May 2, 1944. L. A. PALEY 2,348,180

BUILDING STRUCTURE

Filed July 22, 1940 4 Sheets-Sheet 1

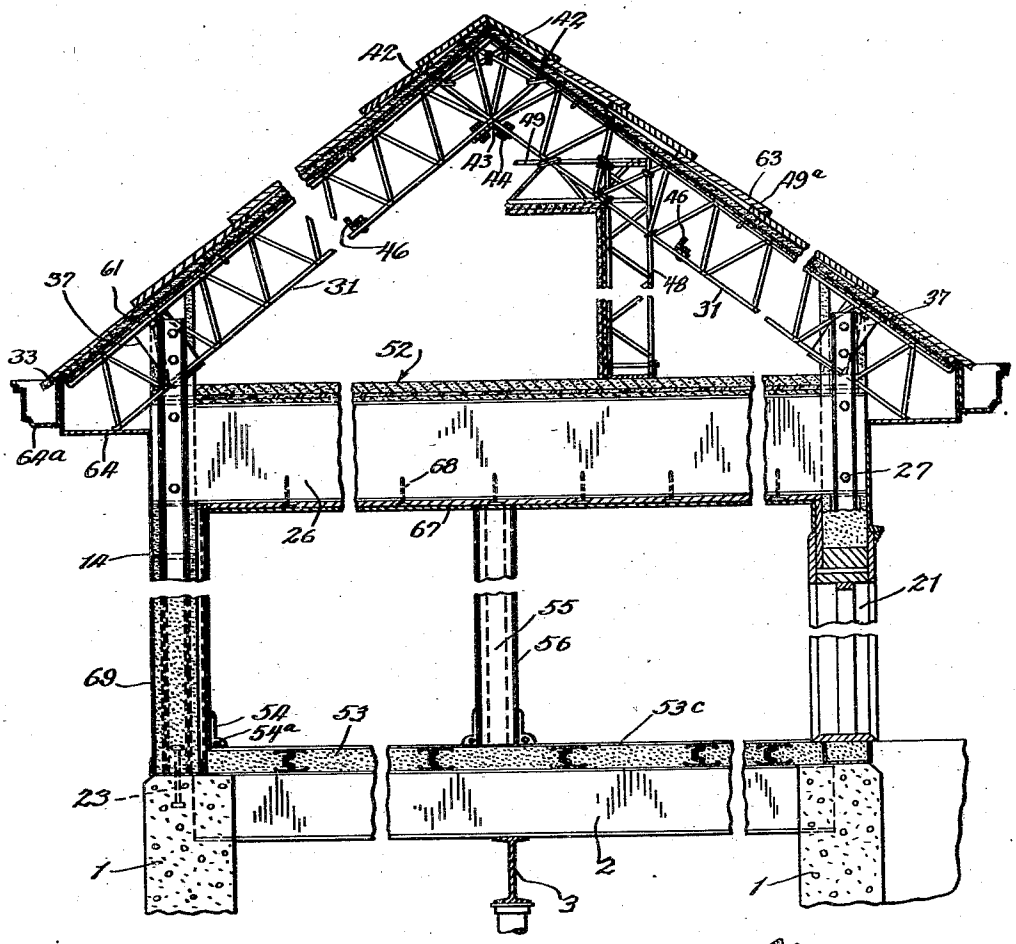


Fig. 1.

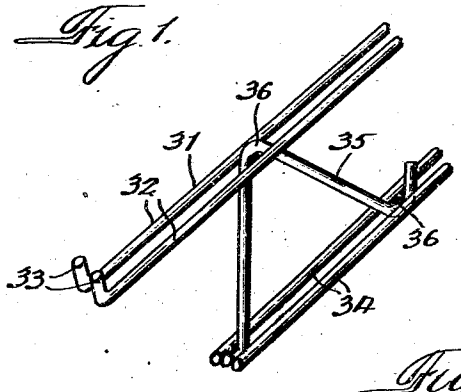


Fig. 3.

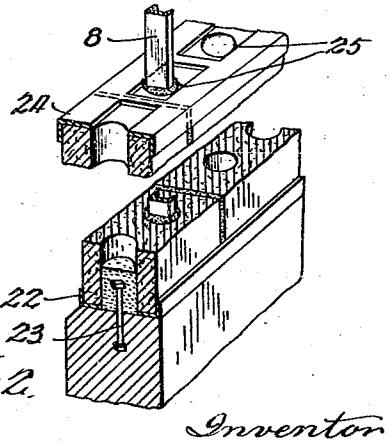


Fig. 2.

