Feb. 8, 1966 W. H. MICHEELS ETAL 3,233,374

BUILDING AND METHOD OF CONSTRUCTING SAME

Filed Jan. 21, 1963 7 Sheets-Sheet 1

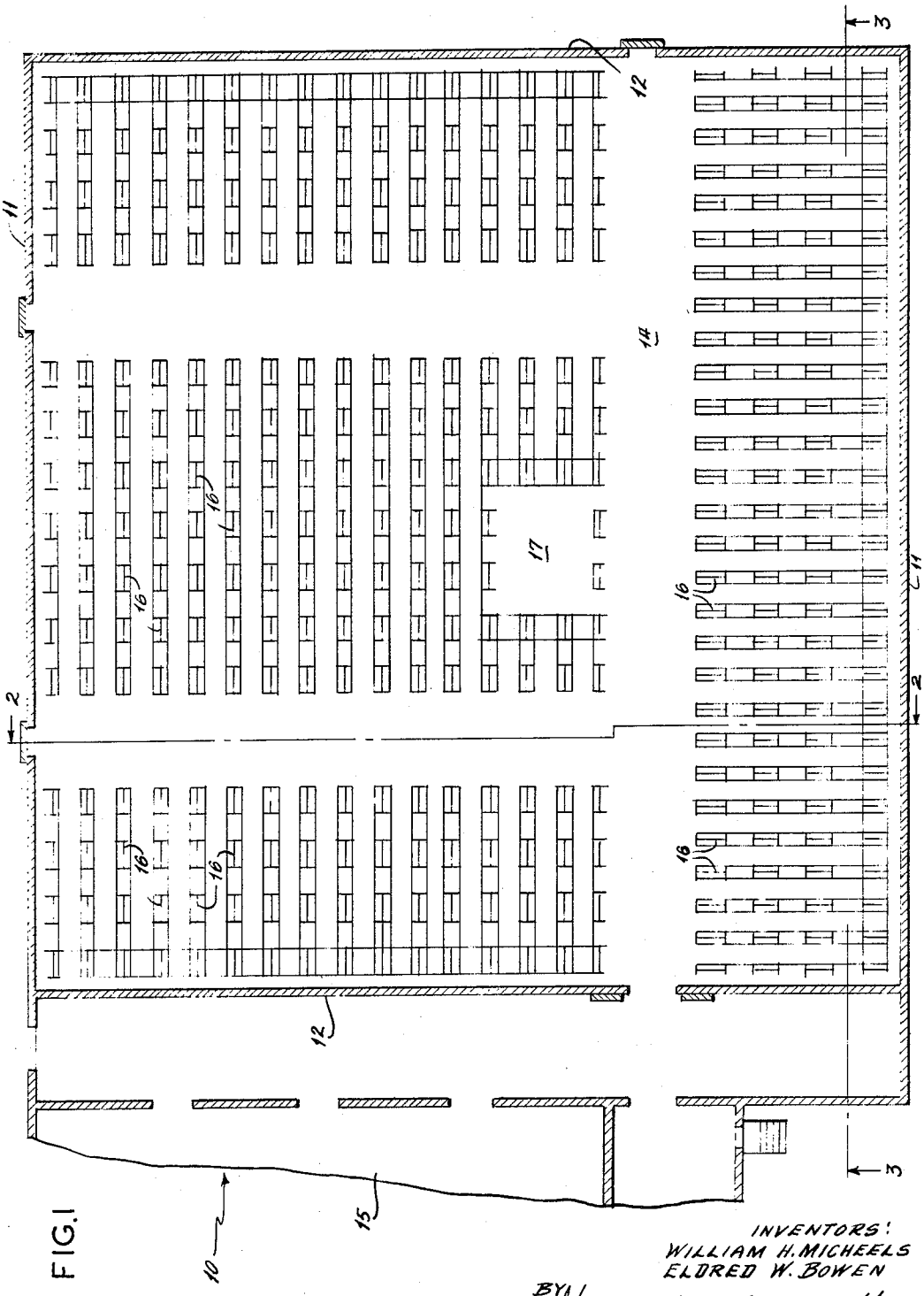


FIG. 1

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BUILDING AND METHOD OF CONSTRUCTING SAME

