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Fig. 1.

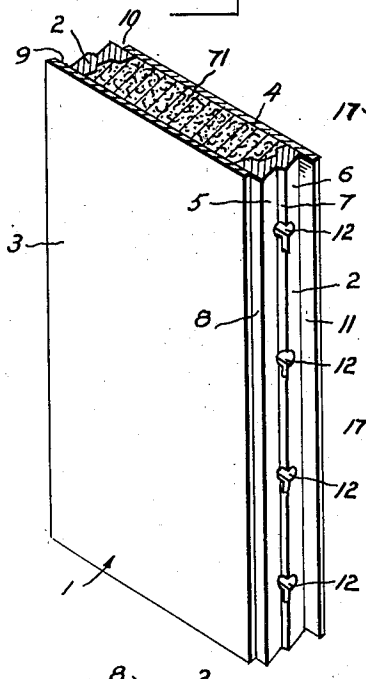


Fig. 3.

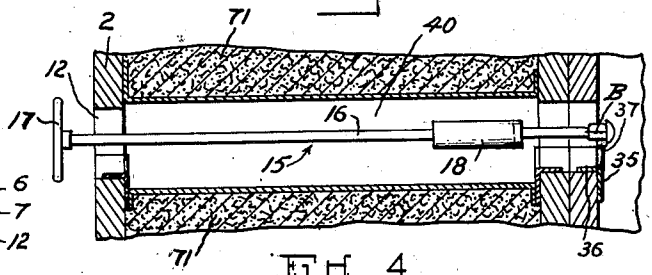


Fig. 4.

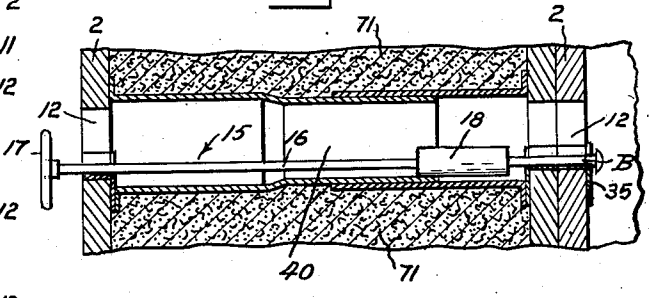


Fig. 2.

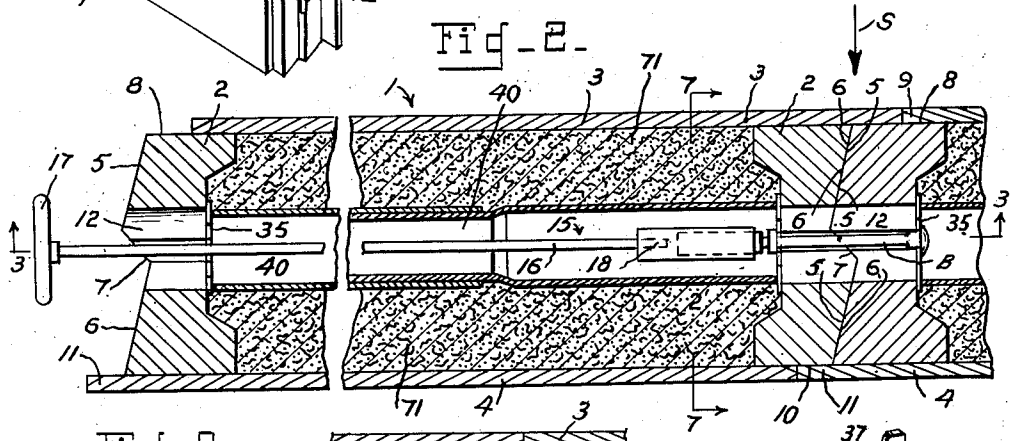
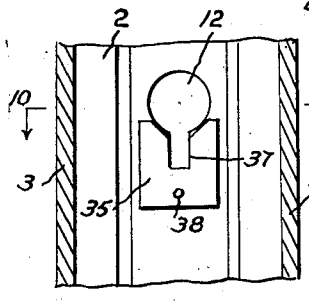


Fig. 9.



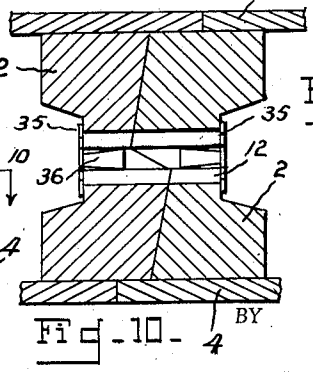
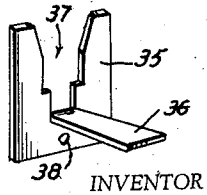


Fig. 10.

Fig. 11.



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Fig. 5.

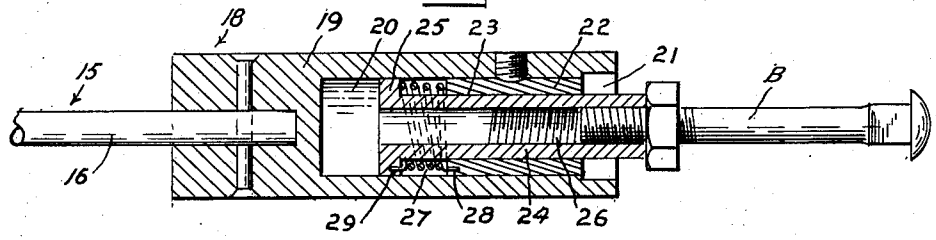


Fig. 6.

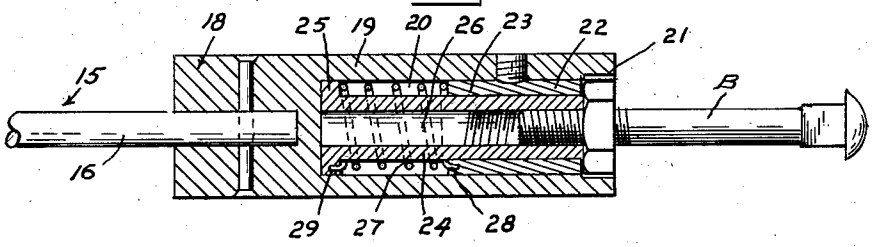


Fig. 7.

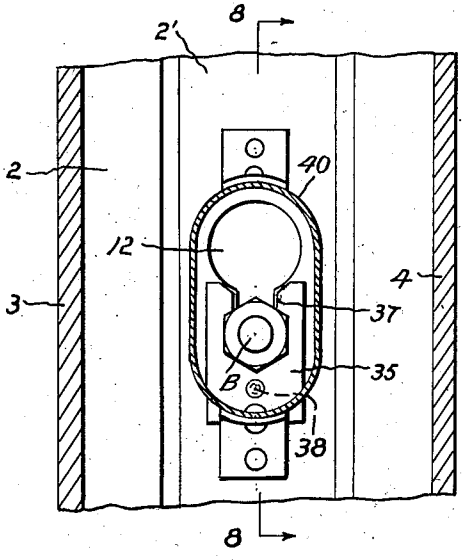
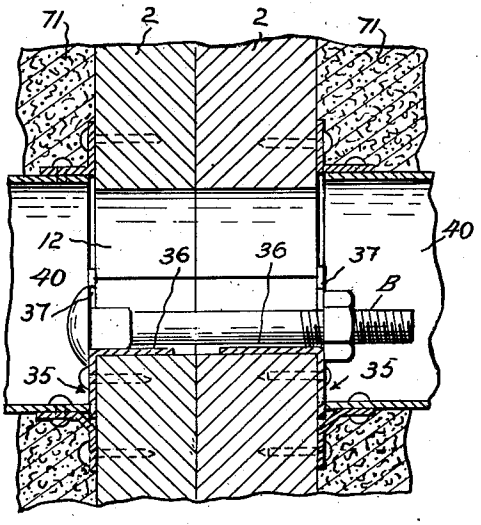


Fig. 8.



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Fig. 12.

