Aug. 19, 1969 H. A. BALINSKI 3,461,638

STRUCTURAL MEMBER

Filed Dec. 30, 1966 4 Sheets-Sheet 1

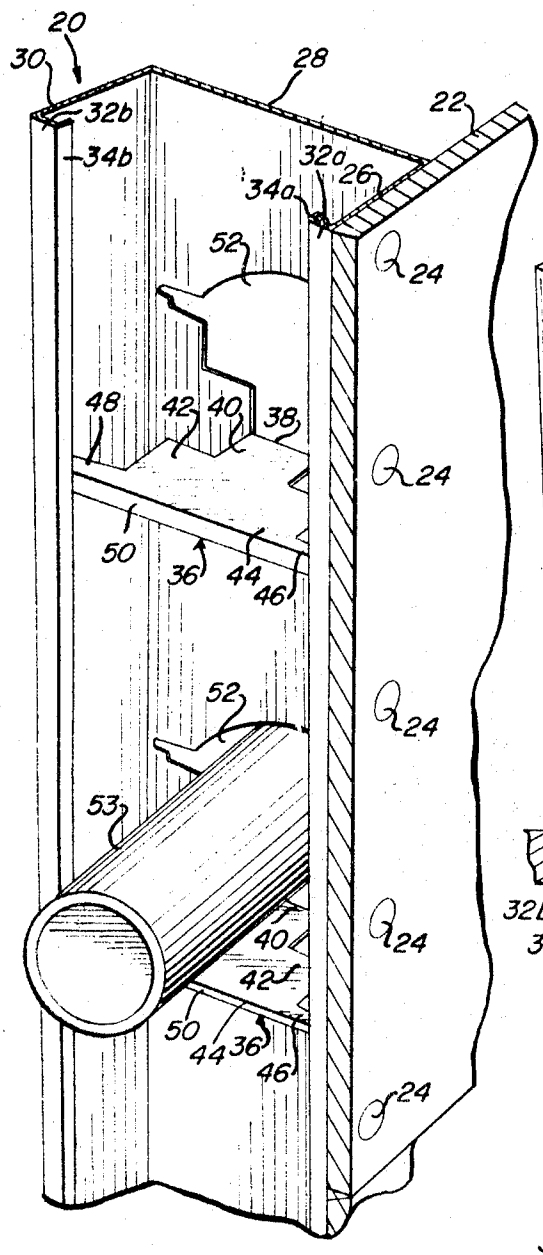

Fig. 1

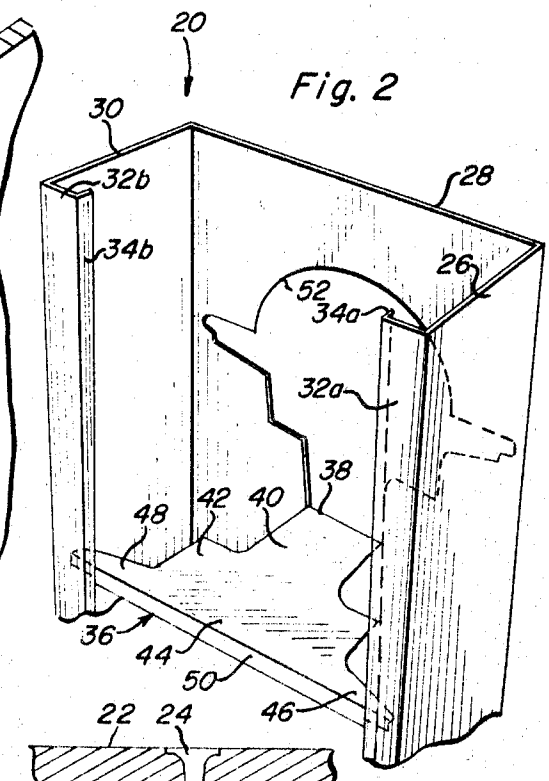

Fig. 2

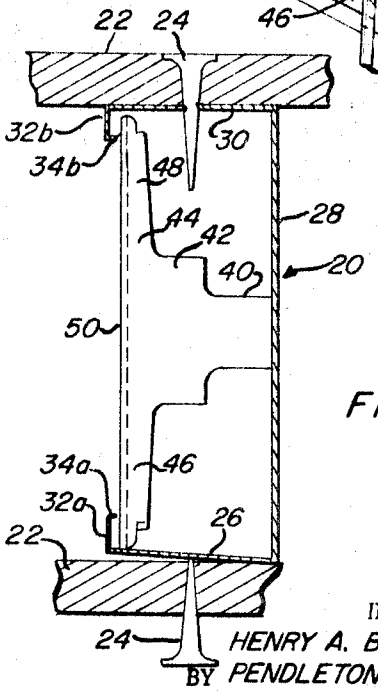

Fig. 3

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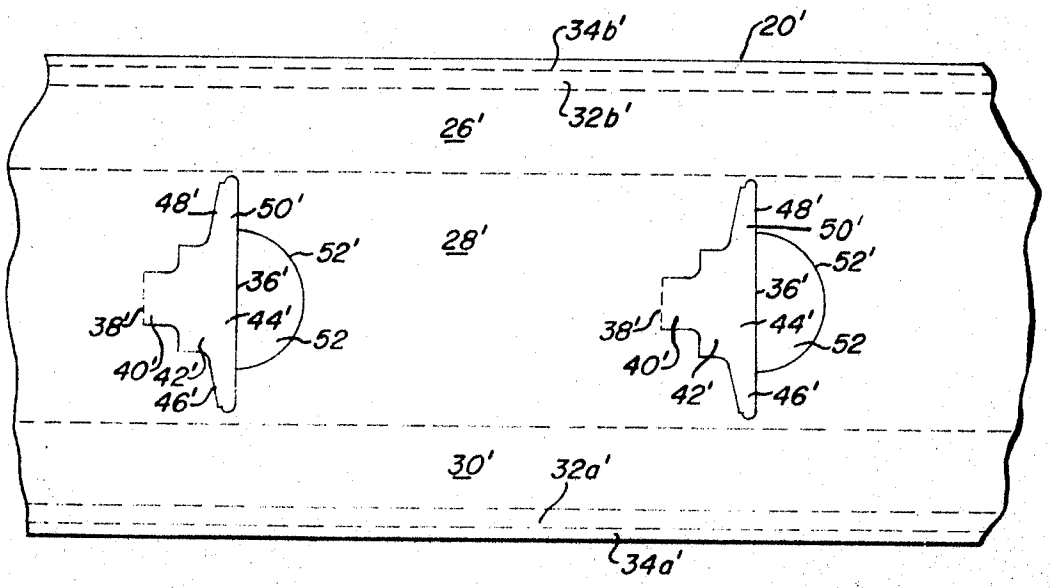

Fig.4

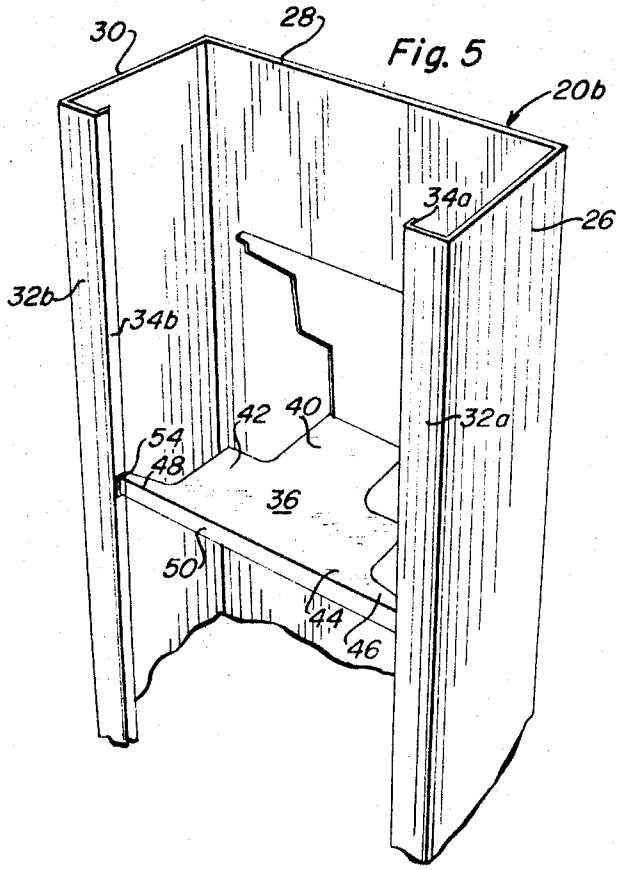

Fig. 5

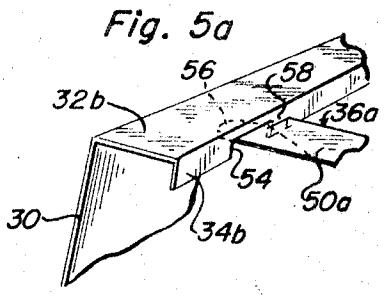

Fig. 5a

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Fig. 6

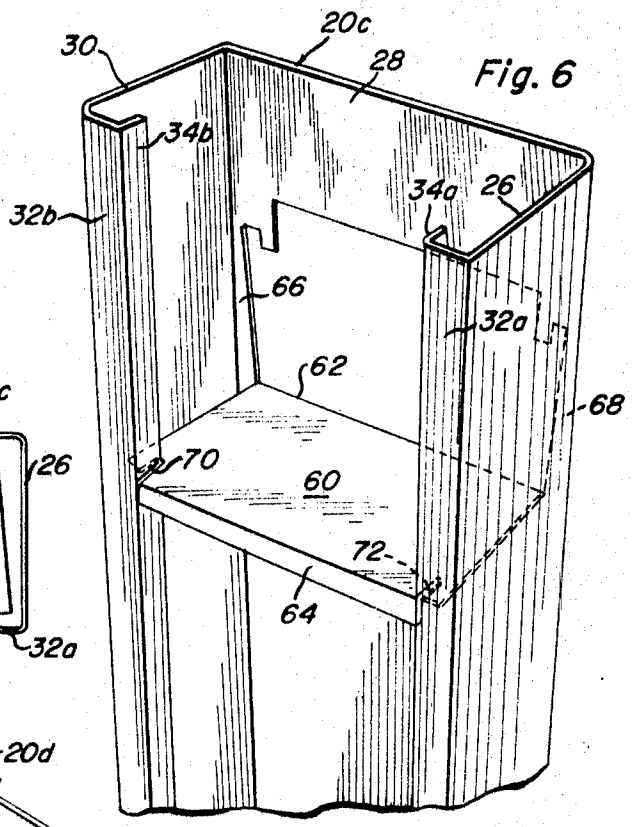
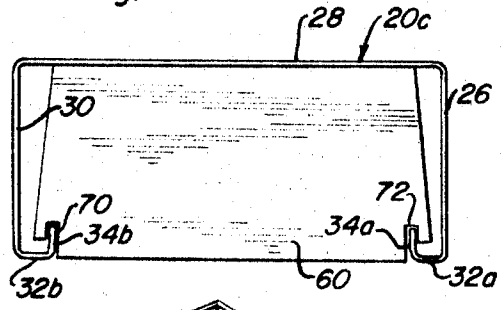


Fig. 7



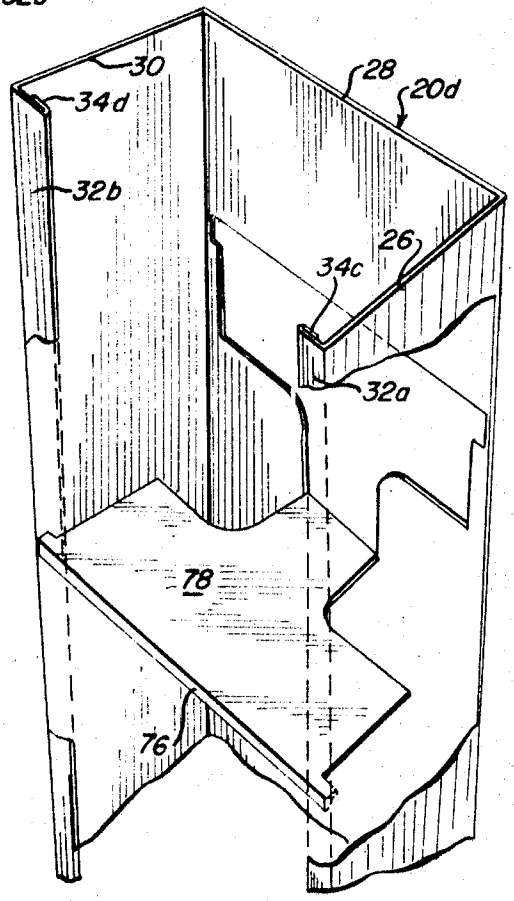


Fig. 8

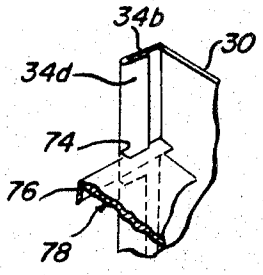


Fig. 8a

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Fig. 9

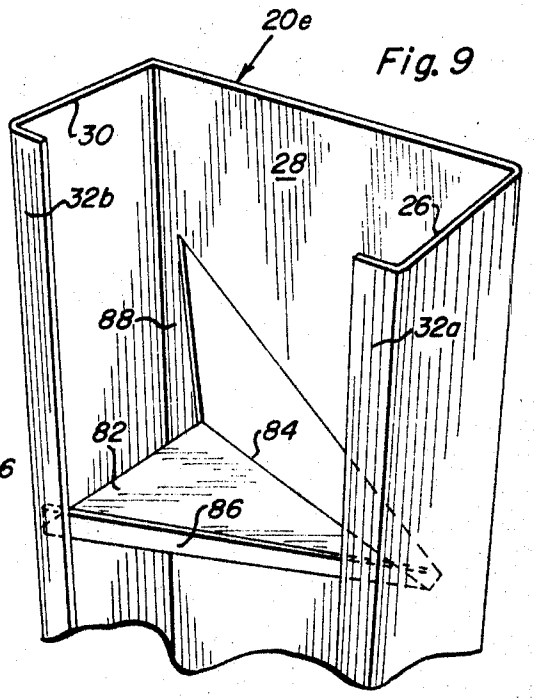
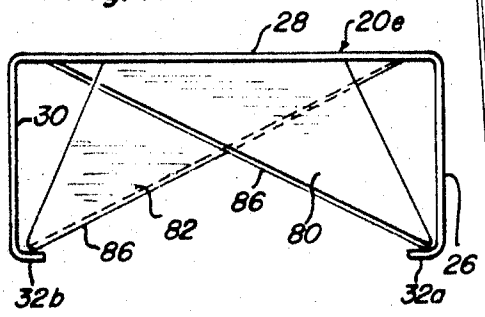


Fig. 10



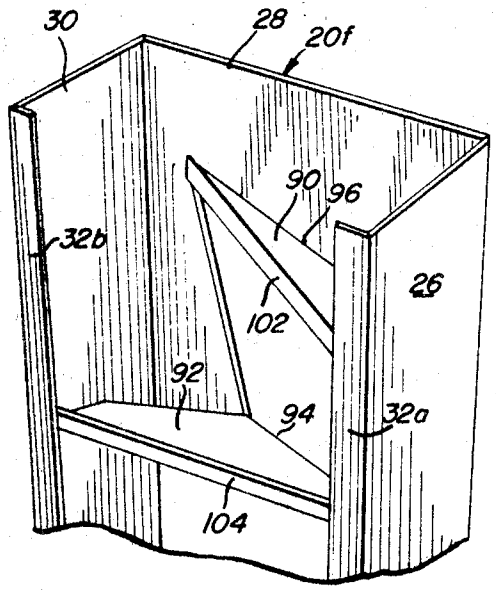
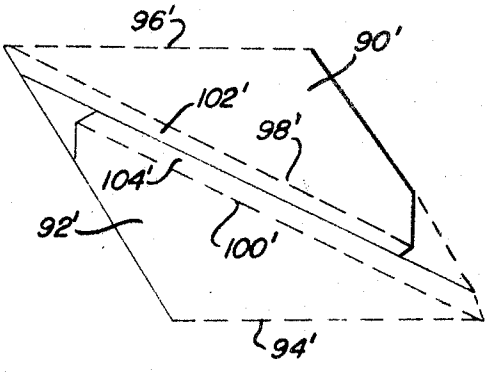


Fig. 11

Fig. 13



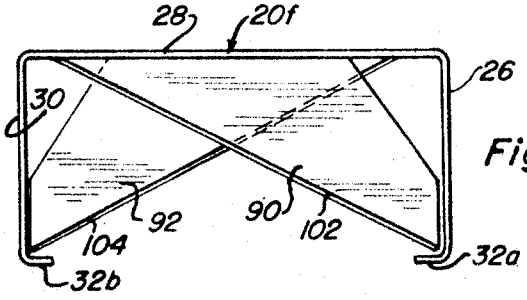


Fig. 12

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United States Patent Office 3,461,638
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3,461,638

STRUCTURAL MEMBER

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Filed Dec. 30, 1966, Ser. No. 606,318
Int. Cl. E04c 3/30; E04h 1/00
U.S. Cl. 52—732 15 Claims

ABSTRACT OF THE DISCLOSURE

An elongated structural member comprising a web with at least one flange extending laterally from the web. At least one truss element is struck from the web and the truss element extends laterally from the web and includes a portion disposed adjacent a distal portion of the flange to brace the flange.

This invention relates to structural members and particularly to beams, studs or trusses formed of sheet metal or like materials for use as components in constructing walls, ceilings, floors and roofs.

One particular use for this invention is in studding support members for interior building walls wherein wallboard panels are secured to metal studs by driving self-tapping rotary screw fasteners through the panels and into or through flange portions of the studs, for instance as disclosed in Nelsson et al. United States Patent No. 3,056,234. A stud currently in common use in such construction is a channel-type sheet metal stud. However, there is a tendency for the flanges of this stud to bend and to be deflected inwardly away from a wallboard panel when a workman attempts to drive fasteners through the flanges during attachment of panels. This may prevent penetration of the fasteners into the flanges. Thereupon, the usual course is to attempt to apply the fastener at another location, until a firm securement is made.

Another problem encountered is that the leading end or penetrating tip of the driven fastener may travel laterally over the flange from its initial point of contact and then penetrate the flange at a misaligned angle. Such problems of lack of securement and misalignment of the fastener often result in surface and core damage to the wallboard along with inadequate securement of the wallboard to the supporting stud member. In some cases the fasteners are not placed at desired locations along the wallboard because of the severe deflection of the metal stud flange at a particular location. Where additional force is applied to the fastener under the conditions of a deflecting flange, rotation and bending of the metal stud may result, as well as strain and damage to the wallboard. To overcome these problems, temporary lateral support is often required to hold the flanges in place while the fasteners are being started. Another approach taken is the use of an excess quantity of fasteners. These problems necessitate additional finishing treatment to wallboard surfaces which become marred, and interfere with effcient and economical construction of the most desired finished wallboard constructions.

Various attempts have been made to overcome the aforementioned problems, including the design of sheet metal stud members having internal cross bracing, for instance as taught in my copending application Ser. No. 359,867, filed Apr. 15, 1964, now U.S. Patent No. 3,349,535, and in the copending application Ser. No. 499,939 of Frederick A. Thulin, filed Oct. 21, 1965, now U.S. Patent No. 3,369,619.

It is an object of this invention to provide another solution to the aforementioned problems, and more specifically to provide an improved light-weight structural member of the indicated type which will overcome the tendency of the flanges to bend under laterally applied loads. It is another object of this invention to provide an improved structural member of the indicated type which may be economically fabricated. It is a further object of this invention to provide such an improved structural element which may be fabricated from a unitary blank of formable sheet material in substantially the same manner and at substantially the same rate of production as the channel-type sheet metal studs now in common use. Additional objects and advantages of this invention will become apparent to those skilled in the art from the description, accompanying drawings and appended claims.

In carrying out this invention in one illustrative form, an elongated channel-shaped member is fabricated from a sheet metal blank. This member includes a web section and a pair of spaced imperforate side flanges extending from the opposite edges of the web. A series of internal reinforcing truss elements are struck and bent from the web to extend laterally of the web beteween the two flanges. Each truss element includes a distal end section of a width substantially equal to the distance between the distal edges of the side flanges. The distal edge of each truss is disposed generally normal to the side flanges and may be formed with a reinforcing edge flange to enhance its compressive or column strength. The distal edges of the truss elements also may be in interlocking engagement with suitably formed lips on the distal edges of the side flanges. The openings formed in the web by striking out the truss elements may serve as passages for wiring, conduits or the like.

For a more complete understanding of this invention, reference should now be had to the examples illustrated in the drawings wherein:

FIG. 1 is a fragmentary perspective view of a partition construction including a stud employing teachings of this invention;

FIG. 2 is a perspective view of a portion of a stud according to FIG. 1;

FIG. 3 is a cross-sectional view through a stud according to FIG. 1 in a partition construction, showing stages of attachment of wallboard panels thereto;

FIG. 4 is a plan view of a portion of a sheet metal blank cut to form a structural member such as the stud of FIG. 1;

FIG. 5 is a perspective view of a portion of another stud employing teachings of this invention;

FIG. 5*a* is an enlarged detailed view of a modified interlocking arrangement between a truss and the side flanges in the stud of FIG. 5;

FIG. 6 is a perspective view of a portion of another stud employing teachings of this invention;

FIG. 7 is an end view of the stud of FIG. 6;

FIG. 8 is a perspective view of a portion of another stud employing teachings of this invention;

FIG. 8*a* is an enlarged detailed view showing the interlocking arrangement between a truss and the side flanges in the stud of FIG. 8;

FIG. 9 is a perspective view of a portion of another stud employing teachings of this invention;

FIG. 10 is an end view of the stud of FIG. 9;

FIG. 11 is a perspective view of a portion of another stud employing teachings of this invention;

FIG. 12 is an end view of the stud of FIG. 11; and

FIG. 13 is a plan view illustrating the pattern for formation of the trusses of the stud of FIG. 11.

Referring now to the drawings and more particularly to FIG. 1, a stud 20 is illustrated as being supported in a vertical position and having a wallboard panel 22 secured thereto by a plurality of fasteners 24. The fasteners may

be self-tapping rotary screw fasteners such as are disclosed in United States Patent No. 3,056,234, and which are driven through the panel and through the underlying flange 26 of the stud 20.

As also seen in FIGS. 2 and 3, the stud 20 comprises an elongated web 28 and a pair of spaced, opposed, generally parallel, elongated side flanges 26 and 30. The flanges are integral with the respective side edges of the web 28 whereby the web and flanges form the channel-shaped element. Each flange 26 and 30 is formed with a lip portion or return flange along its distal edge, as illustrated. This lip portion on flange 26 comprises a lateral section 32*a* and a return portion 34*a*, while the corresponding parts of the lip portion on flange 30 are identified by numerals 32*b* and 34*b*, respectively. Internal reinforcing truss elements 36 are struck from the web portion 28 at spaced locations along the length of the structural element 20 and are bent about their lines of attachment to the web 28, as at 38, to positions between the flanges 26 and 30 as illustrated. The truss elements 36 are disposed parallel to one another and perpendicular to the plane of the web portion 28 and to the planes of the side flanges 26 and 30.

Each truss element 36 is of a generally T-shaped configuration, including a body portion comprising a relatively narrow section 40 extending from the web 28, at hinge line 38, to a wider section 42 which in turn merges into a distal edge or bracing section 44. Bracing section 44 includes arms 46 and 48 which extend outwardly to points adjacent the inner surfaces of the respective flanges 26 and 30 near the outer or distal edges of these flanges. The section 44 is of a width slightly less than the spacing between the flanges 26 and 30 whereby the outer ends of arms 46 and 48 are spaced from the inner surfaces of these flanges. As will be observed in FIG. 3, when a fastener 24 is driven against a side flange, such as flange 26, the flange will bend inward only slightly before it abuts the adjacent arm of bracing section 44 which then provides lateral support to hold the flange in position for driving of the fastener therethrough. If sufficient inward force is applied the stud will be distorted until the opposite end of section 44 abuts the other flange 30, thereby placing the end section 44 in compression between the side flanges and providing greater lateral support for flange 26, particularly when the flange 30 is secured to a panel or is otherwise supported. By reference to the flange 30 in FIG. 3, it will be observed that when a fastener 24 is in its final seated position, the side flange is drawn outward into parallel face-to-face contact with the adjacent surface of the board 22, thereby restoring the clearance between the flange and the end section 44. By this arrangement, the truss elements 36 provide lateral support for the side flanges 26 and 30 during application of the fasteners, and thereafter a clearance is provided between the truss elements and the flanges to avoid any noise problem such as might arise from the flanges and truss elements rubbing against one another during any slight movements of the partition. These clearances also assist in minimizing sound transmission through the finished partition construction. After the partition is completed, with the flanges secured to the wallboard panels, the studs 20 assume the approximate strength characteristics of a box-type stud, and the reinforcing contribution of the truss elements 36 is no longer necessary.

Each truss element 36 is provided with a reinforcing flange 50 along end section 44. Flange 50 is normal to the remainder of the truss element and enhances the compressive strength of the bracing section 44 extending between the side flanges.

The illustrated stud 20 may be formed of a unitary blank of formable sheet material, such as sheet metal, for instance sheet metal on the order of 0.02" thick. This is perhaps best illustrated by reference to the unitary blank 20', shown in FIG. 4. The dashed lines in this figure indicate the lines along which the blank will be bent or folded in forming the stud 20 and thus delineate the sections 28', 26', and 30', 32*a*', 32*b*', 34*a*' and 34*b*' which will form the web 28, side flanges 26 and 30 and lip flanges 32*a*, 32*b*, 34*a* and 34*b*, respectively. Elements 36' are cut or struck from the central web portion 28' and are subsequently bent along lines 38' in forming the truss elements 36. As can be readily seen, each element 36' includes sections 40', 42' and 44', the latter including arm sections 46' and 48' and a flange forming section 50', for forming the corresponding parts of each truss element 36.

The stepped configuration of the truss elements 36 provides an advantageous configuration of the openings which are provided in the web 28 by the striking of the truss elements 36 therefrom, particularly when combined with the removal of additional material as indicated by line 52', directly opposite the base section, to form an opening 52. The lower and narrower portion of each strike out corresponding to section 40 forms an opening adapted to receive a relatively narrow channel member passing through the stud 20, whereas the wider strike out corresponding to section 42 permits passage of a wider channel member. These openings, in cooperation with the arcuate openings 52, permit passage of sizeable round conduit such as illustrated at 53 in FIG. 1. It will also be observed that the openings are centrally located in the web sections 28, being symmetrical about the center line of the blank 20' and of the resulting structural element 20. The openings in web 28 thus may accommodate conduit or other service elements, or reinforcing members such as are sometimes extended through aligned openings in a series of studs in partition constructions.

FIGS. 5 through 13 illustrate various modifications of stud 20. Accordingly, for convenience, the same numerals will be applied to corresponding elements in most instances.

FIGS. 5 and 5*a* illustrate a stud 20*b* including an interlocking connection between the distal edge portions of the truss elements 36 and the return flanges 34 of flanges 26 and 30. In this embodiment return flanges 34*a* and 34*b* are formed with notches 54 which receive end portions 56 of the reinforcing flange 50*a* (see FIG. 5*a*). Each flange 50*a* is provided with a shoulder 58 at each end. The distance between the shoulders 58 of a flange 50*a* is equal to the desired spacing between return flanges 34, or slightly less than this distance to provide clearances between the trusses and side flanges as discussed above regarding stud 20. By providing the truss elements 36 of a length (measured normal to web 28) slightly greater than the distance between web 28 and the opposed inner edges of return flanges 34, the portions 56 may be caused to engage notches 54 with a snap action to facilitate production of this type of structural element. In an alternative interlocking arrangement of the trusses and side flanges, the shoulders 58 may be eliminated and the notches 54 may be formed of a width slightly greater than the depth of the reinforcing flange 50*a* whereby the ends of arms 46 and 48 will abut the inner surfaces of flanges 26 and 30 as in the embodiment of FIG. 1.

FIGS. 6 and 7 illustrate a stud 20*c* wherein each trussing element 60 is in the shape of a trapezoid. Each element 60 is joined to the web 28 along a bend line 62 and is provided with a reinforcing flange 64 along its distal edge. The outermost surface of the reinforcing flange 64 lies flush with the front surfaces of flange sections 32. The bracing edge section of truss element 60 thus extends between the inner surfaces of the return flanges 34, whereby the lateral bracing support for the side flanges is provided on the return flanges. By providing the bracing edge section of truss element 60 of a width to extend between flanges 34, the corresponding strike outs may be sufficiently narrow to leave a substantial portion of web material at each side of the strike out openings, as at 66 and 68, to provide adequate strength

against deflection of the rear edges of flanges **26** and **30** in this area. If desired, the distal portion of the truss element **60** may be formed with slots **70** and **72** to receive the return flange portions **34** whereby the flanges **26** and **30** are supported by the truss element **60** against outward as well as against inward deflection.

FIGS. 8 and 8*a* illustrate a stud **20***d* including a truss element of another configuration and including another alternative interlocking arrangement between the truss element and the lip portions of the side flanges. In this arrangement, the edge portions **34***c* and **34***d* of the side flanges **26** and **30** are bent back parallel to the sections **32**. The portions **34***c* and **34***d* are cut away for short lengths to form notches **74**, as illustrated in FIG. 8*a*, for receiving the reinforcing flange **76** extending along the outer edge of the truss element **78**.

In the studs **20***e* and **20***f* illustrated in FIGS. 9–12, each truss element is of a generally triangular configuration and provides lateral support for a single side flange of the stud.

Stud **20***e* (FIGS. 9 and 10) incorporates alternate truss elements **80** and **82** engaging, respectively, side flanges **26** and **30**. The elements **80** and **82** are identical except for being reversed with respect to one another as seen in FIG. 10. Each of these truss elements is joined to the web **28** along a bend line **84** and has its apex disposed adjacent the inner surface of the distal edge portion of the respective side flange. Each truss element **80** and **82** is provided with a reinforcing flange **86** along its distal edge. The bend line **84** and one side of each element **80** and **82** define an obtuse angle, as best seen in FIG. 10, and each bend line **84** extends at an angle of less than 90° to the plane of the respective side flange. By this construction, adequate material may be left between the strike out and the edge of web **28**, as at **88**, for support of the rear edge of the adjacent side flange, and the apex of the truss is disposed adjacent the respective side flange when the truss element is bent into its flange supporting position as illustrated in FIGS. 9 and 10.

FIGS. 11 and 12 illustrate a stud **20***f* including pairs of oppositely directed, generally triangular truss elements **90** and **92** formed from contiguous strike outs by utilizing a strike out pattern as shown in FIG. 13. The individual truss elements **90** and **92** are similar to the truss elements **80** and **82** of FIGS. 9 and 10, except that the distal or apex ends of elements **90** and **92** are truncated to provide more extensive bearing areas with the side flanges **26** and **30**. In FIG. 13, portions **90'** and **92'** identify the strike outs which form the respective truss elements **90** and **92** when bent about lines **94'** and **96'** into flange supporting positions. Lines **94** and **96** may extend at acute angles to the respective side flanges as described above regarding bend line **84** in stud **20***e*. Lines **98'** and **100'** indicate the bend lines for forming reinforcing flanges **102** and **104** from portions **102'** and **104'**.

It will be appreciated that in the instance of each modification shown, an apropriate number of trussing elements may be provided in spaced relation along the length of the structural elements **20**. Reinforcing ribs may be embossed in the various truss elements. In each embodiment clearances may be provided between the truss elements and the side flanges, whereby the truss elements will provide the necessary support for the side flanges during assembly, as in fabrication of a wallboard partition, but will thereafter remain free of these elements to avoid squeaking and to minimize noise transmission through the resulting partition. Interlocking designs may be utilized as illustrated in FIGS. 5–8*a*, and may be designed to confine the side flanges against outward deflection as well as against inward deflection, for instance as illustrated in FIGS. 6 and 7. The distal edges of the truss elements may be affixed to the side flanges for providing added rigidity of the structural elements **20**, if desired, as by crimping, spot welding, or other securing means, though this will add to the expense of production.

It will thus be seen that an improved structural member has been provided which includes support against deflection of the side flanges. Further, it will be appreciated that the trussing elements by which the improved deflection strength is obtained may be formed by very simple manufacturing processes, for instance by stamping or striking the truss elements from the web section and subsequently bending them into supporting position. It will be found that these operations may be conveniently performed by machines in production lines operating at substantially the same speeds usually encountered in high speed production of simple channel type sheet metal structural elements. Accordingly, there is very little increase in cost of the structural elements embodying this invention over simple channel-type structural elements of corresponding size, weight and materials. Thus, the improved structural elements of this invention may be economically produced.

While particular embodiments of the invention have been shown, it will be understood, of course, that this invention is not limited thereto since many modifications may be made by those skilled in the art, particularly in light of the foregoing teachings.

I claim:

1. An elongated structural member comprising a web, at least one flange extending laterally from said web, and a plurality of truss elements struck from said web intermediate the ends of said member, said web being provided with an opening therethrough adjacent each of said truss elements, each of said truss elements extending laterally from said web and including a portion disposed adjacent a distal portion of said flange to brace said flange, said truss elements being spaced from one another longitudinally of said member to brace said flange over substantially the entire length of said member.

2. An elongated structural member as in claim **1** wherein each of said truss elements is spaced from said flange to provide clearance between said flange and said truss elements except when said flange is pressed inward toward said truss elements.

3. An elongated structural member as in claim **1** wherein each of said truss elements includes a flange along its distal edge and a body section joined to said web, each of said truss flanges extending at an angle to the respective truss body section to provide compressive load strength along the distal edges of said truss elements.

4. An elongated structural member as in claim **1** wherein each of said truss elements is of a generally triangular configuration, each of said truss elements being joined to said web along one side of such triangle and having its apex adjacent the distal portion of said flange.

5. An elongated structural member as in claim **1** wherein said portion of each of said truss elements is in interlocking engagement with the distal edge portion of said flange.

6. An elongated structural member as in claim **1** wherein said flange includes a lip portion extending along the distal edge thereof and formed with a plurality of notches, and each of said truss elements is engaged in one of said notches.

7. An elongated structural member as in claim **1** wherein each of said truss elements is formed with a notch in its distal edge, and said flange is provided, along its distal edge, with a lip portion extending toward said web, said lip portion extending into said notch of said truss elements.

8. An elongated structural member as in claim **1** wherein each of said trusses is disposed in a plane normal to the plane defined by said flange.

9. An elongated structural member formed of a blank of sheet material and comprising a web, first and second flanges extending laterally from said web, said flanges being integrally joined with opposite edges of said web

whereby said web and said flanges define a channel-shaped member, first and second truss elements struck from said web and each extending laterally therefrom, said first truss element including a portion disposed adjacent a distal portion of said first flange to brace said first flange, and said second truss element including a portion disposed adjacent a distal portion of said second flange to brace said second flange.

10. An elongated structural element as in claim 9 wherein each of said truss elements is of a generallyy triangular configuration and is joined to said web along one side of such triangle, said truss elements being formed in pairs from contiguous portions of said web, one truss element of one pair bracing one of said flanges and the other truss element of such pair bracing the other of said flanges.

11. An elongated structural member formed of a blank of sheet material and comprising a web, first and second flanges extending laterally from opposite edges of said web whereby said web and said flanges define a channel-shaped member, and a plurality of truss elements struck from said web intermediate the ends of said member, said web being provided with an opening therethrough adjacent each of said truss elements, each of said truss elements extending laterally from said web and including a portion disposed adjacent a distal portion of said first flange and a portion disposed adjacent a distal portion of said second flange to brace said flanges, said truss elements being spaced from one another longitudinally of said member to brace said flanges over substantially the entire length of said member.

12. An elongated structural element as in claim 11

wherein each of said truss elements includes a base section joined to said web and a distal end section including said portions extending adjacent said flanges, each of said truss elements being disposed centrally of said web and being of less width than said web.

13. An elongated structural member as in claim 12 wherein each of said base sections is of stepped configuration and includes a first portion joined to said web and a portion wider than said first portion and narrower than said end section.

14. An elongated structural member as in claim 13 wherein said web is provided with an opening of a configuration conforming, in part, to the outline of said base section.

15. An elongated structural member as in claim 9 wherein each of said truss elements includes portions disposed adjacent distal portions of each of said flanges.

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BOBBY R. GAY, Primary Examiner

A. M. CALVERT, Assistant Examiner

U.S. Cl. X.R.

52—238

PO-1050
(5/69)

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,461,638 Dated August 19, 1969

Inventor(s) Henry A. Balinski

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 69, "3,369,619" should read -- 3,381,439 --. Column 7, line 10, "generallyy" should read -- generally --.

SIGNED AND
SEALED
FEB 3 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents