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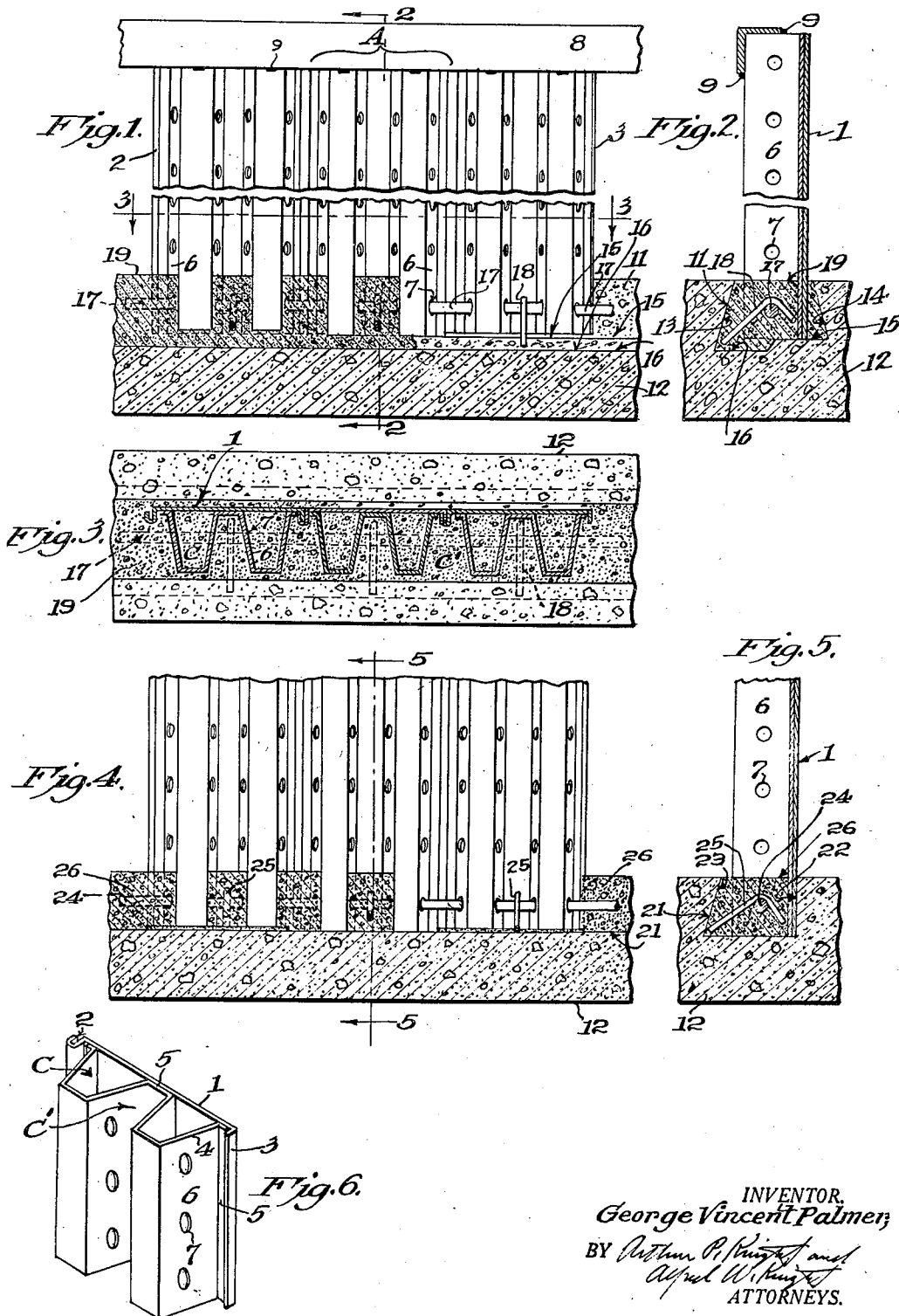
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2,200,636

