United States Patent [19]

Vetovitz

[11] **3,782,052**

[45] **Jan. 1, 1974**

[54] **APPARATUS AND METHOD FOR BUILDING CONSTRUCTION**

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[52] **U.S. Cl.** **52/745,** 52/66, 52/122, 52/173, 52/747, 156/71, 248/354, 249/1

[51] **Int. Cl.** **E04b 1/04,** E04c 2/06

[58] **Field of Search** 52/747, 749, 173, 52/122, 125, 263

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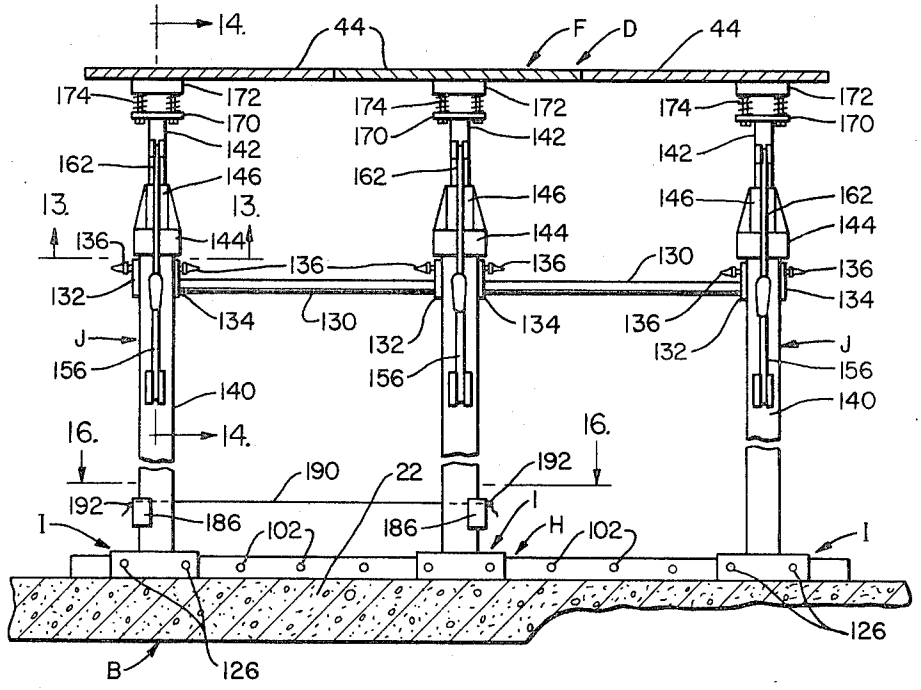
Primary Examiner—Henry C. Sutherland
Attorney—James H. Tilbeery et al.

[57] **ABSTRACT**

A plurality of modular wall units are constructed on a base area within a temporary shelter removably positioned on the base area. The temporary shelter is then moved from the base area. With the shelter removed from the base area, the wall units are first lifted vertically and moved horizontally for lowering into position on a building foundation.

31 Claims, 27 Drawing Figures



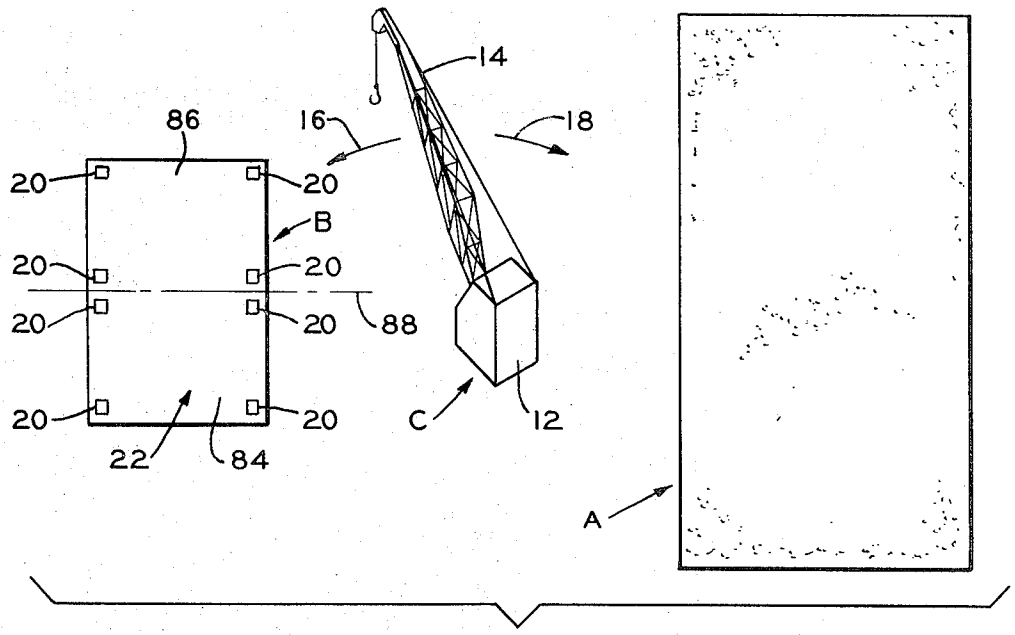


FIG. 1.

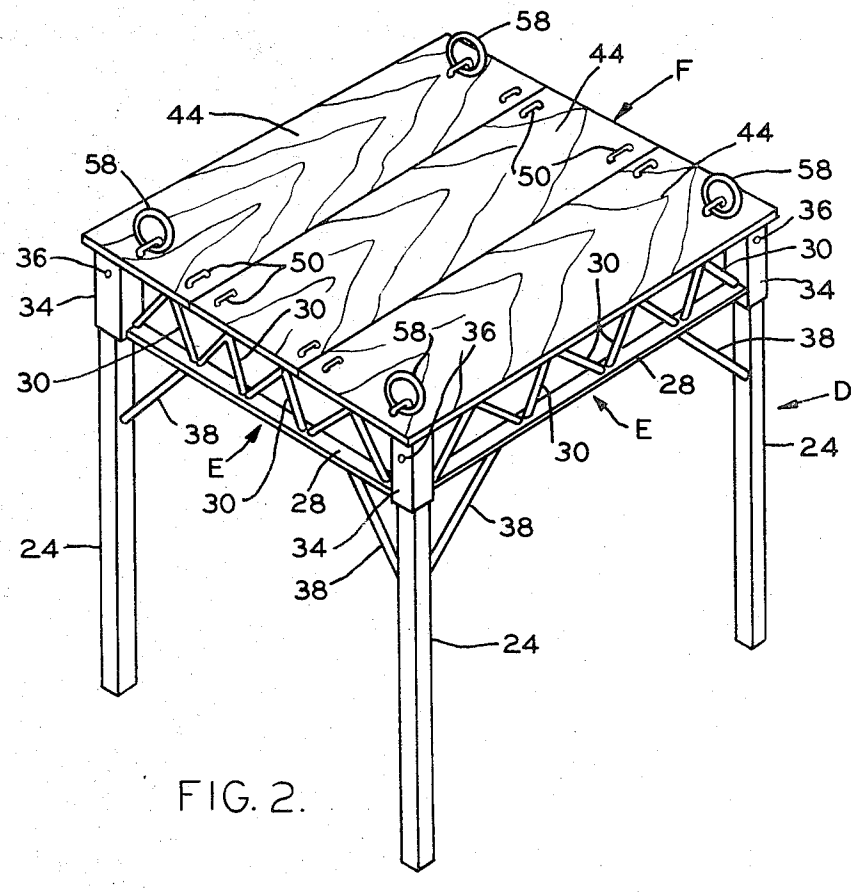


FIG. 2.

FIG. 3.

