

[54] Title: A MODULAR BUILDING CONSTRUCTION AND METHOD OF INSTALLATION THEREOF

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[22] Filed: August 14, 1991

[21] Application Serial No: 42942

FOREIGN APPLICATION PRIORITY DATA

[31] Number (s) : None

[32] Date (s) : None

[33] Country (ies) : None

[52] PH Class ..... 52/79.1

[51] Int. Class ..... E04B 1/00

[58] Field of Search ..... 52/79.1

[56] Reference (s) Cited and/or Considered:

U.S Pat. Nos. 4,691,490 Leaven 9-8-87  
3,979,863 Hurky 9-14-74

[57]

ABSTRACT

The present invention relates to a modular building construction and method of installation thereof that comprises an assembly of precast modular building elements such as wall panels, floor panels, columns, stairs, window frame panels and doorframes which are connected to the building foundation and to each other by weldedly attaching their respective steel bar or plate connectors together and filling up the exposed connectors and gaps between elements with mortar packings.

# 26931

## ABSTRACT

The present invention relates to a modular building construction and method of installation thereof that comprises an assembly of precast modular building elements such as wall panels, floor panels, columns, stairs, window frame panels and doorframes which are connected to the building foundation and to each other by weldedly attaching their respective steel bar or plate connectors together and filling up the exposed connectors and gaps between elements with mortar packings.

A MODULAR BUILDING CONSTRUCTION AND METHOD OF  
INSTALLATION THEREOF

Field and Background of the invention

The present invention generally relates to a building construction. More particularly, this invention relates to a modular building construction that is installed by assembling precast modular building elements such as wall panels, floor panels, columns, stairs,  
5 window frame panels and doorframes, all made of concrete.

Multi-storey building units are normally constructed by the conventional method of construction wherein every component of the building is cast or formed at the site by pouring concrete into  
10 temporary moldings containing the structural frameworks or merely assembling a plurality of hollow blocks. This conventional process of building construction is already an established system with a time element, cost estimates, necessary manpower, machineries, construction material, labor and whatever deemed necessary in the art,  
15 already established at a certain specification standard. As far as installation cost saving is concerned, there is not much that can be had by adapting such conventional method of building construction.

There are certain modular building constructions adapted in the art, but they are characterized by complexity of design and method of  
20 assembly which require a certain level of expertise and highly skilled manpower. Because of such features, same is unpopular and fails to attract the interest of building contractors and technical experts in the field.

SUMMARY OF THE INVENTION

25 The present invention seeks to overcome the shortcoming and

disadvantages of the prior art by providing a modular building construction and the method of installation thereof which can be carried out in such a short period of time using an average level of skill or expertise. With the construction method in association  
5 with the precast modular building elements of the present invention, construction time involved in erecting a building unit is much reduced, and the workers needed are much lesser in number as compared with that of the conventional way. Assembly or installation of modular building elements, in order of succession by floor level, is  
10 easily carried out by just weldedly attaching or connecting steel connecting means or connectors provided to said elements which are brought together in an abutting relation.

It is therefore the main object of the present invention to provide a modular building construction and method of installation  
15 thereof that has a much-reduced assembly time and does not need a high level of expertise or skills in the construction thereof.

Another object thereof is to provide a modular building construction which, when constructed in the method herein disclosed, generates a significant saving in almost all aspects of a building  
20 construction.

Still another object thereof is to provide a modular building construction that comprises precast modular building elements which are very simple and efficient in design and construction.

Yet another object thereof is to provide a modular building  
25 construction that has design features that meet the specification standard required of a building construction.

A further object thereof is to provide a modular building construction and method of assembly thereof that outwits the foreign

technology in its simplicity, efficiency and modernity, thereby very much competitive as far as the marketing aspect thereof is concerned.

These and other objects, features and advantages of the present invention will become apparent and be appreciated upon reading the following detailed description made in conjunction with the appended drawings wherein:

FIGURE 1 is a perspective view of a building unit constructed with the method of the present invention;

FIGURE 2A is a perspective view of a precast modular wall panel of the present invention;

FIGURE 3 is a perspective view of a precast modular floor panel thereof;

FIGURE 4 is an inverted cross-sectional view taken along line 4-4 of Fig. 3;

FIGURE 5A is a cross-sectional view of the exterior wall-to-wall connection thereof with in-between floor panel;

FIGURE 5B is a cross-section view of the interior wall-to-wall connection thereof with in-between floor panels on opposite sides;

FIGURE 6A is a plan view of the floor-to-floor side connection thereof;

FIGURE 6B is a cross-sectional view thereof taken along line 6B-6B of Fig. 6A;

FIGURE 7A is a cross-sectional view of the exterior wall-to-foundation connection thereof;

FIGURE 7B is a cross-sectional view of the interior wall-to-foundation connection thereof;

FIGURE 7C is a cross-sectional view the interior partition wall-to-flooring connection thereof;

FIGURE 8 is a cross-sectional view of a precast modular column thereof as erected on a foundation;

FIGURE 9 is an elevational side view of a precast modular stair thereof with cross-sectional portions showing their structural connections;

