

**May 5, 1936.**

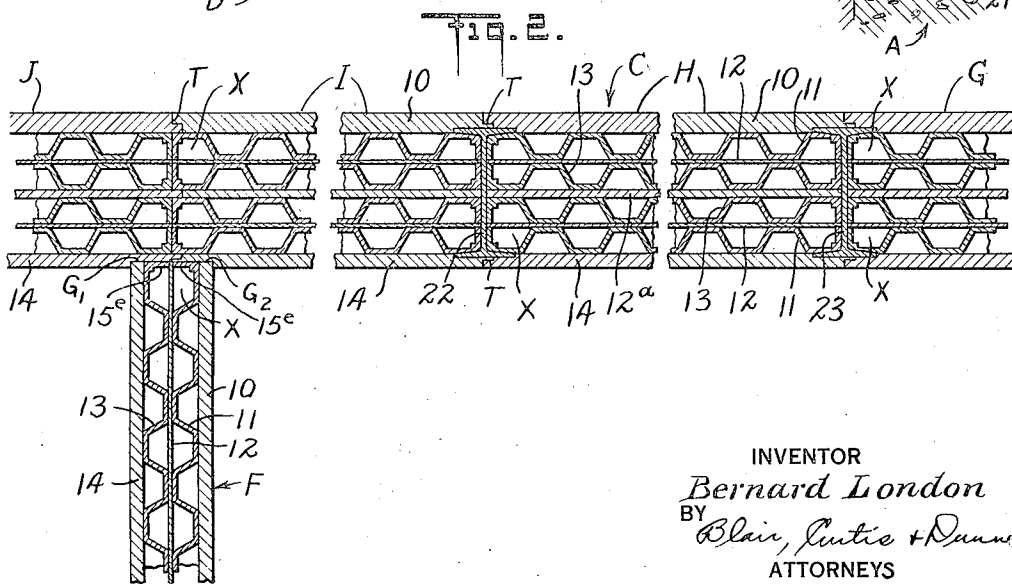
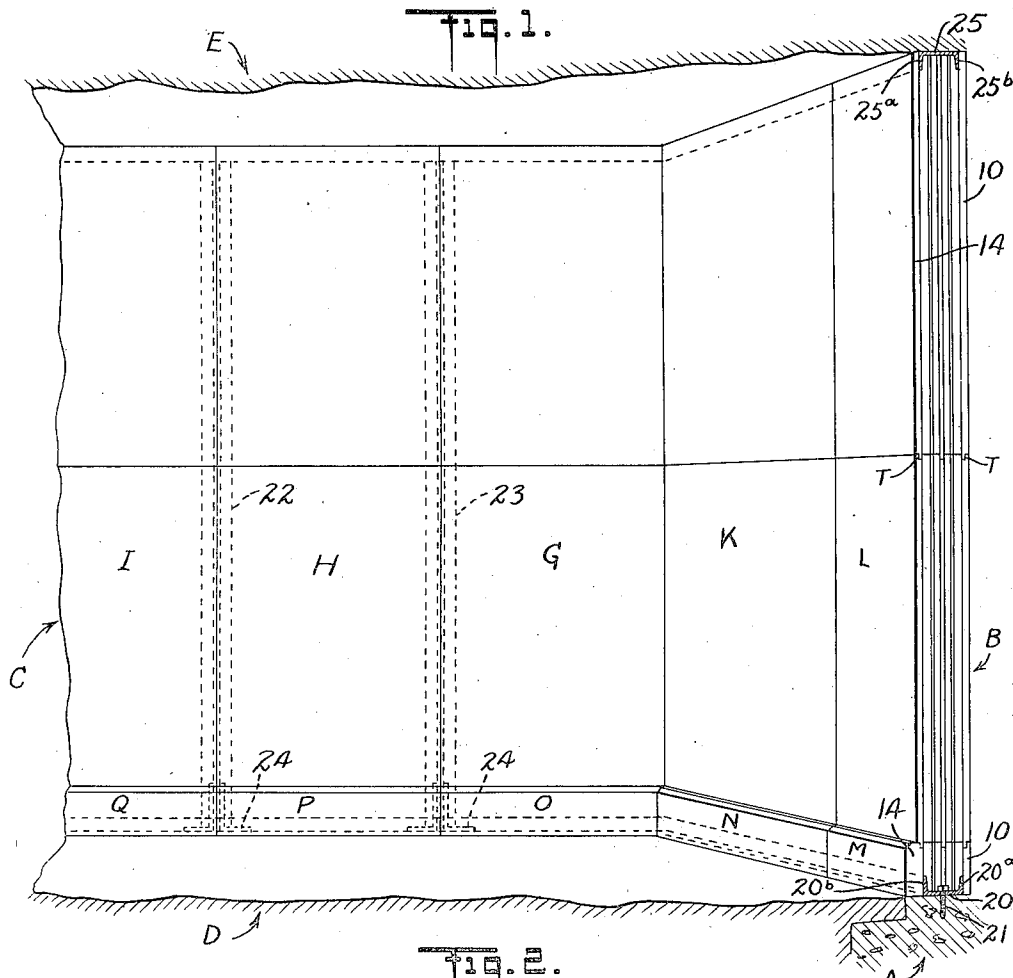
B. LONDON

2,039,601

BUILDING CONSTRUCTION

Filed Nov. 14, 1934

3 Sheets-Sheet 1



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*Bernard London*  
BY  
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**May 5, 1936.**

