Sept. 23, 1941. C. F. DAVIS 2,257,001

BUILDING UNIT AND CONSTRUCTION

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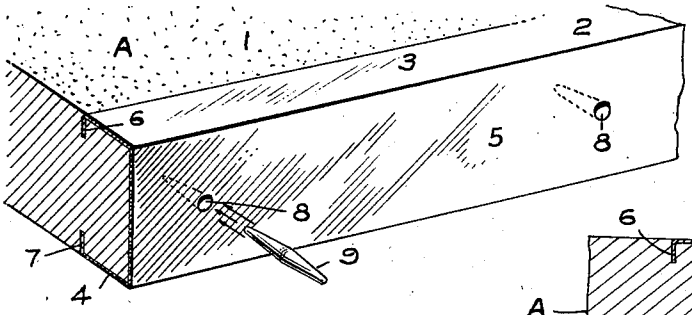
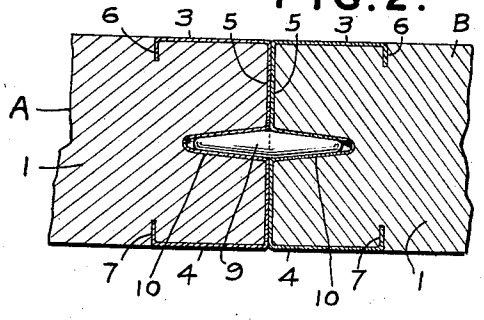


FIG. 1.

FIG. 2.



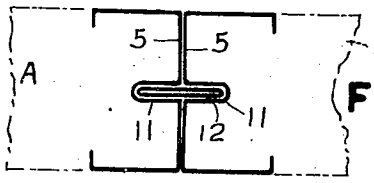


FIG. 3.

FIG. 4.

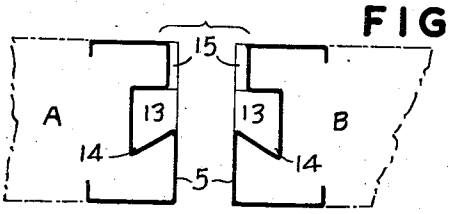
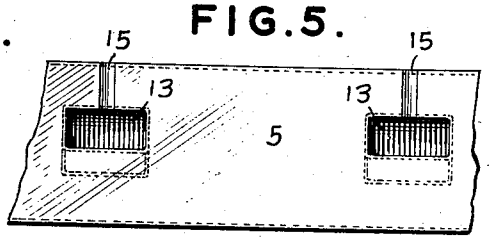


FIG. 5.



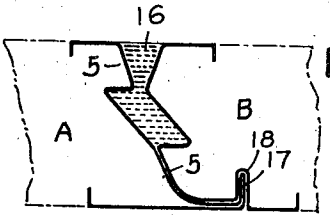


FIG. 6.

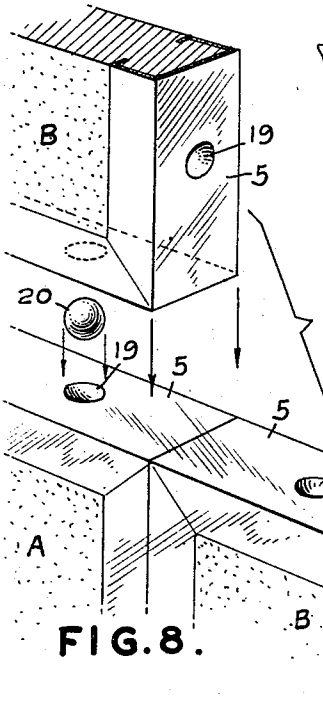


FIG. 8.

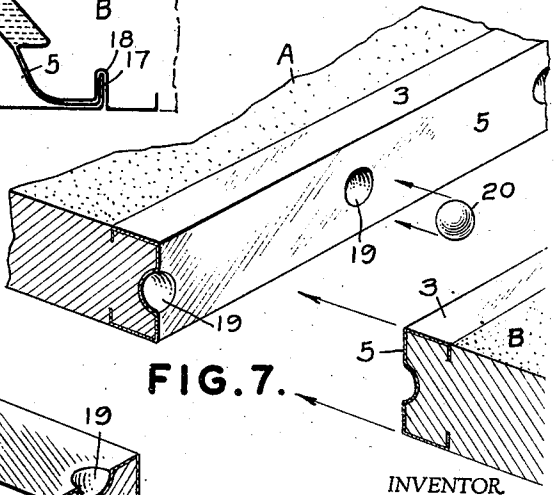


FIG. 7.

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BUILDING UNIT AND CONSTRUCTION

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FIG. 9.

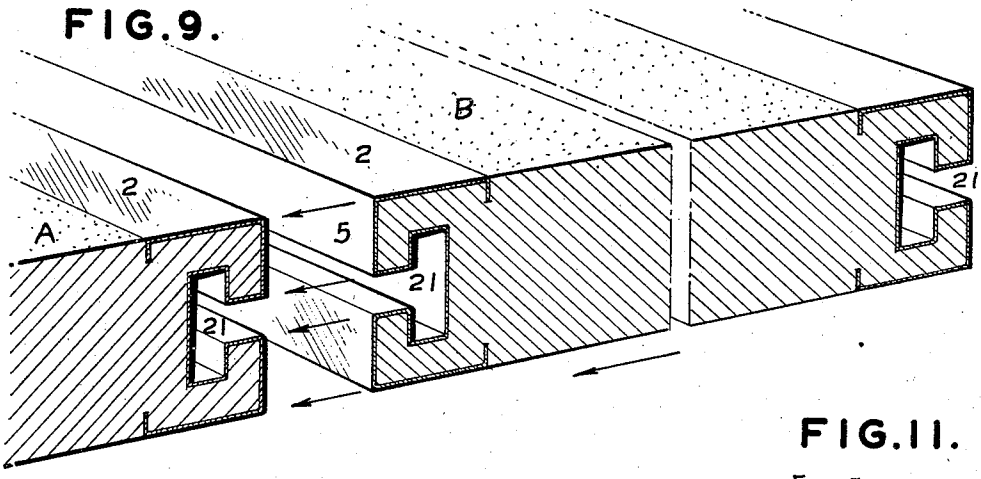


FIG. 10.