METAL WALL BUILDING CONSTRUCTION

Filed April 13, 1936

2 Sheets-Sheet 1



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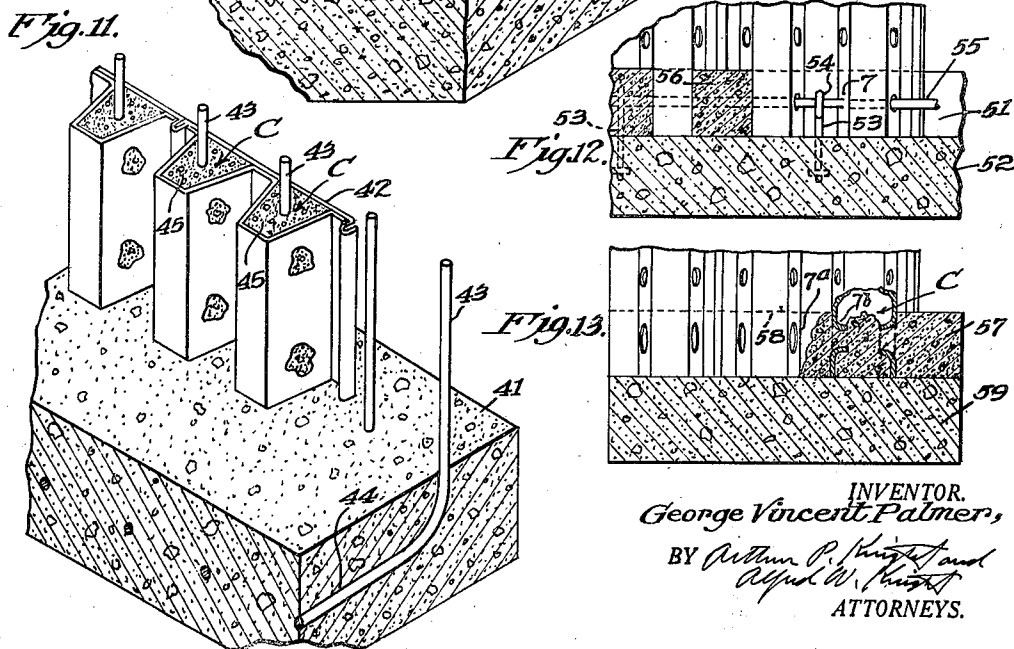
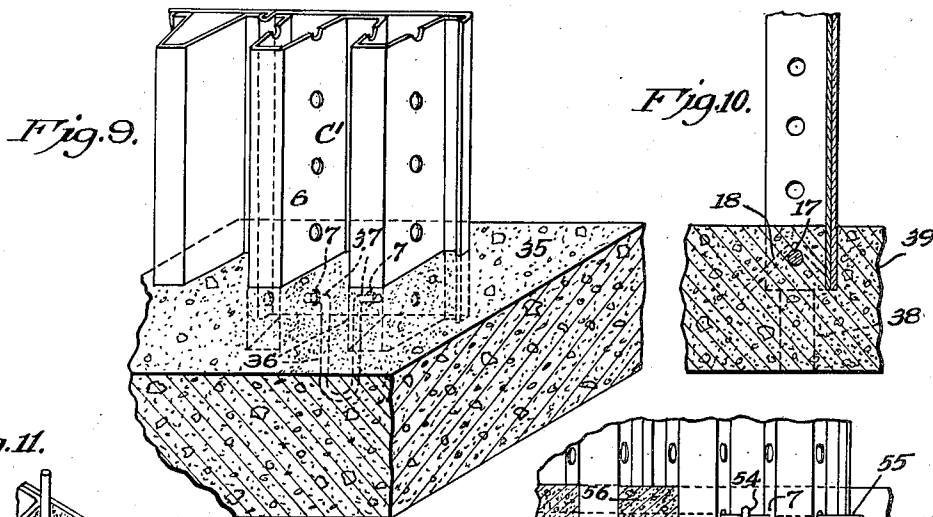
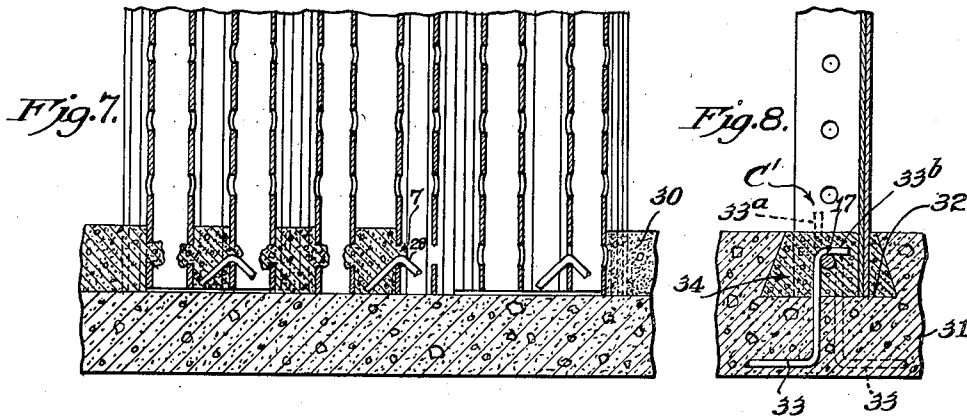
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METAL WALL BUILDING CONSTRUCTION

