

[54] **METHOD FOR BUILDING CONSTRUCTION**

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[51] Int. Cl. **E04g 17/04**

[58] Field of Search **52/743**, 309, 221; 264/54, 45; 18/DIG. 33, 699, 701

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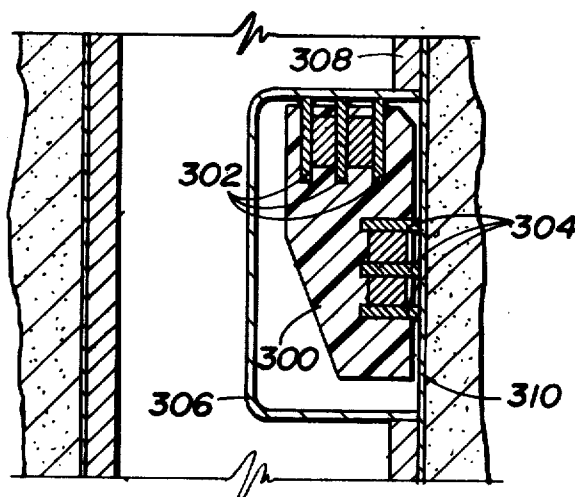
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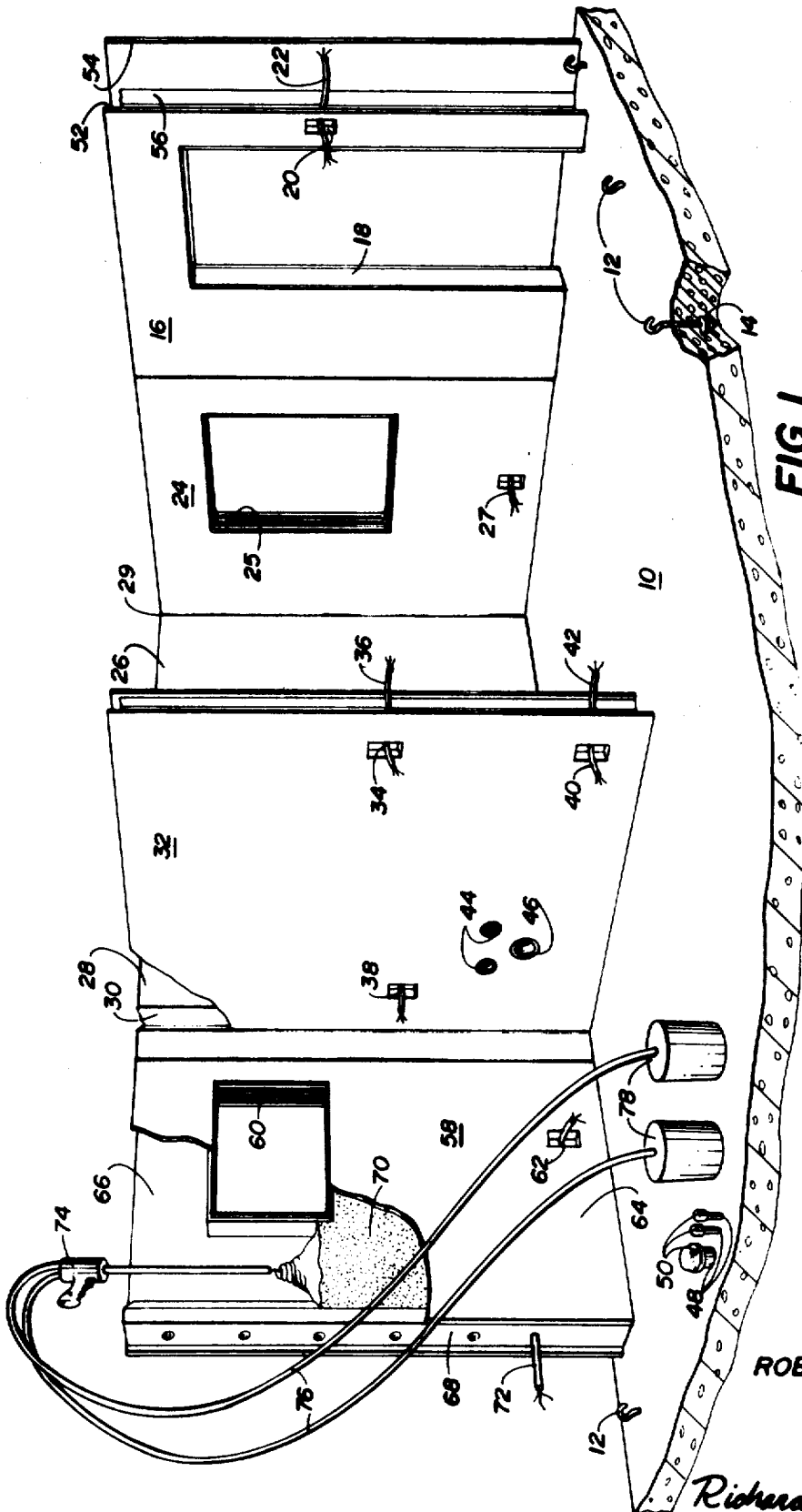
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ABSTRACT

A method for building a habitable structure having all wall sections thereof constructed from two wall panels and a foamed core. The wall panels are erected on a foundation structure at the building site. Various fixtures including window frames, door frames, electrical junction or outlet boxes, water and sewer piping are installed between the wall panels and project into suitable openings in the wall panels. Construction forms are used to backup the wall panels. The construction form has a sheet of magnetizable material contacting the outer surface of the wall panel. The various fixtures are magnetically attached to the wall panels to hold the fixtures in place during the remainder of the construction process. After two wall panels, the various fixtures utilized therewith and two backup forms are erected. The space between the wall panels not occupied by fixtures is filled with a foamed in situ, synthetic, polymeric composition. After the foamed composition has partially solidified, the forms are removed leaving a completed wall section erected on the foundation structure. The foamed composition bonds the two wall panels together in a predetermined spaced relationship, bonds the fixtures in place and also bonds the wall section to the foundation structure. This type of wall panel can be installed either on the interior of a building structure or can be installed at the periphery of the foundation structure by using an exterior wall panel on one side of the wall section and by using an interior wall panel on the inward side of the wall section. A roof panel can be installed over the wall section by foaming the polymeric composition to within, for example, six inches of the top of the wall panels, placing the roof panel over the wall section and foaming a polymeric composition in the remaining six or so inches to bond the roof panel to the wall section.

