July 28, 1936. B. VALE 2,048,901

BUILDING STRUCTURE

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FIG. 4.

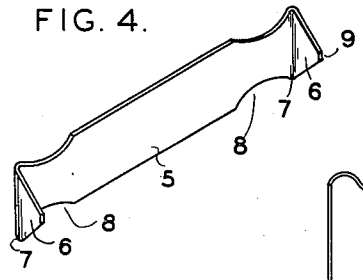

FIG. 1.

FIG. 2.

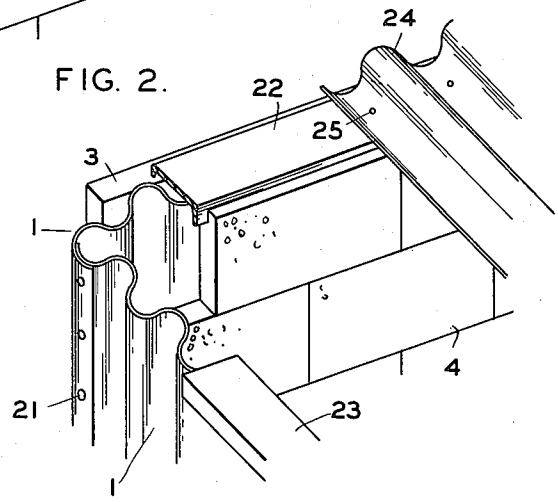

FIG. 3.

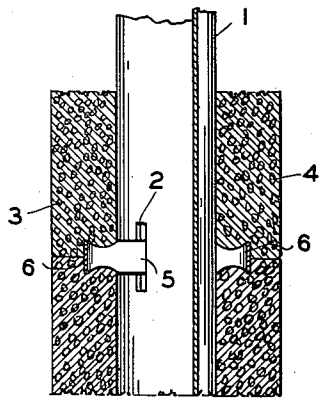

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FIG. 5.

