April 14, 1942. W. J. McDERMOTT 2,279,873

BUILDING STRUCTURE

Filed Feb. 3, 1940 3 Sheets-Sheet 1

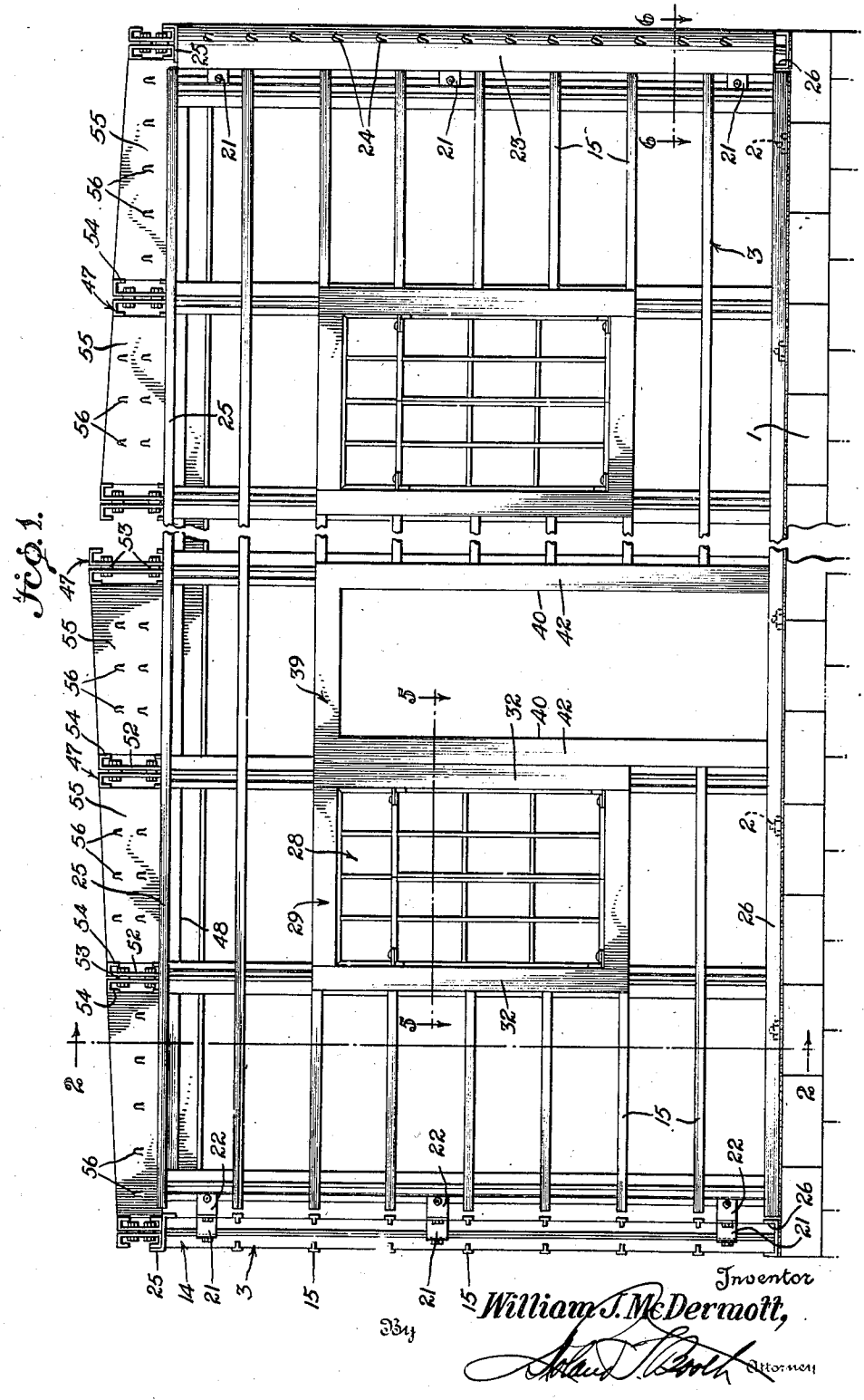


Fig. 1.

