United States Patent [19]

Reps

[11] **3,857,217**

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[54] **LIGHTWEIGHT, RIGID STRUCTURAL PANEL FOR WALLS, CEILINGS AND THE LIKE**

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[51] **Int. Cl.** **EO4c 1/10,** EO4c 2/36

[58] **Field of Search** 161/69, 68, 159; 52/576, 52/577, 618, 625, 615, 405, 589, 576, 577, 580

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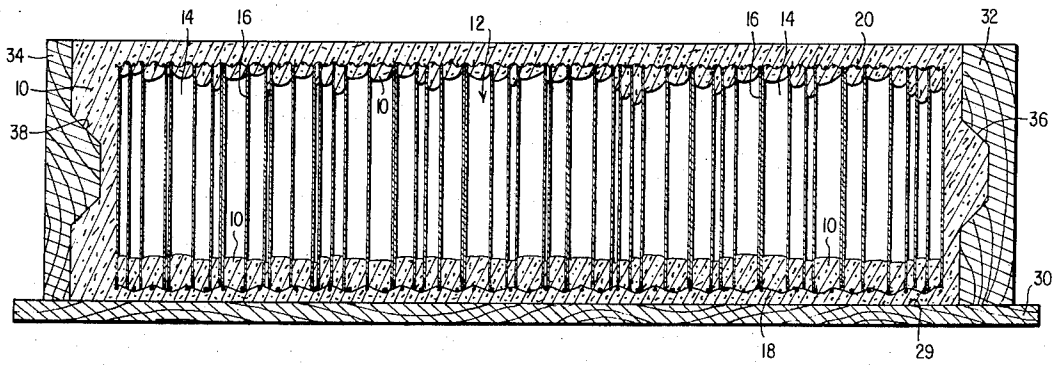
[57] **ABSTRACT**

A structural panel is disclosed having a core comprising a plurality of recesses or tubular-shaped passageways formed of web material which open onto opposite sides of the core. A first layer of woven material is positioned adjacent the openings on one side of the core and a second layer of woven material is positioned adjacent the openings on the other side of the core. A covering of cementatious material completely surrounds the core partially filling the recesses or tubular-shaped passageways to form the panel.