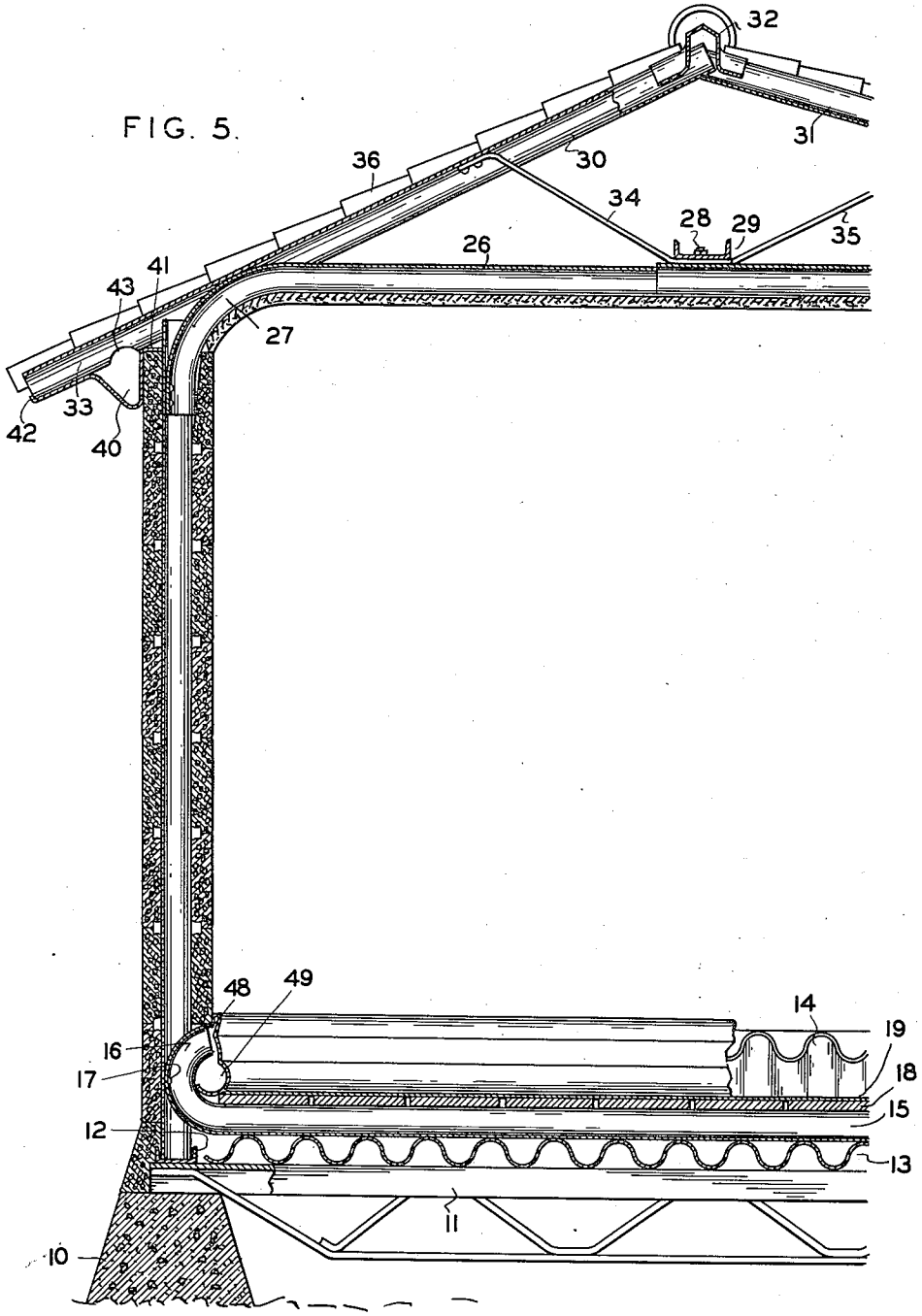

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FIG. 6.

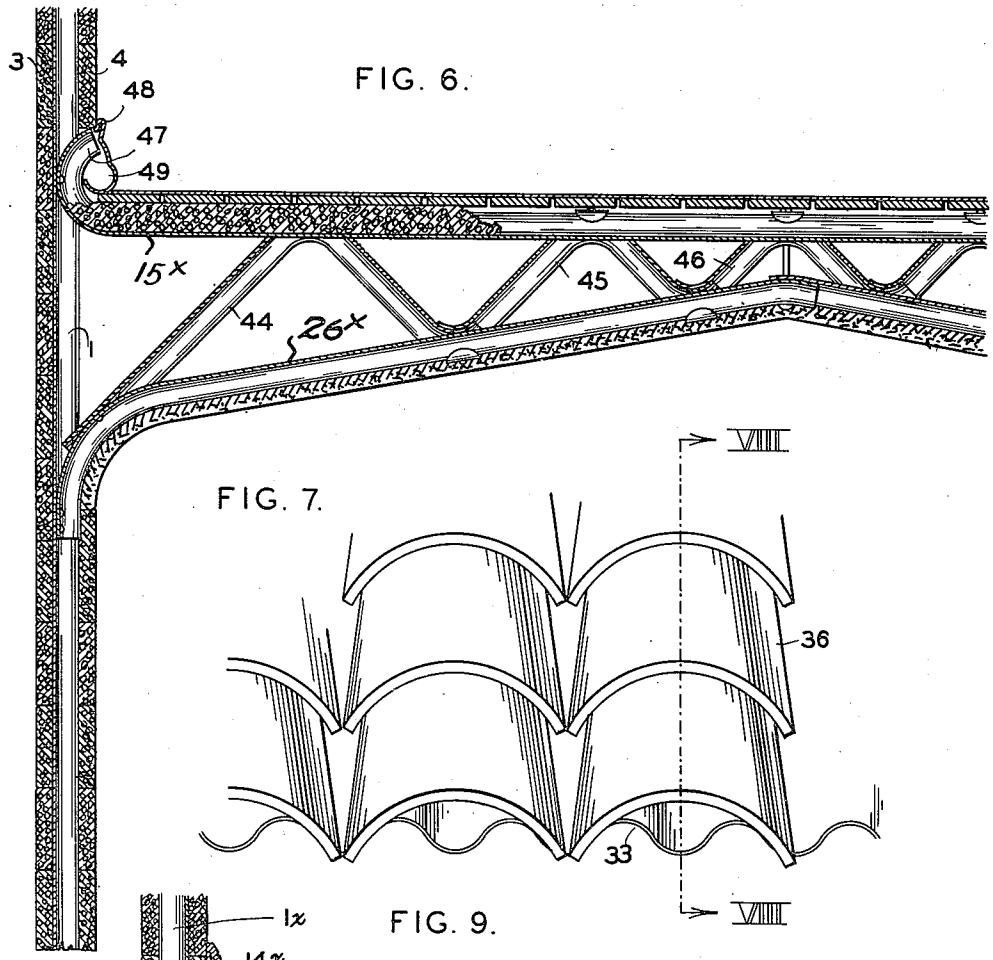

FIG. 7.