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,200,636

METAL WALL BUILDING CONSTRUCTION

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Application April 13, 1936, Serial No. 74,116

9 Claims. (Cl. 189—1)

This invention relates to building construction, and particularly to a building construction employing preformed metal wall elements and to advantageous means for securing a vertical wall structure formed of such metal wall elements to a foundation member.

This application is a continuation-in-part of my co-pending application Serial Number 688,306, filed September 6, 1933, allowed January 7, 1936.

The present invention involves the use of metal wall elements which are commercially available or may be easily manufactured, and which may be assembled in a novel and advantageous manner to form walls and wall sections of high structural strength at a low cost. Structural shapes such as shown and described in U. S. Patent No. 1,867,433, issued to J. H. Young, July 12, 1932, may be used to good advantage for the purposes of this invention, but it will be understood that other types of preformed metal wall elements, examples of which are referred to hereinafter, may also be used.

One of the important objects of the invention is to provide for easy and effective attachment of a sectional metal wall construction to a foundation member.

A further object of the invention is to provide a construction in which a vertically extending metal wall or metal wall element of the character described may be sealed to a masonry member extending along the lower edge of said wall or wall element in such manner as to obtain a weather-tight joint having high resistance to stresses applied in any direction.

A further object of the invention is to provide a construction in which a plurality of similar structural elements are joined to give a composite unitary wall structure in which the upper ends of said elements are alined at a common level, while the lower ends thereof are supported on a concrete or other masonry foundation member in such manner that variations in the length of such structural elements are compensated for, to provide substantially equal load-bearing characteristics for each of the said structural elements, and to provide for properly supporting the lower ends of all of said elements.

A further object of the invention is to provide a construction whereby a plurality of structural elements are secured and held in mutual alinement by a suitable concrete or other masonry construction.

A further object of the invention is to provide a construction in which a plurality of similar

structural elements are joined to give a composite unitary structure having its lower edge portions disposed in a masonry foundation member and interlocked therewith through the agency of a suitable reinforcing structure, whereby the composite wall structure and the foundation structure will effectively be made into an integral structural assembly.

Further objects and advantages of the invention will be pointed out hereinafter or will be apparent from the following description.

The construction of the present invention contemplates the use of structural elements formed of sheet steel or other metal, and consisting generally of flat plates provided or not with one or more hollow cells secured thereto and extending longitudinally thereof, said flat plate portions of the structural elements being preferably provided at their longitudinal edges with overlapping portions whereby two or more of said elements may be assembled in a plane to form a vertical wall. The overlapping portions may, if desired, be so formed as to interlock with one another so as to form, when so assembled, a substantially continuous structural wall or wall section of high load-carrying capacity and high resistance to stresses applied in any direction in the plane of the wall.

In the forming of a wall through the use of structural elements of the character above described, the several elements are preferably disposed in alined vertical relation and the several elements may be suitably secured at one end, as by welding or otherwise, to a suitable structural member extending along the length of the wall, and the other ends embedded in a masonry member extending along the full length of such wall.