Inventor
William J. McDermott,
By Roland Welch
Attorney

April 14, 1942. W. J. McDERMOTT 2,279,873

BUILDING STRUCTURE

Filed Feb. 3, 1940 3 Sheets-Sheet 2

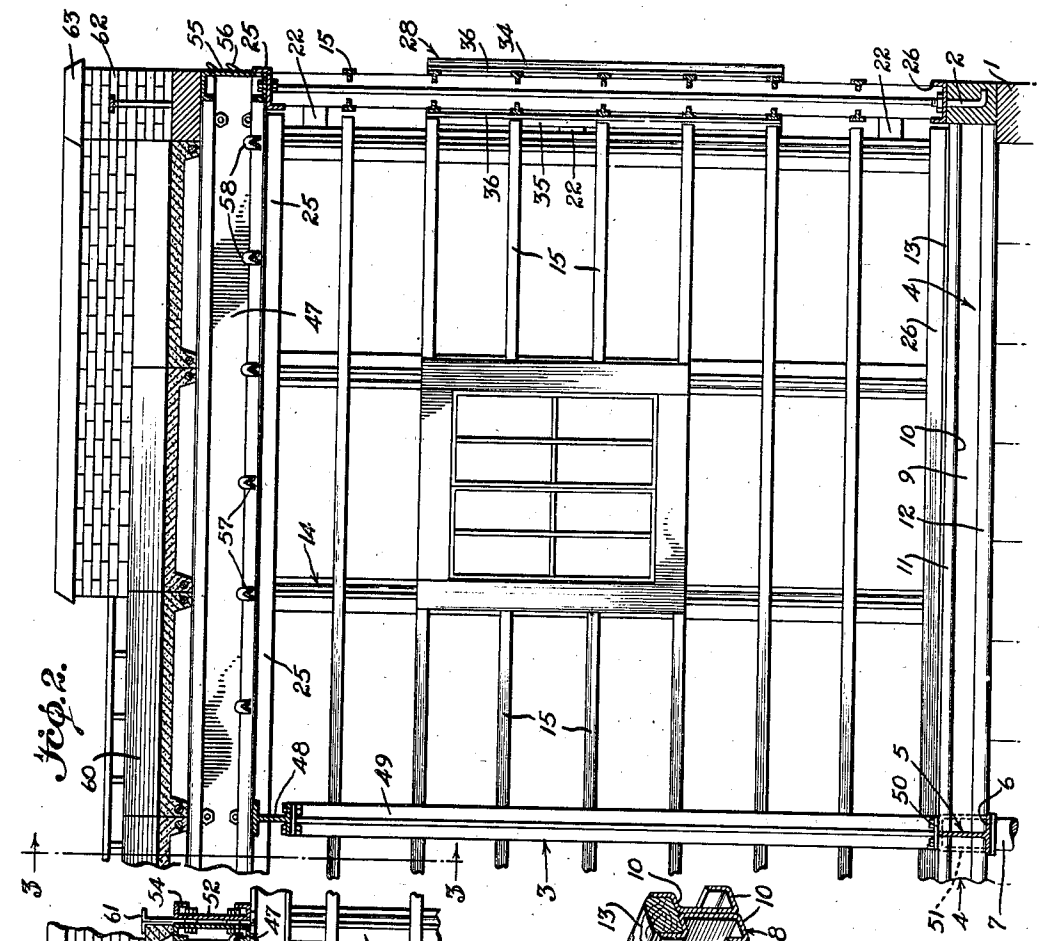


Fig. 2.

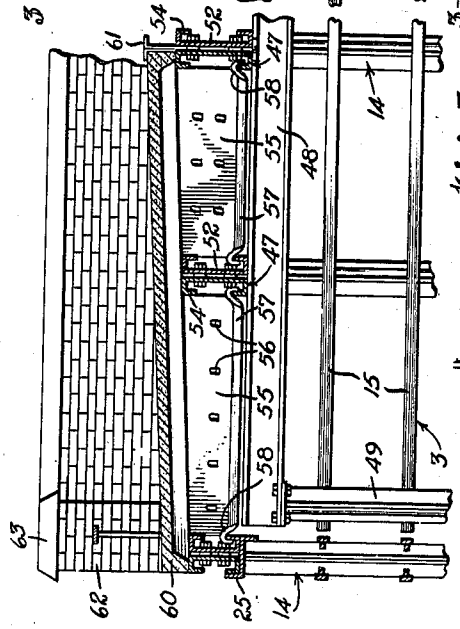


Fig. 3.

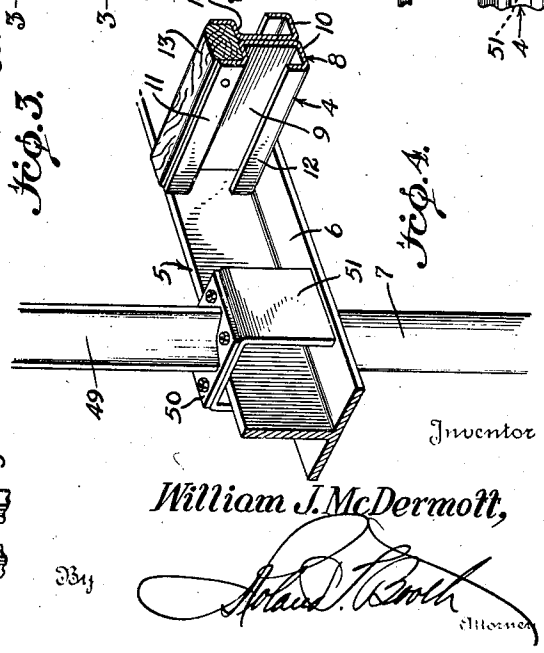


Fig. 4.

Inventor

William J. McDermott,

By

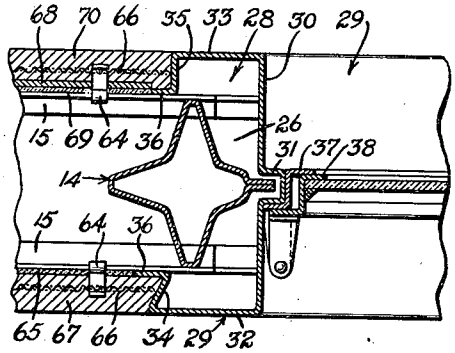
Attorney

April 14, 1942. W. J. McDERMOTT 2,279,873

BUILDING STRUCTURE

Filed Feb. 3, 1940 3 Sheets-Sheet 3

Fig. 5.



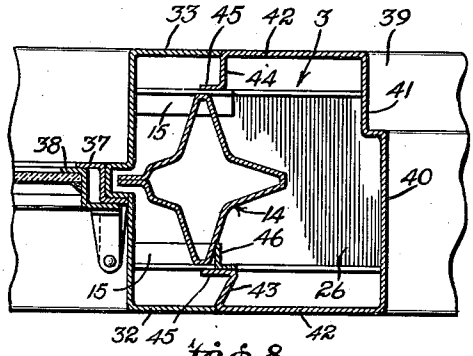


Fig. 8.



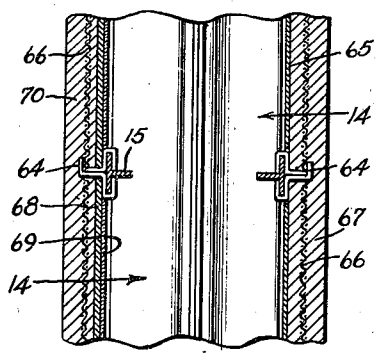


Fig. 7.

Fig. 9.

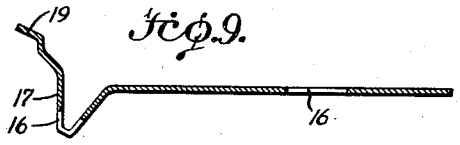


Fig. 10.

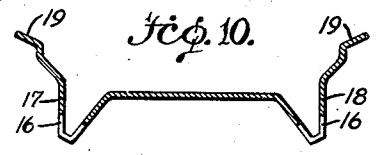


Fig. 11.

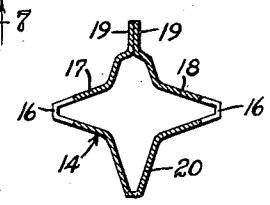
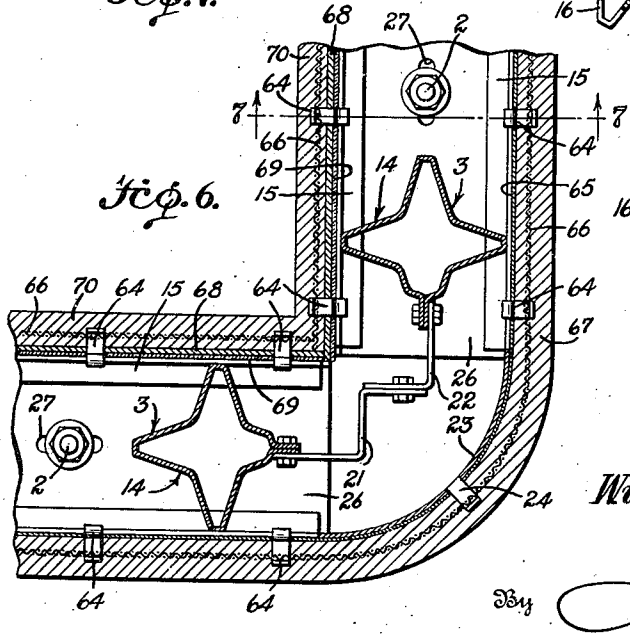


Fig. 6.



