Dec. 7, 1937. G. V. PALMER 2,101,090

COMPOSITE GIRDER CONSTRUCTION

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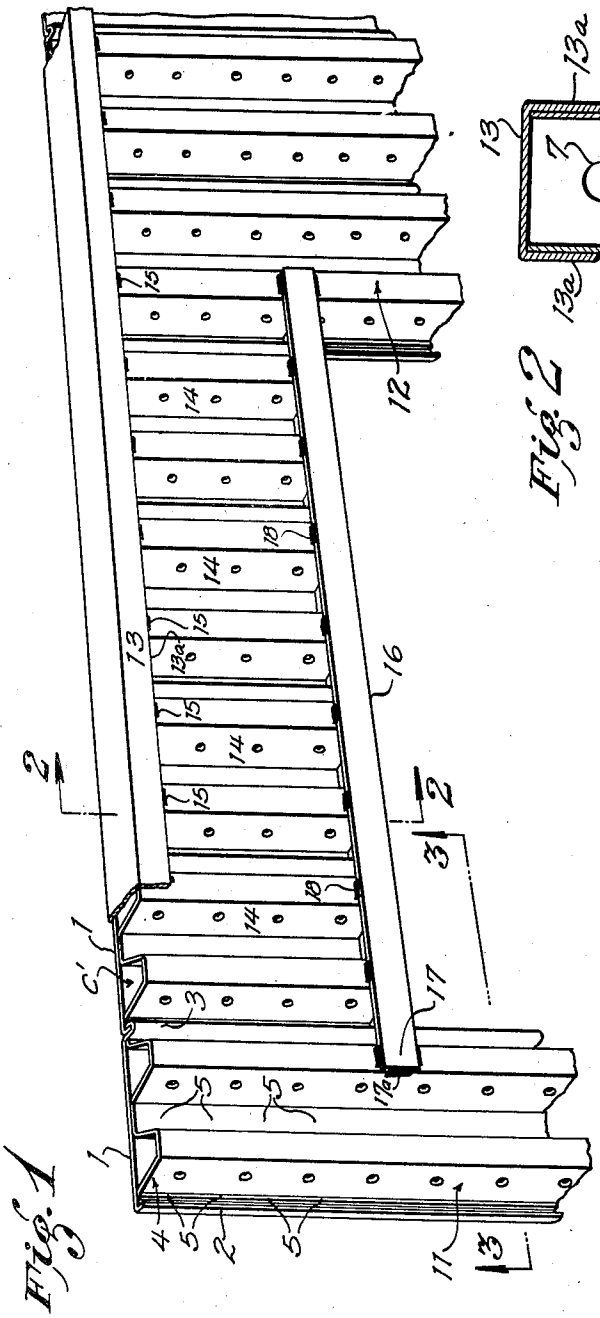