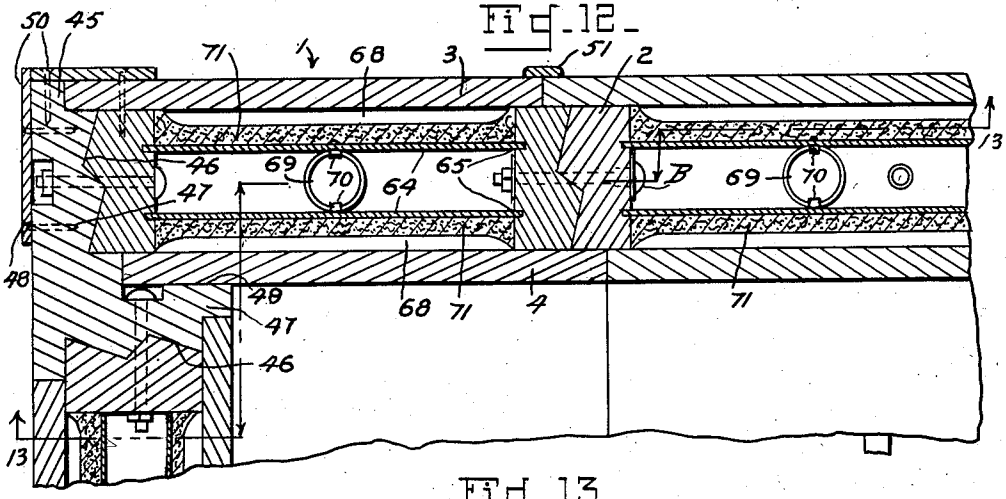
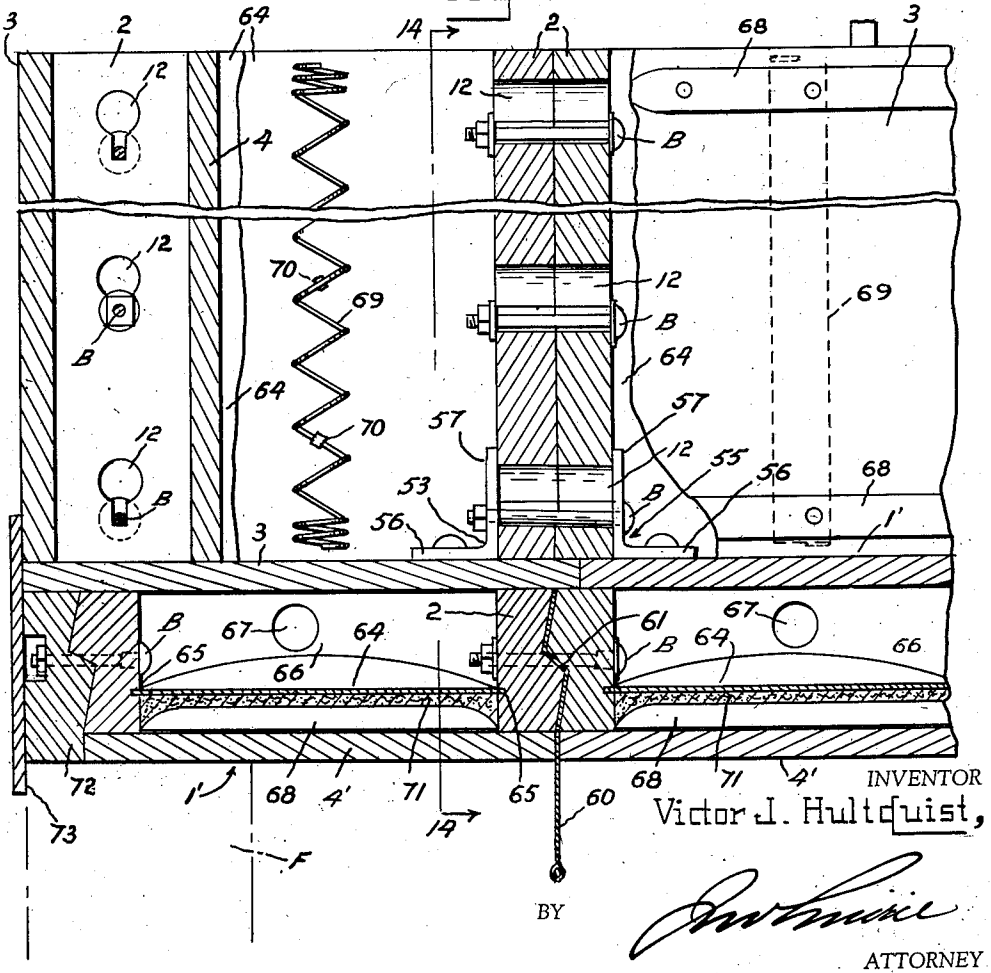


Fig. 13.



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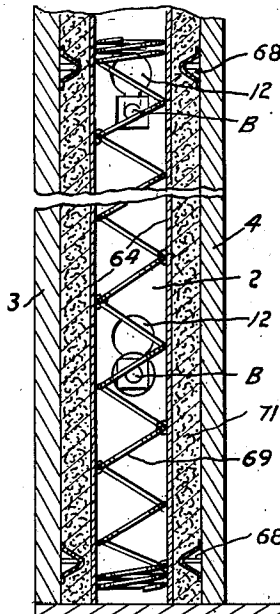


Fig. 15.

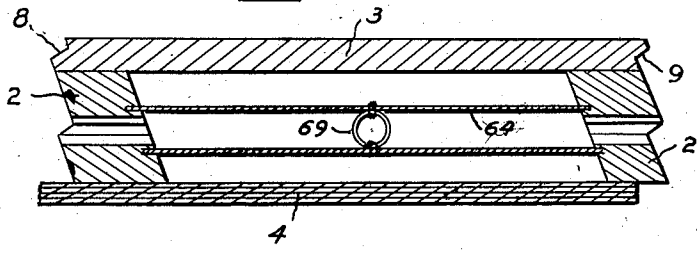


Fig. 14.

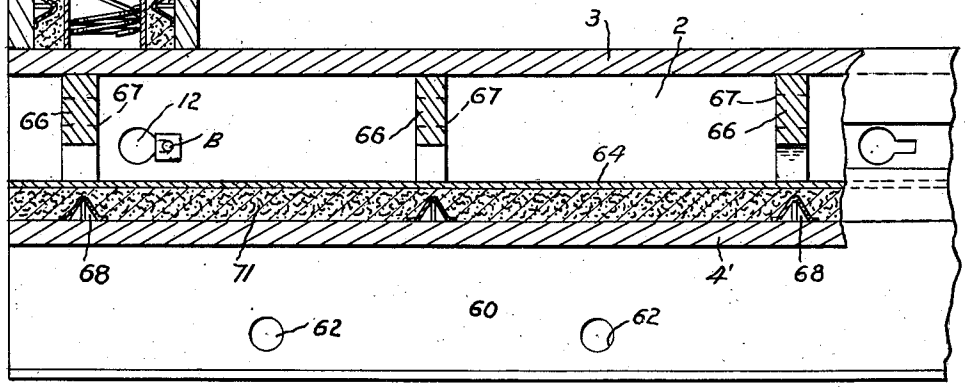
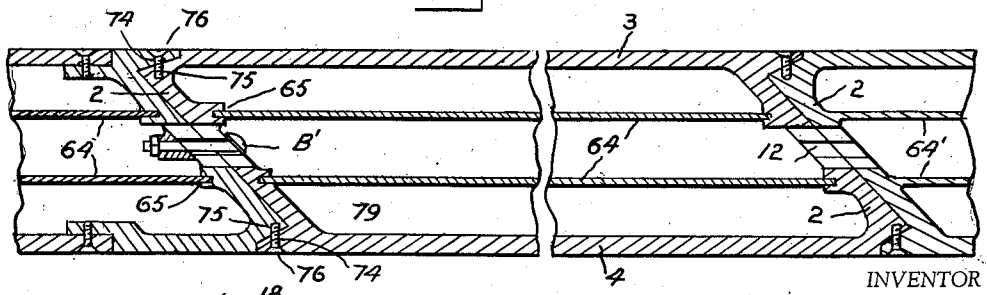


Fig. 16.



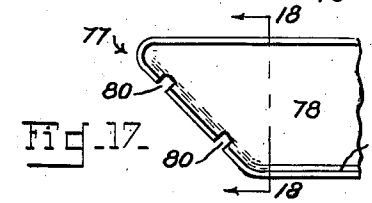


Fig. 17.

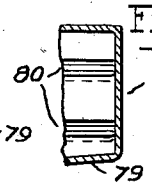


Fig. 18.

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Fig. 19.

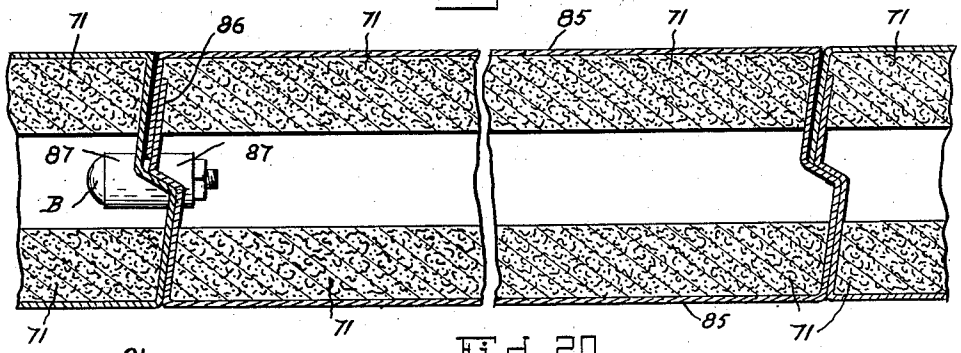


Fig. 20.