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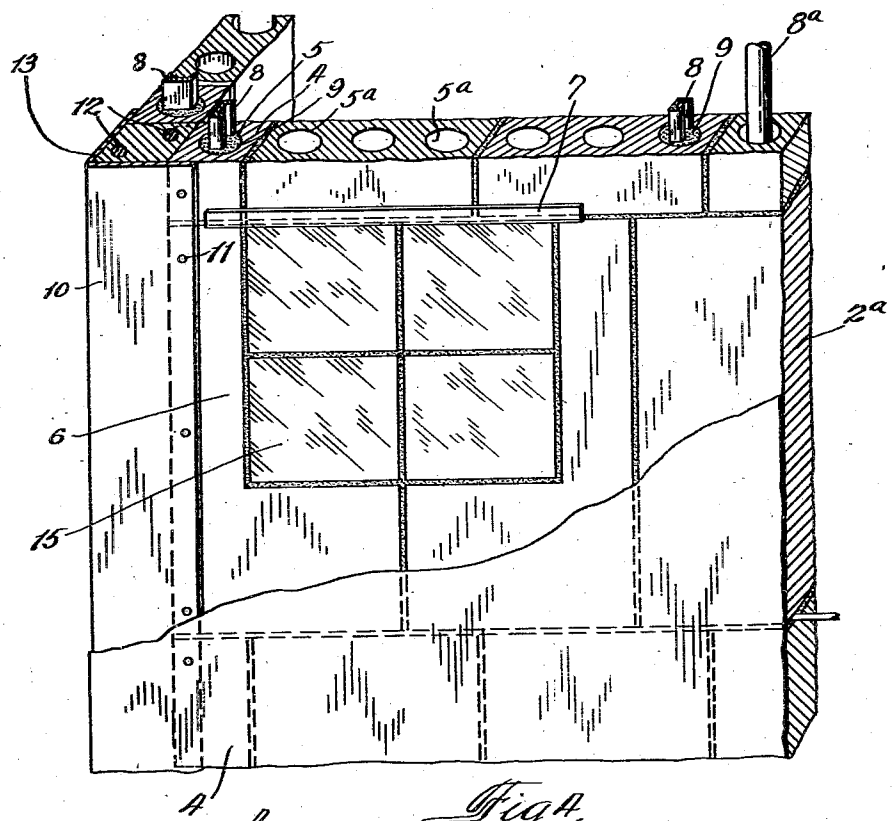


Fig. 4.

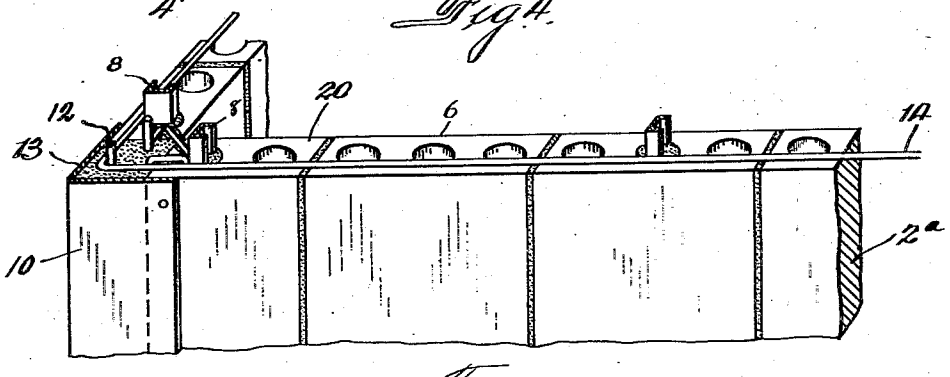


Fig. 5.

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BUILDING STRUCTURE

Filed July 22, 1940 4 Sheets-Sheet 3

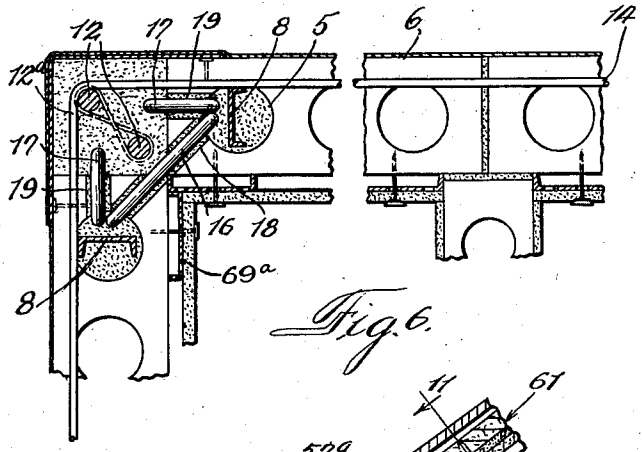


Fig. 6.

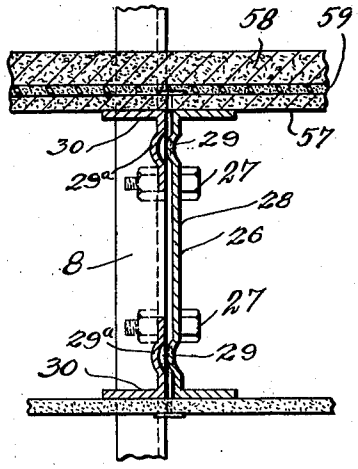


Fig. 8.

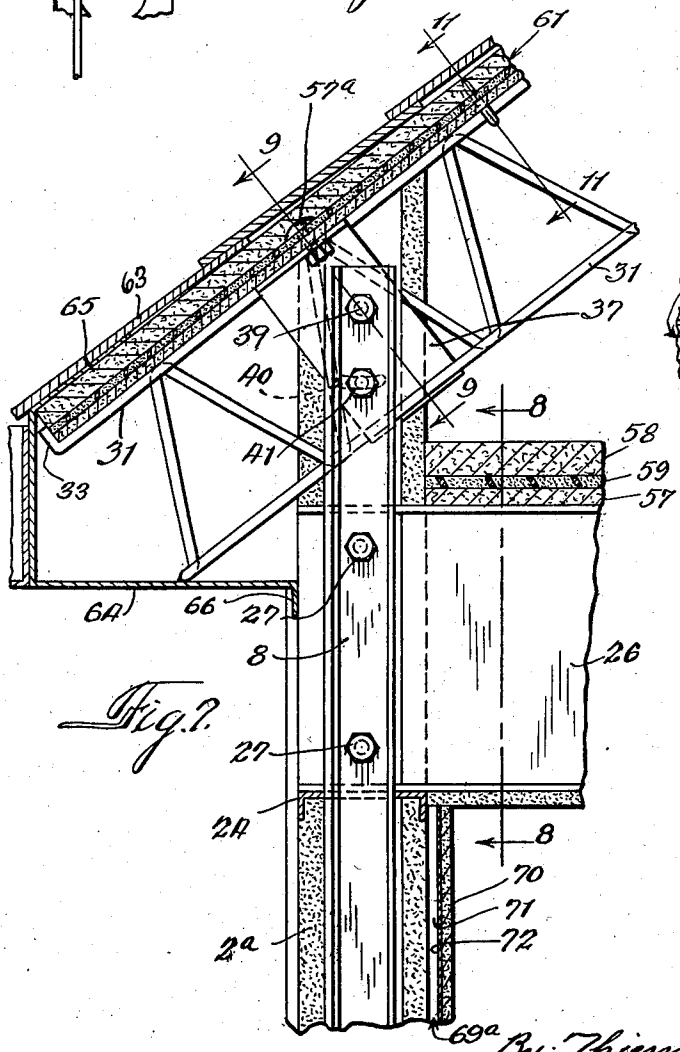


Fig. 7.

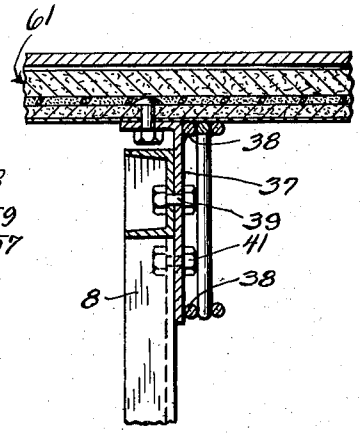


Fig. 9.

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BUILDING STRUCTURE

Filed July 22, 1940 4 Sheets-Sheet 4

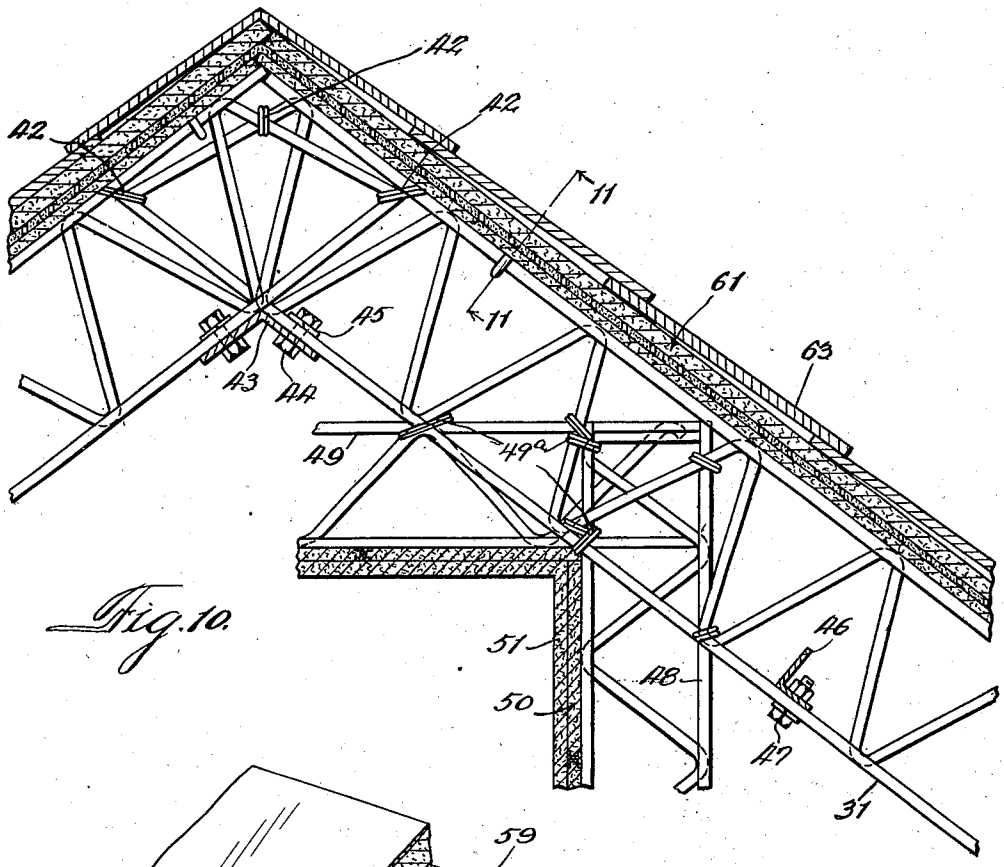


Fig. 10.

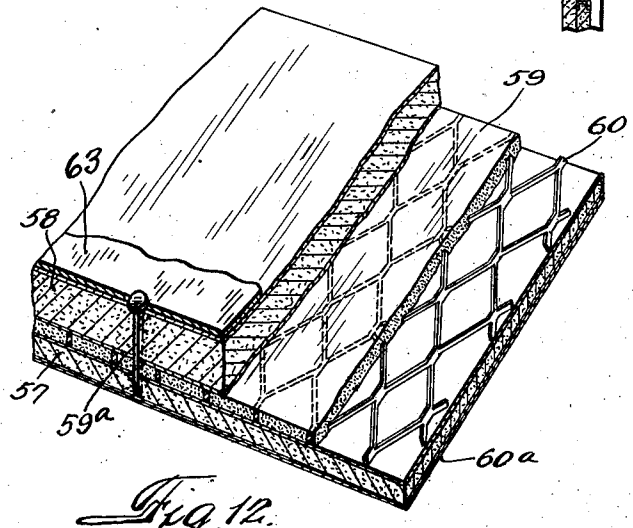


Fig. 12.

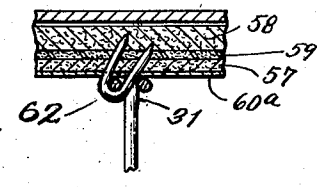


Fig. 11.

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Patented May 2, 1944 2,348,180

UNITED STATES PATENT OFFICE

2,348,180

BUILDING STRUCTURE

Lewis A. Paley, Bloomingdale, Ill., assignor to United States Gypsum Company, Chicago, Ill., a corporation of Illinois

Application July 22, 1940, Serial No. 346,687

3 Claims. (Cl. 72—1)

This invention relates to building structures, and more particularly to fireproof buildings such as dwellings and the like which are formed of quickly and easily assembled units, most of which are preformed or prefabricated standardized parts which are adapted after assembly to provide a substantially integral structure of great strength with exceptional fireproof characteristics. The cost of material ordinarily used in building a small home is relatively high, irrespective of the type of material used, and the expense of skilled labor required in the erection of the average house is sometimes very great.

Various attempts have been made to design poured cementitious structures such as small houses. However, with structures built of poured gypsum, great difficulty was experienced because the walls would not dry out for long periods, in fact, sometimes for several years, because of the affinity of the gypsum for the water in the mixture. The present invention provides a structure in which the gypsum elements are largely precast and factory-dried, and such parts as are poured in the present structure are formed of a particular type of high-strength gypsum which does not present the drying out problem of prior structures, particularly as the poured gypsum is used only in comparatively small amounts in widely separated locations.

An important object of the present invention is to provide a small building structure having good heat insulating characteristics, which will be fireproof and which may comprise comparatively small inexpensive units easily assembled into a rigid, partically integral structure with a minimum cost for materials and a minimum expense for labor of any type, also wherein the necessity for skilled labor or labor of any type is reduced to a minimum.

Another object is to provide a wall structure for low cost homes which is made largely of gypsum and steel and which is entirely fireproof in so far as the finished structure is concerned, except for such additional elements as might be desired for window and door casings and various trim elements, and in which even these elements may be of fireproof construction if desired.

Another object is to provide a type of wall in which low cost gypsum tiles may be used and suitably reinforced and secured together in permanent relationship by means of interlocking and interengaging members and wherein all of the elements co-operate to provide a rigid, substantial, and permanent low cost structure.

Another object is to provide a particularly efficient type of structure for the intersecting portions of walls wherein gypsum tiles having vertical registering core holes and staggered vertical joints are interlocked with each other and with the corner construction in such a manner as to form substantially a permanent integral construction.

Another object is to provide a particular type of roof deck and floor construction which may, if desired, be assembled on the job and which provides unusual strength, fireproofness, and exceptional nail holding qualities.

A further object of the invention is to provide a particularly desirable fireproof roof construction in which the rafters may be extremely light and yet sufficiently rigid to perform the desired functions and in which a suitable adjustment is provided so that the roof angle may be adjusted as desired during construction.

A still further object is to provide a structure of the character described in which the finishing elements, such as wall coverings, floor coverings, shingles, and the like, may be nailed directly to the fireproof structure without the use of wood or other combustible elements.

Further objects will be apparent from the specification and the appended claims.

In the drawings:

Fig. 1 is a transverse sectional view through one embodiment of the invention and illustrates in detail a completed low cost dwelling.

Fig. 2 is a fragmentary perspective view of a portion of the wall structure and illustrates the relationship of the various elements, particularly the channel irons which may be used interchangeably as sills or caps.

Fig. 3 is a fragmentary perspective view of the lower end of one of the wire rafters.

Fig. 4 is a fragmentary perspective view partially in section of the intersecting side walls and illustrates the method of starting a tier of the wall tile at a corner of the building with a tile section having a single vertical core hole therethrough.

Fig. 5 is similar to Fig. 4 but illustrates the method of starting a tier of the wall tile at a corner of the building with a tile section having two core holes therethrough. This view also illustrates the method of interlocking the blocks and corners of the structure.

Fig. 6 is a top view of a partially completed wall at a corner intersection, certain structural elements being shown in section.

Fig. 7 is an enlarged view of the eave and

rafter construction and illustrates its assembly with the side wall.

Fig. 8 is a transverse sectional view through the ceiling or floor joist and is taken on a line substantially corresponding to line 8—8 of Fig. 7.

Fig. 9 is a detail sectional view through the adjustable rafter support and is taken on a line substantially corresponding to line 9—9 of Fig. 7.

Fig. 10 is a fragmentary sectional view through the peak of the roof and illustrates the method of assembling the rafters and various associated elements.

Fig. 11 is a detail sectional view taken on a line substantially corresponding to line 11—11 of Figs. 7 and 10 and illustrates the method of fastening the roof deck to the rafters.

Fig. 12 is a fragmentary perspective view of the laminated roof deck or floor deck element.

Referring to the drawings in detail, the embodiment illustrated comprises a foundation wall 1 which may be of any suitable structure or material, preferably of concrete. Transverse joists 2 are supported on the foundation walls in spaced relation in the usual manner, and additional support in the form of an intermediate transverse I-beam 3 may be provided if desired. The joists 2 may be of the type illustrated in Fig. 8 and are so constructed that floor members may be nailed thereto. These floor joists are of a special construction particularly adapted to hold the nails by clamping them between steel elements. They are well known to the trade and will be described later.

The side walls of the structure are formed of low cost gypsum tiles 2*a* such as shown particularly in Figs. 4, 5, and 6. These tiles are preferably about 30 inches long, 12 inches wide, and 4 inches thick, and are provided with three vertical core holes which may be substantially 2½ inches in diameter and extend completely therethrough. The holes are properly spaced so that at least certain selected, equally spaced holes in an assembled wall will register in vertical alignment and enable the locating therein of metallic studding. The tiles are preferably made without foam by a well known process which enables the production of nailable tile; that is, other elements of the building structure may be nailed directly to the tile, which is sufficiently dense when made without foam to provide good nail holding characteristics.

In Fig. 4 each alternate horizontal tier of the wall is started at the corner of the building by a narrow vertical tile section 4 having a single core hole 5 therein so that, when assembled with full-sized tile 6 in the various tiers in assembled relation, the core holes 5 will be in vertical alignment with one of the outer core holes 5*a* in the adjacent tier of tile. The complete side wall may be assembled in this manner with the tile joints in staggered relation and with the usual layer of mortar 7 therebetween. The wall structure shown in Fig. 5 is substantially identical with that in Fig. 4 with the exception that the first tier of tile is started adjacent the corner with a narrow tile 20 having two core holes therein instead of one, as in the structure previously described.

Channel iron studdings 8 of suitable dimensions are vertically positioned in selected spaced core holes as shown, and a preferably specially prepared gypsum 9 is poured into the holes as the wall is built up so that the channel irons or studding 8 are securely embedded therein and the entire wall becomes practically an integral structure with reinforcing studs therein. Conduits or pipes 8*a* (Fig. 4) may also extend through registering core holes to supply light, water, and gas to the dwelling.

The poured gypsum preferably used in the present invention is of the type disclosed and claimed in Patent No. 1,901,051, issued March 14, 1933, to Randel et al., and for convenience is designated therein as "alpha gypsum" and will be so designated herein. In accordance with the disclosure of the above noted patent, a very high-strength, quick-setting calcined gypsum having a low pouring consistency is produced which eliminates the drying out problem previously mentioned with reference to prior attempts to use poured gypsum in building structures. Also, this material may provide excellent nail holding characteristics, particularly when a small amount of fiber is added and the material prepared and used in a manner which will be described later in connection with the roof deck structure. This high-strength alpha gypsum has unique properties in that its compressive and tensile strength equals or exceeds that of Portland cement, whereas its setting time is approximately that of ordinary plaster of Paris, viz., 15 to 30 minutes. The compressive strength of this product is very high and it has a pouring consistency of less than 50%.

Alpha gypsum is manufactured by treating lumps of gypsum rock having a diameter of ½ inch to 2 inches in a closed container with steam at 17 to 20 pounds gauge pressure. This steam calcination is carried on for 5 to 7 hours with a constant steam pressure and with a constant withdrawal of water of condensation obtained from the heating steam and also from the expelled water of crystallization. After calcination, the product is dried while maintaining at a temperature high enough to prevent its rehydration, and the product is ground so that 85% or more passes through a 100 mesh screen. The strength of set casts prepared from alpha gypsum increases as the amount of water mixed with the calcined gypsum is decreased. All ordinary gypsum calcined according to present methods requires the addition of more than 50% water to bring the resultant mix to pouring consistency. The crystalline calcined gypsum calcined according to the process herein described possesses the property of requiring less than 50% water to bring the mix to pouring consistency. This property of low normal consistency, therefore, explains in part the high strength of casts prepared from this material. It should not be understood, however, that this property of low consistency is the only cause of high strength of this product.

At the intersection of the walls to form a corner of the building, an angle strip 10 (Fig. 4) is secured to the tiles by means of nails 11, and reinforcing vertical rods 12 are positioned in the rectangular space formed by the walls and the angle iron. The alpha gypsum product previously mentioned is properly prepared and poured into this space, as shown at 13, to embed the reinforcing rods and form a corner substantially integral with the side walls.

Between each horizontal tier of tile, a horizontal reinforcing rod 14 may be positioned as shown in Figs. 4 and 5, and these rods may be coextensive with the wall except where openings are provided for doors and windows. The rods 14 are of small diameter and are positioned in the mortar joints between the tile

and extend around the building, whereby they serve to prevent any tendency of the walls to bulge. The tiles adjacent the corners may also be connected to the corner concrete structure by interlocking U-shaped members 16 and 17, which may be positioned in grooves 18 and 19, respectively, formed in the tile, and these interlocking members may also be embedded in gypsum in their respective grooves, which gypsum may be applied at the same time the studdings are embedded and the corners are poured. The reinforcing rods 12 in the corner portions may be tied together by wire or other means, as shown at 12a, to further reinforce the structure.

During the building of the side walls, suitable door and window openings such as shown at 21 (Fig. 1) may be provided, and these may be cased in any suitable well known manner by either wood or metal casings. Glass blocks 15 (Fig. 4) may also be embedded in the tile wall to provide interior lighting and a channel iron header 15a is positioned above the glass block, as shown. Before starting to build the side walls, channel iron sills 22 are laid on the foundation 1 and the tiles are vertically positioned therein to form the side walls. If desired, anchor bolts 23 may be secured in the foundation and extend upwardly into the gypsum corner sections 13 and be embedded therein, or they may extend into certain of the core holes in the blocks 6 and be embedded in gypsum therein.

An inverted channel iron 24 similar to the channel iron sill 22 just described is positioned along the top of the wall substantially as shown in Fig. 2. These channel irons or sills 22 and 24 may be provided with spaced slots 25 so that the studding 8 may extend upwardly therethrough. Joists 26 are supported on the inverted channel iron 24 in suitable spaced relationship and each joist is secured to the associated upwardly extending studding 8 by means of bolts 27. The bolt holes in the studding are preferably larger than the bolts extending therethrough, so that the weight of the joists will rest on the inverted channel iron 24.

The joists 26 may be constructed substantially as illustrated in Fig. 8 and comprise a channel iron portion 28 having beads 29 in the web adjacent the edges. Angle irons 30 are secured to the channel iron 28 in slightly spaced relation as shown, and these angle irons are provided with complementary beads 29a. These joists are of well known construction and are adapted to enable building elements to be nailed thereto by driving the nails into the space between the beads, whereby the nails are securely clamped between the elements. The studdings 8 extend upwardly any required distance above the ceiling joists 26, and the side wall tiers of tile are continued upwardly, but certain blocks are cut away around the joists, as required, and the interstices filled with poured gypsum. The end walls and end studding are extended upwardly to the roof line or as high as required.

Wire rafters 31 are secured to the upper ends of the studding 8. A portion of the lower end of one of the rafters 31 is shown in perspective in Fig. 3 and comprises upper chord wires 32, which are turned upwardly at their ends substantially at a right angle at 33. These upturned ends are engaged by the lower edges of roof boards during assembly of the building and retain the boards in place until they are later securely fastened to the rafters. The rafters are provided with lower chord wires 34 and a zigzag web wire 35, which latter is welded at its crests 36 to the corresponding chord wires. This wire structure provides a skeleton I-beam which is of inexpensive construction and great strength.

Each of the rafters is provided with an L-shaped bracket plate 37 (Figs. 7 and 9), and this bracket is secured to the web wires, preferably by welding, as shown at 38. The rafter is pivoted to the studding 8 by means of a pivot bolt 39 so that the angle of the rafters may be adjusted as required. The bracket 37 is also provided with a slot 40 on a radius from the pivot bolt, as shown by dotted lines in Fig. 7, and, after proper adjustment of the rafters, they are secured to the studding by means of bolts 41 extending through the slots 40.

The upper ends of co-operating rafters are secured together by means of wire ties 42, and all of the rafters are secured together by means of an elongated angle plate 43 and bolts 44. The bolts may extend between the chord wires of the respective rafters and clamp thereto by means of suitable washers 45. The rafters may also be secured together by means of intermediate angle irons 46 which are bolted to the rafters in the same manner by means of bolts 47.

The attic walls or second floor walls may be formed by suitable positioning vertical studdings 48 and horizontal beams 49, and these studdings and beams may be of the same wire construction as the rafters just described and may be tied together and to the rafters 31 by wire ties 49a. Gypsum lath 50 may be secured to these studdings in the usual manner and a coating of plaster 51 applied thereto. The attic floor 52 is supported on the joists 26 and may be of substantially the same construction as the roof deck which will be described later.

The lower floor, which is supported on the joists 2, may be of the usual well known metal-edged gypsum slabs 53 and secured by nails driven into the joists 2, which may be of the same construction as previously described and illustrated in Fig. 8. These floors may have linoleum 53a applied thereto or any other suitable covering, and the usual baseboards 54 may be applied to the wall. These baseboards are preferably of metal construction adapted to enclose a wiring conduit 54a. The interior partitions 55 may be formed of the usual three-inch gypsum partition tiles in the well known manner, and these tiles may have a surface coating 56 of plaster or other suitable material.

A portion of the roof deck is illustrated in perspective in Fig. 12 and comprises two layers of paper-covered gypsum boards 57 and 58 which are adhered together by means of a layer of high-strength alpha gypsum 59 having a sheet of expanded metal 60 embedded therein. The top gypsum board 58 is preferably about one-half inch thick, and the bottom board about three-eighths inch thick, so that the embedded expanded metal 60 will be below the neutral axis of the slab, thereby making a materially stronger roof deck with the use of a comparatively small amount of material. The lower exposed surface of the gypsum board 57 is provided with a heat resistant coating of metallic foil 60a or the like. These slabs may be preformed if desired. However, it is preferable to laminate the deck on the job. This is accomplished by applying the lower boards 57 to the rafters 31, where they are re-

tained by means of the upturned ends 33 of the rafter. They are also bolted to the rafter brackets 37 by bolts 57a. The expanded metal 60 is then laid on the roof and will give a foothold for the workman while he applies a thin coating of the high-strength alpha gypsum. This coating need be only sufficiently thick to embed the expanded metal. The upper boards 58 are then applied to the gypsum coating and pressed thereon by nailing or the like, and the high adhesive characteristics of the alpha gypsum form a very strong roof deck which is practically monolithic. The expanded metal 60 is preferably bent over the peak of the roof so as to provide a strong peak construction.

The previously described high-strength alpha gypsum 59, in which the expanded metal is embedded, is used not only to provide great strength in the roof deck, but also for the reason that it provides exceptionally good nail holding characteristics. Ordinary gypsum board may be used for the layers 57 and 58. However, such boards do not provide good nail holding qualities. It has been found, however, that, by the use of the alpha gypsum containing a small proportion of paper fiber, excellent nail holding characteristics may be obtained and the alpha gypsum is not cracked or broken. It will be obvious that the main object is to provide a high-strength calcined gypsum layer, through which nails may be driven without cracking or breaking the layer and in which the layer, and in fact the entire roof deck, is materially strengthened by the expanded metal. The nail holding qualities of the roof deck may be materially improved by using gypsum boards 57 and 58 having a dense gypsum core made without the use of foam or other density reducing agents. However, the high-strength gypsum layer 59 through which the nails 59a extend, as shown in Fig. 12, provides exceptional nail holding power which is sufficient for all ordinary purposes. After the roof deck is applied as shown at 61 (Figs. 7 and 10), it may further be secured to the rafters by means of staples 62 which are passed around one of the chord wires of the associated rafter and driven diagonally into the roof deck as shown. Conventional shingles 63 may then be applied to the roof and nailed to the roof deck in the usual manner. As previously stated, the attic floor is illustrated as being constructed in the same manner as the roof deck just described, and suitable ceiling gypsum or other boards 67 may be nailed to the joists 26 by means of nails 68.

The cornices preferably comprise a sheet metal box-like member 64 (Figs. 1 and 7) having a roof flange 65 which may be nailed to the roof deck and a wall flange 66 which may similarly be nailed to the side walls. A sheet metal gutter 64a may be secured to the cornice 64 by welding or other suitable means.

The exterior finish of the walls may be of any suitable material such as asphalt shingles, asbestos-cement shingles or siding, roll brick siding, or even wooden clap boards. However, in the preferred embodiment, granule-coated roll roofing 69 is adhered to the wall with asphalt emulsion supplemented by a few nails driven into the tiles. This roofing is preferably provided with surface granules of white crushed porcelain, and these granules are painted with exterior cement or other suitable paint to provide any tint desired and to prevent any discoloration of the white granules by bleeding of 2a are preferably provided with a coating of the asphalt. The exterior surfaces of the tiles asphalt primer paint prior to erection to impart temporary weather resistance to the tile and to provide a better bond between the asphalt emulsion and the tile.

The interior of the wall is provided with perforated furring channels 69a, to which insulating gypsum boards 70 (Fig. 7) are secured as by nailing through the furring strips into the tiles 2a to provide an air space 71. The gypsum board 70 is provided on its inner surface with a bright metal foil coating 72 which acts as a vapor seal and as a heat insulating medium. Instead of the boards 70, a finish coat of gypsum plaster may be applied to the inside of tiles 2a where low cost is desired.

Where I have specified the use of alpha gypsum, other gypsum materials may be used, such as anhydrite or pre-aged gypsum plaster, each of which has low consistency properties in varying degree.

The walls of the building may be conveniently constructed by laying the first two courses of titles 2a on the foundation. Studs 8 are then inserted in registering core holes 24 inches apart and the core holes are poured full of gypsum cement to embed the studs. The succeeding courses of tiles 2a are laid up by threading each alternate tile over the protruding ends of studs 8 which extend through the registering core holes. The rafters, joists, and other elements of the structure are then assembled. When the construction of the building is temporarily discontinued, as at night, the inside surfaces of tiles 2a may be protected from a shower by loosely attaching a strip of metal along the top of the wall, the strip extending inwardly and downwardly as an eave, shielding the inside of the tile wall from rain.

The present invention provides many advantages for low cost building construction in that the building is fireproof and substantially monolithic and is easily and inexpensively constructed. It is also moistureproof and formed of materials which are largely precast and factory-dried. The assembled elements are made substantially integral by interlocking high-strength gypsum molded on the job. The roof pitch is variable, and the walls, floors, and roof decks are provided with exceptional nail holding characteristics. The structure is suitable not only for dwellings, but for industrial buildings of various kinds.

It is intended, of course, that the invention should not be limited to the specific embodiment or embodiments disclosed herein, since modifications may be made, and it is contemplated, therefore, by the appended claims to cover any such modifications as fall within the true spirit and scope of this invention.

Having thus described this invention, what is claimed and desired to be secured by Letters Patent is:

1. A nailable floor or roof deck slab comprising two gypsum boards adhesively secured together by a layer consisting essentially of hard, dense, strong calcium sulfate resulting from the setting of low consistency gypsum, and a sheet of expanded metal embedded in said layer.

2. A nailable floor or roof deck slab comprising two gypsum boards adhesively secured together by a layer consisting essentially of hard, dense, strong calcium sulfate resulting from the setting of low consistency gypsum, and a sheet

of expanded metal embedded in said layer, said layer being only sufficiently thick to embed the expanded metal, and the upper one of said boards being materially thicker than the other so that said layer and embedded expanded metal are remote from the neutral axis of said slab.

3. The method of building a laminated, fireproof, nailable floor or roof deck in a permanent building structure, comprising securing a layer of gypsum board on a permanent support forming part of said structure, superimposing a sheet of large mesh expanded metal on said gypsum board, applying a cementitious layer of material comprising essentially low consistency gypsum of only sufficient thickness to embed said expanded metal therein, and pressing a second layer of plaster board snugly on said gypsum.

LEWIS A. PALEY.

CERTIFICATE OF CORRECTION.

Patent No. 2,348,180. May 2, 1944.

LEWIS A. PALEY.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 35, for "partically" read --practically--; page 4, second column, line 1, strike out "2a are preferably provided with a coating of" and insert the same after "tiles" in line 2; line 25, for "titles" read --tiles--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3rd day of October, A. D. 1944.

Leslie Frazer

(Seal) Acting Commissioner of Patents.