13 Claims, 15 Drawing Figures





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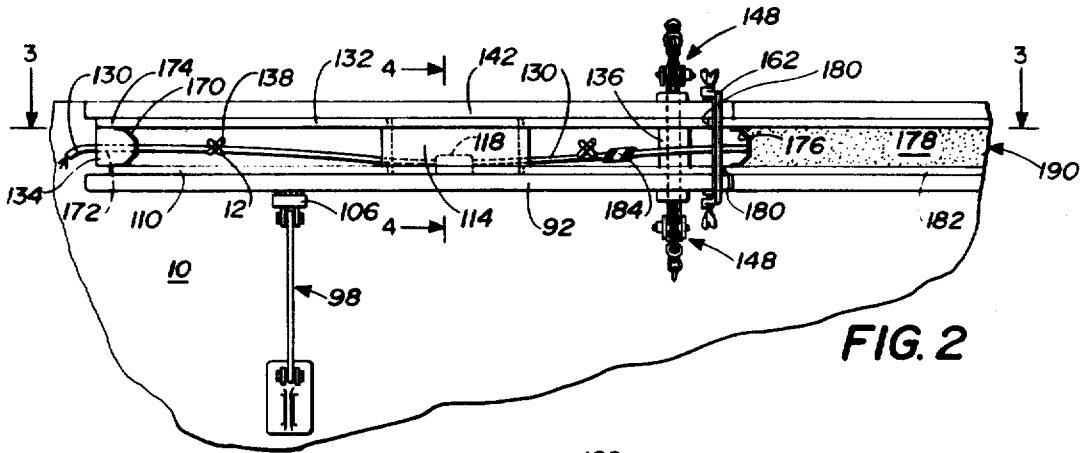