7 Claims, 4 Drawing Figures



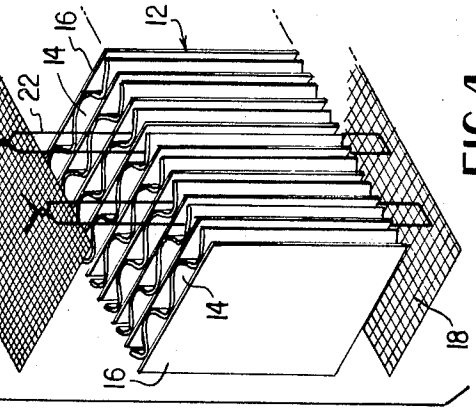


FIG. 4

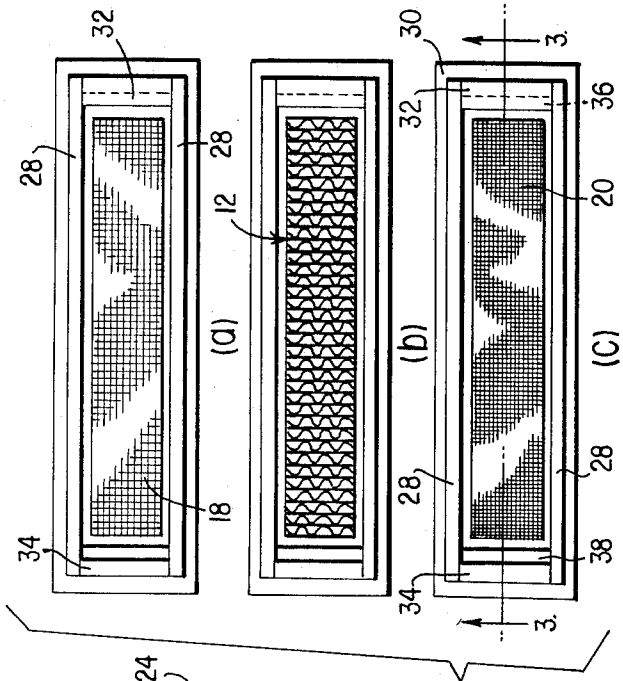


FIG. 2

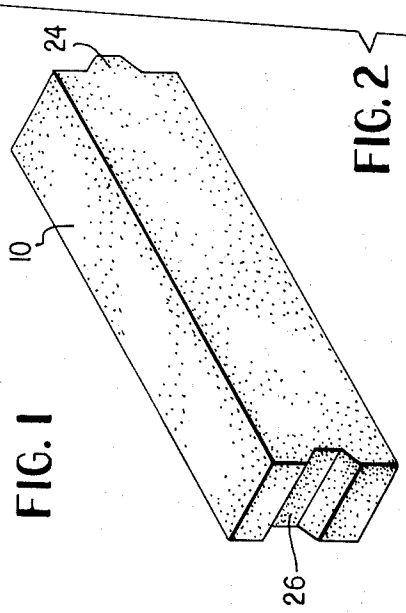


FIG. 1

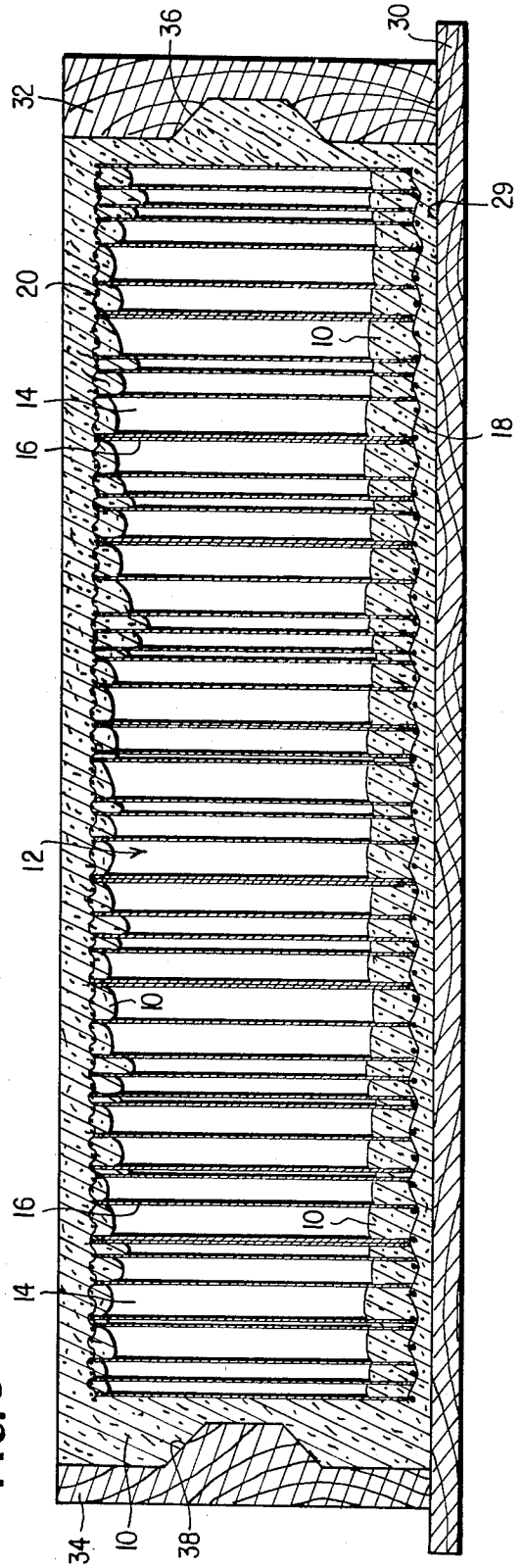


FIG. 3

LIGHTWEIGHT, RIGID STRUCTURAL PANEL FOR WALLS, CEILINGS AND THE LIKE

BACKGROUND OF THE INVENTION

This invention relates to structural panels and more particularly to a lightweight molded panel structure and method of manufacturing the molded panel.