Fig. 1

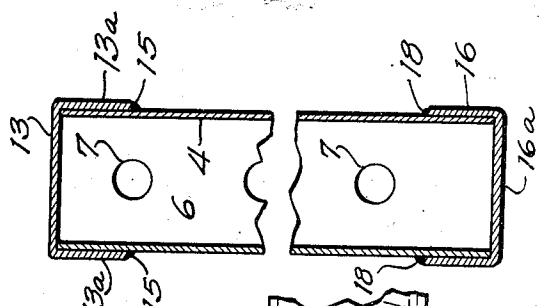


Fig. 2

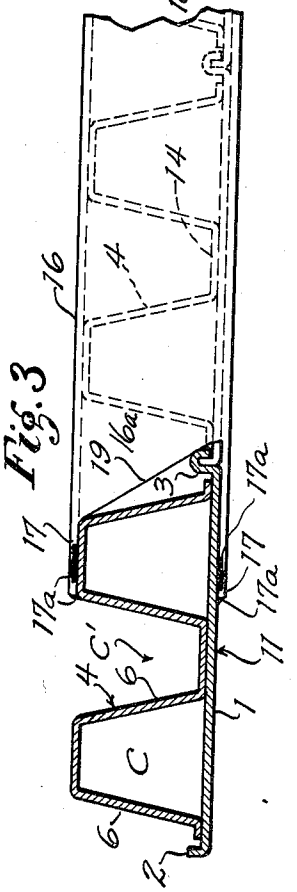


Fig. 3

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Fig. 4

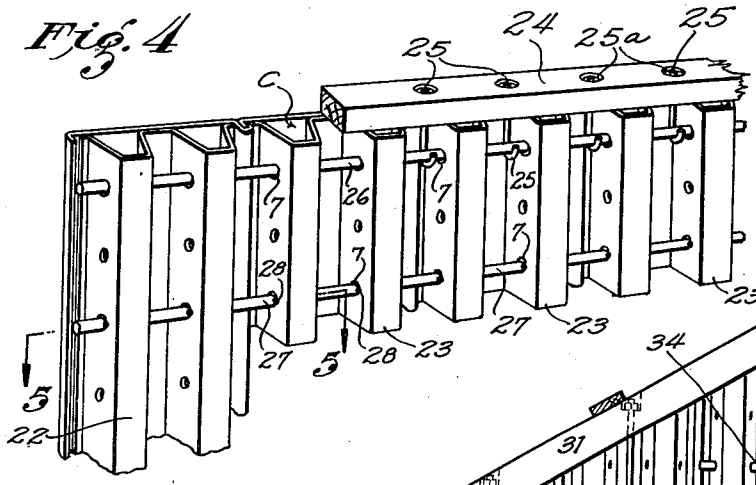
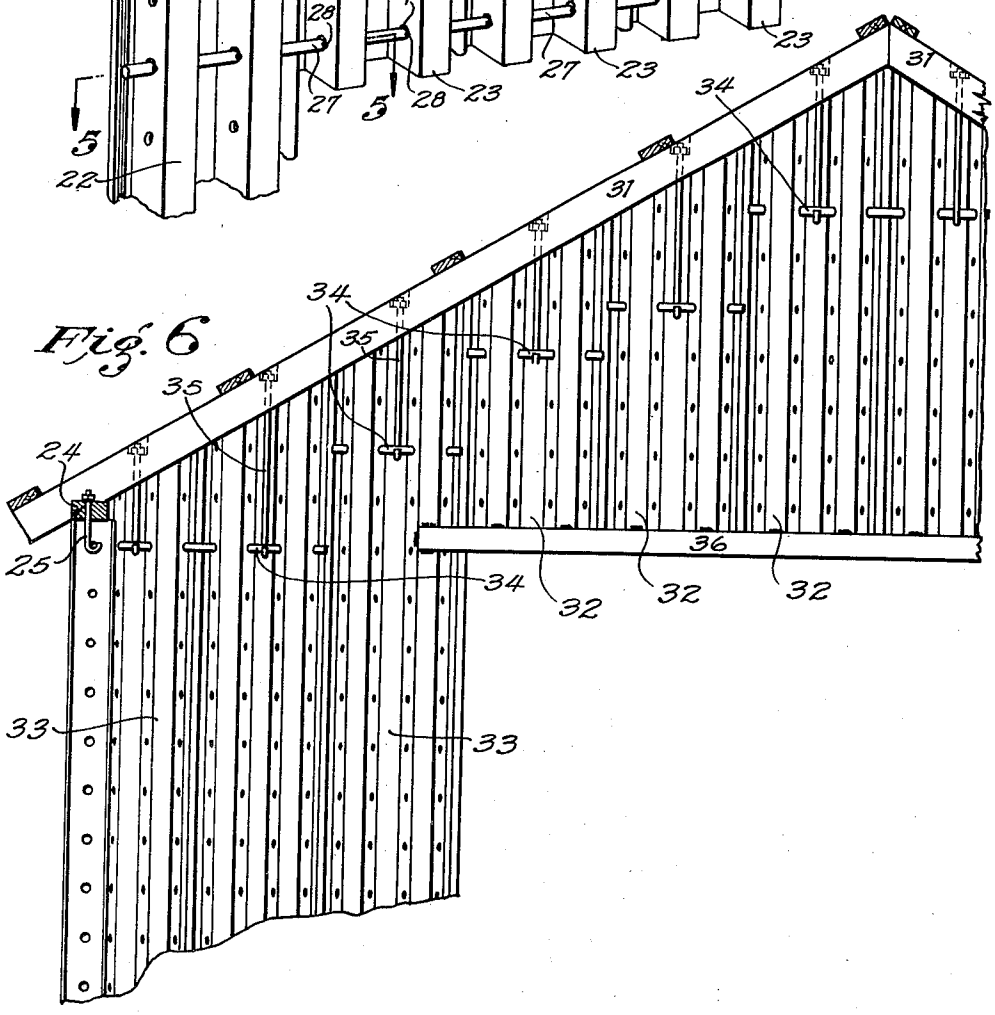