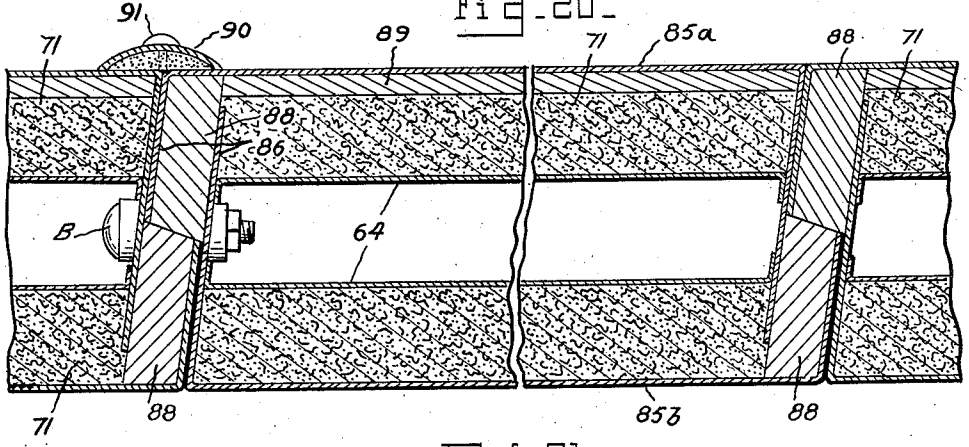
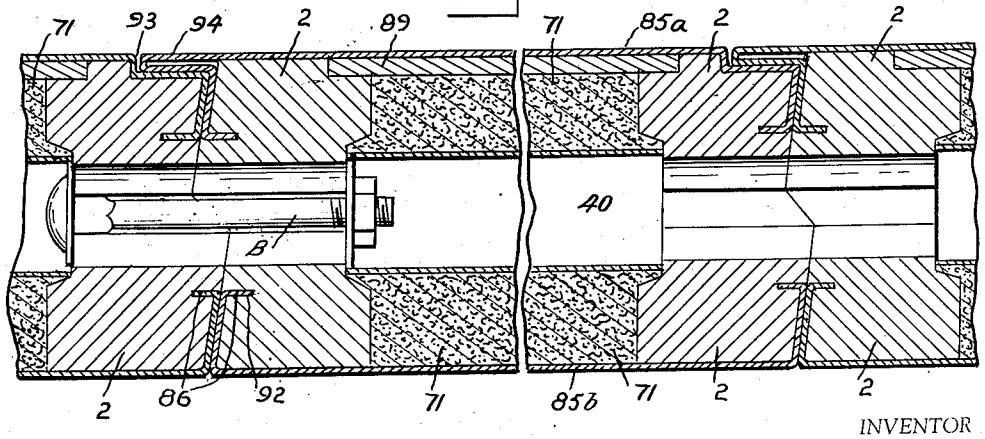


Fig. 21.



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Fig. 22.

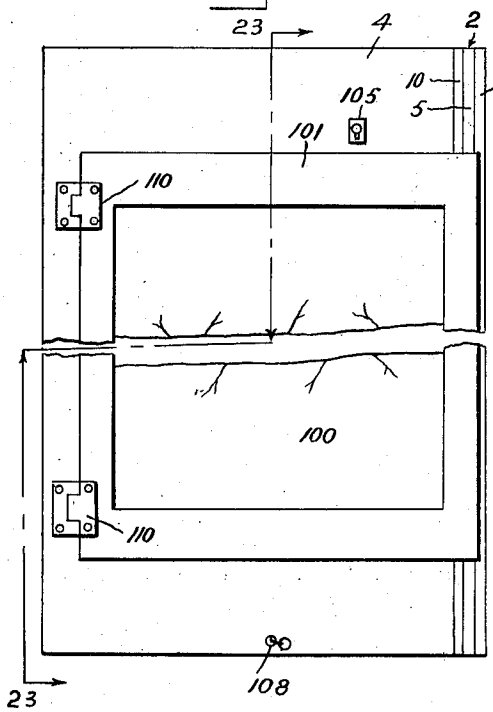


Fig. 23.

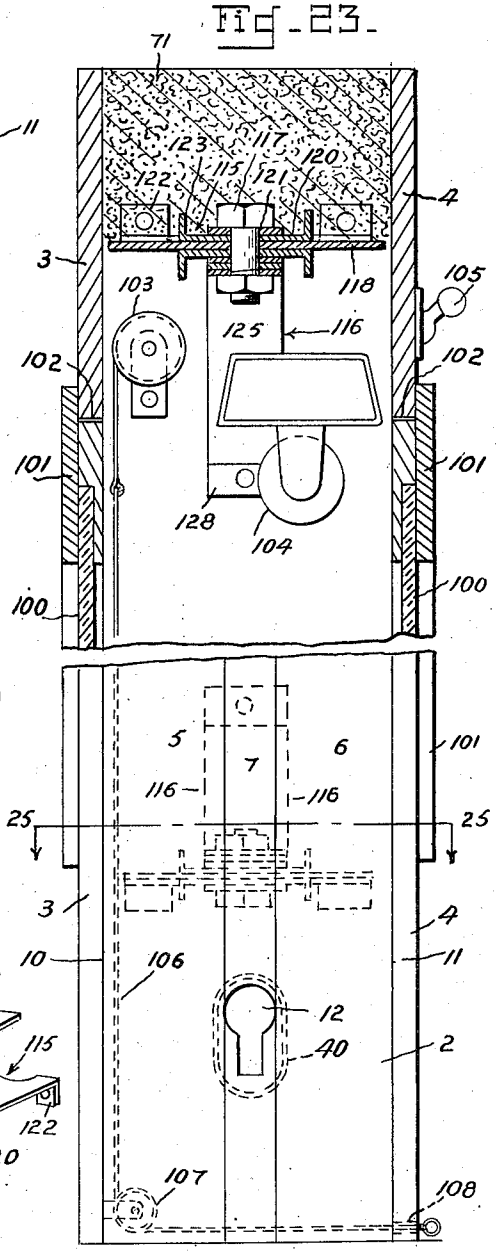
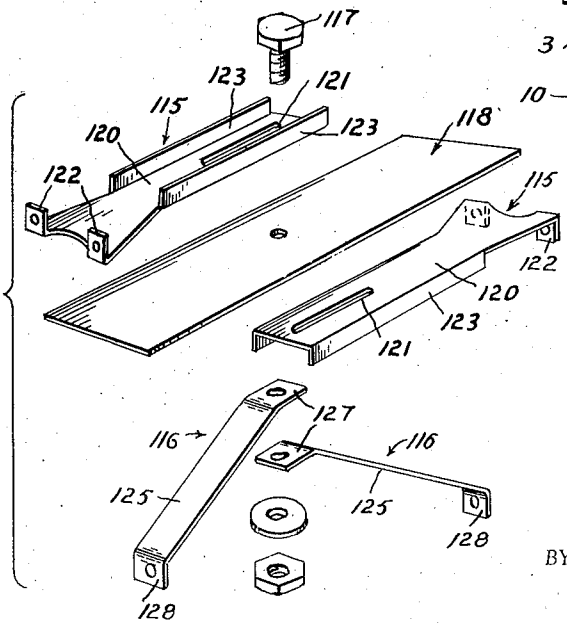


Fig. 24.



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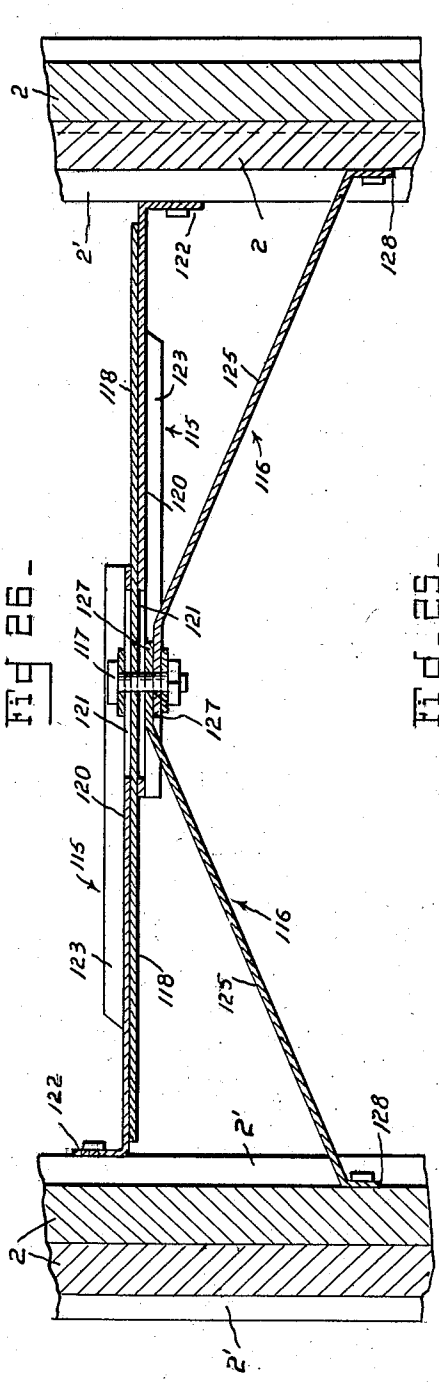


Fig. 26.

