

March 26, 1946.

G. W. GILLELAND

2,397,345

BUILDING STRUCTURE

Filed Feb. 15, 1943

2 Sheets-Sheet 1

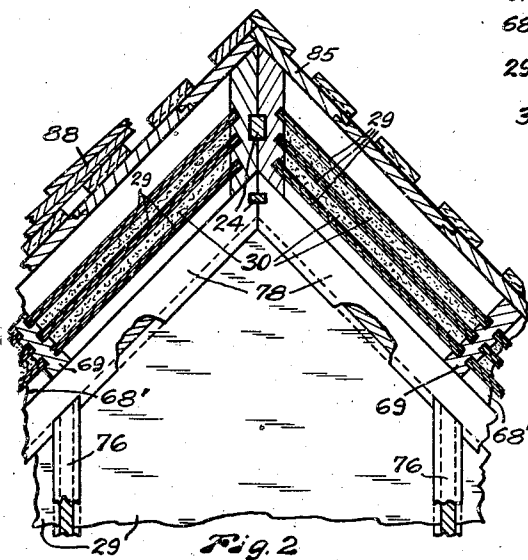


Fig. 2

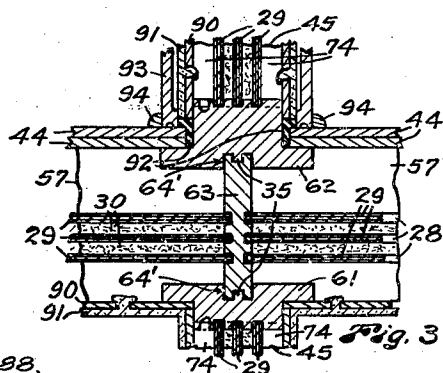


Fig. 3

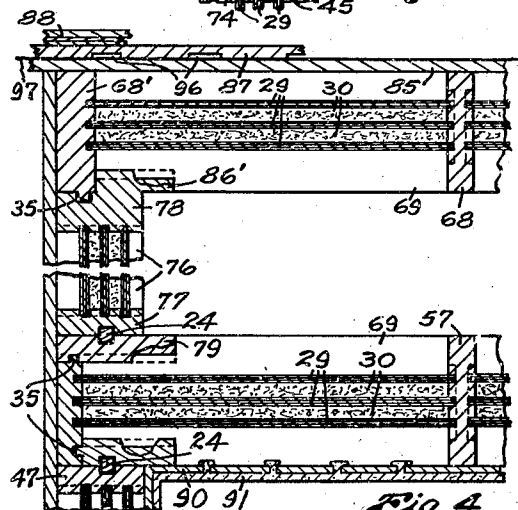


