United States Patent [19]

Tenorio

[11] **3,826,052**

[45] **July 30, 1974**

[54] **COMPOSITE WALL PANEL FOR BUILDING CONSTRUCTION**

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[22] Filed: **Oct. 16, 1972**

[21] Appl. No.: **297,975**

[52] **U.S. Cl.** **52/293,** 52/294, 52/300, 52/309, 52/439, 52/443, 52/607

[51] **Int. Cl.** **E04c 2/10,** E04b 2/42

[58] **Field of Search** 52/293, 294, 309, 415, 52/378, 453, 379, 444, 439, 577, 576, 405, 250, 259

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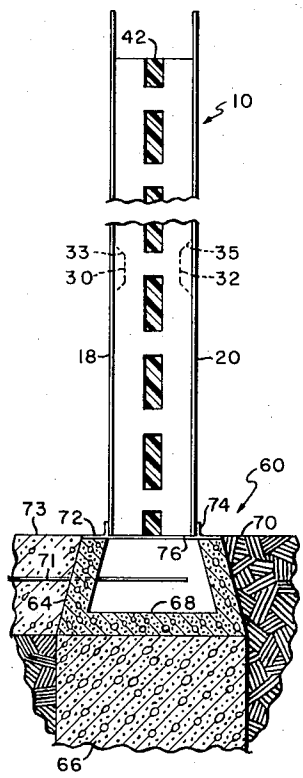
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Primary Examiner—John E. Murtagh
Attorney, Agent, or Firm—Irwin P. Garfinkle

[57] **ABSTRACT**

A wall panel comprising an upright core of plastic insulating material with skins overlying opposed faces of the core and extending beyond its top edge to form a continuous upper trough. Sets of generally vertical grooves extend from the continuous upper trough adjacent the skins to the bottom of the core. Additional sets of passages interconnect with the vertical passages to form a network of passages. The passages and open trough are filled with concrete to form a continuous upper beam supported by an integral open web type of construction. Panels may be placed end to end to form perimeter and other walls of a building.