There has long been a need in the construction industry for a structural panel which can be easily and rapidly fabricated by unskilled labor from readily available inexpensive materials in sizes ranging from that of a common building block to a single piece wall or ceiling structure while at the same time being rigid and of lightweight.

Present methods of manufacturing cement-type panels of any appreciable size usually result in a high rate of rejection due to warpage or other internal defects. To prevent warping during manufacture or serious deflection under load, many prior art panels employ reinforcing devices encased in the cement-type material such as steel rods or other honeycomb metal structures. The aforementioned devices have solved the warping and deflection problems to a degree in the fabrication of large size panels, however, in doing so, the weight of the panel is considerably increased due to the added weight of the metal being used which in turn makes the panel impractical or difficult to use in many applications. The cost of these prior art panels is also substantially increased due to the cost of the various metal reinforcing devices. In addition, such panels require a long curing time and readily transmit heat or cold due to the poor insulating qualities of concrete-type materials and metal.

The present invention overcomes the aforementioned problems by providing a panel which can be constructed in sizes large enough for use as entire walls or ceilings or in small block size. The panel is lightweight, extremely rigid and can be manufactured by unskilled labor with simple, low cost forming apparatus and of low cost material. The panel cures rapidly and has excellent insulating characteristics to temperature as well as being resistant to insects and other vermin. Further, because of its unique design, the panel of the present invention can be constructed of a great variety of materials without significantly altering its structural rigidity; thus, making it suitable for fabrication and use in underdeveloped countries where only building materials of a primitive nature exist.

SUMMARY OF THE INVENTION

The panel structure of the present invention comprises a core consisting of ribboned or webbed material which are joined together to form a plurality of recesses or tubular-shaped passageways. Each tubular-shaped passageway opens into an upper and a lower surface of the core. A first layer of large mesh, screen-like material is located adjacent the lower surface of the core so as to cover all of the openings in the lower surface. A second layer of small mesh, screen-like material is located adjacent the upper surface of the core so as to cover all of the openings in the upper surface. A covering of cementatious material completely surrounds the first and second layers of screen-like material as well as the portion of the core not covered by the first and second layers of screen-like material to form the panel.

In producing the panel, an amount of cementatious material is first poured into the bottom of a cavity in a mold. The shape and size of the mold cavity being the shape and size of the finished panel. The first layer of large mesh, screen-like material is centered on the cementatious material. The core is then centered on the first layer such that the openings on one surface of the core are adjacent the first layer. The core is then pressed toward the cementatious material causing the material to flow through the first layer and into the tubular passageways of the core a specified distance. A second layer of small mesh, screen-like material is centered on the core such that the openings on the other surface of the core are covered by the second layer. The remainder of the mold cavity is then filled with cementatious material and permitted to cure before removal from the mold as the finished panel.

The small mesh of the screen-like material of the second layer permits only a very small amount of cementatious material from passing through the mesh into the tubular passageways. The tubular passageways therefore remain substantially hollow, thus, considerably reducing the overall weight of the panel.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view in perspective of a building block or panel made according to the invention having tongue and groove construction at opposite ends of the block.

FIGS. **2** (*a-c*) is a plan view of the steps of forming the core in a mold of the building block or panel of the present invention.

FIG. **3** is a sectional view of the building block or panel taken along the lines **3** — **3** of FIG. **2**(*c*).

FIG. **4** is a perspective view showing the relationship of the elements forming the core of the building block or panel of the present invention.

DESCRIPTION OF THE INVENTION

Referring now to the drawing, the panel as shown in FIG. **1** consists of an outer surface or layer **10** of cementatious material. The cementatious material **10** can be gypsum, lime, lightweight concrete, wood fiber concrete, or cellular concrete. The present invention is not concerned with the particular cementatious material per se, and it will be understood that cementatious materials other than those specified above can be used as long as they are strong and of lightweight.

The panel also consists of a core **12** having a plurality of recesses or tubular-shaped passageways **14** formed of webbed material **16.** The webbed material **16** forming the core **12** may be of any suitable lightweight material such as paper, resin impregnated paper or the like. Paper impregnated with other chemicals can be used to render the paper fire, insect and vermin resistant.