Filed Jan. 21, 1963 7 Sheets-Sheet 2

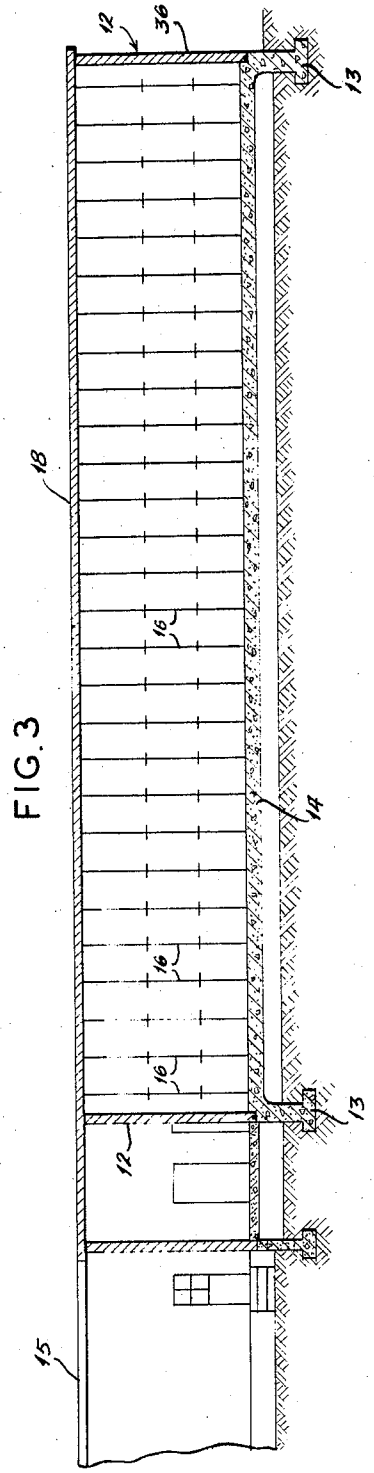


FIG. 3

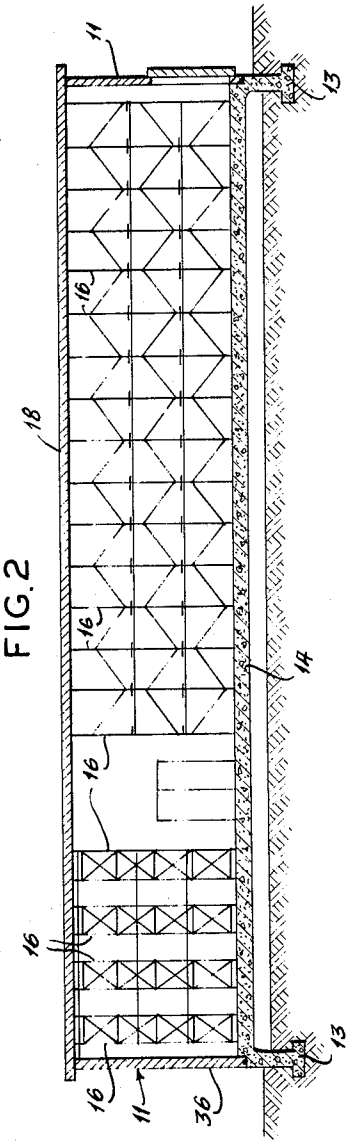


FIG. 2

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BUILDING AND METHOD OF CONSTRUCTING SAME

Filed Jan. 21, 1963 7 Sheets-Sheet 3

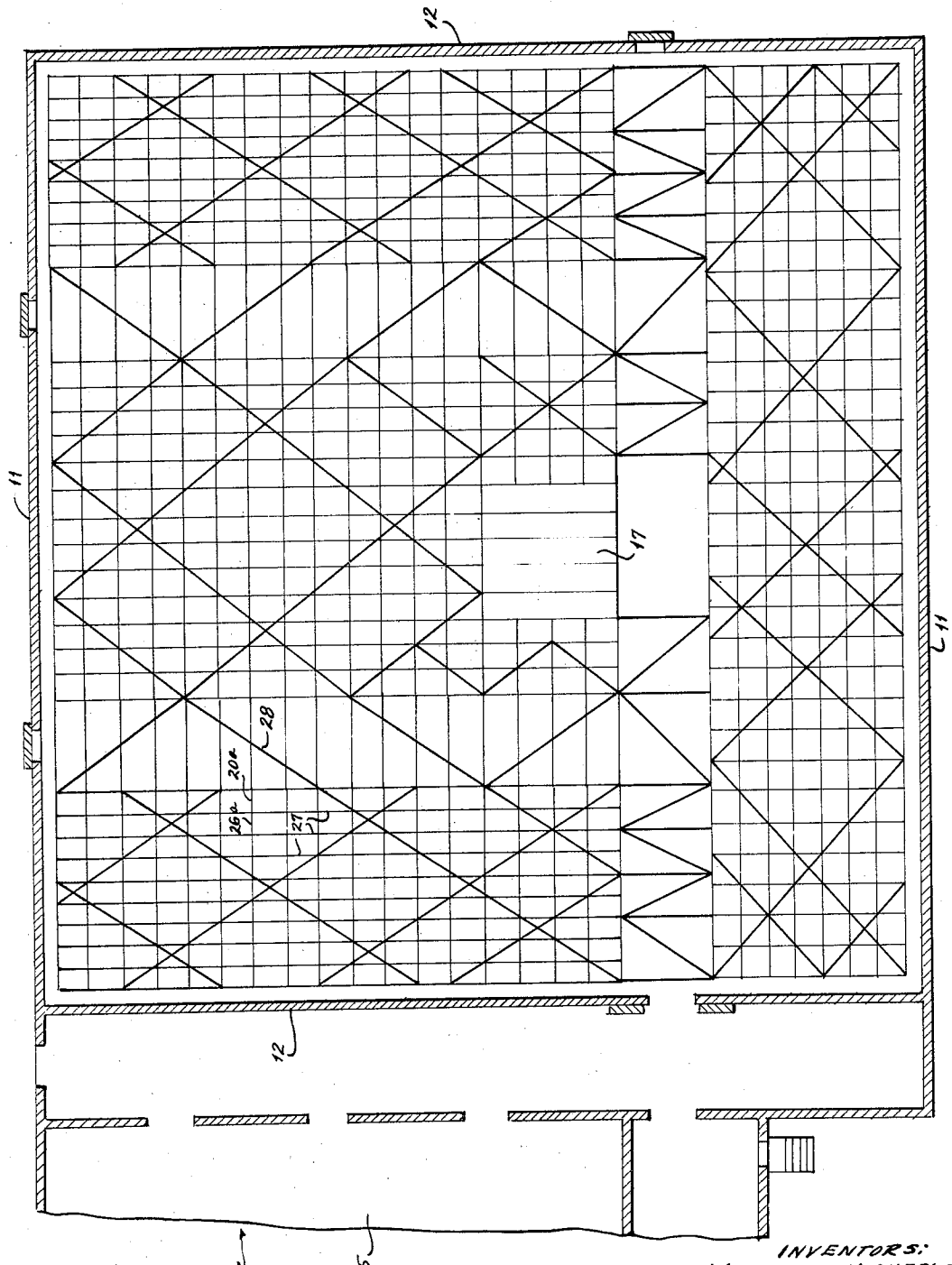


FIG 4.