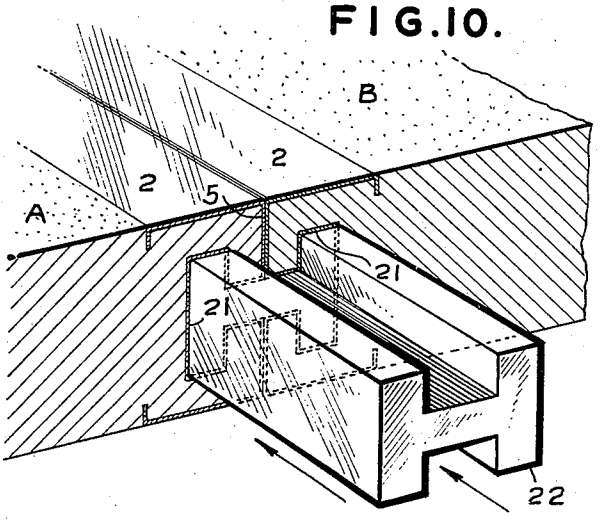


FIG. 11.

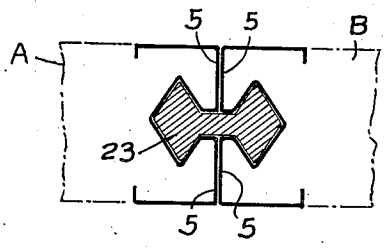
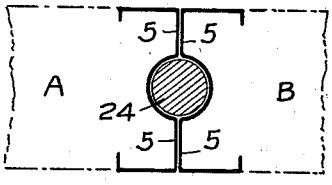


FIG. 12.



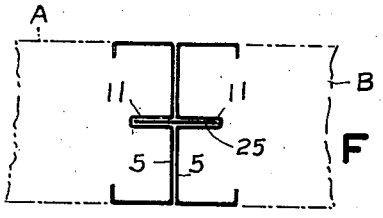
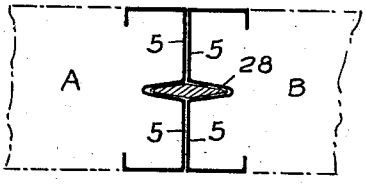


FIG. 13.

FIG. 15.



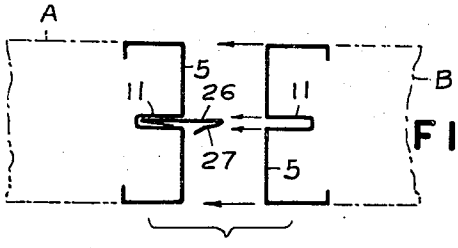


FIG. 14.

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FIG. 16.

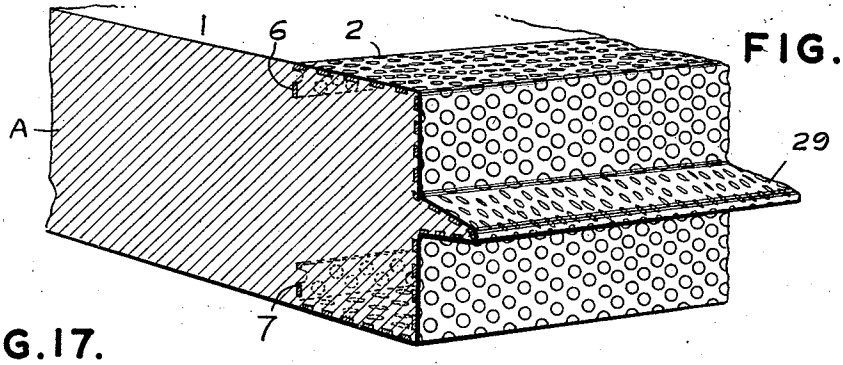


FIG. 17.

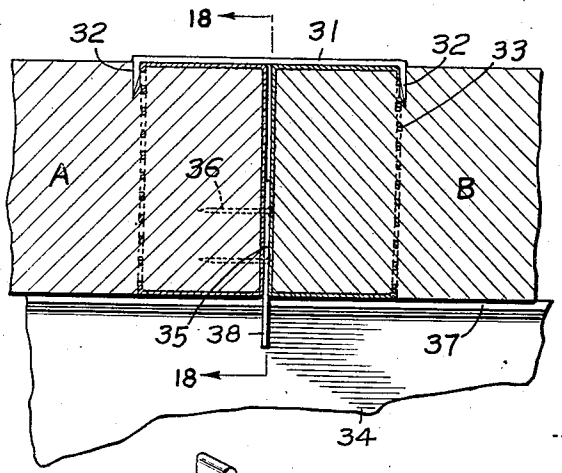


FIG. 18.

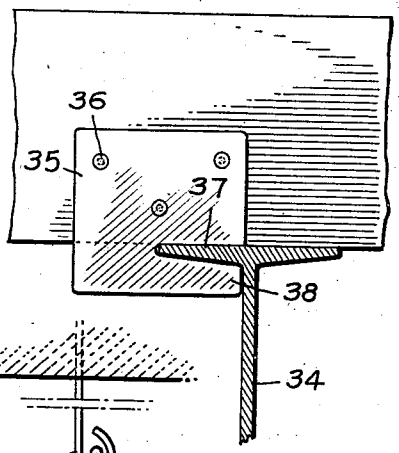


FIG. 19.

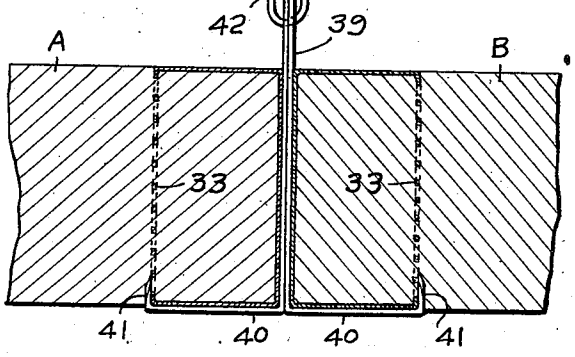


FIG. 20.