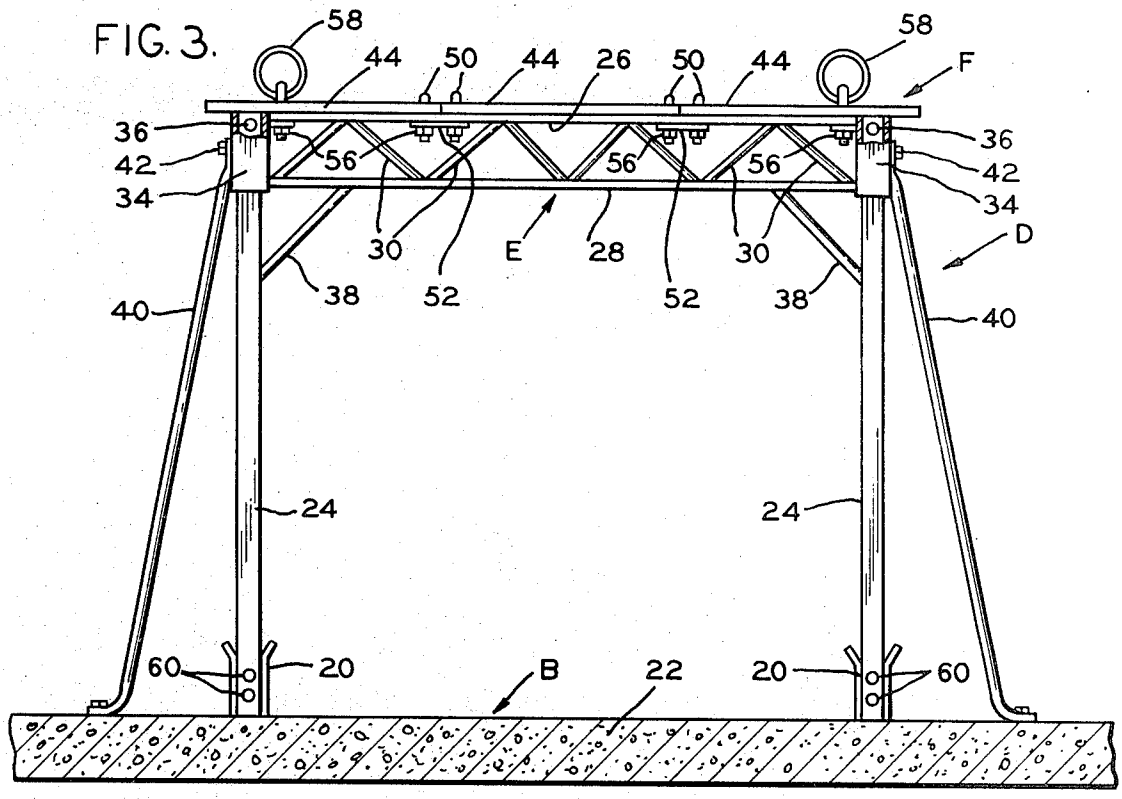

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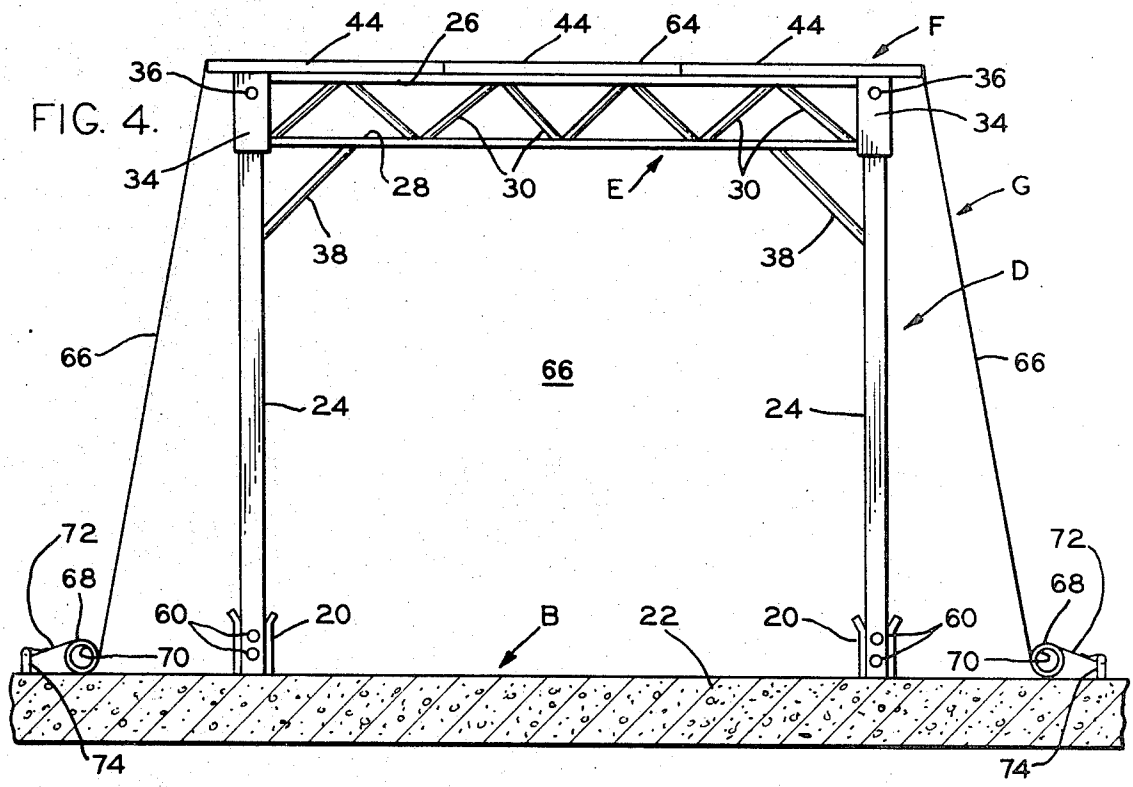
FIG. 4.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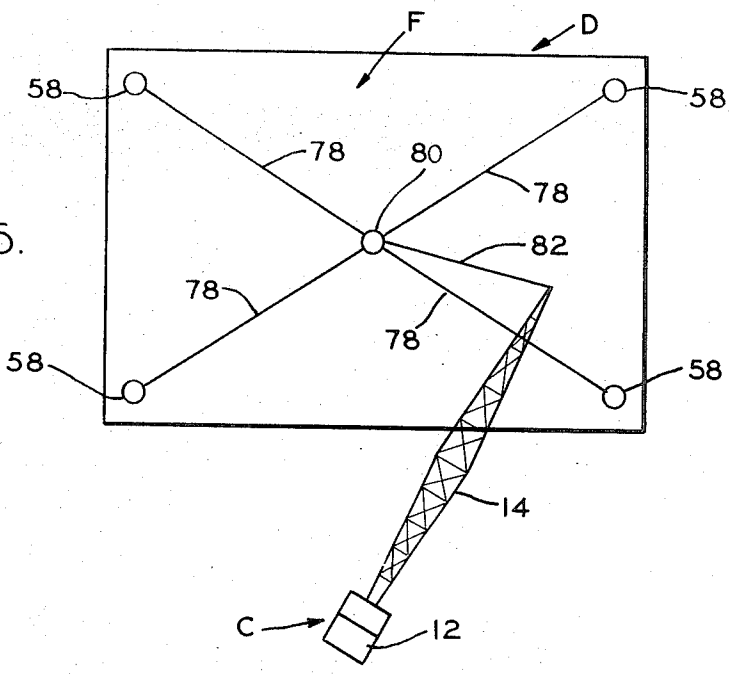

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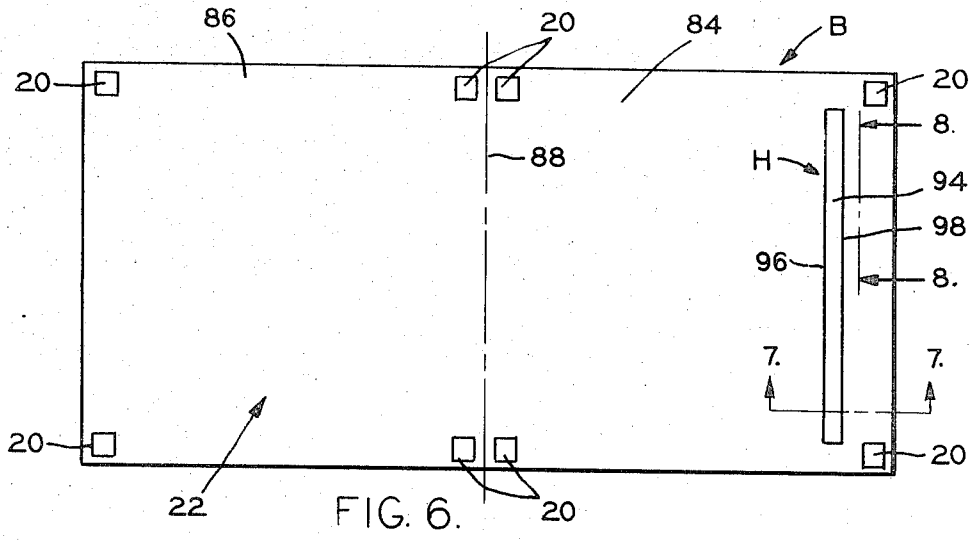

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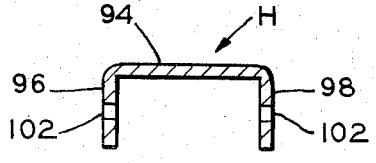

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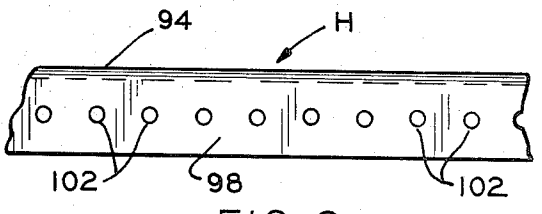

FIG. 8.

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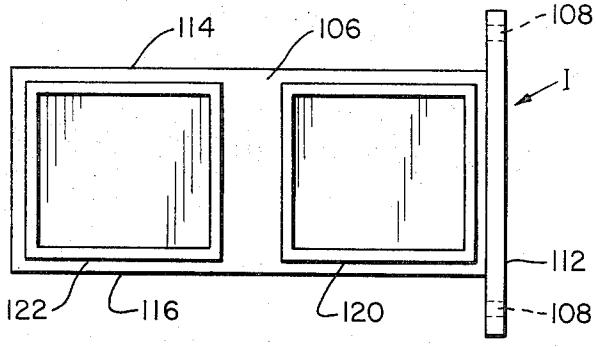

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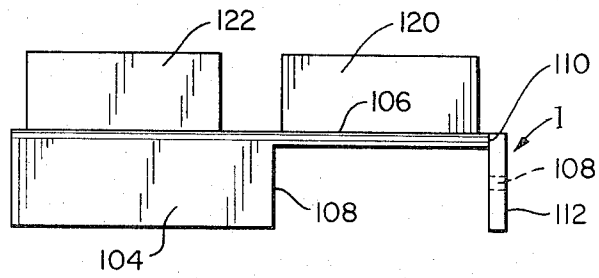