FIG. 9.

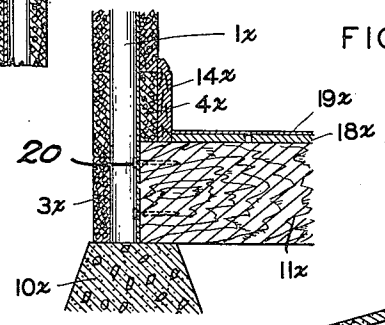

FIG. 8.

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FIG. 10.

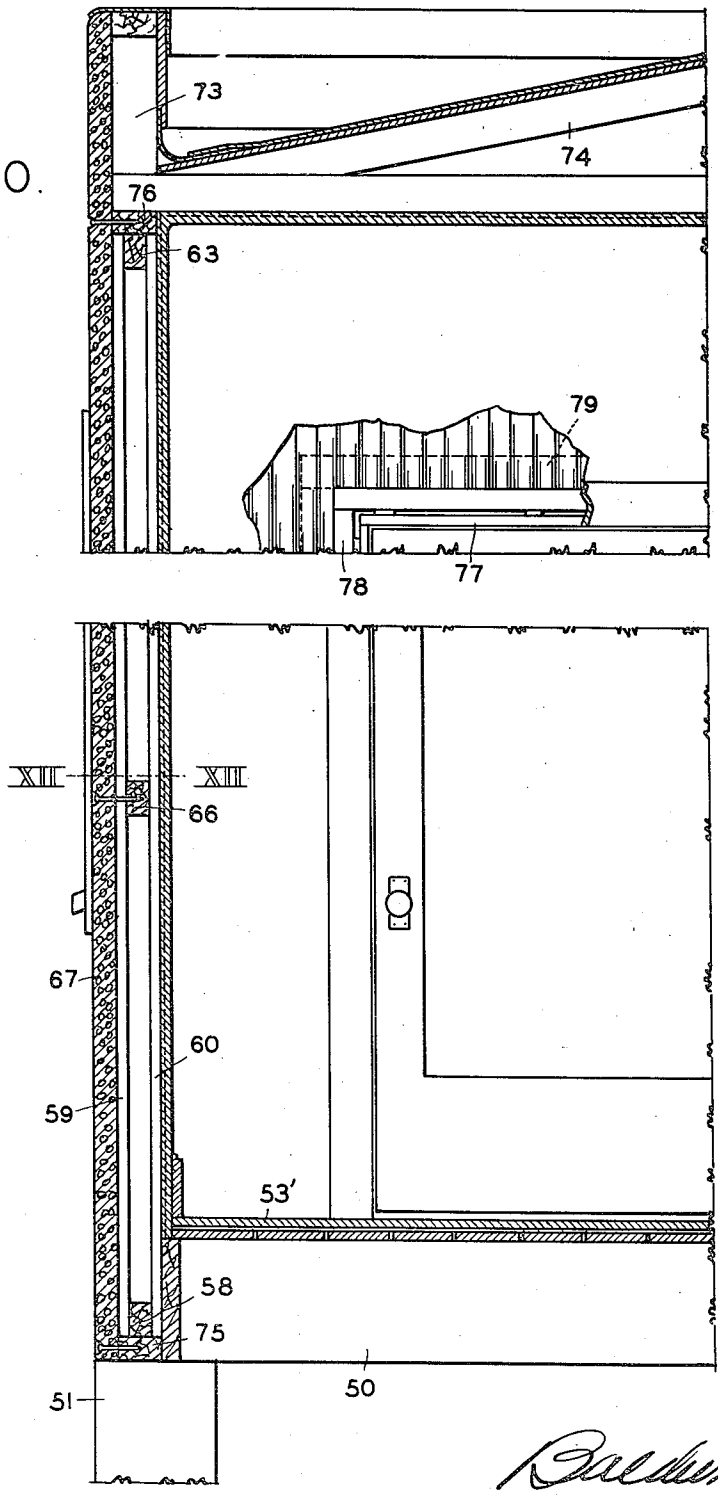

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FIG. 11.