Inventor

William J. McDermott,

By Roland J. Booth

Attorney

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UNITED STATES PATENT OFFICE

2,279,873

BUILDING STRUCTURE

William J. McDermott, Port Robinson, Ontario, Canada

Application February 3, 1940, Serial No. 317,163
In Canada February 8, 1939

15 Claims. (Cl. 189—1)

This invention relates to a metal frame building structure, particularly adapted for the building of homes and other similar types of small buildings.

The invention comprehends the provision of a building structure with a metal frame, in which side frames have vertical spaced tubular columns made from sheet metal with horizontal bars arranged in spaced parallel relation, permanently secured to the opposite edges of said columns to form a rigid side frame structure, while bearing plates are mounted on the upper and lower ends of the columns for supporting the frame at the bottom by means of the bottom plate, and for supporting a floor or roof structure on the top plate. The horizontal bars provide a furring structure on the inner and outer faces of the frame to support the inner and outer wall surfacing structure. Each side frame is secured to adjacent side frames at the ends through brackets providing a rigid but detachable connection. Filler plate sections extend between the ends of adjacent frames to provide cooperation with the horizontal bars for supporting the insulation and metal lath or mesh.

The window frames are integrally united with the side frame structure above mentioned, and are constructed of sheet metal of substantially U-shape in cross section. These window frames are arranged for mounting in an opening between a pair of columns in the side frame so that the flanges of the window frame structure will embrace the columns at the sides of the window opening, while the upper and lower portions of the window frame will embrace and be permanently secured to horizontal bars on the inner and outer faces of the frame.

Door frames are formed in the same manner as the window frames, and both are provided with either ribs or rabbets, for mounting the windows and doors in the frame in a convenient manner to close the opening.

The roof structure of the present invention provides sheet metal roof rafters that extend across the building from side to side and have the ends bearing upon the top plates of the side frames. These roof rafters are formed of a pair of sheet metal channel members having the central portions secured together in spaced parallel relation with suitable spacing members engaged between, while suitable roofing slabs are mounted on top of these rafters with the joints between the slabs arranged to register with the spaces between the channel members of each beam, so that suitable securing means can be engaged with the roofing slabs to extend through the space between the channel members of each rafter and be anchored thereto.

The invention further comprehends thorough heat insulation of the building by mounting sheet insulating material on opposite faces of the horizontal bars with suitable securing means in the form of clips, or the like, at spaced intervals, which also carry metal mesh or lath on the inner and outer faces of the frame in spaced relation to the insulating sheets for receiving a plastic wall covering on both the inner and outer faces of the frame structure to complete the wall structure of the building. By making each frame in one unitary section, they can be readily used for the construction of single-story homes or may well be used in the construction of two-story homes.

The columns of the side frames are constructed of sheet metal by a method of manufacture in which a flat strip of sheet metal is used to form each column by first having spaced strip sections of the sheet metal strip offset laterally to the normal plane of the strip to form a pair of U-shaped ribs. The sheet metal strip is offset substantially simultaneous with the forming of the pair of ribs to provide offset marginal edges along the longitudinal edges of the strip. Then, the central section of the strip is folded to form another U-shaped rib which causes the first-mentioned ribs to move into oppositely extending positions relative to one another and brings the opposite edges of the strip into superimposed relation so they may be subsequently united to form a rigid tubular column structure.

In the drawings:

Fig. 1 shows the building frame of this invention in assembled relation in side elevation with portions broken away for convenience in illustration.

Fig. 2 is a vertical cross section taken on line 2—2 of Fig. 1.

Fig. 3 is a vertical cross section through the upper portion of one of the side frames and the adjacent roof structure, taken on line 3—3 of Fig. 2.

Fig. 4 shows the supporting beam for the ends of the floor joists that extend across the central portion of the building, in perspective, together with one of the supporting columns for the roof structure and a portion of one of the floor joists.

Fig. 5 is an enlarged cross section with portions broken away, taken on line 5—5 of Fig. 1.

Fig. 6 is an enlarged cross section through a corner portion of the building taken on line

6—6 of Fig. 1, showing the insulating and wall surfacing structures added for illustrating a finished wall in cross section.

Fig. 7 is an enlarged vertical cross section taken on line 7—7 of Fig. 6.

Figs. 8, 9, 10 and 11 illustrate the progressive steps in forming a strip of sheet metal to provide one of the tubular columns with the cross section as shown in Fig. 11.

A foundation is provided for the building in the usual manner, and is indicated at 1 in Figs. 1 and 2. The upper edge of the foundation is provided with suitable anchor bolts 2 at spaced intervals that are adapted to anchor the side frames generally indicated by the numeral 3 to the foundation.

The upper inner edge of the foundation at opposite sides of the building is provided with pockets to receive the ends of floor joists 4. Depending upon the size of the building construction, these floor joists may be constructed so that each joist extends between opposite walls of the building or a structure may be provided where the outer end of a floor joist 4 is mounted in a pocket in the foundation while the inner end is carried by a cross beam 5 on the horizontal flange 6 thereof. This cross beam extends at right angles to joists 4 between opposite sides of the building and is supported at its ends by the foundation. This cross beam may also be supported intermediate its ends by suitable columns 7, one of which is shown in Fig. 2.

Cross beams 5 are preferably T-shaped in cross section as illustrated in Figs. 2 and 4 with horizontal flanges 6 at the bottom to provide support for the floor joists. The floor joists 4, according to this invention, are each constructed of a pair of channel members 8 formed of sheet metal having central sections 9 formed with laterally extending flanges 10 at the opposite edges which terminate in flanges 11 and 12 at the free edges extending in spaced parallel relation to central sections 9. Flanges 11 and 12 extend in the same direction from flanges 10, thereby providing a structure in which flanges 11 extend beyond the edge of central sections 9, while flanges 12 overlie central sections 9 in parallel relation. Each of the channel members 8 composing one of the joists 4 is formed in opposite relation to the other, as illustrated clearly in Fig. 4. Central sections 9 of each channel member 8 forming a joist 4 are welded together or otherwise rigidly secured together in assembled relation to form a completed joist, as illustrated.