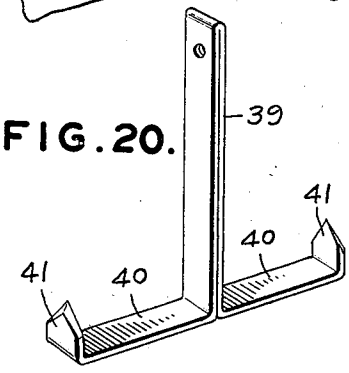
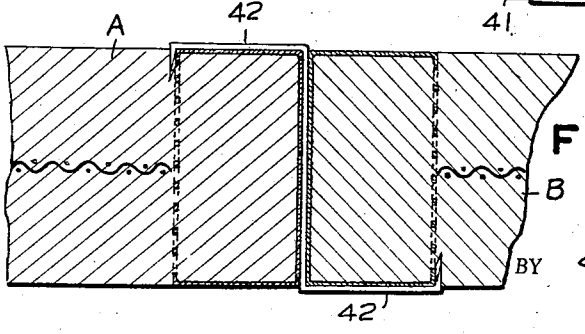


FIG. 21.



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FIG. 22.

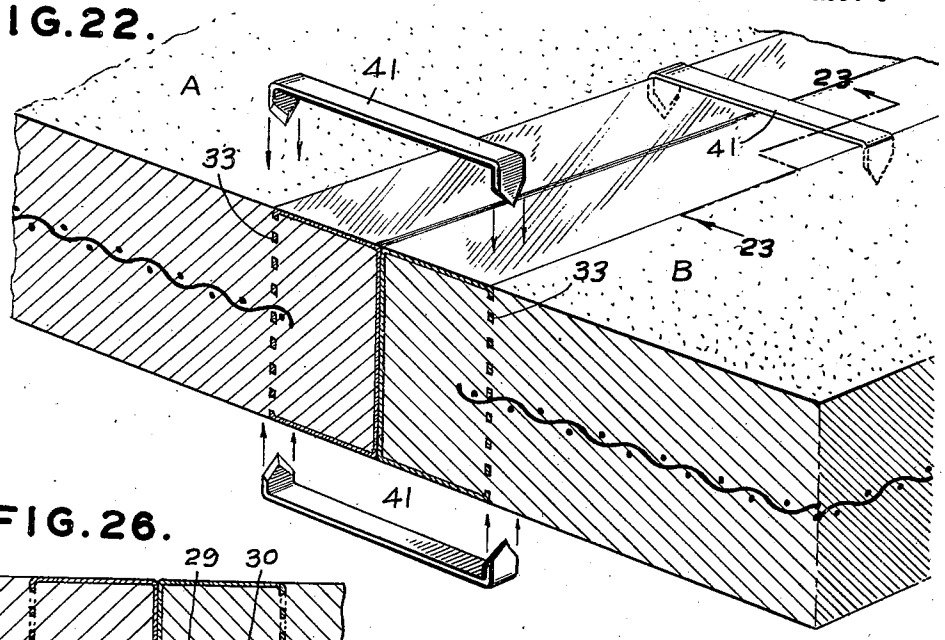


FIG. 26.

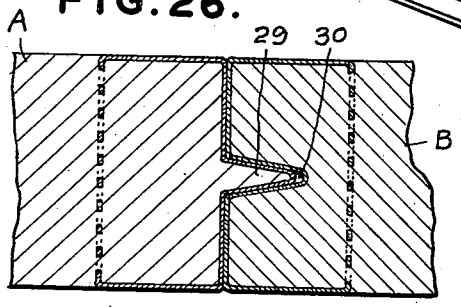


FIG. 23.

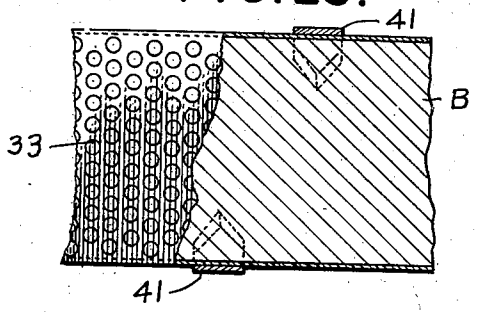


FIG. 24.

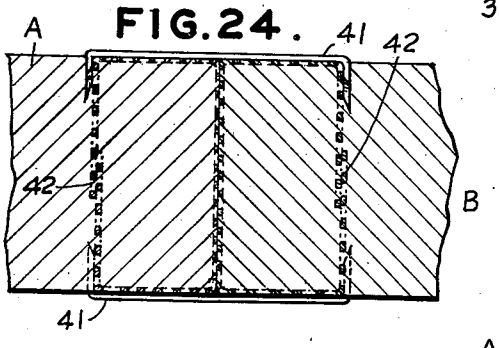


FIG. 27.

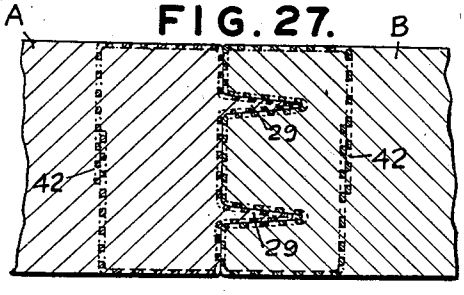
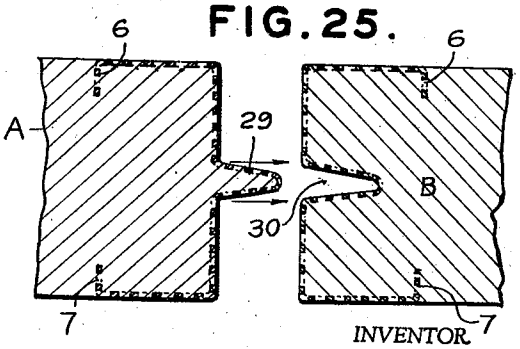


FIG. 25.