Fig. 6



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Fig. 7

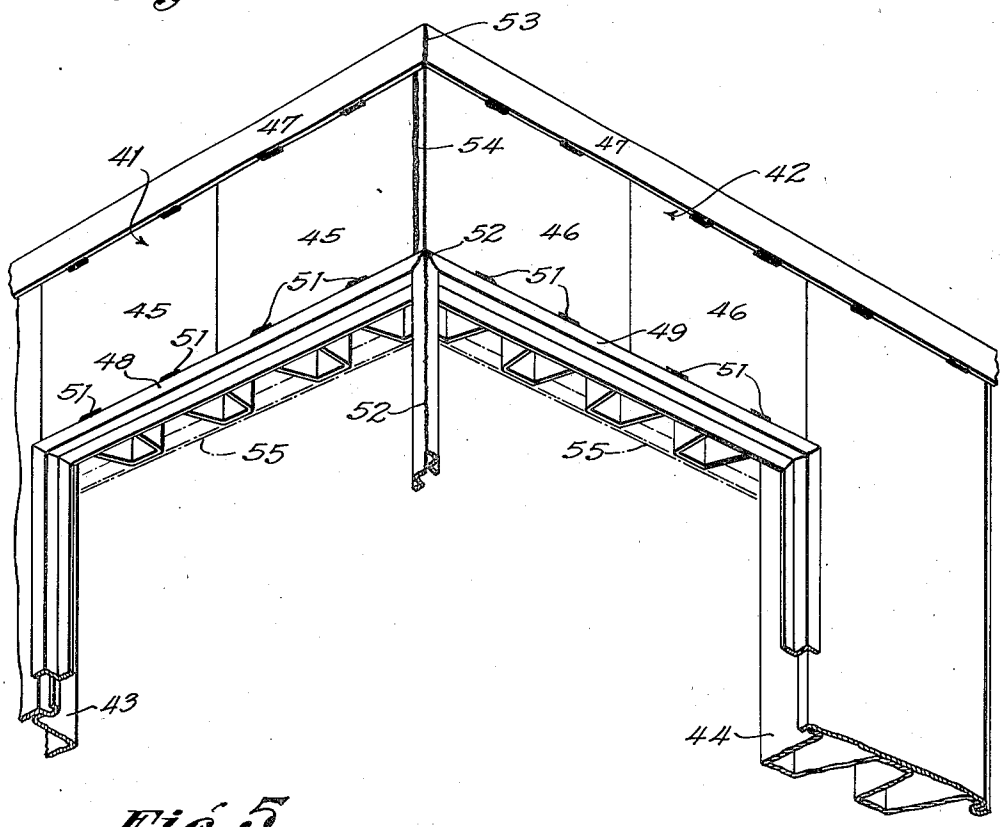
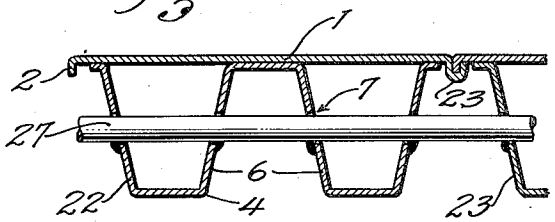


