

June 9, 1942.

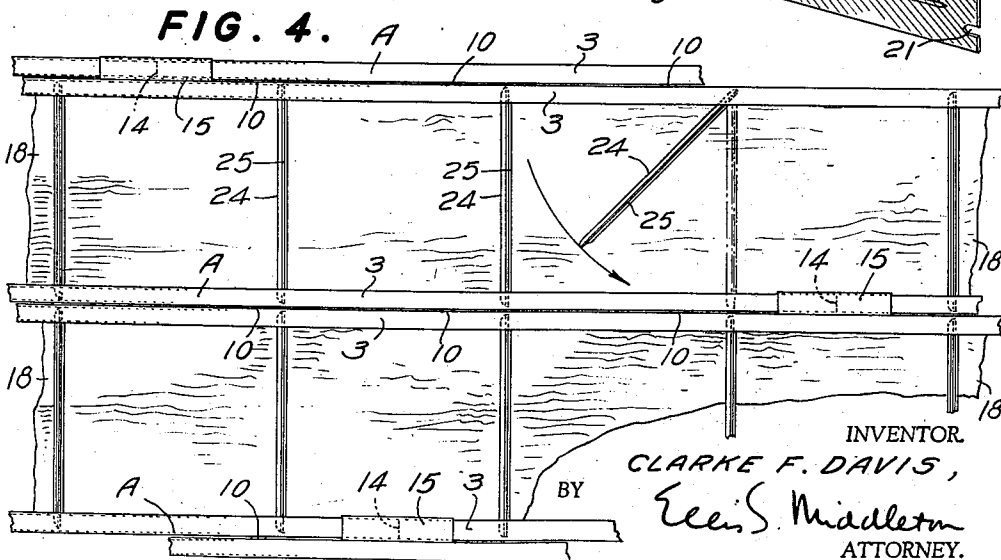
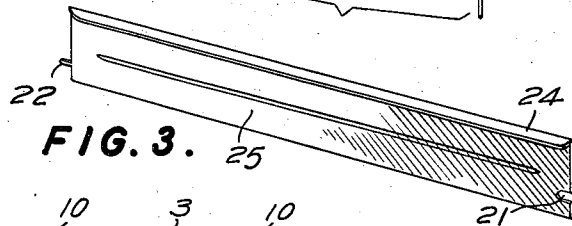
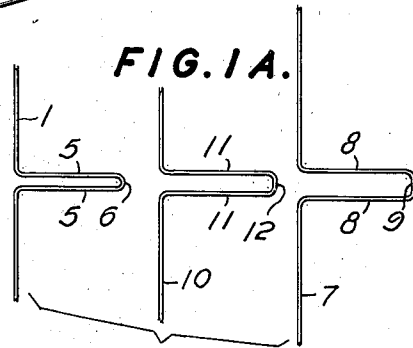
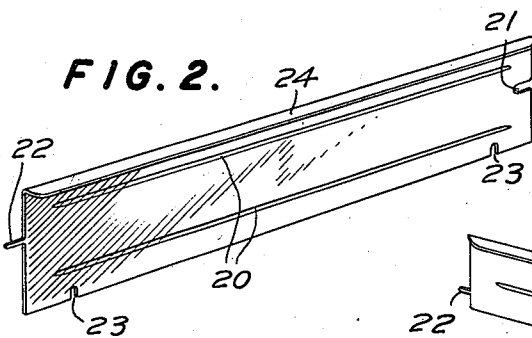
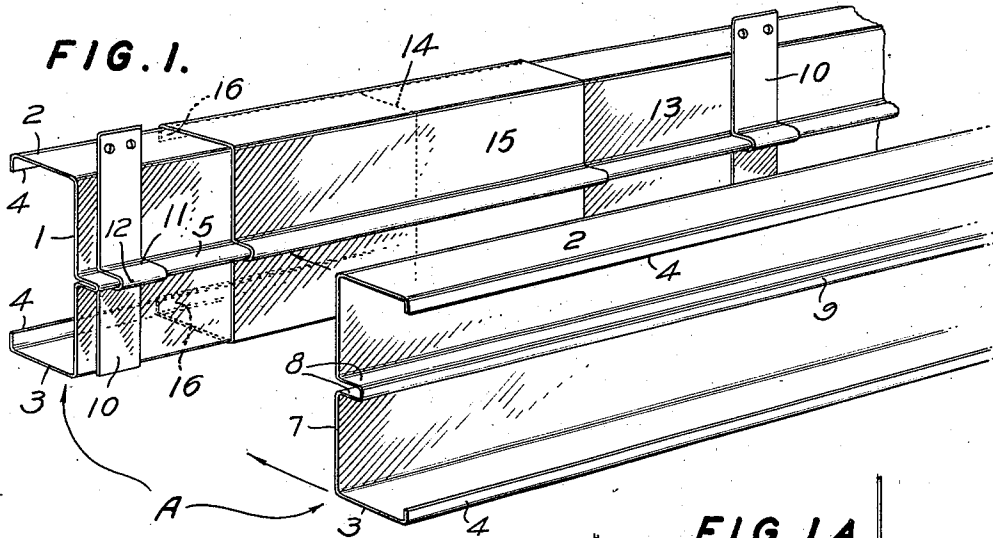
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2,286,167

FABRICATED BUILDING UNIT AND CONSTRUCTION EMBODYING THE SAME

Filed Nov. 13, 1939

5 Sheets-Sheet 1



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June 9, 1942.

