30** and **30***a* forming one wall of the corridor are in position end to end, the top extension portions abut each other and the cut-away portions **50** and **50***a* define a doorway opening. The advantage of this type of construction is that the unit panel construction of the wall is not weakened by a doorway recess such as if the doorway would be midway in a panel. Normally, the lateral wall panel members **10**, for instance, would abut imdway of a single corridor wall panel unit **30** and the cut-away portions of two end-to-end wall panels **30** and **30***a* would be midway of a bay or room.

Referring now to FIG. 6 in the drawings, another embodiment of floor elements is shown wherein each floor element A includes a central rectangular portion **55** having vertical side edges **57**. Rectangular tongues **59** and **61** extend longitudinally from each end of the central rectangular portion **55** and are substantially half the width of the central portion **55**. Lateral edges of the central portion **55** forming the shoulders on each side of the tongues **59** and **61** are numbered **63** and are sloped inwardly downwardly. The lateral edges of the tongues **59** and **61** are sloped inwardly upwardly at **65**. As can be seen from FIGS. 6 and 7, as these panels A are placed so that they are supported by two wall members **10**, the tongues **59** and **61** extend past the wall members in a cantilevered style and the sloping edges **65** of the tongues **59** and **61** mate with the sloping edges **63** of the shoulder portions of identical wall elements B.

The tongues **59***b* of an element B fill in the space between the tongue **61** of adjacent floor elements A as shown in FIG. 6. Grouting can be provided between the various edges, such as at **63** and **65**.

In this way, the adjacent staggered floor elements A and B are completely interlocked in a horizontal plane since their tongues are interlocked.

In a preferred embodiment, the manner in which the wall elements **10** or the corridor wall panels **30** and **31** are connected to a further wall in the same vertical plane, that is, between two stories as is shown in FIG. 9. The wall panel **10***c* is molded with anchor rods **65**. In the upper portion of the wall **10***d*, oversized recesses are provided to receive the anchoring rod **65**. As the walls are being positioned, that is, **10***c* over **10***d*, grouting is poured into the oversized hole **67** and the wall is placed so that the anchor rod sinks into the grouting in the recess **67**. Of course, as the grouting is hardened, it anchors the anchor rod **65** connecting the two walls and **10***c* and **10***d* to each other.

I claim:

1. A concrete pre-fabricated space frame structure comprising,

means defining a plurality of spaced-apart vertical load bearing wall panels,

means defining a plurality of elements forming floors,

said wall panels and said elements coacting to define bays or rooms,

said elements forming floors including means defining a first type of element the length of which is greater than the spacing between adjacent wall panels and coacting with two of said wall panels so that each element of said first type spans the space between said two of said wall panels and projects beyond of the latter panels to form cantilevered portions,

said elements forming floors further including means defining a second type of element the length of which is less than the spacing between adjacent wall panels and the ends of which are supported by means including cantilevered portions of two elements of said first type, the elements being staggered in checker-board fashion whereby the lateral edges of adjacent panels are non-aligned.

2. A concrete pre-fabricated space frame structure comprising,

means defining a plurality of spaced-apart vertical wall panels,

means defining a plurality of elements forming floors, said wall panels and said elements coating to define bays or rooms,

said elements forming floors including means defining a first type of element the length of which is greater than the spacing between adjacent ones of said wall panels and coacting with two of said wall panels so that each element of said first type the space between said two of said wall panels and projects beyond both of the latter panels to form cantilevered portions,

said elements forming floors further including means defining a second type of element the length of which is less than the spacing between adjacent wall panels and the ends of which are supported by means including cantilevered portions of two elements of said first type,

wherein each of said wall panels are formed with a central tongue portion in each vertical edge so that vertically contiguous ones of said wall panels coact to define notches between consecutive ones of said tongue portions and further comprising,

vertical parapet beams supported in said notches.

3. A concrete pre-fabricated space frame structure comprising:

means defining a plurality of spaced-apart, vertical load-bearing wall panels,

means defining a plurality of elements forming floors, said wall panels and said floor elements coacting to define bays for forming rooms,

said elements forming floors including certain elements supported by at least two load bearing wall panels, adjacent floor elements being staggered and forming an interlocking pattern in a horizontal floor generally overlying a vertical wall panel,

said floor elements comprising at least two distinct types, one type floor element having a length greater than that of adjacent ones of said wall panels and having terminal cantilever portions projecting beyond the vertical wall panels, said other type floor element having a length less than that of the adjacent two wall panels and including terminal portions supported on the terminal cantilever portions of said one type floor element.

4. The structure as claimed in claim 3 in which at least two end-to-end vertical wall panels define a cut-away portion at the end thereof substantially equal to one-half an opening required for a door opening, two end-to-end wall panels form a wall defining a door opening.

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JOHN E. MURTAGH, Primary Examiner

U.S. Cl. X.R.

52—236, 262