Fig. 5



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UNITED STATES PATENT OFFICE

2,101,090

COMPOSITE GIRDER CONSTRUCTION

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Application April 15, 1936, Serial No. 74,447

7 Claims. (Cl. 189—37)

This invention relates to a novel form of composite girder or truss.

The principal object of the invention is to provide a composite girder or truss construction in which a plurality of preformed metal wall elements are associated into an integral load-bearing unit of high structural strength. For the purpose of simplicity of description, the present construction will be hereinafter referred to as a "girder" construction, the comparable nature of girders and trusses being readily apparent to one skilled in the art, at least with reference to the hereindescribed structural shapes.

A further object of the invention is to provide a composite girder construction in which a plurality of intersecured vertically extending sectional metal elements define a web member, in association with advantageous forms of compression and tension members secured to the individual sectional elements.

A further object of the invention is to provide a composite girder structure for a corner construction in which two half-girder portions of separate intersecting walls are joined at the intersection of said walls to form a continuously supported beam or girder extending through or around such corner.

A further object of the invention is to provide an advantageous compression member construction associated with a plurality of vertically extending sectional elements in the formation of a composite girder.

The sectional elements employed in the present invention may conform in general to the elements shown and described in U. S. Patent No. 1,867,433, issued July 12, 1932, to J. H. Young. The invention herein set forth resides mainly in the novel association of a plurality of elements of this type with other structural members in the formation of a composite cellular girder construction. In my co-pending applications Serial Nos. 688,306 and 688,307, filed September 6, 1933, I have described and claimed certain wall structures employing sectional metal elements of the type described in the above-mentioned patent and the structures herein set forth are primarily adapted for use in connection with such wall constructions, although the usefulness thereof in other structures will be apparent to one skilled in the art.

The girder construction herein described is intended particularly for use as a simple beam supported at both ends, and the following description will refer particularly to such use thereof, although it will be understood that it may also be employed as a cantilever beam. The girder construction of the present invention comprises, essentially, a plurality of sectional metal elements provided with one or more vertically extending hollow cells and disposed in contiguous alined relationship to form a wall or a continuation of a wall. A transverse structural member is provided at the upper ends of the alined sectional elements in a relation such as to function as a compression member and assist in fixed alinement of said elements, and the lower ends of said elements are intersecured through the agency of a separate transverse member adapted to function as a tension member for the lower chord of the girder formed by the structure as a whole. The several sectional elements are preferably also intersecured at points intermediate the upper and lower transverse members to reduce shear stresses in said transverse members at the juncture of adjacent cellular elements.

Other objects of the invention will be brought out in the following description or will be apparent therefrom. The accompanying drawings illustrate certain preferred embodiments of the invention, and referring thereto:

Fig. 1 is a partly broken-away perspective of a girder construction of the present invention;

Fig. 2 is a vertical section thereof taken on line 2—2 in Fig. 1;

Fig. 3 is an inverted horizontal sectional detail thereof taken on line 3—3 in Fig. 1;

Fig. 4 is a view corresponding to Fig. 1 showing one end of a modified form of girder construction;

Fig. 5 is a horizontal sectional detail thereof taken on line 5—5 in Fig. 4;

Fig. 6 is a partly broken-away view of a structure embodying the present girder construction in the formation of a gable; and

Fig. 7 is a perspective view showing a corner construction, as viewed upwardly from the salient side of said corner, in which two girder portions in adjacent intersecting walls are brought together in the formation of a continuous girder.