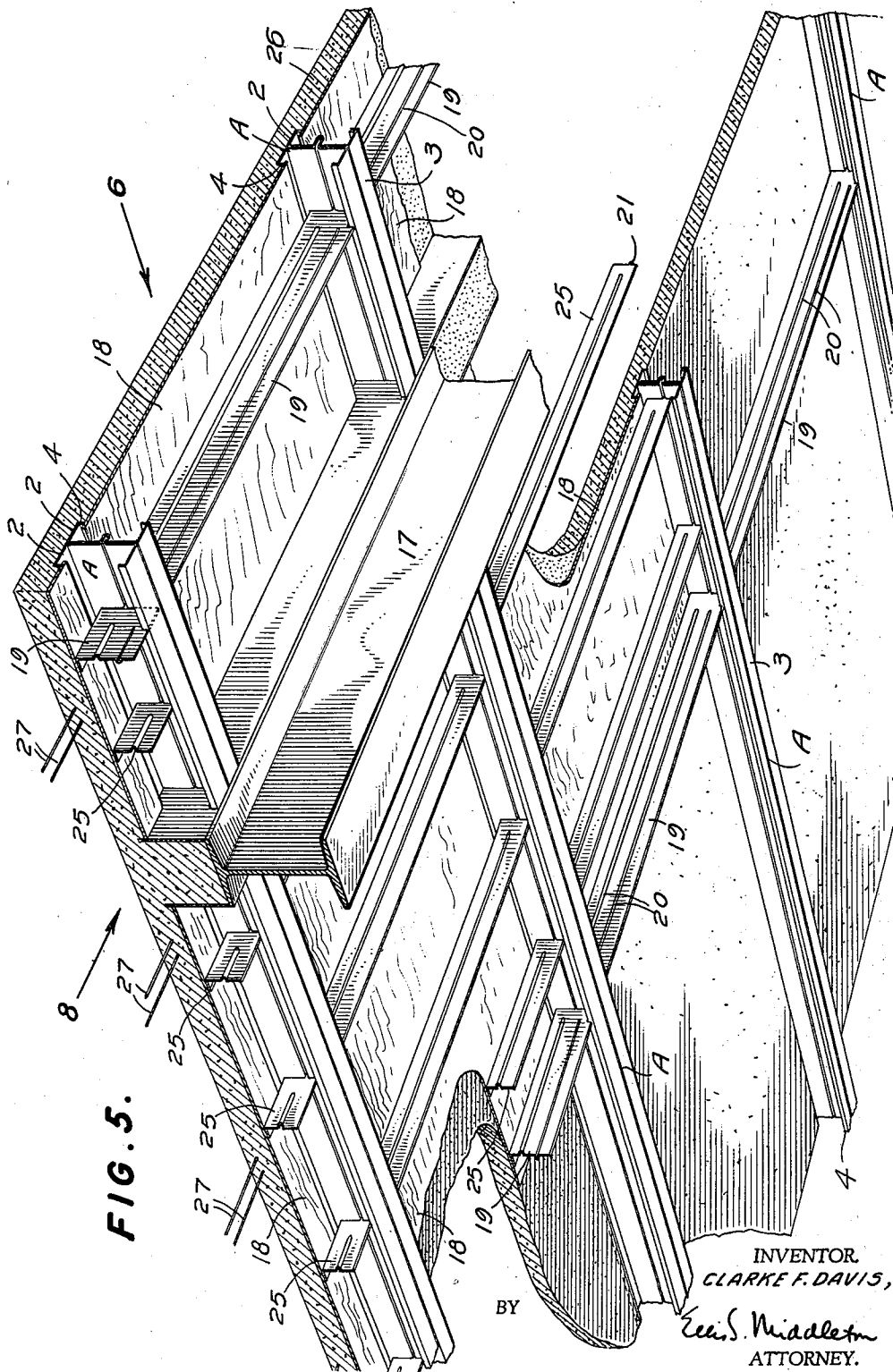
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FABRICATED BUILDING UNIT AND CONSTRUCTION EMBODYING THE SAME

Filed Nov. 13, 1939

5 Sheets-Sheet 2



June 9, 1942.