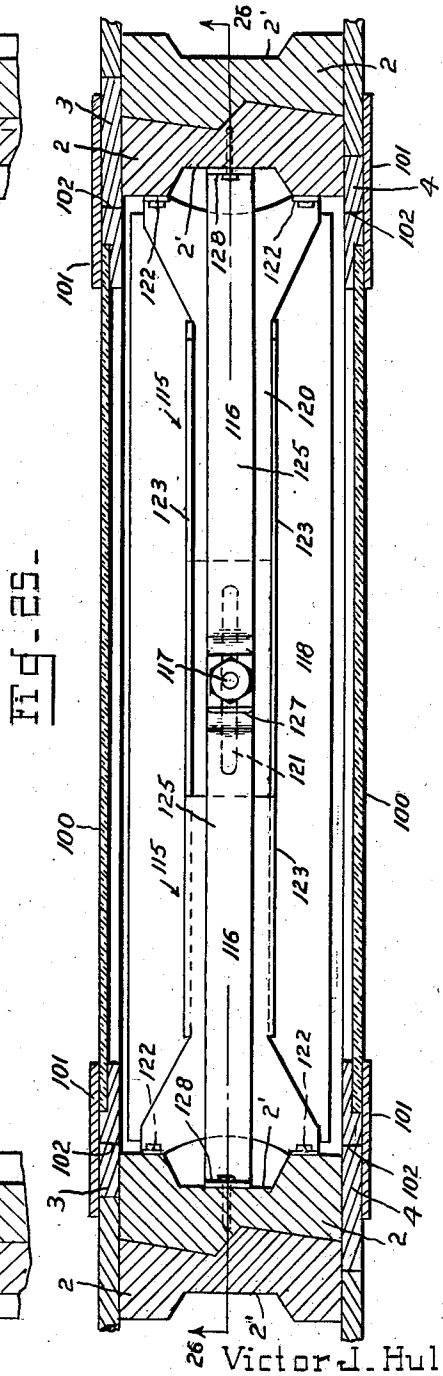


Fig. 25.

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United States Patent Office 2,825,098 Patented Mar. 4, 1958

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PREFABRICATED BUILDING CONSTRUCTION

Victor J. Hultquist, Alcoa, Tenn.

Application August 17, 1951, Serial No. 242,345

10 Claims. (Cl. 20—2)

This invention relates to prefabricated building construction, and more particularly to a prefabricated unit and the method of assembling such units in a building construction.

This application is a continuation-in-part of application Serial No. 733,267, filed March 8, 1947, issued February 24, 1953 as Patent No. 2,629,138.

The erection of prefabricated buildings has rapidly assumed a place of importance in present day construction. This type of construction owes its increasing popularity to its inexpensiveness, and the speed and facility with which a building can be erected by a small crew of workmen who need not be skilled craftsmen. The inexpensiveness is due to several factors: mass production of the units used in the final construction, the relatively few different types of units employed to complete the job, and the large areas covered by the erection of a single unit.

It is the principal object of the present invention to provide a building unit which, due to its particular structural features, is capable of withstanding the different stresses imposed upon walls, roof, and flooring, and may be used for all of these purposes, thus reducing to one the types of units needed in the erection of a single building.

Another object of this invention is to provide a building unit of this type so constructed that when assembled with other similar units, an interlocked structure of great strength and rigidity will be provided.

A further object of the invention is to provide a complete factory-made building unit which when assembled with similar units will produce a finished wall, floor, or roof, the unit being so standardized that it can be made in volumn production at minimum expense.

A still further object is to provide such a unit which, due to its multiple cellular construction, will have high insulation capacity, this capacity being increased through the use of reflecting surfaces on the interior cellular walls.

It is also an object of the invention to provide a building unit which will be light in weight, easily handled by one person, and of such construction that the units may be assembled by unskilled labor in a minimum of time.

It is a still further object of the invention to provide a method of assembling building units that is easy, simple and provides a finished construction.

It is yet another object of the invention to provide a building unit having simplicity of organization, economy of fabrication and efficiency in operation.

The novel features that are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawings, wherein like reference characters indicate like parts throughout the several figures and in which :

Fig. 1 is a view in perspective of a building unit in accordance with the present invention;

Fig. 2 is a cross-sectional view taken transversely through the unit shown in Fig. 1 and illustrating the method of assembling the units;

Figs. 3 and 4 are fragmentary cross-sectional views taken on line 3—3 of Fig. 2 and illustrating different steps in the method of assembling the units;

Figs. 5 and 6 are fragmentary cross-sectional views taken longitudinally through a wrench for assembling the units in accordance with the invention;

Fig. 7 is a fragmentary cross-sectional view taken on line 7—7 of Fig. 2;

Fig. 8 is a cross-sectional view taken on line 8—8 of Fig. 7;

Fig. 9 is a cross-sectional view similar to Fig. 7 but with parts removed to show the bolt washer elements;

Fig. 10 is a cross-sectional view taken on line 10—10 of Fig. 9;

Fig. 11 is a view in perspective of a washer unit;

Fig. 12 is a cross-sectional view taken horizontally through a corner of a building embodying modified building units in accordance with the present invention;

Fig. 13 is a staggered cross-sectional view corresponding to line 13—13 of Fig. 12;

Fig. 14 is a cross-sectional view corresponding to line 14—14 of Fig. 13;

Fig. 15 is a cross-sectional view transversely through a modified form of wall unit;

Fig. 16 is a cross-sectional view transversely through an assembly of modified units;

Fig. 17 is a partial plan view of a cover plate used in connection with the building units;

Fig. 18 is a cross-sectional view corresponding to line 18—18 of Fig. 17;

Figs. 19, 20 and 21 are cross-sectional views transversely through assemblies of further modifications of the building unit;

Fig. 22 is a side or face view in elevation of the inner side of a light transmitting form of unit;

Fig. 23 is a cross-sectional view taken on line 23—23 of Fig. 22;

Fig. 24 is an exploded view in perspective of brace elements used in the unit shown in Figs. 22 and 23;

Fig. 25 is a cross-sectional view taken on line 25—25 of Fig. 23; and

Fig. 26 is a cross-sectional view taken on line 26—26 of Fig. 25.

Referring now to the drawings, the present invention comprises a building unit adapted for substantially universal application, as shown in Fig. 1, a method of assembling such units, as shown in Figs. 2–4, including a novel wrench, as shown in Figs. 5 and 6, and a building construction as shown in Figs. 12–14.

Referring specifically to Fig. 1, the invention comprises a building unit 1 which is rectangular in shape. The unit 1 comprises a double-walled closed unit composed of spaced edge rails 2, an outer panel 3 and an inner side panel 4, the panels bridging the space between the edge rails and being longitudinally coextensive therewith and connected to the opposite sides thereof by any desired means, such as by an adhesive or by fasteners such as screws or nails. The size of the unit may vary to suit particular needs, but, preferably, the unit is relatively long and when used in wall construction will be the height of a single story, and of such width that it will cover a substantial area and yet not be too bulky to be handled by one workman.

In use, whether for wall, roof, or floor, the units are designed to be assembled in edge-to-edge relationship, with the edge rail of one unit abutting the edge rail of the next. When the unit is in place in a wall, the edge

rails 2 serve as studs to take the vertical weight thrust, and in certain constructions, when used as roof or flooring, the edge rails function as weight supporting rafters and joists. The edge rails are so formed that adjacent units will interlock, imparting strength and rigidity to the assembled units and providing a weather-seal. The interlocking structure preferably takes the form of a stepped joint to facilitate assembly of abutting edge rails.

As shown in Figs. 1 and 2, each edge rail has its outer face formed with a plurality of angularly disposed rectilinear steps which extend the full length of the rail. Specifically, these steps may preferably comprise three longitudinally extending surfaces 5, 6 and 7. The outer surfaces 5 and 6 preferably are substantially parallel and extend inwardly from, and at an angle to the perpendicular of, the sides, and toward the center of the rail. The intermediate surface 7 is disposed at a relatively wide angle to and connects the surfaces 5 and 6 along the center portion of the edge rail and forms a step or shoulder therebetween. The two edge rails of a unit are oppositely formed or positioned so that they will interlockingly engage the edge rails of adjacent units and facilitate assembly as will be hereinafter described.

