

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

0 392 610
A2

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: **90200842.4**(51) Int. Cl.⁵: **E04C 2/26**(22) Date of filing: **09.04.90**(30) Priority: **10.04.89 US 335445**(43) Date of publication of application:
17.10.90 Bulletin 90/42(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE(71) Applicant: **Harrington, Bruce**
145 Rosewood Circle
Jupiter, FL 33458(US)(72) Inventor: **Harrington, Bruce**
145 Rosewood Circle
Jupiter, FL 33458(US)(74) Representative: **Mittler, Enrico et al**
c/o Marchi & Mittler s.r.l. Viale Lombardia, 20
I-20131 Milano(IT)(54) **Wall units for constructing buildings.**

(57) Wall units for buildings are prepared by positioning pieces of insulation (30-33) in a mold (20) with furring members (42) between the blocks of insulation (30-33). Reinforcement members (46) can also be positioned in the mold (20), and preferably are secured to the furring members (42). A cementitious material is poured in the mold (20) and cured to form a light weight wall unit having good strength

and insulating characteristics. Several wall units are cast in suitable shapes to form, when assembled, the walls of a building. Suitable fastening structure (64, 65) can be incorporated into the wall units to facilitate the interconnection of adjacent units. Additional fastening structure (60, 61) can be provided in the wall units by which the wall units can be secured to a foundation.

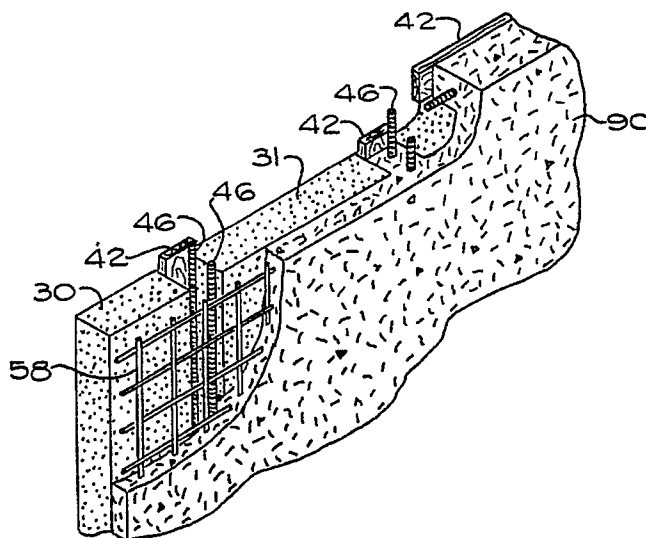


FIG 6

EP 0 392 610 A2

Background of the Invention

Field of the Invention

This invention relates generally to methods and apparatus for constructing buildings, and more particularly to wall units for assembly into building constructions.

Description of the Prior Art

The erection of buildings is a time consuming and expensive process. Attempts to simplify the process have often resulted in a reduction in the quality of the finished product. A properly constructed building should be strong, durable, and have good insulating characteristics. Attempts to speed the process, or to reduce its cost, usually result in a reduction in the quality of at least one of these characteristics. Pre-formed wall units have been constructed but typically are heavy and difficult to transport, and also are difficult to position and to secure. Buildings constructed according to these systems are often limited in style and design.

It would be desirable to provide a building construction system by which buildings could be quickly assembled by a relatively few workers. Buildings constructed with the system should preferably be relatively inexpensive. It would further be desirable, however, that gains in speed and cost of construction be made not at the sacrifice of strength, durability, insulating characteristics, or design flexibility.

Summary of the Invention

It is an object of the invention to provide a building construction system by which buildings can be constructed in shorter periods of time, or with comparatively fewer man-hours of labor, than is possible with conventional building construction techniques.

It is another object of the invention to provide a building construction system which has good insulating properties.

It is still another object of the invention to provide a building construction system with good strength and durability characteristics.

It is yet another object of the invention to provide a building construction system which can be utilized to produce buildings of several different styles and designs.

These and other objects are accomplished by

a building construction system comprising a plurality of wall units. The wall units are prepared by placing pieces of insulation, preferably polystyrene blocks, into a mold. Furring members can be placed between the insulation blocks, as well as reinforcement members. The reinforcement members can be attached directly to the furring members to secure their position within the mold. A cementitious material is then poured into the mold to form an individual wall unit.

The insulation and furring members can be positioned in a mold having at least one facing surface and a plurality of perimeter side edges, and preferably rest on the facing surface of the mold. The cementitious material is poured into the mold and hardens. The furring members and insulation are provided substantially at the face of the completed wall unit which becomes the interior surface of the wall.

Wall units prepared according to the invention have good construction properties. The insulation provides light weight with good insulating characteristics, while the cementitious matrix and reinforcement members provide good strength and durability characteristics. The furring members, being provided at the interior face of the wall unit, speed the attachment of wall panels and other items to the wall units at the construction site.

A layer of the cementitious material covers the insulation and furring members to provide an exterior wall surface. A stamp or other suitable molding device can be applied to the exterior surface while the cementitious material is still wet to provide a wall unit with a particular exterior appearance, for example, simulating brick. The exterior finish can be altered simply by changing the die used to stamp the exterior surface.

Fastening structure for securing the wall units to one another and to the foundation of the building can also be provided. The fastening structure for interconnection of the wall units can be metal plates which are cast into perimeter side portions of the wall units, and which align when the wall units are positioned at the building site. The metal plates are secured together by suitable means, such as welds. Alternatively, strapping plates can be attached across adjacent wall units to secure the wall units together. Suitable fastening structure for the strapping plates can be anchored into the wall units during construction. The fastening structure can also be utilized for the temporary attachment of lifting cables or the like for placement at the construction site.

The wall units are secured to a foundation preferably by structure adapted to receive one or more projections extending upwardly from the foundation or other surface. Clamping structure on the projections is adapted to press against portions

of the wall units to secure the wall units to the projections and to the foundation. The projections are preferably bolts, and the clamping structure is preferably a plate slidably mounted over the bolt. A threaded nut cooperates with threaded structure on the bolt to force the plate against a portion of the wall unit to secure the wall unit in place.

A furring member according to the invention has structure for engaging one or more reinforcement members so as to space the reinforcement members from the face of the mold as the cementitious material is poured. The reinforcement members will thereby be thoroughly embedded within the cementitious material to provide a durable wall construction. Additional reinforcement structure, such as wire mesh, can be laid into the mold prior to pouring and will rest on the blocks of insulation.

Door frame members and window frame members can be positioned in the mold prior to pouring so as to integrate window frames and door frames into the individual wall units. The door frame members and window frame members also serve as portions of the mold during pouring of the cementitious material to provide door openings and window openings in the completed wall units. Anchor structure adapted to extend into the cementitious material, when poured, is preferably provided on the door frame members and window frame members so that these members will become firmly secured to the cementitious material when it hardens.