Flanges 11 provide a channel structure along one side of each joist for receiving a nailing strip 13 of wood or other suitable material that will normally lie at the top edge of the joist to receive and support the sub-flooring of the building. This sub-flooring is nailed to nailing strip 13 in a well known manner. Strip 13 is secured in the channel between flanges 11 by nails extending through flanges 11 at spaced points into nailing strip 13 in transverse relation, parallel to flanges 10. This retains each nailing strip 13 permanently secured to each joist 4 so that when the floor is nailed to nailing strips 13 it will be rigidly held in place.

The ends of each floor joist 4 supported on flanges 6 of cross beam 5 may be secured in position against movement thereon by welding the end of the joist to flange 6.

Each side frame 3 is constructed of one integral unit from a plurality of fabricated metal members comprising a plurality of spaced parallel vertical tubular sheet metal columns 14 and a plurality of spaced parallel horizontal bars 15 mounted on both sides of columns 14 in order to provide furring means on both sides of the frame.

Each sheet metal column 14 is constructed in a convenient manner from an elongated strip of sheet metal in the manner illustrated in Figs. 8 to 11 inclusive.

Each sheet metal strip for the construction of a column 14 is first cut to proper size while still in flat form, as shown in Fig. 8 in cross section. A plurality of transverse slots 16 are formed in two rows in spaced parallel relation about midway between the central portion of the strip and the opposite free edges. The strip is then formed by die-stamping or the like to form a longitudinally extending rib in each side of the strip with the central portion of the rib extended along the center line through the transverse slots, as shown in Figs. 9 and 10. These ribs are formed successively, first, one in one side, as shown in Fig. 9, and then the other rib in the opposite side as shown in Fig. 10 and indicated by numerals 17 and 18. These ribs are formed as illustrated, so that the side portions of each rib extend in angular relation and are spaced apart with each transverse slot 16 extending around the central portion or apex of the rib, and thereby provide a slot extending transversely of the rib and opening outwardly through its edge or apex.

Substantially simultaneously with the formation of ribs 17 and 18, each margin of the strip is offset as indicated at 19 from the adjacent portion of the strip.

The central portion of the strip is then die-stamped to form another similar rib 20 extending longitudinally thereof. As the strip is bent into U-shape to form rib 20, ribs 17 and 18 are moved toward one another in such a way that they project in opposite directions when the formation of rib 20 is completed. This also brings marginal portions 19 into superimposed relation so they may be brought together and suitably welded, or otherwise permanently secured, to form the completed rigid tubular column structure having the cross section shown in Fig. 11.

Horizontal bars 15 are preferably of angle form and are T-shaped in cross section, as illustrated in the drawings. The central flange of each of these T-shaped bars is inserted into corresponding aligned slots 16 in horizontal relation in columns 14. When each bar is engaged in slots 16 in the manner illustrated in the drawings, it is then welded to each column, thereby providing a rigid assembled unitary frame structure. These bars are placed in spaced parallel relation on both sides of columns 14 and provide a supporting structure on the inner and outer faces of each frame to receive and carry the remaining portions of the wall structure. As will be noted in Fig. 6, for example, the spaced side portions of each rib engage the central flange of the angle bar in spaced relation where it passes through the transverse slot in the rib, so that the column engages each angle bar at a pair of spaced positions. This structure takes care of twisting strains in the frame structure and eliminates the necessity for diagonal braces.

The end columns of each frame 3 are provided on the end edges at one end with brackets 21 at the top, central and bottom portions, and brackets 22 in corresponding positions projecting

outwardly from the opposite ends. These brackets are preferably mounted on the superimposed margins 19 of each column, and for this purpose, these margins are directed outwardly from the end portion of the frame as shown, for example, in Fig. 6. Brackets 21 are of substantial Z-shape, while brackets 22 are of angle form and so arranged that brackets 21 and 22 will have their free ends engaged in overlapping relation, as shown in Fig. 6, so they may be suitably bolted together to secure the ends of two frames at the corner of a building in assembled relation, to provide a rigid assembled frame structure.

It will be noted in Figs. 1 and 6, that the corner of the building is left open between the frames at either side. After brackets 21 and 22 are bolted together, a filler plate 23 of arcuate form is inserted at the outside corner of the frame and has its opposite edges welded or otherwise suitably secured to the ends of horizontal bars 15 on the outer face of the side frames 3. Filler plate 23 is provided with a plurality of struck-out tongues 24 adapted to receive and support metal mesh or lath. This filler plate 23 may be of angle form of other suitable shape instead of arcuate in cross section as illustrated in Fig. 6, depending upon the desired type of finish at the corner of the building.

The top and bottom of each frame is provided with upper and lower bearing plates 25 and 26, respectively. Upper bearing plate 25 is formed of a Z-bar having the central portion welded or otherwise permanently attached to the upper ends of all of the columns 14 of a side frame, the bar extending from end to end of side frames 3 as illustrated. When the Z-bar 25 forming the upper bearing plate is thus secured to the upper ends of columns 14, the edge flanges on the central portion will be arranged so that the outer flange extends upwardly while the inner flange extends downwardly as shown, for example, in Fig. 2.

Lower bearing bar 26 is constructed of a channel bar having its central portion engaged with the lower ends of columns 14 of a side frame 3 and extending from end to end thereof, the ends of the columns being welded or otherwise secured thereto. The flanges of channel bar 26 extend upwardly on opposite sides of columns 14 in a manner clearly shown in Fig. 2. Channels 26 are provided with slots 27, Fig. 6, at spaced intervals, arranged to receive bolts 2 in the foundation, so as to position the side frames in desired relation on the foundation. The slots are made of sufficient length to provide for an adjustment of the side frames on the foundation, so that brackets 21 and 22 may be engaged in proper relation for bolting together as illustrated in Fig. 6. After the frames are in position with bolts 2 extending through slots 27, washers and nuts are applied to bolts 2 in the manner shown clearly in Fig. 6 for rigidly securing the side frames to the foundation.

As shown in the drawings, the side frames for each side of the building are constructed of one integral unit. It is within the scope of the invention for some types of houses, where desirable, to make the side frames in more than one unit and have them arranged in end to end relation and bolted together with brackets similar to brackets 21 and 22.