In order to seal the joint between units, and also to assist in the interlocking of these units, the panels 3 and 4 may be secured to the edge rails 4 in staggered relation to one another. The panel 3, for instance, may be positioned with one longitudinal edge substantially midway of the side of one edge rail to provide an offset or step 8, and with its other longitudinal edge overlapping and extending beyond the outer face of the opposite edge rail to provide a flange 9. The panel 4 is reversely positioned with respect to the panel 3 to provide an offset or step 10 on the opposite side of the same edge rail from the flange 9 and to provide a flange 11 opposite the offset step 8. With this construction, the flange portions of the respective panels will overlap the joint between the edge rails of adjacent units and nest in the offset steps in the abutting edge rails.

When assembling a building with the present building units, two units are placed in edge-to-edge position and the units are joined by means of bolts B extending perpendicularly through the abutting edge rails 2. It should be noted that the bolts B are standard carriage bolts which have a square shank portion immediately adjacent the bolt head. Due to the fact that, in the erection of a building, the units are of closed, box structure and are sequentially positioned, the bolts must be passed through the abutting edge rails which are completely enclosed and are remote from the free edge of the last positioned unit.

It will be obvious that under the foregoing circumstances special means must be provided for positioning the bolts and for drawing them up into place. To this end, the opposite edge rails have formed therein aligned bolt holes 12, so that the bolts B may be inserted through the unit and seated in the aligned holes 12 in the opposite edge rail as well as the abutting edge rail of the adjacent unit. The bolt holes 12, as shown in Figs. 1 and 9, are in the form of keyhole openings, the enlarged upper portions being of sufficient size to permit the passage of the bolt B, its companion nut, a washer if necessary, and the head of the wrench 15. The lower portion of the opening is of sufficient width to receive the shank of the bolt and snugly fit two opposite sides of the square portion on the bolt shank.

The bolts are inserted by an elongated wrench 15 which is specially designed to support, insert through the unit and then operate a bolt. The wrench 15 comprises an elongated shank 16 having a handle 17 at one end and a head 18 at the other end. The shank 16 of the wrench preferably is of a diameter no greater than that of the bolts B, so that the wrench shank can be lowered to fit into the slot of the keyhole in the free edge rail in order to lower the bolt into the slot of the keyhole in the opposite rail. The wrench shank 16 preferably is slightly less in diameter than the width of the keyhole slot so that it will be free to rotate while in the slot.

The wrench head 18, as best shown in Figs. 5 and 6, comprises a body 19, having a cylindrical axial bore 20 opening through the forward end thereof, the outer end portion of the body around the bore being formed as a wrench socket 21 for receiving and cooperating with a bolt nut. A sleeve 22, which is shorter than the bore 20, is fixed within the bore 20 with its outer end preferably substantially coinciding with the inner end of the socket 21. The sleeve 22 has a cylindrical bore 23 in which is slidably and rotatably mounted a sleeve 24 that is provided at its inner end with a flange 25 slidable within the bore 20.

The sleeve 24 also has an axial bore 26 and at least the forward end of this bore 26 is internally threaded to receive the threaded end of a bolt B. A coiled spring 27 is fitted within the bore 20, around the sleeve 24 and interposed between the flange 25 and the inner end of the fixed sleeve 22. The ends of the spring 27 are turned outwardly and are respectively seated in small holes 28 and 29 in the inner end of the fixed sleeve 22 and the flange 25, respectively. Thus, the coiled spring 27 biases the threaded sleeve 24 into the body 19 and resists relative rotation therebetween.

When it is desired to couple two of the building units, a pair of washers if necessary, may be placed upon a bolt B, and a nut threaded on the end of the bolt. The threaded end of the bolt is then threaded into the bore 26 of the sleeve 24 far enough to support the bolt in alignment with the body of the wrench. The bolt is then pulled to slide the sleeve 24 out, as shown in Fig. 5, whereupon the nut is threaded back substantially against the end of the sleeve and aligned with the socket 21, the sleeve 24 then being retracted by the spring 27 to seat the nut in the socket 21, as shown in Fig. 6.

Two of the units 1 are then assembled by positioning them in edge-to-edge relation with the stepped open faces of the edge rails 2 substantially interfitting and with at least one keyhole 12 of each of the abutting edge rails in 2 in alignment. The wrench 15, carrying a bolt B, is then passed through the upper part of the keyhole 12 in the free edge rail which corresponds to the aligned keyholes in the abutting edge rails, as shown in Figs. 2–4. The wrench, with the bolt, is passed through the unit and the bolt is inserted through the upper parts of the aligned keyholes in the opposite edge rail and the edge rail of the abutting unit, as shown in Fig. 3. By means of the wrench, the bolt is so positioned that the bolt head is on the inside of one abutting edge rail and the nut on the inside of the other abutting edge rail.

The wrench is then lowered, as shown in Fig. 4, so that the shank of the wrench is inserted into the lower slot of the keyhole in the free edge rail and the bolt is inserted into the lower slots of the two keyholes in the abutting edge rails, which slots are of sufficient width to receive the bolt shank but of less width than the bolt head and the nut, and washers if they are used. The lower portion, at least, of the slots is of a width to snugly fit two opposite sides of the square portion on the shank of the bolt B adjacent the bolt head to prevent the bolt from turning. The wrench is then turned to thread and tighten the nut on the bolt to clamp the abutting edge rails together.

When the nut is tight on the bolt B the wrench 15 is then removed from the bolt and withdrawn through the keyhole in the free edge rail of the unit. To remove the wrench from the bolt, the handle 17 is pulled in opposition to the spring 27, to withdraw the socket 21 from the nut. The wrench is then rotated to unthread the sleeve 24 from the bolt. The sleeve 24 is restrained against rotation in the bore 23 and caused to rotate with the wrench by the spring 27 due to the anchoring of

its ends in the holes 28 and 29. This step is illustrated in Fig. 2.

As hereinbefore noted, when the units 1 are assembled, they are juxtapositioned to align at least one pair of corresponding keyholes 12 in the abutting edge rails 2. Normally, of course, the edge rails will properly interfit and each of the respective pair of keyholes will be in alignment. Frequently, however, at least one of the edge rails will be warped, particularly if it is formed of unseasoned wood. In this case, the keyholes of the abutting edge rails will not automatically be aligned and it will be necessary to draw the warped rail or rails into interlocking position so that their corresponding keyholes will be aligned.

One of the primary advantages of the invention resides in the facility with which the foregoing difficulty is overcome by the inherent characteristics of the present invention. As previously described, the open faces of the edge rails are formed with angular stepped surfaces 5, 6 and 7 which are disposed at relatively wide angles. Moreover, there is only one overlapping flange 9 or 11 disposed along only one side of each rail.

Because of this construction, even if one or both of the abutting rails are warped, the widely angular surfaces can be sufficiently interfitted for at least a portion of their length to effectively align one pair of their keyholes that will enable insertion of a bolt. Then, when the bolt is tightened, the angular surfaces will cooperatively cam the abutting rails into sufficiently interfitting relation for an additional portion of their length to effectively align the adjacent pair of keyholes. Obviously, the operation can be repeated until the rails are completely interlocked.

As the overlapping flanges 9 or 11 are laterally disposed along only one side of each edge rail, they will not interfere with the interfitting of the angularly disposed surfaces. On the contrary, these flanges will be drawn laterally into nesting relation with the respective offsets 8 and 10 as the abutting angular surfaces 5, 6 and 7 cooperatively cam the juxtapositioned rails into interfitting and interlocking alignment.

It will be readily appreciated that the cooperative action of the angular surfaces 5, 6 and 7 and the lateral disposition of the overlapping flanges 9 and 10 is a distinct advantage over known interlocks such, for example, as the tongue and groove. In the latter case, the tongue and the groove must be drawn into alignment before the tongue can be inserted into the groove and this is extremely difficult, particularly when dealing with relatively thick members which are capable of use as studs, joists and rafters.

Another principal advantage afforded by the invention resides in the resistance to shear of the interlocked and bolted edge rails. Any shear force that is exerted against the abutting rails, such as indicated by the arrow S in Fig. 2, is transposed into a camming action between the angular surfaces 5, 6 and 7. This cam action tends to cause the rails to directly separate, instead of just shifting laterally, and such separation is taken longitudinally by the bolt B which is the direction of their strongest resistance. Moreover, as the bolts span the planes of shear forces, they directly resist such forces. Finally, the rails themselves have their strongest dimension disposed in direct opposition to shear forces.

The edge rails 2 may be provided with flat inner faces and these faces may be perpendicular to the plane of the unit 1, as shown in Fig. 12, or they may be angularly disposed as shown in Fig. 15. Preferably, however, the inner faces of the edge rails are provided with a centrally disposed longitudinal channel 2' which preferably has sloping side walls, as shown in Fig. 2. By this construction, two interlocked rails form an I-beam as shown at the right of Fig. 2. The channeled rail is advantageous because its weight is reduced without materially decreasing its strength, any tendency to warp is reduced, the length of bolt required for connecting adjoining rails is shortened, and the bolt heads and nuts are recessed.