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BUILDING AND METHOD OF CONSTRUCTING SAME

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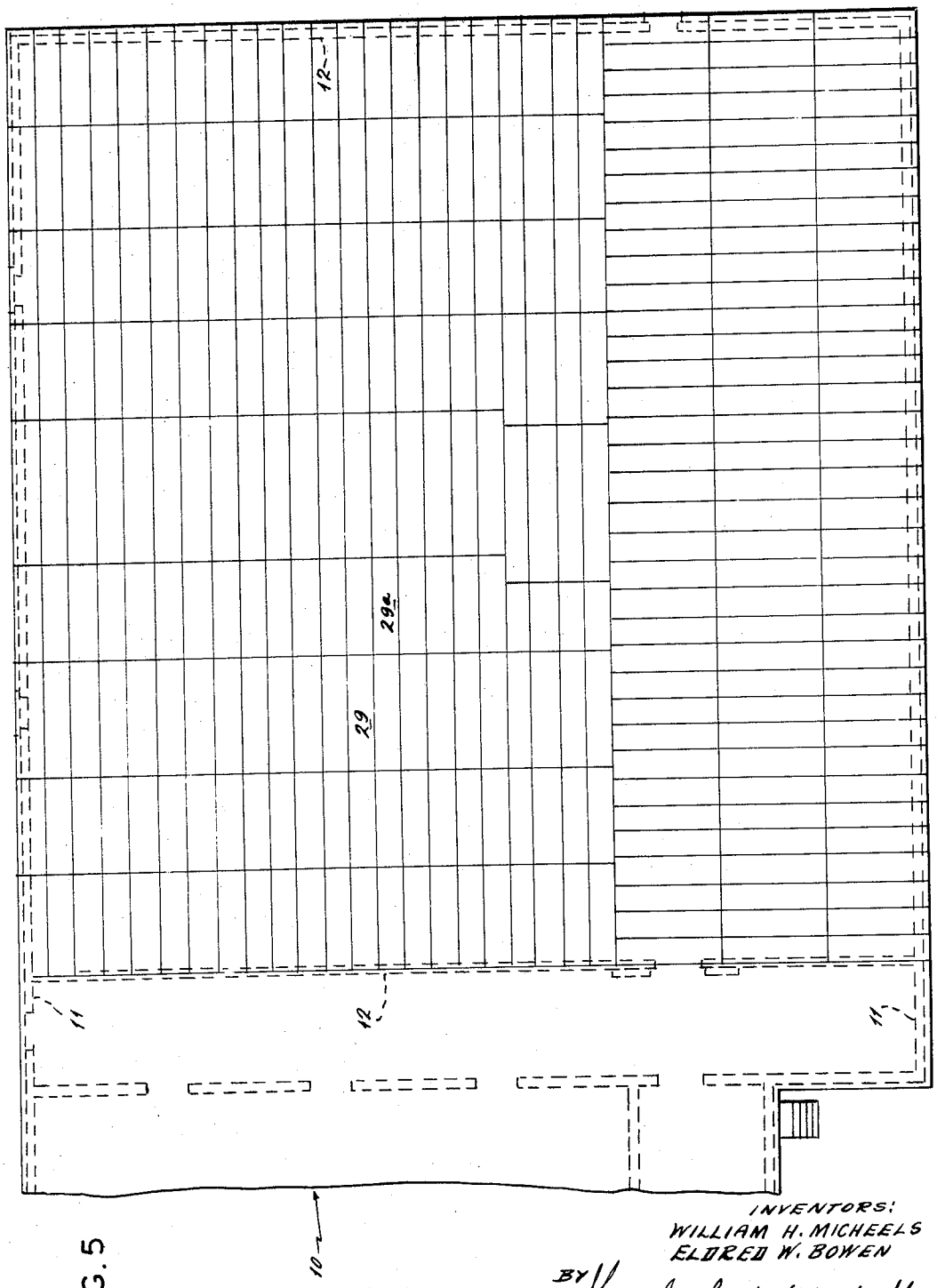


FIG. 5

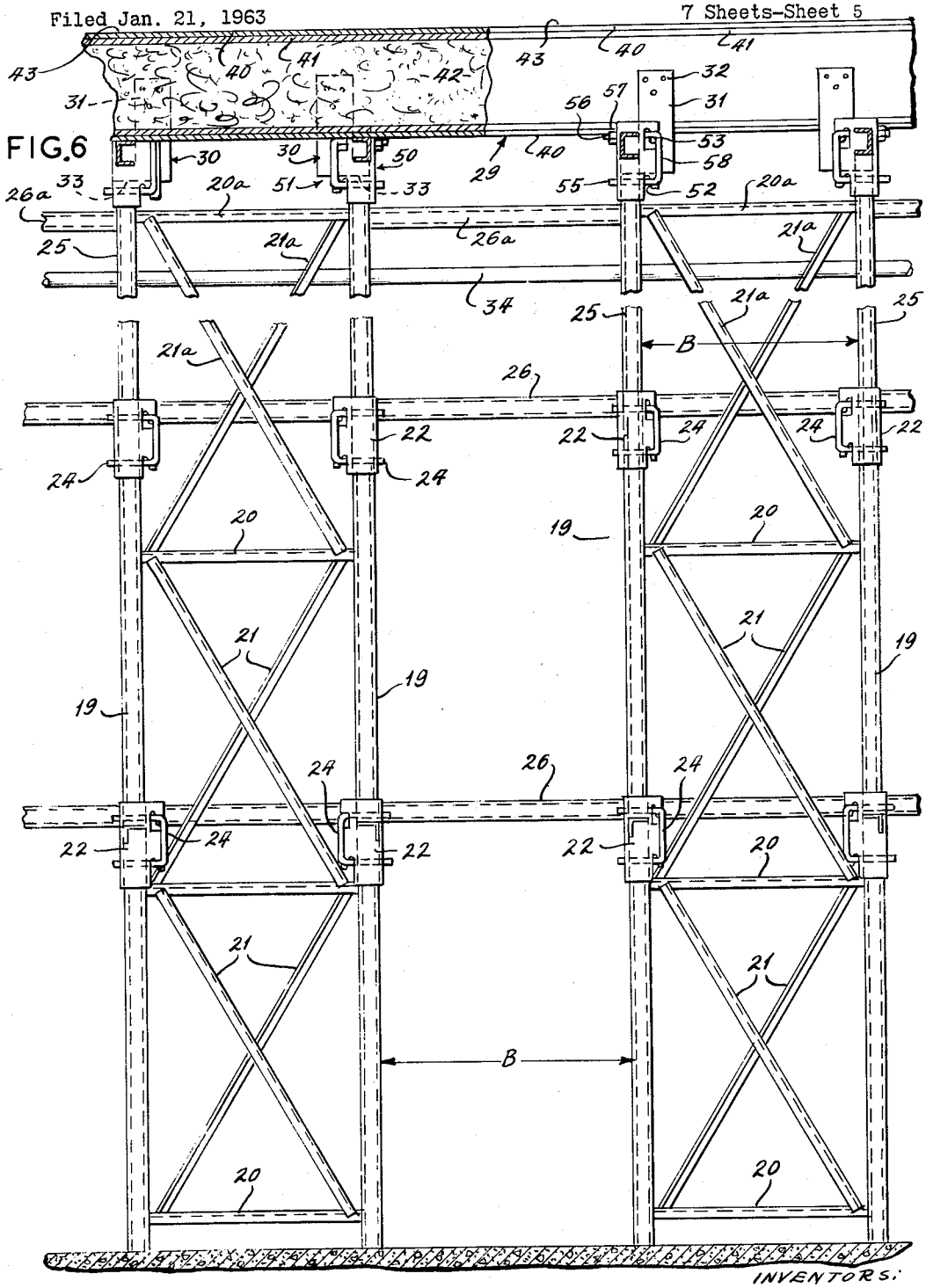
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Feb. 8, 1966 W. H. MICHEELS ETAL 3,233,374

BUILDING AND METHOD OF CONSTRUCTING SAME

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FIG.6



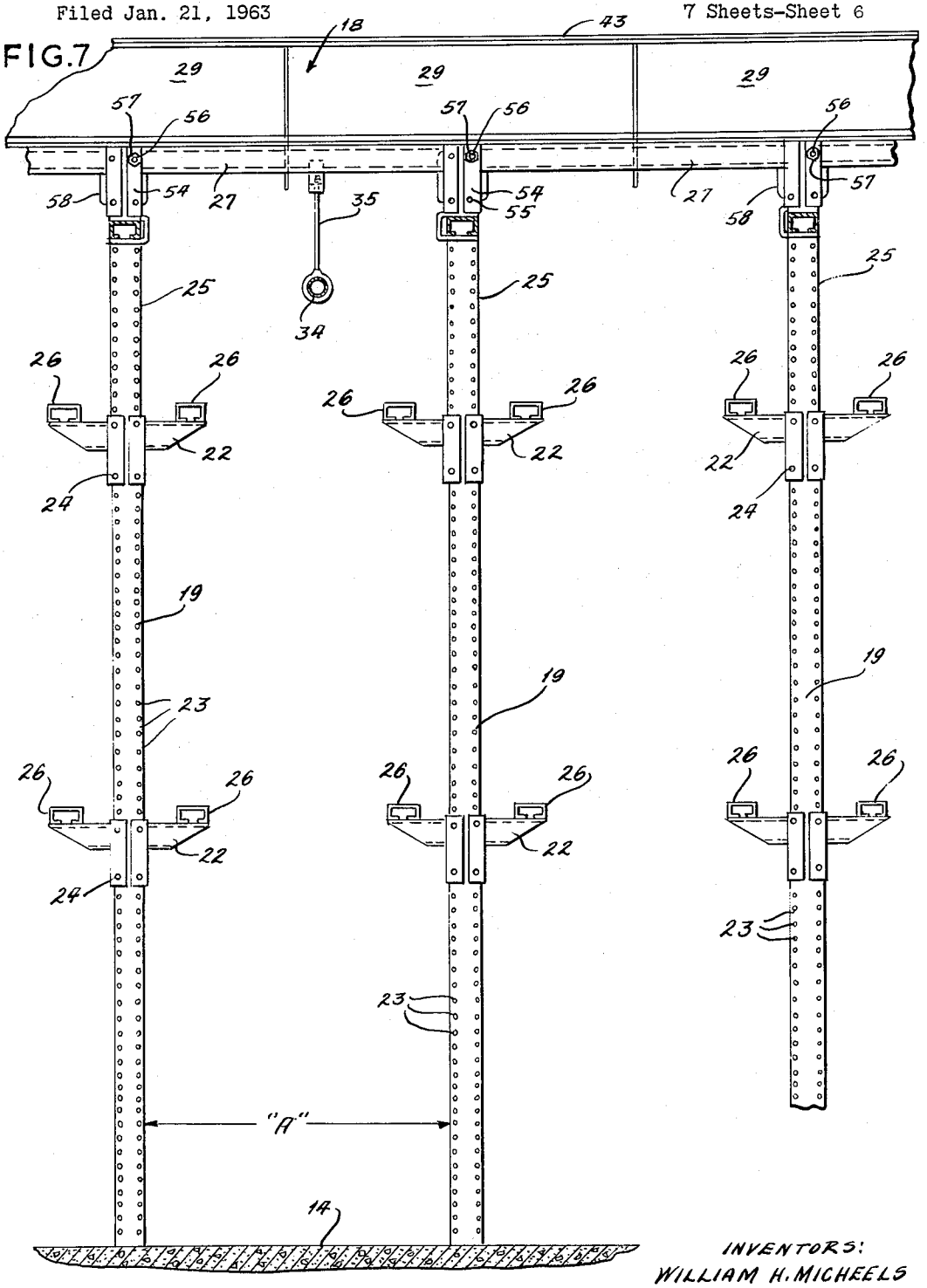
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BUILDING AND METHOD OF CONSTRUCTING SAME

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FIG. 7



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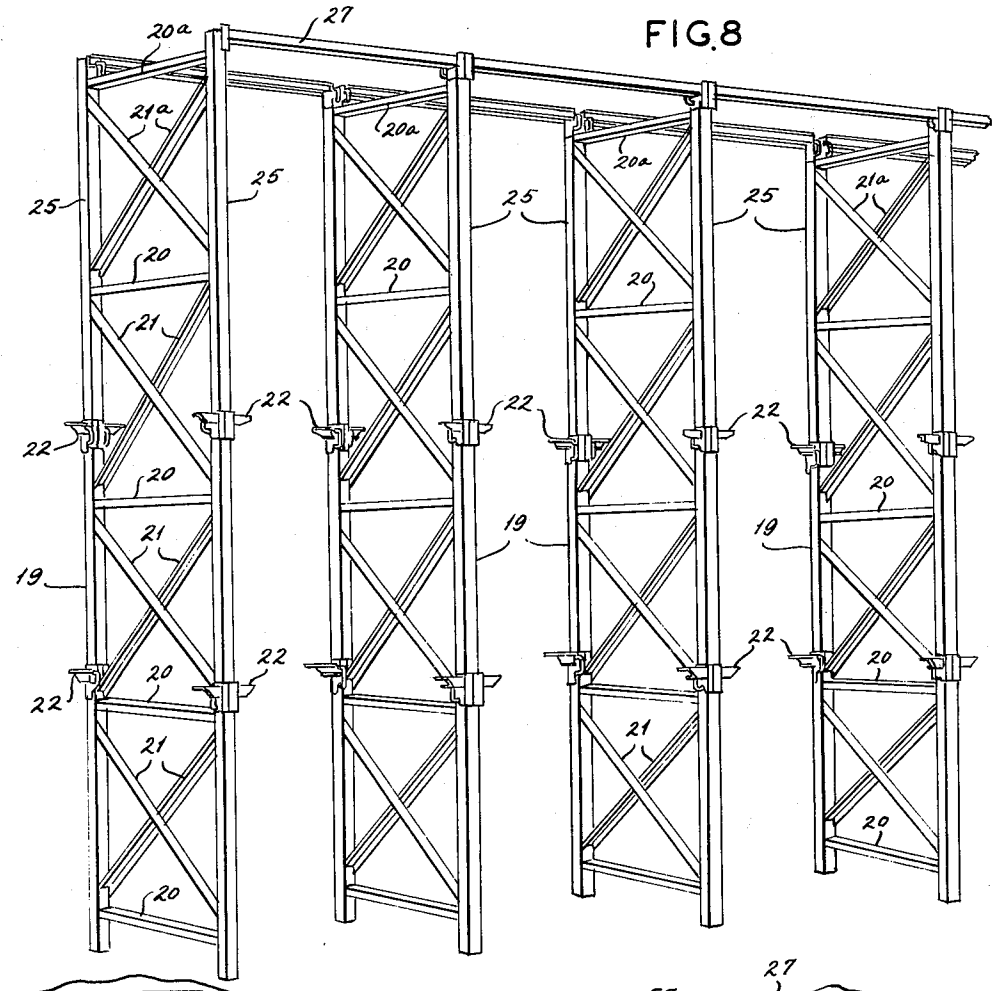
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BUILDING AND METHOD OF CONSTRUCTING SAME

Filed Jan. 21, 1963 7 Sheets-Sheet 7

FIG.8



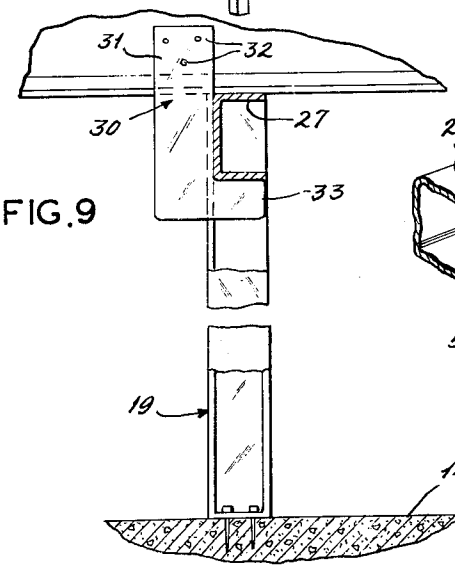


FIG.9

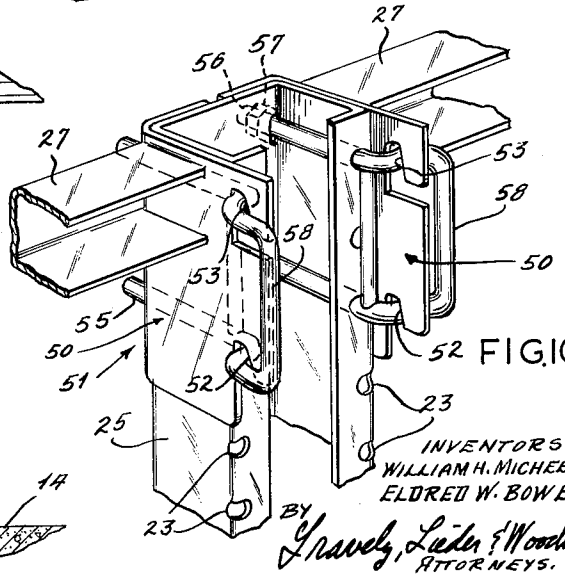


FIG.10

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United States Patent Office 3,233,374 Patented Feb. 8, 1966

3,233,374 BUILDING AND METHOD OF CONSTRUCTING SAME

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Filed Jan. 21, 1963, Ser. No. 252,817
4 Claims. (Cl. 52—36)

The present invention relates to a building and method of constructing same, and particularly to an insulated refrigerated warehouse having drive-in storage racks and to a method of constructing same.

One of the principal objects of the present invention is to provide a building wherein drive-in storage racks provide support for the roof.

Another object of the present invention is to provide a method of erecting a building wherein drive-in racks are fastened to a concrete or prefabricated flooring and are erected prior to positioning the wall and roof panels which are fastened to the racks.

Another object of the present invention is to provide a building constructed of prefabricated insulated wall and roof panels and prefabricated drive-in storage racks which function as support members and eliminates the need for beams and posts.

Another object is to provide a building which can be constructed by manual and unskilled labor and which comprises prefabricated outside walls and roof panels supported by initially erected prefabricated drive-in racks.

Another object of the present invention is to provide an insulated refrigerated building wherein the normal posts and structural steel are eliminated.

A further object of the present invention is to provide a frozen food warehouse having substantially reduced construction costs and constructed substantially entirely of prefabricated parts.

Another object of the present invention is to provide a refrigerated warehouse having a single refrigeration unit positioned near the center of the building rather than several refrigerating units positioned at the outer walls of the building.

Another object is to provide a building wherein utilities, such as sprinkler pipes, electrical conduit, light fixtures, refrigeration piping, etc. are suspended from supports connecting the tops of drive-in racks, which also are used to support roof panels, to avoid penetration of insulated panels by fasteners.

Still another object of the present invention is to provide a building having reduced footing and foundation (due to light wall loads) and wherein the roof load is evenly distributed over the entire floor area and does not bear principally at the outside walls and at interior post footings as in conventional building construction.

Still another object of the present invention is to provide an insulated warehouse for frozen products wherein the outer roof and wall surfaces are prefabricated aluminum covered fibreglass insulated panels coated with a reflecting white acrylic coating.

Still a further object of the present invention is to provide a building wherein the expansion and contraction of the support members is reduced because the building is surrounded by an insulated wall and roof envelope.

Another object is to provide specially constructed drive-in racks for supporting the additional weight of the roof and to provide attachment means for attaching the racks to the roof.

Another object of the present invention is to provide a building wherein separate structural members are not necessary to support the roof, wherein an insulated envelope surrounds the building and the supporting

members, thereby reducing the expansion and contraction, wherein no interior footings are needed, and wherein a minimum exterior foundation is necessary, and wherein commercially available prefabricated elements are used throughout so that on site costs are reduced.

Still another object is to provide a building which may be easily automated by the positioning of gravity roller bearings and conveyors in the pallet supporting areas.

These and other objects and advantages will become apparent hereinafter.

The present invention comprises an insulated modular building having drive-in rack uprights supporting prefabricated roof panels. The present invention also includes the insulated warehouse and method of constructing same hereinafter described and claimed.

In the figures, wherein like numbers refer to like parts wherever they occur:

FIG. 1 is a horizontal sectional view showing the building walls in section and indicating the overall plan layout of the drive-in racks;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 1;

FIG. 4 is a plan view showing the walls in section and showing the roof removed with the supporting structure for the roof panels outlined in detail;

FIG. 5 is a top plan view of the warehouse showing the positioning of the roof panels;

FIG. 6 is a fragmentary elevational view showing the attachment of the roof panels to the drive-in racks and showing a roof panel partly in section;

FIG. 7 is a fragmentary end elevational view of the structure shown in FIG. 6;

FIG. 8 is a perspective view showing a section of the drive-in racks and the connecting members;

FIG. 9 is a greatly enlarged fragmentary foreshortened view showing the attachment of the roof panels to the drive-in racks; and

FIG. 10 is an enlarged fragmentary view of the connetion between the uprights and the roof support members.

FIGS. 1–3 show a refrigerated insulated warehouse 10 comprising insulated side walls 11 and insulated end walls 12 positioned on a footing 13. Although the building 10 is shown as a refrigerated warehouse, the present building concept is suitable for any structure which utilizes a plurality of roof to floor uprights over a large portion of the floor area. The building 10 also includes a reinforced concrete flooring 14. The floor 14 may be prefabricated panels, if desired. As shown the warehouse 10 is adjacent to an already standing structure 15, but could be an entirely separate building.

Positioned on the flooring 14 are a plurality of drive-in racks 16 adapted to receive loaded pallets (not shown). Near the center of the building 10 is a single refrigeration unit 17. This unit 17 replaces the numerous smaller units which conventionally are positioned around the outer periphery of a refrigerated warehouse. The present central refrigerating installation allows for greater economies of construction and for greater efficiency.

The building 10 also includes an insulated roof 18. As will be discussed more fully hereinafter, the side walls 11, the end walls 12, and the roof 18 all are constructed of prefabricated insulated panels.