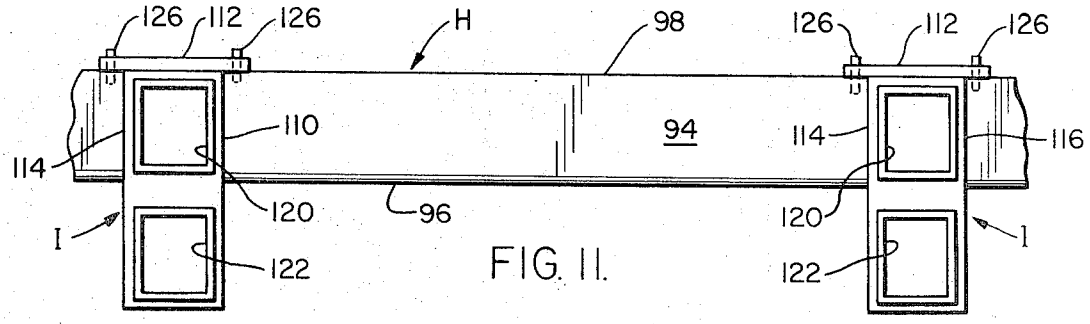

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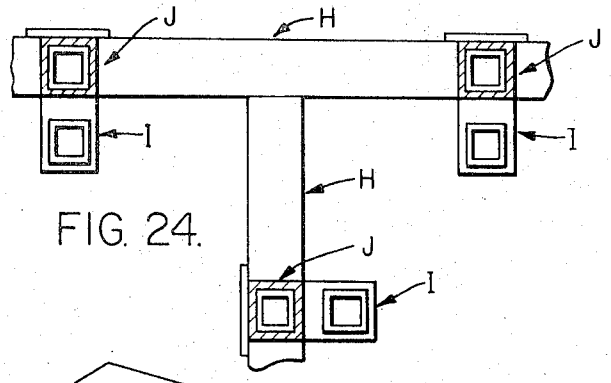

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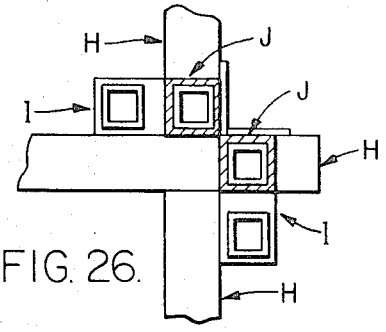

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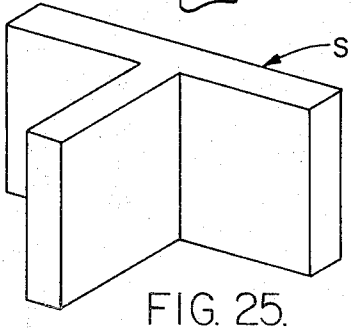

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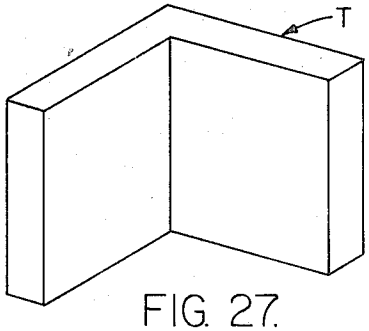
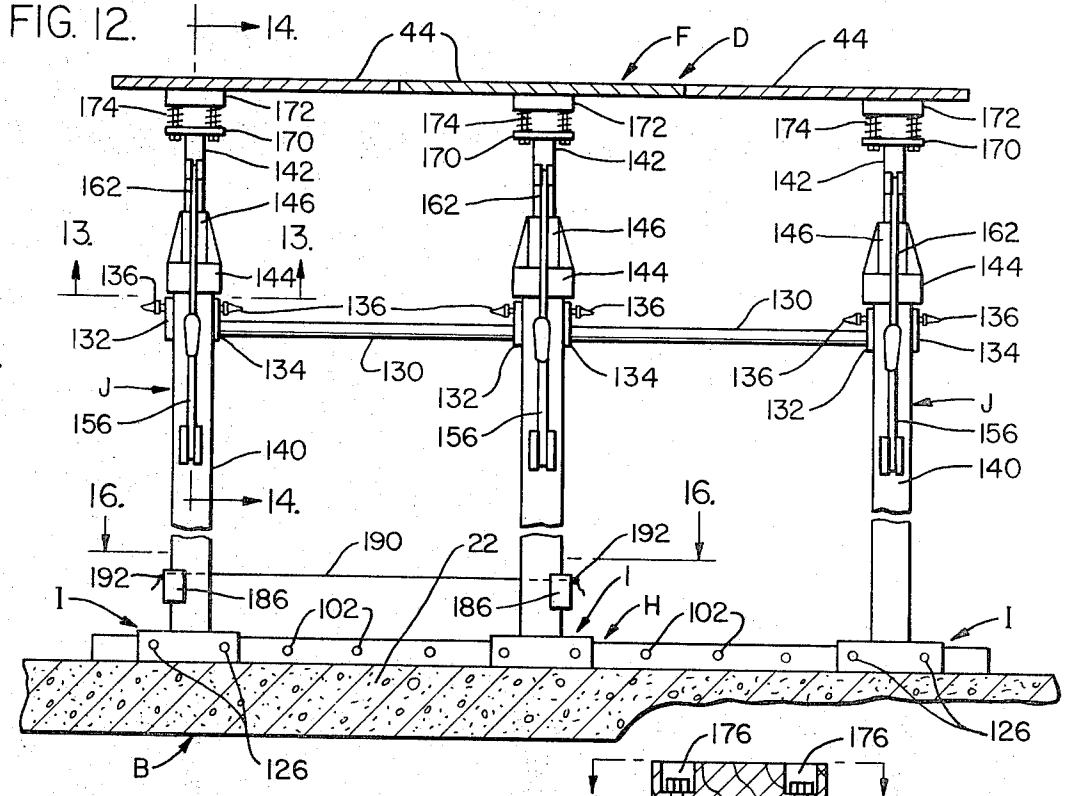
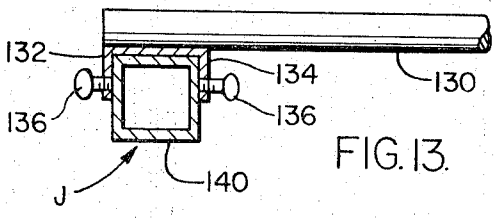


FIG. 27.

FIG. 12.





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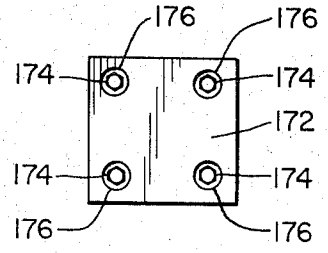

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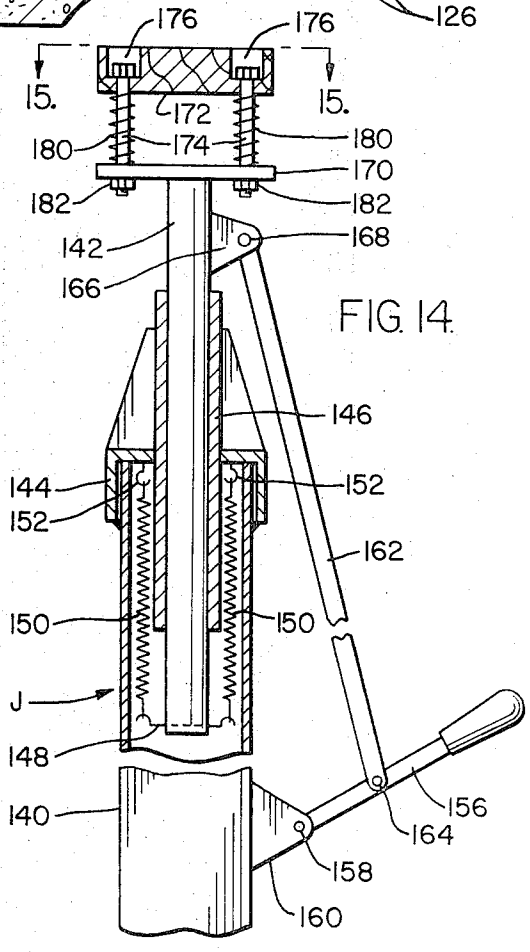
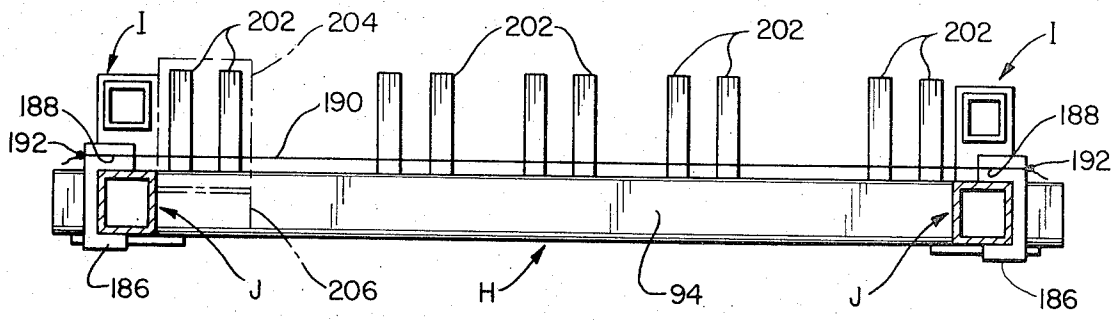


FIG. 14.

FIG. 16.