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FIGURE 10 is a cross-sectional view thereof taken along line 10-10 of Fig. 9;

FIGURE 11 is an alternative embodiment of the precast modular stair thereof, particularly showing the side view of its stringer member;

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FIGURE 12 is a cross-section view of the tread-to-stringer connection of the stair in Fig. 11;

FIGURE 13 is a perspective view of a precast modular window frame panel thereof;

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FIGURE 14 is a cross-sectional view thereof taken along line 14-14 of Fig. 13;

FIGURE 15 is a perspective, exploded view of a precast modular doorframe thereof;

FIGURE 16 is a cross-sectional view thereof taken along line 16-16 of Fig. 15; and

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FIGURE 17 is a top, cross-sectional view of the assembled building structures showing connections by mortar packing between walls, window frame and doorframe.

With reference to the drawings in detail, there is shown an example of a modular building construction 10 constructed with the principle and teaching of the present invention that particularly relates to a modular building construction and method of installation thereof. Any high-rise building construction can be constructed according to the method and principle of the invention within a

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remarkably much-reduced period of time as compared to the conventional way of constructing a building.

Said modular building construction is generally constructed by an assembly of precast modular building elements consisting of precast modular wall panels 11, floor panels 12, window frame panels 13, doorframes 14, columns 15 and stairs 16, all made of concrete.

Fig. 2A shows a perspective view of said wall panel 11, preferably with a dimension of 2.4 x 1.0 x 0.15 meters in the order of length, width and thickness. Said wall panel is provided with a longitudinal groove 17 on the opposite sides thereof, a pair of dowel connectors 18 spacedly extending from the top side thereof, and another pair of dowel connectors 19 downwardly extending at the base portion thereof in alignment to connectors 18 and having their lower portions 20 terminating at the bottom plane of said wall panel, which lower portions are exposed to view by a pair of corresponding coextensive recessed sections 20A at the base corners of said wall panel. Each of the dowels has a hook portion 21 at its inward end embedded within the wall panel. Said wall panel has a hollow inner portion 22 as shown in Figs. 2A and 2B, and is reinforced by steel reinforcements 23. In assembly, this hollow portion 22 serves as passage of other building connections such as electrical wirings, plumbing lines, etc., and also as a walling insulation.

Said floor panel is illustrated in Fig. 3. It consists of a peripheral flange 24 and steel reinforcements 25. In assembly, the orientation of said floor panel is as shown in Fig. 4. A plurality of steel bar connectors 26 are embedded within the top side edge portion of said floor panel, having their outer portion being exposed to view by corresponding recessed section 27 provided at the location same as

those of said connectors 26.

5 Figs. 5A depicts an exterior wall-to-wall connection with in-between floor panel of said modular building construction. Said dowel connectors 18 of a lower wall panel "L" is connected to the  
10 dowel connector 19 of an upper wall panel "U" by welding process with the welded section designated by "W" all throughout the description. An in-between floor panel "F" has its flange rested on top of said panel "L" almost halfway across thereof and said panel "U" resting on said floor panel "F" having its horizontal bar connector 29 weldedly  
15 connected to said connector 18. A mortar packing designated all throughout herein as "P" is filled or poured into said recessed section 20 and the space 30 outwardly between the ends of said wall panels. A floor topping "T" is then applied on the floor panel.

15 An interior wall-to-wall connection with in-between floor panels on opposite sides is shown in Fig. 5B. Connections are the same as that of Fig. 5A except that an opposite floor panel is added in the assembly. The bar connectors 29 of both floor panels are weldedly  
20 connected together as shown in same Fig. 5B. Mortar packing P and floor topping "T" are likewise applied thereafter.

20 Figures 6A and 6B show a side connection between floor panels in assembly. Floor panels are attached together by abutting their respective connectors 26 and welding them permanently before filling them up with mortar packing P. In installation, it is preferred that  
25 a filler steel bar 31 is adapted to be laid over the gap between said abutting connectors 26 and welding said bar 31 onto said connectors 26 as shown by welded sections "W" in Fig. 6B. This set-up securely holds the floor panels in their permanent places with a resulting strength

and capacity of assemblage meeting the specification standard of building construction. The abutting flanges 24 as shown in Fig. 6B function as a supporting beam for supporting the flooring.

5 Building foundations 32 are shown in Figs. 7A, 7B and 7C which are provided with reinforcing rebars 33 as normally done in a conventional building construction. At a location along where the panel walls are erected, the foundation are provided with upwardly extending anchor steel bars 34 spacedly disposed to correspond the connectors 19 of said wall panels. Said wall panels are installed in place by weldedly connecting said anchor bars and connectors 19 as shown in Figs. 7A to 7C. Figures 7A, 7B and 7C respectively show an exterior wall-to-foundation connection, interior wall-to-foundation connection and partition-wall-to-foundation connection. The recessed section of said wall panel is then filled up with mortar packing "P".

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15 In fig. 8, there is shown said column 15 that is erected or anchored on a foundation 35 through their respective plate connectors 36 and 37 welded together along their peripheries as shown by welded section "W." Said plates 36 and 37 are weldedly connected to reinforcing rebars 38 and 39, respectively, of said column and foundation. A space gap 40 between them surrounding the plates is then filled up with mortar packing "P".