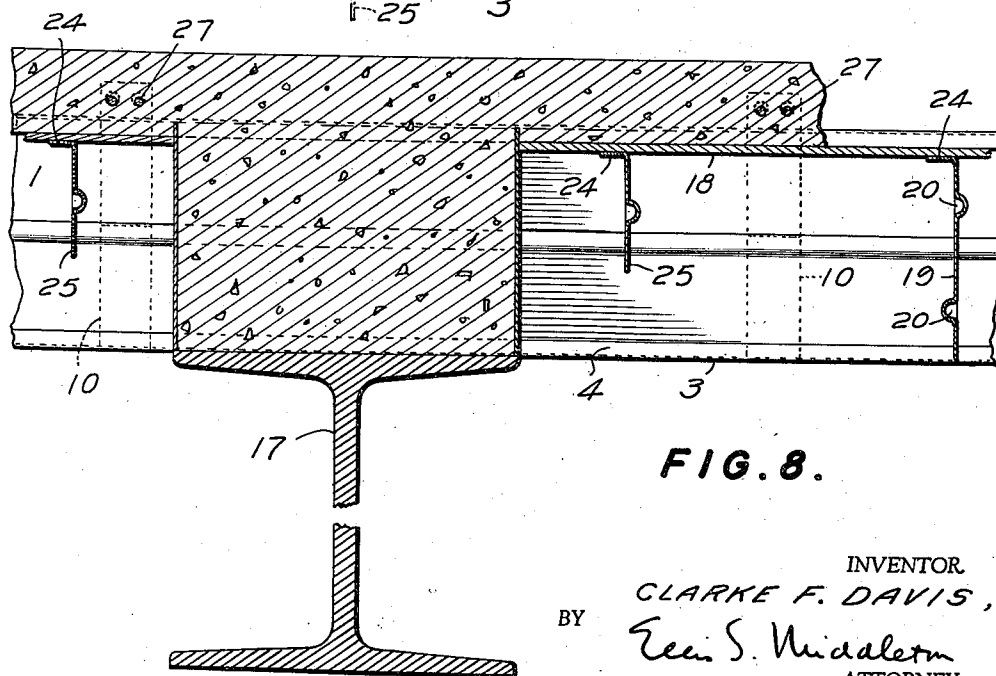
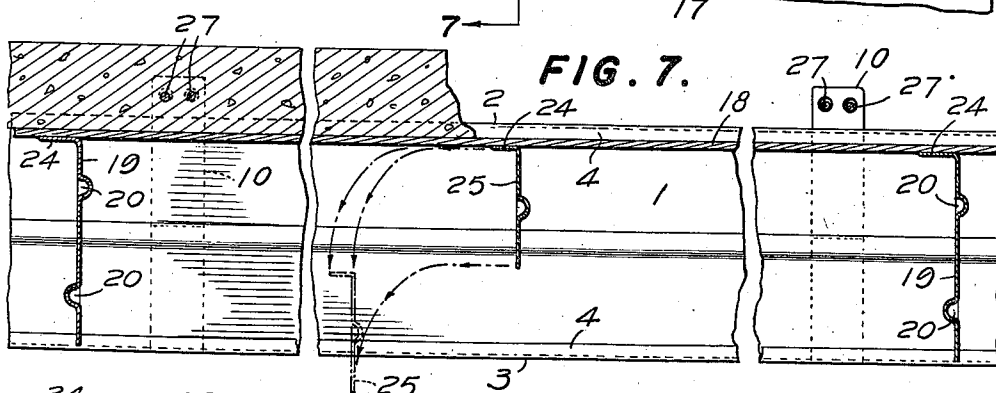
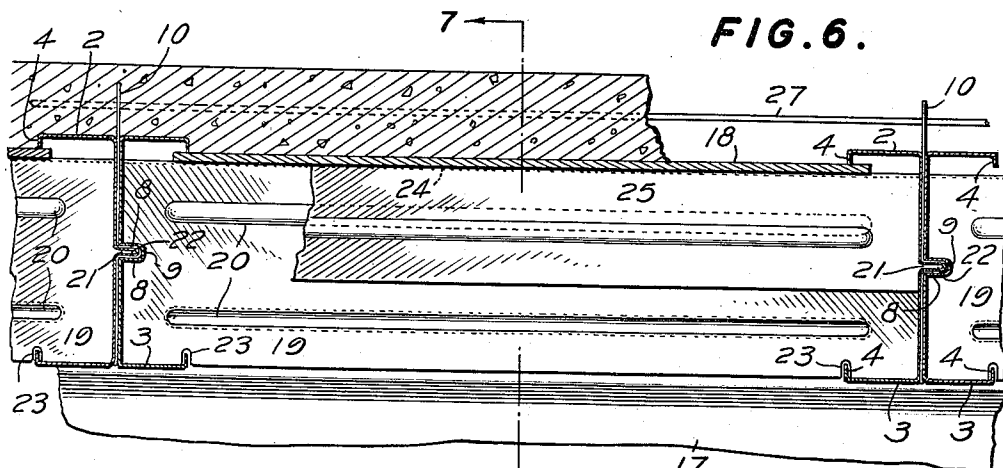
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FABRICATED BUILDING UNIT AND CONSTRUCTION EMBODYING THE SAME

Filed Nov. 13, 1939

5 Sheets-Sheet 3



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FABRICATED BUILDING UNIT AND CONSTRUCTION EMBODYING THE SAME

Filed Nov. 13, 1939

5 Sheets-Sheet 4

FIG. 9.

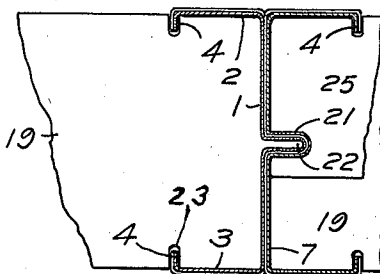
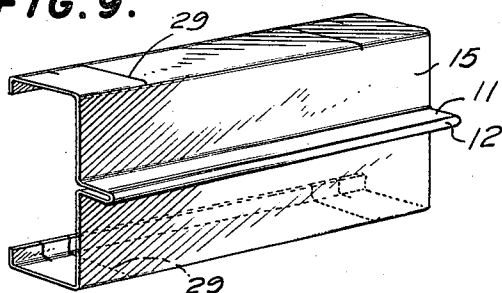


FIG. 11.

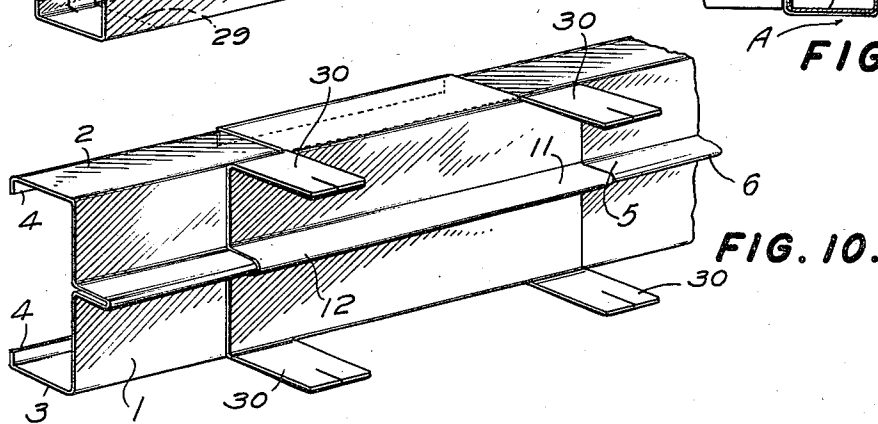


FIG. 10.

FIG. 12.