B. LONDON

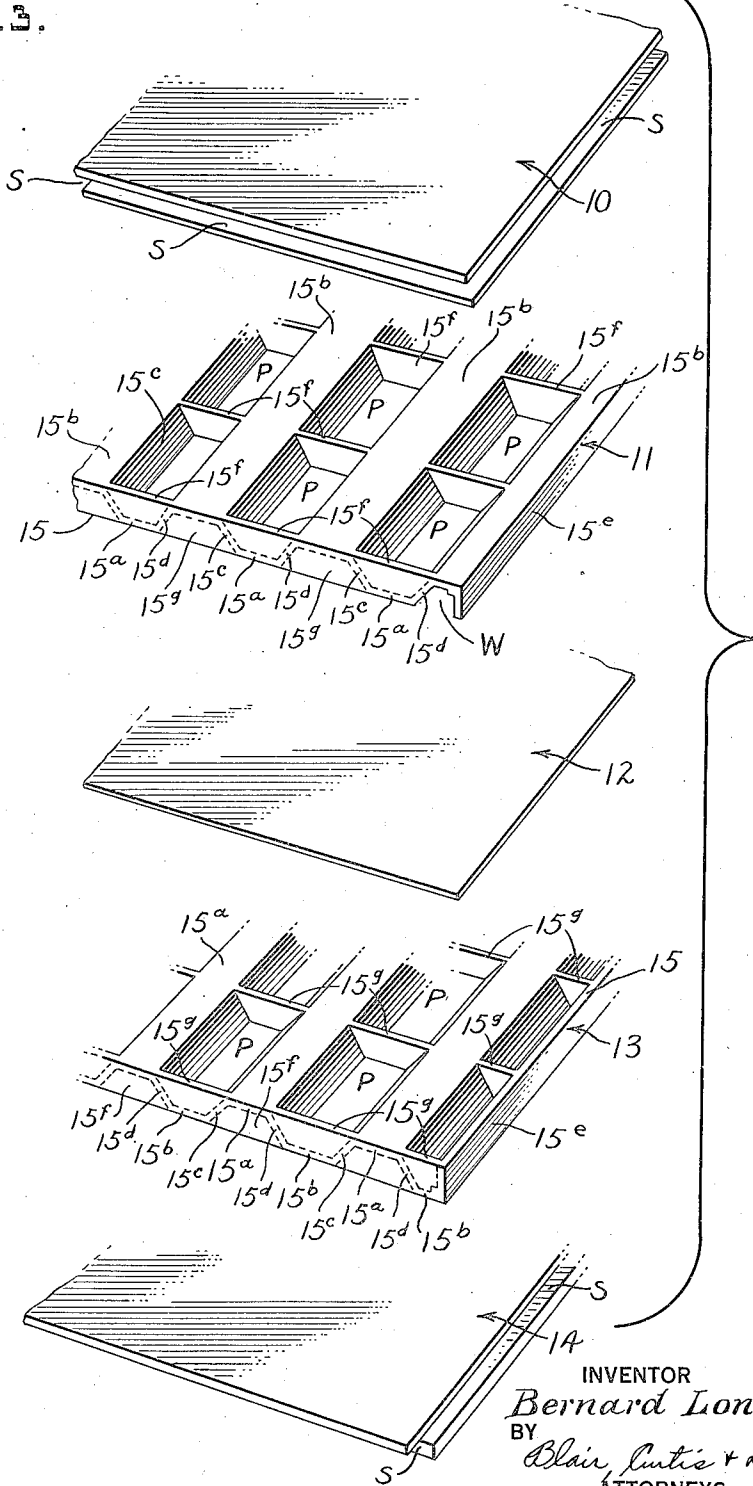
**2,039,601**

BUILDING CONSTRUCTION

Filed Nov. 14, 1934

3 Sheets-Sheet 2

719.3.



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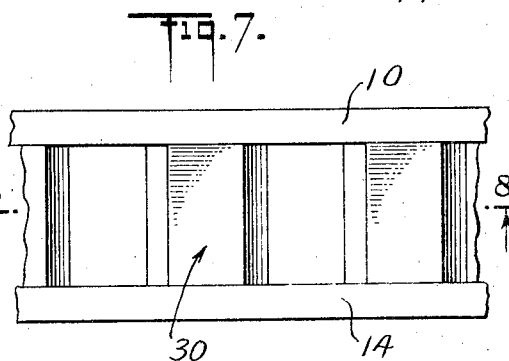
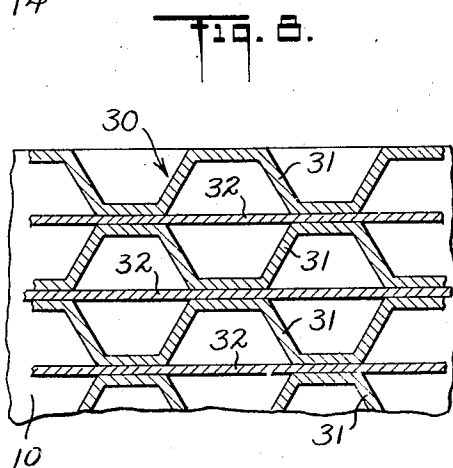
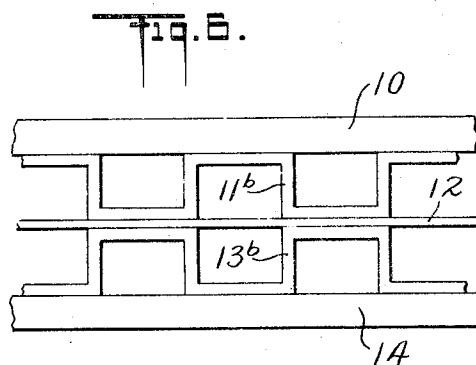
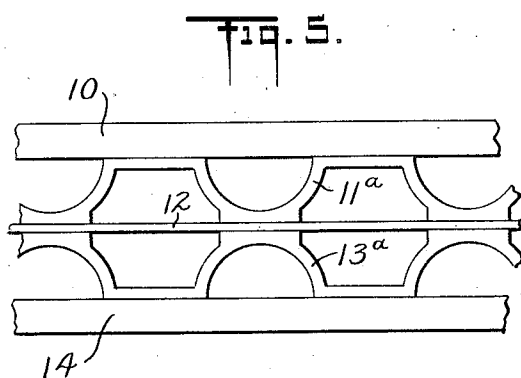
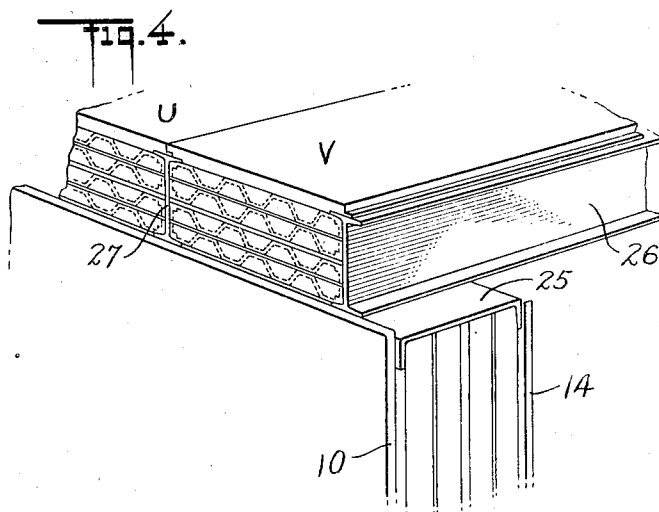
### B. LONDON

**2,039,601**

BUILDING CONSTRUCTION

Filed Nov. 14, 1934

3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

2,039,601

## BUILDING CONSTRUCTION

Bernard London, New York, N. Y.

Application November 14, 1934, Serial No. 752,969

27 Claims. (Cl. 72-16)

This invention relates to building construction.