Fig. 4

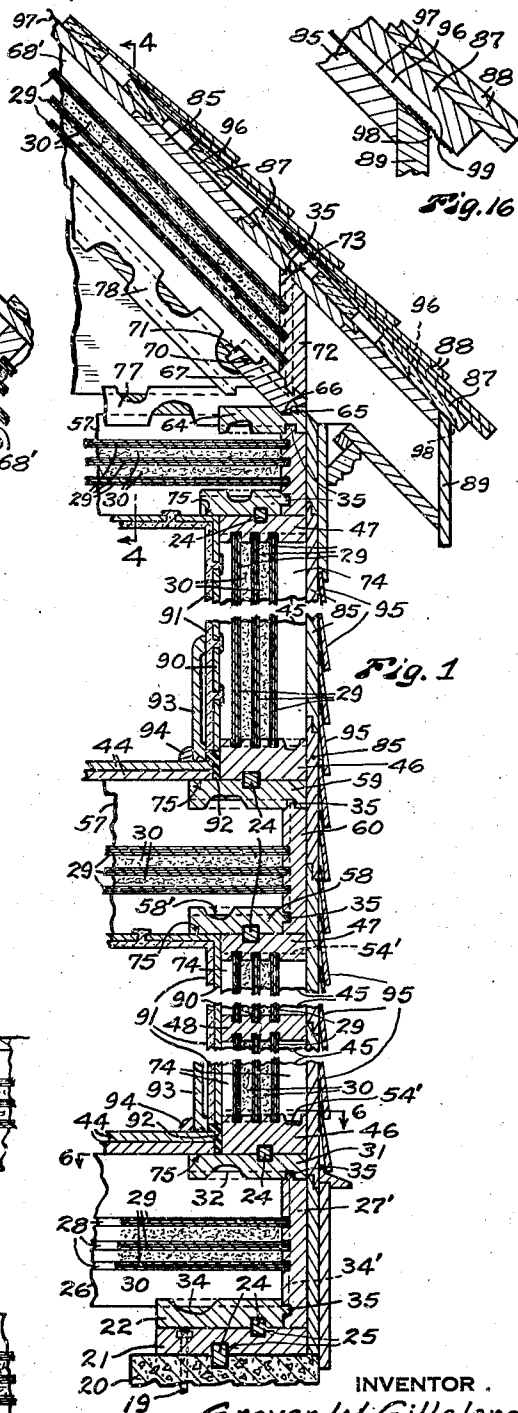


Fig. 16

Fig. 1

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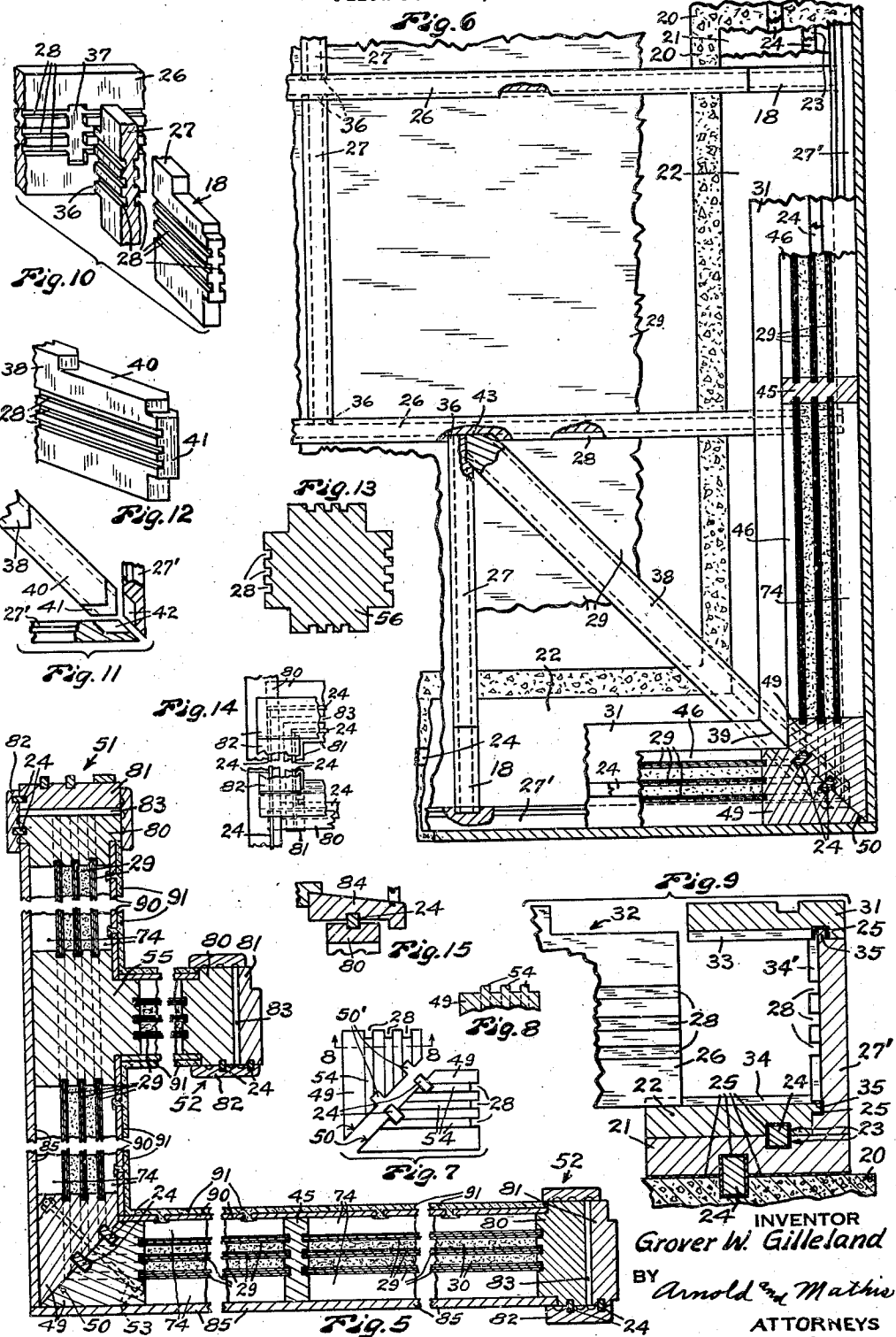
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,397,345

BUILDING STRUCTURE

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Application February 15, 1943, Serial No. 475,891

1 Claim. (Cl. 20—4)

This invention relates to a building structure and more particularly to a building embodying a new type of air sealing means.

It is an object of this invention to provide wall forming units, whether vertical, horizontal, or inclined, which embody therein air sealing means. More particularly this invention embodies an air sealing means in a wall structure employing a plurality of substantially parallel spaced apart air sealing panels which are sealed to the boundary members of the wall forming unit.

It is a further object of this invention to provide air sealing means between adjoining wall forming units such as between a floor unit and a side wall unit.

It is a further object of this invention to provide air sealing means between a foundation member and a floor unit supported thereon.

It is a further object of this invention to provide air sealing means between a ceiling forming unit and a gable forming and roof forming units.

It is a further object of the invention to provide sealing between a gable unit and a roof forming unit and between two different roof forming units or members.

It is an object of this invention to provide sealing means which provide for air sealing and at the same time: sound proofing, moisture proofing, germ proofing, i. e., prevention of the entrance of germs, and gas proofing.

It is a further object of the invention to provide a building structure which lends itself to prefabrication at a factory so that various wall forming units and associated parts may be prefabricated at a factory and assembled at a building site to form a building with a minimum requirement of labor at the building site and maximum efficiency and utility in the completed building construction.

As an example of one type of building to which this invention may be applied I have shown and described an embodiment in the form of a two story dwelling house but it will be understood that the invention may be embodied in substantially any building construction.

All wall forming units embodied in this construction, whether upright such as side wall and partition units, or horizontal such as floor and ceiling units, or inclined such as roof units, are air sealed by the provision therein of a plurality of spaced apart substantially parallel air sealing panels and the term wall as hereinafter used in the specification and claim refers to the wall

structure whether the same is upright, horizontal or inclined.

The above mentioned general objects of my invention, together with others inherent in the same, are attained by the mechanism illustrated in the following drawings, the same being preferred exemplary forms of embodiment of my invention, throughout which drawings like reference numerals indicate like parts:

Figure 1 is a fragmentary vertical sectional view, with parts in elevation, showing a portion of a building constructed in accordance with my invention;

Fig. 2 is a fragmentary vertical section, with parts in elevation, showing parts of the gable construction of this building;

Fig. 3 is a fragmentary vertical section, with parts in elevation showing partition construction at the location of floors and ceilings;

Fig. 4 is a fragmentary sectional view, with parts in elevation, taken substantially on broken line 4—4 of Fig. 1 and showing roof, gable, attic and ceiling construction;

Fig. 5 is a fragmentary horizontal sectional view, with parts in plan, showing a typical corner structure and a partition structure together with door frame and window frame means;

Fig. 6 is a fragmentary view partly in plan and partly in section taken substantially on broken line 6—6 of Fig. 1, showing an arrangement of the floor joists and headers and plates;

Fig. 7 is a detached, exploded top plan view showing a corner post construction;

Fig. 8 is a fragmentary sectional view taken substantially on broken line 8—8 of Fig. 7;

Fig. 9 is a fragmentary exploded view partly in cross section and partly in elevation on a larger scale than the other views showing typical key members and tongues and panels seated in sealing material and providing an air seal between structural members;