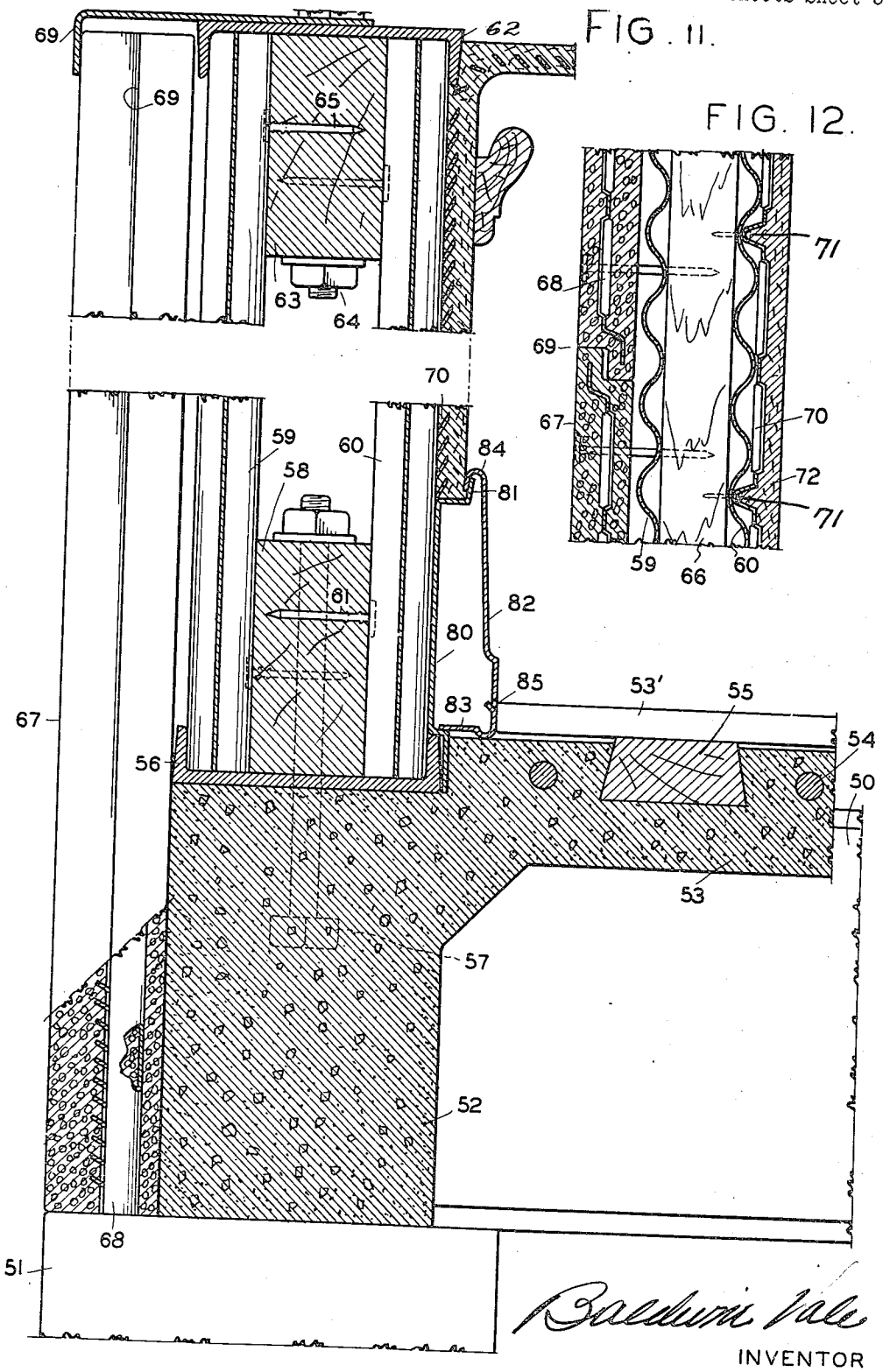

FIG. 12.