13 Claims, 7 Drawing Figures



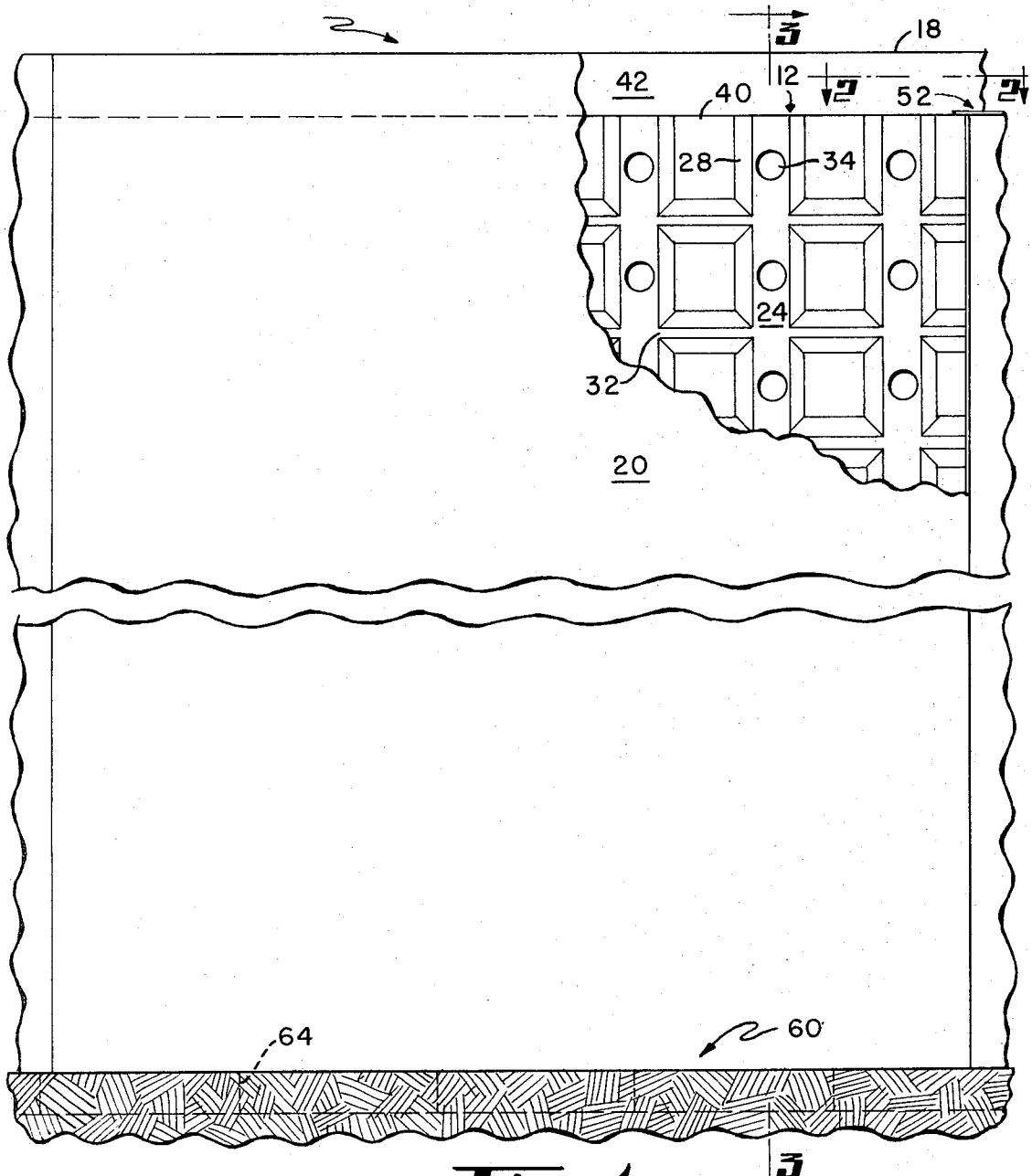

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Fig 1

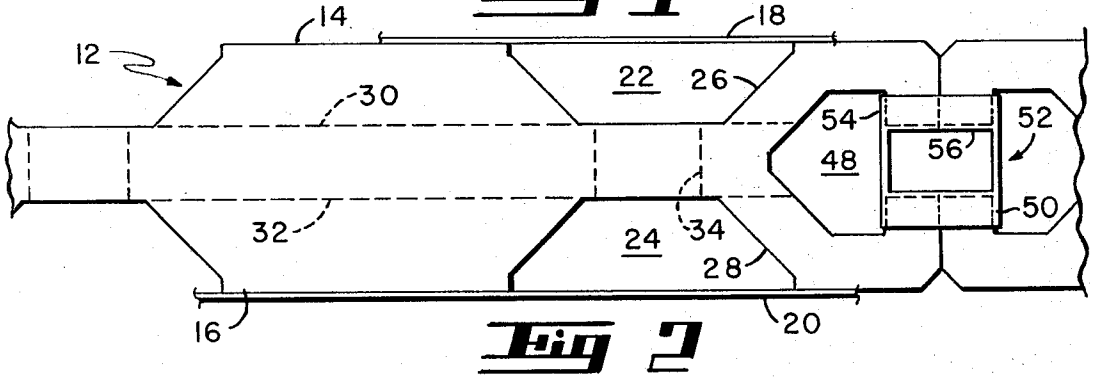

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Fig 2

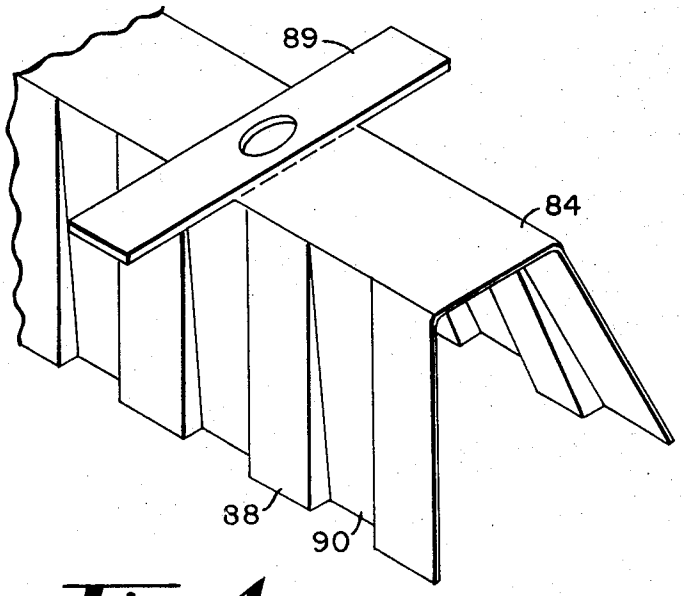


Fig 4

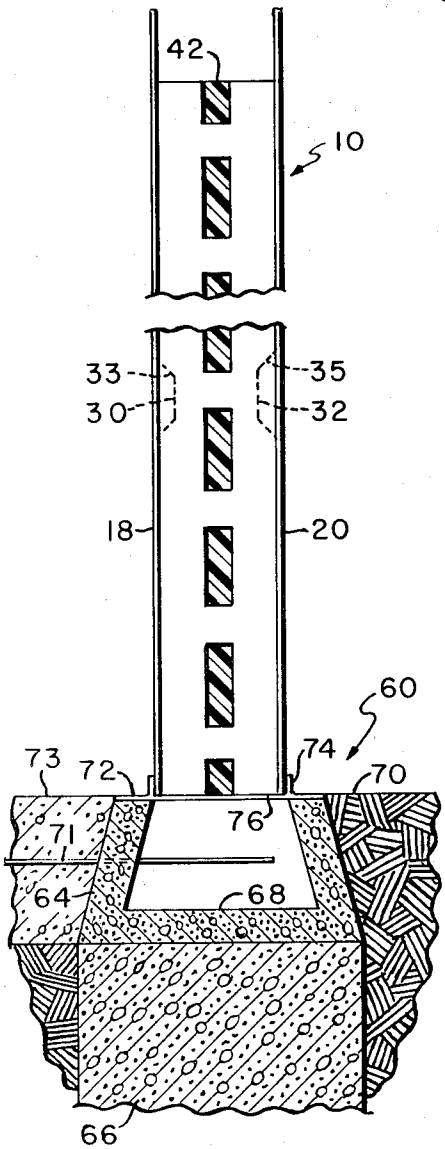


Fig 3

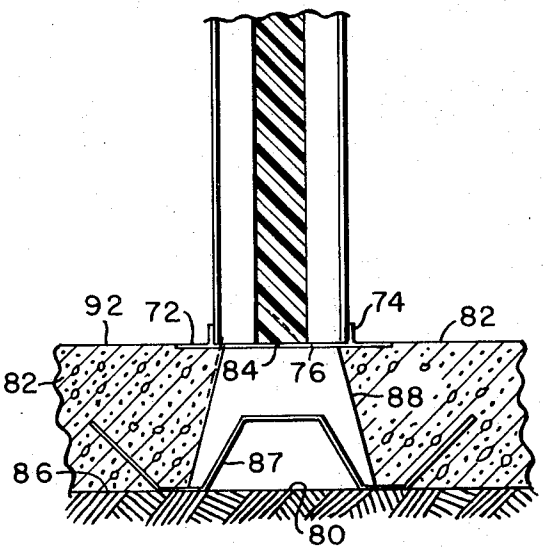


Fig 5

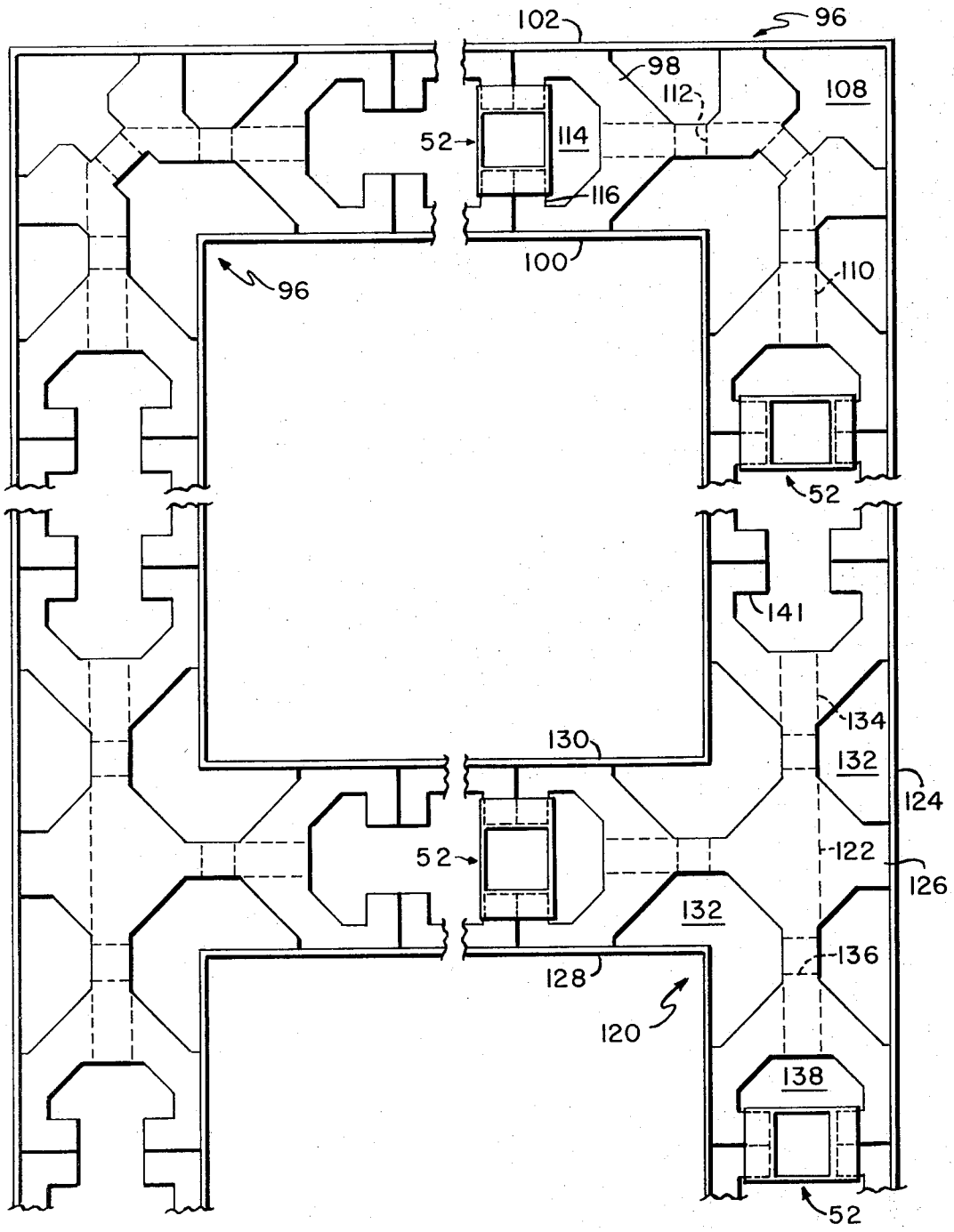

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Fig 6

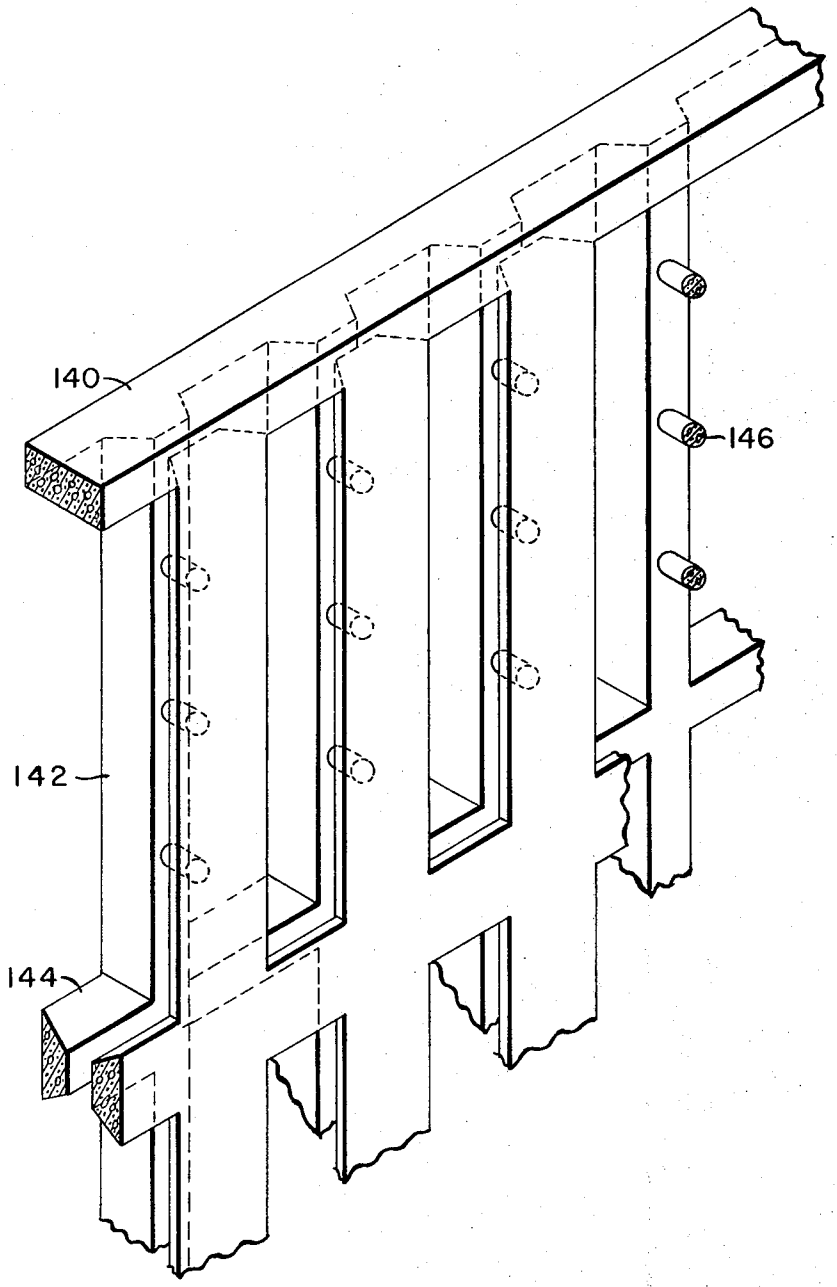


Fig 7

COMPOSITE WALL PANEL FOR BUILDING CONSTRUCTION

BACKGROUND OF THE INVENTION

One of the most commonly used building materials is concrete. It has many advantages, such as, it is relatively inexpensive, easy to work with, relatively strong in compression, and before it sets it is a fluid so that it can be poured to conform to any shape. Some of its disadvantages, however, are that it is very weak in tension. In addition, it is a very poor insulator of both heat and sound. Since it is