The invention can be used to make a plurality of wall units in different shapes and sizes by changing the dimensions and design of the mold. The wall units are relatively light weight and can be fashioned in a location remote from the building site, and thereafter transported to the site when needed. The wall units are set in place, connected to the foundation, and interconnected with one another to quickly create a strong and durable building construction having good strength and insulating characteristics.

Brief Description of the Drawings

There are shown in the drawings embodiments which are presently preferred it being understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown, wherein:

Fig. 1 is a perspective view, partially broken away, of a wall unit according to the invention at a first stage of construction.

Fig. 2 is a plan view, partially broken away.

Fig. 3 is a cross-section taken along line 3-3 in Fig. 1.

Fig. 4 is a perspective view of a wall unit according to the invention at a second stage of construction.

Fig. 5 is a cross-section taken along line 5-5 in Fig. 4.

Fig. 6 is a perspective view of a completed wall unit according to the invention, broken away to show internal features.

Fig. 7 is a perspective view of a furring member according to the invention, broken away to indicate indefinite length.

Fig. 8 is a front elevation of a completed wall unit, partially broken away.

Fig. 9 is a cross-section taken along line 9-9 in Fig. 8.

Fig. 10 is a front elevation of an interconnected wall system.

Detailed Description of the Preferred Embodiments

The wall units of the invention are preferably constructed in molds as shown in Figs. 1-5. The mold 20 has at least one large area facing surface 22 with upstanding side edges 24-27 which are joined to one another at ends thereof and to the perimeter of the facing surface 22 to form the mold 20. The mold 20 can be made from several suitable materials, including wood.

Pieces of insulation such as the blocks 30-33 are placed into the mold 10 during an initial stage of construction. Polystyrene is a preferred insulating material because of its good insulation properties, light weight and durability. Other insulating materials could alternatively be utilized. The insulation can be cut to fit the mold 20 as well as to accommodate other items within the mold such as the window frame 38. The blocks 32-33 are accordingly of a reduced length relative to the blocks 30-31 to allow for the provision of the window frame 38.

The blocks 30-33 rest on the facing surface 22 of the mold 20. A plurality of furring members 42 are positioned on the facing surface 22 between the insulating blocks 30-33 and about the perimeter. The furring members 42 include a strip of furring material 43 fashioned from wood or any other suitable material. The furring members 42 preferably include anchor structure adapted to extend into the mold 20 so as to become embedded in the cementitious material when it hardens. The furring members 42 will thereby be securely fixed at the interior face of the completed wall unit, and can be used for the attachment of wall panels or other fixtures.

Reinforcement members are preferably positioned in the mold so as to become embedded

within the completed wall unit. The reinforcement members 46 should be supported in the mold a distance from the facing surface 22 so that the reinforcement members 46 will become embedded within the cementitious material. The reinforcement members are preferably elongated bars of a rigid material such as iron or steel. Other reinforcement materials are possible.

The reinforcement members 46 can be supported by engagement structure extending outward from the furring strips 43. This engagement structure can also serve to anchor the furring members 42 in the cementitious material. The engagement structure can be a plurality of posts 48 which extend substantially perpendicularly to the furring strip 43 and can be provided in two or more locations along the length of the strip 43 (Fig. 7). Each post 48 has structure for engaging and supporting the reinforcement members, such as the support arms 50. The support arms 50 engage the reinforcement members 46 to support the reinforcement members 46 a distance from the furring strips 43. The reinforcement members 46 become thoroughly embedded in the cementitious material when it is poured. One or more support arms 50 can be provided on each post 48 so that more than one reinforcement member can be supported at different heights above each furring strip 43, as depicted in Fig. 7.

The furring members 42 are preferably distributed in many locations about the facing surface 22 of the mold 20. It is preferable that the furring members 42 be present in several locations around the interior face of a completed wall unit so that there will be sufficient points of attachment for wall panels, plaster board and the like, or other interior fixtures. The furring members 42 are preferably provided between the blocks 30-33 and about the perimeter of the mold 20. Additional furring members 42 can be provided about the interior moldings such as the window frame 38.

Additional reinforcement can be provided in the form of heavy gauge wire ribbing 54, which can be positioned in the mold 20 atop the elongated reinforcement bars 46. A mesh or sheet 58 of wire or another high tensile strength material can be laid atop the reinforcement bars 46 and insulating blocks 30-33 to provide still further strength and durability in the completed wall unit.

Structure for fastening the wall units to a foundation and structure for fastening the wall units to one another is also positioned in the mold 20. The structure for attaching the wall units to a foundation can be provided by suitable channel forming means such as extensions 60 of the blocks 30-33 are used to form a groove in the cementitious material when it hardens. The extensions 60 can be positioned adjacent the facing surface 22 and bot-

tom side edge 24 of the mold 20 in one or more locations as shown in Fig. 3. The frangible insulation material forming the extensions 60 is removable by a knife or other suitable means to form a projection receiving channel 61 (Fig. 8) which can be used to secure the wall unit to the foundation.

The structure for attaching the wall units to one another can be provided as plates 64 which are positioned adjacent to the facing surface 22 of the mold and the perimeter side edges 24-27, and preferably in the corners of the perimeter side edges 24-27 as shown in Fig. 2. Each of the metal plates 64 has an anchor post 65 extending upwardly therefrom which becomes embedded in the cementitious material so as to anchor the attachment plates 64 in the completed wall units. The anchor plates 64 of adjacent wall units can be aligned and secured together by suitable means such as welds to attach the adjacent wall units to one another.

The wall units of the invention are relatively light in weight, however, it is preferable to provide structure within the wall units themselves to permit the attachment of lifting cables or machines. A preferable attachment structure is the threaded channel member 66. The channel member 66 has an anchor portion 68 which is adapted to engage the cementitious material when it hardens. A threaded engagement portion 70 is adapted to receive a bolt 74 or the like. The channel member 66 can be conveniently positioned in the mold 20 by the provision of suitable holes 76 through one of the side edge 24-27 of the mold 20. The bolt 74 can be passed through the hole 76 in the side 26 of the mold 20 and engaged to the channel member 66 positioned on the interior side of the mold 20, as shown in Fig. 2. The bolt 74 is tightened to secure the channel member 66 in place. The channel member 66 will become firmly embedded within the cementitious material when it is poured into the mold 20, and after the cementitious material has hardened the channel bolt 74 can be removed from the channel member 66 and the mold 20 to permit removal of the wall unit from the mold.