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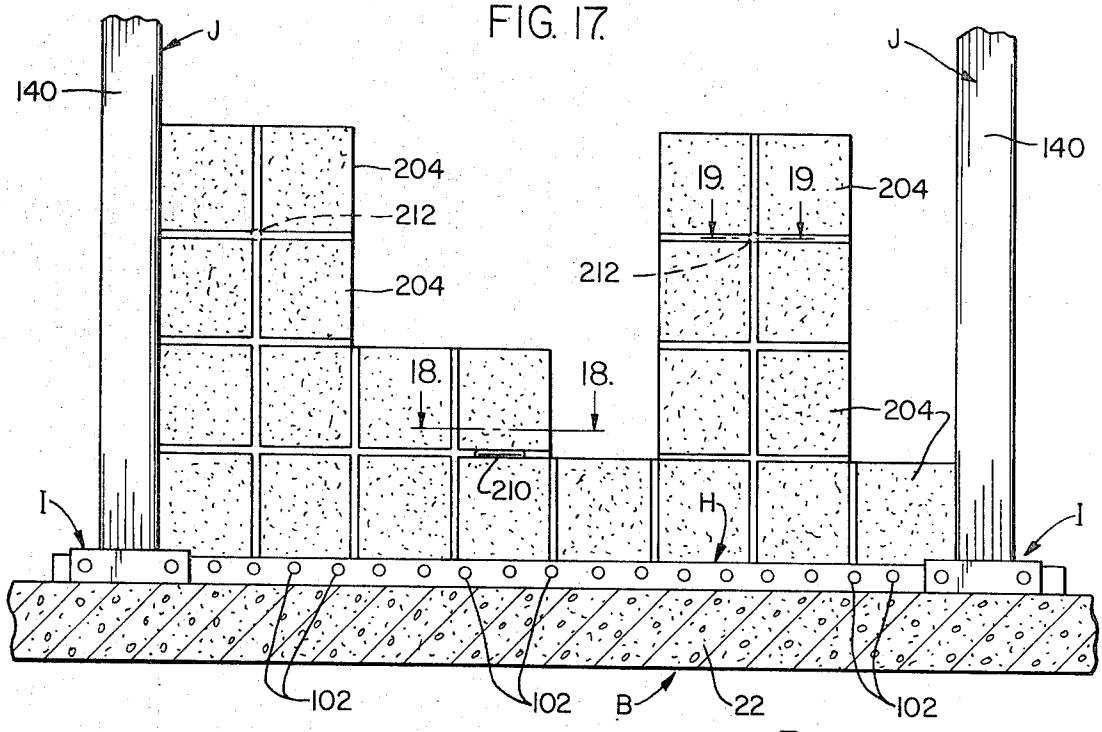

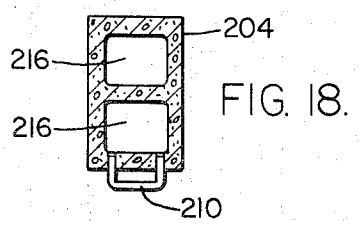

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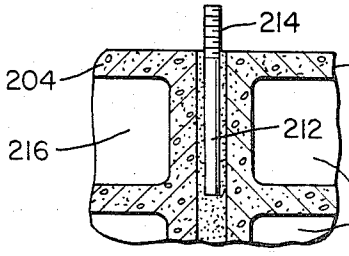

FIG. 19.

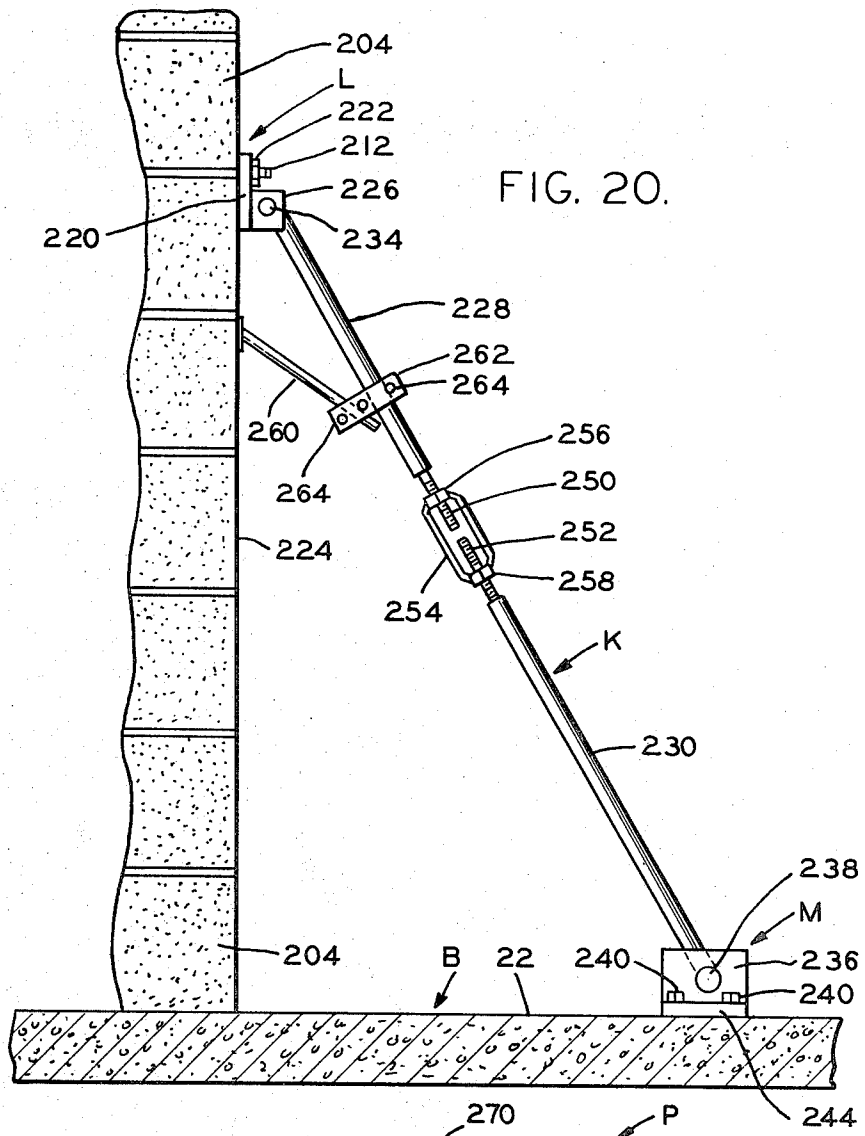
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FIG. 20.

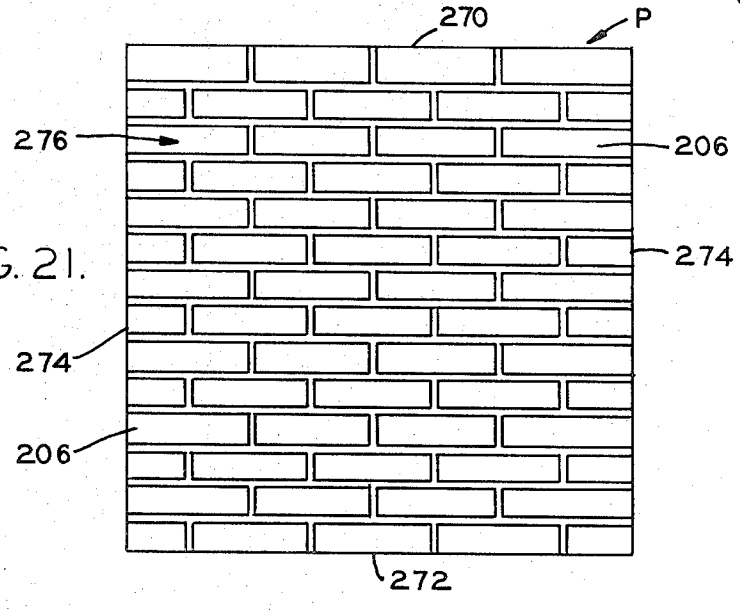
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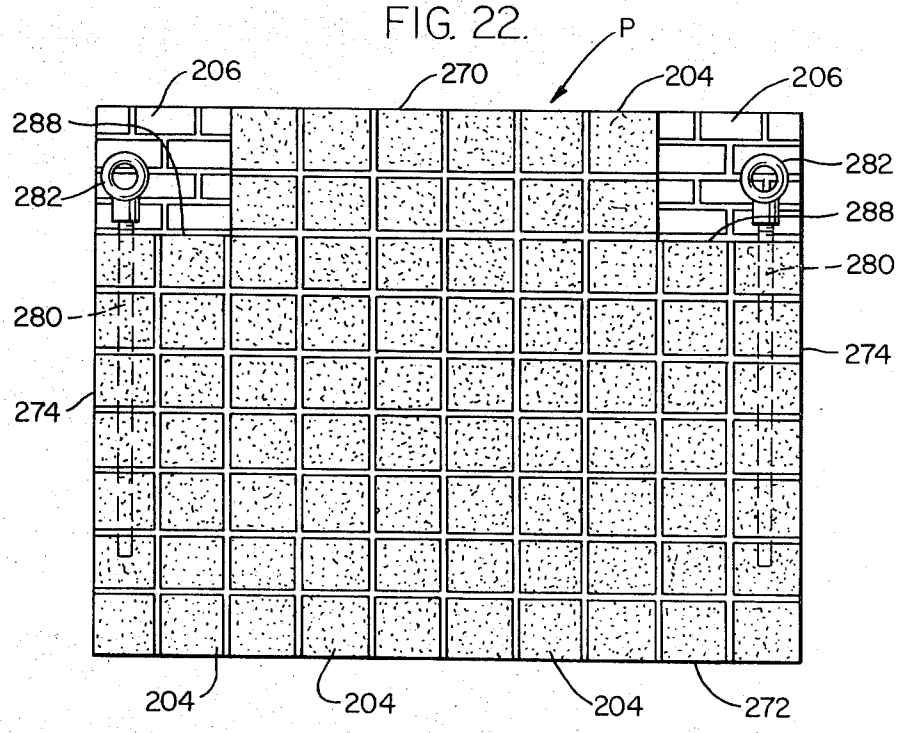
FIG. 21.