In its broad conception, the present invention provides a wall construction in which a plurality of structural wall elements of the character described are alined in a desired vertical plane, with their abutting edges suitably inter-engaged, the lower ends imbedded in a concrete or other suitable masonry foundation member and the upper end preserved in alinement, for example, through the agency of an alinement member secured to or engaging said elements. The structural attachment of the elements by embedment of the lower ends thereof in masonry, as aforesaid, may be augmented by providing suitable apertures in the side walls of the element whereby the masonry may extend through such side walls and thus mechanically interlock the elements to the foundation member, or suitable projections may be formed on the elements,

which may be caused to engage the masonry member and thus contribute to the mechanical interlock.

According to a preferred embodiment of the invention a plurality of structural wall elements of the character described are alined in a desired vertical plane, with their abutting edges suitably interlocked, and the lower edge portions of each of the individual elements are placed in a suitable groove in a masonry foundation member, after which a reinforcing member such as a steel rod is passed longitudinally through the hollow cell portions of the elements through suitable apertures in the side walls of each hollow cell disposed relatively close to the lower end of each of the elements, whereby such rod is positioned below the upper edge level or such groove, and a suitable masonry grout is then cast in place within such groove and surrounding said rod and the lower end portions of said elements. Numerous modifications of such construction are possible, and auxiliary reinforcing members may be employed to obtain a more satisfactory load and stress distribution between such reinforcing rod and the masonry grout, and it will be appreciated that the following disclosed modifications are but exemplary.

The accompanying drawings illustrate the several features of the present invention, together with certain important modifications thereof, and referring thereto:

Fig. 1 is a partly sectional broken-away side elevation of a wall construction according to the present invention, showing one arrangement for securing the lower ends of the wall structure in a masonry foundation member;

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

Fig. 3 is a horizontal section thereof taken on line 3—3 in Fig. 1;

Fig. 4 is a view substantially conforming to Fig. 1, in which a modified form of groove and grout is shown;

Fig. 5 is a section thereof taken on line 5—5 in Fig. 4;

Fig. 6 is a view of a section of a wall element of the type shown in Figs. 1 to 5;

Fig. 7 is a view corresponding generally to Fig. 1, showing a modified type of reinforcing means integrally securing the metal wall elements within the grouting masonry;

Fig. 8 is a view corresponding to Fig. 2, showing a construction in which a reinforcing tie member is embedded in the masonry foundation member and employed to co-operate with a reinforcing rod or the like passed through the metal wall sections within a grouting groove;

Fig. 9 is a perspective view of a modified embodiment of the invention in which the metal wall element is supported in a solid masonry block and provided with a reinforcing tie to said block;

Fig. 10 is a view corresponding to Fig. 2, showing a metal wall element supported in a solid masonry block with a modified form of reinforcing tie;

Fig. 11 shows a construction whereby a metal wall may be secured to a divergent masonry member to form an interiorly and exteriorly reinforced juncture;

Fig. 12 shows a construction in which a reinforcing rod member and a plurality of eye-bolts co-operate to secure alined wall elements to a masonry foundation member; and

Fig. 13 shows a construction embodying a modified

type of wall element provided with projections which may be caused to engage in the foundation or other masonry member to obtain the desired interlock.

The shape of the individual wall elements may be as shown in detail in Fig. 6, wherein such an element is shown as comprising a flat plate 1 provided along one longitudinal edge with a female interlocking member such as a groove 2 and along the opposite edge with a male interlocking member such as a flange 3. The hollow cells which contribute to the structural strength of the elements may be formed by a metal sheet 4 which may be bent to form one or more channels of U or V shape and secured to the plate 1 at points of contact such as at 5 by welding or riveting, or in any other suitable manner, with the open side of the channels facing the sheet 1. The flat sheet 1 and the bent sheet 4 thus define a plurality of parallel longitudinal hollow cells C, each having the closed cross-sectional shape of a symmetrical trapezium and extending along the length of the element and preferably throughout substantially the entire length thereof. An intermediate channel C' of similar but reversed shape is thus also provided, with its open side directed away from the flat sheet 1. The side walls 6 of each of the cells C are provided with one or more openings 7 through which a suitable reinforcing member may be extended, as subsequently described, and such holes 7 are preferably alined in adjacent cells in a plane normal to the length of the elements whereby such a reinforcing rod may be extended through from one cell to another.