One of the objects of this invention is to provide a building construction that will be inexpensive, thoroughly practical, durable, and characterized by such flexibility of arrangement, interrelation, or shaping of the various parts as will meet the widely varying conditions of practical use. Another object is to provide a building construction that will be fire-resistant, weather-proof, sound-proof, and that will have such thermal characteristics as will dependably and efficiently negative or resist the passage through the material thereof of heat. Another object is to provide a building construction and a building material well adapted to meet the requirement of varying climatic and weather conditions.

Another object is to provide an inexpensive, light but strong building material unit capable of ease and speed in assembly with other like units to form inside or outside walls, partitions, flooring, ceilings, roofing, and the like. Another object is to provide a building material unit for walls, partitions, or other portions of a building or house but constructed in such a way that, when assembled with other like units, the assemblage provides the desired inside and outside decorative, mechanical, or like finish appropriate to the reliable functioning of the respective outside or inside surface or surfaces of the structure. Another object is to provide a building material unit which, when assembled with like units to form a wall or other portion of the building, will provide interiorly thereof appropriate passages or channels for the accommodation of piping such as is used for the usual plumbing purposes, and for electrical circuits, conduits, or the like.

Another object is to provide a building material unit that may be inexpensively produced and that will readily lend itself to quantity production. Another object is to provide a unit of the above-mentioned character that will be of low first cost and, moreover, in so far as its erection or assembly with like units is concerned to form a wall or other portion of the building, will not require highly skilled labor and whereby, accordingly, erection of the building may be carried on speedily and at low cost.

Another object is to provide a building material unit that will be substantially self-contained in possessing the desired mechanical, thermal, and other properties appropriate to providing at once such factors as (a) the desired and weather-proof outside material or finish, (b) the desired

or other appropriate inside finish suitable for inside surfaces, walls, or the like, (c) any desired decorative effect or effects for the outside surface or material, (d) the desired inside decorative effect or effects, (e) appropriate mechanical rigidity and strength, (f) appropriate heat insulation or resistance to heat passage therethrough, (g) facility and speed of installation or assembly thereof with other units, and others.

Another object is to provide a building material unit well adapted to be capable of manufacture in standardized sizes or shapes, whereby, upon the selection of appropriate numbers of appropriately mentioned or shaped units, any desired design or architectural construction of building may be achieved upon the assembly of the selected standardized units.

Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, all as will be illustratively described herein, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings in which are shown several of the various possible embodiments of certain features of my invention,

Figure 1 is a perspective view as seen from the inside of a corner of a building, showing two corner walls and the ceiling and floor;

Figure 2 is a horizontal sectional view through an outside wall and an inside partition wall, indicating certain features of my building material units and their interrelation with each other and certain other possible parts;

Figure 3 is an exploded perspective view showing, in perspective, the several parts that may be interrelated to each other to make a building unit;

Figure 4 is a fragmentary perspective view, certain parts being broken away or omitted, showing more in detail a preferred arrangement of floor or ceiling construction and a preferred arrangement of relating a floor or ceiling construction to the upper end of a wall;

Figures 5 and 6 are fragmentary cross-sectional or end view on a larger scale of possible other forms which certain parts of my building unit may take;

Figure 7 is a view like those of Figures 5 and 6 showing in end elevation a fragmentary portion of another form of building unit, and

Figure 8 is a sectional view as seen along the line 8-8 of Figure 7.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Referring first to Figure 1, it is first to be noted that I have there shown, as seen from the inside, a corner portion of a building, illustratively a building such as a house, and for greater clarity of description I have indicated the corner portion of the ground floor of such a building. There is therefore seen in Figure 1 a foundation A, a side wall B making an angle, illustratively a 90° angle, with another side wall C, walls B and C following the contour of the foundation A, the latter being of any suitable construction or material, illustratively of concrete. There is also shown a fragment of the floor D and a fragment of the ceiling E, the latter forming, of course, also the floor of the story over-head.

I may, of course, provide, where desired, inside or so-called partition walls, though for greater simplicity of illustration, I have not shown such a partition wall in Figure 1, but in Figure 2, wherein I have shown in horizontal cross-section a portion of the outside wall of the building and which outside wall may be the wall B or the wall C of Figure 1, there is shown at F, also in horizontal cross-section, a portion of a partition or inside wall, the latter being of lesser thickness than the former, though both embody the features of my invention. For greater facility of understanding and of description, therefore, reference may first be made to the details of construction of the inside partition or wall F of Figure 2, the detailed and preferred construction of the outside wall or walls being accordingly reserved for later description. In Figure 3 I have shown in exploded perspective the parts of a section or building unit of a number of which the inside wall F is constructed and inasmuch as the units of which the outside walls are made have numerous features in common with the units of which the inside or partition wall F is made, and accordingly detailed consideration may now be given to the parts shown in Figure 3 which are assembled to form a building unit, bearing in mind the assembly of these parts as shown at F in Figure 2.

What I have above termed as building construction "units" or as a "building unit" comprises preferably a block-like structure, preferably of substantial dimensions as to length and breadth or height and breadth, embodying certain features of my invention, and capable of ready interfitting and assembly of a relatively small number thereof to form a relatively large wall or other portion of the building. For example, the unit may be and preferably is dimensioned to have a width of several feet and a length or height preferably in excess of its width, having, of course, a thickness appropriate to the particular purpose which the unit is to meet. For example, I may make up the units, of appropriate wall thickness, to have a width of five feet and a length or vertical height of ten feet, the latter dimension approximating the average height of a room, and the walls may be built up of the necessary number of such units.

Or, by way of further illustration, I may dimension the units as is indicated generally in Figure 1, in which I suggest a size of unit approximating a width of three feet and a vertical dimension or height of five feet or six feet, thereby requiring two superimposed units to give the height of the room between ceiling and floor.

It is to be understood, of course, that the above

stated dimensions are merely illustrative and are set forth not by way of limitation.

With the above preliminary understanding of the preferred order of dimensions of the units and recurring to Figure 3, in which the component parts of a unit intended particularly for an inside wall or partition are shown, I make up the parts 10, 11, 12, 13 and 14 (Figure 3) as about to be described and assemble them to form a single structural unit, all as hereinafter described.