Door frame members and window frame members such as the window frame 38 can be positioned in the mold 20 so that door frames and window frames will be incorporated into the completed wall units. The window frame 38 is comprised of individual window frame members 79-82. The window frame members 79-82 preferably have anchor means which can be posts or screws 83 extending outwardly into the mold 20 where they become embedded in the cementitious material to anchor the frame members 79-82 into the wall unit. The window frame members 79-82 and any door frame members also serve as mold members when the cementitious material is poured, to form win-

dow openings and door openings in the wall units.

The cementitious material can be selected from a variety of flowable construction materials which will harden to a structural strength. The cementitious material is mixed and poured into the mold 20 by means known in the art and flows over and around the insulation blocks 30-33 and furring members 42. The posts 48 of the furring members 42, the reinforcement members 46, wire mesh 58, attachment plates 64 and their posts 65, channel members 66, and reinforcement grid 54 become thoroughly embedded in the cementitious material. The cementitious material is poured around, but not within the window frame members 79-82 so that the completed wall unit will have a suitable window opening. The cementitious material is poured into the mold until a layer 90 of the cementitious material covers all of the components within the mold except the window frame members 79-82 (Figs. 4-5). This layer 90 will form the exterior surface of the wall, while the furring members 42 will be provided at an opposite side of the wall unit which will form the interior surface of the wall. A suitable stamp can be applied to the exterior surface prior to curing to form a decorative finish such as the simulated brick facing 91 (Fig. 4).

The cementitious material will harden, and the above-described components will become securely embedded within the hardened cementitious material. The bolts 74 are removed from the channel members 66 to free the wall unit from the mold 20. The wall unit 94 is then removed by suitable methods, which might include inversion of the mold 20 or dismantling the mold 20. The above-described method can be utilized to form wall units of several designs and sizes. A complete set of suitable wall units can be pre-formed to erect the walls of a building.

Installation of the pre-formed wall units at the building site follows the initial preparation of the site, usually including the construction of the foundation. The foundation 98 is preferably formed with a number of upstanding projections 102 embedded therein. The projections 102 can be substantially L-shaped such that the base 103 of the L-shaped projection 102 will become firmly embedded within the foundation 98 when hardened. Other projection designs are possible. The projections are provided substantially about the perimeter of the foundation 98 or other floor structure and define the resting positions of the walls of the building. The wall units 94 can be formed at the construction site, but preferably are formed in a central facility and transported to the construction site as complete units.

The completed wall unit 94 can be positioned on the foundation 98 by suitable methods and with the use of suitable equipment. It is preferred, however, to install eye-bolts 106 in order to provide for

the attachment of lifting cables 108 or other suitable lifting structure. The eye-bolts 106 can be threadably engaged to the channel members 66 to provide a secure attachment site for hooks 110 associated with the lifting cables 108. Other means could alternatively be provided to lift the wall units 94.

The wall units 94 are positioned on the foundation 98 (or other suitable support surface) with the receiving channels 61 positioned over the projections 102 (Fig. 8). The receiving channels 61 are opened toward a face of the wall units 94 so that they may be sideways positioned over the upstanding projections 102. The receiving channels 61 can be in the form of hollow shafts, but preferably are formed as upwardly directed grooves. The ability to laterally align and position the projections 102 in the receiving channels 61 prevents the difficult and sometimes dangerous task of having to lower the wall units 94 vertically onto the projections 102.

The receiving channels 61 can include widened portions 111 which allow for the placement of clamping structure such as the clamping plate 113 and the nut 112. The nut 112 is adapted to threadably engage cooperating thread structure on the upstanding projections 102 and to press the clamping plate 113 against structure in the wall unit 94. Lips 114 formed from a portion of the widened opening 111 can engage the clamping plate 113. The wall unit 94 will thereby be firmly fixed to the foundation 98. Alternative clamping structure for engaging the projections 102 is possible.

The wall units 94 are set in place about the foundation 98 to construct the walls of the building (Fig. 10). Adjacent wall units are then secured to one another. The attachment plates 64 of adjacent wall units 94 abut one another when the wall units 94 are set in place on the foundation 98. The attachment plates 64 provide a means for attaching the wall units 94 to one another. The attachment plates 64 can, for example, be made of metal and welded together by suitable welds 118. It is possible to alternatively secure adjacent wall units 94 together by the provision of a strapping member 122 (phantom lines in Fig. 10) which can span between the adjacent wall units 94 along a top edge thereof. Bolts 126 can be provided through suitable apertures in the strapping member 122 and engage the channel members 66 to secure the strapping member 122 in place and the adjacent wall units 94 together. Caulking or other suitable sealing materials can be placed along the joint between the adjacent wall units 94 to seal the joint completely.

The wall units 94 are set in place about the foundation 98 and attached as described to form the exterior walls of the building. Corners can be

formed by beveling side edges of adjacent wall units forming the corner to permit the adjacent wall units to mate evenly with one another. The invention has been described particularly in the setting of a single story exterior wall construction. It is apparent, however, that the principles disclosed herein could be equally applicable to multi-story constructions and to interior walls, if desired.

This invention can be embodied in other forms without departing from the spirit or essential attributes thereof, and accordingly, reference should be had to the following claims, rather than to the foregoing specification, indicating the scope of the invention.

Claims

1. A method of making wall units, comprising the steps of:
positioning pieces of insulation in a mold having at least one facing surface and perimeter side surfaces extending out of the plane of said facing surface;
placing furring members on said facing surface;
pouring a cementitious material into said mold, said cementitious material at least partially embedding said side pieces of insulation and said furring members, said facing surface of said mold defining an inside surface of said wall unit, an opposite surface of said cementitious material defining an outside surface of said wall unit;
allowing said cementitious material to harden; and,
removing said wall unit from said mold, whereby completed wall units can be secured to and interconnected at a building site to form the walls of a building, and whereby said furring members will be provided at the interior surfaces of said wall units for the attachment of wall panels and other fixtures.

2. The method of Claim 1, wherein reinforcement members are positioned in said mold prior to said pouring of said cementitious material.

3. The method of Claim 2, wherein said reinforcement members are engaged to a side of said furring strip opposite said facing surface of said mold prior to said pouring step, whereby said reinforcement members will be thoroughly embedded within said wall unit during said pouring step.

4. The method of Claim 1, further comprising the step of positioning at least one of the group consisting of window frame member and door frame members within said mold prior to said pouring step, said frames members extending from said facing surface of said mold substantially coextensive to said perimeter side surfaces of said mold, said cementitious material being poured around the perimeter of said frames, whereby said wall units

will include at least one of pre-formed window openings and pre-formed door openings.