Side frames 3 will be provided with suitable openings for door and window frames and any other openings that it may be necessary to provide in the side wall of a house or other building. These openings will always be formed between a pair of columns 14, in the manner illustrated in the drawings, by omitting the horizontal bars 15 on both the inner and outer sides of the frame between a pair of adjacent columns throughout the area that is to form a window opening, door opening, or the like. The drawings illustrate only window and door openings, but it will be understood that all other openings in the side wall of a building will be treated in the same manner as the window and door openings, and that the illustration of the window and door opening and framing construction will be typical of any type of opening that is to be provided in a side frame.

Where a window opening is provided in a side frame 3 as shown in Fig. 1 at 28, it receives a suitable metallic window casing structure 29. This window casing 29 as shown in Figs. 1 and 5, for example, is formed of opposite side and upper and lower sheet metal strips assembled together to form a rectangular frame.

Each of the strips is formed of sheet metal of U-shape in cross section as shown in Fig. 5 having a central portion 30 formed intermediate its edges with a longitudinally extending rib 31, while the side edges of central portion 30 are formed with laterally extending flanges 32 and 33 at the outer and inner edges, respectively, of casing 29. At the free edges of flanges 32 and 33, the window casing strip is formed with inwardly extending flanges 34 and 35 terminating in spaced parallel marginal flanges 36 engaging the outer faces of bars 15, and welded thereto, for permanently mounting the window casing in rigid connection with side frame 3. Each side window casing strip embraces one of the columns 14 as show in Fig. 5, and in being welded to bars 15, adjacent columns 14, along the sides of the window opening, a rigid window casing structure is provided. It will be noted that flange 34 extends inwardly at an acute angle to flange 32 in order to provide a keying groove between flanges 34 and 36 around the outer face of the window casing, to receive the plastic coating on the outer face of side frame 3, so that it is interlocked with the window casing and side frame by means of this groove. The ends of the upper and lower window casing sections are welded to the ends of the side window casing sections to form the complete rectangular casing as shown in Fig. 1, all of the sections having the same cross sectional structure hereinabove described. The upper and lower window casing members will have flanges 36 thereof secured to the adjacent horizontal bars 15 which they are adapted to engage when the window casing is properly positioned in side frame 3, as shown.

A window structure is then set into window casing 29 as shown in Figs. 1 and 5, for example, the window structure including a frame 37 of Z-shape in cross section, as shown in Fig. 5, suitably seated on rib 31 extending around the inner portion of the window casing. This frame is welded to rib 31 to provide a unitary joint. The windows are mounted in sash 38 suitably hinged to frame 37 and adapted to be opened and closed in any manner well known in the art. Conventional window frames and sash, preferably using metal frames, are mounted in window casings 29. Any conventional type of window frame may be mounted in window casings 29 and suitably secured therein in order to mount the window sash in position in the usual manner, the illustration of the window frame 37 and sash 38 being only

for the purpose of showing how the frames are arranged in the casing.

As stated above, the door casings are constructed in a similar manner to the window casings. There is a little variation, however, in the door casing construction illustrated, in that the door casing 39 is formed of sheet metal having side and top sections of substantially U-shape in cross section. Fig. 5 illustrates the cross section of one side of the door casing 39 and shows the central portion 40 thereof formed with an offset 41 providing a rabbet to receive the margin of the door. The rabbet is shown as being formed at the inner edge of the door casing so as to receive a door that will open inwardly.

The central section 40 of casing 39 is provided with side flanges 42 terminating in inwardly extending flanges 43 and 44 at the inner and outer free edges of flanges 42, respectively, flange 43 extending inwardly in acute angular relation toward central section 40. The inner edges of flanges 43 and 44 terminate in marginal edge portions 45 to engage the outer faces of bars 15 to which they are welded, or otherwise permanently secured. An angle member 46 extending vertically at the ends of bars 15 on the outer face of side frame 3 is welded to the ends of bars 15 and to flange 45 on flange 43 of the door casing, to assist in providing a rigid mounting and framing structure around the door opening. It will be noted that the door casing members at each side of the door are arranged to embrace adjacent columns 14 of side frames 3. The bottom of the door opening will be provided with a suitable sill (not shown) which will be put in place after the wall structure to be carried by side frames 3 is completed, and after the floor of the building adjacent the door casing is completed. It will be welded across the bottom ends of the side portions of door casings 39 at the floor level or slightly above. It will be obvious to those skilled in the art how this door sill may be placed in position and it will also be obvious that any type of door sill construction may be built into the bottom of the door openings in completing the building structure.

With the present side frame construction, there may be instances where a door and window opening will be adjacent to one another and for the purpose of showing how the casings will be constructed in such a case, Figs. 1 and 5 illustrate a construction of this character. As shown in Fig. 5 the window casing will have flanges 34, 35 and 36 together with a portion of flanges 32 and 33 omitted where the free edges of the window casing abut the adjacent portion of the side portion of door casing 39. In this construction the free edges of flanges 32 and 33 that abut flanges 42 of the door casing will be welded along the edges to the door casing to provide a rigid unitary structure. Flanges 43 and 46 around the outside of the door casing are formed to provide the keying groove for the outer wall surfacing material, the same as the window casing, as can be understood from the illustration in Fig. 5.

These side frames with the window casings, door casings, window frames, sash, etc., are all adapted to be constructed in a shop by placing all of these members in a suitable jig or other supporting structure to hold them in proper position in assembled relation while they are being welded into the rigid frame unit disclosed. They may then be transported from the shop and mounted in assembled relation on the foundation of the building, as shown. When side frame members 3 for all of the sides of a house or other building structure are suitably mounted on the foundation and anchored thereto and secured to each other in the manner above described, top plates 25 are then ready to receive the upper floor or roof structure for the building.

In case an upper floor structure is provided for a two story building, the same floor joists will be used as described above and shown in the drawings. These floor joists will have the ends mounted on the upper faces of upper bearing plates 25 and suitably welded thereto, or otherwise suitably secured in position. Since this mounting of floor beams on bearing plates 25 will be obvious to one skilled in the art from the above description, the drawings have omitted such an illustration and instead, show the roof structure for the building which is also mounted on upper bearing plates 25 of side frames 3.