Referring to the drawings, the preformed sectional metal elements employed in the present invention are shown in Figs. 1, 2, and 3, and each of said elements may comprise a flat plate portion 1 provided at its lateral edges with a male tongue member 2 and a female groove member 3 whereby adjacent cellular elements may be disposed in interlocking relation. The element further comprises a bent plate portion 4 secured to the flat plate portion 1 as by spot welding at suitable points along the height of said plate as at 5 and defining two vertically extending cells C

and an intermediate space C'. It will be appreciated that the specific form of cellular element herein delineated is not peculiar to the present constructions and suitably modified cross-sections may be equivalently employed, depending upon the load conditions to which the structure is to be subjected in use. For example, instead of providing two cells C of closed cross-section at the edge portions of the plate 1, I may for some uses provide a plate portion 4 of such shape as to define a single cell C extending medially of said plate 1. Similarly, two bent plate portions 4 may be brought together face to face to define a double "key-stone" cross-section, in which the tongue and groove members 2 and 3 may be provided by an extension of one or the other of said plate portions 4, as will be apperent to one skilled in the art. The side walls 6 of the cells C are preferably provided with a plurality of vertically spaced and horizontally alined openings 7, the purpose of which will be brought out in connection with the description of one embodiment of the invention.

In the assembly of the composite girder construction of the present invention, as shown particularly in Figs. 1 to 3, a post or column member is provided at each side of the length to be spanned by the girder, as at 11 and 12. These post members may constitute a part of a wall structure embodying a plurality of comparable elements of the shape shown, in which case the plane of the girder will lie in the plane of said wall. In the ensuing description no consideration will be made of stresses which develop in the assembly of the composite girder, inasmuch as the girder is conventionally assembled flat on the ground, whereby all elements are in unstrained condition, and the girder and/or wall of which the girder forms a part is erected as a unit after substantially complete assembly thereof. A compression member is provided extending along the alined upper ends of the posts 11 and 12 and across the space therebetween, which is to be spanned by the girder, said compression member comprising in this embodiment a channel member 13 formed of sheet metal or the like, said channel member being disposed with the side flanges 13*a* covering and depending from the upper ends of the sectional wall elements. A plurality of sectional elements 14 are provided in the plane of the wall intermediate the posts 11 and 12, said elements 14 being of such length as to define the proper depth of girder desired. The several adjacent elements 11, 14, and 12 are assembled in interlocking relation through the agency of the tongue and groove members 2 and 3, and the channel member 13 is secured to each of said elements, as by welding the side flanges 13*a* to the elements at each side of the wall, at suitably spaced intervals along the length of such channel member, as at 15. The lower or tension chord of the girder may be provided by a channel member 16 comparable to the member 13 inverted over the lower ends of the members 14 and provided with flange portions 17 extending longitudinally thereof at the forward and rearward sides of the wall, said portions 17 being secured to one or more cells and to the flat plate portion 1 of the post elements 11 and 12, as by welding at 17*a*, and being also secured to the elements 14 by welding or the like as at 18. The web 16*a* of the channel 16 may be cut away at each end, as shown at 19 in Fig. 3, so as to conform generally to the outline of the abutting portions of the post elements 11 and 12, whereby the web 16*a* may be carried along as great a proportion of the length of said channel as is practicable.

In the showing in Figs. 4 and 5, which illustrate one end of a modified girder construction, a plurality of sectional elements are provided as at 22 and 23, the element shown at 22 corresponding to the post element shown at 11 above and the elements 23 corresponding to the girder elements at 14 above. A compression member is provided along the alined upper ends of the elements 22 and 23 as in the above described embodiment and may comprise a wooden member 24 secured to the individual elements through the agency of J-bolts 25 engaging a transverse reinforcing member or rod 26 extending through a series of alined openings 7 in the side walls of the cells C provided by the several elements 22 and 23. The nuts 25*a* for the J-bolts 25 may, if desired, be recessed within the member 24, but in general it will be found unobjectionable to allow the nuts and bolt ends to project above the upper surface of said member. The tension chord for the girder may be provided by a transverse reinforcing rod 27 extending through a lower series of alined openings 7 in the side walls of the cells C of the several elements 22 and 23, preferably adjacent the lower ends of the elements 23, said rod being secured to the individual elements as by welding the same to the side walls thereof as shown at 28.