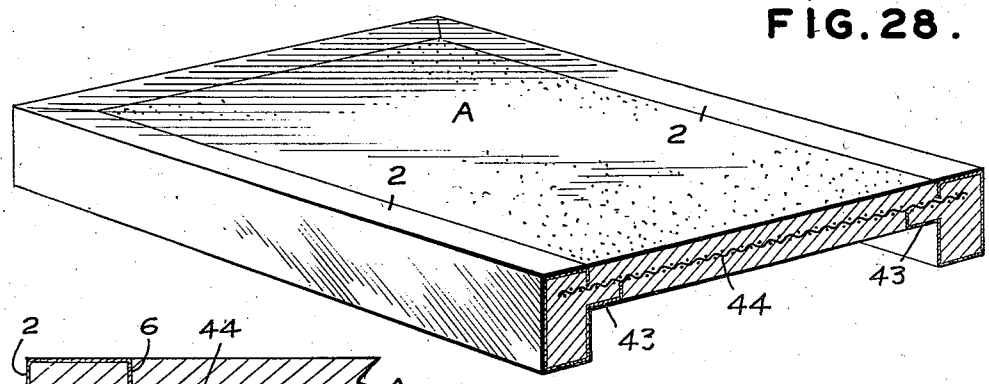
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FIG. 28.



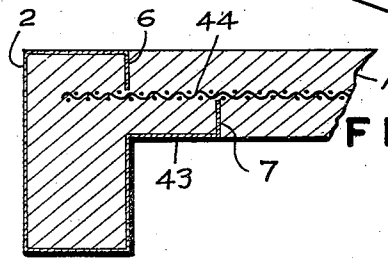
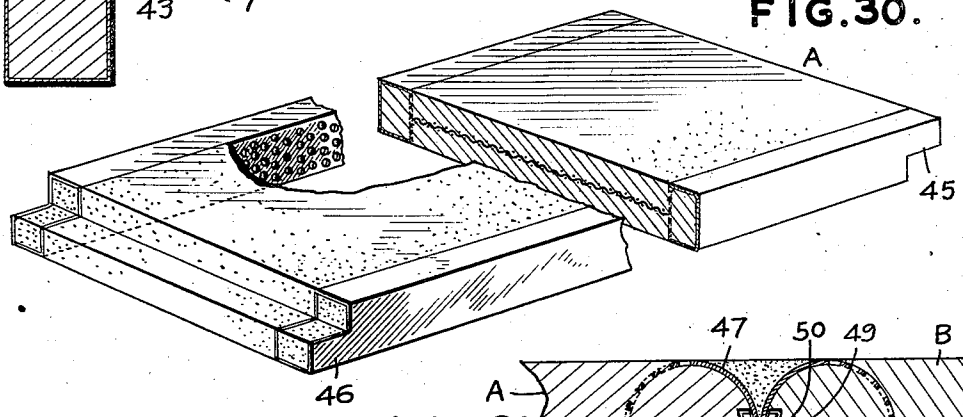


FIG. 29.

FIG. 30.



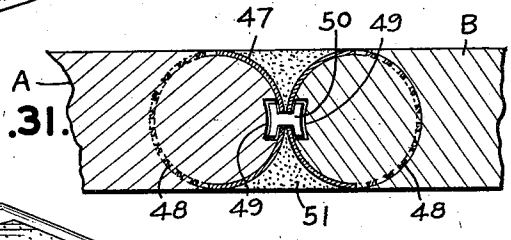
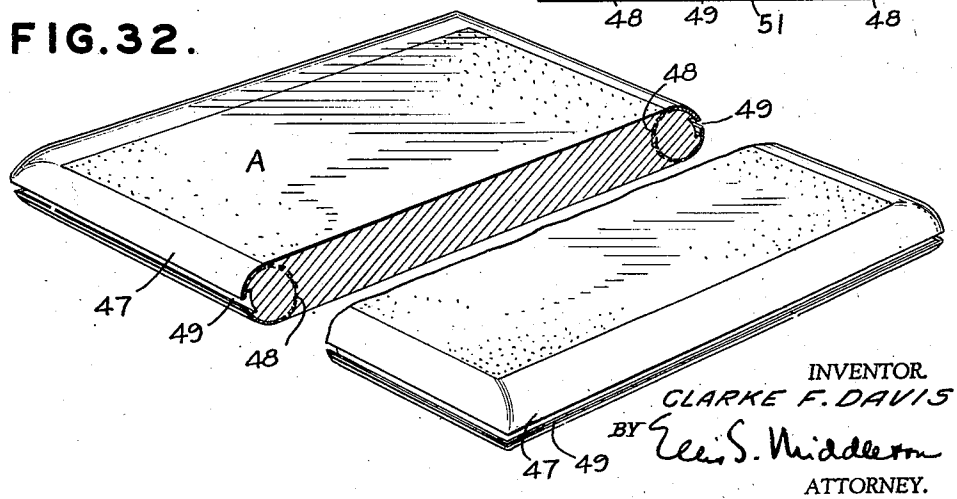


FIG. 31.

FIG. 32.



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FIG.33.

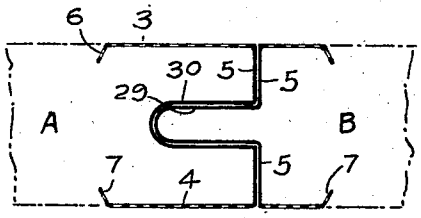
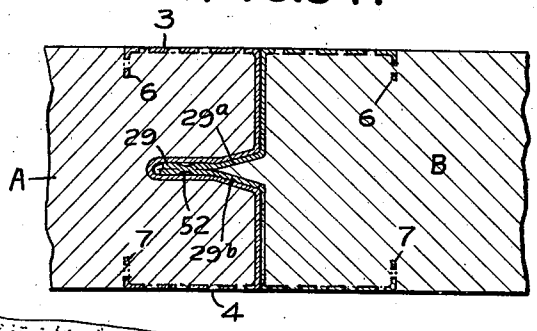


FIG.34.