When the edge rails 2 are formed from a material such as wood, it is necessary to install washers on the bolts B, as shown in Figs. 12 and 13, to prevent the bolt head and the nut from chewing into the material. It is preferred, however, to permanently install washer clips 35 on the inner surfaces of the edge rails 2 adjacent the keyholes 12 prior to assembly, as best shown in Figs. 8–11.

The washer clip 35, as best shown in Fig. 11, comprises a plate having a tongue 36 struck perpendicularly therefrom to form a slot 37 in the plate. The washer clip 35 is installed, as best shown in Figs. 8–10, by positioning the plate 35 flat against the inner face of the edge rail with the tongue 36 inserted in and resting on the bottom of the slot of a keyhole 12 with the washer slot 37 coinciding with the keyhole slot. The tongue 36, or at least the outer end thereof, is outwardly tapered or flared so as to snugly fit between the sides of the keyhole slots and retain the clip in position, as shown in Fig. 10.

The upper end of the slot 37 is also flared to free the keyhole, as shown in Fig. 9, and to help guide a bolt in position. The lower sides of the slot 37 are preferably parallel and spaced to snugly receive the squared shank at the head of the bolt so as to prevent turning of the bolt. This slot may be stepped, as shown in Fig. 11, to accommodate different sized bolts. If desired, the plate 35 may have a hole 38 for a nail, as shown in Fig. 8, to prevent turning of the clip by the bolt or nut.

As previously noted, the unit preferably is of double-walled construction so that it provides a finished building structure when erected. The panels 3 and 4 may be provided with preformed finishes and decoration, that of the outer panel 3 preferably being weatherproof, so that no additional materials, labor or expense are necessary beyond the erection and assembly of the units. Moreover, the units may be insulated and thus provide a complete, finished unitary structural element.

The insulation of the units 1 may be effected in any desired manner and, as shown in Figs. 1–4, may comprise loose fibrous insulation. If such insulation is employed, it obviously would interfere with the passage of the bolts through the unit during assembly of a building structure. In order to maintain a clear path between the corresponding keyholes 12 in the opposite edge rails 2 of a unit, a tubular member 40 may be interposed between said rails and aligned with the keyholes, as shown in Figs. 2–4.

For standard sized units 1, the tube 40 may be of a standard sized unitary member, as shown in Fig. 3. Conversely, for different sized units 1, the tube may comprise a telescopic member, as shown in Figs. 2 and 4. The tube 40 should be of a size to completely surround a keyhole 12 and, therefore, is preferably oval in cross-section, as shown in Fig. 7. Obviously, the tubes 40 are useful in guiding the bolts through the units, whether or not the loose insulation is employed.

In a building construction, the units 1 may be assembled in edge-to-edge relation, as previously described, to form a wall, floor, ceiling or roof. When building a wall, particularly an outer wall, the units may be assembled at a corner in any desired manner. Preferably, however, the units are joined at a corner by a corner element 45, as best shown in Fig. 12. This corner element 45 comprises an angular member having a stepped face 46 on each branch 47 thereof to correspond to the edge of the unit 1.

The branches 47 of the angle member 45 are provided with keyholes corresponding to those in the edge rails and the faces 48 of the branches 47 opposite the stepped faces are recessed around the keyholes to accommodate the bolt heads or nuts as the case may be. The corner element 45 may be assembled with the units in substantially the same manner as the method of assembling the units. The corner structure may be weather-sealed by

corner laps 50 in the conventional manner to cover the exposed bolt and nut recesses. The joints, particularly of an outer wall, may also be weather-sealed or decoratively covered by strips 51, or the outer wall may be covered by a brick or other veneer and the inner wall plastered or the like.

The wall units may be anchored to a floor or foundation and to a ceiling or roof by enclosed connections. A suitable connection between the wall units and floor units is shown in Fig. 13 as comprising angle brackets 55. The base branches of the brackets are secured on the floor by screws or the like in predetermined positions to accommodate abutting edge rails 2 between the upstanding branches 57 of the brackets. The upstanding branches are provided with keyholes which coincide with keyholes 12 adjacent the ends of the edge rails. Thus, the edge rails can be clamped together with the brackets 55 in the usual manner and by a single bolt.

Although standard units may be used as floor units, in Figures 13 and 14 an assembly of floor units 1' of special construction is shown mounted on a foundation F. This floor unit is quite similar to the standard unit in so far as the edge rails 2 and the upper and lower panels 3 and 4' are concerned. One difference in the floor resides in the fact that the lower panel 4' is placed so that its side edges are flush with the side edges of the edge rails. This is to permit the use of stiffener plates 60 between units. Plates 60 are wider than the thickness of a unit and extend below the unit a substantial distance. The upper portion of the plate is bent into an angular step 61 to conform to the stepped joint between units. These plates increase the load-bearing capacity of the assembled units by imparting a truss action between spans. The stiffener plates may be provided with openings 62, so that these plates may serve as hangers for conduits or the like.

The floor unit may be provided with a partition 64 fitted into grooves 65 in the inner faces of the edge rails. The partition is located in the lower part of the unit, and the compartment or cell formed between the partition and the lower panel 4' may be filled with insulation 71.

Extending between the edge rails at spaced intervals in the upper part of the unit are cross bridges 66 which extend from the partition 64 to the underside of the upper panel 3. These bridges serve to strengthen the floor and supply added rigidity to the units. Openings 67 may be provided in the cross bridges 66 to permit the passage of water or electrical conduits.

The lower panels may be supplied with pressed metal U-shaped cleats 68 for strengthening purposes. Obviously, the stiffener plates 60 are provided with keyholes corresponding to those in the edge rails. The floor unit is also suitable for use as a roof unit, and it will be noted that as either flooring or roof, the edge rails serve as joists to support the weight. The truss-like stiffener plates and bridges substantially increase the strength of the assembled floor or roof. The outside edge rail of the assembled floor may be finished off by an edge member 72, similar in principle to the corner member 45, and sealed by a weather strip 73.

The units 1 may comprise different modifications for different uses, to provide different finishes, or to accommodate different methods of fabrication or the like. For example, the units may be internally divided into compartments or to facilitate insulating the units or for other purposes. Such a unit is shown in Figs. 12–14 wherein the edge rails 2 have the longitudinally extending grooves 65 formed in their inner faces. The grooves extend the full length of the rails and receive the side edges of inner partitions 64 which are longitudinally coextensive with the edge rails. The grooves and partitions are similar to those in the floor unit except that there are a plurality of them to divide the unit into compartments to provide a cellular structure. Conduits, pipes or the like may be run through one or more of the compartments or cells.

The outer and inner panels 3 and 4 may be strengthened, if desired, by the pressed metal cleats 68 which are secured transversely of the panels, as by screws. The number of cleats used on each panel will depend, to a large extent, upon the size of the panel and the load to be imposed upon the unit. The depth of the cleats is less than the distance from the outer and inner panels to the partitions 64 so that they do not interrupt the continuity of the cells between the panels and the partitions.

In the central cell, between the partitions 64, spread coil springs 69 are positioned to bear against the partitions to prevent them from bulging inwardly. The springs are fastened at their ends to the partitions 64 and are held in alignment by means of wire clips 70 passing around the spring wire and through the partitions. The coiled springs 69 preferably have all of their convolutions, except a few at each end, spread so that the points of contact with the partitions are wider spaced than would ordinarily be the case to provide a more yielding support, and also to facilitate passage of the bolts through the central cell.

By reason of its cellular construction, the building unit may easily be insulated. Insulating material 71 of any well known type can be inserted into the outer cells between the partitions and the panels. The insulating efficiency of the unit may further be increased by the use of reflecting surfaces applied to the interior walls of the cells by the use of lustrous paints or foils.

Another modification of the unit 1, as shown in Figure 15, employs edge rails 2 that are inclined relative to the side panels. An inner panel 4 may be composed of plywood and may be given any desired finish. The outer panel 3 has its side edges shaped to form a continuation of the angularly stepped configuration of the outer faces of the edge rails. Panel 3 has one edge provided with a partial angular offset 8 and its opposite edge provided with a partial angular flange 9. When two of these units are assembled, the flange of one unit fits into the offset of the next. This added to the step-joint of the edge rails, and the overlapping of the edge rail by the flange 11 of panel 4, forms an extremely rigid as well as weather-tight joint when the units are bolted together.

Figure 16 shows still other modifications of the unit. In the central and right-hand units, the edge rails 2 and inner and outer panels may be integral and formed by casting or by extrusion of metal, plastic or the like. In the left-hand unit the edge rails are separately cast or extruded and separate side panels are attached to the rails as by screws or the like. In horizontal cross-section, the edge rails of these units are shown as being angularly disposed with respect to the panels, and the stepped joint is moved from the center of the edge rails toward the sides thereof.