fluid before it sets, it requires either throw-away forms or rather expensive re-usable forms. Since concrete needs a certain minimum thickness to flow inside a form, the thickness of a poured wall must be above a certain minimum (approximately 3 to 4 inches). For a small building, such as a house, the resultant concrete structure has a strength that is many times greater than the strength required so that large percentage of the concrete used is really wasted material.

One approach to the solution of fabricating concrete into a building panel is found in the patent to Kitson, U.S. Pat. No. 3,000,144. In that patent a core of foamed material has a series of grooves in its opposed faces which are covered with outer skins. These grooves are filled with concrete grout to form a concrete supporting structure within the foamed material. While panel design is effective in minimizing the concrete required, it has the disadvantage that it is not easily filled with concrete grout. The many individual passages and grooves necessitate a laborious process in which individual passages are sequentially filled with concrete grout.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a composite wall panel which has a concrete reinforcing panel which utilizes the strength and which enables the concrete to be easily incorporated in the wall panel during construction.

This end is achieved by a wall panel comprising an upright core of plastic insulating material having spaced opposed faces and a top edge. Skins overlie the opposed faces and extend beyond the top edge of the core to form a continuous upper trough. The core has first sets of generally vertical grooves which form, in combination with the skins, sets of generally vertical passages extending downward from the trough. The trough and the sets of passages are fillable with concrete to form vertical posts supporting an integral continuous upper beam.

In the drawings:

FIG. 1 is an elevational view of a wall panel embodying the present invention;

FIG. 2 is a fragmentary enlarged cross-sectional view of the wall panel of FIG. 1 taken on line 2—2 of FIG. 1;

FIG. 3 is a fragmentary cross-sectional view taken on line 3—3 of FIG. 1, showing a foundation support for the wall panel of FIG. 1;

FIG. 4 is a form used in the fabrication of an alternate foundation support for the wall panel of FIG. 1;

FIG. 5 is a fragmentary cross-sectional view of the alternate foundation support, the wall panel of FIG. 1 which is fabricated using the form of FIG. 4;

FIG. 6 is a plan view of a building structure made of wall panels embodying the present invention; and

FIG. 7 is a perspective view of the resultant concrete structure that is formed when concrete is poured and cured in the wall panel of the present invention.

Referring to FIG. 1 there is shown a composite wall panel generally indicated by reference character **10** which embodies the present invention. This panel may be conveniently made in a 4 foot x 8 foot x 4 inch dimension. However, other sizes may be utilized to equal advantage.