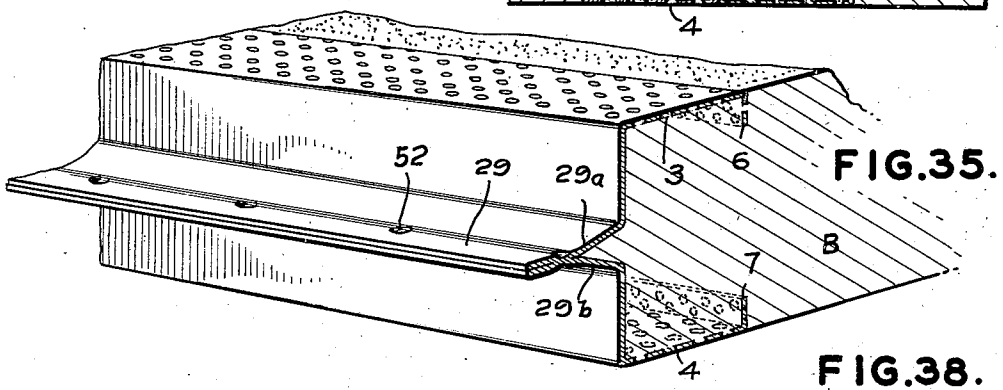


FIG.35.

FIG.36.

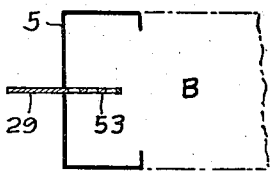


FIG.37.

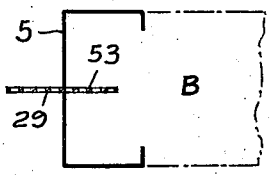


FIG.38.

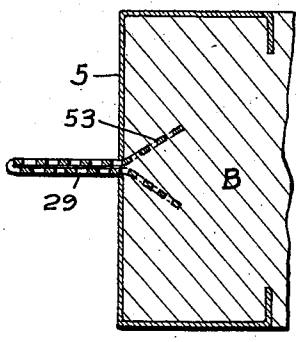


FIG.40.

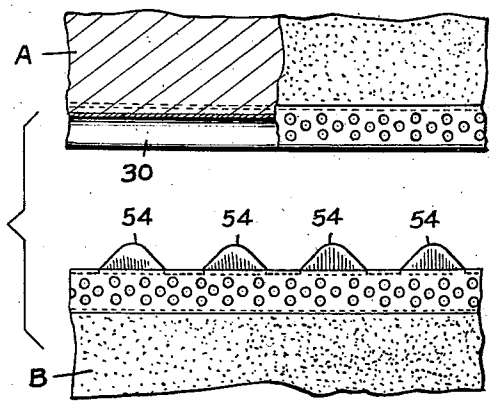
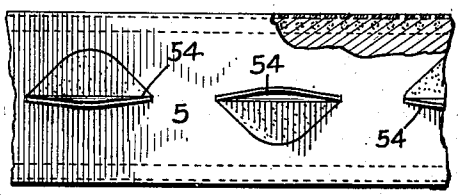


FIG.39.



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Patented Sept. 23, 1941 2,257,001

UNITED STATES PATENT OFFICE

2,257,001

BUILDING UNIT AND CONSTRUCTION

Clarke F. Davis, Short Hills, N. J., assignor to American Cyanamid & Chemical Corporation, New York, N. Y., a corporation of Delaware

Application December 31, 1937, Serial No. 182,728

5 Claims. (Cl. 72—68)

The present invention is concerned with a building unit and a building construction involving such unit. The subject matter of the invention is related to that disclosed in co-pending application Serial No. 632,909 filed September 13, 1932.

Building constructions of today include many types of materials for floor and roof decks, partitions, walls, ceilings and the like, but as far as I am aware, no type of construction has been designed which can equal wood in cheapness of initial cost, flexibility of application and ease of erection. The use of wood, however, in many situations is objectionable from various standpoints, the principal one being that it is readily combustible and involves, therefore, a fire hazard which makes its use prohibitive in many circumstances. Another objectionable feature of wood is that, unit for unit, it does not have the structural strength of metal and, as a result, if requisite strength is to be secured, such elements, if of wood, must be of such size and weight as to be prohibitive in cost and difficult to handle, which of course adds materially to the cost of erection. Moreover, wood is subject to deterioration. All of the above necessarily classifies wood as an undesirable building material when viewed from these aspects, although it does have many desirable characteristics, as above outlined.

The principal object of this invention, therefore, is to design a building unit which may be handled in the same manner as wood lumber or beams, which is fireproof or semi-fireproof, which is not subject to deterioration, and which, through properly designed units, may be made to sustain loads and stresses far greater than anything possible with a wood construction of the same dimension.

Other specific objects of the invention reside in the provision of a building construction which will involve building units comprising slabs having a set cementitious body as of gypsum, concrete or combinations thereof, with or without fillers, the composition of the body being essentially nailable and having applied to one or more edge portions thereof a metallic element which will primarily serve to lend a strength to the composite unit and construction involving it over and above that which the unit and construction would have without such metal element. This last named element also serves the function of a carrier for means whereby two adjacent slabs may be connected together. It is contemplated that the metal element will be of such a gauge that it may be readily severed, thus making it possible to use such units in their full or partial lengths, thus lending considerable flexibility in their application.

The present invention is further particularly concerned with the provision of precast slabs having the said metal edging provided with perforations in all or certain areas so as to permit the cementitious body, when poured, to penetrate and extend through the perforations, thus bonding the metal edging to the body when the cementitious material sets. In some instances, the thus perforated metal element, when applied to opposite edges of a slab, may contain integral tongues and grooves substantially complementary to each other or the interlocking means between slabs may constitute separate elements.

The invention further contemplates modifications wherein separate connecting members may be used between metal edges to produce the effect of tongues and grooves. Such connecting members may be effective to prevent relative movement between slabs in a lateral direction, a longitudinal direction or a direction perpendicular to a slab face or any or all of them.

Obviously the invention contemplates the use of such slabs as walls, floors, roofs, ceilings or other constructions and may include the necessary interior reinforcements such as rods, mesh, structural shapes or the like, wherever additional load sustaining strength is necessary.