FIG. 2

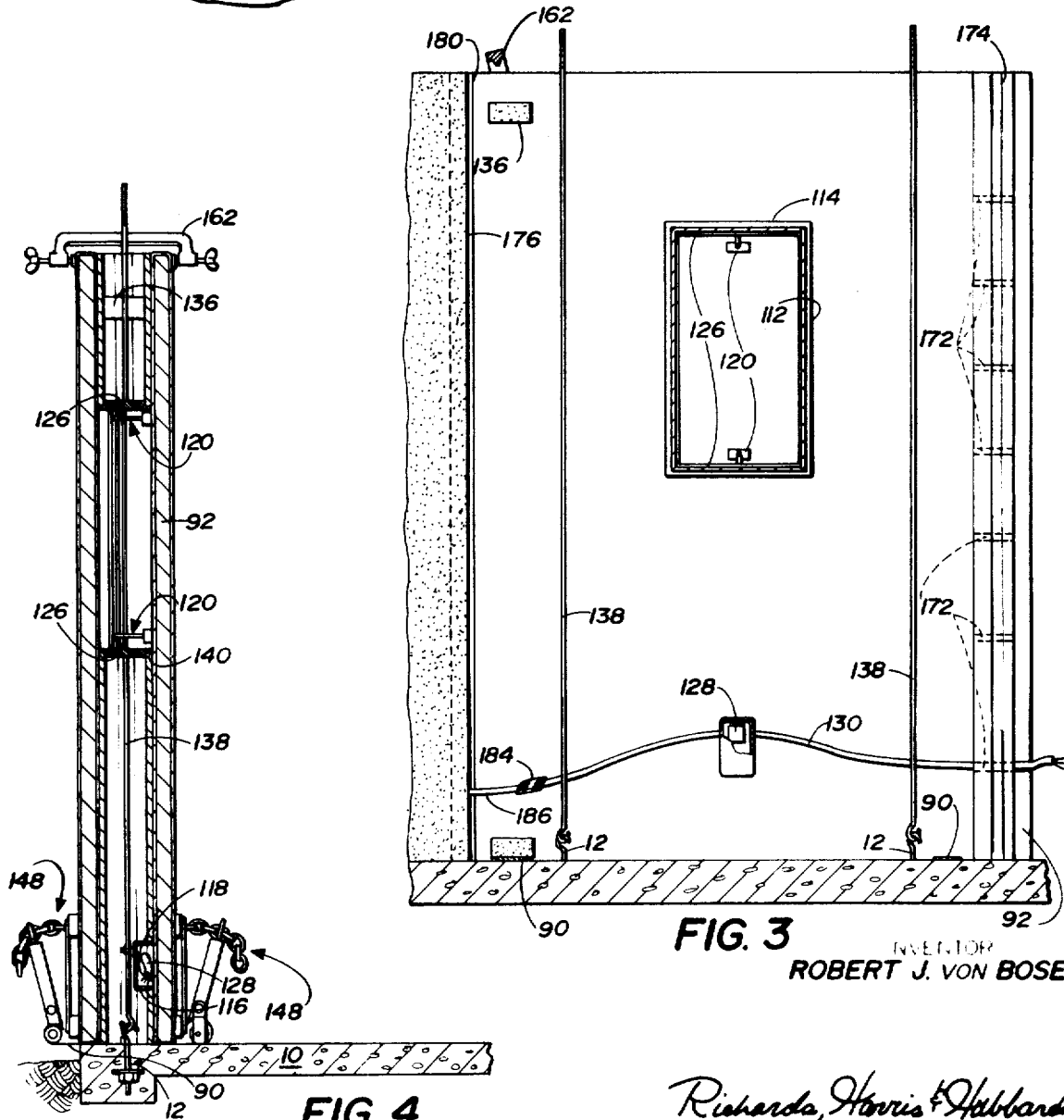


FIG. 3

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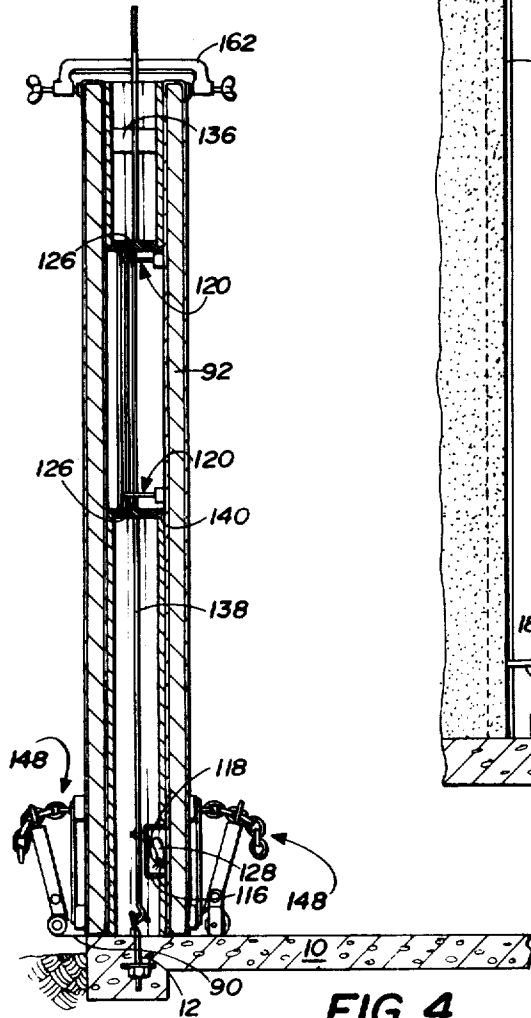
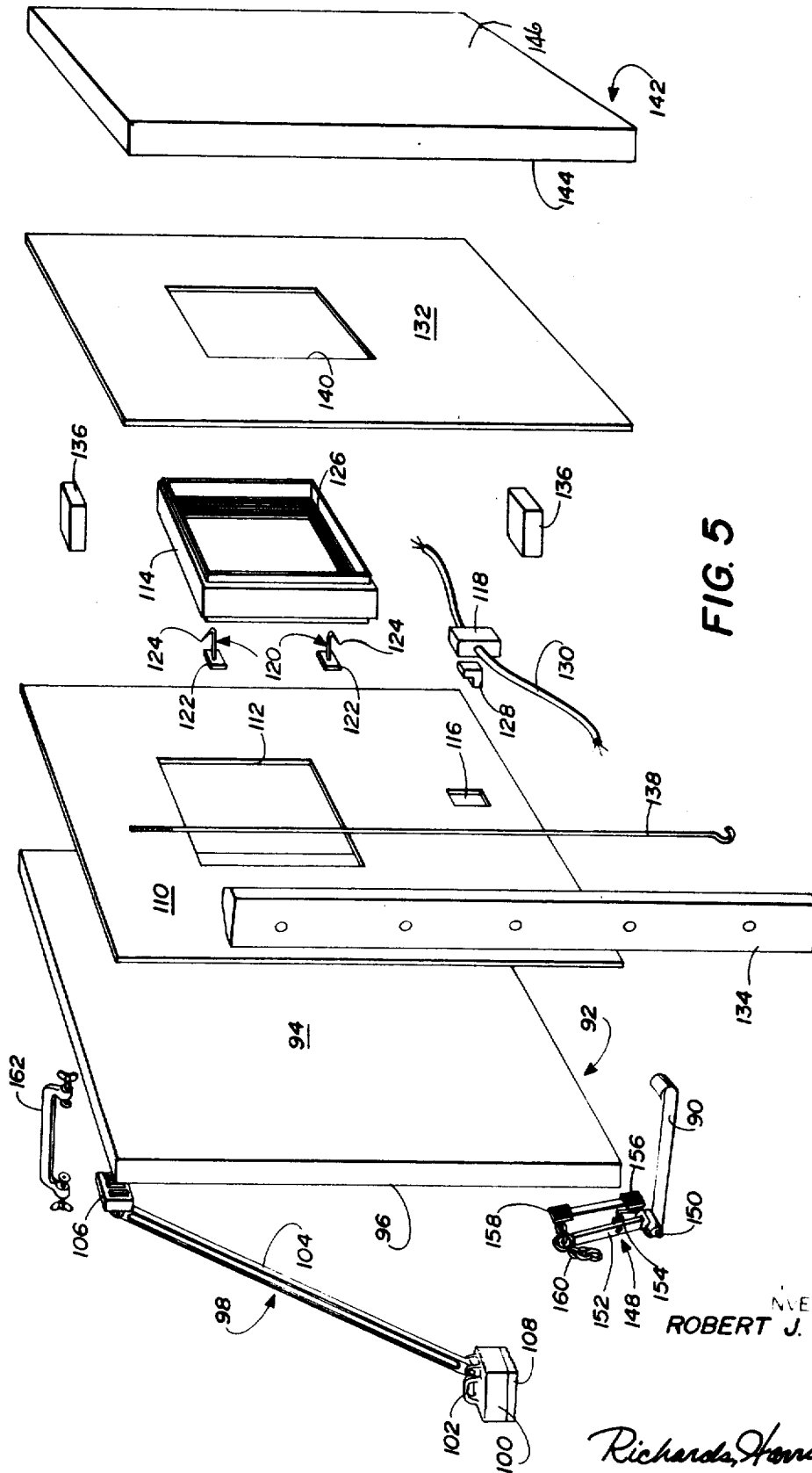


FIG. 4

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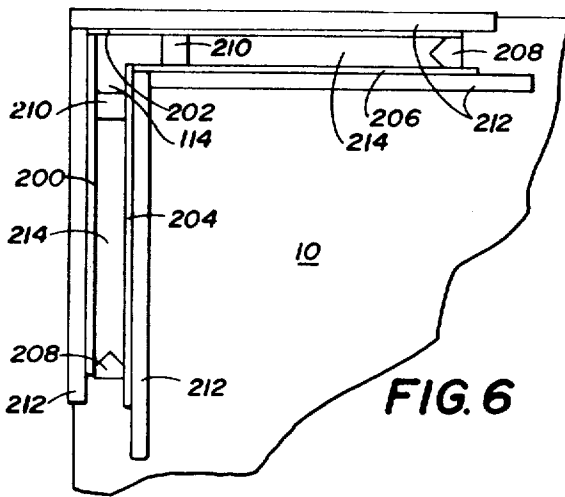