5. The method of Claim 1, further comprising the step of securing attachment members having first engagement means within said mold by positioning said attachment members adjacent an aperture in one of said perimeter sides of said mold, positioning second engagement means from an opposite side of said perimeter side of said mold through said aperture, and engaging said second engagement means to said first engagement means, whereby said attachment member will be held within said mold and will become embedded in said wall unit during said pouring step, and said first engagement means can be removed from said attachment members and from said perimeter side of said mold to permit removal of a wall unit from the mold.

6. The method of Claim 1, further comprising the step of positioning surface engaging means within said mold prior to said pouring step.

7. The method of Claim 6, wherein said surface engaging means comprises at least one receiving channel forming means provided along one of said perimeter sides of said mold prior to said pouring step, said receiving channel forming means being adapted to create a receiving channel in said cementitious material, said receiving channel extending inward from the perimeter of said wall unit along said inside face, said receiving channel being adapted to receive fastening means.

8. The method of Claim 7, wherein said receiving channel forming means is a piece of said insulation, and further comprising the step of removing said channel forming insulation after said cementitious material hardens.

9. The method of Claim 1, further comprising the step of imprinting a design on said outside surface of said wall unit prior to hardening of said cementitious material.

10. A cementitious wall unit having an inside face, an outside face, and perimeter side edges, comprising:
at least one piece of insulation embedded within the wall unit; and,
at least one furring member disposed along said inside face.

11. The wall unit of Claim 10, further comprising at least one reinforcement member embedded within said wall unit.

12. The wall unit of Claim 11, wherein said furring members comprise support means extending inwardly from said inside face, said support means being adapted to engage said reinforcement member.

13. The wall unit of Claim 10, further comprising mesh reinforcement means embedded within said wall unit.

14. The wall unit of Claim 10, further comprising means for engaging said wall unit to a support surface, said engagement means comprising a receiving channel extending upwardly from a bottom side edge of said wall unit and adapted to receive an upwardly extending projection from said support surface.

15. The wall unit of Claim 14, wherein said receiving channel of said wall unit comprises a groove, said groove extending upwardly from said bottom side edge of said wall unit along at least one of the group consisting of said inside face and said outside face, whereby said groove can be visually aligned with said upwardly extending projections on said support surface and said wall units can be engaged to said support surface by lateral movement of said wall units.

16. The wall unit of Claim 15, wherein said grooves further comprise a transverse groove communicating with an upper portion of said upwardly extending groove, said transverse groove being adapted to receive downwardly adjustable engagement means attached to said projections and adapted to press against a bottom side portion of said transverse groove to press said wall unit to a support surface.

17. A method for erecting the walls of buildings, comprising the steps of:

(a) positioning at least one piece of insulation and at least one furring member within a mold having perimeter side edges and at least one facing surface, and said furring member abutting said facing surface;

(b) pouring a cementitious material into said mold to at least partially embed said pieces of insulation and said furring members;

(c) curing said cementitious material to form a monolithic wall unit;

(d) repeating steps (a) - (c) to produce a plurality of wall units; and,

(e) affixing said wall units to a support surface.

18. The method of Claim 17, wherein said positioning step (a) further comprises the step of positioning reinforcement members in said mold.

19. The method of Claim 18, wherein said reinforcement members are engaged to a side of said furring members opposite said facing surface of said mold, whereby said reinforcement members will become thoroughly embedded in said cementitious material and will anchor said furring members at a surface of said wall unit.

20. The method of Claim 17, wherein during said pouring step (b) a layer of cementitious material is applied to cover said pieces of insulation and said furring members and to form an outside surface of said wall unit.

21. The method of Claim 20, wherein molding

means are applied to said outside surface prior to said curing step (c) to produce a desired exterior finish on said outside surface of said wall unit.

22. The method of Claim 17, further comprising the placement of at least one of door frame members and window frame members in said mold during said positioning step (a).

23. The method of Claim 17, wherein said pieces of insulation are polystyrene.

24. The method of Claim 17, wherein said positioning step (a) comprises the positioning of engagement means in said mold, and wherein said assembling step (d) comprises the utilization of said engagement means to lift said wall units.

25. The method of Claim 24, wherein said assembling step (d) comprises the step of attaching strapping to the engagement means of adjacent wall units to secure said adjacent wall units together.

26. The method of Claim 17, wherein said positioning step (a) comprises the provision of surface engagement means in said wall units, and wherein during said assembling step (d) said surface engagement means are utilized to attach said wall units to said support surface.

27. The method of Claim 17, wherein plate means are positioned in said mold during said positioning step (a) so as to be sideways aligned in said wall units during said assembling step (d), and further comprising the step of welding said plates during said assembling step (d) to secure adjacent wall units together.

28. The method of Claim 17, further comprising the step of forming receiving channels in said wall unit, said assembling step (d) comprising the steps of aligning projections extending upwardly from said support surface with said receiving channels formed in said wall units, positioning said receiving channels of said wall units about said projections, and engaging the same to one another.

29. The method of Claim 28, wherein said receiving channel in said wall units comprises an upwardly extending groove.

30. The method of Claim 29, wherein said assembling step (d) comprises affixing plate means to said projections means, said plate means being adapted to engage portions of said receiving grooves to secure said wall units to said support surface.

31. A furring member, comprising:
an elongated furring strip;
at least one reinforcement member; and,
means for engaging said reinforcement member to said furring strip, whereby said furring member can be positioned in a mold and can be cast in a wall unit formed from a flowable material, the flowable material surrounding and hardening about the reinforcement member to secure the furring strip to

the surface of resulting wall unit and to reinforce the wall unit with said reinforcement member.