The recesses or tubular-shaped **14** passageways may be semi-circular as shown, honeycomb, or other configurations which provide a rigid structure. The air entrapped in the recesses greatly increase the insulating properties of the panel.

A layer of reinforcing material **18** is positioned adjacent the openings of the recesses **14** on one side of the core **12.** The reinforcing material **18** serves to strengthen the panel and render the core **12** more rigid and resistant to flexing under load. The reinforcing material **18** can be steel wire, wire fabric which is welded, woven or twisted, filaments of other metals, woven fi-

bers of jute, hemp, bamboo, cane or the like. The reinforcing material **18** also serves to protect the core **12** from damage due to an impact on the surface **10** adjacent the material **18** as well as prevent cracking of the surface **10** as a result of such impacts. The reinforcing material **18** can be in the form of a woven sheet made of the aforementioned materials or it may be in the form of metal filaments or non-metallic fibers dispersed throughout the mass of the cementatious material forming the outer surface **10.** If the reinforcing material **18** is a sheet of woven material, the mesh of the material should be sufficiently large to permit cementatious material forming the outer surface **10** to enter the recesses **14.** Such a mesh would be, for example, one of four to the linear inch.

A layer of material **20** substantially impervious to the passage of the cementatious material forming the outer surface **10** is positioned adjacent the openings of recesses **14** on the other side of the core **12.** The layer of material **20** can be woven of the same materials previously described with respect to reinforcing material **19;** however, the mesh of the material **20** would be very fine, for example, on the order of ten to the linear inch. The layer of material **20** serves a dual function, one of which is to provide further rigidity to the panel structure and the other of which is to prevent all but a very small amount of the cementatious material **10** from entering and filling the recesses **14.** The small amount of cementatious material **10,** which does pass through the fine mesh, secures the cementatious material **10** to the woven material **20** as well as to the core **12.**

In order to insure that the cementatious material **10** and the woven material **20** remain adjacent the core **12,** wire, cord or other suitable tying means **22** can be passed through the recesses **14** and through the mesh of the layers **18, 20** and tied in the manner shown in FIG. **4.**

The finished panel as shown in FIG. **1** and the cross-section thereof shown in FIG. **3** has the core **12** thereof positioned substantially in the center of the panel. The layer of reinforcing material **18** is positioned adjacent the openings of the recesses **14** on one side of the core **12.** Cementatious material **10** is permitted to extend through the mesh of the reinforcing material **18** into the recesses **14** a predetermined distance as will be described in greater detail later. The layer of substantially impervious material **20** is positioned adjacent the openings of the recesses **14** on the other side of the core **12** and a small amount of cementatious material **10** extends through the mesh of material **20** into the recesses **14.** Cementatious material **10** also surrounds the sides of the core **12** to complete the panel structure. The panel can have a tongue **24** and a groove **26** to facilitate alignment as well as sealing of adjacent panels. It being understood, of course, that the tongue **24** and the groove **26** can be eliminated or modified and that the panel structure itself can be made in any size ranging from that of a conventional-size building block to an entire one-piece wall or ceiling panel.

Having described the panel itself, the method of manufacturing the panels will now be described. The cementatious material **10** is prepared having a consistency suitable for molding but not too loose so as to permit the cementatious material **10** to readily pass through the mesh of material **20.**

A mold is then provided having an internal cavity the size and configuration of which is the external size and configuration of the desired panel. Referring to FIGS. **2** and **3,** a typical mold for forming the panel shown in FIG. **1** has a rectangular frame with side portions **28** which rest on the flat surface **29** of supporting structure **30.** Spaced apart end portions **32, 34** are secured between side portions **28** and the supporting structure **30.** End portion **32** has a recess **36** for forming the tongue **24** and end portion **34** has a protuberance **38** for forming the recess **26** of the panel.