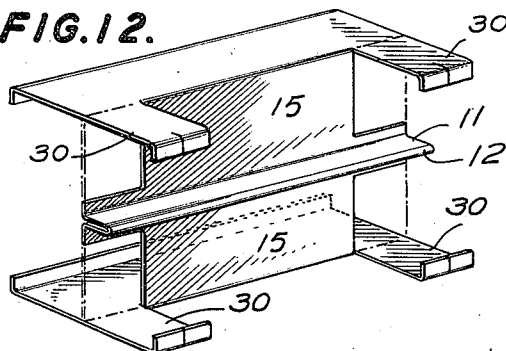


FIG. 13.

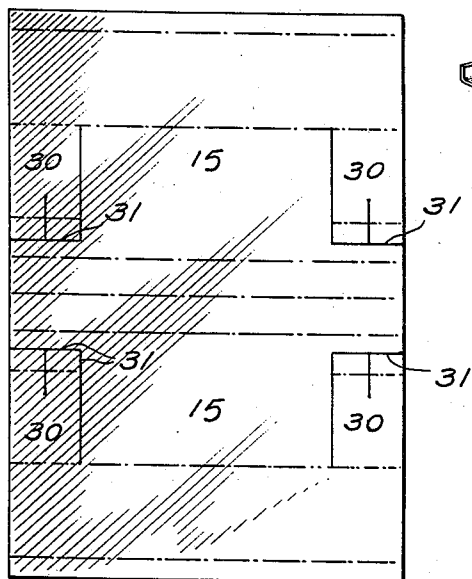
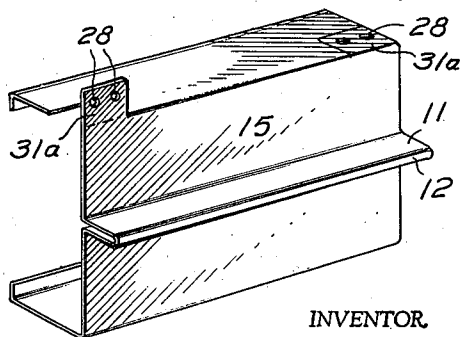


FIG. 14.



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FABRICATED BUILDING UNIT AND CONSTRUCTION EMBODYING THE SAME

Filed Nov. 13, 1939

5 Sheets-Sheet 5

FIG. 15.

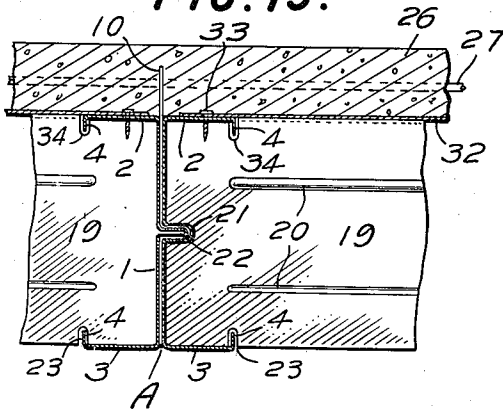


FIG. 19.

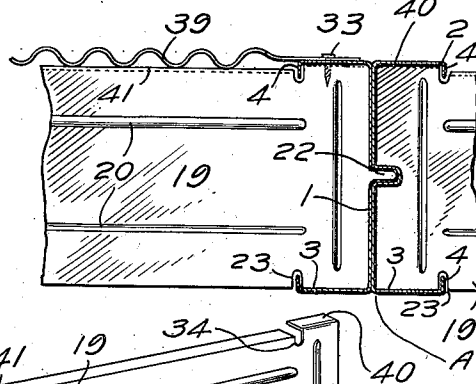


FIG. 20.

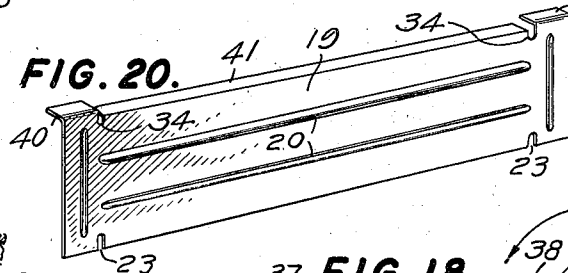


FIG. 17.

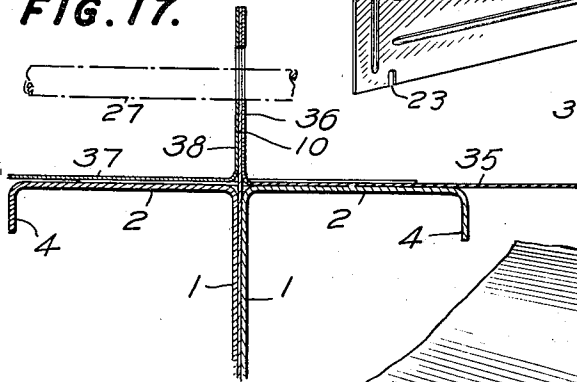


FIG. 18.