Additional shapes of wall elements, having hollow cells of modified cross-sectional configuration, have been heretofore described in the above-mentioned Young patent and are further delineated in Figs. 2 and 3 of my co-pending application Serial Number 688,307, filed September 6, 1933.

Referring to Figs. 1 to 3, a plurality of units such as shown in Fig. 6 are assembled in a common plane, with the male interlocking member 3 of one element disposed in the female interlocking member 2 of an adjacent element, and a suitable attaching member such as an angle iron 8 may be welded as at 9 or otherwise suitably secured to the upper ends of the elements as shown in Figs. 1 and 2 to provide for disposition of imposed loads among the several elements. Attachment of the angle member 8 in the above described manner effects an alinement of the upper ends of the structural elements, and when the desired length of wall structure is so assembled, it may be shored in place in a vertical position with the lower ends of the respective elements in a suitable groove 11 in a masonry foundation block 12. In this particular modification, the groove 11 is shown as provided with outwardly sloping side walls 13 and 14, whereby the bottom of said groove is of greater dimension than the top of said groove and a desirable dove-tail construction is provided. The groove 11, furthermore, is preferably slightly wider at its upper portion than the transverse thickness of the wall elements to provide an easy insertion of such elements within the groove, and the bottom wall of the groove is preferably formed with upper and lower stepped portions 15 and 16, whereby the wall elements may rest on the upper portion 15 and a clearance is provided between the bottom edge of the wall elements and the lower stepped portion 16 to provide for easy flow of the

grout material upwardly within the hollow cells C. In fabrication of the wall elements, some variation in the longitudinal dimensions thereof will occur, or when longer elements are cut to form a wall of a given height, the cutting may not be perfect, but such variation in the length of adjacent elements is in no sense sufficient to provide an adequate space at the ends to allow free flow of the grout material into the groove 11. In Fig. 1 the central element A is shown as a long element resting against the bottom portion 15 of the groove 11, while the right and left hand sections are shown as somewhat shorter and separated from the groove portion 15 a short distance. It will be understood that the angle member 8, as above pointed out, provides for satisfactory alinement of the elements of the upper edge of the wall and thus the variations in the length of adjacent elements are confined to the lower edge of the wall. The side walls 6 of the cells C are provided with suitable openings 7 as described in connection with Fig. 6, and through the lowermost series of such openings a suitable reinforcing rod 17 is extended. A suitable number of transverse reinforcing elements such as bent rods 18 may be laid over the rod 17 in the cell spaces C' to provide for distribution of load from the rod 17 into the grout provided in the groove 11. After the reinforcing rods 17 and 18 are placed in position, the groove 11 may be filled with masonry flush with the upper surfaces of the masonry foundation member 12 as shown at 19, and allowed to harden.

In the above construction, the individual section wall elements are accurately maintained in alinement by their embedment in the grout 19, will resist force applied transversely to the plane of the wall due to the presence of the rod 18 and the flat plate portions 1 of the elements, will resist forces applied horizontally in the plane of the wall by virtue of the projecting cells C, and will resist forces applied vertically in the plane of the wall by reason of the rods 17 and 18, it being comprehended that at all times the grout 19 is securely positioned with respect to the masonry foundation member 12 by virtue of the dove-tail interlocked therewith.

In the modification shown in Figs. 4 and 5, the masonry foundation member 12 is provided with a modified form of groove 21, which is shown as provided with a positioning edge 22 against which one side of the wall elements may be disposed in alinement, and an upwardly sloping side-wall portion 23 at the opposite side to provide a partial dove-tail construction. A rod 24 corresponding to the rod 17 and a plurality of rods 25 corresponding to the rods 18 may be employed after the manner shown in Fig. 1 to further assist in the maintenance of the wall elements within the grout groove, and a suitable grout 26 may be cast into the groove 21 in the manner above described.

