Aug. 31, 1965 E. O. BRANSFORD, JR 3,203,151

METAL BUILDING CONSTRUCTION

Filed April 11, 1961 4 Sheets-Sheet 1

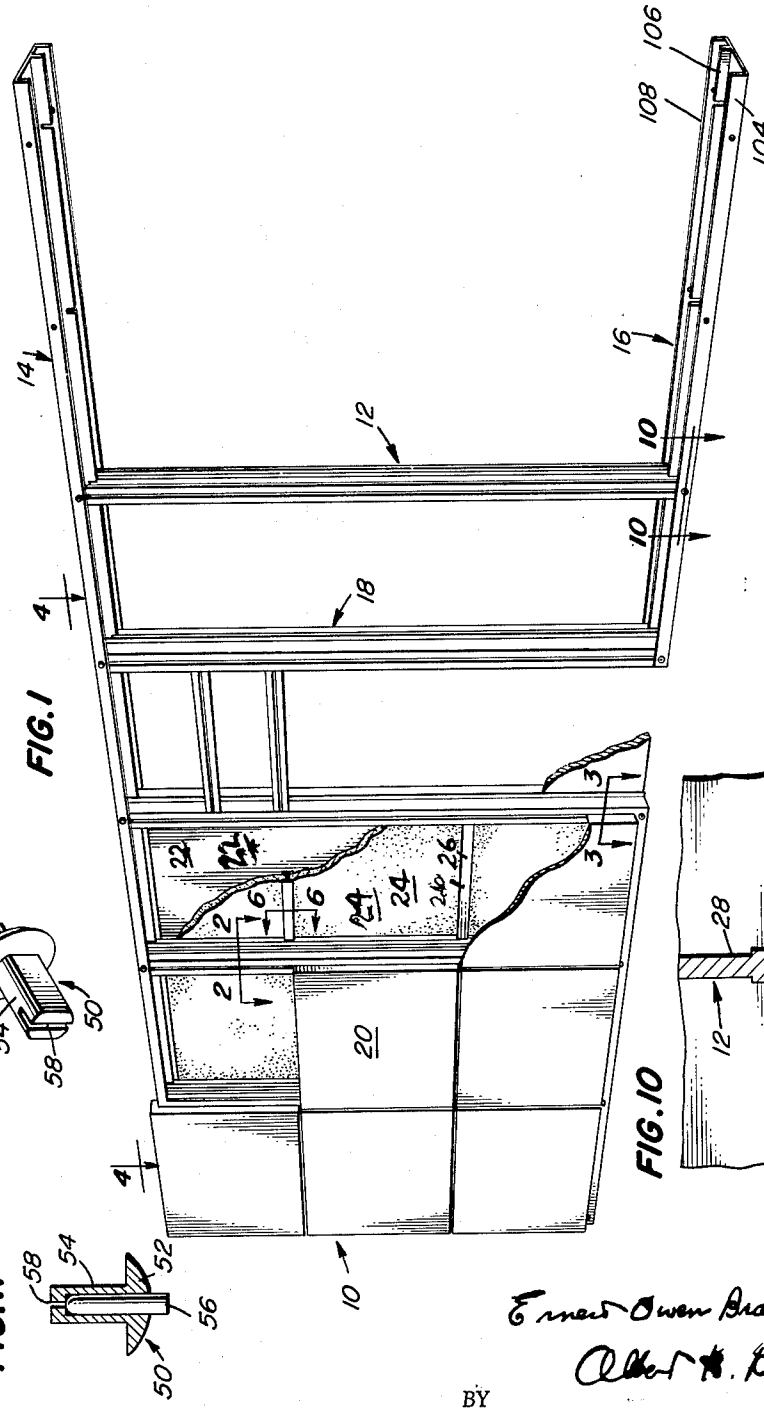

FIG. 1

FIG. 12

FIG. 11

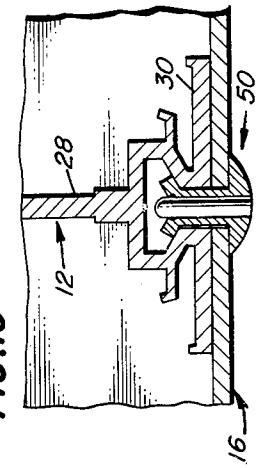

FIG. 10

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METAL BUILDING CONSTRUCTION

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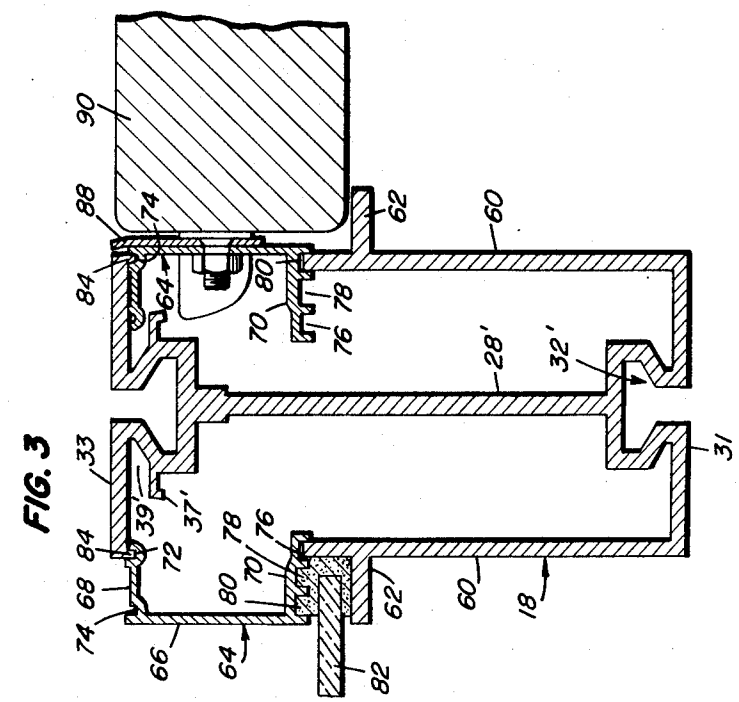

FIG. 3

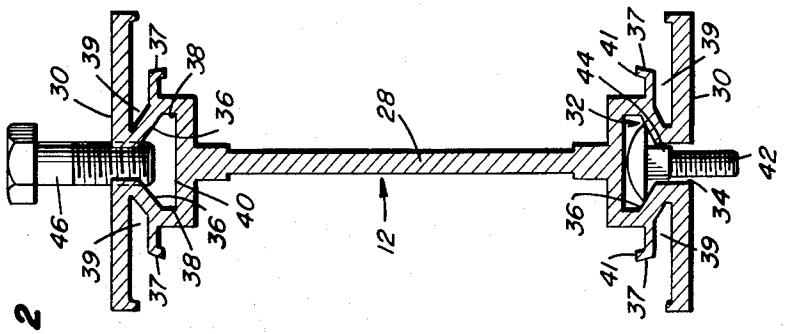

FIG. 2

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METAL BUILDING CONSTRUCTION

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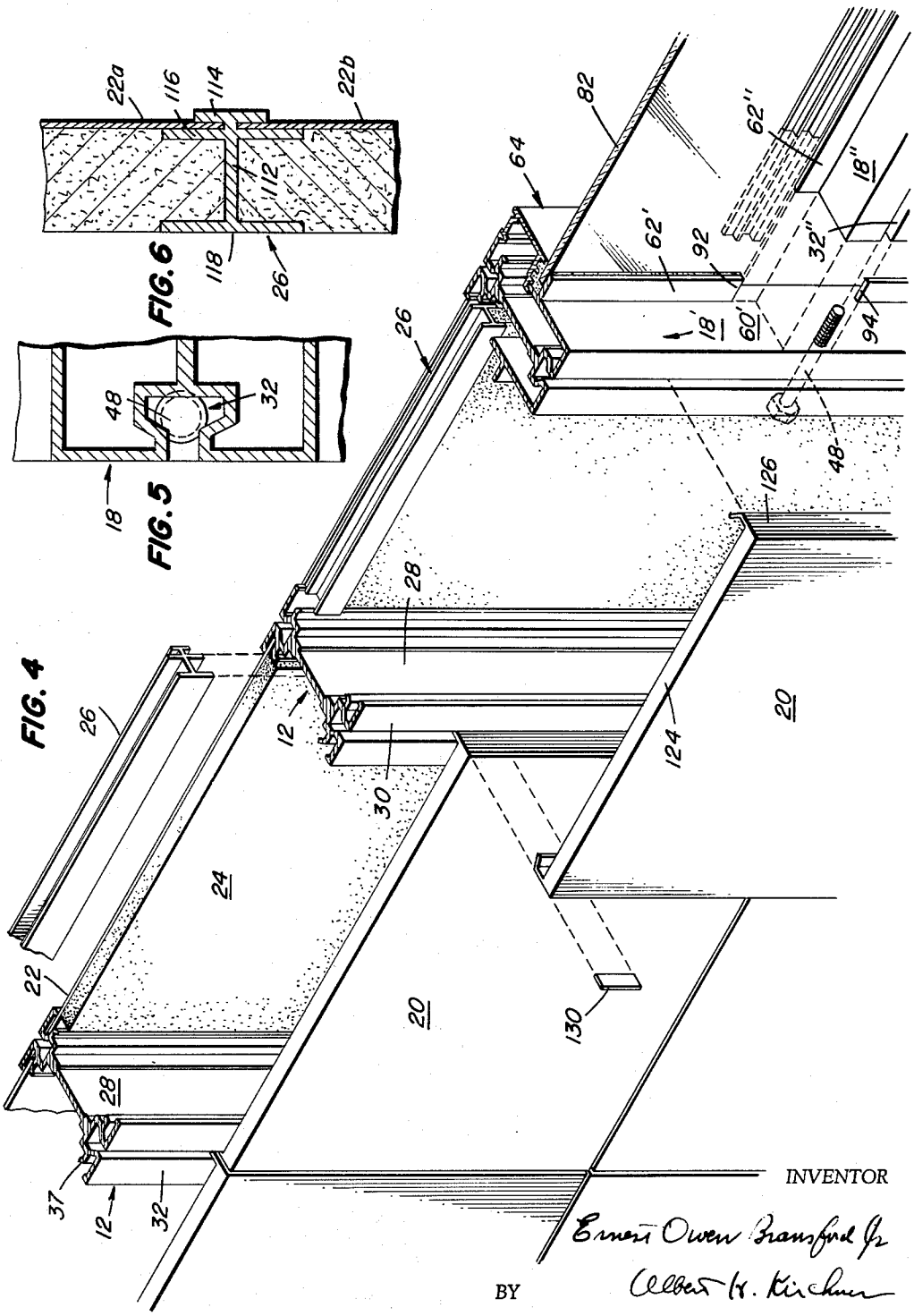

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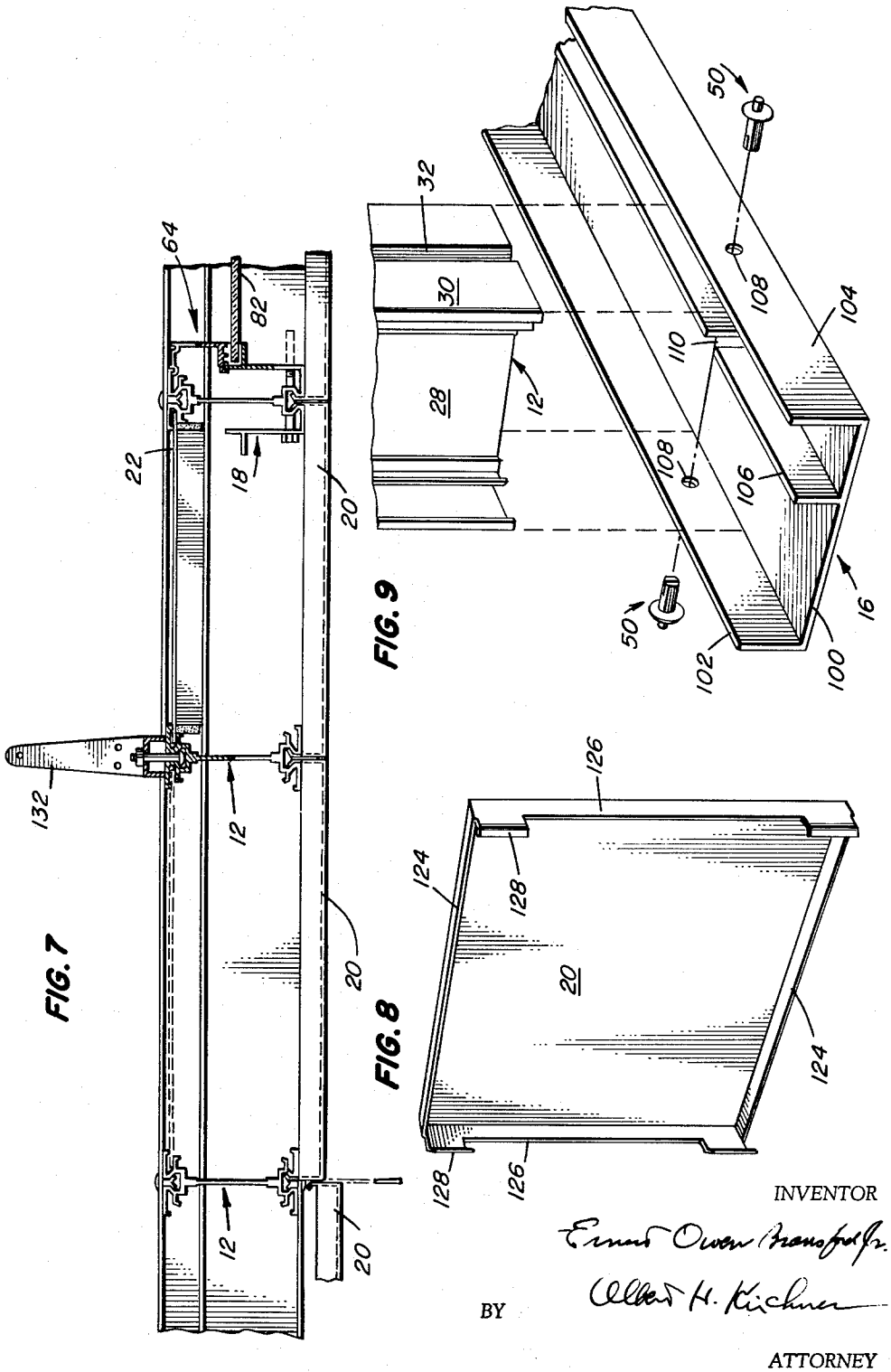

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3,203,151

METAL BUILDING CONSTRUCTION

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Filed Apr. 11, 1961, Ser. No. 102,174
4 Claims. (Cl. 52—729)

This invention relates to metal building construction and more particularly to a construction including structural components such as studs and wall panels which are prefabricated for subsequent assembly at the building site.

It is an object of this invention to provide a metal building construction including interlocking stud and panel members which provide ease and economy of fabrication, assembly, and maintenance.

It is another object of the invention to provide a metal building construction including stud and panel members which function in a dual structural and finish role, thereby achieving an unusually efficient use of material.

It is another object of the invention to provide a metal building construction including stud framing to which prefinished metal panels may be securely affixed without drilling or otherwise piercing the finished panels and which will permit individual replacement of panels if necessary.

It is still another object of the invention to provide a metal building construction including stud framing to which collateral structural members and building accessories may be attached without drilling of the stud or of the associated paneling and without requiring close alignment of mating parts.

Further objects and advantages of the invention will become apparent with the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is an isometric view of a wall constructed in accordance with the invention, with parts broken away to reveal important elements of the construction;

FIG. 2 is a view in horizontal section along the line 2—2 of FIG. 1, showing the primary framing stud;

FIG. 3 is a view in horizontal section taken along the line 3—3 of FIG. 1, showing details of the modified framing stud used for accommodating conditions occurring at door, window, and other openings in the wall structure;

FIG. 4 is an isometric view taken at the plane 4—4 of FIG. 1 showing details of the wall construction;

FIG. 5 is a view in transverse section showing how a thread-cutting metal screw may extend longitudinally into the groove or slot of either of the basic stud members;

FIG. 6 is a view in vertical section along the line 6—6 of FIG. 1 showing the engagement of one of the batten members with the inner wall panels and with the rigid insulation bats;

FIG. 7 is a top plan view of a wall assembly in accordance with the invention;

FIG. 8 is an isometric view of one of the panels used in the wall and stud construction;

FIG. 9 is an isometric view showing the method of securing the framing studs to channels at the head and sill of the wall;

FIG. 10 is a view in horizontal section along the line 10—10 of FIG. 1 showing details of the connection of the framing stud to the sill channel;

FIG. 11 is a view in section of one of the blind rivets used in the construction; and

FIG. 12 is an isometric view of the blind rivet of FIG. 11.

In achievement of the above recited objectives, there is provided in accordance with this invention a metal building construction including metal studs which are

preferably extrusions of aluminum alloy or the like, the studs each including a web and oppositely disposed flanges. The studs are connected at their upper and lower ends to sill and head channels. At least one flange of each stud is provided intermediate the width of the flange with a vertical groove, preferably of T-shaped cross section, which opens inwardly from the outer face of the flange. Exterior panels extend between adjacent studs, the panels including vertical edges which interlockingly engage the grooves of the stud flanges. The grooves of the stud flanges, in addition to receiving the panel members in interlocked engagement, are also so shaped as to receive selectively various types of fastener members, such as carriage bolts, threading screws, rivets, and the like.

The studs are also provided with projections spaced inwardly from the oppositely disposed flange, the projections together with the oppositely disposed flange defining vertical grooves which receive the edges of interior panels. The interior panels are positioned in vertically superposed relation and are separated from each other by horizontally-extending battens, the battens including groove means for receiving insulation bats disposed adjacent the inner wall panels.

In accordance with the invention there is also provided a modified stud which includes a vertical groove in the flange thereof for interlockingly receiving the edges of the exterior panels, the modified stud additionally including means for receiving a telescopically adjustable closure bead which adapts it for special conditions at window and door openings. The modified stud may also be used to provide framing at door and window openings by positioning a horizontal section of the modified stud in abutting relation to a vertical section of the modified stud.

Referring now to the drawings and more particularly to FIG. 1, the wall construction is generally indicated at **10** and includes basic vertical studs **12** secured to channels **14** and **16** at the head and sill of the assembly and modified basic studs **18** secured to channels **14** and **16** at door and window openings. Exterior type panels **20**, which may be made of porcelain enamel or other suitable finishing coating on sheet metal, are provided with flanges which are inserted into a vertical groove in the flange of the basic stud **12** or modified basic stud **18**. Interior panels **22** of flat sheet metal are received in vertical grooves of adjacent framing studs. Battens **26** join and brace vertically superposed interior panels **22** and also hold insulation bats **24** securely in position against the inner surface of the interior panels **22**.

The basic framing stud **12** is best seen in FIG. 2 and is made preferably as an aluminum die extrusion of generally I-shape including a web **28** and oppositely disposed flanges **30**. Each of the flanges **30** of stud **12** is formed to include a groove generally indicated at **32** of T-shape in horizontal cross section, including a throat portion **34** extending inwardly from each of the oppositely disposed flanges. Groove walls **36** diverge inwardly at an angle of some 60 degrees from the inner end of throat portion **34** of the groove. Each diverging groove wall **36** at its inner end joins a straight groove wall **38** lying in a plane parallel to web **28** of the stud **12**, and each straight groove wall **38** at its inner end joins a flat groove wall **40** lying in a plane parallel to the plane of flange **30** of the stud.

The groove **32** of each flange **30** extends the entire vertical height of the stud **12**, and is open to receive one of the fastening means (hereinafter to be described) extending through the throat portion **34** of the groove or, alternatively, extending longitudinally from an open end of the groove.

As seen in FIG. 2, the groove **32** is so proportioned that the head of a standard type of carriage bolt **42** may

be inserted at one of the longitudinal ends of the groove 32 and then be slid longitudinally along the groove to the desired location. Carriage bolt 42 is prevented from rotation during attachment of a nut thereto due to the engagement of the square shoulder 44 of the bolt with the opposite side walls of the throat 34 of the groove. Also, as seen in FIG. 2, a standard thread-cutting screw 46 will thread into the parallel sides of the throat 34 of groove 32. Furthermore, as shown in FIG. 5, a standard thread-cutting screw 48 will thread longitudinally into the groove.

Another type of fastener which may be used in assembling other structural elements to the groove 32 of either the stud 12 or the stud 18 is a blind rivet generally indicated at 50 in FIG. 11, the rivet including a head 52 and a shank 54.

The head 52 of the rivet and a portion of the length of shank 54 are drilled along the central longitudinal axis of the rivet to receive a cylindrical metal pin 56 which protrudes above the head 52 of the rivet. The inner end of the shank 54 of the rivet is slotted as indicated at 58, the slot 58 communicating with the drilled passage in the rivet shank. The rivet shank 54 is then flattened as best seen in FIG. 12 so that it includes two parallel flat surfaces which are parallel to the axis of slot 58 of the rivet, the opposite flat walls of the shank being spaced from each other by a dimension equal to the width of the throat 34 of groove 32. The rivet may then be inserted through the groove throat 34 into the interior of groove 32, and the pin 56 of the rivet be driven inwardly until the outer end of the pin is flushed with the outer surface of the head 52 of the rivet. When pin 56 is driven inwardly as just described, the inner end portions of the rivet on opposite sides of the slot 58 are spread in opposite directions to lie along the inclined walls 36 of the groove 32, as best seen in FIG. 10.

By flattening the side walls of the rivet as just described, the rivet may be inserted in groove 32 only in a manner which orients rivet slot 58 so as to cause the spread end portions of the rivet to lie along the inclined walls 36 of groove 32.

Thus, it will be seen that the groove 32 is adapted to cooperate with any one of a plurality of different types of fastening means to permit collateral structural members, building accessories and the like to be secured to the stud 12 or to the stud 18 (which is similar to stud 12 insofar as the groove 32 is concerned). Carriage bolt 42 provides a maximum strength structural fastening and is used in a typical case for joining adjacent wall sections, particularly when future disassembly and removal of the building are contemplated. Rivet 50 provides a quickly installed permanent fastener of lower strength than bolt 42 but is quite satisfactory for certain applications as described hereinafter. Threading screw 46 can be used in lieu of rivet 50 when the availability of the rivet presents a problem or the cost of the rivet is a consideration. As any of these fasteners may be located at any point along groove 32, the problem of alignment with mating members is virtually eliminated.

A pair of additional grooves 39 are provided inwardly of each flange 30 of stud 12 by projections 37 which extend from the portion of the extrusion forming groove 32, each groove 39 being defined by the space between the inner surface of stud flange 30 and the spaced facing surface of projection 37. Each projection 37 extends for most of its length in a direction generally parallel to flange 30, but includes at its outer end a lip 41 which extends angularly from the projection 37 in a direction away from the adjacent flange 30.

The modified stud 18 shown in FIG. 3 is used to accommodate conditions occurring at doors, windows, and other openings in the wall structure. The modified stud 18 includes a web 28' oppositely disposed flanges 31 and 33, and a vertical groove 32' extending inwardly from

each of the flanges 31 and 33. Stud 18 also includes projections 37' adjacent to but spaced from the inner surface of flange 33, projections 37' being similar to projections 37 of stud 12 previously described, and together with flange 33 defining grooves 39' similar to the grooves 39 previously described. The stud 18 additionally includes legs 60 extending from opposite ends of flange 31 for approximately two-thirds of the front-to-back length of stud 18, and relatively short lateral secondary legs 62 adjacent but spaced from the outer or free ends of legs 60 away from flange 31.

Cooperating with the modified stud 18 to accommodate conditions occurring at doors, windows, and other openings in the wall structure is a closure bead generally indicated at 64 having an end wall 66 which extends parallel to the legs 60 of stud 18. Closure bead 64 also includes side walls 68 and 70 which extend perpendicularly from wall 66 adjacent opposite edges of wall 66 and in a direction parallel to flange 33 of stud 18. Side wall 68 of closure bead 64 includes a groove or identation 72 away from wall 66 and a groove 74 at the end thereof adjacent wall 66. The side wall 70 of closure bead 64 includes three spaced projections extending perpendicularly therefrom in a direction parallel to wall 66 to define the grooves designated 76, 78, and 80.

As best seen in the view of FIG. 3, the closure bead 64 is assembled in either of two ways with respect to stud 18, depending upon the desired function, and is telescopically movable wtih respect to stud 18 to either of several alternative positions, depending on the desired function. At window openings, a glass pane 82 may be set against the leg 62 of stud 18 with a suitable caulking compound, after which groove 76 of closure bead 64 is engaged with the end edge of wall 60 of stud 18. The closure bead 64 is engaged with stud 18 by deflecting wall 68 of the closure bead inwardly to engage groove 72 of wall 68 with inwardly projecting lip 84 of flange 33. Thus, the glass pane 82 is secured between the leg 62 of stud 18 and the wall 70 of closure bead 64.

At door openings, closure bead 64 may be engaged with stud 18 to form a substantially flush closure. This is accomplished by engaging groove 80 of bead side wall 70 with the upper end of leg 60 and engaging groove 74 of bead side wall 68 with inwardly projecting lip 84 of flange 33, and then sliding the closure bead 64 down into engagement with the stud 18. Latch plates such as 88, and other accessories such as hinges needed for mounting the door 90, are secured to closure bead 64 prior to its engagement with stud 18. Secondary leg 62 of stud 18 forms a doorstop for the door 90.

Stud 18 may also be used to form head and sill framing at door and window openings by positioning a stud 18 horizontally and perpendicular to a vertical stud 18. Thus, the stud 18' shown in FIG. 4 is positioned vertically, while the stud 18'' is positioned horizontally and extends perpendicularly to the stud 18'. In order to accomodate the horizontally extending stud 18'', the stud 18' has its secondary leg 62' cut away at 92 and 94 for a distance sufficient to accommodate the height of the horizontally extending stud 18'' as measured between the outer edges of the oppositely disposed horizontally extending secondary legs 62'' of stud 18''. A hole is drilled through the vertical stud 18' at the desired height for attachment of the horizontal stud 18'', and a thread cutting screw 48 is extended through the drilled hole in vertical stud 18' and into threaded engagement with the groove 32'' of horizontal stud 18''. The vertical stud 18' and the horizontal stud 18'' are thereby secured into flush perpendicular relation to each other.

As seen in FIG. 1, the studs 12 and 18 are spaced from each other and secured in the desired modular arrangement by channels 14 and 16 at the head and sill of the wall structure. As best seen in FIG. 9, the channel 16 (which is also illustrative of the channel 14) includes a

base **100**, vertically upstanding flange portions **102** and **104** at opposite edges of the base, and an intermediate vertical flange **106**. The vertical flanges **102** and **104** of channel **16** are pre-drilled as indicated at **108** to receive rivet **50**. The intermediate vertical flange **106** of the channel is slotted or notched at **110** to receive the web **28** of stud **12**. The stud **12** is lowered into position with the oppositely disposed flanges **30** lying in directly abutting relation to the inner surfaces of vertical flanges **102** and **104** of channel **16** and with the grooves **32** of stud **12** in alignment with drilled openings **108** of the oppositely disposed vertical flanges **102** and **104**. The rivets **50** are then inserted through the drilled openings **108** and into the groove **42** of each flange and are then expanded into locked engagement with the grooves as previously described and as shown in the view of FIG. 10.

To complete the wall assembly, it is necessary to install prefinished exterior panels **20**, interior panels **22**, and insulation bats **24** between adjacent stud framing members, as best seen in FIG. 4. The interior panels **22**, which are flat metal sheets, are installed first and are snapped into grooves **39** between the inner surface of flange **30** and projection **37** of the stud **12** (FIG. 2) or into groove **39'** between the inner surface of flange **33** and projection **37'** of stud **18** (FIG. 3). In order to stiffen the interior wall, the interior metal panels **22** are divided into vertical sections with adjacent sections joined by horizontal battens **26**. As best seen in the view of FIG. 6, the batten **26** includes a normally horizontally extending web portion **112** having connected thereto at the end thereof inwardly of the wall structure a pair of closely spaced vertical flanges **114** and **116** which define between them a groove which receives an upper flat interior panel **22A** and a lower interior panel **22B**. The batten **26** also includes a third vertical flange portion **118** extending above and below the web **112** at the side thereof disposed toward the exterior of the wall and in laterally spaced relation to flange **116** of the batten. Insulation bats **24** are received in the space between the inner surface of flat interior panels **22A** and **22B** and the flange **118** of batten **26**.

Exterior panels **20** (FIG. 1, 4 and 8), which may be made of porcelain enamel or other suitable finishing material on metal, are especially formed to be received and held in place by the groove **32** or **32'** of stud **12** or **18**. Thus, panels **20** are flanged on all four sides of their perimeters, including upper and lower horizontal flanges **124** and vertical flanges **126** which extend beyond the horizontal flanges **124** by a distance approximately equal to the depth of the neck portion **34** of groove **32** of stud **12**. Vertical flanges **126** also include tab portions **128** which extend inwardly from flanges **126** at substantially the same angle as that between neck portion **34** and inclined side walls **36** of groove **32** of stud **12**.

Panels **20** may be snapped into grooves **32** with the tab portions **128** extending through the neck **34** of groove **32** and into overlying substantially parallel relation to the inclined wall portions **36** of the groove. The panel **20** may be held tightly in position with respect to grooves **32** by short lengths of resilient vinyl plastic wedges **130** (FIG. 4) inserted at intervals along the length of the joint between adjacent panels **20**. The joints between the exterior panels may then be packed with a suitable caulking compound to render the wall weatherproof.

As best seen in FIG. 7, accessories such as a shelf bracket **132** or the like may be attached to the inner wall by means of a carriage bolt whose head is received in the slot **32** of a stud **12**, the threaded end of the bolt projecting outwardly beyond the stud and being suitably attached to the bracket **132**. In a similar manner, shelves, light fixtures and other appurtenances may be attached directly to the stud, thereby obviating the drilling of the panel for this purpose. This feature is of particular advantage where accessory fixtures and the like are attached to the exterior wall of the building structure and when the preferred porcelain enameled steel panels **20** are used in the exterior wall structure, since the drilling of holes through such panels exposes the unprotected steel edges to corrosion. This undesirable corrosion is eliminated by the attachment of such fixtures directly to the grooves of the stud members, as illustrated in FIG. 7, although in the embodiment of FIG. 7 the bracket **132** is mounted on the interior of the building structure rather than on the exterior thereof.

The manner of assembly of the exterior wall panels **20** into the grooves **32** of the stud members and of the interior wall panels **22** into the grooves **39** of the stud members has the additional advantage of providing structural bracing against the collapse of the studs in the plane of the wall. Additional cross-bracing or excessive strength of the stud in the plane of the wall to resist wind and roof loads is not needed. Furthermore, the panels **20** and **22** can move longitudinally in the grooves **32** and **39**, thereby compensating for differential thermal expansion of the studs and panels.

A particularly important advantage of the interlocking panel and stud construction hereinbefore described is that a damaged panel may be individually replaced. Individual replacement of exterior panels is accomplished by first removing the caulking and the plastic wedges **130** from the joint surrounding the panel **20** which is to be replaced, after which the panel can be pulled out of engagement with groove **32**. The new panel can then be snapped into place, the wedges **130** inserted, and the joints re-caulked. Interior type panels **22** are removed by lifting the horizontal batten **26** together with the panels **22** thereabove a sufficient distance to permit the panel to be deflected inwardly and out of engagement with groove **39**. The new interior panel can then be installed by reversing the removal sequence.

It should also be noted that the system of panel attachment described hereinbefore also is adaptable for use in application of facing type panels for remodeling or finishing of buildings of conventional frame or masonry construction. Porcelain panels in particular have been widely used recently as a means of finishing masonry walls of buildings. Whereas the stud framing hereinbefore described is preferably designed with sufficient strength to support the roof and wind loads imposed on the building, a lighter non-structural but otherwise similar stud can be attached directly to a structural masonry or frame wall, thereby providing a grid for securing porcelain or other type panels in the manner described.

It is believed to be evident from the foregoing that there is provided in accordance with this invention an improved metal building construction providing ease and economy of fabrication, assembly, and maintenance. The construction includes primary elements, such as studs and panel walls, which perform the dual function of affording structural strength as well as ornamental finish, thereby achieving a highly efficient utilization of material. The metal building construction and method of building permits prefinished panels to be securely affixed to the stud structure without drilling or otherwise piercing the finished panels and makes possible the individual replacement of panels if necessary.

While there have been shown and described certain particular embodiments of the invention, which are presently preferred, it will be obvious to those skilled in the art that various alterations and substitutions may be made therein without departing from the spirit of the invention, and all such modifications are therefore to be regarded as within the scope and purview of the more broadly worded of the appended claims.

I claim:

1. A stud for use in a building wall construction comprising a metal member of general I-shape having a web and oppositely disposed flanges extending perpendicularly to said web at opposite edges thereof, at least

one of said flanges having a groove therein extending substantially the entire length of said one flange, said groove including a narrow throat portion forming a slot opening from the outer face of said one flange intermediate the width of said one flange and including interior walls laterally obliquely diverging from the inner end of said throat portion whereby the groove is substantially T-shaped in cross section with its base substantially wider than its throat portion and is thereby adapted to receive and interlockingly hold the divergently reversely bent hooked flanges of a pair of edge-abutting sheet metal wall panels, each of said laterally obliquely diverging interior walls being formed with an outstanding projection spaced inwardly from and parallel to said one flange and forming therewith a pair of aligned grooves extending in opposite directions from said narrow throat portion for reception of the marginal edges of wall panel elements.

2. A stud for use in a building wall construction comprising a metal member of general I-shape having a web and oppositely disposed flanges extending perpendicularly to said web at opposite edges thereof, at least one of said flanges having a groove therein extending substantially the entire length of said one flange, said groove including a narrow throat portion forming a slot opening from the outer face of said one flange intermediate the width of said one flange and including interior walls laterally obliquely diverging from the inner end of said throat portion whereby the groove is substantially T-shaped in cross section with its base substantially wider than its throat portion and is thereby adapted to receive and interlockingly hold the divergently reversely bent hooked flanges of a pair of edge-abutting sheet metal wall panels, the flange opposite said one flange being provided with a pair of primary legs extending from its opposite edges back toward said one flange in parallelism with said web and terminating in free ends spaced inwardly from said one flange with a relatively short

secondary leg extending laterally oppositely from each of said legs adjacent to but spaced from the free end thereof.

3. A metal stud as claimed in claim 2, in which the space between the free end of at least one of said primary legs and the edge of said one flange is closed by a bead having its edges engaged with said primary leg and flange.

4. A metal stud as claimed in claim 2, in which at least one of the edges of said one flange is formed with an inwardly projecting lip and the space between said one edge and the free end of the adjacent primary leg is closed by a bead having one of its edges provided with a channel enclosing said lip and having its opposite edge provided with a channel enclosing the free end of the adjacent primary leg.

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