An amount of the previously prepared cementatious material **10** is poured into the mold cavity to completely cover the bottom surface **29** of supporting structure **30** and partially fill the mold cavity. A layer of reinforcing material **18** is then placed and centered on the fresh, unhardened cementatious material **10** as shown in FIG. **2**(*a*). The reinforced core **12** is then placed on the reinforcing material **18** as shown in FIG. **2**(*b*) and sufficient pressure is exerted on the core **12** to force the cementatious material **10** through the mesh of material **18** and into recesses **14** of the core **12.** Pressure is exerted on core **12** until the cementatious material **10** extends into the recesses **14,** a distance of approximately one-half inch. A layer of substantially impervious material **20** is then placed on top of the core **12** to cover the adjacent openings of the recesses **14** as shown in FIG. **2**(*c*).

The mold cavity is then completely filled with cementatious material **10** to thereby encase the core **12,** reinforcing material **18** and impervious material **20.** The entire mold may then be vibrated slightly to ensure complete encasement of the core **12,** however, the vibration should not be of such duration so as to allow the cementatious material **10** to pass through the fine mesh of material **20** and fill the recesses **14.**

The cementatious material **10** is then permitted to remain in the mold cavity for a time period until completely cured which time period is of relatively short duration due to the fact that the air trapped in the recesses **14** aids in the curing process. The finished panel is then removed from the mold.

If the reinforcing material is in the form of metal filaments or non-metallic fibers dispersed throughout the cementatious material **10** rather than in the form of a woven sheet **18** as shown in FIGS. **2** and **4,** the core **12** would be pressed directly into the cementatious material **10** containing said filaments or fibers. For additional strength, cementatious material having the aforementioned filaments or fibers could be used together with a woven sheet of reinforcing material. When tying wire **22** or the like is used, the woven material **18, 20** can be secured to the core **12** before the core **12** is immersed into the cementatious material **10.** In addition, if the tongue **24** and groove **26** are subjected to stress, the reinforcing material **18** can be wrapped entirely around the four sides of the core **16** in order to hold the cementatious material **10** forming the sides, tongue **24** and the groove **26** to the core **16.** Further, if a less rigid panel is acceptable for its intended use, the woven sheet of reinforcing material **18** can be eliminated and only the core **12** immersed into the cementatious material **10,** the aforementioned predetermined distance. The woven sheet of reinforcing material **20** can then be placed on the core **12** or secured to the core **12** by tying wire **22** before the core **12** is immersed in the cementatious material **10** to thereby prevent the cementatious material **10** from filling the recesses **14.**

If an ornamental panel is desired, the flat surface **29** can be shaped with various designs which will then be formed on the outside surface of the panel. Pigment of various colors can also be added to the cementatious material **10** if colored panels are desired.

While I have shown and described a preferred form of my panel and a preferred method of making my panels, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from the spirit of my invention or the scope thereof as set forth in the appended claims.

What I claim is:

1. A lightweight, rigid, structural panel of cementatious material comprising:

a. a core consisting of webbed material having a plurality of open-ended, separate tubular recesses of substantially equal height, a layer of very fine mesh reinforcing material adjacent to and covering one end of said recesses, said fine mesh material having a mesh on the order of ten per linear inch to insure the passage therethrough of only a sufficient amount of said cementatious material into said recesses to secure said layer of fine mesh material to said core, and a layer of coarse mesh material adjacent and covering the other end of said recesses, said coarse mesh material having a mesh on the order of four per linear inch to insure the ready passage therethrough of a greater amount of said cementatious material into said recesses than said first layer to secure said permeable material to said core, and

b. cementatious material covering said fine and coarse mesh material and said entire core to form a monolithic panel, said layers of fine and coarse mesh reinforcing material, when secured to said webbed material by said cementatious material, serve to prevent said panel from flexing under applied loads.

2. A structural panel as set forth in claim **1** further comprising a tongue formed on one surface of said panel and a groove formed on the other surface of said panel.

3. A structural panel as set forth in claim **2** wherein said cementatious material has reinforcing elements dispersed throughout it.

4. A structural panel as set forth in claim **2** wherein said cementatious material extends into said recesses, a distance of approximately one-half inch.

5. A structural panel as set forth in claim **2** wherein said fine mesh and said permeable material are secured to said core by tying means extending through said hollow recesses.

6. A structural panel as set forth in claim **1** wherein said fine mesh and said coarse mesh woven material is fiberous.

7. A structural panel as set forth in claim **2** wherein said webbed material is fiberous.

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