Referring to Fig. 7, the wall elements may be disposed within a grout groove 30 of the type shown in Fig. 2 or of the type shown in Fig. 5, and a plurality of short reinforcing rods 28 inserted through the openings 7 in the side walls of the elements, said rods 28 having their end portions bent downwardly so as to cause such rods to persist in position. Any suitable number of such rods may be employed dependent upon the particular construction desired, and while I have shown but one rod in each hollow cell C, it will be appreciated that one or more rods may be inserted in each perforated side wall of each cell whereby an added strength is obtained.

Referring to Fig. 8, a masonry foundation member 31 is shown as provided with a dove-tailed flat-bottomed grout groove 32, although it will be appreciated that a stepped bottom groove such as shown at 15-16 in Fig. 5 may be equivalently employed, and a plurality of reinforcing rods 33 are cast in the block 31 in such position as to have a portion extending upwardly within the space C' provided between two adjacent cells C of a wall element, whereby after insertion of a reinforcing rod 17 the upper end portions of such rods 33 may be bent downwardly from their original position (as shown in dotted lines at 33a) into engagement with the rod 17, as shown at 33b. After the upper end portions of the rods 33 are bent downwardly over the installed rod 17, masonry of a suitable consistency may be cast into the groove 32 in position to surround the lower ends of the wall elements and engage the rods 17 and 33 after the manner shown at 34.

In Figs. 9 and 10 I have shown a construction in which the end portions of the individual wall elements are cast in the foundation block itself, and according to Fig. 9, a reinforced tie between the wall element and the concrete or other masonry foundation member 35 may be provided as by means of a U-shaped member 36 having outwardly bent portions 37 disposed in place within the space C' with the projecting portions 37 extending through opposing openings 7 in the side walls 6 of such element. In assembling a structure such as shown in Figs. 9 and 10, it will be practical to place a suitable block or the like such as shown at 38 in Fig. 10 in load supporting relation to the elements during the placement of the masonry foundation, as will be apparent to one skilled in the art.

In Fig. 10 a rod 17 and a plurality of rods 18 may be employed in a manner comparable to that shown in Fig. 1, the wall elements blocked in place as above described and the masonry foundation cast in place about the elements as shown at 39.

In Fig. 11 I have shown a construction in which a wall comprising one or more metal wall elements, for example of the type shown in Fig. 6, are tied to a divergent masonry structure through the use of reinforcing rods or the like. The numeral 41 may represent a masonry foundation or other supporting structure and the elements may form a wall 42. A plurality of reinforcing rods 43 are disposed within any one or any number of the hollow cells C of the elements and may be extended into the area occupied by the masonry member 41 as shown at 44. Concrete or other suitable masonry may be poured into the hollow cells C as shown at 45 concurrently with the pouring of the member 41 so as to surround the rods 43 and, if desired, the lower ends of the elements may be embedded in the member 41 after the manner shown in Figs. 9 or 10. If desired, the member 41 may be preformed with the rods 43 in place as shown at the right-hand side of this figure and the elements placed in position over such rods with or without the use of a groove and grout as shown in Figs. 1 to 8, and masonry placed as at 45 whereby the wall 42 is securely positioned with respect to the member 41. This construction provides a junction between a metal wall and a divergent structural member of very high strength characteristics, particularly in that the individual masonry columns or blocks 45 are interiorly reinforced through the agency of the rods 43 and are exteriorly reinforced by the metal wall elements. As 75

an alternative construction, the member 41 may be preformed with the rods 43 in place and a suitable grout groove such as shown in Fig. 2 provided to receive the ends of the wall elements, as above suggested, and then concrete or other suitable masonry poured into the grout groove as described in connection with Figs. 1 to 3, in which case the concrete will rise within the lower portion of each of the elements and provide the desired interlock.