20  
25 The stair of the present invention is also precast and modular that comprises precast modular stringers 41 and treads 42 to be assembled at the site. Said stringer is provided with reinforcing steel bars 43 embedded along its length. A plate connector 44 which is fixed at the upper portion of said stringer is anchored thereto by bended rebars 45 embedded therein. A plate 46 is also provided at the base portion of said stringer which is to be weldedly connected to

said plate connector 44 in assembly as shown in Fig. 9. The first stringer that is anchored on the foundation has its reinforcing steel bars 43 welded to the anchor steel bars 47 of said foundation. Said tread is connected on the stringer by welding their respective plate connectors 48 and 49 correspondingly anchored to both by anchor steel bars 50. In assembly, said plate connector 44 of a lower stringer is welded to connector 46 of an upper stringer which has its base connected and supported securely by a floor landing 51 through steel bar connectors 52.

10 An alternative embodiment 53 of the stringer is shown in Fig. 11 which is characterized by a provision of a plurality of generally rectangular apertures 54 angularly oriented along its length. These apertures receive corresponding treads 55 in assembly, the latter being connected to the former by welding their respective plate connectors 56 as shown in Fig. 12.

15 Fig. 13 shows a perspective view of said precast modular window frame panel which is provided with a window opening 57 and a peripheral flange 58. The opposite longitudinal sides of this panel are provided with corresponding grooves 59 extending fully along its length. A reinforcing steel bar 60 is provided to said frame panel as shown in Fig. 14.

20 Said precast modular doorframe that is shown in Fig. 15 comprises of three (3) separate modular members, namely: a pair of door jambs 61 and lintel 62. Each of said jambs 61 is provided outwardly along its length with a groove 63 and a reinforcing steel bar 64. Said lintel is also provided with a pair of grooves 64A at both ends thereof, which are in alignment with said grooves 63 in assembly. An inwardly directed portion 65 of said jamb is provided on said jamb opposite said groove 63 to serve as an integral door framing as substitute for

the wooden frame conventionally adapted in the art.

In assembly, the grooves of the wall panels, window frame panels or doorframes are matched to each other whichever of these elements are placed in juxtaposed relation as shown in Fig. 17. The space or  
5 cavity 66 produced is then filled up with mortar packing "P" or any concrete mixture preferred to stabilize and permanently fix these elements in place in accordance with the specification standard of building construction.

The floor panels of the invention function also as a roofing of  
10 the building when installed at the topmost level or deck section thereof. The gaps between these panels are sealed with mortar packings or toppings or other means conventionally adapted in the art.

The method of installation or construction of said modular building unit comprises the following basic steps, to wit:

- 15 1. constructing the building foundations and installing a plurality of anchor steel bars and steel plate connectors in a set-up wherein said bars and connectors correspond respectively with the connectors 19 of said wall panels and the plate connectors of the columns and/or stairs indicated  
20 in the plan layout, before pouring the concrete mixture to permanently fix the structure;
2. mounting the columns, stairs and wall panels in their respective places by aligning and abutting their respective steel bar and plate connectors to those of the foundation at  
25 the ground floor level;
3. welding the abutted connectors in place to permanently fix the structural connections, this step of welding the abutted connectors being repeatedly carried out in the duration of the construction process at every floor level;

4. filling up the recessed sections where the connections are located, and the columnar cavity produced by the matching grooves in between wall panels with mortar packings to further strengthen and stabilize the building structure, this step being repeatedly carried out in the duration of the construction process at every floor level;
5. installing the floor panels, in order of succession by floor level, by mounting the flanges thereof to rest on top of said wall panels wherein steel bar connectors thereof are in alignment with the connectors of said wall panels, and the side steel bar connectors of adjacent said floor panels are abutted for attachment of a filler bar by welding process;
6. mounting the next batch of wall panels, in order of succession by floor level, on top of said floor panels along the plane of the initially installed wall panels in a manner that the connectors of respective wall panels are abutted together;
7. mounting the next columns and stairs, in order of succession by floor level, on top of the initially installed columns and stairs;
8. welding and filling up of mortar packings as described in step 3 and 4, respectively;
9. installing of the window frame panels and doorframes in between wall panels by matching their respective grooves to be filled up with mortar packing; and
10. plastering the exposed building surfaces, applying mortar floor toppings, and carrying out such other finishing processes normally adapted in constructing a building unit.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above construction without departing from the spirit and scope of the invention, it is construed that all matter contained in the above description or shown in the drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

# 26931

## I CLAIM:

1. A modular building construction having at least one story, comprising in assembly:

5 a plurality of generally rectangular precast reinforced modular <sup>concrete</sup> wall panels each consisting of a pair of longitudinal grooves correspondingly provided along the opposite sides thereof, steel bar connecting means at its top and bottom end portions for attachment thereof to corresponding anchor bar connectors on a building foundation in the initial stage of the construction and subsequently for end-to-end attachment thereof to adjoining wall panels, wherein said connecting means at the bottom end portion are exposed to view within the areal boundary of corresponding recessed sections provided at the base portion of said panels, and