Where the two exposed faces of the structural unit are to have the same physical characteristics, as is usually the case with an inside wall or partition, the parts or members 10 and 14 of Figure 3 may be of the same material, and any appropriate material capable of fabrication into sizes, dimensions, or shapes, as abovementioned, may be employed. For example, the slab-like members 10 and 14 may be cast or formed of materials like cement, materials such as are used in tiles and including glaze, or the like, and in such cases, if desired, those faces of the members 10 and 14 that are ultimately to be exposed (the upper face of member 10 and the under face of member 14, as viewed in Figure 3) may be glazed. Likewise, where the members 10 and 14 are thus preformed or cast, any desired surface decoration or decorative effects, including coloring, tinting, or the like, on these exposed surfaces may be permanently incorporated therein; for example, these parts may be made of so-called artificial stone and treated or made in any desired way to give any desired decorative effect or appearance, such as, for example, imitation marble, or the like. Members 10 and 14, particularly where they are to form part of a structural unit to be embodied in an inside wall or partition, may also be made of so-called plaster-board, maze-wood, fiber-wood, fiber-board, card-board, asbestos compositions, or any other appropriate or suitable material. They may also be made of sheet-rock or appropriately dimensioned slabs of natural stone.

It is to be understood, however, that the two outside members 10-14 of the structural unit need not be made of the same material; one of them may be made of one material and the other of any other material; likewise one of them may have permanently incorporated in its outside surface one decorative motif, tint, coloring, or the like, and the other member may have some other decorative motif, tint, coloring, or the like. Members 10 and 14 may thus be fabricated in standardized shapes and dimensions and it will be seen that they per se lend themselves readily to quantity production. In length and breadth they are dimensioned as earlier above indicated to correspond to the length and breadth of the ultimate building or structural unit; in thickness they may be any suitable dimension, on the order of 3/8" or 1/2", or thereabouts.

Members 11 and 13 are preferably of identical construction to facilitate quantity production thereof though it is to be understood that they may vary one from the other in various or desired particulars. As shown in Figure 3, however, they are geometrically substantially similar but, where they are to be assembled in the relation about to be described, one is reversed with respect to the other, as will presently become clear. In view of their similarity of construction, it will suffice to describe only one of the parts 11 and 13 in detail and hence detailed consideration may now

be given to member 11 of Figure 3, the detailed description of which is equally applicable to member 13.

Member 11 is preferably made of a motif or plastic material and is cast or pressed in a suitable mold having separable parts, each containing recesses and protrusions, the protrusions in the one entering but not filling the recesses in the other, resulting in the production of a shape like that of part 11, as shown in Figure 3.

Accordingly, it will be seen that the member 11 comprises in effect a sheet 15, the thickness of which illustratively may be on the order of  $\frac{1}{4}$ " or  $\frac{1}{2}$ ", or the like, depending upon the material employed, the sheet 15 extending completely from the left-hand edge of the member 11 to the right-hand edge thereof but waved, curved, corrugated, or zigzagged, or otherwise shaped as will be further described hereinafter. In Figure 3 the sheet 11 is shaped to provide a plurality of plane portions 15<sup>a</sup> lying in one plane and to provide a plurality of plane portions 15<sup>b</sup> preferably similarly dimensioned as the portions 15<sup>a</sup> but lying in a plane spaced from the plane of the latter, the portions in the respective planes being joined by inclined portions 15<sup>c</sup> and 15<sup>d</sup>. The spacing between the planes of the outer faces of the portions 15<sup>a</sup> and 15<sup>b</sup> may be on the order of 2", for example.

At the left and right-hand ends (the left-hand end in Figure 3 not being shown but being the same as the right-hand end), there is provided an end or edge portion 15<sup>e</sup>, integral, of course, with the sheet 15, but extending preferably at right-angles to the planes of the portions 15<sup>a</sup> and 15<sup>b</sup>; the vertical dimension of the portion 15<sup>e</sup> is, of course, and preferably, the spacing between the planes of the portions 15<sup>a</sup> and 15<sup>b</sup>. Preferably the edge portion 15<sup>e</sup> extends at right angles from one of the outside plane portions, such as a part of the endmost portion 15<sup>b</sup>.

At suitable intervals lengthwise of the channels formed between the connecting portions 15<sup>c</sup>—15<sup>d</sup> that are exposed upwardly, as viewed in Figure 3, I provide transverse ribs or web-like portions 15<sup>f</sup>, and similar webs at similar intervals are provided upon the under face of the member 11, as viewed in Figure 3, and preferably juxtaposed to the web members 15<sup>f</sup>; in the lower portion of Figure 3, where member 13 is shown and which is similar in construction as the member 11 but turned upside down, these bridging web members are better shown and they are indicated at 15<sup>g</sup>.

At the lower edge of member 11, the upper edge being broken away in Figure 3 but appearing as the lower edge in the member 13 in Figure 3 (it being remembered that member 13 is the same as member 11 only turned upside down), the upper web members 15<sup>f</sup> and the lower web members 15<sup>g</sup> are in alignment with each other and with the lower vertical end plane of the member 11 or 13.

The member 11 will thus be seen to be provided with numerous pockets P on each side thereof, the purpose of which will be later described.

As above stated, the member 11 and hence also the member 13, is preferably made of any suitable material capable of being readily molded. Such a material may comprise clay, cement, or like plastic materials that harden upon drying or upon being "fired", or it may be made of any of the moldable materials earlier above mentioned as illustrative of the materials of which

either or both of members 10 and 14 may be made. In any case, the member 11 is strong, durable, and light in weight, having cross-sections, virtually in any direction or plane, that are of structural shapes and adapted to meet or sustain stresses of compression, torsion, bending, or the like. Preferably, however, the member 11 is made of a fibrous material or composition the principal ingredient of which is straw, illustratively of the kind or character described in Patent 1,760,446 from which the manner of making this material and its facility of molding is sufficiently clear for illustrative purposes herein. That straw or fibrous material is very light in weight, is strong, fire-resistant, sound-proof, or sound-deadening, and is a poor conductor of heat.

Members 11 and 13, thus constructed, are given dimensions as to length and breadth commensurate with those of the outside members 10 and 14, and the four members 10, 11, 13 and 14 may now be assembled face to face. Member 10 and member 11 are alined with each other placed face to face so that the under face of member 10, as viewed in Figure 3, contacts with the portions 15<sup>b</sup> upon which, prior to assembly, I first spread a suitable adhesive which may take the form of any appropriate or suitable glue, cellulose compounds, rubber cements or the like. In similar manner, member 13 and member 14 may be assembled but with the upper face of member 14, as viewed in Figure 3, engaging the faces of portions 15<sup>b</sup> of member 13, with a suitable adhesive interposed therebetween.

By such assembly the pockets P in the upper face of member 11 (Figure 3) are closed and hermetically sealed by the member 10 and the downwardly facing pockets P of the member 13 are similarly closed and hermetically sealed by the member 14.