FIG. 22.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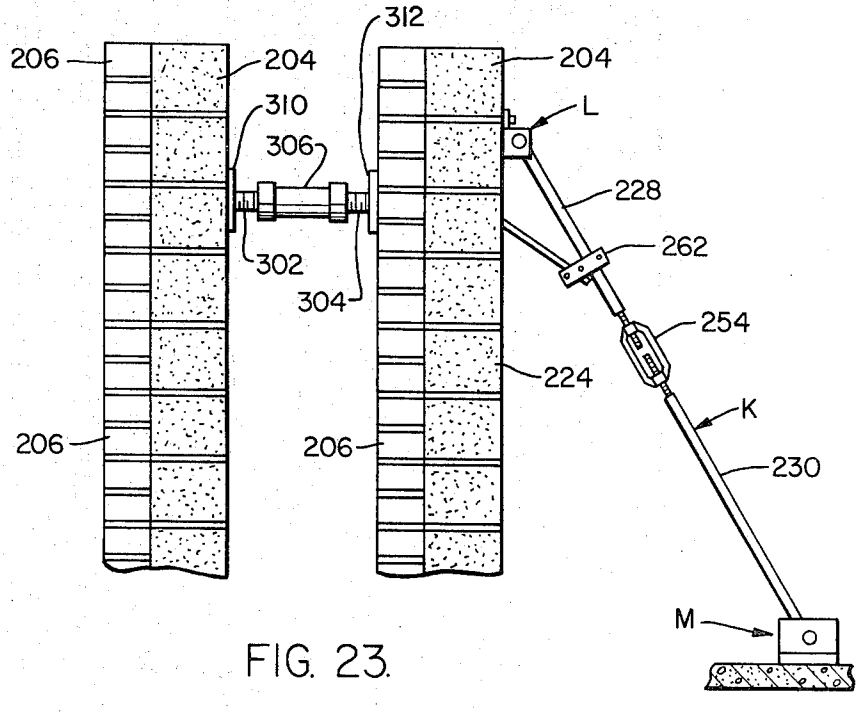
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FIG. 23.

APPARATUS AND METHOD FOR BUILDING CONSTRUCTION

BACKGROUND OF THE INVENTION

This application pertains to the art of building construction and more particularly to prefabricated building construction. The invention is particularly applicable to prefabricated construction of brick walls and will be particularly described with reference thereto. However, it will be appreciated that the invention has broader applications and may be used with other types of modular building components.

Buildings are commonly constructed by laying bricks to form vertical walls on a foundation. The bricklayers cannot work during inclement weather and this considerably delays completion of a building. The cost of buildings is also increased due to such delays.

Many buildings are also constructed from preformed modular building components which are constructed at a factory. Such modular components must be shipped to the site of the building. Transportation costs are extremely expensive. Delays in shipping or arrival of such components at the building site also delay completion of the building and increase costs because the workmen are idle while waiting for additional components. Breakage of such preformed building components also occurs during shipment.

It would be desirable to have building construction arrangement whereby preformed modular building components could be assembled even during inclement weather, and without requiring shipment of such components to a building site.

SUMMARY OF THE INVENTION

An arrangement for constructing buildings includes a large concrete slab providing a base area. The base area may be a part of the building foundation itself or may be constructed nearby. The slab providing the base area is preferably at a distance from the building site which is not greater than the swing span of a hoisting crane used to move the modular wall units into position. A temporary shelter including a roof is removably positioned on the base area. The temporary shelter may have canvas or other types of sidewalls to provide an enclosure. Workmen construct a plurality of rows of modular brick wall units on the base area within the shelter. The walls are assembled using high early setting mortar so that the wall units can be moved after a period of three days. Once the space under the temporary shelter is filled, the temporary shelter is moved away from the base area to expose the modular wall units.

A crane then lifts the wall units vertically from the base area and transfers them laterally over to proper position on the building foundation. The wall units are then lowered into proper position on the building foundation.

In a preferred arrangement, the base area includes first and second base area portions each having an area at least as great as the area enclosed by the temporary shelter. When the area below the shelter is completely filled with modular wall units constructed on the first base area portion, the shelter is moved to the second base area portion. The shelter is again filled with modular wall units constructed on the second base area portion. By the time the second base area portion is filled, the mortar in the wall units on the first base area portion will have set sufficiently so that they can be moved into position on the building. The temporary shelter is simply shifted back and forth between the first and second base area portions.

The slab on which the base area is formed includes attaching means for removably attaching the temporary shelter thereto so that high winds will not move the temporary shelter. The temporary shelter may be mounted on rollers for horizontal shifting movement between the first and second base area portions, or it may be lifted vertically by a crane and moved laterally between the first and second base area portions.

Elongated horizontal guide means are positioned on the base area and the modular wall units are constructed on these horizontal guide means. Spaced-apart vertical guide means extend between the horizontal guide means and the roof of the temporary shelter. The modular wall units are constructed on the horizontal guide means between the spaced-apart vertical guide means. The vertical guide means are removably positioned between the roof of the temporary shelter and the horizontal guide means so that they may be shifted for constructing successive rows of modular wall units.

In accordance with one arrangement, the vertical guide means include telescoping inner and outer posts. The inner post is biased outwardly from the outer post by springs. The upper end of the inner post engages the underside of the roof of the temporary shelter with yielding force. Operating means is provided for telescoping the inner tube within the outer tube against the force of the springs. In one arrangement, this operating means includes a lever pivotally connected to the outer post for pivotal movement in a vertical plane. A link is pivotally connected with the lever and the inner post. Pulling downward on the lever causes a downward pulling force on the inner post through the link to telescope the inner post within the outer post against the spring force.

In a preferred arrangement, the upper end of the inner post has a flat plate member mounted thereon. The flat plate member is yieldably mounted on the upper end of the inner post and can also tilt so that it will be in firm engagement with the roof of the temporary shelter even though the roof is slightly pitched.

Guide shoes are positionable on the horizontal guide means for properly spacing the vertical guide means. The vertical guide means and shoes include cooperable sockets and projections for releasably securing the vertical guide means to the horizontal guide means.

The modular wall units are of brick or block and mortar construction. Each modular wall unit includes front and rear surfaces, and top and bottom edges. Each modular wall unit also has a midpoint between its top and bottom edges. Brace means is secured to the rear surface of each modular wall unit in the first row above the midpoint thereof. The brace means is secured to the base area so that the wall units cannot topple or be blown over. The brace means includes length adjustment means for adjusting the length of the brace means. Standoff means is also positioned between the brace means and the rear surface of the modular wall unit for preventing the outer end of the brace means from falling below a horizontal plane extending through the bottom edge of the wall unit. The brace means may be grasped by workmen when the wall units are being lowered into position on a building foundation. The standoff means prevents the brace means from contacting the foundation before the modular

wall unit when the wall unit is lowered into position on a building foundation.

It is a principal object of the present invention to provide an improved arrangement for constructing buildings.

It is also an object of the present invention to provide an improved method for constructing buildings.

It is another object of the present invention to provide a building construction arrangement and method which is very economical and efficient.

It is an additional object of the present invention to provide a building construction arrangement and method which enables workmen to construct building components even during inclement weather.

It is a further object of the present invention to provide an arrangement and method for prefabricating modular wall units while minimizing the danger of breakage during movement of the wall units to a building foundation.

BRIEF DESCRIPTION OF THE DRAWING

The invention may take form in certain parts and arrangement of parts, a preferred embodiment of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof.

FIG. 1 is a plan view showing a construction site where the arrangement and method of the present invention are carried out;

FIG. 2 is a perspective illustration showing a temporary shelter used in carrying out the principles of the present invention;

FIG. 3 is a elevational view showing the temporary shelter of FIG. 2;

FIG. 4 is a view similar to FIG. 3 and showing sidewalls on the temporary shelter;

FIG. 5 is a top plan view of the temporary shelter of FIGS. 2-4;

FIG. 6 is a plan view of a base area showing a horizontal guide member positioned thereon;

FIG. 7 is a cross-sectional elevational view looking generally in the direction of arrows 7—7 of FIG. 6;

FIG. 8 is a partial elevational view looking generally in the direction of arrows 8—8 of FIG. 6;

FIG. 9 is a side elevational view showing a shoe member used in the arrangement of the present invention;

FIG. 10 is a plan view looking generally in the direction of arrows 10—10 of FIG. 9;

FIG. 11 is a plan view showing the shoe of FIGS. 9 and 10 installed on the horizontal guide member of FIGS. 6—8;

FIG. 12 is an elevational view showing support members positioned within the temporary shelter;

FIG. 13 is a plan view looking generally in the direction of arrows 13—13 of FIG. 12;

FIG. 14 is a partial cross-sectional elevational view looking generally in the direction of arrows 14—14 of FIG. 12;

FIG. 15 is a plan view looking generally in the direction of arrows 15—15 of FIG. 14;

FIG. 16 is a cross-sectional plan view looking generally in the direction of arrows 16—16 of FIG. 12;

FIG. 17 is an elevational view showing a modular wall unit being constructed;

FIG. 18 is a cross-sectional plan view looking generally in the direction of arrows 18—18 of FIG. 17;

FIG. 19 is a cross-sectional plan view looking generally in the direction of arrows 19—19 of FIG. 17;

FIG. 20 is a side elevational view showing the completed wall of FIG. 17;

FIG. 21 is a front elevational view showing a completed wall;

FIG. 22 is a rear elevational view of a completed modular wall unit;

FIG. 23 is a side elevational view showing two rows of modular wall units constructed in accordance with the present invention;

FIG. 24 is a plan view showing an alternative arrangement for horizontal guide means used in accordance with the present invention;

FIG. 25 is a perspective illustration of a wall unit constructed on the guide means of FIG. 24;

FIG. 26 is a plan view showing another arrangement of vertical guide means; and

FIG. 27 is a perspective illustration showing a modular wall unit constructed on the guide means of FIG. 26.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to the drawings, wherein the showings are for purposes of illustrating a preferred embodiment of the invention only and not for purposes of limiting same, FIG. 1 shows a horizontal concrete slab A defining a foundation for a building. Slab A is shown rectangular in plan view and it will be recognized that the foundation may take many different shapes. Foundation A is adapted to having a plurality of modular vertical wall units assembled around the periphery thereof to define a rectangular enclosure. Another horizontal concrete slab B is laid adjacent to building foundation A.