The roof structure will comprise a plurality of roof rafters generally designated 47 arranged in spaced parallel relation and extending across the building from one side to the other, having opposite ends engaged on the top faces of top bearing plates 25. As shown in Fig. 1, roof rafters 47 are so constructed that the central rafter will have a vertical dimension greater than the next adjacent rafters and so on to the outer edges of the building. This will provide the necessary pitch to the roof in order for moisture to run off to the sides. These roof rafters may be reinforced across the central portion of the building by an I-beam 48 where desired or necessary, the I-beam being supported by tubular columns 49 similar to columns 14 intermediate its ends. Each column 49 is provided at the lower end with end plates 50 welded or otherwise secured to a U-shaped supporting bracket 51 mounted in inverted relation on transverse beam 5 in the manner shown in Fig. 4.

Columns 49 will be arranged to extend in alignment with columns 7 and thereby provide a rigid support for the central portion of the roof of the building. The ends of I-beam 48 are supported by additional columns 49 as shown in Fig. 3.

Roof rafters 47, according to the invention, are preferably constructed of sheet metal using a pair of sheet metal channel members 52 formed in opposite relation and having their central portions arranged in spaced parallel relation and separated by spacer members 53 engaged about the bolts securing members 52 together. Each of these members are of channel shape and have channels opening in opposite directions as illustrated, with the free edges of the channels provided with inwardly extending flanges 54.

The space along the top plate 25 between roof rafters 47 at opposite sides of the building is closed by filler plates 55 formed of sheet metal of channel shape in cross section. The central portion of the channel members forming filler plates 55 is disposed vertically and outwardly along the outside of side frames 3 as shown and is formed at spaced intervals with a plurality of tongues 56 to which the wire mesh is secured. These filler plates 55 will be welded or otherwise suitably secured to top bearing plates 25.

Ceiling bars 57 formed of metal angle members are provided with hooks 58 at opposite ends and arranged to extend between adjacent rafters 47 in spaced parallel relation, as shown in Fig. 2, with hooks 58 engaging over bottom flanges 54 of roof rafters 47 as shown in Fig. 3, so the

ceiling bars are supported with the lower edges in the plane of the lower faces of roof rafters **47**. These bars may be suitably secured in place by welding, or any other suitable means, if desired, and are used for supporting the ceiling of the building.

Suitable roofing slabs **60** are mounted on the upper faces of roof rafters **47**, in the manner illustrated in Figs. 2 and 3, to provide the roof structure for the building. These roofing slabs are constructed so the joints between the ends of adjacent slabs will register with the spaces between channel members **52** of roof rafter **47** in order that anchor members **61** may be engaged with the ends of roofing slabs **60** and extend therebetween, downwardly through the space between channel members **52** of adjacent roof rafter **57**, so the lower ends of the anchor members **61** may be anchored to roof rafter **47** along the bottom face thereof. The roofing slabs illustrated and described are of conventional form available in the open market and after being mounted on the roof rafters, as shown, have their joints suitably cemented to provide a non-leakable roof. These roofing slabs provide the foundation for the roof which is then covered with any suitable form of commercial roof covering. The roof covering will be finished in any suitable conventional manner with flashing around the edges of the roof and around any chimney or other projection through the roof.

The outer walls of the building above side frames **3** may be extended upwardly by constructing a parapet **62** around the top of the building. A brick parapet structure may be constructed as generally indicated in Figs. 2 and 3 of the drawings, with a suitable cap plate **63** on the top. The construction of a parapet of this character frequently aids in enhancing the design and appearance of a house constructed with a metal frame and also helps to conceal the roof. The parapet disclosed is illustrated merely for the purpose of showing how conventional architectural means may be supplied in connection with the framing structure in the construction of a completed building utilizing the present invention.

With the building frame constructed and assembled as above described and the roof and parapet structure applied, it will be understood that the framing of the building is substantially completed and ready to receive the wall covering. It is desired to provide efficient insulation against loss of heat with this building structure, and for this purpose the side frames between the outer and inner horizontal bars **15** including the interior of columns **14** will be filled with a suitable fibrous insulating material of suitable form now well known in the art, such as that known by the name "Rock Wool." The space above ceiling bars **57** under roof plates **60** will also be filled with the same insulating material.

Suitable sheet material insulation will then be applied to the outer faces of the side frames **3** all around the building and secured to horizontal bars **15** of the side frames by suitable clips engaged over bars **15** at spaced intervals and generally indicated at **64** in Figs. 6 and 7. This insulating sheet material is indicated in Figs. 5, 6 and 7 at **65**. It may be any suitable form of sheet insulating material well known in the art. It will extend around the corners of the building in the manner shown in Fig. 6 to be secured to the corner filler plate **23** by attachment to projections **24** thereof. On the outside of insulating sheet covering **65** will then be mounted a suitable conventional metal mesh or lath **66**, also secured to clips **64** and arranged in spaced relation beyond the surface of insulating sheet material **65**. A plastic outer wall covering will then be applied to metal mesh **66** to form the outer side wall of the building indicated in cross section by numeral **67** in Figs. 5, 6 and 7. Any suitable form of plastic wall covering material may be used which is now well known in the art. This plastic coating will engage in the keying grooves around the window and door casings in the manner illustrated in Fig. 5 and by this construction the plastic coating will be firmly held in position around both window and door casings. It will be understood that metal mesh **66** will extend upwardly above the side frames **3** on the outside of the building so as to be engaged on projections **56** of filler plates **55** and then extended on above these filler plates beyond the ends of roof slabs **60** and up along the outer face of parapet **62** to which it is secured by nailing or other suitable means well known in the art.

The plastic wall covering will extend over the entire face of the building structure and terminate along the bottom edge of cap members **63** on top of parapet **62**, thereby fully enclosing and finishing the outside wall of the building.

After the outer wall of the building is completed and the electrical wiring, plumbing and other structures to be mounted in the partitions and wall structure of the building are in place, the inner walls are then completed at the usual time and in the manner that will now be described.

When the building has been completed to the point that the inner wall plaster is ready for application, brackets **64** will be applied to bars **15** along the inner faces of side frames **3**, and an inner insulating covering for the inner face of side frames **3** will then be applied over these brackets as shown at **68** in Figs. 5, 6 and 7.

Sheet insulating material having a metal foil coating on the outer face will preferably be used and disposed adjacent side frames **3**, the foil being indicated in the drawings by the numeral **69**. Metal mesh **66** will then be applied on the inner ends of clips **64**, on the inner side of the insulating sheet material **68** in spaced relation thereto, in order to receive the inner plaster wall of usual conventional form designated in cross section in Figs. 5, 6 and 7 by numeral **70**. This will provide the inside wall finish on the side frames of the building with the plaster abutting flanges **35** of window casings **29**, and **44** of door casings **39**. It is believed that the manner in which this plaster will engage the door and window casings will be clearly understood from the drawings.