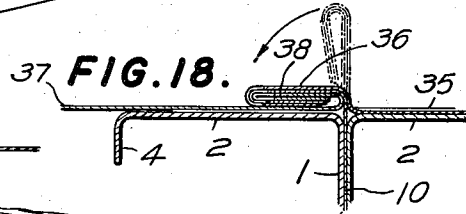
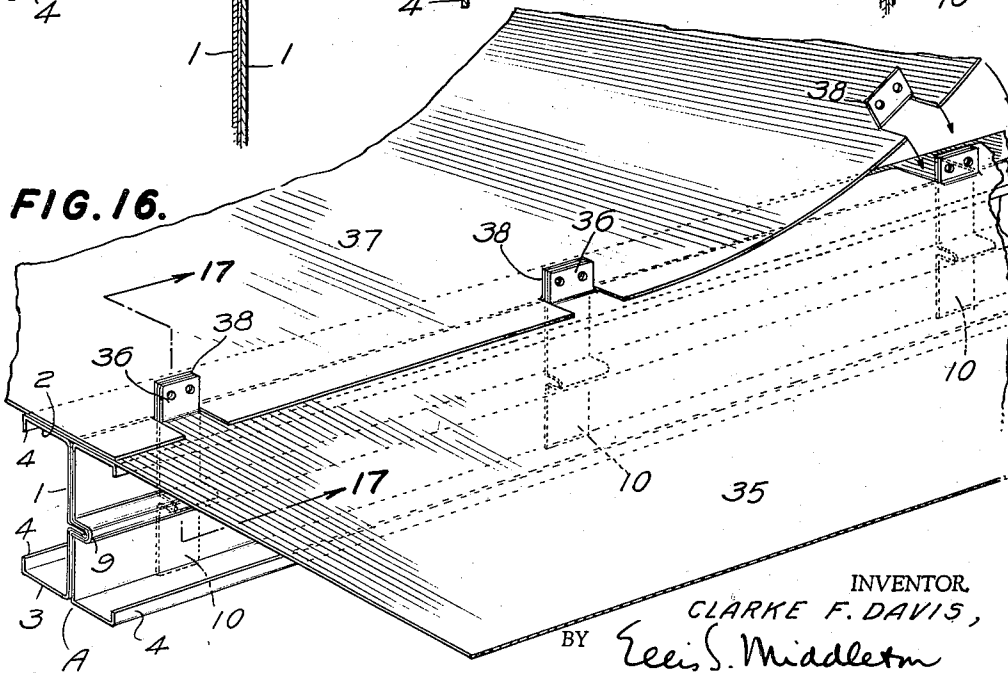


FIG. 16.



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UNITED STATES PATENT OFFICE

2,286,167

FABRICATED BUILDING UNIT AND CONSTRUCTION EMBODYING THE SAME

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Application November 13, 1939, Serial No. 304,069

6 Claims. (Cl. 72-68)

The present invention relates to a fabricated building unit and construction embodying the same.

The principle of I-beam construction is a well recognized one, such units being usually hot-rolled from billets. Such shapes in even the lightest weights necessarily carry a large quantity of metal, inefficiently distributed, inasmuch as the two flanges and connecting web are usually integral. Fabricated I-beams are also well known, such as those in which the flanges are constituted by angles joined by either a plate web or a deformed bar, such as is known as a bar joist. Such fabricated beams may be heavier or lighter than the integral type of I-beam above described but are open to much the same objection above described.

Both of the above shapes are open to the objection that they are heavy, expensive to manufacture, difficult to handle and, what is more important, they do not possess that flexibility of application to building situations which is most desirable. That is, they are of such dimension that they may not be readily cut and fitted in the field without a great deal of trouble. As a matter of fact, it is standard practice for fabricating companies to act as the intermediate between the manufacturer and consumer, the function of this middle man being primarily to cut and fabricate shapes such as are desired by the consumer. This set up entails expensive detailing as for the most part, each individual shape must be detailed accurately for the final place in the building which it will occupy.

As a result of the above, very few small buildings, such as private homes, garages and the like are able to use these shapes because of their expense, both from the initial standpoint and the standpoint of erection.

The principal object of the present invention, therefore, is to provide complementary shapes of sheet metal of either the hot- or cold-rolled type which, when placed in proximity to each other, will form an I-beam of requisite strength.

The invention contemplates the use of shapes of such design as will permit of their being hot- or cold-rolled from Bessemer steel, which is an advantage over the use of open hearth steel, for instance. While the latter, in the course of manufacture, is more uniform in its composition and consequently shapes made therefrom are less liable to show up defects, yet the cheapness with which Bessemer steel can be produced makes this material particularly desirable for the production of shapes of such design that the non-uniformity

of the steel composition will not result in defects. While Bessemer steel is preferred, yet the invention is not to be construed as being limited to metal from this source, inasmuch as the shapes hereinafter described are so designed that practically any iron or steel composition may be used in their manufacture to advantage.

Another important object of the invention is to produce shapes which may be run off on a metal rolling and shaping machine in extreme lengths without undue distortion and then cut into standard pieces for shipment. Such lengths are designed to be of a gauge that the erector may readily cut and shape the same on the job to fit the particular circumstances of that building without difficulty.

Another important object resides in furnishing a fabricated I-beam of sheet metal with which other building materials such as plaster, concrete, cinder concrete, or the like, may be readily incorporated to give an advantageous construction.

Other objects and advantages will appear as the description proceeds.

To this end, the invention contemplates the provision of two complementary shapes of sheet metal, each having a central web, one of the members carrying a tongue and the other a groove, both members having flanges at the top and bottom of the web, the flanges terminating in strengthening edge portions at an angle to the flange. In the preferred form, the tongues and grooves have substantially parallel sides at right angles to the plane of their web, the end of the tongue being rounded so as to facilitate entry into the fillet of the groove.

In order to facilitate the shaping of these sections during manufacture and to prevent cracking, splitting or other weakening of the metal along the general line of deformation, the metal is bent or shaped about a radii between $\frac{3}{32}$ " and $\frac{1}{8}$ ".

In the preferred form of the invention, the tongue does not tightly fit within the groove, that is, the dimension of the tongue at its point of greatest thickness is less than the dimension of the thickness of the groove by an amount substantially equal to twice the thickness of the metal forming the tongue or groove. This looseness of fit permits the insertion between the complementary parts of splice plates, clips, hangers, fastening devices or the like made of material of substantially the gauge of that of the complementary parts. It is contemplated that in most instances the clips, splice plates, hanging

devices or the like will not completely fill the space between webs of the complementary sections, although in some instances it may be desirable to insert a reinforcing element of considerable length between the complementary members and this reinforcing device may be of a length coincident with that of the mated parts.