Members 11 and 13, with members or parts 10 and 14 respectively assembled thereto as just described, may now be secured to each other with the portions 15<sup>a</sup> of each secured together by an adhesive, as above-mentioned, but in making this assembly I prefer to interpose between the portions 15<sup>a</sup> of the two parts 11 and 13 the part 12 of Figure 3; part 12 is a relatively thin sheet illustratively of a thickness on the order of  $\frac{1}{8}$ " or so and is preferably made of a relatively strong fibrous material, illustratively fiber-board. Accordingly, in this preferred arrangement and still viewing Figure 3, the downwardly exposed faces of portions 15<sup>a</sup> of member 11 are secured as by the above-mentioned adhesive to the sheet member 12 and the upwardly facing portions 15<sup>a</sup> of the member 13 are secured to the opposite or under face of the sheet member 12.

With the interposing of the sheet 12, I cause the latter to close and seal the downwardly facing pockets P of the member 11 and the upwardly facing pockets P of the member 13 though I may, if desired, omit the member 12, in which case these pockets of the members 11 and 13 become nevertheless sealed by the adhesive though, by the omission of member 12, larger pockets are formed.

It is to be understood that the adhesive is applied not only to the outwardly exposed faces of portions 15<sup>a</sup> and 15<sup>b</sup> in the course of the above-described assembly, but also to the edges of the ribs or webs 15<sup>f</sup> and 15<sup>g</sup>, these edges lying in the plane of the faces of portions 15<sup>b</sup> and 15<sup>a</sup>, respectively. It is also to be understood that the above-described sequence of assembly need not be adhered to. For example, members 11 and 13 or

members 11, 12 and 13 may first be secured together and thereafter members 10 and 14 applied.

The resultant structural unit, disregarding for the present certain other features later described, is now ready for installation and, where it is to form a vertical wall portion as distinguished from a ceiling or floor portion, it is preferred to set the unit so that the portions 15<sup>a</sup> and 15<sup>b</sup> extend vertically and in such case, the resultant structural unit or the resultant wall made up of a suitable number thereof has a horizontal cross-section as appears better in the wall portion F of Figure 2.

Before considering certain other unique aspects of my invention, as thus far described, reference is now again made to Figure 2 in which, as above noted, I have shown also an outside wall assumed to be the wall C of Figure 1. In that wall C, as shown in Figure 2, there appear structural units G, H, I and J, and each is constructed of components such as those above described in detail in connection with Figure 3, though, to meet the greater requirements as to strength, weather-resisting characteristics, heat insulation characteristics, and the like, of an outside wall, I prefer, in construction of the structural or building units for the outside wall or walls to duplicate therein certain of the elements employed in the unit of Figure 3 and above described. Accordingly, and referring to Figure 2 and selecting illustratively the unit H, the member 10 thereof being the weather side of the wall, is made of any of the materials earlier above mentioned appropriate and suitable for weather-resisting exposure, whereas member 14 may be made of any such materials earlier above mentioned appropriate to give the inside wall of the room or building the desired characteristics, finish, appearance, or the like. Illustratively, as shown in Figure 2, the outside member 10 may be made substantially thicker than the inside member 14. Interposed between members 10 and 11 are two sub-assemblies or sub-units, each comprising the members 11, 12 and 13 of Figure 3 but having interposed between these sub-units or sub-assemblies a sheet member 12<sup>a</sup> which may have the physical and structural characteristics of the member 12 of Figure 3 though, illustratively, it may be thicker, as shown in Figure 2. Of course, it is to be noted that, in so far as certain features of my invention are concerned, and as already above indicated, the outside wall unit or units, such as the units H, need not embody the members 12 or 12<sup>a</sup> or may embody as many of them as well as of members like members 11 and 13 as may be desired.

Accordingly, the building or structural units will be seen to be capable of easy and rapid assembly and manufacture to meet varying requirements of practical use, it being noted that throughout standardized and easily and inexpensively constructable parts or materials are employed.

Furthermore, it is to be noted that I achieve great rigidity of construction accompanied by desirable lightness in weight. Heat transmission is effectively nullified or minimized due to the provision of the air cells, or air pockets, all sealed, these numerous cells giving a honeycomb effect, and due to the provision of the peculiar cross-section or cross-sections which, viewing the wall F or the wall C of Figure 2, will be seen to provide exceedingly circuitous or long paths of small cross-section for any possible flow of heat from the face of one member 10 to the face of the other member 14; to this heat insulation the pre-

ferred material above mentioned to be embodied in the members 11 and 13 is a contributing factor, being per se an exceedingly poor conductor of heat.

Furthermore, the resultant wall structure is substantially sound-proof, not only because of the sealed cellular structure thereof and other factors but also because of the character of the preferred material employed in the members 11 and 13, the preferred materials being also poor transmitters of sound.

Considering now the assembly of the structural units, reference may again be made to Figure 3 and particularly to members 10 and 14 thereof from which it will be seen, and also by reference to Figure 2, that the peripheral edges of these members are stepped as at S, preferably on all four sides in order that they provide tongues and grooves, as indicated at T in Figure 2, the one receivable within the other. Exact and precise mating of the units, in the course of their assembly, is thus achieved and speed and facility of wall building made possible, the joints being sealed or secured together by any appropriate cement, adhesive, glue, or the like.

Where the units are of substantial dimensions as to width and height (see Figure 1) it will be seen that, in spite of such dimensions and due to the structural features above explained and described, the individual units are still light in weight and may easily be handled manually, as, for example, by two men, and that accordingly, due to the ease of interfitting and the self-aligning features of the construction, the wall may be easily, inexpensively, but reliably built up.

In Figure 1 I have indicated at A the foundation upon which the outside walls B and C are to be laid. Accordingly, I may seat the structural units I, H, G, K and L, etc., directly upon the foundation A, interfitting the units along their vertical edges, and build, as indicated in Figure 1, the wall up by other units superimposed upon the bottom ones and interfitted by the tongue and groove connections T along the horizontal mating edges with the lower reach of units, and so on. Or, as already above indicated, the building units may be of a vertical dimension equal substantially to the height of the room or equal substantially to the spacings from floor to floor of the building.

Also, I prefer to provide what I may term base structure units, as indicated at M, N, O, P, Q, etc., in Figure 1. These units are constructed as was already above described, excepting that the inside member 14 thereof is shaped, molded, or otherwise formed to constitute the ultimate baseboard of the interior of the room, the units being tongued and grooved, being otherwise of a thickness like the units G, H, I, etc., but of a height commensurate with the height of the baseboard.

Preferably, and in order to achieve, where desired, certain other features of coaction, though not essential to the practical carrying out of certain features of my invention, I prefer first, still referring to Figure 1, to run a channel iron, of relatively light metal, along the top of the foundation A, securing it thereto as by bolts 21, with the webs 20<sup>a</sup> and 20<sup>b</sup> thereof projecting upwardly.