The invention further consists in the novel arrangement, combination and construction of parts more fully hereinafter described and shown in the accompanying drawings. In the drawings:

Fig. 1 is a perspective view of a slab having a metal edging showing the manner of application thereto of a dowel-like connecting means;

Fig. 2 is a sectional view of a modified form using dowels;

Fig. 3 is a sectional view through the joint involving a spline;

Fig. 4 is a sectional view of a joint involving the use of grout or other joining material applied in liquid or plastic form capable of solidification;

Fig. 5 is an edge view of one of the slabs of Fig. 4;

Fig. 6 is a sectional view of a joint of the general type of Fig. 4 showing also an interlock between metal parts;

Fig. 7 is a perspective view showing the method of assembly of two slabs using a ball as the interengaging means;

Fig. 8 is a perspective view showing the modification of Fig. 7 in a slightly different application;

Fig. 9 is a perspective view of a modified splined joint;

Fig. 10 is a perspective view showing the method of application of the spline of Fig. 9;

Fig. 11 is a sectional view showing the use of a modified spline;

Fig. 12 is a sectional view showing the joint in which the connecting means comprises a cylindrical element;

Fig. 13 shows another form of joint in which the connecting member is of single thickness in contradistinction to that of Fig. 3;

Fig. 14 is a view of a modification of the joint of Fig. 13;

Fig. 15 illustrates another type of splined joint;

Fig. 16 is a perspective partly in section of a slab having one edge encased in a metal element having a perforated area;

Fig. 17 is a sectional view of a joint involving slabs having a perforated metal edging with a separate connecting member and means to attach these slabs to a supporting member;

Fig. 18 is a view along the line 18—18 of Fig. 17;

Fig. 19 is a sectional view showing a method of using the slabs of Fig. 17 to form a ceiling;

Fig. 20 is a perspective view of the hanger of Fig. 19;

Fig. 21 is a sectional view showing a modified way of joining the slabs of Fig. 17;

Fig. 22 shows a building construction using the slabs of Fig. 21 joined as by the connecting means of Fig. 17;

Fig. 23 is a sectional view along the line 23—23 of Fig. 22;

Fig. 24 is a sectional view showing a slightly modified form of perforated metal edging with the joining means of Fig. 22;

Fig. 25 is a sectional view showing the manner of making the joint using a slab of Fig. 16;

Fig. 26 shows a slightly modified metal edging tongued and grooved in a manner similar to Fig. 25;

Fig. 27 shows still another form of metal edging using multiple tongues and grooves;

Fig. 28 is a perspective view of a slab having a greater edge thickness than that at the center, two of such slabs being adapted to be secured together as by means shown in Figs. 17, 21 or 22;

Fig. 29 is an enlarged sectional view of the edge portion of the slab of Fig. 28;

Fig. 30 is a perspective view partly in section of a slab similar to that of Fig. 17 with shiplapped ends.

Fig. 31 is a sectional view of a modified slab in which the edge member takes the form of hollow cylindrical elements;

Fig. 32 is a perspective view partly in section of one of the slabs of Fig. 31;

Fig. 33 is a view showing a modified form of tongue and groove over that of Fig. 25;

Fig. 34 shows another form of tongue and groove;

Fig. 35 shows an enlarged perspective view of the tongued slab of Fig. 34;

Fig. 36 is a view showing a modified form of tongue;

Fig. 37 shows still another form of tongue;

Fig. 38 shows still another form of tongue;

Fig. 39 is an edge view of a slab having spaced apart punched out tongues; and

Fig. 40 is a plan view of a slab having the tongues of Fig. 39 in combination with a slab having a complementary groove.

In the drawings, many figures show the metal element and slab outlined as a single line for ease of illustration. It is to be understood, therefore, that the parts fit closely together with no space in between unless otherwise indicated in the description.

In Fig. 1, a slab is shown at A having a body 1 of a suitable set cementitious material of which gypsum is typical. It may contain the usual fillers, such as fibre, wood chips or the like. While gypsum has been found to be advantageous because of its lightness, yet where greater strength is desired in the slab body itself and weight is of no consideration, this body may obviously be made of other materials such as concrete, magnesium oxychloride or sulphate cements or the like.

As shown, at least one edge of each slab is provided with a metal element designated generally at 2 embracing the edge of the body 1 and having its end portions folded back to form top flange 3 and bottom flange 4 with a central vertical web portion 5. The flanges 3 and 4 have their ends 6 and 7 preferably turned inwardly into the body 1 so as to firmly bond the edge members to the slab body. In most cases, the metal members on abutting edges of two slabs are either similar or of complementary configuration.

Fig. 1 shows the vertical web portion 5 of the metal element 2 provided with apertures 8 adapted to receive one or more dowel pins 9 inserted through the aperture in the direction of the arrows, the end of the pin being in contact with the body material 1, substantially half of the pin projecting on each side of the web portion 5. It will be obvious, therefore, that if an abutting slab edge is provided with a similar apertured metal element, that the two slabs will be secured together by means of the pins 9 in somewhat the manner shown in Fig. 2.

Where the body material 1 is of a fragile composition such as gypsum or the like, the fact that the pin 9 passes through the metal web 5 is of particular advantage as the metal lends strength and support to the slab where stress is transmitted to the pin which would not be otherwise true. Also because the web 5 is a part of the element encasing the edge of the slab A and is securely fastened thereto makes for strength and rigidity which could not hope to be secured without these parts.

Fig. 2 shows a slightly modified form of locking means over and above Fig. 1 in that instead of a simple aperture in the web 5 as in the former case, the actual metal of the web has been upset in a rearward direction to form a metal socket 10. A similar socket 10 also appears in the metal element attached to slab B. This makes for a very strong construction.

In Fig. 3, web 5 of the metal elements attached to slabs A and B are provided with substantially similar grooves 11 within which is located a spline 12 preferably made of a piece of metal folded upon itself so that upon being tightly fitted into the grooves 11, the desired degree of rigidity will result.

In Figs. 4 and 5, the vertical web 5 is provided with spaced apart depressions 13 having a downwardly extending portion 14 with a two-part funnel hole 15 so that when the two slabs are put together a liquid or plastic joining material may be poured through the hole 15 to fill the cavity 13 and solidify thereupon firmly affixing the two

parts together. This cementing or affixing material may be such substances as grout, fused metal, resins or the like.