On the other hand, it may be found desirable to have the tongue of one member tightly fit the groove of the other so as to develop a strong frictional joint which is particularly efficient where the tongue and groove have parallel sides as above described.

The invention further contemplates a building construction involving the use of a series of such fabricated I-beams used, for instance, in a deck where two or more of these I-beams will be spaced apart upon supports. It is contemplated that temporary forms may be inserted between adjacent I-beams, the side edges of the forms underlying the strengthening edge portions of the complementary sections, such forms being held in that position by means of bridging also extending between adjacent I-beams. By pouring a cementitious fill thereover, a particularly efficient deck results especially if clips are located between the complementary parts of the I-beams, project upwardly into the cementitious material and carry rods or the like embedded therein. When such cementitious material has set, the bridging and forms may be removed and as a consequence, a composite construction remains in which the set cementitious layer forms in effect an enlarged and continuous upper flange for the otherwise light sheet metal I-beam, and due to the fact that the cementitious material is tied to the I-beam by reason of clips, the parts work together to raise the neutral axis of the I-beam and an advantageous construction results. Where desired, metal bridging may be replaced with or without additional elements so as to prevent the spaced apart I-beams from tipping or separating.

The invention further contemplates the other details of construction shown and/or described herein.

The invention additionally contemplates the use with the present embodiments of such details of construction as are shown and described in my co-pending application Serial No. 276,213, as may be applicable.

The invention in other aspects contemplates the details of construction and combination of parts more fully hereinafter described and shown in the accompanying drawings. In the drawings,

Fig. 1 is a composite view of complementary sections of a fabricated beam made according to this invention showing its manner of assembly, together with clips and a plate used either to splice the joint or to reinforce the beam;

Fig. 1A is a diagrammatic showing of the manner of mating the parts of a beam with intermediate elements;

Fig. 2 is a perspective view of one form of bridging;

Fig. 3 is a perspective view of a modified form of bridging useful to support a form;

Fig. 4 is a bottom plan view of a building construction showing the manner of insertion of bridging useful as a temporary support for a form;

Fig. 5 is an underside perspective view of a deck construction according to the present invention;

Fig. 6 is a sectional view looking in the direction of the arrow 6 in Fig. 5;

Fig. 7 is a sectional view along the line 7—7 of Fig. 6;

Fig. 8 is a sectional view looking in the direction of the arrow 8 in Fig. 5;

Fig. 9 is a perspective view of one form of splice or reinforcing element;

Fig. 10 is a perspective view showing the element of Fig. 9 applied to one of the complementary units;

Fig. 11 is a sectional view showing an element of Fig. 9 applied to a composite beam to secure the complementary parts together;

Fig. 12 is a modified form of splice or reinforcing element;

Fig. 13 is a development of the device of Fig. 12 showing the manner of cutting the same from a sheet;

Fig. 14 is a perspective view of another form of splice or reinforcing element utilizing a part thereof as a fastening means for finish material;

Fig. 15 is a sectional view of a modified composite deck;

Fig. 16 is a fragmentary perspective view showing one manner of attaching a finish material to a fabricated beam;

Fig. 17 is a sectional view along the line 17—17 of Fig. 16;

Fig. 18 is a fragmentary sectional view showing the manner of fastening the ears and clip of Fig. 16 together;

Fig. 19 is a sectional view showing a modified form of deck using sheets; and

Fig. 20 is a perspective view of one type of bridging used with the deck of Fig. 19.

Referring now with particularity to the embodiments shown, one of the complementary sections is shown in Fig. 1 to consist of a web 1 having top and bottom flanges 2 and 3, the ends of the flanges terminating in a strengthening edge 4 at an angle thereto.

The web 1 in the male shape is provided with a tongue shown more particularly in Fig. 1A having two parallel sides 5 arranged generally at right angles to the web 1 and terminating in a rounded end 6.

The other complementary shape shown in Fig. 1 also includes a web 7 having top and bottom flanges 2 and 3 and strengthening edges 4. The web of this female shape carries a groove defined by parallel portions 8 of metal substantially at right angles to the web 7 and terminating in a rounded end 9. It is to be noted in this form that the tongue does not tightly fit within the groove but, on the contrary, the dimension of the greatest thickness of the outside of the tongue is less than the greatest dimension of the inside of the groove by an amount substantially equal to twice the thickness of the metal comprising the tongue.

It is to be noted that these complementary elements are of sheet metal, preferably of steel from one to twenty-two gauge rolled to shape. In order to minimize any tendency to crack or develop flaws at the bends, it is preferable that the radius of such deformed portions be substantially $\frac{3}{8}$ " to $\frac{1}{4}$ " inclusive. After a considerable number of experimental runs, it was found that this dimension is more nearly applicable to the production of shapes of this character from the contemplated gauges to an optimum degree and consequently minimizes defects due to deformation.

Thus, as shown, each shape is bent eight times,

about radii from $\frac{3}{32}$ to $\frac{1}{16}$ inch which materially strengthens and stiffens the entire structure. It is contemplated in some instances that the tongue may have but a single bend at the end thereof using the above radius.

It is contemplated that such shapes may be made in depths of from two to thirty inches and of indeterminate length. As the lengths are taken from the shaping machines, they may be readily cut at any convenient point so as to be furnished to the consumer in standard lengths. Such shapes may either be straight or curved, as desired.

In use, the complementary elements above described will be mated together to form what will hereinafter be referred to as a fabricated beam A. The word "beam" is not to be taken as restrictive of the use to which these mated parts may be put as it is contemplated that the united sections A may serve as a beam, purlin, joist, column, partition stud or the like and used vertically, horizontally or at any angle therebetween.

In the modification shown in Fig. 1 where the tongue normally fits loosely within the groove of a complementary section, means are provided to take up this looseness and cause the parts to fit tightly together. At the same time, these means serve an additional definite function. For instance, it may be desirable to secure finish material, coverings, cementitious overlays, wood battens, or other devices to such a fabricated beam and for this purpose a clip such as that shown at 10 may be used. In such case, the clip would be provided with a deformed portion having parallel walls 11 and the rounded end 12 as shown in Fig. 1A, the parts being so proportioned as to receive the tongue 5 tightly on the inside and the groove 8 tightly on the outside. As a consequence, when the parts are mated together in the direction of the arrow in Fig. 1, the complementary parts of the beam A are prevented from separating by reason of the tight frictional engagement with the clip and due to the fact that the clips 10 are spaced apart, there will be areas such as are generally indicated by the numeral 13 where the webs 1 and 7 will be spaced apart. Such a slot may be useful for many purposes where, for instance, in a building construction, it is desirable to drive a nail therein or to insert other devices of this character.

It is also contemplated that the complementary parts of the beam A may be used in the field in random lengths, that is, it is not at all necessary that two complementary parts extend completely between end supports but, on the contrary, there may be an end to end joint on one of the complementary members, the other element extending integrally past that joint. Such a situation is shown in Fig. 1 where an end to end joint on one of the complementary members is indicated at 14. In order to completely restore the strength to this joint, a reinforcing element indicated generally at 15 also serving the purpose of the splice plate as shown. Such an element may be in effect but a section of a male shape of such proportions that it may be sprung over one of the complementary parts to bridge the joint therebetween as shown. In this instance, it is to be noted that the splice plate or reinforce 15 is also provided with strengthening edges 16 which overlap the strengthening edges 4 and thus securely hold the part 15 in place.

Similarly, a shape may be inserted within the female element 7 to serve the same function, it

being in effect a section from a shape sufficiently small to fit into this locality.

Obviously, to act as a reinforce such a shape need not necessarily occur at or near an end joint but may be used wherever necessary to give the required strength to the fabricated beam. It may be of any extent and of the same or different gauge from that of which complementary parts are made.

Inasmuch as it may be desirable in some instances to have the complementary parts of the fabricated beam A fit tightly together in a frictional joint without the aid of clips or reinforces, such a construction is illustrated generally either by the two left hand parts of Fig. 1A or the two right hand parts of that figure. In the former case, the section at the right hand end of the figure may be considered as a reinforce which would fit within the female member while in the latter case, the left hand part of the figure represents a reinforce which may be used within the male shape.

One of the most useful forms of building construction embodying such a fabricated beam A is shown in Fig. 5 where two such beams A are spaced apart and supported upon the usual form of I-beam 17. In this case, a cementitious overlay is desired and consequently, some kind of a form will be required during the pouring thereof. Sheet material such as plywood or the like shown at 18 may be used for this purpose inserted beneath the strengthening edges 4 of the top flanges 2 of the two beams and held in place by one or more supporting devices such as those shown in Figs. 2 and 3. As shown, the bottom of the cementitious overlay extending below the flange 2 adequate support to the top flange and strengthening edge is given in a lateral direction.

That in Fig. 2 comprises a sheet 19 with or without strengthening corrugations 20 and having a cut-out 21 to clear the tongue 5 on the male element and with or without a projection 22 to fit within the inside of the groove 8 on the complementary part of the fabricated beam. Notches 23 may be provided to straddle the strengthening edges 4 on the bottom flanges 2 of the beam.

In order to give extended area contact between this support and the plywood or form 18, the top of the sheet may be bent over as at 24.

A slightly modified form of support is shown in Fig. 3, which comprises the plate 25 slightly more than half the depth of that shown in Fig. 2.

Fig. 4 being an underside view showing the course of construction of the composite deck of Fig. 5 illustrates the two spaced apart fabricated beams A with splice plates or reinforces 15 with plywood or other form material at 18 is held in place therebetween by means of the support 19 put in position by moving the same in the direction of the arrow. Obviously, either the supports 19 or 25 may be used in such circumstances and Fig. 5 actually shows the use of both kinds of supports. The form sheets 18 being thus held in position, cementitious material 26 of any character may be poured thereover. It is assumed that the construction of Fig. 5 includes clips 10 shown in Fig. 1 located between the complementary parts of the fabricated beam A and that rods 27 will be passed through apertures 28 in the upwardly projecting parts of the clip prior to the pouring of the cementitious overlay. In this way, the set overlay 26 is definitely tied directly to the beams A as an integral structure. After the necessary set has taken place, the supports

19 or 25 are removed by reversing the procedure shown in Fig. 4 and the forms 18 removed. Where desired, one or more of the supports 19 or 25, particularly the former, may be replaced in position to act as lateral bridging between beams A. As a consequence, the entire structure is stiffened and the beams are prevented from tipping or moving toward or away from each other.

Such bridging will be found to be of material value in situations where an overlay or finish is used, of such type that it does not serve to prevent tipping or movement of the beams themselves. For instance, in the event that a wooden floor is laid directly over the beams, such floor may or may not be fastened thereto. If not fastened, the use of such bridging diaphragm as shown in Figs. 2 and 3 will lend the necessary stiffness and sturdiness to the whole construction independent of the floor. In such cases, it is desirable that the overlay or finish rest directly on the top of the bridging.

It may be found desirable in some cases to tie the composite parts of the fabricated beam A together and to prevent their separation in a positive manner rather than to rely upon friction. Such a device suitable for this purpose is shown in Figs. 9, 10 and 11. There it may simply be a reinforce or splice plate 15 such as shown in Fig. 1, the flanges and their strengthening edges being cut along the lines 29 to form ears 30 which, when the complementary and female member of the fabricated beam A is placed adjacent thereto, are bent down over the flanges and strengthening edges thereof as shown in Fig. 11. Under these circumstances, the two parts of the fabricated beam are absolutely prevented from accidental separation. Such a construction may be used with or without diaphragm bridgings 19 or 25.

Fig. 12 shows a slightly modified form of clip for holding the complementary parts together in which the ears 30 are formed from the web 15 by cutting a sheet along the lines 31 as shown in Fig. 13.

Fig. 14 shows a modified splice or reinforcing plate 15 provided ears 31a adapted to receive reinforcing rods 27 in apertures 28, thus serving the purpose of a clip when a cementitious overlay is to be used.

In Fig. 15 a composite deck is shown in which a sheet metal form 32 extends between top flanges 2 on spaced apart beams A, being secured in place as by self-threading screws 33. It is to be noted that the sheets 32 are directly supported upon a modified bridging element 19 having a notch 34 at the top thereof to accommodate the strengthening edge portion 4 on the top flange 2 of the beam. This is in contradistinction to the form of bridging shown in Fig. 2 not provided with upper notches.

Another method of attachment of metal sheets of the fabricated beams is shown in Fig. 16 wherein clips 10 are pinched between the complementary male and female shapes 1 and 8 as shown in Fig. 1. Sheet 35 is provided with ears 36 turned back from the edge thereof, the slot left in the edge of the sheet by such deformation straddling the upwardly projecting end of the clip 10. An additional sheet 37 provided with similar ears 38 is then overlapped onto the edge of sheet 35 so that the ears 38 abut the upwardly projecting end of clip 10. Inasmuch as the ears 36 and 38 and the clip 10 have aligning apertures, rods 27 may be inserted therethrough where a cementitious overlay, such as that shown at 26

in Fig. 5 is to be used. Where no cementitious overlay is to be provided, these three adjacent projecting parts may be double-crimped as shown in Fig. 18 and folded down flat against either sheet 37 or sheet 35. The two sheets are thus firmly held against separation from each other and securely fastened down to the beam A by reason of the clip 10. The entire deck may then be finished, such for instance as moping with tar or other thermoplastic material with or without a finish waterproof sheet material.

In Fig. 19, a somewhat modified form of finish material is shown. This may take the form of a corrugated sheet 39, the ends of which overlie the flanges 2 of one of the complementary sections and to which it is fastened by any suitable means such as screw 33. As in the case of modification of Fig. 15, a generally rectangular metallic bridging 19 is shown except that in this case end flanges 40 are provided to insure additional contact with the underside of the top flanges 2 of the complementary sections and a flange 41 extends between notches 34 and at a lower level than the pair of end flanges 40. As shown in Fig. 19, the corrugated sheet 39 is adequately supported by the flange 41. It is to be noted that in the modification shown in Fig. 19 no overlay is used in this instance and inasmuch as the sheet 39 is fastened to the beam flange, no clips are required. Consequently, in this form, the tongue and groove of the complementary sections fit tightly together except where splice or reinforcing plates are used.

While the invention has been shown and described with particular reference to specific embodiments, it is to be understood that it is not to be limited thereto but is to be construed broadly and restricted solely by the scope of the appended claims.

I claim:

1. A building construction comprising two spaced apart sheet metal I-beams each including two complementary sections tongued and grooved together, and thin sheet material extending between I-beams and overlying the top flanges thereof with generally rectangular metallic bridging members extending between the webs of said I-beams, each of the complementary sections of the I-beams having strengthening edge portions extending at an angle to its flange, said bridging being provided with top and bottom notches at each of its ends, receiving and straddling the strengthening edge portion of the sections between which it extends.

2. A fabricated I-beam comprising two complementary sections tongued and grooved together, each having a web, a top and bottom flange at the ends of the web, each flange having a strengthening edge portion extending at an angle thereto, and means to hold the complementary sections together in which said means is provided with a web with two pairs of flanges, one pair extending on one side of its web and the other pair extending on the other side thereof, the ends of said flanges engaging the strengthening edges on the flanges of the complementary sections, whereby accidental separation of the sections is prevented.

3. A building construction including two spaced apart sheet metal I-beams each composed of two complementary sections tongued and grooved together, each of said complementary sections having a top flange, a clip located and pinched between the tongues and grooves of the comple-

mentary sections, a rod carried by said clip, and a set cementitious overlay in which the rod is embedded, a portion of the overlay extending below the top flange of said section.

4. A building construction comprising two spaced apart sheet metal I-beams each including two complementary sections tongued and grooved together, and thin sheet material extending between I-beams and overlying the top flanges thereof with a clip pinched between the tongue and groove of one of the beams and extending above the top flange thereof, said sheet having an ear lifted from one edge thereof to form a slot, said slot straddling the upwardly projecting portion of the clip, the ear lying on one side of the clip and a second piece of sheet material having an ear lifted from an edge thereof to form a slot, said edge overlying the first mentioned sheet of material, the slot in the second sheet straddling the upwardly projecting portion of the clip, the second ear lying adjacent the clip and on the

other side thereof, and means to fasten the two ears and the clip together.

5. A building construction comprising two spaced apart sheet metal I-beams each including two complementary sections tongued and grooved together, and thin sheet material extending between I-beams and overlying the top flanges thereof with a generally rectangular metallic bridging member extending between the webs of said I-beams.

6. A building construction comprising two sheet metal I-beams each including two complementary sections tongued and grooved together, supports lying between the I-beams substantially at right angles thereto, the upper edge of which lie substantially in the plane of the top flanges of the I-beams, and thin sheet material extending between I-beams, overlying the top flanges thereof and resting on the upper edge of the supports.

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