FIG. 6

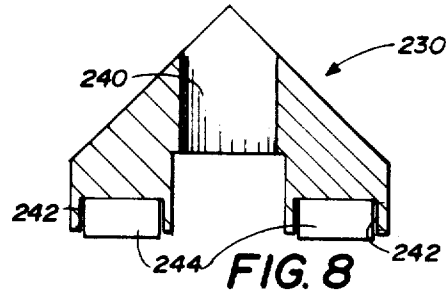


FIG. 8

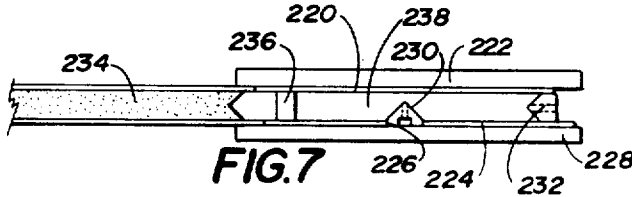


FIG. 7

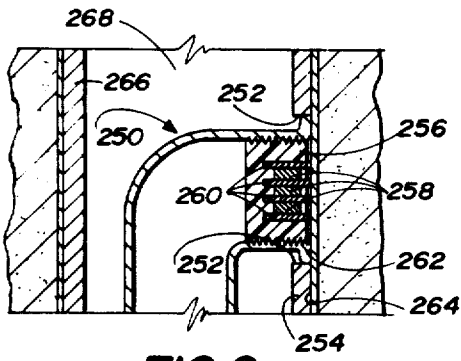


FIG. 9

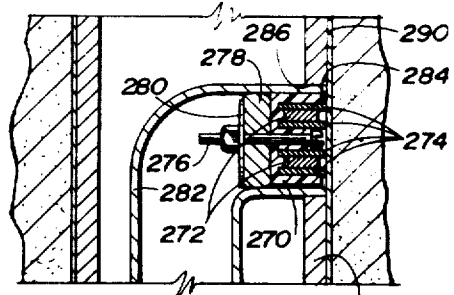


FIG. 10

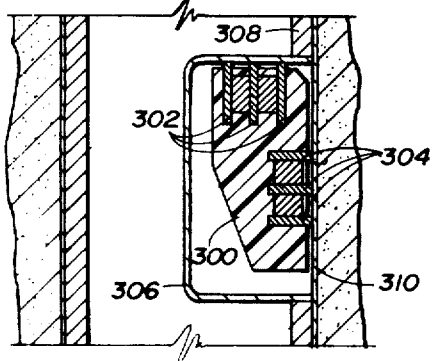


FIG. 11

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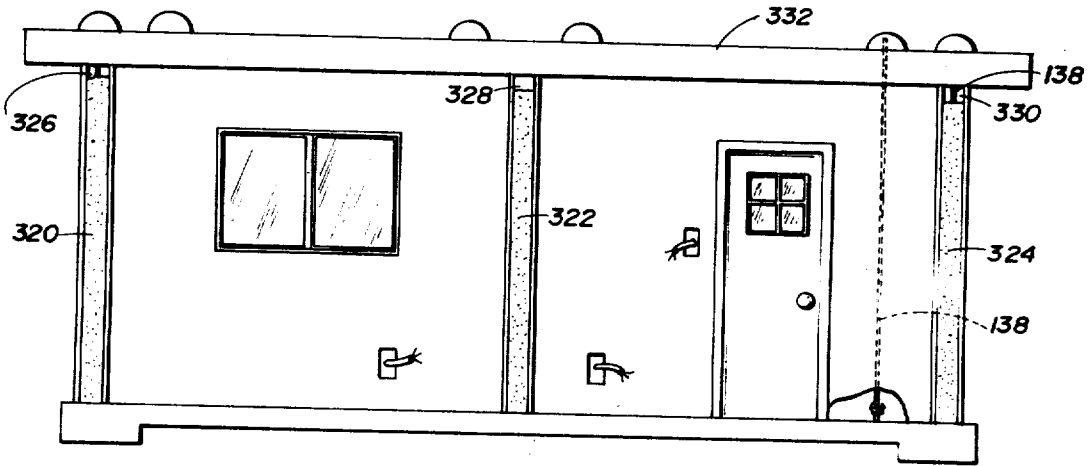


FIG. 12

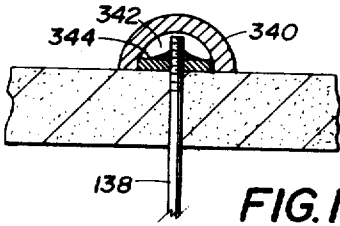


FIG. 13

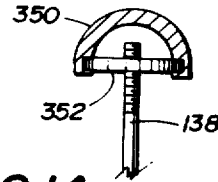


FIG. 14

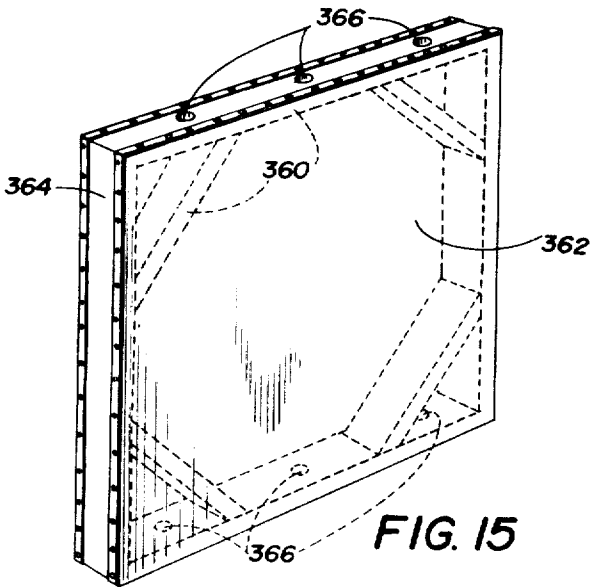


FIG. 15

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METHOD FOR BUILDING CONSTRUCTION

BACKGROUND OF THE INVENTION

This invention relates to building construction, particularly to a novel building structure and a method for producing habitable structures utilizing wall panels, fixtures and a foamed in situ, polymeric composition, and more particularly to a method of building construction utilizing a magnetomotive force to temporarily integrate portions of the building structure as it is being built.

Various uses of magnetomotive force and foamed polymeric material have been made. However, none of the prior art disclosures has come forth with a method which fully integrates on-site construction of a habitable structure. Furthermore, many of the prior art disclosures are complex and require costly capital outlays. Labor costs in such construction are the same as or possibly greater than with conventional construction techniques. For example, U.S. Pat. No. 3,305,991 discloses reinforced modular foam panel structures. These panel structures are prefabricated at a point removed from the construction site. On the construction site these structures require additional surfacing to be placed on an exterior wall and plaster or other similar material to be applied to the interior walls. In addition, these panels contain expensive metallic reinforcement which not only adds weight to the foamed panel but also can create difficulties when attempting to add plumbing to and install electrical wiring in the structure. In addition other conventional fastening techniques must be utilized to combine a plurality of the panels into a unitary structure. In U.S. Pat. No. 3,315,424 a method of on-site construction utilizing a foamed polymeric composition is disclosed. The technique therein disclosed requires initial erection of a steel or metallic reinforcing framework. Wall panels are then bonded or glued to the metallic frame, spacers are bonded to the frame, and an exterior panel is erected and bonded to the spacers. Thereafter, the space between the wall panels is filled with a foamed polymeric composition. This method, however, leaves something to be desired in that fixtures such as door frames and window frames are installed at a later time utilizing conventional construction techniques. In addition, complex integrating structures must be used when connecting pluralities of panels and when connecting or adding a roof structure. This method is not suitable to fast, efficient and economical construction of low cost housing. A method and apparatus for the prefabrication of foam panels are disclosed in U. S. Pats. No. 3,328,836 and 3,402,520. U. S. Pat. No. 3,449,879 discloses a composite wall section which is partially prefabricated and partially built on the construction site. The major portion of the panel is prefabricated while a foamed insulating layer is applied on the construction site to insulate and to seal the wall panels. Mechanical bonding means are used to connect the wall section to the foundation structure and to a roof panel.

Various applications of magnetomotive force and magnetic attachment have been made. The only disclosure presently known which is pertinent to the application of magnetomotive force to on-site construction of habitable building structures is U. S. Pat. No.

3,287,782. This patent discloses iron base sheets combined with electromagnets to hold bricks or other masonry items at a predetermined location while the interstices between the masonry structures are filled with mortar. This method and its associated apparatus again seem to be unduly complex, expensive and require a good deal of labor. In addition, the apparatus and method disclosed therein is not applicable to the low cost housing construction industry.

SUMMARY OF THE INVENTION

The present invention therefore provides a low cost housing unit which is economical to construct both from a materials standpoint and a capital outlay standpoint for the contractor. The invention also provides a low cost wall section which can be efficiently erected at the construction site at least in part from conventional building materials. The invention provides a finished wall section containing various fixtures which can be erected in substantially less time than is required when conventional construction techniques are employed. The invention provides a wall section with fixtures therein which needs only finishing touches such as installation of switches, outlets, doors, windows and interior or finishing fixtures such as sinks, counters, and the like.