In Fig. 6 a somewhat similar construction is shown, the solidified joining agent being indicated at 16. In this figure, however, and in order to prevent relative lateral movement between the slabs A and B, the metal element on slab B is provided with an upturned tongue 17 received within a corresponding groove 18 in the metal element on slab B.

Figs. 7 and 8 illustrate a method of aligning or affixing together two slabs by means of spherical bodies, the vertical webs 5 and the metal elements on each slab being provided with sockets or depressions 19 adapted to receive a ball 20. This depression 19 may actually be deformed in the web 5 as shown in Figs. 7 and 8 or, on the contrary, may simply be an aperture in the web 5 as in Fig. 1 in which event that portion of the ball 20 passing through the aperture will be in contact with the body of the slab. The ball 20 may be of rigid material such as steel, plaster, terra cotta, marble or the like or it may be of a substance capable of some deformation such as a rubber composition. In the latter event, a distinct wedging effect may be secured between the part. In any event, it will be apparent that the ball 20 definitely aligns the two slabs into their proper position and prevents relative movement between the parts in a direction perpendicular to the slab face.

Fig. 7 shows the two slabs A and B in more or less horizontal position while Fig. 8 illustrates a form in which such ball positioning devices are arranged on slabs located more or less vertically and on more than one edge thereof.

Fig. 9 shows the slabs A and B provided with metal elements 2 on opposite edges thereof, the webs 5 of each of said parts being provided with substantially similar grooves 21 of T-formation and adapted to receive the H-shaped spline 22 as shown in Fig. 10.

In Fig. 11, a spline 23 is shown of slightly different configuration, the other parts being substantially the same.

Fig. 12 shows a modification somewhat similar to that of Figs. 7 and 8 except that the separate interlocking device comprises a cylindrical element 24 of any desired material or extent.

Fig. 13 shows a particularly desirable combination of parts in which the metal elements on each A and B are provided with longitudinally extending grooves 11 formed in the web portions 5. The spline 25 may be of a single thickness of metal if this metal is deformed or bent even to the slightest extent. When the two slabs are pushed together, any unevenness in the spline will cause the same to be very securely fixed into the grooves 11, thus making accidental separation of the slabs A and B practically impossible.

In Fig. 14 a more or less spring interlock is illustrated by providing a spline 26 of spring sheet metal with bent over end portions 27 adapted to engage substantially similar grooves 11 in the web portions 5. This is also of advantage in view of the fact that the actual end of the turned over portions 27 of the spline will have a tendency to dig into the engaged portions of the metal constituting the grooves 11 and thereby overcome any tendency for slab separation.

On the other hand, an elongated spline of any suitable material having tapered edge portions is shown at 28 in Fig. 15 which is also an effective means for securing the two slabs A and B together.

In Fig. 16, there is shown a slab A in which the metal element 2 encasing the edge portion of the body 1 is made of perforated metal having a projecting tongue 29 adapted to be received within a complementary groove 30 on the slab B (Fig. 25) in a tight frictional joint. It has been found that such a construction is particularly effective not only from the standpoint of strength, ease of handling and security of the joint between the slabs, but also because in many instances such perforated metal may be bought as scrap from other industries, such for instance as that normally discarded from the rubber heel industry where nail washers have been punched from sheets. This, of course, is but one instance of the source of the material. Another particular advantage in the use of perforated metal is that when the plastic material of which the body of slabs A and B is made is poured into the mold including the edge members, the plastic material flows through the apertures and thereby firmly bonds the edge members to the body.

One of the difficulties encountered in the field in applying plaster or other finish directly over the joint, for instance of the type shown in Fig. 2, is that it is not always possible to secure a firm bond between such overlaying plaster and the metal flanges 3. However, in the case of Figs. 16 and 25, any overlaying plaster is very definitely bonded to that part of the cementitious body 1 which projects through the perforated metal. This advantage is also true, of course, with the other forms of the invention which use an exposed perforated area.

In Fig. 17, there is illustrated means for joining the slabs A and B comprising a staple 31 having end prongs 32 adapted to be embedded into the body material of the slabs, preferably immediately adjacent the ends of the metal members on those slabs. In this case, completely embedded flanges on the metal members take the form of a more or less continuous wall 33 suitably perforated to permit the body material to flow therethrough while plastic and take its eventual set. Where such slabs are used in a floor or roof system and are supported by beams or girders 34 it will be found desirable to secure them thereto by means of a clip 35 secured as by nails 36 to the slab A. The clip is provided with a cut out portion adapted to straddle a flange 37 on the beam 34, the bottom portion 38 of the clip underlying the flange. By suitably proportioning the cutout or aperture in the clip 35, the clip may be made to wedgingly engage the flange.

In Fig. 19 is illustrated a method of hanging a ceiling which includes slabs A and B of the type shown in Fig. 17. This hanger may take the form shown in Fig. 20 to consist of an upright portion 39 doubled on itself to form 2 thicknesses of material, the ends of which terminate in arms 40 having prongs 41. A wire 42 or the like hung from any convenient overhead support engages an aperture in the upright portion 39 to suspend the slabs A and B in a ceiling construction.

An alternative means for securing two slabs of the type shown in Figs. 17 and 19 is illustrated in Fig. 21 in which the joining element takes generally a Z-shape as at 42, engaging slabs A and B on the top and bottom respectively.

In Fig. 22 there is shown slabs of the type illustrated in Figs. 17, 19 and 21 using staples 31 at both top and bottom. This is sometimes desired. Obviously these staples may be arranged

similarly on top and bottom or they may be suitably spaced apart in non-coinciding relation such for instance as in Fig. 23.

In Fig. 24 a somewhat similar arrangement is shown except that the area of the metal element is completely perforated, the ends of which overlap as at 42 within the slab body.

In Fig. 26, a construction similar to that shown in Fig. 25 is illustrated except that only the rear portions of the metal elements are perforated and what would otherwise constitute flanges 6 and 7 are extended to form a substantially continuous wall embedded in the slab body. The fact that the tongue 29 is of continuous metal and engages the similar surface of groove 30 makes for added strength.

Fig. 27 is somewhat similar to the combination shown in Figs. 24 and 25 except that a plurality of tongues 29 in the other corresponding grooves is shown.