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UNITED STATES PATENT OFFICE

2,048,901

BUILDING STRUCTURE

Baldwin Vale, San Francisco, Calif.

Application December 13, 1933, Serial No. 702,137

10 Claims. (Cl. 72—1)

This invention relates to improvements in building structures and more particularly to composite hollow walls.

The principal object of the invention is to produce a self framing steel walled building, insulated against heat, cold, sound and moisture, and proof against fire, earthquake, wind, corrosion, insects such as termites, rodents, odors and decay.

Another object is to conform to the conventional interior and exterior finishes and architectural designs.

Further objects are to reduce the cost of material and labor items and simplify the construction of the types of buildings to which the invention is applicable.

Other objects and advantages will appear as the description progresses.

In this specification and the accompanying drawings the invention is disclosed in its preferred form. It is to be understood, however, that it is not limited to this form because it may be embodied in other forms without departing from the spirit of the invention as defined in the claims following the description.

In the five sheets of drawings:

Fig. 1 is a fragmentary perspective view of a portion of wall constructed in accordance with this invention.

Fig. 2 is a similar view of the same, showing the corner construction.

Fig. 3 is a fragmentary vertical section showing one manner of assembling the interior and exterior insulating finish walls and the corrugated spacing core.

Fig. 4 is a detail in perspective of the cross tie clip.

Fig. 5 is a vertical section of a portion of a building embodying this invention.

Fig. 6 is a similar view of a portion of the same, illustrating one form of combined floor and ceiling truss embodying this invention.

Fig. 7 is a perspective top view of a roof portion showing the application of conventional roof tiles.

Fig. 8 is a vertical section of the same, taken on the line VIII—VIII, showing one way of attaching the tile to the roof.

Fig. 9 is a view similar to a portion of Fig. 5, showing in detail a modified form of floor joist structure.

Fig. 10 is an interior view in elevation of the corner of a building, showing a composite double wall structure and the manner of framing doors and windows within the wall.

Fig. 11 is an enlarged detail of this wall and foundation in vertical section.

Fig. 12 is a horizontal section taken at XII—XII, Fig. 10 in fragmentary detail showing one manner of attaching the interior and exterior finishes to the sustaining wall.

Broadly stated, the invention consists of forming building walls of corrugated steel and applying interior and exterior composition surfaces to the corrugated wall.

In detail the construction illustrated in the drawings, comprises the corrugated steel core wall 1, provided at proper intervals with the holes 2.

The cementitious blocks 3, 4 are arranged in superimposed courses on opposite sides of this core wall. The tie clips 5 are extended through the openings 2 and have their angular ends 6—6 embedded in the opposed edges of the blocks 3—4 on opposite sides of the core wall 1. See Fig. 3.

These blocks 3—4 are preferably composed of aerated cementitious material, such as concrete, gypsum, and similar plastics. The aeration is accomplished by pumping air into the mix, or by introducing reactive materials into the mix that will generate gases which form bubbles in the blocks while they are in the molds.

Wire mesh lath can be attached to the core wall and plaster applied in the conventional manner, as shown on the ceiling in Figs. 5 and 6. Plaster board and similar sheets or insulated metal plates can also be applied in an obvious manner, in lieu of the blocks 3—4. The nature of the external walls can be chosen to suit climatic and other controlling conditions.

It is advantageous to preserve the air space provided between the external walls by the curvilineal corrugations of the core wall 1. This air space contributes to the thermal insulation of the wall as a whole.

The clip shown in Fig. 4 has the body 5, and the angularly bent ends 6—6 adapted to be pushed into the body of the blocks 3—4, the nature of which facilitates the penetration of the corners 7—7. The opposed curves 8—8 serve the double purpose of forming penetrating points at 7—7 and as gages for locating these points in the center of the thickness of the blocks 3—4. The tapered ends 6—6 serve a similar purpose in sharpening the corners 7, the points 9—9 gaging the penetration of the clips to one half their width. These clips can be varied in accordance with the nature of the attached material.

It is obvious that garages, tool houses, barns, and the like, can be made self-framing, substan-

tially as in Fig. 5. In such instances the attached plating, such as the blocks 3—4, can be omitted.