These provisions are accomplished through the method for forming a wall section on a foundation structure using forms composed of a frame having attached thereto a substantially planar sheet of a material to which a magnetomotive force is attracted. The steps of the method comprise erecting a first form such that the sheet is in a substantially upright position, positioning a first wall panel against the sheet of the first form, positioning a second wall panel a spaced distance from the first wall panel, erecting a second form in an upright position such that its sheet is contacting the second wall panel on the opposite side thereof from the first wall panel, and filling the space between the wall panels to a predetermined level with a foamed in situ, synthetic, polymeric composition, thereby bonding the wall panels together and to the foundation structure and forming a wall section. Additionally, roof panels can be attached to the wall sections using a similar construction step by filling the space between the wall panels only to a predetermined distance from the tops thereof leaving a void space between the wall panels along the top of the wall section, positioning a roof panel to contact the top of the wall section, filling the void space with a foamed in situ, synthetic, polymeric composition, thereby bonding the roof panel to the wall section. Fixtures are placed in the wall section by, prior to positioning the first wall panel, forming an opening of predetermined configuration therein to receive a fixture and after positioning the first wall panel, inserting a fixture of the predetermined configuration into the opening in the first wall panel and securing it in the opening at least partially by a magnetomotive force attracted to the sheet of the first form. If the fixture is of the type which will extend through the wall section, such as a window frame, an opening in the second wall panel is formed prior to positioning the second wall panel which opening corresponds to a fixture inserted in the first panel.

The invention also provides the wall section produced by the foregoing method which wall section is mounted on a foundation structure and comprises a first wall panel contacting the foundation structure and positioned in a substantially vertical orientation, a second wall panel spaced substantially equidistantly from the first panel, at least one of the panels having an opening therein, a fixture mounted in the opening, a foamed in situ, synthetic, polymeric composition filling the space between the wall panels and bonded to the wall panels, the foundation structure, and the fixture, the periphery of the opening in the wall panel and the foamed composition forming the sole supporting and bonding material for the fixtures.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the invention will be derived by reference to the ensuing specification and the accompanying drawings wherein:

FIG. 1 is a perspective view of a partially completed building structure erected utilizing the method of the present invention and embodying wall sections of the present invention;

FIG. 2 is a top view of a partially completed wall section of the present invention;

FIG. 3 is a cross sectional view of the wall section of FIG. 2 taken along section line 3—3;

FIG. 4 is a cross sectional view of the wall section of FIG. 2 taken along section line 4—4;

FIG. 5 is an exploded view illustrating the procedure by which a wall section is constructed utilizing the method of the present invention;

FIG. 6 is a top view of an exterior corner wall section of a building constructed by the method of the present invention;

FIG. 7 is a top view of a wall section constructed by the method of the present invention which can be joined with an intersecting interior wall section;

FIG. 8 is a top view of a spacer which can be utilized to erect the wall section of FIG. 7;

FIG. 9 is a partial cross sectional view of a partially constructed wall section illustrating the means by which an interior threaded pipe is fitted to a corresponding opening in a wall panel;

FIG. 10 is a partial cross sectional view of a partially completed wall section illustrating the means by which a nonthreaded pipe or tubing is fitted to a corresponding opening in a wall panel;

FIG. 11 is a partial cross sectional view of a partially completed wall section illustrating the means by which a fixture composed of iron is positioned and maintained in a corresponding opening in a wall panel;

FIG. 12 is a side elevation view of a partially completed structure built by the method of this invention illustrating a means by which a roof panel can be attached to a plurality of wall sections;

FIG. 13 is a cross sectional view of one means for fastening a roof panel to a wall section and the foundation structure;

FIG. 14 is another fastening means similar to that shown in FIG. 13;

FIG. 15 is an illustration of a wall form which can be utilized with the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to FIG. 1, a partially completed structure is shown which has been constructed from the wall sections and by the method of the present invention. A foundation structure 10 is first provided by pouring a material such as concrete into forms and leveling the floor surface thereof. For some applications it is also necessary while pouring foundation structure to embed hooks 12 in the foundation by means of the plate assembly 14. In other applications this particular step may be bypassed since the extra reinforcement for which they are provided is not a necessity. A plurality of wall panels are then constructed on the foundation surface. These wall panels have embedded therein a variety of fixtures. Wall section 16 contains a door frame and sill 18 ready for hanging a door structure. It also contains an electrical junction box 20 provided with electrical wiring thereto which is connected to various outlets and exterior lights. This electrical junction box 20 will then be utilized as a switch box and need be only fitted with the switch mechanism and the switch plate. As can be seen electrical wiring 22 extends from within the wall section 16 such that it can be connected to the next adjacent wall section to be constructed. Wall section 24 contains a completed window frame 25 and an electrical junction box 27 to be fitted with a socket or receptacle plate. Wall section 24 joins wall section 26 along a seam 29 at a corner of the building structure. In turn, the wall section 26 joins a wall section 28 which has a grooved portion 30 therein for connection to an interior wall section or dividing section 32.

Wall section 32 is provided with various fixtures as would an interior wall of, for example, the kitchen area in a habitable structure. Wall section 32 is provided with a switch outlet box 34 connected to appropriate wiring 36 extending from between the wall section 32. Another electrical switch box 38 is provided at the other end of the wall section. A receptacle or outlet box 40 is provided near the bottom of the wall section and is also connected to appropriate electrical wiring 42 extending from the wall section. Also provided within wall section 32 is appropriate plumbing for connection to, for example, a kitchen sink. The outlets of hot and cold water pipes 44 are shown and below the water pipe is a sewer inlet pipe 46. The usual provision in this type of construction would be to extend these plumbing fixtures down the middle of the wall section 32 and into the foundation 10. Normally the rough plumbing will be installed prior to pouring the concrete foundation structure 10. Rough fixtures will then be left extending above the floor surface of the foundation structure 10. Such plumbing fixtures 48 are shown on a portion of the foundation surface where a wall section has not yet been constructed. These fixtures contain caps 50 to prevent dirt and other foreign matter from entering the fixtures.

A typical wall section, for example 16, is constructed from an interior wall panel 52, an exterior wall panel 54, extended an extra length for purposes of a corner joint as will be described in more detail later, the door frame 18, electrical fixture 20, and a foamed in situ, synthetic, polymeric core 56 which serves to bond the wall panels 52 and 54 together and to hold them in an erect position and also serves to bond the wall section

16 to the foundation structure 10 along the contiguous surfaces thereof. The foamed composition also provides excellent insulation for comfortable habitation in both summer and winter. With reference to wall section 58, here shown partially cut-away, a diagrammatic representation of the method by which the wall sections and hence the building structure of the present invention are produced. Wall section 58 extends from wall section 28 and contains as fixtures a window frame 60 and electrical outlet junction box 62. The window frame 60, of course, extends between the interior wall panel 64 and the exterior wall panel 66. The junction box 62 of course protrudes only through an opening in the interior wall panel 64. An end form 68 is provided to close the open end of the partially completed wall section during construction thereof and is removed at a later stage which will be more particularly described hereinafter. The end form 68 is provided with openings or orifices through which electrical wiring 72 can be extended for joining to similar wiring in a next adjacent wall section. A foamed in situ, synthetic, polymeric composition 70 is then deposited in the void spaces between the wall panels 64 and 66 and the end form 68. The interior of the window frame and the electrical junction box are, of course, not filled. As described previously, the foamed composition serves as insulation and as the bonding agent between the wall panels 64 and 66 and the foundation structure 10 and also serves to join wall section 58 to wall section 28 through the use of a joint which will be described in more detail hereinafter. The foamed composition 70 is provided by combining a suitable synthetic polymeric resin and a foaming agent in an appropriate injector or gun 74. The resin and foaming agent are fed to the gun through flexible conduits 76 from appropriate containers 78.