The ceiling will be plastered at the same time as the side walls and suitable clips **64** will be attached to ceiling bars **57** and secured thereto in the same manner as they are secured to bars **15**. The insulating material **68** with metal foil coating **69** will be applied to the ceiling bars in the same manner as it is applied to the side frames. Wire mesh **66** will be applied below the insulating covering on the ceiling of the building and secured to clips **64** carried by the ceiling bars so as to receive and support the plaster ceiling applied at the same time as the plaster is put upon the side walls. The building is then completed in the usual and well known manner common in the art with the various interior finishes and also with any additional exterior construction that may be desired and customary according to the architecture of the building.

It will be understood from the construction of the walls, as above described, that triple insulation is provided, arranged so two insulating sheet material coverings on the outer and inner faces of side frames 3 separate contact between the outer and inner plastic coverings 67 and 70 so as to eliminate heat conduction from the outer and inner wall coverings 67 and 70 to side frames 3, except to a minor extent that may occur through the medium of clips 64. This reduces heat conduction between the inner and outer walls to a minimum and with the insulation provided in the side frame between the wall coverings, the building will be efficiently insulated so that it may be economically heated in winter and also keep the interior cool in summer. The building is fireproof throughout.

Instead of the flat roof structure above described, a hip roof or other style of roof may be used by adding additional metal beam structure in a manner clear to one skilled in the art.

By the ribbed construction of columns 14 it will be understood that a substantially rigid one-piece column construction is provided that carries the entire weight of the building and distributes it to the foundation. The top and bottom plates 25 and 26 distribute the weight applied thereto directly through the columns to the foundation, while bars 15 carried by columns 14 support both the inner and outer side walls and transmit the weight thereof to columns 14.

The side frame structure including columns 14 and horizontal bars 15 with the window structure described, can be readily fabricated in the shop and when made in standard sizes and designs, it facilitates the construction of metal frames for buildings at low cost that may be transmitted to the desired place, and assembled in a short space of time with a minimum of labor, thereby providing a metal building frame that will supply a rigid and lasting building structure that is economical to make.

The invention claimed is:

1. A building structure, comprising an integral wall frame for each side, means joining the ends of adjacent sides to form an assembled side frame structure, each side frame having a plurality of spaced parallel vertical tubular columns, said columns having a plurality of horizontally aligned slots on the inner and outer sides thereof, top and bottom plates mounted on opposite ends of said columns, and a plurality of horizontal members rigidly attached in spaced parallel relation in aligned slots on both sides of said columns for supporting the inner and outer wall covering.

2. A wall frame, comprising a plurality of spaced parallel vertical tubular columns formed with a plurality of horizontally aligned slots on the inner and outer sections thereof, and a plurality of angle bars extending from end to end of said frame on both sides of said columns in spaced horizontal relation with one flange of each bar engaged in an aligned slot of each column and rigidly secured therein, said bars and columns forming a rigid side wall frame unit structure for mounting the inner and outer walls on the other flange of said horizontal bars on the respective inner and outer sides of said columns.

3. A wall frame, comprising a plurality of spaced parallel tubular vertical columns, each formed on the inner and outer edge portions with a plurality of spaced parallel slots extending laterally of the column axis, the slots in the corresponding sides of one column being in horizontal alignment with those in each of the other columns, a plurality of horizontal members mounted on both the inner and outer sides of said columns, engaged in said slots and rigidly secured to said columns to form a rigid frame for supporting the inner and outer wall surface structures on said horizontal members, and top and bottom plates permanently attached to the ends of said columns.

4. A wall frame, comprising a plurality of spaced parallel tubular vertical columns, each formed on the inner and outer edge portions with a plurality of spaced parallel slots extending laterally of the column axis, the slots in the corresponding sides of one column being in horizontal alignment with those in each of the other columns, a plurality of horizontal members mounted on both the inner and outer sides of said columns, engaged in said slots and rigidly secured to said columns to form a rigid frame for supporting the inner and outer wall surface structures on said horizontal members, a U-shaped bottom plate rigidly secured to the lower ends, of said columns with the extremities of the columns received in the channel of said bottom plate, and a Z-bar rigidly mounted on the upper ends of said columns to form a top plate.

5. A wall frame, comprising a plurality of spaced parallel tubular vertical columns, each column being formed of sheet metal having ribs extending toward the outer and inner sides of said frame formed with a plurality of transverse horizontal slots aligned with corresponding slots of other columns, and a plurality of horizontally spaced parallel angle bars mounted along opposite sides of said columns with portions engaged in aligned slots and rigidly secured to said columns to form a rigid frame, said angle bars supporting the inner and outer wall covering materials and transmitting the load to said columns.

6. A unitary wall frame, comprising a plurality of spaced parallel tubular vertical columns, each column being formed of a single sheet metal strip having opposite margins of the longer edges joined together and a pair of longitudinally extending intermediate portions formed into U-shaped ribs directed outwardly in opposite directions at the outer and inner sides of said frame, said ribs having transverse slots formed therein at spaced intervals between the ends of said columns, the slots in each column being horizontally aligned, and a plurality of spaced horizontal angle bars mounted on each side of said columns with one flange of each bar engaged in one row of aligned slots in said columns and rigidly secured to said columns at the intersection thereof with the columns, said horizontal bars forming inner and outer furring means for supporting the inner and outer wall coverings and transmitting the load to said columns.

7. A unitary wall frame, comprising a plurality of spaced parallel tubular vertical columns, each column being formed of a single sheet metal strip having opposite edges of the longer sides joined together and having a pair of longitudinally extending intermediate portions formed into oppositely extending U-shaped ribs directly outwardly at the inner and outer sides of said frame, said ribs having transverse slots formed therein at spaced intervals between the ends of said columns, the slots in each column being horizontally aligned, a plurality of spaced horizontal angle bars mounted on each side of said

columns with one flange of each bar engaged in one row of aligned slots in said columns and rigidly secured therein, a bottom plate permanently mounted on the lower extremities of said columns for supporting said frame, and a Z-bar permanently mounted on the upper extremities of said columns for receiving and supporting upper portions of a building, said horizontal bars forming inner and outer furring means for supporting the inner and outer wall surface covering layers, while said columns and plates receive and distribute the load in cooperating with said bars.