In situations where it is desirable that the edge portions of a slab be of greater thickness than an intermediate area, the form shown in Fig. 28 will be of value. There the slab has opposite edges encased in a metal element indicated generally at 2, those edges being of greater thickness than the center section of the slab. It will also be noted that an underlying lip 43 is provided beneath the section of lesser depth which terminates in the flange 7. Such a construction makes possible the use of mesh reinforcing 44 extending over the top of flange 7 and beneath the bottom of flange 6. Fig. 29 also shows this form.

In Fig. 30, a slab similar to that shown in Fig. 22 is illustrated except that the end portions are oppositely ship lapped as at 45 and 46.

It will be obvious, of course, that the invention is not limited to the use of a substantially rectangularly arranged metal edging or one of cylindrical configuration such as that shown in Figs. 31 and 32. This metal edge in those figures consists of unperforated area 47 and a perforated area 48, the last permitting the flow of the body material through the same and to set therein. A longitudinal slot 49 in the unperforated area permits the introduction of an H-shaped spline 50 in order to secure the parts together. Grout or the like 51 may then be applied to make a flush joint.

In Fig. 33 a form is illustrated somewhat similar to that of Fig. 26 except that the tongue and groove 29 and 30 respectively are of slightly different configuration found desirable in some instances and terminal flanges 6 and 7 of the shortened variety are provided, similar, for instance, to those in Fig. 25.

Fig. 34 shows a modification in which the metal element on one slab, preferably that forming the tongue, is made in two parts. This is perhaps more clearly shown in Fig. 35, the two parts, 29*a* and 29*b*, joined together as by spot welding 52 to form the tongue 29. Such a construction makes possible the use of narrower strips of sheet metal.

In Figs. 36, 37 and 38, there is shown various forms of separate tongues inserted through the web 5 of the metal edging on slab B, that part of the tongue 53 projecting within the slab body being perforated so as to be effectively bonded by the passage of the plastic material of which the body is made thereto. In Fig. 38 the tongue 29 was made of a sheet of perforated material doubled on itself, the terminal ends of which are spread as shown.

Where it is found unnecessary to use a continuous tongue while at the same time making use of a continuous groove, the modification shown in Figs. 39 and 40 may be used. Other individual tongues 54 are punched out in alternate directions of the vertical web 5 and received within the groove 30. This form will be found to be of particular advantage where the tongues 54 are not bent into complete alignment inasmuch as when they are then forced into the groove 30, their natural spring tendency will cause them to bind on the walls thereof and thus resist the tendency to slab separation.

It is to be noted that as a natural consequence of the use of the joining devices of Figs. 1, 2, 7, 8 and 12 adjacent slabs are maintained in predetermined relationship and against relative movement except in a direction perpendicular to a slab edge. This is particularly true in the case of the use of dowels, cylindrical elements or balls which lie within depressions or grooves in opposite edges of adjoining slabs. While such joining means as shown in Figs. 3, 11, 13 and 25 theoretically permit relative longitudinal movement between slabs, that is, in a direction parallel with a joining edge, yet actually there is sufficient friction between the parts to prevent this undue movement.

It will also be obvious that the slabs constructed according to the present invention form an ideal surface for interior or exterior decorations as any of the accepted finishing materials may be applied thereto, such as lime, gypsum, magnesium oxychloride or oxysulphate cements, plastic paints, oil or cold water paints as well as paper or cloth decorated surfaces secured in place either by means of paint-like substances, size or glue.

Obviously the slabs of this invention may be used as sustaining walls, partition walls, roof decks, floors, ceilings and in any position vertical, horizontal or any angle therebetween, and tied to, laid upon or hung from any desirable type of support. It will be obvious from the foregoing description that by making the metal element of suitable gauge, these slabs may be sawed in any desired lengths to fit the particular circumstances of erection and applied in exactly the same manner as wood planks or lumber.

It is contemplated that due to the extreme lengths in which this material may be made by reason of the fact that the load sustaining portion thereof is the metal element, one slab may span any distance up to its length without regard to support spacing or the occurrence of joints, that is, a joint need not necessarily occur directly over, under or coincide with the support to which the slab is attached or upon which it rests. It is preferable, of course, in a building construction that the joints between contiguous rows of units be staggered in order to give maximum strength.

While several specific forms of the invention have been shown and described, yet it is understood that I am to be limited only to the scope of the claims.

I claim:

1. A building construction including two precast slabs erected with two of their edges adjacent, each slab having a set cementitious body with a sheet metallic element encasing an edge adjacent that of its neighbor, each element containing a plurality of perforations extending over substantially the entire area thereof, with the said body material extending through the perforations, and means to tie the two adjacent edges of the slabs together.

2. A ceiling construction including two units,

each having a metallic edge adjacent a metallic edge of its neighbor, means for suspending a ceiling from the units including a hanger extending downwardly between the units and engaging the adjacent metal edges of adjacent units in which each metal edge extends at least partially beneath the body of its unit, the hanger engaging that portion of the metal edge which is on the bottom of its unit.

3. A building construction including two precast slabs having two edge portions adjacent, each of said edge portions having thereon a metal element, that portion of each metal element lying between the slabs being provided with openings therein directly opposite each other, joining pins separate from the slabs for tying the two metal elements together, said pins passing through the said openings and projecting into each slab body, each metal element also having flanges projecting away from the joint between slabs and substantially parallel to a slab face, each flange being bonded to its slab body, the two slabs with their metal elements having a load sustaining value in excess of that of the slabs without the metal element.

4. A precast slab having a set cementitious body with complementary metal elements on at least two opposite edges, one being tongued and the other grooved, each of said elements being perforated, with the cementitious material of the body extending through the perforations each metal element having parallel flanges flush with the outer face of the cemetitious body.

5. A building construction including two precast slabs having two edge portions adjacent, each of said edge portions having thereon a metal element, that portion of each metal element lying between the slabs being provided with openings therein directly opposite each other, joining balls separate from the slabs for tying the two metal elements together, said balls passing through the said openings and projecting into each slab body, each metal element having flanges projecting away from the joint between slabs and substantially parallel to a slab face, each flange being bonded to its slab body, the two slabs with their metal elements having a load sustaining value in excess of that of the slabs without the metal element.

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