These units are shown as of cellular construction and the left-hand and central units are shown as having the vertical grooves 65 to serve as guides for the removable partitions 64 while the right-hand unit has integral partitions 64'. These units are to be secured together by bolts B' having angularly disposed heads and washers to accommodate the inclined walls. In addition, holes 74 and 75 may be formed in the flanges and steps respectively, so that bolts 76 may be inserted to further aid in holding the units together. The left-hand unit with separate edge rails is especially adaptable as a fill-in unit, for small spaces.

With the extruded types especially, cover plates 77, as fragmentarily shown in Figs. 17 and 18, may be used to close the ends of the units. These covers are of pressed metal and are substantially pan-shaped, having a bottom 78 and a surrounding side flange 79. The cover is shaped to fit the inside of the unit, the flange being slightly flared to yieldingly bear against the inner surfaces of the side rails and panels. Recesses 80 are formed in the flange to receive the partitions.

The units may also comprise a sheet metal construction as shown in Figs. 19, 20 and 21. In Fig. 19 the unit comprises a single sheet 85 bent to form the side panels and

edge rails with the sheet edges **86** overlapped along one edge rail and secured by spot welding, metal adhesive or other suitable means. In contrast, in Figs. 20 and 21 the units comprise a pair of sheets **85***a* and **85***b* which are respectively bent to form one side panel and part of the two edge rails, with the edges **86** of each pair of sheets spaced by an insulating element.

The unit of Fig. 19 is more especially adapted for internal wall construction. The edge rails are formed exclusively by the metal sheet **85** and special stepped washers **87** are required to accommodate the stepped sheet metal edge rails for the bolts B. These units may be insulated for temperature or sound and fibrous bats are shown as lining the side panels.

The unit of Fig. 20 has the sheet edges **86** offset and parallelly overlapping, with a relatively thick strip **88** interposed between the overlapping edges and forming the step therebetween. This unit may be employed in an outer wall and for this purpose at least the outer panel, if not the inner panel, may be strengthened by a liner **89** of plywood, asbestos or hard fiber board or other suitable sheet material. This liner may be cemented to the sheet metal and preferably also has insulation properties and acts as a vapor barrier.

This unit may comprise sheet metal partitions **64** and one or both outer compartments may contain insulation. To adapt this unit, and even the unit of Fig. 19, for outer wall construction, the outer joints between the edge rails may be covered by a springy metal joint strip **90** that is secured by corrugated weather strip nails **91** driven into the joint between the edge rails. The strip **90** is filled with a sealing compound such as caulking cement or other suitable material.

The unit shown in Fig. 21 has the metal sheets **85***a* and **85***b* secured to and spaced by standard edge rails, the edges **86** of the sheets seating in grooves **92** in the angular surfaces on the outer faces of the rails. The rails may be provided with offsets at their inner corners to accommodate the edges of the liner **89**. These units are particularly adapted for outer wall construction by providing an offset **93** in the outer side of one edge rail, to which the metal sheet **85***a* conforms, to receive a flange **94** formed by a reverse fold along the opposite side of the sheet **85***a* of the adjoining unit and thereby provide a lap joint. In order to prevent moisture or air leakage, a non-hardening material, such as a bituminous paint is applied to the lap joint when the units are assembled.

It will be understood that all outer wall units will be constructed as load bearing units, and these units may be employed for interior construction where load supporting is required. Interior wall units which are for partitions only, and not load bearing, may be of lighter construction.

From the foregoing description, it will be apparent that the present invention contemplates an efficient construction unit having ease of assembly to provide a finished construction. This construction may be permanent in nature and yet it is advantageous over temporary construction in that it may be readily disassembled by merely reversing the method of erection and substantially completely salvaged.

Obviously, the units **1** may comprise built-in windows or doors, and, if desired, either or both of the outer and inner panels **3** and **4** may comprise transparent or translucent materials. Moreover, as shown in Figs. 22 and 23, light transmitting sections, and accessories thereto if desired, may be built directly into the units. Such sections, as shown in Fig. 23, may comprise transparent or translucent panels **100** in frames **101** which seat in and overlap openings **102** in the side panels.

While such sections may be rigidly interposed in the side panels, for many constructions it is desirable to afford means for interrupting the visibility through the panels **100**. To this end, a blind or shade, such as a roller shade **103**, may be mounted directly within the unit, and between the panels **100**. Moreover, it is frequently desirable to mount a light unit **104** within the unit for indirect lighting effects.

These accessories will preferably be located beyond the line of sight through the panels **100** and are shown as being thereabove. Remote controls may be provided on the inner side of the unit as by means of a switch **105** for the light unit **104** and a pull cord **106** for the shade **103**, said cord being trained around a pulley **107** and passing through an aperture **108** in the inner panel **4**. The inner frame **101** may be mounted on hinges **110**, as shown in Fig. 22, for accessibility to the accessories within the unit.

As the openings **102** tend to weaken the side panels **3** and **4**, and thus weaken the entire unit, it is desirable to provide internal braces for the units. Such braces are particularly desirable for these last described units but they may be incorporated in any of the different types of units when required. A particularly suitable form of brace is shown in Figs. 23–26.

The structure of this preferred brace is best shown in Fig. 24 as comprising a pair of cross braces **115**, a pair of struts **116** and a suitable fastener **117** such as a bolt, nut and lock washer. The cross braces are identical but oppositely disposed and the struts **116** are identical but reversely disposed in assembly. In certain instances, a closure plate **118** will be interposed between the cross braces.

Each cross brace comprises an elongated plate **120** having a slot **121** at one end and perpendicular ears **122** at the other end with flanges **123** along its side edges. In assembly, the braces **115** are turned end-to-end for attachment of the ears **122** to the edge rails **2** and back-to-back to enable registry of their slots **121** without interference by their flanges **123**. When the braces are adjusted as to length so that the ears **122** engage the edge rails, the braces may be secured by the bolt **117** inserted through the registered slots **121**.

Th struts **116** each comprise a strip **125** having angularly bent tabs at each end, the tab **121** at one end having a hole **127** for receiving the bolt **117** and the tab **128** at the opposite end being adapted to be secured to the respective edge rail **2**. In assembly, the struts **116** extend at angles to the braces **115**, as best shown in Fig. 26. The closure plate **118** is interposed between the braces **115** to substantially close or partition transversely the interior of the unit **1** for retaining loose insulation or the like, as shown in Fig. 23.

Although certain specific embodiments of the invention have been shown and described, it is obvious that many modifications thereof are possible. The invention, therefore, is not to be restricted except in so far as necessitated by the prior art and by the spirit of the appended claims.

What I claim is:

1. A prefabricated building unit comprising spaced edge rails and spaced panels respectively connecting both sides of said edge rails and forming a closed double-wall building unit, said edge rails having longitudinally extending rectilinear surfaces on their opposed outer faces and defining external and reentrant angles respectively on each face, the angles on one edge rail being complementary to the angles on the other edge rail and adapted to wedgingly interfit with the angles on the edge rail of a juxtaposed unit, the rectilinear surfaces of said outer faces all being inclined to the transverse planes perpendicular to said unit to be self-aligning and have a high resistance to shear in either direction transversely of the unit, said edge rails having a plurality of aligned keyhole shaped openings sequentially spaced along the length thereof, said openings being parallel with said panels and opening through the angle faces of said edge rails and having enlarged upper portions for passing bolts and narrow lower portions for receiving the shanks of such bolts, corresponding openings in said spaced edge rails being aligned, the interior of said unit between said aligned openings being open and defining unobstructed paths be-

tween said aligned openings and enabling the passing of bolts through a keyhole opening in one edge rail and through said unit to be seated in the lower narrow portions of the corresponding juxtaposed keyhole openings in the opposite edge rail and the mating edge rail of a juxtaposed unit, whereby the bolts will span the mating edge rails of juxtaposed units and releasably tie the units together in a rigid monolithic structure.

2. A prefabricated building unit comprising spaced edge rails and spaced panels respectively connecting both sides of said edge rails and forming a closed double-wall building unit, said edge rails and panels being formed integrally from a single unit of material, said edge rails having longitudinally extending rectilinear surfaces on their opposed outer faces and defining external and reentrant angles respectively on each face, the angles on one edge rail being complementary to the angles on the other edge rail and adapted to wedgingly interfit with the angles on the edge rail of a juxtaposed unit, the rectilinear surfaces of said outer faces all being inclined to the transverse planes perpendicular to said unit to be self-aligning and have a high resistance to shear in either direction transversely of the unit, said edge rails having a plurality of aligned keyhole shaped openings sequentially spaced along the length thereof, said openings being parallel with said panels and opening through the angle faces of said edge rails and having enlarged upper portions for passing bolts and narrow lower portions for receiving the shanks of such bolts, corresponding openings in said spaced edge rails being aligned, the interior of said unit between said aligned openings being open and defining unobstructed paths between said aligned openings and enabling the passing of bolts through a keyhole opening in one edge rail and through said unit to be seated in the lower narrow portions of the corresponding juxtaposed keyhole openings in the opposite edge rail and the mating edge rail of a juxtaposed unit, whereby the bolts will span the mating edge rails of juxtaposed units and releasably tie the units together in a rigid monolithic structure.