The parts 10 and 14 of such structural units, be they base units M, N, O, etc., or units like L, K, G, etc., or even units like those of the wall F of Figure 2, are, along their inside faces, grooved or recessed as is indicated in the lower right-hand part of Figure 1, to receive the webs 20<sup>a</sup>

and 20<sup>b</sup> of the channel 20, it being understood that these grooves may easily be molded or otherwise formed in the parts 10 and 14 during the construction of the latter, just as the stepped or recessed portions S (see Figure 3) that provide the tongues and grooves of the ultimate structure are formed.

Accordingly, the channel iron 20, once appropriately alined and secured to the foundation A, acts also automatically, to aline the structural units interfitted with its webs, appropriate cements, or the like, being employed, if desired, and thus greater ease of installation and alinement are achieved as well as greater rigidity of construction.

Likewise, and by similarly grooving the members 10 and 14 as, for example, of the units G, H and I of Figure 2, along their vertical edges, I may interpose, during the assembly of the units, vertical columns of I-cross-section, as indicated at 22 and 23 in Figures 1 and 2, the I-beams being suitably interfitted with the bottom channel 20 and secured thereto as by welding, bolting, riveting, or brackets, as is generally indicated at 24 in Figure 1. Thus, the I-beams, where employed, are completely embedded in the wall structure and take part, aside from the action of the tongue and groove connection between the units, in vertically alining the units as they are superimposed one upon the other.

Still referring to Figure 1, when an appropriate height of wall has been achieved, as, for example, the spacing between floor and ceiling, I run along the upper edge of the thus far constructed wall a channel 25 similar to the channel 20 above-mentioned but inverted, having its flanges or webs 25<sup>a</sup> and 25<sup>b</sup> directed downwardly and fitted into the grooves or recesses provided in the members 10 and 14. Channel 25, extending, like channel 20, throughout several or any suitable number of building units and along the edges thereof and interlocked therewith, thus assists, when employed, in maintaining the otherwise tongued and grooved units in appropriate alinement but I prefer to employ the channel 25 particularly for the purpose of distributing throughout the units of the wall thus far built and to transmit to the vertical columns 22, 23, etc., when and where the latter are employed, some of the load of the floor or ceiling beams, reference now being made to Figure 4 wherein two ceiling beams 26 and 27, as illustrative of a number thereof, are shown resting directly, upon the upper channel 25 and being secured thereto in any suitable manner, as by bolting, riveting, welding, or the like (not shown). It will be understood that, if desired, the upper channel member or members 25 (Figure 1) may be secured to the vertical columns 22, 23, etc., when the latter are employed, in any suitable manner (not shown), for example, in the same way as the lower channel member or members 20 are secured thereto as at 24 in Figure 1.

The beams 26 and 27 are preferably I-beams of a character generally similar to the I-cross-section columns 22, 23, etc. (see Figures 1 and 2) and they are spaced apart from each other by distances commensurate with the widths of building units like the units K, G, H, etc. so that units of this character, two of them being fragmentarily shown in Figure 4 at U and V, may be interlocked and interfitted with the webs of the beams 26—27, etc., just as the webs of the columns 22 and 23, etc. are interfitted (see Figure 2) with the structural units, as already above de-

scribed. And thus I build up the flooring or ceiling, it being noted in this connection that, as is better shown in Figure 4, the cross-sectional configuration of the unit provides, as already above indicated, arch-like or truss-like structures well adapted to resist the strains to which floorings are subjected.

Furthermore, the units that go into the flooring or ceiling may have their upper and lower members, corresponding to the members 10 and 14 already described, made of materials appropriate to their respective uses. For example, the lower member may be made of a material, as already indicated, to mate with or contrast with the inside material of the other building units that form the walls of the room in question. The upper member, in effect the flooring per se of the story above, may be made of a material such as cement, artificial stone, sheetstone, or any other material appropriate for direct use as a floor or flooring.

As already above indicated and pointed out, the interfitted joints of the various units are preferably also cemented by any suitable cement, adhesive, composition, or the like, and it will be seen that a building structure results of the highest sanitary order, being virtually vermin-proof.

It will also be seen that, if desired, the structural steel members, such as the channel irons and columns or like members that are employed when desired, may be of any desired weight or strength, depending upon such factors as the height to which the building is to be carried. When my structural units are employed particularly in home building, these structural steel members when employed can be of relatively light weight for, as will now be clear, the structural units employed according to my invention, are capable of such dependable interaction in the resultant wall structures that the coaction therewith of the structural steel members may be dispensed with or be made available to any degree or extent desired. Furthermore, it will be seen that it is also possible to carry the construction of walls and floors or ceilings along concurrently with the erection of the structural steel members when it is desired to embody the latter in the construction.

As earlier pointed out, the internal parts of the structural units may take shapes or forms other than those described in connection with Figures 2, 3 and 4 and several illustrative modified forms are shown in Figures 5—8 inclusive.

Turning now to Figure 5, there is there shown on a larger scale a portion of a building unit again embodying the members 10 and 14 above described in detail but in which the members 11 and 13 of Figures 2, 3 and 4, instead of having the sheet-like portion 15 thereof (see Figure 3) shaped as shown in Figure 3, are given the shapes, in cross-section, as shown at 11<sup>a</sup> and 13<sup>a</sup>, respectively, in Figure 5, the structure as to the cross-webs 15<sup>c</sup> and 15<sup>e</sup> of Figure 3 being the same in Figure 5. By the shape shown in Figure 5, I am enabled to utilize effectively the mechanical advantages of a true arch and I preferably embody also a member 12 like the member 12 of Figure 3.

In Figure 6 another possible construction is shown embodying again the outside members 10 and 14 and also members like members 11 and 13 but shaped in cross-section as shown at 11<sup>b</sup> and 13<sup>b</sup> in Figure 6, again preferably embodying therebetween the member 12. The structure of Figure 6 is otherwise the same as that of Figure 3.

In the structures of both Figures 5 and 6, many

of the mechanical and other features and advantages of the structure of Figure 3 are realized and achieved, and the sealed pockets or air cells likewise embodied therein. The members 11<sup>a</sup> and 13<sup>a</sup> of Figure 5 and 11<sup>b</sup> and 13<sup>b</sup> of Figure 6 may be easily molded or produced much the same as was described above in connection with the parts 11 and 13 of Figure 3.

In Figures 7 and 8 I have shown another possible form of structure in which there are again the members 10 and 14 but interposed therebetween is a cellular structure generally indicated at 30 and better shown in Figure 8, being made up of a series of members 31 substantially or broadly speaking corrugated much in the same manner as the parts 11, 11<sup>a</sup>, 11<sup>b</sup> and 13, 13<sup>a</sup> and 13<sup>b</sup> of Figures 3, 5 and 6, respectively, are shaped in cross-section, but are stacked one upon the other with intervening strips 32 of a material like that as employed in the member 12 of Figure 3, all of the parts 31 and 32 having a dimension in a direction at right angles to the plane of the paper as one views Figure 8 equal to the spacing between the outside and inside members 10 and 14 (see Figure 7), members 31 being preferably made, as by molding, of materials such as are used in making up the members 11 and 13 of Figure 3.

Accordingly, members 31 and 32 having been secured together by an adhesive, or the like, to form a unit section of length and breadth commensurate with those of the ultimate structural unit, such a unit section is interposed between the two members 10 and 14 (see Figure 7) and secured thereto as by such a cement or adhesive as above mentioned, members 10 and 14 closing and sealing the cells or pockets formed between the members 31, 32, 31, 32, etc., as seen in Figure 8.

Otherwise, as to the tongue and groove or other slotted or recessed relations, such as were above described in detail in connection with Figures 1-4 inclusive, it is to be understood that these structural features are also preferably embodied in the illustrative modifications or forms of Figures 5, 6, 7 and 8.

I have above described various possible materials of which either the outside or inside members or slabs (10 and/or 14 of Figure 3, for example, or of Figures 5-8) may be made, giving, as above indicated, a wide range of adaptability to meet the particular conditions met with in practice; it is to be understood, however, that either or both of these members or parts may be of composite construction. For example, I may carry the material of which parts 11 and/or 13 of Figure 3 may be made, such as the fibrous or straw material like that of Patent 1,760,446, in whole or in part into either or both of the outer members 10 and 14. The latter may be made entirely of such material or an inner thickness or layer thereof may be made of such material and the outer layer or thickness thereof of some other material, such as cement, glass, ceramics, etc. Furthermore, I may construct my building units with either or both of the outer members 10 or 14 given any suitable or appropriate rough surface appropriate for the reception of stucco, plaster, or the like. Or these members may be appropriately surfaced to receive a coat of paint or other finish, and for interior walls or partitions, these parts of the building units may be finished to receive a coat or layer of plaster, or finished to receive paint, or a layer of tile, or sheet marble, or paper, or textile, or other materials commonly employed for interior decoration, or even to re-

ceive and have applied thereto paneling of wood, composition, or other suitable material.

Where an inside wall or partition, such as the wall F of Figure 2, is to abut against another wall, be it an inside or an outside wall, illustratively the wall of Figure 2 made up of the building units J and I, I prefer to have the building unit or units which are to be abutted by the abutting wall F grooved so that the units of the abutting wall may be set into the groove, as is clearly indicated and shown in Figure 2 in which in that figure the abutting wall F happens to abut against the junction of the building units J and I, and accordingly I may pre-fabricate the latter units, as providing for complementary recesses or grooves G<sub>1</sub> and G<sub>2</sub>, in the members 14-14 thereof respectively, or these grooves may be formed in the building units in any other suitable or desired way.

Recurring for a moment to the optional feature above described according to which structural steel members may or may not be employed in conjunction with my building units, it is to be noted that, where such structural steel members are employed, they are, as appear particularly from Figures 1, 2 and 4, effectively and dependably encased or enclosed by the building units with or without the use of a cement, adhesive, or the like, and they are thus dependably protected against exposure and the effects thereof of the elements. Note, for example, how the columns 22 and 23 (Figures 1 and 2) are effectively buried in the construction and the particular interlocking or interengaging relations of the columns with the building units together with the specific I-cross-section of the columns are to be understood as merely illustrative of one of various possible modes of carrying out these features while retaining the broader features and aspects of my invention.

Recurring now to Figure 2, it will be noted that, if the horizontal end webs (see the parts 15<sup>a</sup> or 15<sup>b</sup> of Figure 3) are broken out, cut-away, or omitted, uniformly throughout the air pockets or sealed air cells that are aligned not only in any given structural unit but also throughout the other structural units that may be aligned therewith, there is provided a continuous channel or passage running vertically of the wall and accordingly I am enabled to utilize such a continuous passage for the accommodation of electrical circuits, conduits, piping, such as is used for heating, water supply, etc., or other plumbing. I may, therefore, when molding the parts 11 or 12 of Figures 3, 5 and 6 omit the cross-webs 15<sup>a</sup> or 15<sup>b</sup> in any one channel or run, illustratively as indicated in Figure 3 at W, in the part 11, thus providing a continuous vertical channel as at the points X in Figure 2.

Such channels or runs, thus provided, may be utilized not only for purposes above noted, but also they may be utilized to function as conduits per se and in this connection it is to be noted that certain unique advantages are achieved. Where utilized as such channels or conduits and particularly where the material employed in making up the member or members such as members 11 and/or 13 of Figure 3 out of which the walls of the resultant conduit are formed, is a good heat insulator or a low or poor conductor of heat, I prefer to utilize such conduits for the transmission therethrough of conditioned air, as from a central air conditioning or heating or cooling plant.

And because of the material forming the walls 75

of such a continuous conduit, it being understood that I may break away or omit portions of the member 12 where desired thereby to increase the size of the conduit, I may with great efficiency effect a distribution of conditioned air throughout the building, and do so without necessitating special or additional piping, the continuous conduits being tapped in any suitable manner as by providing appropriate openings in the outer members of the building units for the emission of the conditioned air or for the connection thereto of pipes or conduits. Thus cooled air may be transmitted without the acquisition thereof of heat and heat may be transmitted without the loss therefrom of heat.

Thus, it will be seen that there has been provided in this invention a building construction and structural unit in which the various objects hereinbefore noted, together with many thoroughly practical advantages, are successfully achieved. It will be seen that the units are capable of standardized manufacture in quantity production, may utilize inexpensive materials, yet result in permanence, strength, and durability of construction, not to mention again the facility and inexpensiveness of erection. Moreover, it will be seen that numerous thoroughly practical advantages, some of which have been pointed out above, may be realized effectively.

As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth, or shown in the accompanying drawings, is to be interpreted as illustrative and not in a limiting sense.

I claim:—

1. In construction of the character described, in combination, a building unit of substantial length and breadth and comprising two spaced outer sheet-like members of suitable material, and a plurality of intervening otherwise open-pocketed members respectively secured to each other and to said outer members, thereby to close the pockets and form sealed air cells, one or more of said intervening members being made of a material that is a poor conductor of heat.