Each of the drive-in racks 16 comprises a pair of upright members 19, horizontal members 20, crossed stringers 21, and rail supporting ears 22. The uprights 19 are securely attached to the concrete floor 14, which as may be seen in FIGS. 2 and 3, does not have any in-

terior footings and has only as minimum outer wall foundation 13.

The drive-in racks 16 are prefabricated items which are readily assembled on site with unskilled labor. The upright 19 is provided with vertically spaced holes 23 adapted to engage connectors 24 which fasten the rail support ears 22 to the uprights 19. Thus the rail support ears 22 are adjustable in a vertical direction on the upright 19.

The connection between the ears 22 and the uprights 19 is shown in detail in FIG. 6. The rail support ears 22, the uprights 19 and the connectors 24 are standard items of commerce sold under the name "Speed Rack" by Storage Products Corporation of Skokie, Illinois.

The drive-in racks 16 also include upright extension portions 25 which extend above the uppermost set of ears 22 and horizontal rails 26 which are positioned on and secured to the ears 22. The rails 26 receive the loaded pallets (not shown).

The upright extensions 25 are provided with crossed diagonal brace members 21*a* and, at the upright ends, longitudinal spacing members 20*a* are positioned below the topmost edge thereof.

In the fabrication of the warehouse 10, the aforementioned portions of the drive-in racks 16, namely, the upright 19 (including the extension portions 25), the longitudinal horizontal brace members 20 and 20*a*, the stringer 21 and 21*a*, and the rail support ears 22 (including the connectors 24 are assembled on the ground, erected into place, and fastened to the floor 14.

The racks 16 are spaced laterally a distance "A" which is determined by the width of the loaded pallets, the pallet loading equipment, etc. The racks 16 are spaced longitudinally a distance "B" which is approximately the longitudinal width of the racks 16. After the racks 16 are erected, enlarged C shaped channels 26*a* are fastened between adjacent racks 16. The braces 26*a* provide added longitudinal steadiness to the racks 16. When the rails 26 are fastened to the upright ears 22, additional longitudinal bracing is provided.

The enlarged C shaped brace channels 26*a* also are fastened to the upright extensions 25 below the top most end thereof.

Lateral bracing stringers 27 are fastened immediately below the tops of the upright extensions 25 by removable connectors 24. The lateral stringers 27 brace the racks 16 against lateral movement. The lateral stringers 27 are C shaped channels and help support the roof 18, as will be shown more clearly hereinafter. FIGS. 6, 7 and 10 show the connection between the stringers 27 and the upright extensions 25 more clearly.

The connection comprises a plate 50 fastened to the end of the stringer 27, and a fastening bracket 51 which connects the plate 50 to the top of the upright extension 25. The extension 25 directly engages the underside of the roof panel 29. The plate 50 is provided with a free notch 52 in the bottom edge and an L shaped slot 53. The back side 54 of the plate 50 is bent around the edge of the upright 25 and is provided with elongated openings which coincide with the upright openings 23. The fastening bracket 51 is of generally U shape with free ends 55 and 56, at least one of which is threaded to receive a nut 57. The base 58 of the U is bent out of plane of the legs 55 and 56.

In making the connection, the bracket legs 55 and 56 pass in front of the plate 50 and pass through two of the openings 23 in the upright extension 25, and through the openings in the bent around portion 54 of the plate 50. The base 58 of the U is trapped in the slot 53 and in the slot 52. When the nut 57 is drawn up, the connection between the stringer 27 and the upright extension 25 is made secure.

Diagonally connecting the lateral braces 27 are cross stringer members 28 which are positioned according to the span of roof panel which is required to be supported.

This is clearly shown in FIG. 4 which is a plan view of all of the brace members positioned atop the drive-in rack upright extensions 25 in the illustrated embodiment of the warehouse 10.

By superimposing FIG. 5 on FIG. 4, one can see how the prefabricated insulated panels 29 which comprise the roof 18 are positioned with respect to the brace members 27 connected to the drive-in rack upright extensions 25, and the diagonal bracing 28 fastened to the lateral members 27.

The roof panels 29 are connected to the lateral supporting members 27 by means of L-shaped clips 30. An upright leg 31 of the clip 30 is attached to one of the sides or ends or a roof panel 29 by suitable attaching means, such as nails 32, and the other right angular leg 33 of the clip 30 fits around and underneath the lateral channel 27 to securely retain the roof panel 29 to the superstructure. Thus it is seen that the load of the roof 18 is transferred through the uprights 19 of the prefabricated drive-in racks 16 to a plurality of areas on the floor 14.

The walls 11 and 12 do not support any part of the roof load. Neither are there beams and posts, which require separate interior footings, as are found in conventional constructions. The racks 16 serve the dual roles of providing shelving and support for the contents of the warehouse 10 and of providing the structural support for the roof 18.

Suspended from the drive-in rack superstructure are sprinkler pipes 34 which are fastened to the lateral braces 27 by suitable suspending means 35 and are positioned in the superstructure before the roof panels 29 are installed. Heretofore, sprinkler systems had to be suspended directly from the roof, which hindered the use of prefabricated roof panels and was a very expensive and time consuming skilled job. The suspending means 35 comprises C clamps having extensions which hook over the pipes 31 and which are tightened down to engage a flange of the brace 27.

The sprinkler pipes 34 are illustrative of all of the utilities, such as electrical conduits, light fixtures, refrigeration piping, etc. which may be suspended from the superstructure to avoid penetration of the insulated roof panels.

The panels 36 which form the sides 11 and ends 12 are fibreglass insulated and have a groove in their lower edge which fits against a plate which is secured to the foundation 13. The panels 36 are adapted to be fastened to each other by suitable internal fastening means and are similarly fastened at their upper edges to the outermost edge of the drive-in rack superstructure.

Both the roof panels 29 and the side wall panels 36 are modular panels having an aluminum or stainless steel skin 40 inserparably bonded to waterproof plywood 41. The interiors of the panels 29 and 36 are filled with glass fiber insulating material 42, and the outer surfaces are coated with a reflecting white acrylic coating 43 which protects the surface and aids in the insulating properties, since it reflects heat and sunlight outwardly. The side panels 36 and the roof panels 29 are joined together in a suitable fashion (not shown). The modular panels 29 and 36 are prefabricated items which can be purchased from Freezer Box Division, Annapolis Yacht Yard, Inc. of Annapolis, Maryland.

In assembling the warehouse 10, the outer footings 13 are poured, the flooring 14 is poured, and the single refrigeration unit 17 is installed. The drive-in racks 16 (including the upper extensions 25) are preassembled on the ground, and the individual racks 16 then are suitably positioned on the flooring 14 and fastened thereto. The necessary longitudinal stringers 20*a* are fastened to the drive-in racks 16 and the lateral stringers 27 are secured by the fastening means 50 and 51 on top of the rack upright extensions 25. After the sprinkling system pipes 34 are secured to the lateral stringers 27, additional cross

reinforcing, such as the diagonal stringers **28**, is installed. The rails **26** also are installed on the ears **22** of the uprights **19**.

Thereafter, the side wall panels **36** are hoisted into position on the outer foundation **13** and secured thereto. The side wall panels **36** also are suitably fastened to the drive-in racks **16**. The roof panels **29** then are positioned on top of the drive-in rack super-structure and secured to the lateral reinforcing members **27** by means of the L-shaped clamps **30**.

The side panels **36** are secured to each other by threaded connectors on their side edges and the roof panels **29** are secured to each other by similar means. Also, the joints between the panels can be caulked or covered with a bead trim. A suitable water collection system of spouts and gutters is positioned around the outer peripheral edge of the roof **18**.

Among the advantages of the present invention are the fact that about 33% of the normal construction costs of a warehouse are saved in this installation. For example, a warehouse which would be expected to cost about $21 per square foot for a 17,000 square foot floor space and more than one third million cubic feet of usable storage space has been constructed for about $14 per square foot. All beams and posts have been eliminated and consequently the normal crane operator and operating engineer and welder are not necessary. The construction is bolted throughout and can be erected by one working supervisor and three laborers.

Furthermore, a third of the normal foundation and interior footing costs are saved because there are no interior footings and the load is supported over an entire floor area and not positioned solely at the outside wall. The use of the racks to support the pipes for the sprinkler system also eliminates the usual hanging of these pipes from the roof. Also, the entire support means is enclosed in an insulated envelope and expansion and contraction is minimized.

This invention is intended to cover all changes and modifications of the examples of the invention herein chosen for purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. A storage building comprising a floor, prefabricated modular side panels forming the sides of said building, modular prefabricated roof panels forming the roof of said building, and a roof supporting and stores supporting inner structure comprising a plurality of laterally spaced rows of upright supports longitudinally spaced in said rows, said upright supports extending from floor to roof and providing the sole support for said roof, said supports positioned over a subtantial portion of the floor area of the building, laterally extending rail support ears positioned at spaced intervals along the vertical height of the rack supports and extending from both sides thereof into the area between said rows, longitudinally extending rails positioned on and secured ot the rail support ears of the longitudinally spaced supports, said rails defining laterally spaced pallet supporting surfaces, the free area in the rows between the said pallet supporting surfaces defining an alley through which lift trucks may move in loading and unloading of pallets from said rails, cross bracing between adjacent pairs of the longitudinally spaced uprights, laterally and longitudinally extending support means interconnecting the uprights adjacent to the upper most ends thereof, means fastening the roof panels to the inner structure, said wall panels extending between said floor and said roof panels, said support means comprising C shaped channels and the fastening means comprising L shaped brackets, one leg of the L being fastened to an edge of a roof panel and the other leg of the L being positioned against the underside of a support channel.

2. The structure of claim **1** wherein the roof and wall panels are insulated and wherein utilities are suspended from the inner structure without penetrating the inner surfaces of the insulated panels.

3. The structure defined in claim **2** including a single substantially centrally positioned refrigeration unit on the floor.

4. A warehouse building comprising a floor free of interior footings, prefabricated modular side panels forming the sides of said building, modular prefabricated roof panels forming the roof of said building, and a roof supporting and pallet supporting inner structure comprising a plurality of laterally spaced rows of upright rack assemblies longitudinally spaced in said rows, said upright rack assemblies extending from roof to floor and positioned over a substantial portion of the floor area of the building, the said rack assemblies including a pair of longitudinally spaced upright rack supports of channel shaped cross section, cross bracing between the longitudinally spaced upright rack supports, vertically adjustable and laterally extending rail support ears positioned at spaced intervals along the vertical height of the rack supports, to define vertically spaced longitudinally aligned tiers of rail supporting usrfaces, longitudinally extending rails positioned on the rail supports to define laterally aligned and spaced pallet supporting surfaces, the free area in the rows between the said pallet supporting surfaces defining an alley through which lift trucks may move, longitudinally extending braces interconnecting longitudinally adjacent rack assemblies adjacent to the uppermost ends thereof, laterally extending brace and roof support means interconnecting laterally adjacent rack assemblies at the uppermost ends of the uprights adjacent to the undersurface of the roof panels, and means for fastening the roof panels to the laterally extending brace and roof support means, said support means comprising C shaped channels and the fastening means comprising L shaped brackets, one leg of the L being fastened to an edge of a roof panel and the other leg of the L being positioned against the underside of a support channel.

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