In Fig. 12 I have shown a plurality of elements, the lower edges or ends of which are disposed within a grout-groove 51 in a foundation member 52. At suitable intervals along the length of the groove 51 eye-bolts 53 are embedded in the foundation member, either being cast in place when the member 52 is cast, or cemented into the said member at a later date. The eye-ports 54 of the bolts 53 are preferably positioned in approximate alignment with the lower row of holes or openings 7 in the side walls of the elements, in position to engage a reinforcing rod 55 passed through said holes. When the grout 56 is filled in, as shown at the left side of this figure, the rod will be engaged by said grout, and, through the agency of the bolts 53, both said rod and said grout will be firmly positioned with respect to the foundation member. It will be appreciated that a dove-tailed grout is not essential to this embodiment of the invention, inasmuch as a straight-sided grout may advantageously be employed without sacrifice of structural strength in the construction.

In Fig. 13 I have shown a modified construction in which a modified type of wall element is employed, in which the lowermost openings 7a in the side walls of the cells C are formed by punching a relatively large portion of the metal of the side wall into the cell C, to form a laterally projecting portion 7b within said cell. When a grout 57 is poured into position within the groove 58 in the foundation member 59, about the lower ends of this particular type of wall element, the masonry will flow into position surrounding the portions 7b and thus secure a firm interlock of the grout with the wall structure. It will be appreciated that the above-described form of laterally projecting portion of the wall elements is not the only type which would be useful according to this embodiment of the invention, inasmuch as practically any desired type of laterally projecting grout-engaging member of like function may be provided. It will be further appreciated that the embodiments shown in Figs. 12 and 13 are equally adapted to monolithic foundation constructions, the form shown in Fig. 13 being employed in a manner comparable to that described in connection with Fig. 10, and the form shown in Fig. 12 may be adapted to monolithic construction by wiring the bolts 53 in place to dispose the same in a preferred medial position with respect to the spaces between the adjacent cells C.

In Figs. 1, 4, 7, and 12, the grout has been broken away at the right-hand side, and in Fig. 13 it has been broken away at the left-hand side, whereby the embedded structure may be more clearly shown, and it will be appreciated that the grout will be placed in substantially the full length of the grouting groove in conventional practice of the invention, although under some circumstances it may be advisable to omit the grout at certain areas, according to the particular construction involved.

Numerous additional modifications of the herein delineated constructions will occur to those

skilled in the art, and it will be appreciated that I consider myself in no sense limited to the specific forms shown, but rather to the scope of the appended claims. For example, the reinforcing rods 17 or 24 and the associated reinforcing elements may be omitted under some circumstances, if desired, and a structural interlock or interbond of the fluid grout depended upon, as by causing such grout to fill the spaces C and C' and interbond through the embedded openings 7, using the form of wall elements shown in Fig. 6, after the manner shown in Fig. 13. It will also be appreciated that supporting blocks such as shown at 38 with respect to Figs. 9 and 10 will not be required to support each element of the wall structure, but may be placed at suitable intervals along the length of such structure, the intervening wall elements being supported jointly by the structural member along the upper ends thereof (angle 8, Fig. 1) and the rod 17, 24 or the like at the lower end of the wall.

I claim:

1. A metal wall building construction comprising a plurality of vertically extending preformed metal wall elements disposed in contiguous aligned relationship to form a wall, and a masonry member extending along the lower edge of said wall, the lower end portion of each of said wall elements being embedded in said masonry members, at least one of said metal wall elements comprising one or more vertically extending hollow cells, and said invention comprising in addition, reinforcing means embedded in said masonry member and secured to one or more of said hollow cells.

2. A metal wall building construction comprising a plurality of vertically extending preformed metal wall elements disposed in contiguous aligned relationship to form a wall, and a masonry member extending along the lower edge of said wall, the lower end portion of each of said wall elements being embedded in said masonry member, at least one of said metal wall elements comprising one or more vertically extending hollow cells, and comprising in addition, reinforcing means embedded in said masonry member and having portions extending into one or more of said hollow cells, and said masonry member having portions disposed within said last-named cells and surrounding and engaging said extending portions of said reinforcing means.