10 a hollow inner section, wherein said wall panel are initially anchored on the foundation through welded attachment of respective abutted connectors, and subsequently connected weldedly to adjoining wall panels through their abutted connecting means,

15 wherein said grooves match with those of the adjacent wall panels and the resulting columnar cavities being filled up with mortar packing;

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25

a plurality of generally rectangular precast reinforced  
modular<sup>concrete</sup> floor panels each consisting  
a downwardly directed peripheral flange,  
steel bar connecting means at its both ends for  
5 end-to-end attachment thereof to same connecting  
means of adjacent floor panels,  
a pair of longitudinal grooves correspondingly  
provided along the opposite sides thereof,  
a plurality of steel bar side connectors exposed to  
10 view from corresponding recessed sections at  
the side sections thereof,  
wherein said floor panels have their flanges mounted on  
the top ends of and in alignment to said wall  
panels and the abutting steel bar connecting means  
15 of said floor panels are weldedly connected  
together,  
wherein said side connectors of adjacent floor panels  
are abutted to each other and weldedly attached  
together,  
20 wherein said floor panels serve as a roofing when  
installed at the deck of the building, the gap  
in-between floor panels being sealed by sealing  
means;  
a plurality of precast reinforced modular<sup>concrete</sup> columns each  
25 provided with a connecting means in the form of a steel

plate fixed at the base thereof, said columns being weldedly attached to corresponding anchor plate connectors of the foundation and to corresponding connecting means of other modular columns in assemblage;

5 a plurality of precast reinforced modular <sup>concrete</sup> stairs each consisting,

at least one stringer member having a stepped upper side and provided with anchor plate connectors at

10 both ends thereof initially attached weldedly to the connectors of the foundation and subsequently to same connectors of other columns and floor level landing slabs,

a plurality of treads weldedly connected on said

15 stringer member through plate connectors provided underneath thereof,

a plurality of precast reinforced modular <sup>concrete</sup> window frame panels each consisting

a pair of longitudinal grooves correspondingly

20 provided along the opposite sides thereof,

a window opening at the upper portion thereof,

an outwardly directed peripheral flange,

wherein said grooves match with those of the adjoining wall panels and the columnar

25 cavities produced are then filled up with mortar packings;

a plurality of precast reinforced modular <sup>concrete</sup> doorframes each consisting

5 a pair of precast modular door jambs each provided with a longitudinal groove at the outer side thereof and an integral door framing <sup>at the</sup> inward side thereof,

a precast modular lintel having longitudinal grooves at its both ends which are in alignment with the grooves of said jambs in assembly,

10 wherein said grooves match with those of the adjoining wall panels or window frame panels and the columnar cavities produced are then filled up with mortar packing.

2. A modular building construction <sup>as defined</sup> in claim 1, wherein said modular stairs consist of at least one stringer member that <sup>is</sup> provided with a plurality of generally rectangular apertures along its length to facilitate the mounting of the treads, instead of said stepped section.

3. A method of construction of a modular building unit <sup>as</sup> defined in claim 1, comprising the steps of:

20 constructing a building foundation according to a given plan layout and installing a plurality of anchor steel bars and steel plate connectors to facilitate mounting of precast modular <sup>concrete</sup> building elements;

25 mounting said building elements in their respective locations by aligning and abutting their respective steel bar and plate connectors to those of the foundation in the initial stage of the construction process and subsequently to same connectors of

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adjoining building elements;

welding the abutted connectors to permanently fix the  
building elements in place; and