Fig. 10 is a fragmentary exploded perspective view showing floor joist and header construction;

Fig. 11 is a detached fragmentary plan view with parts in section showing a corner construction;

Fig. 12 is a fragmentary detached perspective view of the end portion of a header shown in Figs. 6 and 11;

Fig. 13 is a detached sectional view of an upright wall frame member to be used in partition walls at locations where partition walls radiate in four directions;

Fig. 14 is a fragmentary detached elevation,

with parts broken away, showing two corners of a window frame having air sealing means provided therein;

Fig. 15 is a detached cross sectional view through the frame of an opening, as the sill portion of a window frame, showing air sealing means therein; and

Fig. 16 is a fragmentary sectional view showing air circulation and water diverting means embodied in the sealed roof unit of the building between the shingles and the sealed portion of the roof section.

In accordance with this invention, wall, partition, gable and roof units to be used in the construction of the building may be partially fabricated in a factory or construction plant and then moved to the site of the building for assembly. The floor and ceiling units may be prefabricated or they may be put together in the process of erecting the building. Interior and exterior finishing is done in the usual manner.

In a two story building, as shown in Fig. 1, the following is the preferable order in assembling the several units on a previously laid foundation: first a plate is laid on and sealed to the foundation; next a prefabricated lower floor unit is laid, or this unit is positioned on the foundation; then the prefabricated wall and partition units of the lower story are positioned; then a prefabricated second story floor unit, which also forms the ceiling of the first story rooms, is properly positioned on the upstanding walls and partitions, or this unit is assembled on the job; then the prefabricated wall and partition units of the second story are positioned on the second story floor; then a prefabricated ceiling unit of the second story is positioned, or this unit is assembled on the job; and then the prefabricated gable units and the prefabricated roof sections are positioned in the order mentioned.

Preferably the outer walls, such as sheeting and siding, the inner walls such as plaster board and plaster, the floors, trim and roof covering, such as sheeting and shingles, are applied after the prefabricated frame units are assembled.

In the following description the above mentioned units will, as far as possible, be described in the order in which they are assembled.

A foundation 20, Figs. 1 and 6, will first be provided and a foundation plate 21, commonly called a mud sill, laid on and preferably bolted to said foundation, as by bolts 19. A key type sealing member 24, positioned in suitable grooves in the plate or mud sill 21 and foundation 20 and laid in sealing material 25, see Fig. 9, is provided between the plate 21 and foundation 20 to air seal the basement portion of the house. The sealing material 25 may be a waterproof glue, as a synthetic resin glue, and may help to secure the plate 21 to the foundation 20.

Floor unit

The prefabricated floor unit which is adapted to rest on the plate or mud sill 21 comprises spaced apart parallel floor joists 26 having floor joist headers 27 extending crosswise therebetween at suitable intervals, see Figs. 1 and 6. All of the floor joists 26 and headers 27 except those that are positioned adjacent the outer walls of the house have longitudinally extending spaced apart parallel grooves 28 provided in both sides thereof. These grooves 28 are preferably omitted from the outer sides of the marginal floor joists 27', commonly referred to as box sills, and shown at the

lower right in Fig. 1, and at both the right and bottom of Fig. 6.

Spaced apart sheets or panels 29 of air sealing material, such as plywood, have their edges positioned in the grooves 28 and form spaced apart air sealing partitions between the floor joists 26 and headers 27 and box sills 27'. The edges of the sheets or panels 29 are sealed within the grooves 28 by suitable sealing material 25, as shown in Fig. 9, so that no air can pass around these edges and preferably the spaces between the sheets or panels 29 are filled with heat insulating material 30. The sealing material 25 may be bituminous material or a waterproof glue, as a synthetic resin glue.

The end portions of the floor joists rest within grooves 34 in lower floor joist plate members 22, see Figs. 1 and 9, and these parts are preferably adhesively connected. The lower floor joist plate members 22 are adapted to be positioned on the foundation plate members 21, or mud sills, when the house is assembled. Said plate members 21 and 22, see Fig. 9, are provided with registering grooves 23 within which is disposed a key type sealing member 24, which is preferably formed of wood.

The key type sealing member 24, shown in Fig. 9, is a typical example of key type sealing members set in sealing material such as synthetic resin glue and used in many places throughout this structure. These key type sealing members, although varying somewhat in shape and size, are all designated by the numeral 24. These key type sealing members 24 are, in all instances, set in the sealing material 25.

An upper floor joist plate member 31 is positioned within notches 32, one of which is provided near the end and in the upper edge portion of each floor joist 26 and each plate member 31 has grooves 33 that fit over the notched portions of said floor joists. One notch 32 and one groove 33 are shown in Fig. 9. The headers 27 that help to support the plates 31 have similar notches 18, as shown at the lower portion of Fig. 6.

The marginal floor joists or box sills 27' that extend crosswise of the end portions of the floor joists 26 have grooves 34' that receive the end portions of the floor joists 26. Also said box sill members 27' have tongue and groove connections 35 with both of the plates 22 and 31. Sealing material 25 such as synthetic resin glue is used in all tongue and groove connections 35. All of the tongue and groove connections herein are similar and are designated by the numeral 35 throughout the drawings and description. Sealing material 25 is also used in all instances herein where parts of this structure are received within grooves or mortise cavities in other parts. This provides a very strong structure and economizes on the use of nails.

The header members 27, Figs. 6 and 10, have tenons 36 thereon that are adapted to fit into mortise cavities 37 in the floor joists 26 and box sills 27' and are adhesively secured in said cavities.

Diagonal corner headers 38 are provided in the floor units, see Figs. 6, 11 and 12, for the purpose of supporting the upper floor joist plate members 31 where said plate members 31 are joined together along diagonal lines 39 at the corners of the structure. The diagonal corner headers 38 have their top edges provided with notches 40 near their outer ends to receive the plate members 31 and also have tenons 41 on their outer end portions that fit into notches 42 in the mar-

ginal floor joists or box sills 27', see Fig. 11. The inner end portions of the diagonal corner headers 38 are positioned in suitably shaped mortise cavities 43 that are formed in the floor joists 26 and headers 27 at the location where said floor joists and headers intersect, see Fig. 6.

If it is desired to nail the plate member 22 to the plate member or mud sill 21 then the end section of panels 29 and the parts 27' and 31 shown in Fig. 1 may be left off at the time the floor unit is prefabricated and applied after the floor is placed on the foundation and the plate 22 nailed to the mud sill 21.

Preferably after the prefabricated portions of the house have been erected the usual flooring 44 is laid on the floor joists 26 and headers 27. The marginal portions of this flooring rest on the edge portions or shoulders 75 of the plate members 31, as shown in Fig. 1.

Side wall and partition units

The side wall units each comprise a plurality of upright spaced apart parallel studding members 45 extending between a lower studding plate 46 and an upper studding plate 47 and having transverse headers 48 provided therebetween at suitable intervals.

Corner post members 49, see Figs. 5, 7, and 8, having diagonal faces 50, are provided at the ends of each side wall unit. Window frame members 51, see Figs. 5, 14 and 15, and door frame members 52 are provided wherever desired in the side wall units.

The window and door frame members, Figs. 5 and 14, each comprise marginal frame members 80 extending around the openings, and facing members 81 positioned adjacent to the frame members 80. Usually the facing members 81 are spaced as respects the frame members 80 and an opening 83 is left therebetween. Trim members 82 are positioned in overlapped relation to the edge portions of the frame members 80 and facing members 81. A key type sealing member 24 is disposed within suitable grooves (the position of the grooves being such to properly locate facing 81) between each frame member 80 and the adjacent trim member 82 and between each facing member 81 and the adjacent trim member 82. This provides an efficient air seal on each side of the opening 83. At the bottom of a window, Fig. 15, the facing member is in the form of a window sill 84 and a key type air sealing member 24 is provided between this sill 84 and the adjacent frame member 80. The seal at the bottom of a door is similarly formed as respects the usual door sill. In Fig. 14 the dotted lines show the manner in which the key type sealing members 24 join at the corners of a window or door frame to avoid leaving any openings at these corners.

Spaced apart parallel air sealed panels 29 are provided between the studding 45, plates 46 and 47, headers 48, corner posts 49 and window and door frame members 51 and 52 in the same manner as hereinbefore explained in connection with the floor unit. All edge portions of these panels 29 are embedded in and sealed in the frame members with which they make contact to provide complete air sealing and leave closed and sealed air spaces between the sheets 29, which closed and sealed air spaces are preferably filled with heat insulating material 30 to prevent air circulation.

The headers 48 form air stops to check movement of the air and also form fire stops in compliance with the usual building codes.

In all instances the air sealed panels 29 are positioned inwardly from the planes of the faces of the frame members by which they are surrounded. This provides air spaces 74 between the panels 29 and any wall surface forming members, such as sheeting, plaster board and plaster, flooring or roofing that are attached to the edge portions of the frame members. These spaces 74 are not air sealed. The space 74 between the panels 29 and either the wall surfacing, such as outside sheeting and siding or inside plaster board and plaster, is available for the reception of wiring, plumbing, heating conduits and the like. Usually the inside space 74 will be used for these purposes. It is obvious that the thickness of the wall and the positioning of the panels 29 in the wall unit may be varied to provide the desired space for any installations to be made in the wall.

The diagonal faces 50 of the corner post members 49 are provided with suitable grooves 50' for key type sealing members 24, preferably disposed at right angles to the inclined faces, see Figs. 5 and 7. This provides a structure which will permit the two walls to be readily moved into their correct positions relative to each other in assembling the house. Bolts 53 are used to secure each pair of corner posts 49 together. Each end of each corner post 49 is provided with tongues 54, see Figs. 7 and 8, that are adapted to fit within the grooves 28 which are provided in the plate members 46 and 47 to receive the panels 29. The panels 29 fit closely against the ends of the tongues 54 to maintain the air seal at these locations.

A key type sealing member 24 is provided between the lower studding plate 46 and the upper floor joist plate 31 of the previously described first floor unit and a similar key type sealing member 24 is provided between the top studding plate 47 and a hereinafter described joist plate 58 above it.

The end portions of the studding 45 are disposed in suitable transverse grooves 54' in the studding plates 46 and 47 as shown in Fig. 1. In all instances the studding plates 46 and 47 are of less width than the joist plates against which they abut. This allows portions of the joist plates to overhang the studding plates and form shoulders 75 which receive and support the edge portions of floor means and ceiling means as hereinafter described.

At locations where partitions are to join the walls upright studding members 55 of T shaped cross section are provided, as shown in Fig. 5. Each partition is preferably prefabricated independently and attached to walls or other partitions when it is erected on the job. The structure of the partitions is substantially the same as the structure of the outside walls in that the three spaced apart parallel panels 29 with heat insulating material 30 between said panels are used. The means for connecting the partitions to the ceiling above involves the use of a T shaped plate 61 in the ceiling. The means for connecting the partitions to the ceiling above involves the use of a T shaped plate 61 in the ceiling. The means for connecting the partitions with the lower floor is the same as that used in connection with the upper floor, as shown in Fig. 3 and hereinafter described. Members 55 of T shaped cross section are also provided in partitions to which other partitions are to be attached.

Fig. 13 shows an upright wall studding member 56 having a cross sectional shape similar to a cross and adapted to be used in partitions where four walls radiate from one location.

Ceiling-floor unit

The unit which cooperates in forming the ceiling for the first story and the floor for the second story comprises floor joists 57 connected with lower joist plates 58, upper joist plates 59 and marginal floor joists or box sills 60. The parts 57, 58, 59 and 60 are somewhat similar to the corresponding parts 26, 22, 31, and 27' respectively in the lower floor and are assembled in a similar manner and have similar key type sealing members 24 and tongue and groove connections 35. Also similar spaced apart parallel air sealing walls or panels 29 are provided in this unit. It is to be noted that the lower joist plate 58 differs from joist plate 22 in that it is set into a notch 58' in the joist 57 and is flush with said joist 57 and provides a shoulder 75 to which a surface, as plaster board, may be attached. At the location where partitions are to be connected with this ceiling-floor unit, I provide T shaped upright members 61 and 62 spaced apart and supported by a header member 63, the edges of the headers 63 being set into grooves 64' in the T shaped members 61 and 62 and also having tongue and groove connections 35 with these members. Other headers corresponding to the headers 27 of Fig. 6 are preferably provided at suitable intervals between the joists 57. The T shaped member 62 is preferably somewhat larger in cross section than the T shaped member 61 to facilitate connection therewith of floor means, as herein-after described.