5

10

15

20

25

30

35

40

45

50

55

8

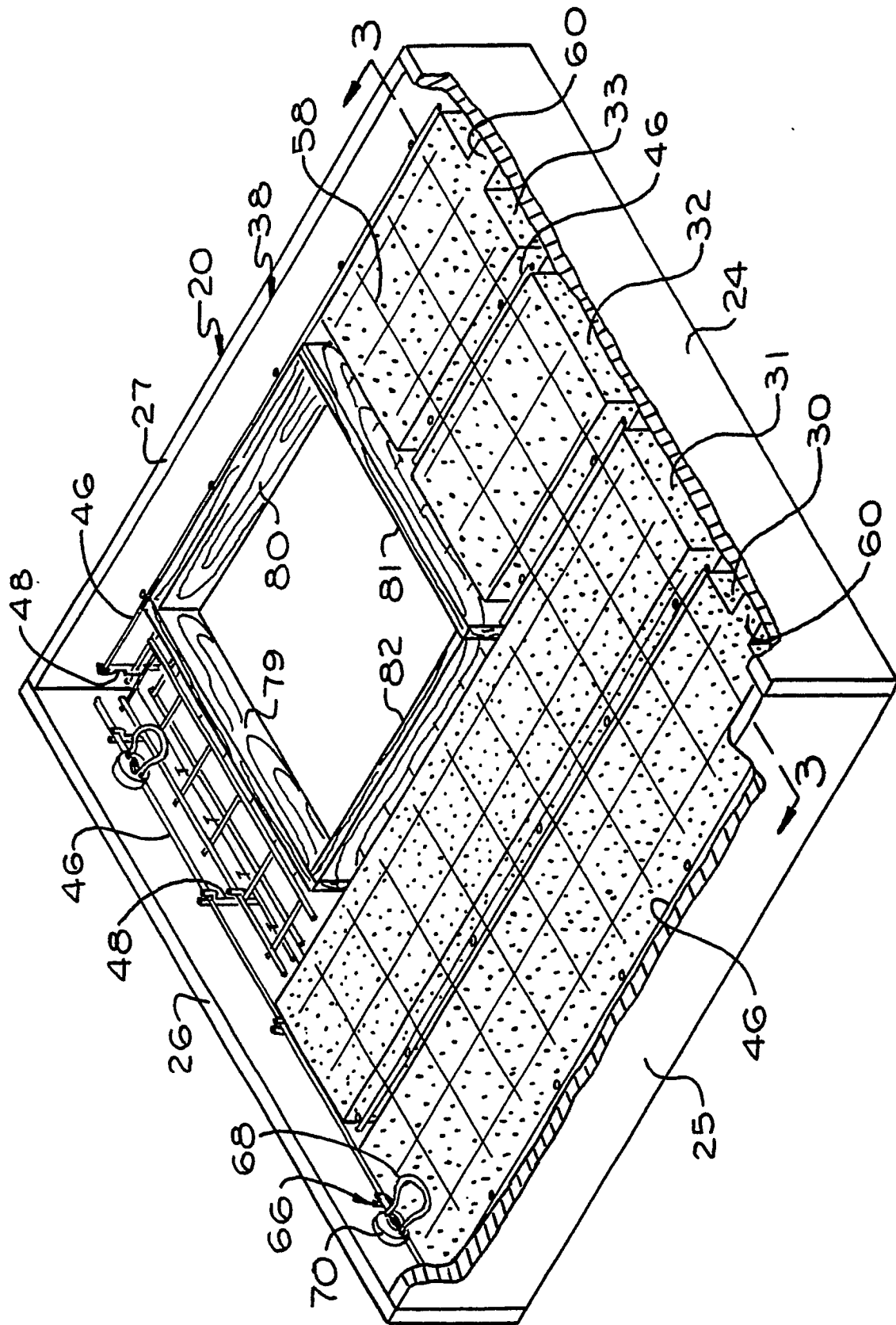
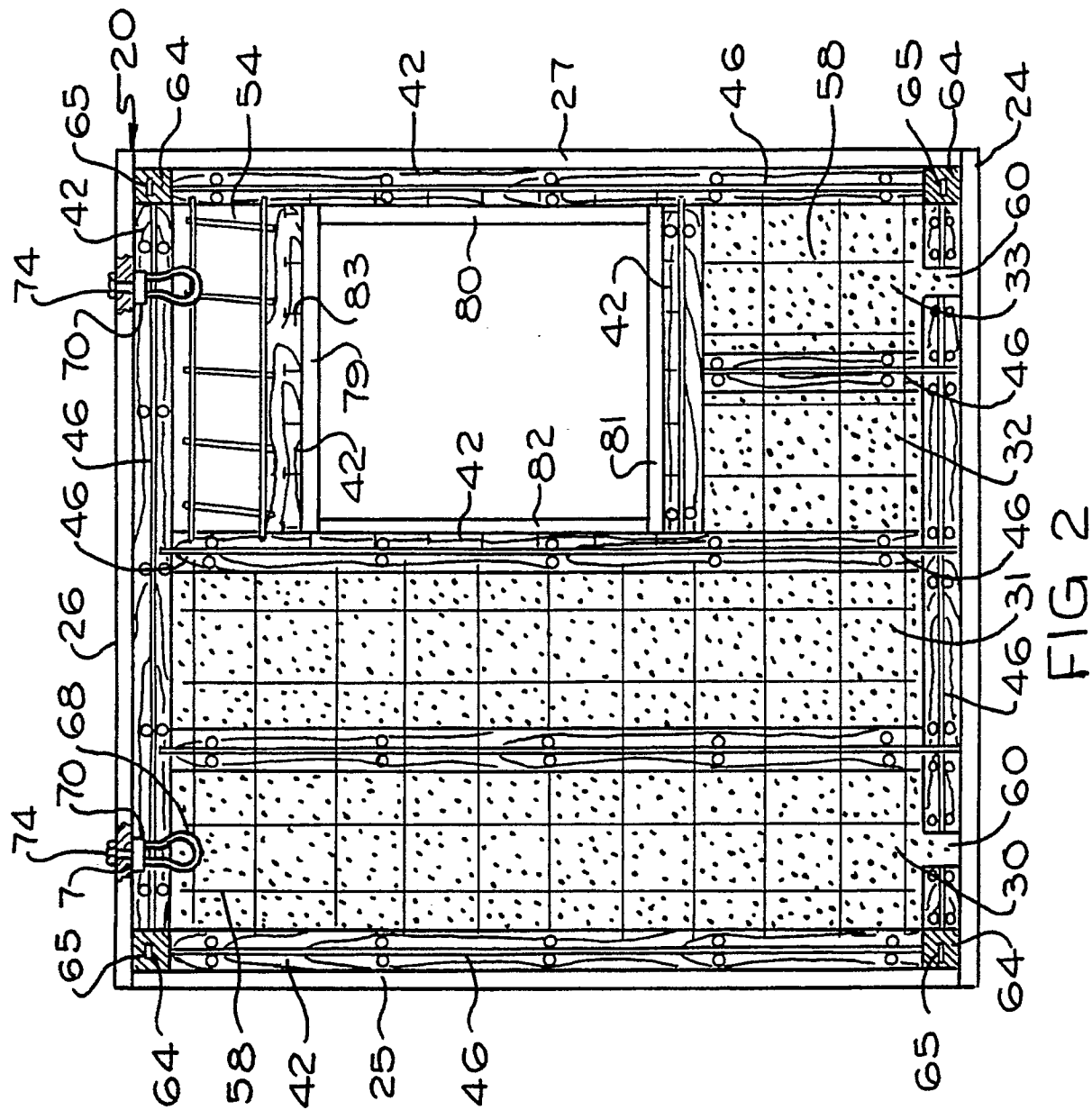


FIG 1



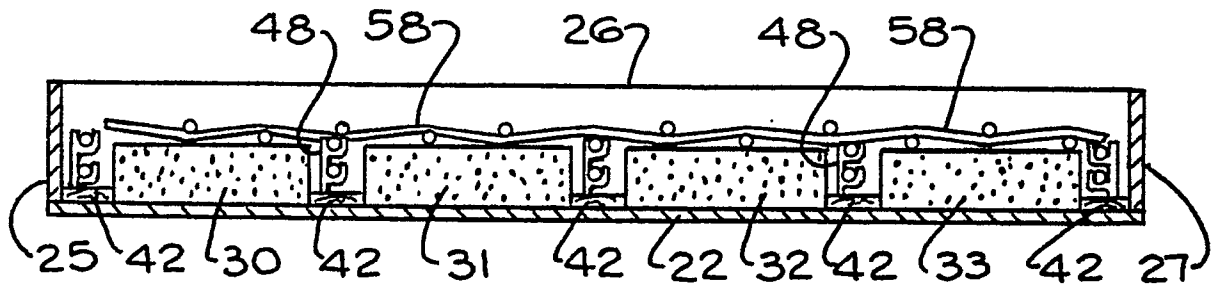


FIG 3

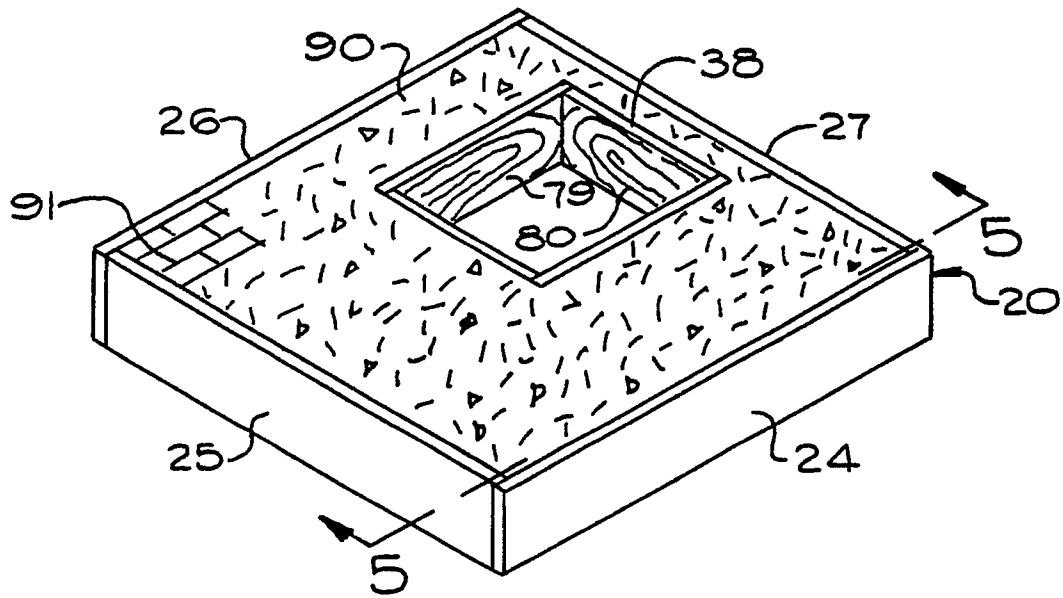


FIG 4

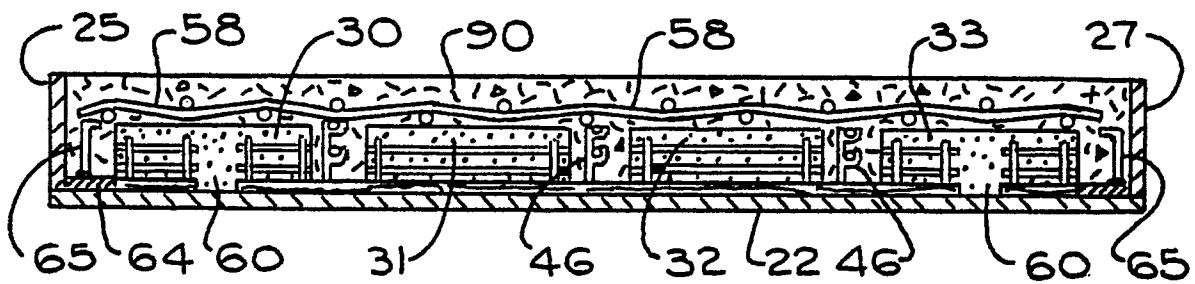