Modular wall units constructed on slab B are moved therefrom over to building foundation A by a conventional hoisting crane C. Crane C includes a cab portion 12 and a boom 14. Cab 12 is pivotal on its supporting base to move boom 14 in the direction of arrows 16 and 18. Boom 14 is moved in the direction of arrow 16 so that it extends over the top of slab B. A modular wall unit on slab B may then be vertically raised and transferred horizontally over to building foundation A. The modular wall unit is then lowered into the desirable position on foundation A.

In the preferred arrangement, slab B is located relative to foundation A so that all modular wall units constructed on slab B can be placed on foundation A in a single swing of boom 14 on crane C. That is, crane C does not have to move on its tracks for transferring all wall units on slab B to their desired position on foundation A. Generally, this distance will be not greater than 150 feet because that is approximately the maximum swing span of a conventional crane used in building construction. In other words, the greatest distance between a position on slab B at which a wall unit is constructed, and a position on foundation A where the furthest wall unit will be installed, is not greater than the swing span of crane C, or around 150 feet.

Slab B has a plurality of socket members 20 embedded therein for removably attaching a temporary shelter to slab B. Slab B has a substantially horizontal plane upper surface defining a base area.

FIG. 2 shows a form of temporary shelter used for carrying out the principles of the present invention. Shelter D includes spaced-apart vertical supporting

legs 24 located at the corners of a rectangle or square. Beams E connect the upper ends of legs 24.

Each beam E includes upper and lower flanges 26 and 28, and web struts 30 interconnecting upper and lower flanges 26 and 28. Rectangular socket members 34 which open downwardly are welded or otherwise suitably secured to the opposite ends of beams E. Thus, socket members 34 serve to interconnect all beams E.

The upper ends of vertical legs 24 are received in sockets 34 which may have closed upper ends. Suitable holes are provided through socket members 34 and the upper end portions of legs 24 for receiving bolts as at 36 to releasably secure beams E and sockets 34 to the upper end portions of legs 24. Diagonal braces as at 38 may be welded or otherwise secured to legs 24 and bottom flanges 28 of beams E. Outer diagonal braces 40 may also be provided. Outer diagonal braces 40 have their upper ends bolted as at 42 to socket members 34. The lower ends of diagonal braces may have brackets attached thereto for removable bolting to expansion anchors positioned in holes in slab B.

A plurality of rectangular plywood panels 44 are positioned on top flanges 26 of beams E. Panels 44 preferably extend outward slightly beyond top flanges 26 of beams E. Panels 44 have a plurality of pairs of spaced-apart holes therethrough adjacent top flanges 26 for receiving U-shaped clamping members 50. The legs of inverted U-shaped clamping members 50 extend through panels 44 on opposite sides of top flanges 26 of beams E. Rectangular plate members 52 having spaced-apart holes therethrough are positioned on the leg of clamping members 50 beneath top flanges 26. Bolts 56 are then threaded onto the leg ends of clamping members 50.

At least four of clamping members 50 adjacent the corners of temporary shelter D may have hooking rings as at 58 positioned thereon prior to insertion of the legs of those clamping members through the holes in panels 44. With panels 44 assembled as described, a roof F is provided on temporary shelter D spaced vertically above base portion 22 of slab B.

Rectangular upwardly opening socket members 20 embedded in slab B receive the bottom end portions of rectangular legs 24. Sockets 20 and the bottom portions of legs 24 have suitable holes therethrough for receiving bolts as at 60 to releasably and removably attach temporary shelter D to slab B. Suitable holes may be formed in the upper surface of slab B for receiving expansion anchors to releasably and removably secure the bottom end portions of outer diagonal braces 40 thereto.

A tent-like canvas cover member G is positioned over temporary shelter D as shown in FIG. 4. Cover member G includes an upper portion 64 completely covering roof F, and sidewall portions 66. Sidewall portions 66 may be trapezoidal in shape and have zippers or other fastening devices along their opposite edges for securing each of the four sides 66 together at their edges. Each side 66 of cover member G may also have transparent plastic panels sewn together to provide illumination within temporary shelter D. Thebottom end portions of sides 66 are looped over and sewn to provide passageways 68 for receiving elongated pipe member 70. Flexible ties 72 may be sewn or otherwise secured to the outer surface of passages 68. Eyelet members 74 may be threaded into expansion anchors positioned in suitable holes bored in slab B. Ties 72 may be secured to eyelets 74 to releasably anchor sidewalls 66 in position. During nice weather, sidewalls 66 may be rolled up and simply positioned on top of roof F. During inclement weather, sides 66 may be rolled down and secured as described.

Hooking loops 58 may be exposed by sliding cover member G slightly. Hooks on the end portions of chains or cables 78 are then receivable through hooking loops 58. All of cables 78 may be connected at a central point as at 80. Cable 82 of crane C may then be hooked to cable 78 at point 80. Crane C is then moved until the end portion of boom 14 is substantially vertically above point 80. Crane cable 82 is then reeled in for raising temporary shelter D from slab B when the releasable bolting and securing arrangements have been disconnected. Crane C may then be swung to transfer temporary shelter to another area where it is lowered into position and secured in the manner described.

It will be recognized that the temporary shelter described may take many forms. The roof of the temporary shelter may also be slightly pitched and be supported by many different beam arrangements. In actual practice, roof F of temporary shelter D will be much larger than shown for purposes of illustration. For example, roof F may be a square having 32 foot edges. Many different sizes and arrangements of temporary shelter D are possible. The size and type of temporary shelter simply depends upon the size and particular requirements of the job. It will also be recognized that temporary shelter D may be removably secured to slab B in many different ways. For example, temporary shelter D may be mounted on wheels for rolling movement relative to slab B instead of requiring lifting thereof. Such a wheeled shelter could simply have suitable angle brackets with holes therethrough for receiving bolts which would thread into expanding anchors positioned in suitable holes in slab B. For small jobs where the weather is good, such a wheeled temporary shelter could simply be blocked without bolting or other securement to slab B if there were no danger of high winds.

In a preferred arrangement, as shown in FIG. 1, slab B includes first and second base area portions 84 and 86. First and second base area portions 84 and 86 lie on opposite sides of transverse line 88 bisecting base area 22 of slab B. Each base area portion 84 and 86 has an area at least as great as the area enclosed by temporary shelter D. Temporary shelter D may be removably positioned on first base area portion 84. Construction of prefabricated modular wall units may then be carried out within temporary shelter D on first base area portion 84. Once shelter D is filled, it may be lifted and moved over to second base area portion 86 where construction of modular wall units again proceeds. This leaves the wall units on base area portion 84 exposed for vertical lifting and transfer over onto building foundation A. Shelter D is simply transferred back and forth between first and second base area portions 84 and 86. It will be recognized that other arrangements are also possible. For example, base area 22 could simply be slightly over one and one-half times the length of temporary shelter D. Temporary shelter D could then simply be shifted or moved from one end to the other of base area 22 for exposing completed modular wall units for lifting over onto foundation A.

Instead of a separate slab B adjacent foundation A, it will be recognized that base area 22 could be defined

by the surface of building foundation A itself where room permits. For a very large building, foundation A itself may be sufficiently large to position temporary shelter D thereon for carrying out the principles of the present invention. In addition, slab B could simply be defined by a parking lot or driveway slab located adjacent foundation A.

With temporary shelter D removably positioned on first base area portion **84**, an elongated substantially U-shaped channel member H is positioned thereon. Channel member H may comprise several lengths butted together to extend substantially completely across first base area portion **84** within temporary shelter D. Channel H includes a web portion **94**, and spaced-apart legs **96** and **98** depending therefrom. Channel H is positioned on first base area portion **84** with web **94** facing upward, while legs **96** and **98** rest upon first base area portion **84**. At least one of legs **98** of channel member H has a plurality of spaced-apart holes **102** therein.

FIGS. **9** and **10** show a shoe used with channel H for aligning and positioning the vertical guide members. Shoe I comprises a substantially U-shaped channel member having spaced-apart legs **104** depending from a top web **106**. Legs **104** are cut away as at **108** so that web **106** extends from cutaway edge **108** to its terminal end **110** a distance which is substantially the same as the distance between the outer surfaces of legs **96** and **98** on channel H. A rectangular plate member **112** is welded to terminal end **110** and projects downwardly the same distance as leg **104**. Web **106** has opposite edge portions **114** and **116**. Holes **118** are formed through plate member **112**. Rectangular projections **120** and **122** are welded to the upper surface of web **106**.

A plurality of shoes I are positionable on channel member H in spaced-apart relationship as shown in FIG. **11**. Pins **126** are positioned through holes **118** in plate member **112** and holes **102** in channel member H for locking shoes I in a predetermined spaced-apart relationship on channel member H.

A plurality of elongated vertical guide means defined by vertical post members J having hollow rectangular cross-sectional configurations are positionable on shoes I. Post members J have open bottom ends which receive projections **120** or **122** on shoes I. With post members J positioned over projections **120**, the outer surfaces of post members J are flush with opposite edges **114** and **116** on shoe I. The outer surfaces of post members J are also flush with the outer surfaces of legs **96** and **98** on channel member H. Shoes I and post members J are spaced-apart any desirable distance depending upon the width of a wall unit which is to be constructed. Furthermore, post members J may be positioned at variable spacings along a horizontal channel member H when it is desired to construct a plurality of different width wall units in a single row.

Post members J are connected at their upper end portions by spacer beams **130**. Spacer beams **130** have plate members as at **132** and **134** welded thereto and extending therefrom in parallel spaced-apart relationship. The inner surfaces of plate members **132** and **134** are spaced-apart a distance slightly greater than the width of post members J. Plate members **132** and **134** have threaded holes therethrough for threadably receiving wing bolts **136** which can be tightened to bear against the opposite outer surfaces of post members J for holding spacer beams **130** thereto. The upper end portions of post members J are then spaced-apart the same distance as their lower end portions.

In accordance with a preferred arrangement, each post member J includes an outer post member **140** and an inner post member **142** telescopically received therein. The upper open end portion of outer post member **140** has a cap member **144** welded thereto. Cap member **144** includes an elongated cylindrical tube member **146**. Inner post **142** is cylindrical and is reciprocatingly received through tube **146**. The bottom end portion of inner post member **142** has a transverse slot therein receiving a bracket member **148**. Coil springs **150** are hooked onto the opposite end portions of bracket **148** and to hook members **152** on cap member **144**. Springs **150** normally bias inner post **142** upwardly relative to cylindrical member **146**. The combined length of inner and outer posts **140** and **142** is such that springs **150** normally bias inner post **142** upwardly into engagement with the underside of roof F on temporary shelter D.

In a preferred arrangement, manual operating means is provided for relieving the force of springs **150** and telescoping inner post **142** within outer post **140** so that post members J can be moved and properly positioned. In one arrangement, this operating means includes a lever member **156** pivotally connected as at **158** to a bracket member **160** welded to an outer surface of outer post **140**. Lever member **156** is preferably located close enough to the bottom portion of post members J so that it can be reached by a person standing on base area **22** of slab B. An elongated link **162** is pivotally connected to lever **156** as at **164** and to a bracket **166** welded to the outer surface of inner post **142** as at **168**. Lever member **156** is pivotal in a substantially vertical plane. Downward pivotal movement of lever **156** applies force through link **162** to inner post **142** for telescoping inner post **142** within outer post **140** against the biasing force of springs **150**. Releasing lever **156** will allow inner post **142** to move outwardly relative to outer post **140** due to the biasing force of springs **150**.

In a preferred arrangement, the upper end portion of inner post **142** has a substantially rectangular plate member **170** welded thereto. Plate member **170** has four Spaced-apart holes therein located at the corners of a rectangle or square. A rectangular wooden plate member **172** also has holes therethrough aligned with the holes in plate **170** for receiving bolts **174**. The holes in plate member **172** are recessed as at **176** so that the heads of bolts **174** are recessed beneath the outer upper surface of plate member **172**. Coil springs **180** are positioned around bolts **174** between plates **170** and **172** for normally biasing plate **172** away from plate **170**. Nuts **182** are threaded onto the ends of bolts **174** on the bottom side of plate member **170**. The holes in plate member **170** through which bolts **174** extend are somewhat larger in diameter than the diameter of bolts **174** so that plate member **172** may tilt in all directions for moving its upper surface out of a substantially horizontal plane into a plurality of inclined planes slightly inclined to the horizontal. This insures good bearing engagement with the under surface of roof F even if roof F is pitched. This provides a releasable friction engagement between plate member **172** and the under surface of roof F on temporary shelter D. Post members J are plumbed so as to extend vertically.

With channel H and post J so positioned, a bricklayer may position chalk line slides **186** on the outer surfaces of adjacent spaced-apart posts J. Slide members **186** have notches **188** therein for receiving a string **190** which is then knotted or otherwise secured as at **192** after being stretched in tension between slide blocks **186.** The tension in string **190** frictionally holds slide blocks **186** in their desired elevational position relative to post J. The exterior surfaces of post J may have spaced-apart indicia thereon for properly positioned slide blocks **186.** A bricklayer then simply moves slide blocks **186** to the proper position on post members J so that guide string **190** extends horizontally and in the proper location for guiding the bricklayer in making each layer of brick substantially horizontal and at the proper height.

With the parts assembled as described, a mason may begin construction of a modular wall unit. A composite wall unit including concrete blocks and facing bricks will be described. The mason positions supports **202** rearwardly of channel H. Supports **202** have a thickness which is the same as the distance from the bottom edges of legs **96** and **98** on channel H to the upper surface of web **94** thereof. Supports **202** may simply be wooden blocks or may be short lengths of channel section H. With supports **202** butted up against channel H, the length of supports **202** is such that the concrete blocks will be aligned with their outer edges. The mason then begins laying concrete blocks on supports **202** with the forward end of the blocks resting on channel H. A first concrete block is indicated by numeral **204** in FIG. **16.** The space remaining on channel H is adapted to receive facing bricks designated at **206.** The mason continues to lay concrete blocks **204** between the inner facing surfaces of post members J until a rectangular vertical wall is constructed. Vertical post members J determine the desired width of the wall unit. U-shaped ties as at **210** are inserted at various positions in the joints of the concrete block wall for receiving additional ties which are positioned between various joints of facing bricks **206** for tying facing bricks **206** to the concrete block wall in a known manner. Above the midpoint of te wall, the mason inserts brace attaching means in the form of bolts **212.** Bolts **212** have threaded end portions **214** extending outwardly from the rear surface of the wall. Slide members **186** are simply moved vertically upward after laying each row of concrete blocks **204** so that string **190** will guide the mason. Once the wall of concrete blocks is completed, facing bricks **206** are laid on channel H beteween posts J in layer-by-layer fashion to form a facing brick wall. Concrete blocks **204** are hollow as indicated at **216** in FIG. **18.** Hollow spaces **216** are vertically aligned throughout the length of the wall.

As soon as the concrete block wall is completed above brace attaching bolts **212,** a diagonal brace member K is attached thereto as shown in FIG. **20.** A bracket member L including a plate portion **220** having a hole therethrough is positioned on threaded end **214** of bolt **212.** A nut **222** is then threaded onto threaded end portion **214** for securing bracket L to rear surface **224** of the wall. Bracket **220** has spaced-apart outwardly projecting plates **226** with holes therethrough. Brace member K includes rod portions **228** and **230.** The upper end portion of rod **228** is flattened and has a hole therethrough alignable with the horizontal holes in plates **226.** A bolt **234** is positioned through the holes in plates **226** and the upper end of rod **228,** and a nut is attached to the bolt for pivotally securing rod **228** to bracket L for pivotal movement in a substantially vertical plane.

A substantially U-shaped bracket member M includes spaced-apart upstanding plates **236** having aligned holes therein. The lower end portion of rod **230** is flattened and has a hole therethrough alignable with the holes in plates **236.** A bolt **238** is receivable through the aligned holes for securing the lower end portion of rod **230** to bracket M. Suitable holes are drilled in slab B for receiving expanding anchors into which bolts **240** are threaded. Bolts **240** extend through suitable holes in base plate portion **244** of bracket M. Bolt **238** has a nut thereon. Either bolt **238** or bolts **240** are removable so that brace K is removably secured to slab B.

Brace K includes length adjustment means N for adjusting the length thereof. The lower end portion of rod **228** has right hand threads **250** formed thereon, while the upper end portion of rod **230** has left hand threads **252** formed thereon. A carrier member **254** defines a turnbuckle having threaded nuts **256** and **258** at opposite end portions thereof. Nut **256** has right hand threads while nut **258** has left hand threads. Nuts **256** and **258** are threaded onto end portions **250** and **252** of rods **228** and **230.** Carrier member **254** is simply rotated for threading nuts **256** and **258** onto threaded portions **250** and **252** to move rods **228** and **230** toward or away from one another to adjust the overall length of brace K.

A standoff means in the form of a short rod **260** is also secured to brace K. A pair of spaced-apart plates **262** having holes therethrough are positioned on opposite sides of rod **228.** Bolts **264** are positioned through the holes in plates **262.** Nuts are applied to the bolts for securely clamping plates **262** together in spaced-apart relationship onto rod **228.** The inner end portion of standoff rod **260** may have a hole therethrough alignable with one of bolts **264.** This pivotally secures standoff rod **260** to brace K for limited pivotal movement in a substantially vertical plane. Inner end portion **268** of standoff rod **260** bears against rear surface **224** of the wall. When the wall is vertically raised, standoff rod **260** maintains brace K in its diagonal relationship so that the lower end portion of brace K does not fall below a horizontal plane extending through the bottom edge of the wall. When the wall is lowered into position, there is no danger of bending brace K and a workman does not have to hold it out from the wall while the wall is lowered onto the building foundation. Brace means K can be grabbed by workmen for manipulating the wall into the proper position as it is suspended from the cable of a hoisting crane.

FIG. **21** shows a front elevational view of a completed modular wall unit P. The wall includes top and bottom edges **270** and **272,** and opposite side vertical edges **274.** Finish bricks **206** define a front surface **276** on wall P.

Elongated reinforcing rods **280** having loops **282** on their upper end portions are inserted into openings **216** in the endmost vertical rows of concrete blocks **204.** The spaces **216** in these rows of blocks are then completely filled with grout or concrete for securing rods **280** to wall P. In the arrangement shown, finish bricks **206** extend up higher than the endmost columns of concrete blocks **204.** This provides ledges as at **288** on which beams may be positioned. Loops **282** may be re-

movably threaded onto rods **280.** A chain or cable may be hooked onto loops **282** and the chain is connected with the cable of a hoisting crane C. A modular wall unit P may then be vertically raised from slab B for direct transportation over to the building foundation.

In constructing modular wall units, a first row of modular wall units is constructed on channel H of FIG. **6.** After completion of that row, an additional channel H is laid extending substantially parallel to the first channel and spaced-apart therefrom around two feet. Vertical guide members J are then removed from the first row and positioned on the second channel. The vertical posts J are properly positioned and aligned as previously described. A second row of modular wall units is then constructed. This procedure continues until entire temporary shelter D is substantially filled with modular wall units. Brace means K secures the first row of wall units to slab B and prevents toppling thereof. Horizontal braces R as shown in FIG. **23** may be positioned between each succeeding row of wall units. Horizontal braces R may simply comprise opposite rod portions **302** and **304** having a turnbuckle **306** threaded thereon as described with respect to diagonal brace means K. Rods **302** and **304** may have plates **310** znd **312** thereon for bearing against the front surface of one wall and the rear surface of an adjacent wall.

It will be recognized that many different types of wall units may be constructed. Wall units which include only finished bricks may be constructed, and do not have to be a combination of blocks and bricks. Where walls are constructed in more than one layer, shoes I provide two projections **120** and **122** so that two channels H may be laid closely adjacent one another in parallel relationship. The first vertical layer of blocks or brick may then be assembled on one of channels H between posts J. Posts J may then be moved to the next projection on a shoe I for laying the next course of bricks.

It will be recognized that many different shapes of modular wall units may be formed in accordance with the present invention. For example, FIG. **24** shows channels H assembled in a substantially T-shaped configuration. Vertical posts J are positioned thereon in the manner previously described. Laying blocks on channels H of FIG. **24** will then form a substantially T-shaped wall unit S as shown in FIG. **25.** Such a wall unit may also have rods attached thereto by inserting such rods into hollow spaces in the blocks and filling the spaces with concrete or grout. Columns J provide vertical guide means for all of the vertical edges of T-shaped modular wall unit S. FIG. **26** shows channels H positioned in a right-angular corner arrangement. Vertical columns J are also positioned thereon in the manner previously described. Laying blocks on channels H of FIG. **26** between vertical guides J results in a vertical modular wall unit as shown at T in FIG. **27.** Many other shapes of modular wall units, including substantially U-shaped units may be constructed.

When shelter D is filled with modular wall units, temporary shelter D is moved from first base area portion **84** over onto second base area **86** in the manner previously described. The modular wall units constructed on first base area portion **84** may then be lifted vertically upward by crane C and transferred laterally for lowering onto building foundation A. Naturally, the mortar in the wall units is allowed to set for at least three days before the wall units are moved. Meanwhile, construction of additional modular wall units may take place on second base area portion **86** within temporary shelter D.

It should be recognized that many modifications of the described procedure are possible. For example, it is possible to simply leave supporting legs **24** of temporary shelter D in position while transferring roof F thereof from such legs on each of first and second base area portions **84** and **86.** In any event, it is desirable to completely remove roof F in order that the modular wall units can be lifted vertically from the construction area.

Each modular wall unit in each row constructed within temporary shelter D has brace attaching means **212** therein. Even though the braces are not attached to each succeeding row of wall units, such braces are usually attached before each wall unit is moved by crane C so that workmen can grasp diagonal braces K and manipulate each wall unit into proper position on building foundation A. It will be recognized that many other variations are possible. For example, spacer beams **130** of FIG. **12** may have a plurality of spaced-apart holes therein. Plates **132** and **134** may then be secured to a socket member slidably receiving spacer beams **130.** Holes in the socket member would be alignable with the holes in spacer beams **130** so that plates **132** and **134** could be adjusted along spacer beams **130** for locating vertical posts J at any desirable spacing. It will also be recognized that the arrangement and procedure of the present invention may be used for constructing multi-story buildings. A large number of modular wall units may be constructed in the manner described and raised into position for each story of the building by crane C. Roof F of temporary shelter D is normally spaced a substantial distance above slab B. A movable scaffold is then positionable within temporary shelter D so that the workmen can construct walls having a substantial height, such as around **12** feet. However, it will be recognized that modular wall units of any height may be constructed within temporary shelter D.

It will be noted that the modular wall units are not tilted or otherwise moved until after the mortar has set. This takes around three days for high strength early setting mortar. It will also be noted that the modular wall units are not subjected to any bending stress which might break any joints. The units are lifted vertically from the base area and the joints are simply in shear due to the weight of the blocks and bricks. Channels H prevent adhesion of any wall units to slab B due to dropped mortar and mortar which might contact the slab from the vertical joints in the first layer of blocks or bricks. However, it will be recognized that other horizontal guide means, such as painted lines or plastic strips could be used for certain applications.

Although the invention has been shown and described with respect to a preferred embodiment, it is obvious that equivalent alterations and modifications will occur to others skilled in the art upon the reading and understanding of this specification. The present invention includes all such equivalent alterations and modifications and is limited only by the scope of the claims.

Having thus described my invention, I claim:

1. A building construction method comprising the steps of; laying a slab to provide a base area, removably securing a temporary shelter including an imperforate

roof to said base area with said roof spaced vertically above said base area, constructing a plurality of modular wall units within said shelter beneath said roof on said base area, moving said shelter from said base area, lifting said wall units substantially vertically upward from said base area, moving said wall units laterally away from said base area, and lowering said wall units into position on a building structure adjacent said base area.

2. The method of claim **1** wherein said step of laying a slab is carried out by laying the slab at a distance from said building structure not greater than the swing span of a crane used for carrying out said steps of lifting, laterally moving and lowering said wall units, whereby all wall units constructed on said base area may be lifted therefrom and moved to said building structure in a single lift and swing by a crane.

3. The method of claim **2** wherein said step of laying a slab is carried out by laying the slab at a distance not greater than 150 feet from said building structure.

4. The method of claim **1** wherein said step of laying a slab is carried out by laying a foundation for said building structure.

5. The method of claim **1** and further including the step of positioning spaced-apart vertical guide members between said base area and said roof within said shelter, and constructing said wall units by piling modular blocks and mortar between said guide members.

6. The method of claim **1** and further including the step of positioning elongated horizontal guide members on said base area within said shelter, and constructing said wall units on said horizontal guide members.

7. The method of claim **6** and further including the step of positioning spaced-apart vertical guide members between said horizontal guide members and said roof within said shelter, and constructing said wall units on said horizontal guide members between said vertical guide members.

8. The method of claim **1** wherein said step of constructing said wall units is carried out by constructing a first row of wall units and subsequently constructing a plurality of additional rows of wall units extending substantially parallel to said first row, and further including the step of securing brace means to said base area and to said first row of wall units prior to construction of said plurality of additional wall units.

9. The method of claim **8** and further including the step of inserting brace attaching means to each of said plurality of additional rows of wall units.

10. The method of claim **8** and further including the step of attaching support means between said first row of wall units and each of said additional rows of wall units.

11. The method of claim **11** wherein said step of laying said slab is carried out by laying said slab to provide a base area substantially greater than the area enclosed by said shelter, and including the steps of constructing a first plurality of wall units in a first area portion of said base area, moving said shelter to a second area portion of said base area, and moving said first plurality of wall units to said building structure while constructing a second plurality of wall units within said shelter on said second area portion of said base area.

12. The method of claim **11** wherein said step of laying said slab is carried out by laying said slab to provide each of said first and second area portions of said base area with an area at least as great as the area enclosed by said shelter.

13. The method of claim **1** and further including the step of attaching securing means to said slab for removably securing said shelter thereto.

14. A method of building construction comprising the steps of; laying a slab to provide a slab area, removably securing a temporary shelter including an imperforate roof on said slab with said roof vertically-spaced above said slab area, placing elongated horizontal guide means on said base area, placing vertical guide means between said horizontal guide means and said roof, constructing a first row of vertical modular wall units on said horizontal guide means between said vertical guide means, placing additional horizontal guide means on said base area, and moving said vertical guide means to a position between said roof and said additional horizontal guide means, and constructing an additional plurality of wall units on said additional horizontal guide means between said vertical guide means.

15. The method of claim **14** and further including the step of moving said shelter from said base area, and lifting said wall units substantially vertically from said base area.

16. The method of claim **1** and further including the step of attaching diagonal brace means to said wall units prior to said step of lifting said wall units.

17. The method of claim **16** and further including the step of positioning standoff means between said wall units and said brace means for maintaining said brace means at an outward inclination to said wall units so that the bottom ends of said brace means do not extend below the plane of the bottom ends of said wall units.

18. A building construction arrangement including a slab defining a base area, a temporary shelter including an imperforate roof removably secured to said base area with said roof spaced vertically above said base area, elongated horizontal guide means on said base area, elongated spaced-apart vertical guide means removably extending between said roof and said horizontal guide means, and spacer bar means attached to said vertical guide means adjacent said roof.

19. The arrangement of claim **18** wherein said vertical guide means has upper and lower ends and includes telescoping post means, and yieldable biasing means acting on said telescoping post means for biasing said upper and lower ends away from one another.

20. The arrangement of claim **19** and further including flat plate means attached to said upper ends of said vertical guide means, yieldable urging means for urging said plate means away from said upper end of said vertical guide means, said plate means being tiltable relative to said vertical guide means.

21. The arrangement of claim **19** wherein said yieldable biasing means includes spring means between said telescoping post means, and operating means for retracting said telescoping post means against biasing force of said spring means.

22. The arrangement of claim **21** wherein said telescoping post means includes an outer post and an inner post, said operating means including lever means pivotally attached to said outer post for pivotal movement in a substantially vertical plane, and link means pivotally connected to said lever means and said inner post.

23. The arrangement of claim **18** and further including aligning shoe means on said horizontal guide means for aligning said vertical guide means thereon.

24. The arrangement of claim **23** and further includ-

ing cooperating projection and socket means on said shoe means and vertical guide means for releasably securing said vertical guide means to said shoe means.

25. The arrangement of claim **18** and further including a plurality of spaced-apart attaching means secured to said base area, said shelter including upright support legs releasably secured to said attaching means.

26. The arrangement of claim **18** wherein said base area includes first and second base areas, each of said first and second base areas having an area at least as great as the area enclosed by said shelter.

27. The arrangement of claim **18** and further including a substantially vertical wall unit on said horizontal guide means between said vertical guide means, and diagonal brace means releasably attached to said base area and said wall unit.

28. The arrangement of claim **27** wherein said brace means includes length adjustment means for adjusting the length of said brace means.

29. The arrangement of claim **28** and further including standoff means extending between said wall unit and said brace means for maintaining said brace means at a predetermined inclination to said wall unit.

30. The arrangement of claim **29** wherein said brace means is pivotally attached to said wall unit for swinging movement in a substantially vertical plane.

31. The arrangement of claim **30** wherein said standoff means is pivotally attached to said wall unit for pivotal movement in a substantially vertical plane.

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