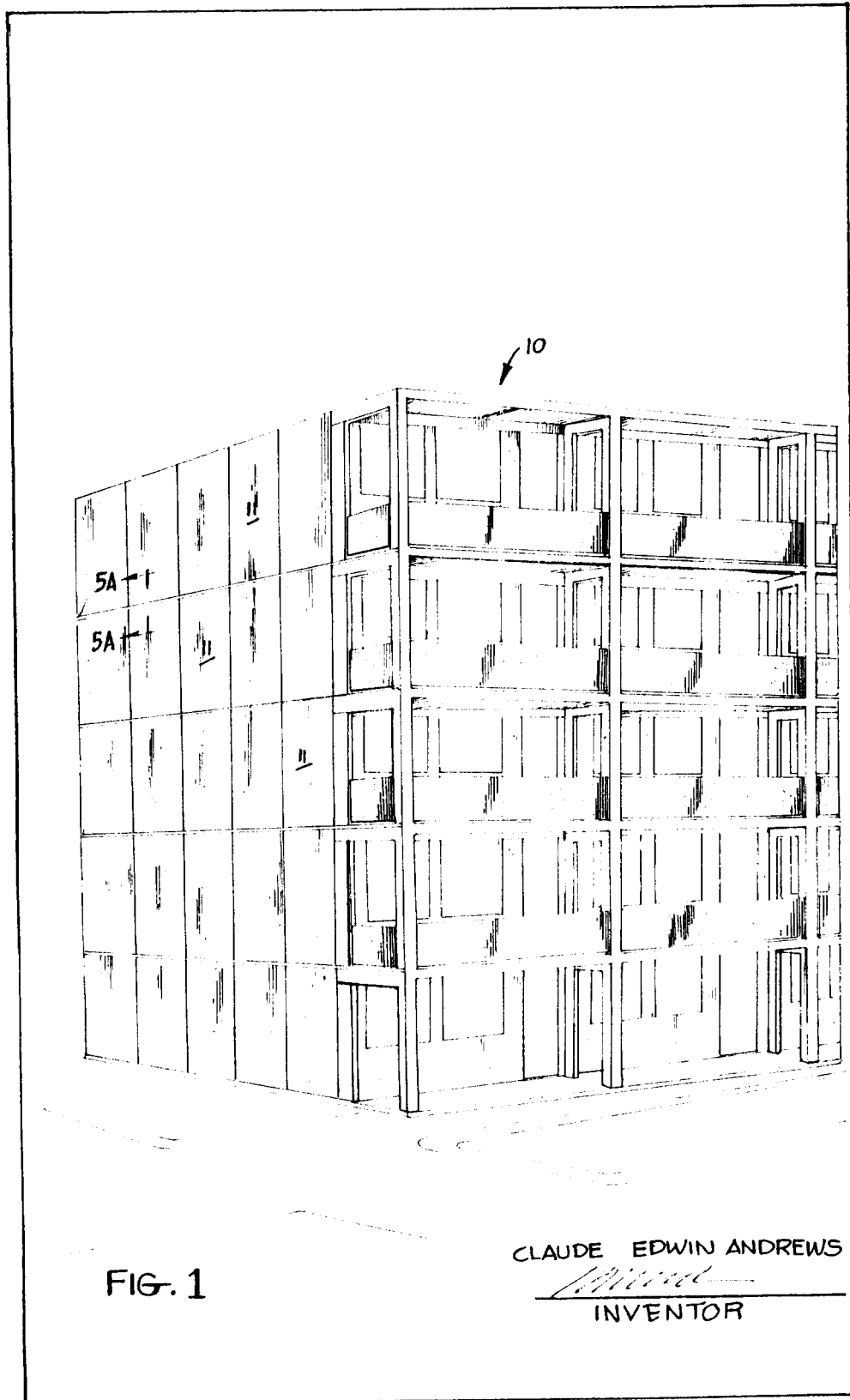
5                   filling up with mortar packings the recessed sections  
                  where the welded connections are located and the  
                  columnar cavities in between adjacent building  
                  elements produced by the matching grooves provided  
                  on the side sections of said building elements.

- 10           4. A method of construction as defined in claim 3, wherein said  
          building elements consisting of precast reinforced modular  
          wall panels, floor panels, columns, stairs, window frame  
          panels and doorframes, said floor panels having their  
          flanges downwardly directed and mounted to rest on top of the  
          wall panels therebelow and the upper wall panels mounted to  
15           rest on the top end portion of said floor panels in a manner  
          that their connectors are abutted together to facilitate  
          welding operation, said window frame panels and doorframes  
          being installed by matching their respective grooves to those  
          of the wall panels and the resulting cavities filled up with  
20           mortar packing.

  
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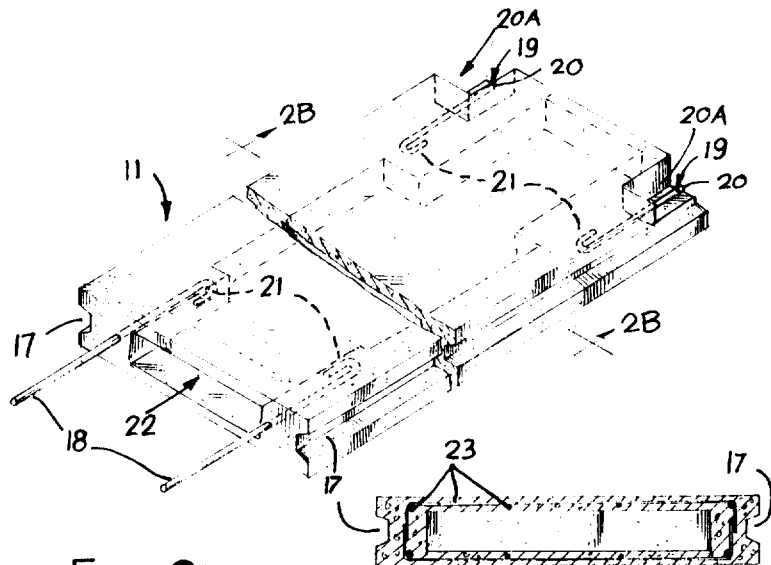