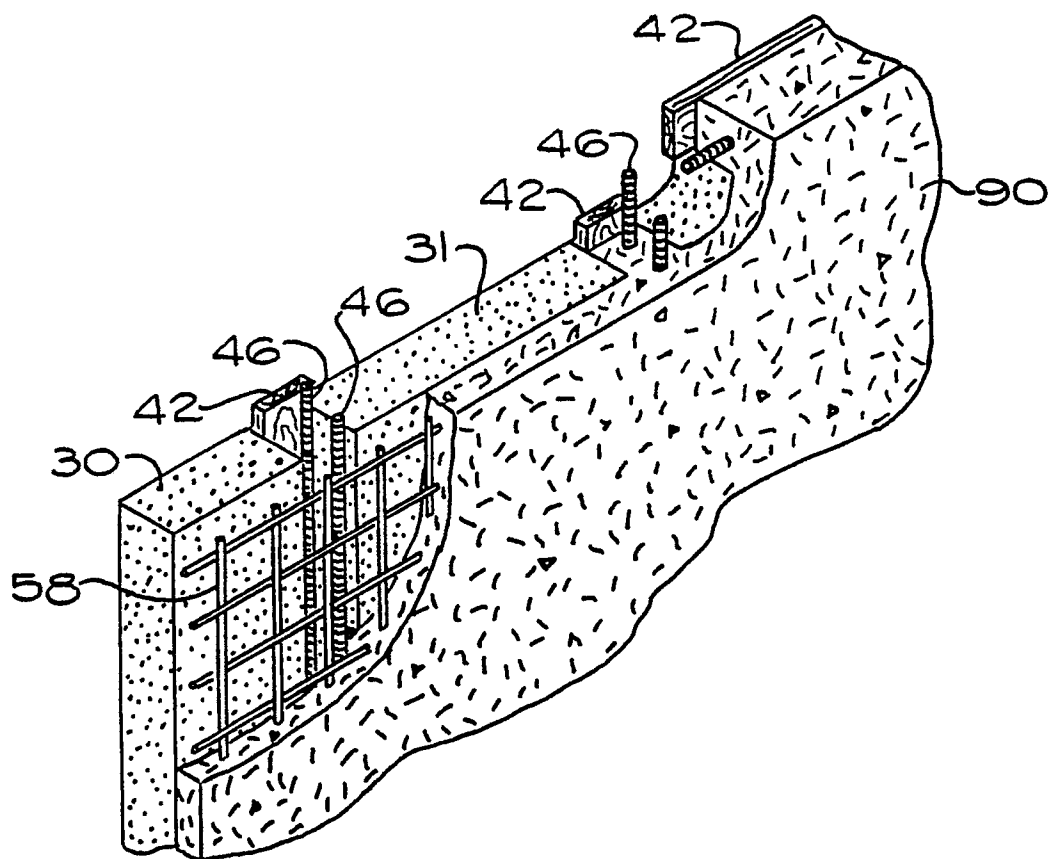
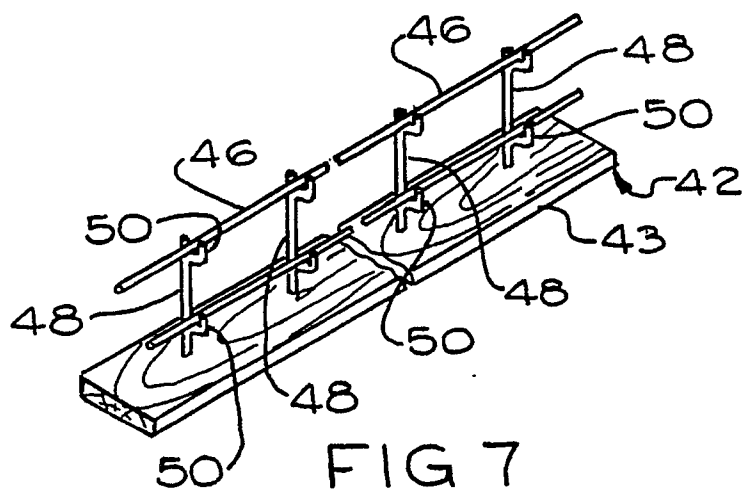
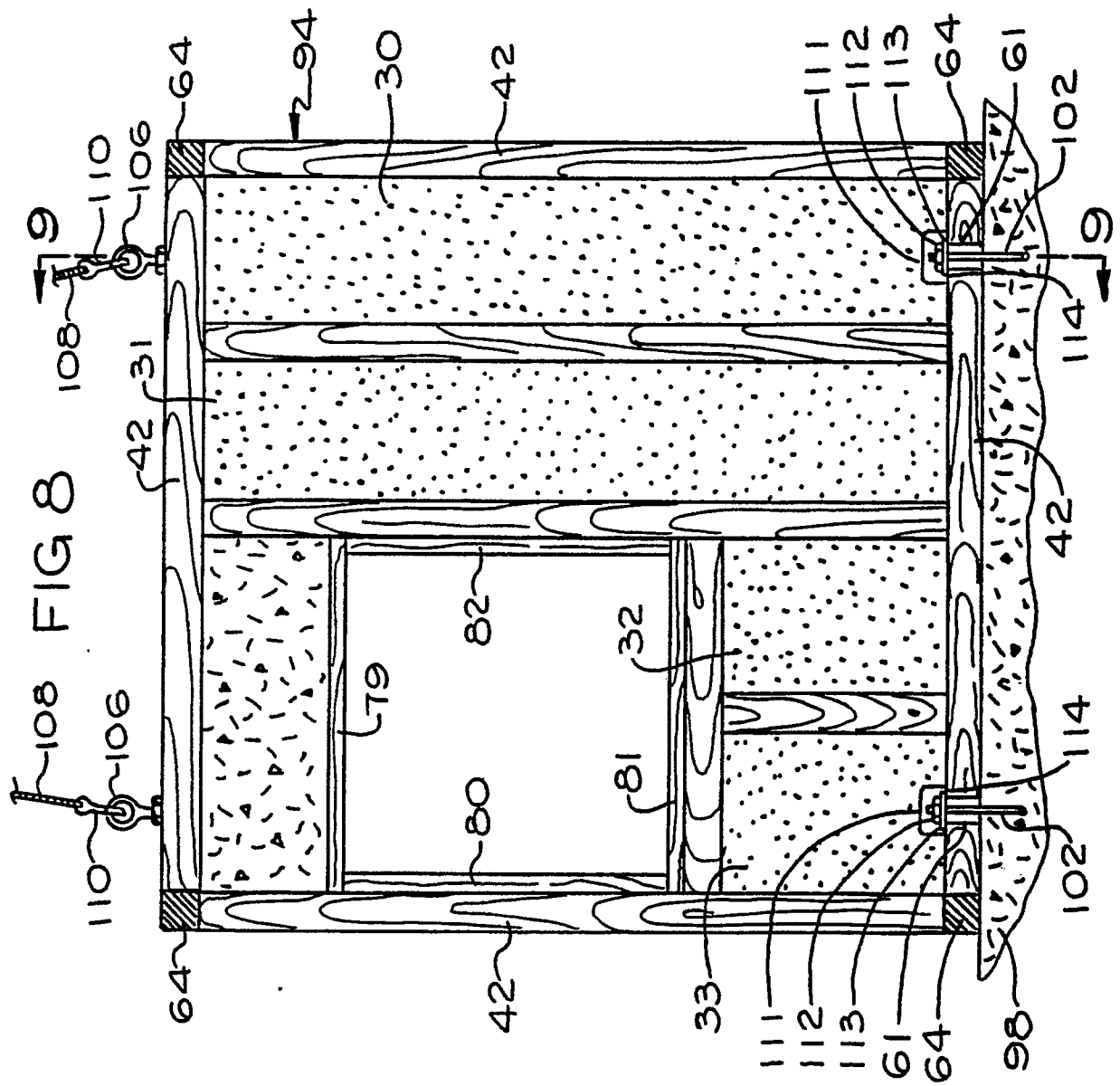