A house constructed in accordance with this invention is erected upon any suitable foundation, such as 10 in Fig. 5. The joists 11 rest upon the foundation and have the sill channels 12 leveled thereupon. The width of the channels should be equal to the depth of the corrugations in the core wall, which rests therein, to stabilize the corrugations of the core walls which sustain the weight of the superstructure.

Where additional sustaining strength or lateral stability is desired, the widths of the sheets forming the core wall 1 may be overlapped to any extent, as at 12, Fig. 1, to act as reinforcing studding at intervals.

The sheets of corrugated steel 13 are laid transversely on the joists 11, as in Fig. 5. These strips have the curled up ends 14 which are welded or riveted to the side walls 1, into the corrugations of which they snugly fit see 15, 16 and 17 described below. The meeting ends of these sheets are overlapped longitudinally and welded together at intervals.

The similar strips 15 are laid transversely of the sheets 13, and also have curled up ends 16 which nest into the corrugations of the wall 1, to which they are welded at intervals, as at 17. The ends of the sheets 15 are also overlapped and welded. The corrugations of the sheets 13—15 superimposed transversely on top of the joists 11, make a very rigid floor foundation. It is desirable to interpose aerated concrete between the sheets 13—15, which expands, as described, and will fill the corrugations running in transverse directions. This adds to the rigidity of the floor and affords thermal insulation.

The upper corrugations in the strips 15 may also be filled with this or other insulating material before the floor boards 18 are laid on top of the sheets 15. These boards may be secured to the sheets 15 by drive screws, barbed nails or other available means suitable for the purpose. The hardwood flooring 19 or plastic flooring, such as magnesite, may be laid on the boards 18 in the usual manner.

Where fire restrictions will permit, the usual wooden joists and flooring can be substituted for the assembly 11 to 19. In such substitutions the walls 1x can be nailed at 20 to the ends or sides of the adjacent joists 11x, see dotted nails, as in Fig. 9.

The room corners may be formed as in Fig. 2, the edges of the meeting walls 1—1 being welded as at 21. The top plate channels 22, 23, are mitered and welded at the corners, to form a rectangular girt around the room in vertical alinement with the sills 12. This gives additional stability to the structure.

The corrugated sheets 24, forming the room ceiling, have their ends or edges laid upon and are welded at 25 to the plate channels 22, 23. This completes the welded corrugated cubical which forms the walls, floor and ceiling of the room.

If cove corners are desired, as in Fig. 5, the ceiling sheets 26 have their ends or sides curved transversely to their planes, as at 27, to meet and be welded to the walls 1. In this structure the plate channels 22, 23 are not required. The inner ends of these sheets overlap and are welded together and bolted at 28 to the stringer channel 29.

The roof is composed of sheets of corrugated steel 30, 31, having their upper edges interlocked and joined by the conventional "ridge roll" 32, to which they are welded. Their lower edges overhang the side walls to form the eaves 33. Where the roof sheets meet the core walls 1, their respective corrugations interlock, either in the structures of Fig. 2 or Fig. 5. The corrugations of the ceiling coves 27, and the roof sheets 30, 31 also interlock and may be welded at intervals. The truss rods 34, 35 extend from opposite sides of the stringer 29 and extend upwardly to and are bolted to their respective roof sheets 30, 31 to support the ceiling. The ceiling sheets 26 act as a chord, or tension brace, to form a truss with the inclined roof sheets 30, 31.

The corrugated roof sheets are particularly adaptable to the ornamental use of conventional segmental tiles 36, see Figs. 7, 8. These tiles are suspended by the wires 37, having their upper ends welded to the ridge roll 32. At intervals these wires have loops 38 into which the tie wires 39 are engaged. These tie wires are looped through the usual hole in the upper ends of the tiles and then coiled around the tie wires adjacent the loops. The lower ends of the wires 37 are fixed to the roof sheets adjacent the eaves 33. In this manner the tiles may be suspended on roofs of any pitch and effectually held against wind, earthquake or other violence of the elements.

It is obvious that horizontal wooden sheathing strips may be fixed to the roofing sheets 30, 31, to which shingles, slate or other forms of roofing can be attached for ornament or increased thermal insulation. It is also desirable to flow aerated cement on top of the ceiling plates 26 to improve thermal insulation.