8. A unitary wall frame, comprising a plurality of spaced parallel vertical tubular columns formed of sheet metal and having ribs extending toward the outer and inner sides of said frame formed with a plurality of transverse slots at spaced intervals between the ends, end columns of the frame having another rib projecting outwardly on the end of the frame, attaching brackets permanently mounted on said last-mentioned rib of each end column for attachment to corresponding complementary brackets on an adjacent end of another wall frame for attaching two wall frames in assembled relation, bearing plates on the upper and lower ends of said columns, and a plurality of angle bars mounted on both sides of said columns with a flange of each bar engaged in aligned slots of said columns and permanently secured therein, said bars forming a furring on the outer and inner sides of said frame for supporting the covering structure.

9. A unitary wall frame, comprising a plurality of spaced parallel vertical tubular columns formed of sheet metal and having a plurality of transverse slots at spaced intervals between the ends, a plurality of angle bars mounted on both sides of said columns with a flange of each bar engaged in aligned slots of said columns and permanently secured therein, said frame having a window opening bounded by a pair of adjacent columns at opposite sides and a pair of angle bars at the top and bottom, and a window frame having side members formed of U-shaped sheet metal strips each embracing one of said pair of adjacent columns, the edges of said strips extending outwardly over opposite sides of said adjacent columns and adjacent portions of said angle bars and permanently attached thereto, and upper and lower U-shaped window frame strips secured at the ends to said side members to form said window frame, the edges of said upper and lower window frame strips being permanently secured to adjacent angle bars.

10. A unitary wall frame, comprising a plurality of spaced parallel tubular vertical columns formed of sheet metal and having a plurality of transverse slots at spaced intervals between the ends, a plurality of angle bars mounted on both sides of said columns with a flange of each bar engaged in aligned slots of said columns and permanently secured therein, said frame having a window opening therein bounded by a pair of adjacent columns at opposite sides and a pair of angle bars at the top and bottom, and a window frame having side, top and bottom members permanently secured together and mounted in said opening, said frame having each of said members formed of sheet metal strips of U-shape in cross section arranged with the central portion extending laterally to said frame through the window opening and the side portions extending over adjacent portions of said frame on the inner and outer faces thereof in spaced parallel relation to said angle bars, the free edges of said strips on the outer side of said frame being formed to provide inwardly extending flanges at an acute angle directed toward the window opening and terminating in flanges engaged with the outer faces of said angle bars to which they are permanently secured, said last-mentioned flanges around said window frame forming a keying groove for receiving and retaining the wall covering mounted on said angle bars around said window frame.

11. A unitary wall frame, comprising a plurality of spaced parallel tubular vertical columns formed of sheet metal and having a plurality of transverse slots at spaced intervals between the ends, a plurality of angle bars mounted on both sides of said columns with a flange of each bar engaged in aligned slots of said columns and permanently secured therein, top and bottom plate members mounted on the upper and lower ends of said columns, said frame having a door opening therein bounded by a pair of adjacent columns at opposite sides, angle bars at the top and said bottom plate at the lower end, and a door frame mounted in said door opening having sheet metal side and top framing members each formed into U-shape in cross section with a central portion extending transversely to the side portions and said wall frames through said door opening and formed with an offset at one side to provide a door jamb, the side portions of said framing members extending over opposite sides of said wall frame adjacent said door opening and having marginal portions engaging said angle bars and rigidly secured thereto.

12. A unitary wall frame, comprising a plurality of spaced parallel tubular vertical columns formed of sheet metal and having a plurality of transverse slots at spaced intervals between the ends, a plurality of angle bars mounted on both sides of said columns with a flange of each bar engaged in aligned slots of said columns and permanently secured therein, said frame having a window opening therein bounded by a pair of adjacent columns at opposite sides and a pair of angle bars at the top and bottom, and a window frame having side, top and bottom members permanently secured together and mounted in said opening, said frame having each of said members formed of sheet metal strips of U-shape in cross section arranged with the central portion extending laterally to said frame through the window opening and formed with an inwardly directed rib to provide a window mounting portion, the side portions extending over adjacent portions of said frame on the inner and outer faces thereof and rigidly secured along the marginal portions to said angle bars.

13. A building frame structure, comprising a pair of metallic side frames, each having a plurality of spaced parallel tubular vertical columns formed of sheet metal and having a plurality of transverse slots at spaced intervals between the ends, a plurality of angle bars mounted on both sides of said columns with a flange of each bar engaged in aligned slots of said columns and permanently secured therein, attaching brackets on end columns of each side frame, the brackets on adjacent ends of adjacent side frames extending beyond the ends of said frames and engaging one another, means securing said brackets together to secure adjacent side frames in assembled relation with adjacent ends slightly spaced apart, and a filler plate extending between adjacent ends of

said side frames and secured thereto, extending between the upper and lower extremities of said frames, and cooperating with said angle bars to provide furring means supporting the outer wall covering.

14. A building having a wall structure, comprising a rigid metallic frame having a plurality of spaced parallel tubular vertical columns formed of sheet metal and having a plurality of transverse slots at spaced intervals between the ends, a plurality of angle bars mounted on both sides of said columns with a flange of each bar engaged in aligned slots of said columns and permanently secured therein and providing furring means on both sides of said frame, a layer of insulating sheet material on the outside of said outer furring means, metal mesh spaced outwardly from said insulating sheet material, supporting means mounted on said angle bars at spaced intervals engaging and supporting said insulating sheet material and said mesh, a plastic wall covering mounted on said mesh forming an outer wall face, an insulating sheathing material on the inside of said inner furring means having a metal foil coating on the face adjacent said frame, a metal mesh spaced inwardly from said insulating sheathing, supporting means mounted on the angle bars at the inner side of said frame at spaced intervals engaged with and supporting said sheathing and mesh, and a plastic inner wall covering mounted on said mesh.

15. A building having a wall structure, comprising a rigid metallic frame having a plurality of spaced parallel tubular vertical columns formed of sheet metal and having a plurality of transverse slots at spaced intervals between the ends, a plurality of angle bars mounted on both sides of said columns with a flange of each bar engaged in aligned slots of said columns and permanently secured therein to form said rigid frame, said angle bars providing furring means on both sides of said frame, outer and inner sheet material insulation covering said frame adjacent said angle bars, metal mesh over both sides of said frame outside and inside of said insulating covering, means securing said mesh in spaced relation to said insulating covering, engaging said covering and mesh at spaced intervals and mounted on said angle bars for supporting said covering and mesh on said bars, and plastic material mounted on said mesh on both sides of said frame forming inner and outer wall surfaces thereon.

WILLIAM J. McDERMOTT.