The wall panel comprises a core **12** of plastic insulating material. The insulating material may be selected from a variety of materials, such as foamed polystyrene, expanded polystyrene or foamed polyurethane. As shown particularly in FIG. **2**, the core **12** has opposed faces **14** and **16** which are respectively covered by outer skins **18** and **20**, respectively. Skins **18** and **20** extend beyond the upper edge **40** of core **12** to form a continuous upper trough **42**, as shown in FIG. **3**. These skins may be conveniently secured to the core at the time of manufacture and can be made from a number of widely available construction materials for inner or outer walls. For example, if the structural panel is used for an outside wall the skin **18** can be a vinyl skin which simulates outside vertical siding and the skin **20** may be formed from self-skinned polyurethane foam for an inside wall. If the panels are to be used for interior walls they may be formed with the polyurethane foam on both sides or with Masonite, wall board, or other interior facing material.

The core **12** has a first set of grooves **22** adjacent face **14** and grooves **24** adjacent face **16**. Grooves **22** and **24** extend vertically downward from trough **42**. Grooves **22** and **24** have diverging side walls **26** and **28**, respectively, for a purpose to be described later. Core **12** has a second set of generally horizontal grooves intersecting the vertical grooves. This set is comprised of grooves **30** intersecting grooves **22** along face **14** and a set of grooves **32** intersecting grooves **24** adjacent wall **16**. Grooves **30** and **32** have beveled side walls **33** and **35**, respectively. Core **12** also has a set of passages **34** extending between grooves **22** and **24**.

If desired, core **12** may also have a series of vertical passages (not shown) formed in between sets of vertical grooves **24** to provide access for electrical outlets via suitable openings through the panels **10**.

The core **12** also has a channel-shaped recess **48** adjacent its side edges. The recess **48** is defined by lips **50** running the height of the core **12**. The lips **50** permit the installation of a clip **52** which has end plates **54** fitted over the back sides of lips **50** to hold core **12** against an adjacent panel, in addition to adhesive placed along lips **50** as described below. The center section of the clip **52** has side walls **56** which act to keep the lips **50** in lateral alignment.

To erect a panel **10** it is placed on one of the foundation supports shown in FIGS. **3** and **5**. The foundation support **60**, shown in FIGS. **3** and **1**, comprises a series of channel-shaped blocks **64** which are placed in end-to-end relationship over a suitable foundation wall **66** which runs along the lower edge of the proposed wall. The foundation blocks **64** have a channel **68** with converging side walls and an upper edge **70**. A series of spaced brackets **72** span the channel **68** and have upwardly extending tabs **74** that position the bottom edge **76** of a wall panel **10** along the channel **68**. A reinforc-

ing rod 71 may extend into the channel 68 through a joint between blocks from a concrete floor 73.

An alternate manner of foundation support is found in FIG. 5 in which a channel 80 with converging side walls is formed in a poured concrete slab 82. This is particularly appropriate for interior walls where the slab 82 forms a floor for the building. To accomplish the formation of channels 80 a form 84 is placed over a W-shaped reinforcing rod 87 on the subsurface 86 before the concrete slab 82 is poured. As is apparent in FIG. 4, form 84 has diverging flexible side walls 88 with longitudinal ribs 90 for reinforcing. In addition, it has laterally projecting tabs 89. The concrete slab 82 is poured around the form 84. When the concrete slab 82 has cured, the form 84 is pulled out of the slab upwardly and the side walls 88 deform to permit withdrawal of the form 84, thus leaving the open channel 80 with the reinforcing rods 87. For this foundation support the wall panel 10 is supported by the brackets 72 which rest in recesses left by the tabs 89 on the upper surface 92 of the slab. As a result, the brackets 72 are flush with the upper surface 92 of the slab. The clips 74 hold the bottom edge 76 of the wall panel 10 in alignment.

When the wall panels 10 are to be incorporated in the building there are special panels provided for the corners and T sections, as shown in plan view in FIG. 6. A typical corner panel 96 comprises an upright core 98 having an L-shaped cross section with a height and thickness equal to that for a panel 10. Core 98 has skins 100 and 102 which extend beyond the upper edge of core 98 to form a continuous trough equal in depth to the depth of trough 42 in panels 10. Core 98 has a set of vertical grooves 108 having diverging side walls adjacent its opposed facing sides and these grooves 108 extend from the open trough to the bottom of the core 98. A second set of horizontal grooves 110, having diverging side walls, intersects the vertical grooves 108. These sets of grooves 110 are positioned to align with the sets of horizontal grooves in the panels 10. Core 98 also has passages 112 which interconnect adjacent vertical grooves 108. At the end of core 98 there are formed channel-shaped recesses 114 defined by lips 116 which receive the clips 52 in order to hold the T-shaped section to an adjacent panel.