FIG. 2A

FIG. 2B

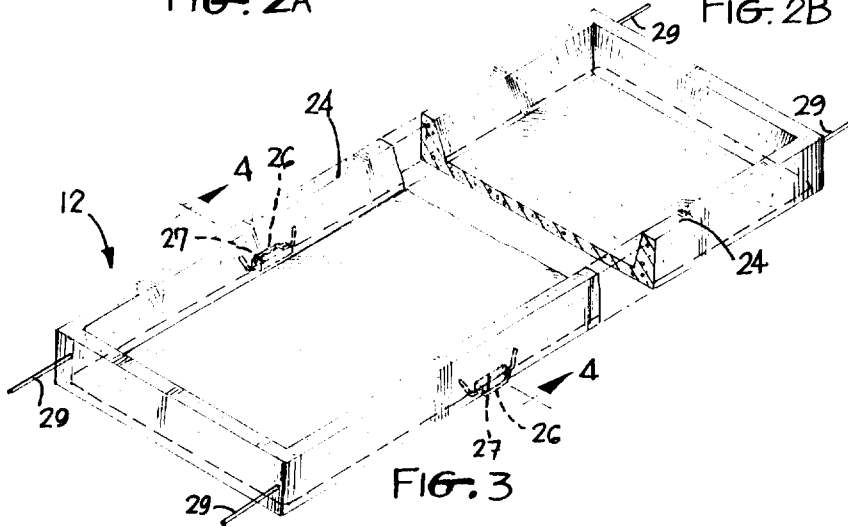


FIG. 3

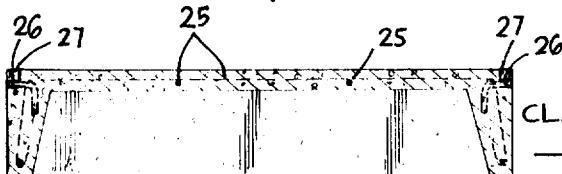


FIG. 4

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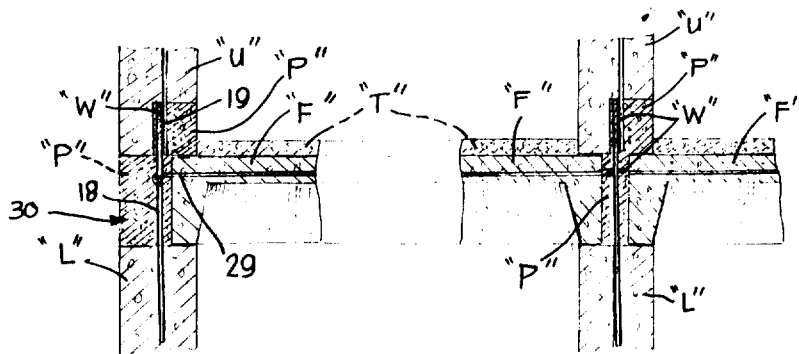


FIG. 5A

FIG. 5B

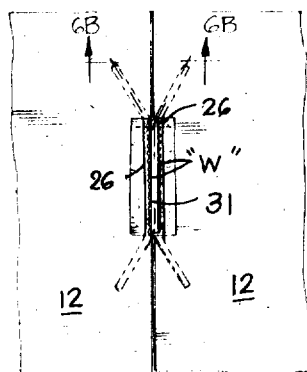


FIG. 6A

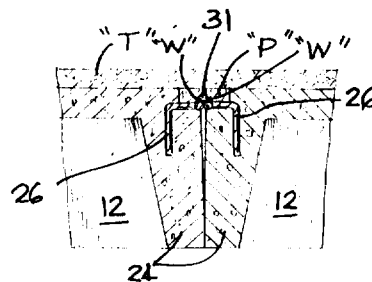


FIG. 6B

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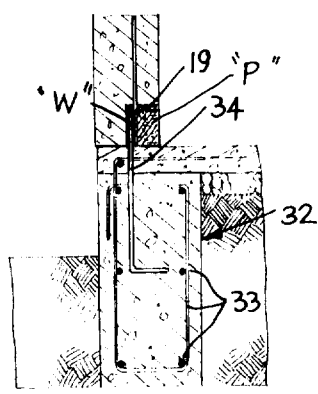