3. A metal wall building construction comprising a plurality of preformed metal wall elements disposed in contiguous aligned relationship to form a vertical wall, at least one of said elements comprising one or more longitudinally extending hollow cells, a masonry member extending along an edge of said wall transverse to the length of said cells, reinforcing means disposed in said masonry member and having portions extending into one or more of said hollow cells, and a masonry member disposed within said last-named hollow cells and surrounding such extending portions of said reinforcing means.

4. A metal wall building construction which comprises: a plurality of vertically extending preformed metal wall elements disposed in contiguous aligned arrangement to form a wall, at least one of said elements being provided with side walls defining at least one hollow cell extending vertically along at least a portion of the length thereof and having openings therein; a reinforcing member extending through one of said openings at the lower end of said element and engaging a side wall thereof; and a masonry

member extending along at least a portion of the lower edge of said wall, in engagement with said one element and at least a portion of said reinforcing member.

5 5. A metal wall construction as set forth in claim 4, the openings in opposing side walls of said hollow cell being in substantially transverse alignment and said reinforcing member extending through such aligned openings in engagement
10 with said side walls.

6. A metal wall construction as set forth in claim 4, the openings in opposing side walls of said hollow cell being in substantially transverse alignment and said reinforcing member extending through such aligned openings in engagement
15 with said side walls, and comprising in addition: one or more transverse reinforcing members engaging said first-named reinforcing member and said masonry member.

20 7. A metal wall building construction comprising a plurality of preformed metal wall elements in contiguous aligned relationship to form a vertical wall, at least one of said elements comprising one or more longitudinally extending hollow cells
25 having open lower ends, a masonry member extending along an edge of said wall transverse to the length of said cells, said masonry member including a portion extending upwardly within the open lower end of a hollow cell of said one element and secured to said element, said hollow
30 cell or cells comprising vertically extending side walls provided with transverse openings, and said construction also comprising reinforcing means embedded in said masonry member and extending
35 through an opening in at least one of said side walls in engagement with said side wall.

8. A metal wall building construction comprising: a plurality of vertically extending preformed metal wall elements disposed in contiguous aligned
40 relationship to form a wall, at least some of said elements being provided with one or more longitudinally extending hollow cells open at their lower ends and providing a group of substantially enclosed vertically extending spaces, the adjacent
45 hollow cells of said wall being spaced from one another along the length of said wall to provide a group of partly enclosed vertically extending spaces, the individual spaces in said last-named group being disposed intermediate the individual
50 spaces of said first-named group, and said hollow

cells serving to define the lateral limits of said wall; a masonry foundation member extending along the lower edge of said wall and having a groove in position to receive the lower end portion of each of said wall elements; and a grout
5 disposed in said groove and engaging said lower end portions of said wall elements, the lower end portion of each of said elements being embedded in and substantially surrounded by said grout, and said grout having portions extending up-
10 wardly from below the lower edge of said wall into the spaces of one of said groups of spaces and within the lateral limits of said wall, and said groove being provided with a stepped lower wall, and at least some of said elements engaging the
15 upper stepped portion of said lower wall at said lower end portions of said elements.

9. A metal wall building construction comprising: a plurality of vertically extending preformed metal wall elements of varying vertical length
20 and disposed in contiguous aligned relationship to form a wall; means integrally securing said sections together along the upper edge of said wall with the upper edges in substantial horizontal alignment with one another; at least some of said
25 elements being provided with one or more longitudinally extending hollow cells open at their lower ends and providing a group of substantially enclosed vertically extending spaces, the adjacent hollow cells of said wall being spaced from one
30 another along the length of said wall to provide a group of partly enclosed, vertically extending spaces, and the individual spaces in said last-named group being disposed intermediate the individual spaces of said first-named group, and
35 said hollow cells serving to define the lateral limits of said wall; a masonry foundation member extending along the lower edge of said wall and having a groove in position to receive the lower end portion of each of said wall elements with the
40 longer of said elements having their lower ends in engagement with the bottom of said groove; and a grout disposed in said groove and engaging the lower end portions of each of said wall elements, said grout having portions extending upwardly
45 from below the lower edge of said wall into the spaces of one of said groups of spaces and within the lateral limits of said wall.

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