Sept. 12, 1972 J. W. ELISCHER 3,691,003

BUILDING BOARD

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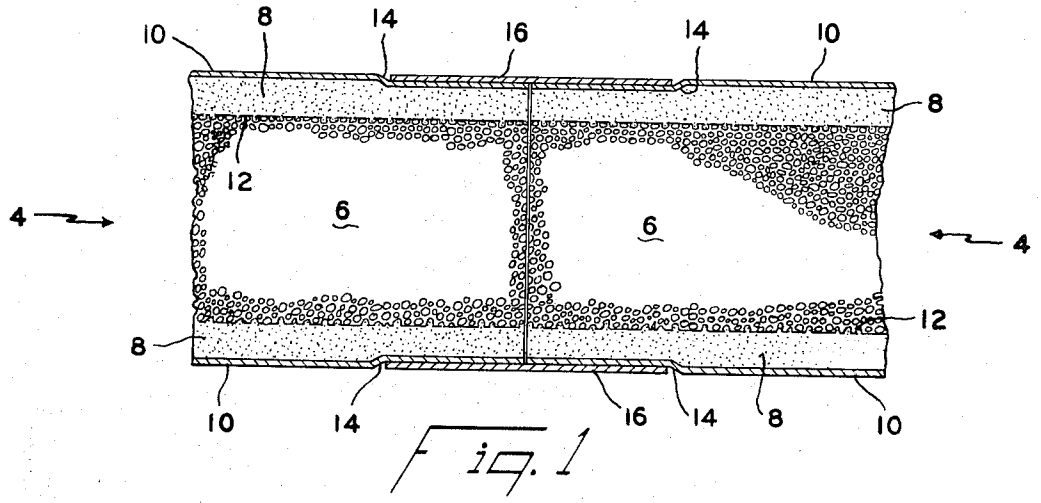


Fig. 1

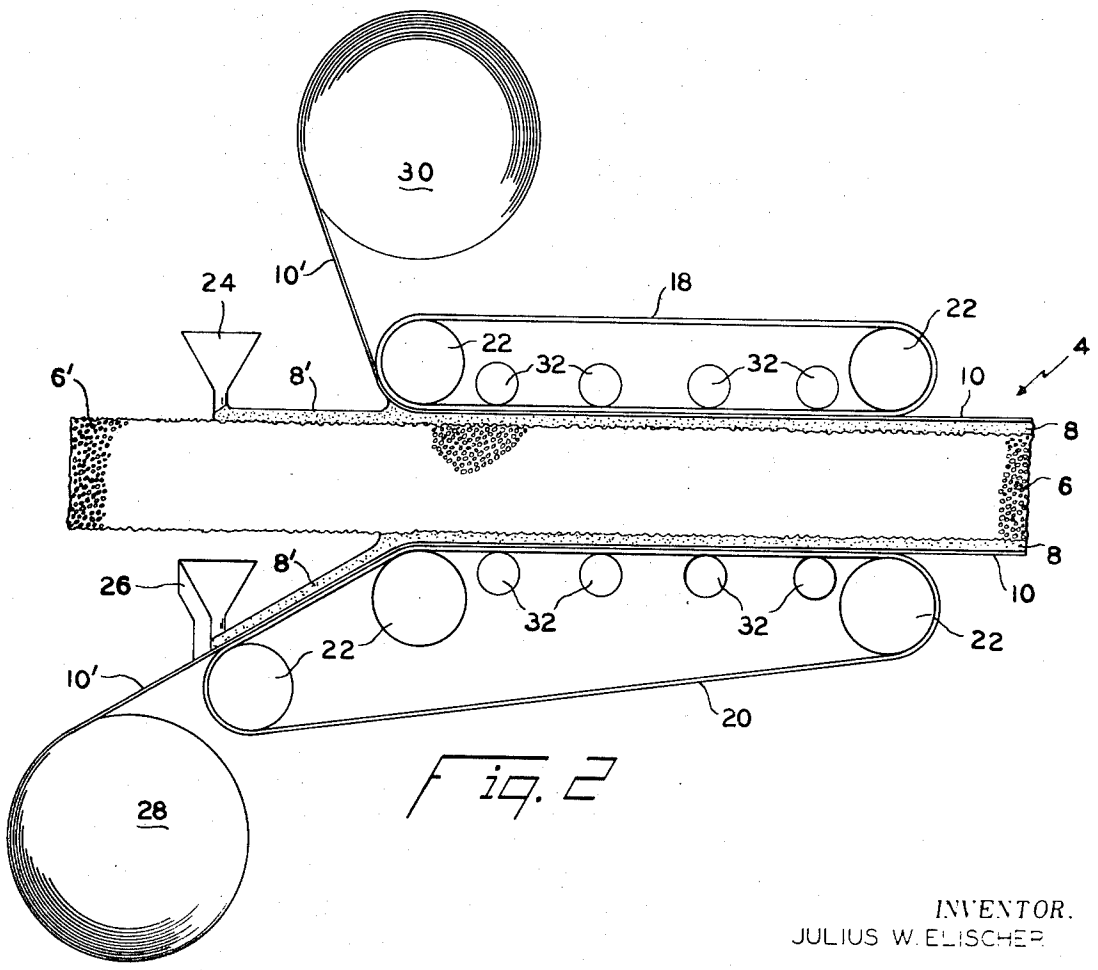


Fig. 2

INVENTOR.
JULIUS W. ELISCHER

BY
Burns & Jenney,
ATTORNEYS

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BUILDING BOARD

Julius W. Elischer, Nedlands,
Western Australia, Australia

Continuation-in-part of abandoned application Ser. No. 869,392, Oct. 24, 1969. This application Nov. 23, 1970, Ser. No. 91,709

Int. Cl. B32b 3/26, 5/18, 13/08

U.S. Cl. 161—159 7 Claims

ABSTRACT OF THE DISCLOSURE

A self-supporting, load bearing building board that is relatively light in weight and economical to manufacture and use. The board has a multi-layered construction with a central core of relatively strong foraminous material, intermediate layers of a different material mechanically bonded to the opposite faces of the core and outer layers of fibrous material bonded to the intermediate layers. The intermediate layers are considerably more dense than the core material and have sufficient compression strength to impart dimensional stability thereto. The outer layers are in tension and insure a lasting bond between the intermediate layers and core.

BACKGROUND OF THE INVENTION

This application is a continuation-in-part of application Ser. No. 869,392, filed Oct. 24, 1969, now abandoned, by the applicant herein.

The invention relates generally to structural building boards or panels, and has particular reference to an improved self-supporting, load bearing building board of laminar construction.

In building construction, load bearing walls have traditionally been built of poured concrete, concrete blocks, bricks or the like. For many years, however, there has been a demand for cheaper and lighter wall constructions, and of the many that have been developed the cheapest and most widely used today, particularly for interior walls, is the stud and plaster board wall which has largely supplanted the rendered stud-lath wall. Because of the popularity of the stud and plaster board wall, there have been a large number of additional developments directed toward improving plaster or wallboards per se.

Another significant approach to light wall construction—aimed at eliminating the triple layer application of the stud and plaster board wall—has been the development of self-supporting prefabricated panels, usually laminated, which in and of themselves form the wall. Though intended to be self-supporting, many of these have or develop a slight bend, and most are not accepted by building authorities as load bearing or permanent structures. In addition, most prefabricated panels developed heretofore lack dimensional stability and have inferior fireproofing and soundproofing characteristics. Those panels that do not have these drawbacks are usually too expenesive for ordinary use.

SUMMARY OF THE INVENTION

The present invention is directed to a greatly improved prefabricated building board that is self-supporting and load bearing, and particularly adapted for use in constructing non-modular, flush walls and ceilings. Compared with conventional plaster board, this prefabricated board is relatively thick, although for normal applications it is less thick than a stud and plaster board wall and far easier to erect. The board is comprised of five layers including a relatively thick central core of foamed hydraulic cement which is lightweight and yet provides structural strength.

Mechanically bonded to the opposite faces of the core are layers of plaster having sufficient compression strength to insure that the core, and thus the board as a whole, will have dimensional stability as to height and width. Outer layers of relatively heavy paper are bonded to the outside faces of the plaster layers, the paper layers forming an external tensile skin for the board. The paper being under tension serves to insure a lasting bond between the plaster layers and cellular core, and enables a flush joint between adjacent boards by sealing the joint in the same way that joints between conventional plaster boards are sealed. The building boards of the invention do not have, and do not require for support, a surrounding frame of any kind as in a modular type panel, such frames making it difficult to conceal the joints in the manner desired for non-modular, flush walls and ceilings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary transverse section through a pair of adjacent building boards embodying the invention, in a non-modular flush wall construction; and

FIG. 2 is a diagrammatic side elevation of an apparatus for making the boards and illustrating the manner in which a board is fabricated.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and with particular reference to FIG. 1, the building board of the invention is indicated generally at 4 and comprises a central core 6 of foamed hydraulic cement, specifically portland cement, a pair of intermediate layers of plaster 8 and a pair of outer layers 10 of fibrous material such as heavy paper. The core is relatively thick to provide structural strength and yet is considerably lighter than a slab of solid concrete or solid plaster of the same dimensions. In accord with the invention, the core has a thickness of at least 1", and for most applications the thickness is preferably in the order of 1½".

The foamed cement is made by a well known process in which a foaming agent is added to a cement slurry. This material is initially cast in large blocks and the blocks are then cut up with a power saw to form slabs of the required thickness for the cores. The sawing opens up the cells in the opposite faces of the core, and the plaster 8 is applied wet or in slurry form to these faces to form the intermediate layers. In so doing, the plaster penetrates the open cells of the core slab and becomes mechanically bonded thereto, the plaster being keyed to the slab at myriad points on the interfaces 12 of the core and plaster.

The plaster 8 in the embodiment disclosed is a gypsum plaster with a compression strength of not less than 2,200 lbs. per square inch. Its primary purpose in the building board is to impart dimensional stability to the foamed cement core and thus to the board as a whole. The plaster is per se dimensionally stable whereas the core material is not; the foamed concrete retains a tendency to shrink even though well cured, and if it were used alone as a building panel cracks would soon appear everywhere the panel joined any other part of the structure. However, it has been found that by cutting open the cells on the opposite faces of the foraminous core and then filling them with the dimensionally stable plaster, shrinkage does not occur in the planes of the faces i.e., with respect to the height and width of the board. Some shrinkage may still occur perpendicular to the faces, affecting the thickness of the board, but since this dimension is small compared with the height and width dimensions, the shrinkage is minimal and its effect is negligible.

In order to have the intermediate plaster layers 8 function as intended, the layers must not be too thin. On the

other hand, it is not advantageous to have them too thick as this would only add unnecessary and undesirable weight to the board. In all cases, the compression strength of the plaster layers must be greater than the forces tending to shrink the core, and using plaster having a compression strength of 2,200 lbs. per square inch, it has been determined that the layer thickness should be from ⅛" to ⅜", with a thickness of ¼" being preferred for a 1½" thick core.

The outer layers **10** of paper or lining board are applied to the intermediate plaster layers while the latter are wet, in a manner to be described, and when the plaster dries the paper shrinks and thus is placed under tension. The paper that is used has relatively high tensile strength and its most important function is to insure a lasting bond between the core and plaster layers. If, for example, a core with plaster layers but no paper is subjected to a substantial impact or a stress tending to bend the core, there is a tendency for the plaster to break away from the core even though there is a strong mechanical bond. The paper layers under tension effectively prevent this.

For the paper layers to function in the desired manner, the physical characteristics thereof must be balanced with those of the plaster layers. Thus, the paper must be capable of being placed under enough tension to keep the plaster firmly bonded to the core but the tension cannot be so great as to crumble or otherwise damage the plaster layers. It has been found that paper in the 74–86 lb. range meets these qualifications with a 76 lb. paper 1/32" thick being preferable for plaster layers having the characteristics described above.

In addition to its function of maintaining a firm bond between the core and plaster layers, the paper protects the plaster against chipping and scratching during handling and enables a continuous, flush skin to be formed in the manner desired for non-modular construction. To this end, the paper and plaster layers may be slightly recessed adjacent the edges of each board as indicated at **14** to accommodate a joining strip **16** of paper or gauze, the strip being secured in position in a known manner by plaster or a suitable adhesive. As will be apparent, the paper skin is also well adapted to receive a finishing surface such as paint or wallpaper.

The five-layered building board of the invention preferably has a minimum thickness of 2" which, of course, is considerably thicker than conventional ⅜" thick plaster board. However, unlike plaster board, the prefabricated boards disclosed herein are in and of themselves self-supporting and load bearing. Moreover, the overall thickness of the boards is less than the overall thickness of a wall comprised of studs and two sheets of plaster board.

In order to obtain a board that is relatively light in weight, a substantial part of the board must consist of a lightweight material and the foamed hydraulic cement has the most desirable characteristics for this purpose. In addition to being lightweight, this material is inexpensive, stronger than foamed plaster or foamed synthetic resins and has good fireproofing and soundproofing properties. Also, the plaster layers can be securely bonded to it without the need for glue or other supplemental means. In certain instances, as for example for ceiling panels and in certain wall installations, wood-wool cement or polystyrene can be substituted for the foamed cement although for most applications the latter is the preferred core material.

In order to effect a suitable compromise between lightness and strength, the density of the foamed cement should be from 25 to 40 lbs. per cubic foot and preferably is in the order of 28–30 lbs. per cubic foot. A slab of foamed cement with this density and a thickness of at least 1" as contemplated by the invention has structural strength and substantial resistance to shear loads. Such a slab, on the other hand, has by itself relatively little strength in tension and compression and, as noted above, is usually not dimensionally stable. With the high compression strength plaster layers bonded to the foamed cement core in the manner described above the core is, however, made dimensionally stable.

With the construction disclosed herein, there is provided a building board with outer layers in tension, intermediate layers in compression and a central core with structural strength and substantial resistance to shear loads. The layers in the combination and with the materials described cooperate in such a way that the resultant board has structural strength that exceeds by far the structural strength of any of its individual components and, at the same time, is lightweight and dimensionally stable. With such a construction, the term "self-supporting" as used herein is intended to mean that the building board of the invention will stand upright, or span the distance between supports in a ceiling, without bending or sagging and without additional support means such as a frame or external structural members. The term "load bearing" as applied to the building board is intended to mean that a partition wall constructed from the board will aid in supporting building structure above and bearing on it.

In a particular embodiment of the invention, given as an example, the central core **6** is foamed hydraulic cement 1½" thick and having a density of 28–30 lbs. per cubic ft. The intermediate plaster layers **8** are gypsum plaster having a compression strength of 2,200 lbs. per square inch and a thickness of ¼". The outer layers **10** are 76 lb. paper that is 1/32" thick. In this specific example, the overall width of the board is 2 1/16" and the ratio of the core thickness to the thickness of one of the plaster layers is 6:1. The substantially greater thickness of the core, in addition to providing strength and shear resistance, serves to provide ample spacing between opposite compression and tension layers which permits these layers to contribute more effectively to the overall strength of the board than if they were close together.

FIG. 2 diagrammatically illustrates apparatus for fabricating the building board. With this apparatus, a preformed, cured slab **6'** of foamed cement is fed by suitable conveyor means (not shown) between a pair of endless belts **18**, **20** supported by rollers **22**. As the slab moves from left to right, plaster **8'** in plastic or slurry form is deposited on the opposite faces of the slab by hoppers **24**, **26**, the lower hopper **26** first depositing the plaster on a web of paper **10'** which is paid out from a suitably supported roll **28**. In this manner, the paper overlies the plaster on the underside of the slab. Another web of paper **10'** is paid out from an upper roll **30** so that it overlies the plaster deposited on the upper side of the slab. The rollers **32**, together with rollers **22**, spread the plaster into layers of uniform thickness and also force it into the open cells of the slab. At the same time, the rollers press the paper layers **10'** into close contact with the plaster layers.

In the building board of the invention, the core must be prefabricated or pre-formed because it is too thick to be formed simultaneously with the plaster layers in a so-called "wet process" such as is used in manufacturing plaster boards. Thus, the wet process is limited to relatively thin boards, less than 1" in thickness, because the layer or layers of plastic material that go into the board must be thin enough to set up quickly. In addition, the wet process does not work well where the layers are of different materials as in the present invention.

From the foregoing description, it will be apparent that the invention disclosed herein provides a greatly improved prefabricated building board having substantial advantages over previously developed boards of this type. As will be understood by those familiar with the art, the invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof.

I claim:

1. A self-supporting, load bearing, frameless building board comprising a central core in the form of a slab of foamed cement having a thickness of at least one inch, an

intermediate plaster layer of high compression strength mechanically bonded to each opposite face of the central core by penetration into the interstitial spaces therein, and an outer pretensioned layer of paper of high tensile strength securely bonded to each intermediate plaster layer.

2. A building board as defined in claim 1 wherein the board has a thickness of at least 2", and each plaster layer is from ⅛" to ⅜" thick.

3. A building board as defined in claim 1 wherein the density of the foamed cement core is in the range of 25–40 lbs. per cubic foot.

4. A building board as defined in claim 1 in which the strength of the plaster layers in compression exceeds the tensile strength of the foamed concrete core whereby the intermediate plaster layers counteract the tendency of the core material to shrink.

5. A building board as defined in claim 4 wherein the plaster layers are comprised of gypsum plaster having a compression strength of not less than 2,200 lbs. per square inch.

6. A self-supporting, load bearing building board having an overall thickness of at least 2" and comprising a central core of foraminous material having a thickness of at least 1", the core being a pre-formed slab having a multiplicity of open cells on the opposite faces thereof, an intermediate plaster layer mechanically bonded to each

opposite face of the core by penetration of the plaster into the open cells therein, the plaster forming the intermediate layers having a compression strength of not less than 2,200 lbs. per square inch, and an outer pretensioned layer of paper of high tensile strength securely bonded to each intermediate plaster layer, the paper in the outer layers being in the range of 74–86 lbs.

7. A building board as defined in claim 6 wherein the thickness of the central core is at least six times the thickness of one of the plaster layers.

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WILLIAM A. POWELL, Primary Examiner

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