It will be appreciated that the above-described forms of girder may be modified with respect to one another, as by substituting the form of compression member shown at 13 for the compression member assembly shown at 24—26 in the structure shown in Fig. 4, or the lower or tension channel 16 may be substituted for the welded rod 27 set forth in Fig. 4, without departing from the spirit of this invention.

In Fig. 6 I have shown two abutting rafters 31 in the role of the compression member, said rafters being secured to a plurality of vertically extending girder elements 32 and to end or post elements 33 through the agency of a plurality of transverse rods 34 each extending through a series of horizontally alined openings 7 and a plurality of J-bolts 35 as described in connection with Fig. 4. A tension member 36 is provided along the lower edge of the suspended elements 32, which may comprise a channel member such as shown in Fig. 1 and similarly disposed and secured to the lower end portions of the girder elements 32 and to the post elements 33, or may alternatively comprise a rod arranged and secured as shown in Fig. 4.

The structure shown in Fig. 7 may comprise two intersecting walls 41 and 42 each formed of a plurality of sectional elements after the manner described in connection with Figs. 1 to 3, and including post elements 43 and 44. The composite girder is formed of a plurality of short elements 45 and 46, the elements in each wall being intersecured along their upper edges through the agency of a channel or the like 47, after the manner shown in Fig. 1, or, alternatively by an assembly comparable to that shown at 24—26 in Fig. 4, and the lower ends of said elements being intersecured through the agency of a tension member extending in the same relation as shown at 16 in Fig. 1 or 27 in Fig. 4. In this particular embodiment, the girder construction is adapted to support the roof loads over a corner window opening, and where steel sash are employed to define the window structures, the upper edge portion of the window sash

may be employed as a tension member, as shown at 48 and 49. The sash portions 48 and 49 are preferably welded to the elements 45 and 46 as indicated at 51, and the abutting ends of said portions 48 and 49 are intersecured as by welding at 52 to complete the tension chord. The intersection of the channels 47 is preferably also welded as at 53.

In each of the above constructions the adjacent or interlocking edges of the several elements are preferably intersecured at intervals along the length thereof as by welding, in order to preserve the alinement of the elements and increase the resistance of the girder to shear under vertical load, and in connection with Fig. 7 the intersecting edge of the two girder portions is preferably welded at least at intervals along the length thereof, as at 54. Under some circumstances, particularly where an exceptionally high roof load occurs in connection with a structure such as shown in Fig. 7, I preferably supplement the tension member provided by the portions 48 and 49 of the steel sash by suitable rods extending through a lower series of alined openings 7 in the elements 43—46, after the manner shown in Fig. 4, and the abutting ends of said rods may be welded together at the intersection of said walls to further augment the tension resistance of the girder. Alternatively, a tension member such as provided by the portions 48 and 49 of the steel sash may be supplemented by a tension strap extending along and secured to the rearward edges of the cells C and to the post cells, as indicated in dot-dash lines at 55, whereby a tension member is provided at each side of the neutral axis of the girder.

In each of the above-described embodiments of the invention, the transverse members employed at the upper and lower ends of the several sectional elements are inadequate, of themselves, to carry the vertically applied loads as a simple beam. In the embodiment shown in Fig. 1, the channel member 13 is of relatively light gauge metal, but the welding attachment of the channel member to the several section elements, together with the tension member at the lower ends of the elements, produces an exceptionally high beam strength in the composite structure. Similarly, in the form shown in Fig. 4, the wooden member 24 is of itself inadequate as a beam, and reliance is placed upon the J-bolts 25 to produce the desired compressional resistance at the upper edge portion of the girder by communicating to the composite girder the inherent resistance to compression possessed by the member 24.

It will be apparent that simple welding of the several elements along the interlocking tongue and groove portions 2 and 3 will not be effective to produce an adequate beam strength in the structure in view of the fact that the lower portions of the welds would be in tension and the tendency would be for the weld to break and the tongue and groove joints to open up under the load. Furthermore, such a welded structure would be objectionable as not concentric with the neutral axis of the beam. The tension member 16 is subjected only to shear at the points of attachment thereof to the posts 11 and 12, and the desired quantity of metal may easily be determined from a knowledge of the load which the girder is required to support, whence, with a given cross-section of the upper channel member 13 or compression member 24, the requirements of the attachment at 17 may be calculated easily.

The use of girder structures according to the present invention in connection with wall structures employing comparable shapes of sectional elements, eliminates the requirement of structural members which are not in consistency with the wall-forming elements, i. e., I-beams and the like, provides easy assembly, and permits both the wall and girder structures to be fabricated of the same stock materials.

I claim:

1. A composite girder which comprises a plurality of vertically extending sectional metal elements each provided with one or more vertically extending hollow cells and disposed in contiguous relationship to form a wall, a transverse compression member extending along one end of said elements and secured thereto, and a transverse tension member extending along the other end of said elements and secured thereto.

2. A composite girder which comprises a plurality of vertically extending sectional metal elements disposed in contiguous alined relationship to form a wall, each of said metal elements having one or more vertically extending hollow cells, a channel member disposed over the upper ends of said alined elements and secured to each of said cells, and a tension member extending along the lower ends of said elements and secured to each of said cells.

3. The construction set forth in claim 2, the hollow cells of said metal elements being provided with a plurality of vertically spaced and horizontally alined openings, and said tension member comprising a reinforcing rod extending through a lower series of such alined openings and secured to said hollow cells adjacent said openings.

4. A composite girder which comprises a plurality of vertically extending metal elements disposed in contiguous alined relationship to form a wall, each of said metal elements being provided with one or more vertically extending hollow cells having a plurality of vertically spaced and horizontally alined openings in the side walls thereof, a compression member extending along the upper ends of said elements, a reinforcing rod extending through a series of said alined openings adjacent the upper ends of said elements, a plurality of bolt members engaging said compression member and said reinforcing rod at intervals along the length of said wall, and a tension member extending along the lower ends of said elements and secured thereto.

5. The construction set forth in claim 4, said tension member comprising a reinforcing rod extending through a lower series of said alined openings and secured to each of said hollow cells at the position of said openings.

6. In a metal wall building construction, a composite girder which comprises: two intersecting wall portions each formed of a plurality of vertically extending metal elements disposed in contiguous alined relationship in a plane, the elements in each of said walls being provided with one or more vertically extending hollow cells; a compression member extending along the upper ends of said elements in each of said walls and secured to said hollow cells, said compression members being intersecured at the juncture of said walls; a tension member extending along the lower ends of said elements in each of said walls and secured thereto, the adjacent elements of said two walls at the juncture thereof being secured to one another and said tension mem-

bers being intersecured at the juncture of said two walls.

7. In a metal wall building construction, a composite girder defining a window lintel and comprising: two intersecting wall portions each formed of a plurality of vertically extending metal wall elements disposed in contiguous alined relationship in a plane, the elements in each of said walls being provided with one or more vertically extending hollow cells; a compression member extending along the upper ends of said elements in each of said walls and secured to said hollow cells, said members being intersecured at the juncture of said walls; a steel window sash disposed below the lower ends of the wall elements in each of said walls and each having an upper edge portion, said upper edge portion of each sash being secured to the lower ends of said elements in the respective walls and to the other sash at the juncture of said walls to define a tension member for said girder.

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