Upper story wall units

The upper story wall and partition units are similar to the lower story wall and partition units and the parts thereof are correspondingly numbered.

Ceiling unit

The unit that forms the ceiling between the upper story and the attic is similar to the ceiling-floor unit hereinbefore described except that an upper joist plate member 64 of modified form is used in place of the joist plate 59. This joist plate 64 has a groove 65 in its top side for the reception of a tongue 66 of a rafter plate 67 hereinafter described.

Gable units

The gable units, shown in Figs. 1, 2 and 4, comprise gable studding 76 having a lower gable studding plate 77 and an upper gable studding plate 78—the plate 78 being inclined to conform to the slope of a roof. The lower gable studding plate 77 rests on a joist plate 79 of the ceiling unit, as shown in Fig. 4. The upper gable studding plate 78 has the cross sectional shape shown in Fig. 4 and is adapted to cooperate in the support of a roof as hereinafter explained. The gable unit is provided with the spaced apart parallel air sealing panels 29 and said gable unit has headers between the studding 76 where the length of the studding requires.

Roof units

The roof units comprise rafters 68, and 68', Figs. 1, 2 and 4, having headers 69 extending crosswise therebetween. Air seal panels 29 having heat insulating material 30 therebetween are provided between the rafters 68 and 68' and the headers 69. The rafter plate 67 has transverse notches 70 to receive the rafters 68 and 68'. The rafters 68 and 68' are provided with a shoulder 71 against which the rafter plate rests. The raft-

ers 68' are end rafters and rest on the upper gable studding plates 78, see Fig. 4, and are air sealed as respects the plates 78 by tongue and groove means 35. The end rafters 68' are shown in Figs. 1, 2 and 4 and one of the intermediate rafters 68 is shown in Fig. 4.

Header members 72 of special construction are provided between the rafters 68 above the rafter plate 67. The lower edge portions of the header members 72 have tongue and groove connection 35 with the rafter plate 67 and the upper edge portions of said header members have tongue and groove connection with roof sheeting 85 that is secured to the rafters preferably after the roof units are placed on the house. The end portions of header members 72 adjacent the gables are notched, as shown in Fig. 4, and rest within corresponding notches in shelf portions 86' that are provided on the upper gable studding plates 78.

The ridge board portion of each roof unit is provided with a ridge board. The two ridge boards are positioned in face to face relation when the roof units are properly assembled and a key type sealing member 24 is provided between these two ridge boards to air seal the joint between these ridge boards and prevent relative displacement of said ridge boards.

Key type sealing members 24 are also provided between the abutting end portions of the upper gable studding plates 78, as shown in Fig. 2.

The ceiling joist plates 64 support the rafter plates 67 and these plates 64 and 67 are rigidly interlocked by the tongue and groove means 65—66. This effectively prevents outward movement of the rafter plate 67 on the wall plate 64 on which it is supported thus preventing spreading of the eave portions of a roof. These parts thus provide a building structure in which spaced upright walls are tied together by ceiling joists which act as tension means to prevent lateral displacement of the walls and in which rafter plates on inclined rafters are interlocked by tongue and groove means with the wall means so that there can be no spreading of the eave portions of a roof.

In the event of a leak in the roof, i. e., through the shingles 88 of this building, portions of the sealing means in the roof unit and also other portions of the building, such as the sealing means in the ceiling unit of the upper story, might be damaged before the leak could be detected and stopped. This makes it desirable to provide some means for preventing this damage by leakage and some means which will make it possible to detect a leak as soon as it occurs. Also when wooden shingles 88 are used for roofing the building it is desirable, in the interest of prolonging the life of these shingles, to provide for air circulation underneath these shingles.