FIG. 7A

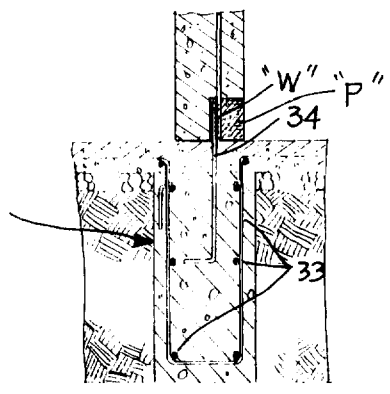


FIG. 7B

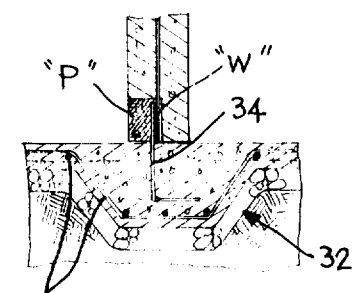


FIG. 7C

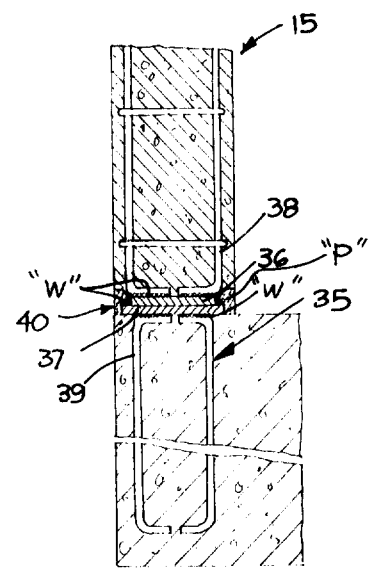
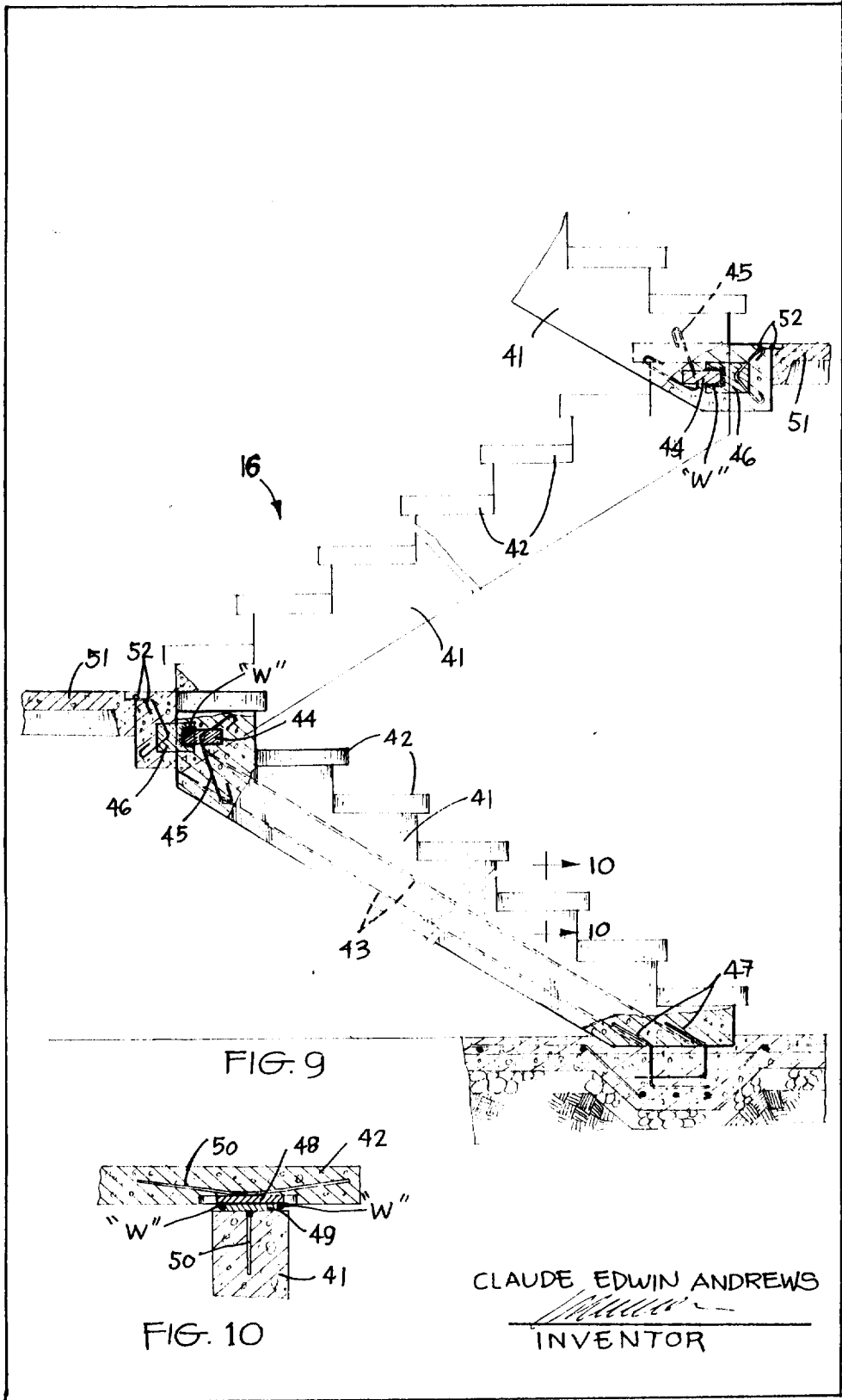
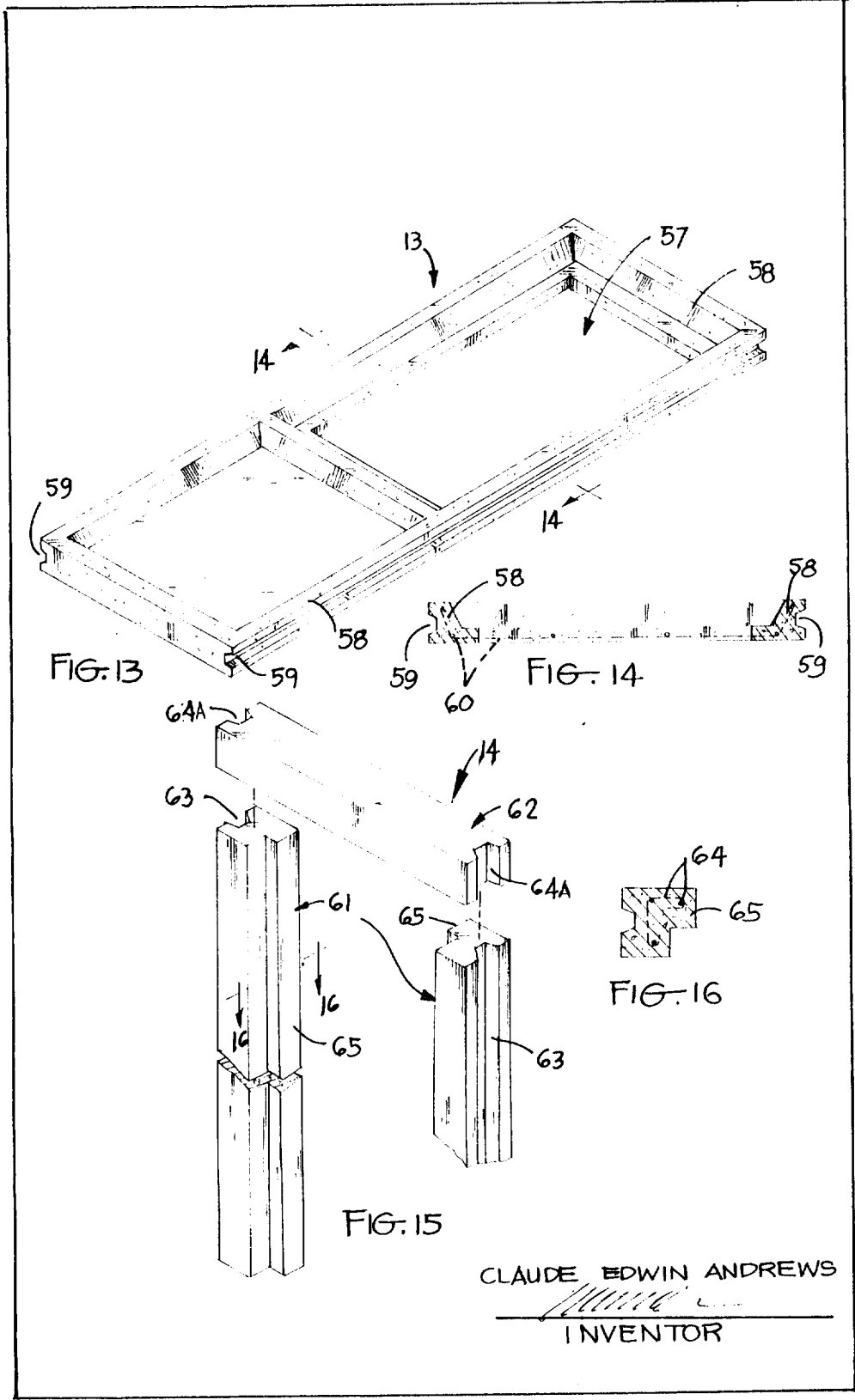


FIG. 8

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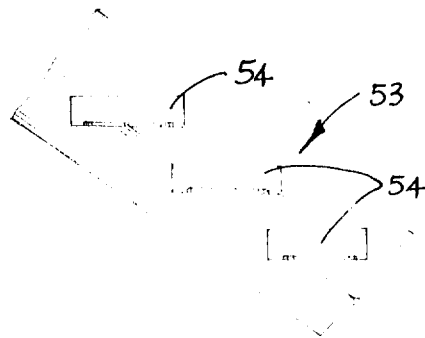


FIG. 11

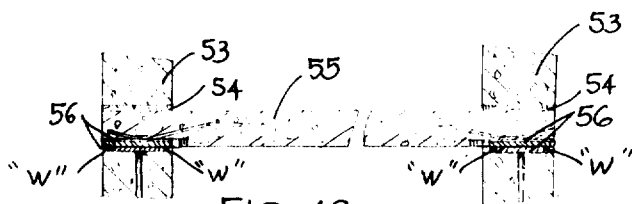


FIG. 12

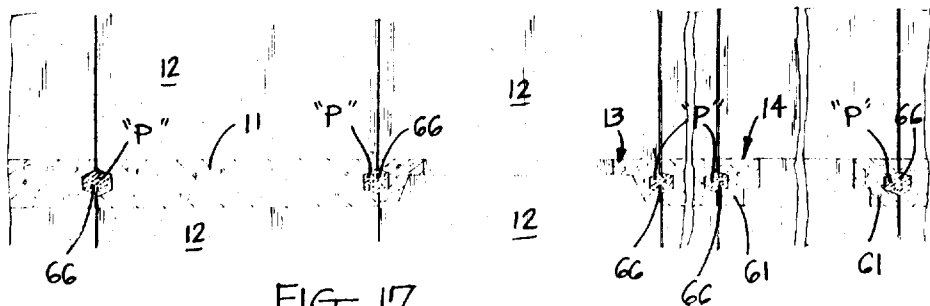


FIG. 17

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