The panels may also be formed as a T-section 120 when an interior wall ends in an exterior perimeter wall. The T-shaped panel 120 comprises a core 122 of plastic foamed material having a T-shaped cross section. A skin 124 is formed on a face 126 of the core 122 and skins 128 and 130 to cover the faces formed by the intersection of the arms with the base of the T. The width and thickness of the legs of the T are equal to that for panels 10 and panels 96. A first set of vertical grooves 132, having diverging side walls, is formed in the opposed faces of the core 122. These grooves 132 extend downward from a continuous open trough formed by extending skins 124, 128 and 130 beyond the upper edge of the core 122. This trough has the same depth as the trough 42 for panels 10 and the trough for panels 96. A set of horizontal grooves 134, having diverging side walls, is formed in the core to intersect the sets of vertical grooves 132. The set of grooves 134 is positioned to align with sets of horizontal grooves on adjacent panels 10 and 96. Passages 136 provide an interconnection to the core between adjacent vertical passages 132. T-shaped panels 120 also have channel-shaped recessed 138 in their ends defined by lips 141. As is apparent, these lips receive clips 52 which are used to hold panels 10 and 120 together.

When a building is to be erected using the panels described above, foundation supports are first laid out in the desired pattern for the house. For example, as in FIG. 6, there is shown a portion of a building comprised of panels 96 making up the corners, panels 10 forming the walls in between and T-shaped panels 120 permitting an interior wall panel to be connected into the perimeter wall. The foundation supports may be the ones, as shown in FIG. 3, for the perimeter wall and the supports in FIG. 5 shown for the interior wall extending between the perimeter wall. Once the foundation blocks are in place the panels are simply placed on brackets 72 which span the channel in the foundation support. The plastic core makes the panels extremely light and easily managed by a single workman. Once the panels are aligned and secured end to end with a suitable adhesive applied to the lips 50 of panels 10, lips 116 of panels 96 and lips 141 of panels 120 and with clips 52, if desired, the structure is ready for filling with a unitary structural curable material, such as concrete. This is done simply by pouring the concrete into the continuous upper trough 42 formed through and between the upper edges of the panels 10 and also through the upper edges of panels 96 and 120. The continuous upper trough permits a highly effective distribution of cement which flows downward through the vertical sets of passages and through the horizontal passages, lateral passages and finally into the channels 68 or 80 formed in the foundation blocks. To facilitate the pouring of the concrete in a rapid fashion it may be desirable to pour at several locations. However, the distribution effect of the open upper trough permits an entire house to be poured at a small number of locations.

Once the concrete has filled up the sets of passages and the lower channels and finally filled the continuous upper trough, it is permitted to cure. Once this is done what results is a structure which has a high degree of insulation and an unusual strength and rigidity for the amount of concrete utilized. As shown in FIG. 7, which is a perspective view of a panel in which the core and skins have been eliminated, the passages enable the formation of a unitary concrete supporting structure comprising a continuous upper beam 140 (formed by trough 42) supported by a set of vertical columns 142 (formed by grooves 22, 24) extending downward to the integral continuous bottom beam (not shown) formed by the channels in the foundation supports. A second set of lateral beams 144 (formed by grooves 30, 32) interconnect and extend between the sets of vertical columns 142 to give the structure additional rigidity. Finally, the cross beams 146 (formed by passages 34) interconnect adjacent vertical columns 142 to form a series of ladder-shaped columns supporting the continuous upper beam 140. This structure has a most efficient strength to weight ratio since the concrete is positioned in the perimeter portions of the wall where it can resist bending and wind forces to the greatest extent. In order to maximize the amount of concrete adjacent the perimeter of the panels all the grooves have diverging sides which produce an outer face for the concrete posts 142 and 144 which are wider than their interior face.