Both of the above stated objects are accomplished in this structure, see Figs. 1, 4 and 16, by providing a layer of roofing paper 97 between the roof sheeting 85 and the batts 87 and by providing transverse grooves 96 in the bottom sides of the batts 87. At the eaves, see Fig. 16, the groove 96 in the lowermost marginal batt 87, which is preferably wider than the other batts 87, preferably ends or tapers out before it reaches the lowermost edge of this marginal batt. This provides a water discharge opening 98 beyond the outer surface of an upright trim board 89 that is secured to the eave portion of roof. The roofing paper 97 preferably ends flush with the outer face of this trim board 89. To prevent insects, such as termites, from entering through the openings 98, I secure a strip of fine mesh screen 99

to the under side of the marginal batt 87. This strip of screen 99 extends across the openings 98 and one end portion thereof is positioned between the batt 87 and roofing paper 97 so that the openings 98 are effectively screened but will allow for a free circulation of air and drainage of water.

The nails used to secure the batts 87 to the roof unit necessarily penetrate the roofing paper 97 but the holes made by these nails in the roofing paper are not objectionable. If a leak develops in the shingles 88 substantially all of the water that leaks through these shingles will run down along the roofing paper 97 through the grooves 96 and discharge through the openings 98. This water discharging from the openings 98 can be detected by observation or examination and the roof repaired. Also ample circulation of air underneath the shingles is insured.

After the several air sealed units of the building have been assembled, as hereinbefore described, the building may have external and internal wall forming means and finishing means applied thereto.

On the exterior of the building I have shown shiplap sheeting 85 and lap siding 95. On the roof I have shown shiplap sheeting 85, spaced apart wooden strip or batts 87 and shingles 88.

On the interior, I have shown flooring 44 for both the lower and upper stories and have shown as a wall and ceiling finish plaster board 90 and plaster 91.

Obviously both inside and outside finishes may be varied as desired.

At the locations where the floors intersect the walls, I leave open spaces which I fill with water repellant sealing material 92, after which the usual baseboards 93 and moldings 94 are applied.

To complement the invention herein and obtain the maximum utility thereof, air sealed windows and doors of special construction, not herein disclosed, are preferably provided for all openings.

The panels 29, if made of strong material, such as plywood, provide considerable strength. Also if plywood is used as the material for the panels 29 the glue between the plies of wood seals the wood against the passage of air therethrough. The use of synthetic resin glue as a sealing material around all possible joints strengthens the entire building structure and economizes in the use of nails.

In view of the use of factory made tongue and groove recesses and tenons and the like herein, preferably the various parts are treated at a factory to control dimensions. Synthetic resin sealers are satisfactory for this purpose.

This building, when constructed in the manner hereinbefore described, is air sealed throughout. For this reason it is highly resistant to temperature changes, is moisture proof, dust proof, germ proof, and gas proof as respects poison gases which may be used in warfare. Also it is substantially sound proof and is effectively sealed against all forms of insects including termites.

Also the air sealing of this building greatly simplifies heating, humidifying and air circulation and conditioning problems as it makes it possible to completely control the amount of air that enters and leaves the building and rooms thereof. The air sealing of each room of the building makes possible an accurate control of the temperature and humidity of the air in each room—a thing especially desirable in hospitals, sanitariums and the like.

Obviously, changes may be made in the forms, dimensions and arrangement of the parts of my invention, without departing from the principle thereof, the above setting forth only preferred forms of embodiment.

I claim:

1. In a building structure, an exterior wall exposed to the weather; an interior wall positioned in spaced parallel relation to said exterior wall and constituting a wall of a room of the building structure; a plurality of spaced plywood panels, each comprising laminations of wood adhered together, positioned intermediate and in spaced parallel relation to said exterior and interior walls providing air chambers between said panels and between said panels and said walls; heat insulation material disposed in the air chambers between said plywood panels and preventing air circulation therein; and marginal frame means adhered to the end portions of said plywood panels and providing an air seal for the edge portions of said air chambers between said plywood panels, whereby the glue lines of the plywood panels and those between the marginal frame means and the end portions of the plywood panels substantially completely air seal said air chambers.

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