A variety of resins and foaming agents can be utilized within the purview of the present invention. The basic composition of the resin depends somewhat upon the type of fixtures being utilized and the makeup of the wall panels utilized. For example, it is undesirable to use a foamed composition which would chemically attack the fixtures embedded within the wall sections or which would attack the wall sections themselves. The foamed composition should be a relatively uniform and minute celled foam type. The foam must be a rigid foam to increase the stability and rigidity of the wall sections and to retain the fixtures in their proper positions. A preferable foamed composition is a polyurethane foam. Such a polyurethane foam is produced from a polyether such as polypropylene glycol treated with a diisocyanate in the presence of water and catalyst (amines, tin soaps, organic tin compounds) as well as fillers, dispersing and emulsifying agents, and other substances. Simultaneously with the polymer forming reactions the water reacts with the isocyanate groups to cause cross linking and curing, and also produces carbon dioxide which causes foaming. In other cases trifluoromethane or similar volatile material is incorporated to serve as a blowing or foaming agent and to reduce the thermal conductivity of the finished foam. Rigid foams such as used with the present invention are based on polyethers made from compounds such as sorbitol, methylglucoside, sucrose and certain aromatic derivatives. Other resins which can be foamed and which can be utilized with the

present invention, depending upon the composition of the fixtures, as heretofore pointed out, are foamed polystyrene and foamed polyethylene. The preferred foamed polyurethane composition will strongly bond itself to wall panels, to the various fixtures, to a concrete or other foundation structure and to the roof panels. These bonds and the rigidity of the cured foam will combine to form a stable rigid wall section of great durability. In addition, wall sections containing a foamed polyurethane core composition will provide excellent thermal insulation and will provide a large degree of sound proofing. Other advantages in using foamed polyurethane are apparent.

Referring now to FIGS. 2 through 5, the typical assembly procedure for a wall section of the present invention will be described. Referring first to FIG. 5 in which is illustrated in an exploded view the components which are utilized when constructing a typical wall section. Firstly, two thin sheet metal strips 90 having arcuate or curled ends thereon are placed on the foundation structure such that their longitudinal mid-points are substantially aligned with the mid-point location between the wall panels to be erected. The metal strips are spaced at a distance less than the width of a wall panel to be utilized. Next, a first form 92 is positioned on top of the sheet metal strips 90. The form has two substantially planar faces 94 and 96 which are positioned in an erect, usually substantially vertical direction. The form 92 is held in its erect position by a suitable brace generally designated 98. The brace comprises a weighted base portion 100 to which is attached a handle 102 and to which is pivotally attached an arm 104. At the upper end of arm 104 a magnetic clamp 106 is pivotally attached. The faces 94 and 96 of the form 92 are composed of a material to which a magnetomotive force is attracted. Usually this material is an iron base material such as sheet steel. The face 94 of the form is preferably continuous and planar having no seams or other fastening projections thereon. The magnetic clamp 106 is attached to the upper portion of face 96 of the form 92. The base 100 of the brace 98 has attached thereto a material 108 which has a high coefficient of friction and is preferably somewhat resilient, for example a sheet of natural or synthetic rubber. The surface of this material is placed on the foundation structure to provide lateral stability to the brace 98 and hence to the form 92.

Thereafter, a wall panel 110 which has had openings cut therein is placed so that the side thereof to be exposed upon completion of the wall section will be contacting face 94 of form 92. In wall panel 110 an opening 112 has been provided for a prefabricated window frame 114. Next, the fixtures are inserted in the appropriate openings, the window frame into opening 112 and the electrical junction box into opening 116. The window frame 114 is secured in the opening by magnetic clamps 120. Clamps 120 have a magnetic portion 122 which will adhere by magnetomotive force to the face 94 of form 92 and a hook portion 124 fitted to engage the prefabricated runners or channels 126 of the window frame. The junction box 118 is secured in the opening 116 by magnetic clamp 128. Since junction boxes are normally composed of an iron base material, magnetic clamp 128 is designed to adhere both to the face 94 and to the interior of the junction box 118. Ap-

appropriate electrical conduits 130 are attached to the junction box 118 prior to insertion into its respective openings.

Wall panel 132 is then situated in a position spaced from and usually substantially parallel to wall panel 110. If the wall panel 132 is of the exterior weather resistant type, its weather resistant surface will be facing in the opposite direction from panel 110. Appropriate spacers 134 and 136 are provided to maintain the proper spacing between the wall panels 110 and 132. If desired and if necessary an appropriate reinforcing or guy rod 138 can be installed prior to positioning wall panel 132. It will be understood, of course, that wall panel 132 has had an appropriate opening 140 formed therein to receive the other end of the window frame 114. After the panel 132 has been positioned, a second form 142 is situated such that it is contacting the exterior face of panel 132. Form 142 is similar or identical to form 92 and has two substantially planar surfaces 144 and 146 which are capable of attracting a magnetomotive force. When the form 142 has been positioned, clamps 148 are applied to prevent lateral movement of the bottom of the forms 142 and 92 and hence the bottom of panels 110 and 132. The clamp 148 is attached to the sheet metal strip 90 through a knurled wheel 150 and a lever arrangement 152 which contacts the upper surface of the arcuate portion of the strip. The lever 152 is pivoted to a frame member 154 to which the knurled wheel 150 is rotatably attached and to which a resilient pad 156 is connected. Pad 156 contacts face 96 of form 92. The clamp 148 also includes a magnetic holder 158 which will be attracted to face 96 of the form 92 and which has attached thereto a chain member 160 which is adjustably attachable to arm 152 to maintain sufficient force through its pivot upon the sheet metal strip 90. Similar clamps are applied to the other three arcuate portions of the strips 90. A U-clamp or cabinet maker's clamp 162 is applied across the upper portions of forms 92, applying force to faces 96 and 146 to prevent relative lateral movement of the forms at their upper portions and hence to prevent movement of the panels 110 and 132.

Referring now to FIGS. 2 through 4 wherein like numerals will be utilized as are used in FIG. 5. In these FIGS. various views of a wall section similar to wall section 58 (FIG. 1) is shown ready for placement of the foamed composition core therein. Referring first to FIG. 2, a top view of the wall section is illustrated. Forms 92 and 142 are shown in an upright position stabilized there by brace 98 magnetically attached to form 92 through clamp 106. Sandwiched between the forms are an interior wall panel 110 and an exterior wall panel 132. A spacer 136 is provided at the right hand end of the wall section while an end form 134 is provided at the left hand end of the wall section. A synthetic, polymeric sheet 170, for example a polyethylene sheet, faces the interior portion of the end form 134 to prevent adherence of the foamed composition to the end form so that it can be easily removed after the foamed composition has partially cured and solidified. The end form 134 is provided with a plurality of channels 172 through which electrical wiring such as conduit 130 can be strung in order to be connected to similar wiring in a next adjacent wall panel to be constructed. The polymeric sheet 170 is continuous across

the entire interior surface of the end form to prevent ingress of the foamed composition into channels 172 not being utilized. When it is desired to string electrical conduit through a channel 172, the polymeric sheet is impaled to form a small opening therein in alignment with the desired channel. The polymeric sheet 170 does not extend along the entire side of the form 134, but terminates at 174 so that the foamed composition to be placed in a next adjacent wall section will adhere to the panels 110 and 132. This can better be seen by reference to the right hand portion of FIG. 2 wherein a previous wall section has been erected. There an end form has been removed and a polymeric sheet 176 is shown bonded to a previously placed foamed core 178 along the vertical mating groove formed by the presence of an end form as foamed core 178 was placed.

As can be seen, the wall panels 110 and 132 are slightly offset. The void left by the previously removed end panel along with the offset panels combine to provide a strong and tight seal between the interior and exterior of the wall sections. As should be additionally noticed, the end forms preferably overlap the ends 180 of the wall panels. This provision is made to ensure that the foamed composition, when deposited between the wall panels, will not issue from any crack or seam between a panel such as 110 and a previously erected panel 182. The foamed composition will cease to foam and expand when it reaches a small crevice such as that formed at 180.

Prior to erection of the wall panels and forms, steel straps 90 are laid on the foundation structure 10. Clamps 148 are secured to the strap to prevent lateral movement of the bottom portion of the forms. In addition, a U-clamp 162 is provided to hold the top portion of the forms 92 and 142 in substantially parallel alignment. A window frame fixture 114 is inserted into appropriate openings in the wall panels 110 and 132. Similarly, an electrical junction box 118 has been inserted in an appropriate opening in wall panel 110 and connected to the electrical cable 130. The right hand end of cable 130 has been spliced at 184 to a cable 186 which extends from the previously erected wall section 190. Two vertical stringers or reinforcing rods 138 are attached to hooks 12 embedded in the foundation structure. The reinforcing rods are to be utilized when and where necessary to provide additional reinforcement for attaching a roof panel to the wall sections.

FIGS. 3 and 4 are cross sectional views taken along section lines 3—3 and 4—4, respectively, of FIG. 2. These views are provided to clarify the relationship of the various components going into a wall section prior to filling the space between wall panels with the foamed composition. As can be seen, the polymeric sheet 170 applied to the interior portion of the end form 134 extends only to line 174 in the horizontal direction. The end form 134 is provided with a plurality of vertically spaced channels 172 through which electrical cable or other connecting fixtures can be strung. The top spacer 136 at the upper left hand portion of the wall panel 110, is held in place either by the force of clamp 180 holding the forms together or by a small amount of adhesive applied to its ends.

The prefabricated window frame 114 is inserted into its appropriate opening 112 in the wall panel 110. It is

secured in place during erection of the panels and forms by magnetic clamps 120 which are magnetically attracted to the face of the interior wall form 92 and are hooked onto the channels 126 of the window frame. Similarly the junction box 118 is secured in its opening 116 by magnetic clamp 128.

FIG. 6 is an illustration of an arrangement by which construction of a building using the method of this invention can be initiated at a corner of the foundation structure 10. Wall panels 200 and 202 are erected such that they meet at an exterior corner of the building structure. Wall panels 204 and 206 are situated so that they meet along a vertical edge at the interior corner of a building structure. End forms 208 are provided at the open ends of the partially completed wall section and suitable spacers 210 are provided near the corner of the wall section. Forms 212 are then erected and stabilized as previously described. Thereafter the cavity 214 is filled with the synthetic, polymeric foamed composition.

A wall section similar to that designated 28 in FIG. 1 which has a provision for an intersecting interior wall is illustrated in FIG. 7. In FIG. 7 an exterior wall panel 220 is erected and backed by a wall form 222. An interior wall panel 224 is erected which has a vertical slot 226 running the full vertical length thereof. A wall form 228 is then erected in contact with the wall panel 224. A wall slot for 230 is then fitted into the vertical slot 226 and magnetically attached to the form 228. An end form 232 is provided at the right hand end of the wall section while the left hand end of the wall section is closed by a previously erected wall section 234. A spacer 236 can be inserted between the panels 224 and 220 if necessary. Thereafter the foam cavity 238 is filled with the foamed composition. FIG. 8 is an enlarged view in cross section of the wall intersection form 230 of FIG. 7. The wall intersection form is provided with a plurality of vertically spaced channels 240 provided for wiring, plumbing and conduit extensions similar to those provided in end forms such as 232 (FIG. 7). Slots 242 are provided at spaced intervals along the vertical length thereof into which magnets 244 are inserted. These magnets provide the magnetomotive force necessary to hold the wall intersection form against a wall form such as 228.

FIG. 9 illustrates in cross section a type of magnetic clamp which can be utilized to secure an internally threaded plumbing fitting into an appropriate opening in a wall panel. The internally threaded plumbing fitting 250 has threaded into it an externally threaded cap 256. The cap is composed of any suitable thermoplastic or thermosetting resin. The cap 256 had a cavity formed therein in which ceramic magnet slices 258 are interspersed with iron pole pieces 260. The iron pole pieces 260 extend beyond one surface of the cap 256 with the exposed ends thereof aligned in a substantially planar manner. The cap 256 is screwed into the fitting 250 sufficiently far to align the ends of the iron pole pieces with the face 262 of the fitting. The fitting is then inserted into an appropriate opening 252 in, for example, an interior wall panel 254. The iron pole pieces are attracted to the magnetically attractive face 264 of the wall form against which the panel 254 has been placed. Thereafter, an opposing wall panel 266 is erected and the foam cavity 268 filled with the foamed composition.

A magnetic clamp of the type to be utilized with a nonthreaded plumbing fitting is illustrated in FIG. 10. A body portion 270, composed of similar material to cap 256 above, is provided with cavities into which ceramic magnets 272 and iron pole pieces 274 are inserted and secured similar to the arrangement in FIG. 9. The center of the body 270 is provided with a hole through which a machine screw 276 is inserted. A cylindrically shaped member 278 composed of a resilient elastomer is provided with an axial opening through which the screw 276 also extends. A plate member 280 is screwed onto the threaded portion of the screw 276 and contacts the cylindrically shaped member 278. Prior to insertion into the plumbing fitting 282 the screw is loosely fitted. After the ends of the iron pole pieces are aligned with the end 284 of the plumbing fitting, the screw 276 is tightened thus expanding the resilient elastomer 278 and securing the magnetic clamp inside the fitting 282. Thereafter the fitting is inserted into an appropriate opening 286 in a wall panel 288. The attraction of the iron pole pieces for magnetically attractive face of wall form 290 will secure the plumbing fitting in the opening 286. The remaining procedure for constructing a wall section is as described before.

FIG. 11 illustrates still another magnetic clamp for securing a fixture which itself is composed of a material to which a magnetomotive force is attracted into an appropriate opening in a wall panel. This magnetic clamp is composed of a body portion 300 having ceramic magnets and iron pole pieces inserted into cavities therein. However in this arrangement, the magnets are arranged such that the ends of the iron pole pieces 302 are arranged in a first plane and the ends of the iron pole pieces 304 are arranged in a second plane substantially 90° to the ends of iron pole pieces 302. Thus, a steel electrical junction box 306 can be secured in an appropriate opening in a wall panel 308 by attraction to the magnetically attractive face of wall form 310.

FIGS. 12 through 14 illustrate the means by which a roof panel is attached to completed wall sections of the present invention. Referring first to FIG. 12 the wall sections 320, 322, and 324 are filled only to a predetermined level with the foamed composition during their erection. For example, vertical spaces 326, 328 and 330 are filled with foam to within approximately six inches of the tops of the wall panels. A roof section 332 is then positioned over the wall sections 320, 322 and 324 in contact with the top edges of the wall panels. In locales where high winds are prognosticated, stringers or reinforcing rods 138 are provided at the periphery of the structure. The reinforcing rods 138 are secured to the top of the roof panels by attachment means such as illustrated in FIGS. 13 and 14. If high winds will not be encountered, there is no need to employ the reinforcing rods 138. After the roof panel 332 has been positioned atop the wall sections, the spaces 326, 328 and 330 are filled with the foamed composition thus bonding the roof panel 332 to the wall sections 320, 322 and 324. It may be desirable, if the reinforcing rods are omitted, to weight the roof panel 332 while filling the spaces 326, 328, and 330 so that it will not be forced away from the wall sections by the expanding foamed composition. The roof panel 332 can be of the prefabricated type with a foamed interior portion reinforced with steel or other reinforcing materials or it can

be fabricated on the building site utilizing the method of the present invention. The panel 332 is provided with suitable holes or channels through which the reinforcing rods 138 are inserted.

FIG. 13 illustrates a first type of connector which can be used with a nonthreaded reinforcing rod 138. With this type of connector, a cap or body portion 340 of, for example, hemispherical configuration, has a cavity 342 therein in which a steel spring type clip 344 is secured. In use the end of the rod 138 is inserted into an opening in the spring clip 344 by a force axial to the rod. This locks the clip 344 onto the rod 138. Similarly an attachment cap 350 (FIG. 14) can be utilized which has a cavity into which is secured an internally threaded nut 352. This type of attachment member is merely threaded onto the externally threaded end of a reinforcement rod 138. The portion of the caps 340 and 350 contacting the top portion of the roof panel can be provided with a gasket or seal to prevent seepage of water into the channels provided in the roof panels. However, this is not essential since the foamed composition placed in voids 326, 328 and 330 (FIG. 12) will function to seal the channels provided for the reinforcement rods in the roof panels.

FIG. 15 illustrates a preferred wall form such as 96 and 146 shown in FIG. 5. A frame 360 is constructed in a suitable manner with conventional construction techniques. The composition of the frame is preferably a light weight wooden material. A planar surface or sheet 362, for example 18-gauge sheet steel, is then applied to both sides of the frame 360. The edges of the sheets 362 are folded around the edges of the frame 360 and riveted or nailed to the frame. Thus the surface of the sheet 362 which will be contacting a wall panel will not have any seams or attachment points thereon, thus eliminating the possibility of marring or damaging a wall panel. If desired an additional strap 364 of steel can be applied to the periphery of the frames 360 to additionally reinforce the wall form. After the sheet material has been applied to the frame, the interior thereof is filled with a synthetic, polymeric foamed composition similar or identical to that used with the method of this invention. Suitable vents 366 are provided for this purpose. It is of course to be understood that the material of which sheet 362 is composed must be of the type to which a magnetomotive force is attracted. An example of such a material, of course, is iron, the preferable material being a thin, light weight steel sheet.

From a reading of the foregoing specification, it will be apparent to one of ordinary skill in the construction industry that many and diverse alterations and variations of the present invention can be made without departing from its concept. The invention is however intended to be limited only by the definition of the appended claims.

What is claimed is:

1. A method for forming a wall section on a foundation structure using forms composed of a frame having a magnetizable face sheet, the steps comprising:

erecting a first form with said face sheet in a substantially vertical position and positioning a first wall panel against said face sheet

positioning a second wall panel a spaced distance from said first wall panel,

erecting a second form in a vertical position with said second wall panel supported thereby, magnetically adhering a fixture to said sheet with said first wall panel and in the void between said wall panels,

coupling from the top of said panels at least one anchor to said foundation with said upward extension thereof positioned between said panels, and filling the space between the wall panels to a predetermined level with a foamed in situ, synthetic, polymeric composition, thereby bonding the wall panels together and to said anchor means and forming a wall section with said fixture embedded therein.

2. The method of claim 1 wherein the space between the wall panels is filled and allowed to foam only to a predetermined distance from the tops of the panels leaving a void space between the wall panels along the top of the wall section.

3. The method of claim 2 comprising removing the forms after the foamed composition has at least partially solidified.

4. The method of claim 2 comprising after foaming the polymeric composition in the space between the wall panels, positioning a roof panel to contact the top of the wall section, filling the void space with a foamed in situ, synthetic, polymeric composition, thereby bonding the roof panel to the wall section.

5. The method of claim 1 comprising prior to positioning the first wall panel, forming an opening of predetermined configuration therein to receive said fixture.

6. The method of claim 5 comprising after positioning the first wall panel, inserting a fixture of the predetermined configuration into the opening in the first wall panel and temporarily securing it in an opening at least partially by a magnetomotive force attracted to said sheet.

7. The method of claim 6, prior to positioning the second wall panel forming an opening in the second wall panel corresponding to a fixture inserted in the first panel which will bridge the space between the wall panels.

8. The method of claim 6 wherein the fixture is composed of a material to which a magnetomotive force is attracted, comprising securing the fixture in the opening solely with magnetomotive force.

9. The method of claim 1 comprising positioning a spacer between the wall panels to assure a predetermined separation distance therebetween.

10. In the method of claim 6 wherein a wall section is formed contiguous to a previously formed wall section having a vertical mating groove therein the steps of positioning third and fourth wall panels in edge contact with respective first and second wall panels of said previously formed wall section, closing the vertical end portion between the third and fourth panels with an end form, filling the space between the third and fourth panels including a portion indented in said previously formed wall section with a foamed in situ, synthetic, polymeric composition thereby interlocking the previously formed wall section with a newly formed wall section.

11. The method of claim 1 wherein the sheet is comprised of an iron composition.

12. The method of claim 8 wherein the fixture is an iron composition.

13. The method of claim 1 wherein the synthetic, polymeric composition is polyurethane.

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