3. A prefabricated building unit comprising spaced edge rails and spaced side panels respectively connecting both sides of said edge rails and forming a closed double-wall building unit, said edge rails and side panels being composed of a metal sheet bent to form with its opposite side edges overlapping and secured to each other along one edge rail, said edge rails having longitudinally extending rectilinear surfaces on their opposed outer faces and defining external and reentrant angles respectively on each face, the angles on one edge rail being complementary to the angles on the other edge rail and adapted to wedgingly interfit with the angles on the edge rail of a juxtaposed unit, the rectilinear surfaces of said outer faces all being inclined to the transverse planes perpendicular to said unit to be self-aligning and have a high resistance to shear in either direction transversely of the unit, said edge rails having a plurality of aligned keyhole shaped openings sequentially spaced along the length thereof, said openings being parallel with said panels and opening through the angle faces of said edge rails and having enlarged upper portions for passing bolts and narrow lower portions for receiving the shanks of such bolts, corresponding openings in said spaced edge rails being aligned, the interior of said unit between said aligned openings being open and defining unobstructed paths between said aligned openings and enabling the passing of bolts through a keyhole opening in one edge rail and through said unit to be seated in the lower narrow portions of the corresponding juxtaposed keyhole openings in the opposite edge rail and the mating edge rail of a juxtaposed unit, whereby the bolts will span the mating edge rails of juxtaposed units and releasably tie the units together in a rigid monolithic structure.

4. A prefabricated building unit comprising spaced edge rails and spaced panels respectively connecting both sides of said edge rails and forming a closed double-wall building unit, said edge rails having longitudinally extending rectilinear surfaces on their opposed outer faces and defining external and reentrant angles respectively on each face, the angles on one edge rail being complementary to the angles on the other edge rail and adapted to wedgingly interfit with the angles on the edge rail of a juxtaposed unit, the rectilinear surfaces of said outer faces all being inclined to the transverse planes perpendicular to said unit to be self-aligning and have a high resistance to shear in either direction transversely of the unit, said edge rails having a plurality of aligned keyhole shaped openings sequentially spaced along the length thereof, said openings being parallel with said panels and opening through the angle faces of said edge rails and having enlarged upper portions for passing bolts and narrow lower portions for receiving the shanks of such bolts, washer clips each comprising a plate having a tongue struck therefrom and forming a slot, said clips being mounted against the inner adjacent faces of said spaced edge rails one at each said opening with their tongues respectively seated in the bottoms of the lower narrow portions of said openings and the plate slots coinciding with said openings, corresponding openings in said spaced edge rails being aligned, the interior of said unit between said aligned openings being open and defining unobstructed paths between said aligned openings and enabling the passing of bolts through a keyhole opening in one edge rail and through said unit to be seated in the lower narrow portions of the corresponding juxtaposed keyhole openings in the opposite edge rail and the mating edge rail of a juxtaposed unit, whereby the bolts will span the mating edge rails of juxtaposed units and releasably tie the units together in a rigid monolithic structure.

5. A prefabricated building unit comprising spaced edge rails and spaced side panels respectively connecting both sides of said edge rails and forming a closed double-wall building unit, said edge rails having longitudinally extending rectilinear surfaces on their opposed outer faces and defining external and reentrant angles respectively on each face, the angles on one edge rail being complementary to the angles on the other edge rail and adapted to wedgingly interfit with the angles on the edge rail of a juxtaposed unit, the rectilinear surfaces of said outer faces all being inclined to the transverse planes perpendicular to said unit to be self-aligning and have a high resistance to shear in either direction transversely of the unit, the longitudinal side edge of at least one side panel extending beyond the outer face of the adjacent edge rail to form a joint covering flange and the opposite side edge of said panel being longitudinally recessed from the outer face of the adjacent edge rail for reception of the joint covering flange on a juxtaposed unit, said edge rails having a plurality of aligned keyhole shaped openings sequentially spaced along the length thereof, said openings being parallel with said panels and opening through the angle faces of said edge rails and having enlarged upper portions for passing bolts and narrow lower portions for receiving the shanks of such bolts, corresponding openings in said spaced edge rails being aligned, the interior of said unit between said aligned openings being open and defining unobstructed paths between said aligned openings and enabling the passing of bolts through a keyhole opening in one edge rail and through said unit to be seated in the lower narrow portions of the corresponding juxtaposed keyhole openings in the opposite edge rail and the mating edge rail of a juxtaposed unit, whereby the bolts will span the mating edge rails of juxtaposed units and releasably tie the units together in a rigid monolithic structure.

6. A prefabricated building construction comprising a plurality of building units each including spaced edge rails and spaced side panels respectively connecting both sides of said edge rails and forming a closed double-wall building unit, said edge rails having longitudinally extending rectilinear surfaces on their opposed outer faces and defining external and reentrant angles respectively on each face, the angles on one edge rail being complementary to the angles on the other edge rail and adapted to wedgingly interfit with the angles on the edge rail of a

juxtaposed unit, the rectilinear surfaces of said outer faces all being inclined to the transverse planes perpendicular to said unit to be self-aligning and have a high resistance to shear in either direction transversely of the unit, said edge rails having a plurality of aligned keyhole shaped openings sequentially spaced along the length thereof, said openings being parallel with said panels and opening through the angle faces of said edge rails and having enlarged upper portions for passing bolts and narrow lower portions for receiving the shanks of such bolts, corresponding openings in said spaced edge rails being aligned, the interior of said unit between said aligned openings being open and defining unobstructed paths between said aligned openings and enabling the passing of bolts through a keyhole opening in one edge rail and through said unit to be seated in the lower narrow portions of the corresponding juxtaposed keyhole openings in the opposite edge rail and the mating edge rail of a juxtaposed unit, said building units being juxtaposed with an edge rail of one unit wedgingly interfitted with the complementary edge rail of a juxtaposed unit, a stiffener plate angled to conform to said edge rail angles and disposed between the interfitted edge rails of juxtaposed units, said plate having a plurality of keyhole openings corresponding to the openings in said edge rails, and bolts extending through the aligned openings of juxtaposed edge rails and the interposed plate and forming a rigid monolithic structure.

7. A prefabricated building unit according to claim 1 comprising tube-like members extending through said unit between said edge rails and respectively aligned with each pair of aligned openings in said edge rails and defining said unobstructed paths.

8. A prefabricated building unit according to claim 7 wherein said tube-like members are constituted by telescopic elements.

9. A prefabricated building unit according to claim 1 wherein said panels comprise metal sheets and said edge rails comprise a material resistant to thermal conductivity and form a thermal barrier between said metal sheets.

10. A prefabricated building unit according to claim 1 wherein said panels comprise metal sheets having their longitudinal edge portions bent inwardly and forming the respectively outer rectilinear surfaces of said edge rails, the longitudinal edge portion of one panel at each edge rail extending in overlapping relation to the adjacent edge portion of the other panel but offset therefrom in the plane of the unit and terminating in spaced relation to said other panel, said edge rails comprising a bar of material resistant to thermal conductivity and sandwiched between said overlapping edge portions with one face thereof exposed and defining an intermediate rectilinear surface of each edge rail to form a thermal barrier between said metal panels.

References Cited in the file of this patent

UNITED STATES PATENTS

774,384	Fisher	Nov. 8, 1904
960,207	Slater	May 31, 1910
1,374,580	Kepley et al.	Apr. 12, 1921
1,421,124	Brandt	June 27, 1922
1,423,468	Stadelman	July 18, 1922
1,549,290	Broady	Aug. 11, 1925
1,643,855	Peterson	Sept. 27, 1927
1,644,710	Crooks	Oct. 11, 1927
1,667,661	Grasley	Apr. 24, 1928
1,747,313	Miss	Feb. 18, 1930
2,140,772	Slayter et al.	Dec. 20, 1938
2,255,511	Muller	Sept. 9, 1941
2,267,652	Hasenburger et al.	Dec. 23, 1941
2,276,071	Scull	Mar. 10, 1942
2,309,389	Goodman	Jan. 26, 1943
2,316,980	Sigloch et al.	Apr. 20, 1943
2,447,272	Parkes	Aug. 17, 1948

FOREIGN PATENTS

581,207	Great Britain	Oct. 4, 1946
918,754	France	Nov. 4, 1946
129,841	Australia	Nov. 5, 1948