It is to be noted that the walls, floors and ceiling of corrugated sheets interlocking at all corners of a room, form a steel box, tight against the ingress of wind, water and insects. After the steel structure is erected it is advisable to spray all exposed surfaces with asphalt or suitable protective coatings. This further seals and strengthens the joints.

Where it is desired to install gutters 40 under the eaves, the upper edge of the trough can be flanged to hook over the top of the outer blocks 3 at 41. The extended edge 42 of the gutter acts as an under trim to give proper finish to the under sides of the eaves. The holes 43 through the trough corrugations of the roof sheets discharge rain into the gutters to be disposed of in the usual manner.

A modification is shown in Fig. 6 adapting this invention to two or more stories. Corresponding parts are identified by the common designating numerals with an x added. In the suggestive modification the ceiling sheets 26x are inclined toward the center to form an arched ceiling with cove corners.

The floor sheets 15x and flooring are the same as previously described. The additional elements are the trusses 44, 45, 46, preferably formed also of corrugated sheets, so that they will nest into the corrugations of the floor sheets above and the ceiling sheets below, to which they are welded at proper points of contact.

This same floor truss support can be substituted for that shown in Figs. 5 and 9, where space permits or other conditions make it preferable.

The various necessary welds indicated are easily accomplished by electric arc welding. The metal wall structure can be grounded and an insulated welding rod applied at the desired points until

the sheets fuse together at the spot. Metal lath, as on the ceilings, Figs. 5, 6, fixture bases, and the like, can be attached by welding in this manner.

The curled ends 47 of the floor sheets, act as supports for the lower course of blocks 4. The curved base boards 48, having the curled lower edges 49, form convenient conduits for electric wiring. The corrugated sheets extending in various directions, together with the floor and ceiling structures, provide convenient conduits for wires, pipes, heating and ventilation.

The surfaces of the blocks 3 and 4 may be painted with cement or oil paints, tints and stucco finishes, as desired. Bathroom, kitchen and interior walls may be plated with artificial marble, metal tile, and like sheets of composition, to attain, in a very simple manner, desirable interior effects.

One of the primary advantages of this invention is that the corrugated sheets supply all the sustaining and supporting strength and weather protection required. The additional elements contribute features of comfort and ornamentation.

Doors, windows and other openings are installed in accordance with common practice, with proper frames and flashings around openings provided in the walls.

Additional sustaining strength can be gained by increasing the gage of the sheets and/or increasing the depth of the corrugations. In buildings greater than two stories, it is advisable to provide proper reinforcing steel framing and utilize the benefits of this invention in curtain walls and partitions, floors and ceilings, etc.

The sustaining wall thus far described requires specially formed sheets 1 with deep corrugations, with their arcs alternating on opposite sides of a common chord line and three or more inches deep, and is intended for an all steel sustaining structure. The invention is equally adaptable to the use of the conventional rolled corrugated sheets with shallow sinusoidal corrugations ranging from 11/32 to 1¼ inches deep combined with conventional lumber such as 2 x 3 shapes, conventional floor joists, rafters, etc., as shown in Figs. 10, 11, 12, wherein the cost may be reduced at the sacrifice of fire, insect and other protection.

In Fig. 10, the conventional steel or wooden joists 50 rest upon the foundation 51 and are joined by the usual fire stop. In Fig. 11 the fire stop 52 is integral with the concrete floor 53, which is reinforced by the bars 54 and has the nailing strips 55 embedded therein. The floor 53' is nailed to these strips.

The open channel 56 rests upon the joists 50 and the fire stop 52 to which it may be held by the bolts 57 at intervals. The spacer 58 is fixed to the channel to form interspaced grooves within the channel. The corrugated vertical sheets 59 and 60 rest within these grooves and are cross nailed or otherwise fixed to the spacer 58 at 61 depending upon the composition of the spacer, thus forming the sill of the wall.

A top plate of similar construction comprising the channel 62 and spacer 63 joined by the bolt 64 encloses the top edges of the corrugated sheets 59 and 60 also nailed to the spacer at 65. It is advisable to interpose another spacer 66 intermediate the height of the wall as at 66, in Fig. 10. The sill 56, plate 62 and the spacer 66 make three girts completely surrounding the building structure, adding greatly to its lateral and vertical stability. The wall is in effect a vertical truss of great rigidity and light weight.

In Fig. 11 the exterior insulation may be composed of vertical panels 67 of suitable composition reinforced as at 68 with high rib expanded metal lath or otherwise. These panels of convenient width rest upon the foundation 51, are embedded in mortar and are held at their tops between the angular plate 69 and the adjacent channel plate 62. Their edges overlap with a sealed joint as at 69 in Fig. 12.

Fig. 12 shows one manner of attaching the conventional high rib metal lath 70 to the interior of the wall. The open ribs 71 are nailed at intervals to the spacers 63, 66 and 58 within the corrugations of and through the corrugated plate 60. These corrugations permit the wall plaster 72 to extend through and key to the lath 70. The space between corrugated plates 59 and 60 can be filled with any of the many forms of insulating material, if desired.

There are so many types of roofing ranging from high pitch to flat that only two general types are shown as in Figs. 5 and 10. In the latter, the coping 73 is superposed upon the wall to conceal the roof in the usual manner. In this instance the rafters 74 rest upon the plate 76 in accordance with the general practice in this art.

As in Fig. 10, wooden sills and plates 75 and 76 may respectively be substituted for the metal channels 56 and 62. In the less expensive structures where wood is acceptable, these sills, plates and spacers 75, 76, 66 provide means for nailing the outer panels 67 to the wall.

The same T form can be utilized in framing the doors and windows as in Fig. 10, in which the conventional door frame 77 is inserted within the supporting frame 78, surrounded by the spacers 79 shown in dotted lines. The corrugated plates 59 and 60 are nailed to the spacers 79 as previously described in relation to the sills and plates.

For partitions, closet walls, etc., the structure in Fig. 1 with reduced cross-section can be introduced, utilizing thin panels such as 67 instead of the blocks 3 and 4.

A modification of the baseboard conduit 49 in Fig. 5 is shown in Fig. 11 and comprises the bent plate 80 embedded in the floor 53 and having the extended upper edge 81. The base board is a bent plate 82 having the bottom flange 83 interposed between the floor 53' and the plate 80. Its upper edge hooks over this plate at 84. The base plate 82 may be removed by introducing a pry through the slot at 85.

I am aware that corrugated steel sheets have been used as sheathing plates for buildings. But to the best of my knowledge, it is novel to utilize corrugated sheets as sustaining walls and as spacing cores in the hollow walls of buildings.

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

1. A building structure including a hollow sustaining wall having a vertically corrugated sheet metal core, cellulate cementitious blocks superimposed to form walls on opposite sides of said core and cross ties engaging said blocks and said core.

2. A building structure including a plurality of horizontally interspaced vertically corrugated sheets connected to a plate and a sill at their upper and lower edges respectively and to a spacer intermediate their height to form a sustaining wall.

3. A building structure including sustaining

walls and ceiling composed of curvilineally corrugated sheet material, the edges of said ceiling sheets being coved transversely to their planes and interlocked with the corrugations of said walls; and inclined corrugated roof sheets joined at their apexes and to said coves and sustained by said walls.

4. A building structure including horizontally interspaced vertically corrugated sheets; and joining members having spacers extending between and lateral flanges enclosing the ends of said sheets.

5. A building structure including horizontally interspaced sustaining walls; spacers between said walls; and an enclosing wall attached to said spacers.

6. A building structure including horizontally interspaced sustaining walls; joining members extending between and overhanging the ends of said walls; and interlocking wall panels attached to said joining members.

7. A building structure including a vertically corrugated wall; metal lath having ribs extending into said corrugations and fixed to said wall.

8. A building structure including a plurality of horizontally interspaced vertically corrugated sheets; joining members extending between said sheets; and a metal lath having ribs extending into said corrugations and attached to said joining members.

9. A wall in the class described including a vertical sustaining sheet having undulating vertical corrugations; and conventional metal lath superimposed upon said sheets.

10. A building structure in the class described including horizontally interspaced vertically corrugated sustaining sheets; spacers between and supported by said sheets; and a wall overlying said sheets.

BALDWIN VALE.