2. In construction of the character described, in combination, a building unit of substantial length and breadth and comprising two spaced outer sheet-like members of suitable material, means intervening said two spaced members and made of sheet-like material but repeatedly reentrant, thereby to form open pockets, and means including cement means and said first two members for securing said members and said means together and for closing and sealing said pockets.

3. A construction as in claim 2 in which the intervening means comprises a plurality of repeatedly reentrant means related face to face to each other and to the first two mentioned members and having additional sheet-like means intervening adjacent reentrant means and secured thereto.

4. In construction of the character described, in combination, a building unit comprising a sheet-like material to form one face of said unit and having secured thereto means of plastic fibrous material molded to form a plurality of intervening sealed air pockets in substantially honeycomb formation.

5. In construction of the character described, in combination, a wall including a structural steel member and building units for interrelation

with said structural steel members, each of said units having two spaced sheet-like members of commensurate area and means of molded fibrous material having the characteristic of being a poor heat conductor intervening said two spaced members and rigidly connected thereto, said units having along certain edges thereof grooves for the reception of flanges of said structural steel member and said intervening means being dimensioned to accommodate at least a portion of the web of said structural steel member.

6. In construction of the character described, in combination, a wall or the like made up of at least one structural steel member and a plurality of building units each comprising two spaced members of rigid material with means for holding the spaced members in spaced relation, said spaced members and said holding means being shaped at certain of their edges to provide, when said units are assembled edge to edge by way of said edges to form the wall, interfitting tongue-like and groove-like parts, and having certain other of their edges shaped to interfit with a face of said structural steel member.

7. In construction of the character described, in combination, a wall or the like made up of a plurality of building units each comprising two spaced members of rigid material with means for holding the spaced members in spaced relation, a member of structural steel cross-section and having flanges but dimensioned to be of lesser thickness than the thickness of said wall, and means provided in edge portions of said building units for the reception of the flanges of said member.

8. In construction of the character described, in combination, a building unit comprising a sheet-like member of substantial length and breadth having related to at least one side thereof a member made of sheet-like material molded or formed to provide a plurality of pockets, some of which face toward and are closed by said first-mentioned member and others of which face away from the latter.

9. A building unit as in claim 8 in which the pocketed member, along a cross-section thereof, has the bottoms of one series of pockets in one plane and the bottoms of the oppositely facing pockets in another plane.

10. A building unit as in claim 8 in which the pocketed member has related to it means providing the other face of the unit for closing the oppositely facing pockets.

11. A building unit as in claim 8 in which the pocketed member has secured to its side opposite that of the first-mentioned member means, such as relatively thin fiber-board, of good tensile strength, for closing the oppositely facing pockets.

12. In construction of the character described, in combination, a plurality of members of I-cross-section extending in spaced relation but substantially parallel to each other, and a plurality of building units closing the spaces between said members and interengaged with the flanges of the latter, said building units having means overlapping the longitudinal faces of said members whereby the latter are substantially completely embedded in or enclosed by said building units.

13. A construction as in claim 12 in which the means that overlaps the outer faces of the said members in each building unit comprise two correspondingly spaced parts of slab-like material

with means of cellular construction intervening them.

14. A construction as in claim 12 in which the means that overlaps the outer faces of said members in each building unit comprising two correspondingly spaced parts of slab-like material having therebetween means of cellular construction that comprises a molded or preformed fibrous material.

15. In construction of the character described, in combination, a wall made up of a plurality of building units having extending along an edge thereof a channel-cross-sectioned member, said units each being made of two spaced members of rigid material and means for holding them in spaced relation, the end course of building units having longitudinal and spaced recesses extending therealong to receive the flanges of said channel-cross-sectioned member.

16. In construction of the character described, in combination, a wall or the like made up of a plurality of building units each comprising two spaced members of rigid material with molded means of low heat conductivity for holding them in spaced relation, a member of structural steel cross-section extending along the upper edge of said wall and having at least one downwardly directed flange and interfitted with all of the building units for aligning the latter and for distributing throughout them the load carried by said wall.

17. A construction as claimed in claim 16 in which the load carried by said wall is a ceiling or floor construction, said construction comprising horizontally extending but laterally spaced beams resting at one end upon said structural steel member, said beams being flanged, and a plurality of floor and ceiling units each extending between two adjacent beams and interlocked with the flanges thereof.

18. In construction of the character described, in combination, a building unit of substantial length and breadth and comprising two spaced outer sheet-like members of rigid material and means secured thereto and holding them in spaced relation comprising a sheet-like material that is repeatedly reentrant, simulating corrugations, and having means sub-dividing the channels in said sheet-like material, thereby forming out of the latter a plurality of pockets.

19. A construction as claimed in claim 18 in which the bases of the channels in said reentrant sheet-like material have external faces substantially flat, and means coacting between said flat faces and said spaced members for holding them in assembled relation to said reentrant means.

20. In construction of the character described, in combination, a building unit of substantial length and breadth and comprising two spaced outer sheet-like members of rigid material and means secured thereto and holding them in

spaced relation comprising a plurality of means of sheet-like material of low heat conductivity, each of said means being repeatedly reentrant, means securing said means together, and means securing each of said outer members to one of said reentrant means.

21. In construction of the character described, in combination, a building unit of substantial length and breadth and comprising two spaced outer sheet-like members of rigid material and means secured thereto and holding them in spaced relation comprising a means of relatively small thickness and of a material of low heat conductivity bridged between said two outer members but shaped so that any possible path of heat flow from one outer member to the other through said intervening means is longer than the smallest spacing between said two outer members.

22. A construction as claimed in claim 21 in which the intervening means has portions forming a plurality of sealed air cells.

23. In construction of the character described, a building unit comprising two spaced outer sheet-like members of suitable material with means intervening said two spaced members and holding them in spaced relation, said intervening means comprising a plurality of relatively thin members made of a material of low heat conductivity and extending substantially parallel to said outer members, said members each providing a plurality of open pockets on one side thereof and a plurality of open pockets on the other side thereof, and means securing all of said members together, each outer member closing the otherwise open pockets facing toward it in the relatively thin member next adjacent to it.

24. A construction as claimed in claim 23 in which the intervening members of material of low heat conductivity are molded out of a plastic fibrous material.

25. A construction as claimed in claim 23 in which the means which secures two intervening members of low heat conductivity together comprises sheet-like means extending substantially parallel to said outer members and closing off the otherwise open pockets of said intervening members on one side of the latter.

26. A construction as claimed in claim 23 in which the intervening members are at least four in number and form, in between said outer members, a relatively thin-walled-honeycomb-like structure.

27. A construction as claimed in claim 23 in which the intervening members are at least four in number and in which there is provided, extending between two adjacent intervening members, a relatively thin sheet-like member secured to both and closing off the contiguous pockets in each.

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