FIG 5





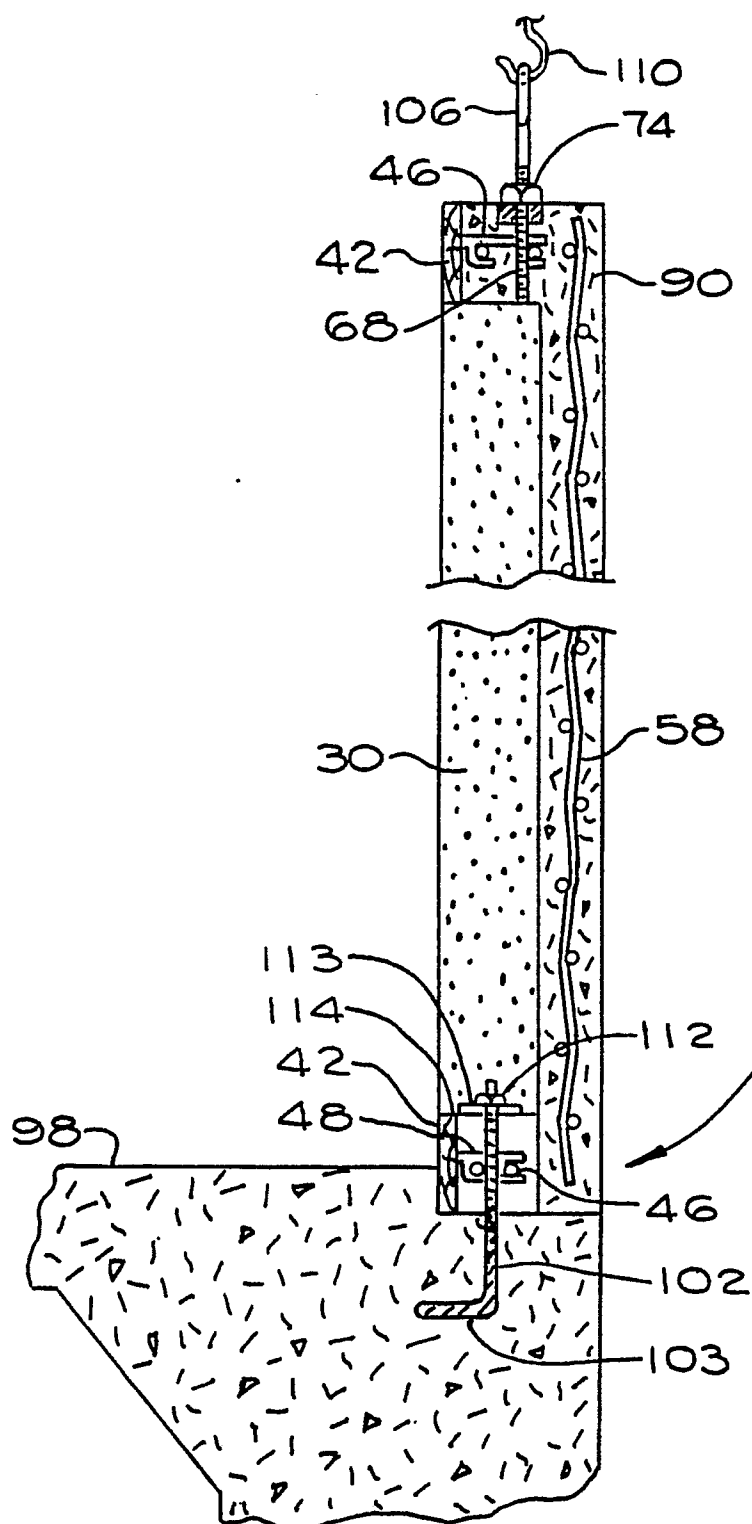


FIG 9

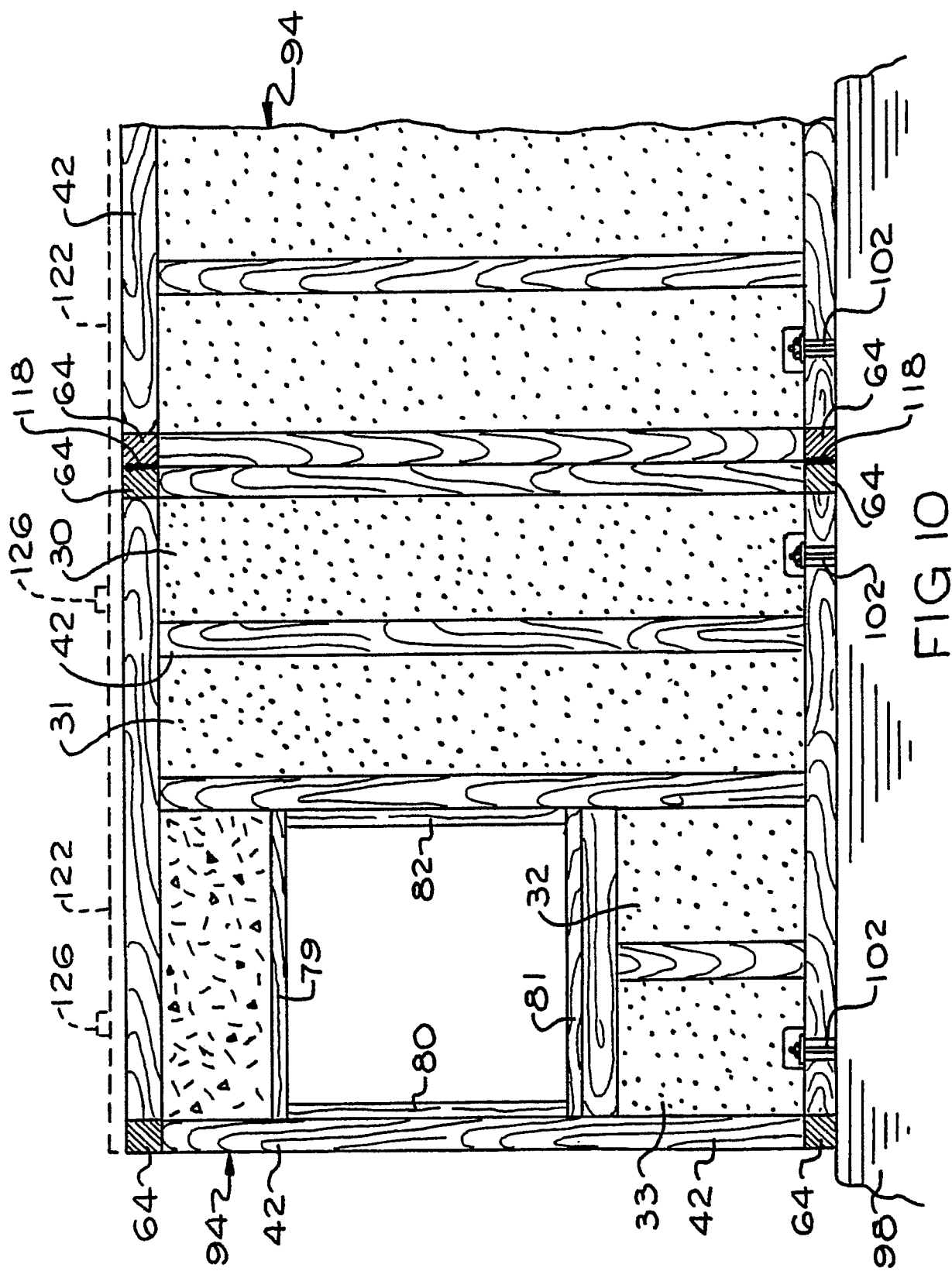


FIG 10