The above panels are so effective that they can be assembled into a completed wall assembly for a house by

several unskilled workmen within several days, thereby minimizing to a high degree the amount of labor necessary to construct a house using this technique. Various supporting functions, such as electrical lines and plumbing lines may be conveniently run through the additional passages, if provided, and may also be partially formed in a factory to further minimize work on the site. It should be pointed out that the plastic insulating material gives such a high degree of insulation that it far exceeds that available in residential types of construction. Furthermore, the plastic outer skins enable the panels to be precolored with durable finishes that do not need the high maintenance presently necessary for conventional facing materials.

While the preferred embodiment of the present invention has been described, it will be apparent to those skilled in the art that it may be produced in other forms without departing from the spirit and scope of the present invention.

Having described the invention, what is claimed as novel and desired to be secured by Letters Patent of the United States is:

1. A building structure comprising:

a plurality of wall panels positioned upright in end-to-end relationship to form a continuous wall structure for a building, said panels comprising cores of plastic insulating material having spaced opposed faces, a top edge and a bottom edge, said core having skins overlying the opposed faces and extending beyond the top edges of the cores to form a continuous upper trough extending between said skins and through and between said panels and forming a continuous upper trough around the periphery of said wall;

said cores having first sets of generally vertically extending grooves in the opposed faces thereof forming, in combination with the skins, first sets of generally vertical passages connected to and extending downward from said trough to the lower edges of said cores;

said cores also having second sets of passages extending between said opposed faces and interconnecting said first sets of passages; and

a unitary structural material filling the first and second sets of passages and the trough to form a continuous upper beam around the periphery of said wall supported by an integral open web structure.

2. A building structure as in claim **1** wherein said cores have third sets of grooves aligned to form sets of continuous grooves through and between adjacent panels in the opposed faces of the cores intersecting the sets of generally vertical grooves and forming, in combination with the skins, third sets of passages interconnecting said generally vertical passages to form networks of passages adjacent said skins, said third sets of passages being filled with said unitary structural material.

3. A building structure comprising:

at least two wall panels positioned upright in end-to-end relationship, said panels comprising cores of plastic insulating material having spaced opposed faces and a top and bottom edge and skins overlying the opposed faces and extending beyond the top edges of the cores to form a continuous upper horizontal trough through and between both panels;

said cores having first sets of generally vertically extending grooves in the opposed faces thereof forming, in combination with the skins, first sets of generally vertical passages extending downward from said trough to the lower edges of said cores;

a unitary structural material filling the sets of passages and the trough to form a continuous upper horizontal beam supported by integral vertical posts;

a generally channel-shaped foundation support having the open end of the channel facing upward; and

means for supporting the lower edge of said wall panels over and along said channel, said unitary structural material from said first sets of passages filling said channel to form a continuous lower beam interconnecting said first sets of passages.

4. A building structure as in claim **3** wherein said foundation supports are formed from concrete blocks having a channel-shaped cross section and adapted to be positioned end to end to form said channel-shaped support.

5. A building structure as in claim **3** wherein said foundation support comprises a continuous concrete slab having a channel therein, said channel being formed by a yieldable form positioned in the concrete slab during pouring and removable after the concrete cures to form said channel-shaped support.

6. A building structure as in claim **3** wherein said means for supporting said panels over said channel comprises a plurality of brackets spanning said channel and having a pair of tabs extending upward for forming a guide on which the bottom edge of the panels rests.

7. A building structure as in claim **1** wherein the skins on one face of the panels are formed as exterior siding panels for said building and the skins on the other face of the panels are formed as interior wall panels.

8. A building structure as in claim **1** wherein said cores are formed from foamed material.

9. A building structure as in claim **10** wherein:

said third sets of passages extend generally at right angles with respect to said first sets of passages; and

said second set of passages interconnect pairs of passages in said first set.

10. A building structure as in claim **1** wherein said cores have recesses adjacent the point at which said continuous trough passes from one panel to another and wherein said building structure further comprises clips received in said recesses to hold said panels in end-to-end relationship during erection of said panels.

11. A building structure as in claim **1** wherein said unitary structural material is concrete.

12 A building structure as in claim **1** wherein said panels are secured in end-to-end relationship by an adhesive applied to their side edges.

13. A building structure as in claim **5** wherein said yieldable form has lateral tabs forming recesses on opposite sides of said channel for receiving brackets supporting said panels over said channel.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,826,052 Dated July 30, 1974

Inventor(s) Carlos A. Tenorio

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 1, "recessed" should read --- recesses ---.

Column 6, line 43, "Claim 10" should read --- Claim 1 ---.

Signed and sealed this 5th day of November 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents