April 5, 1966 R. H. SLOWINSKI 3,243,930

CORRUGATED SHEET METAL STRUCTURAL MEMBERS

Filed May 29, 1962 2 Sheets-Sheet 1

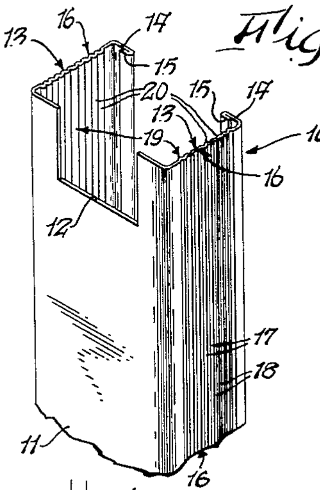

Fig. 1.

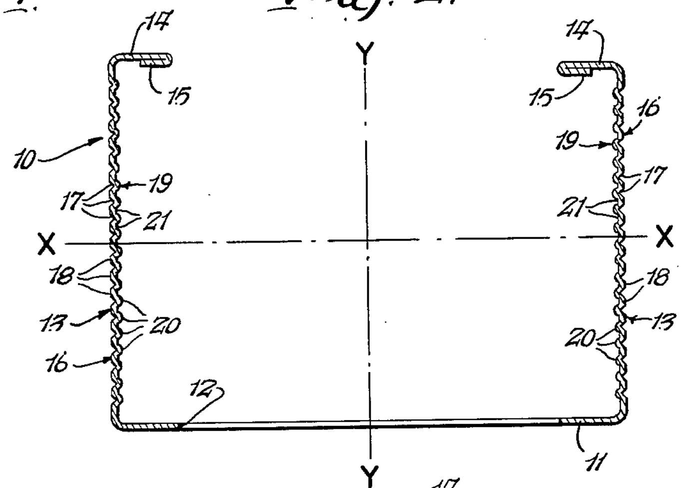

Fig. 2.

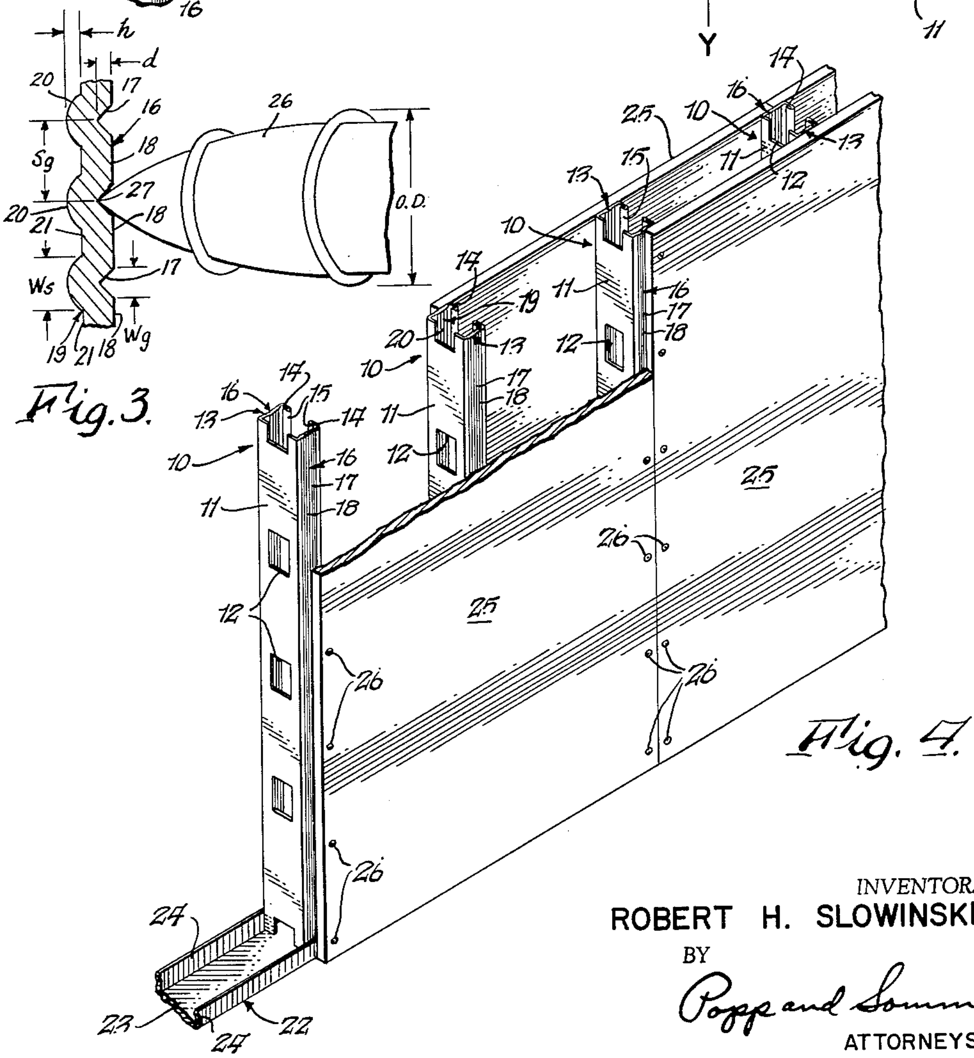

Fig. 3.

Fig. 4.

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CORRUGATED SHEET METAL STRUCTURAL MEMBERS

Filed May 29, 1962 2 Sheets-Sheet 2

Fig. 5.

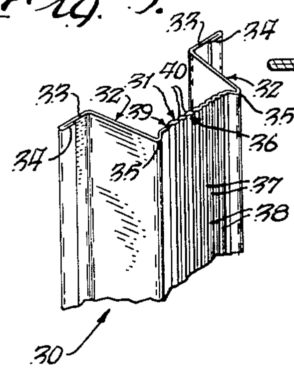


Fig. 6.

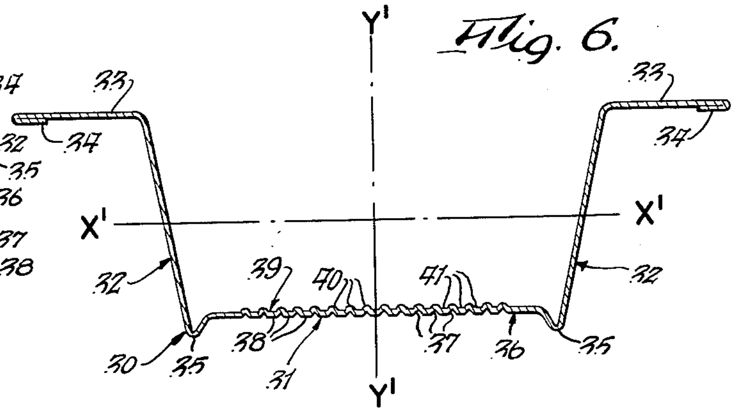
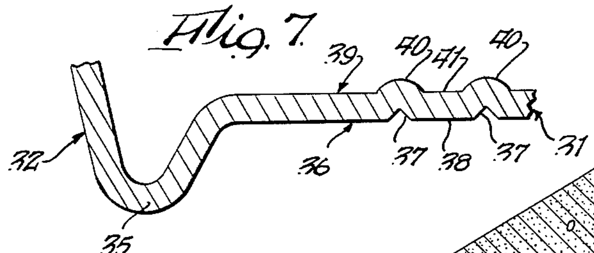


Fig. 7.



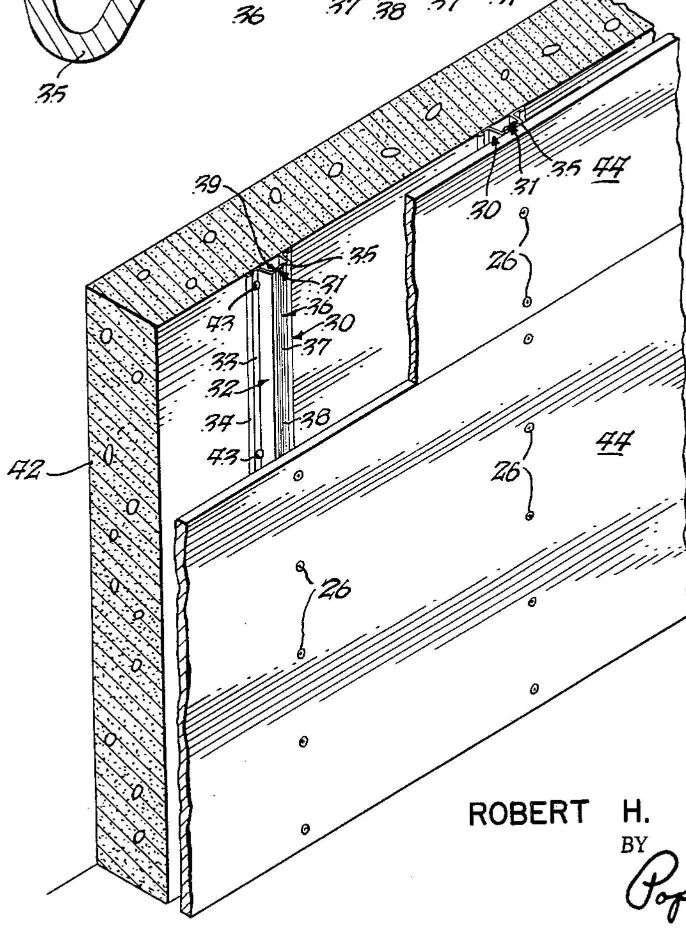


Fig. 8.

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CORRUGATED SHEET METAL STRUCTURAL MEMBERS

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8 Claims. (Cl. 52—364)

This invention relates to improvements in wall construction and more particularly to new and improved corrugated sheet metal structural members such as studs and furring channels.

While sheet metal structural members have been used previously as studs and furring channels for constructing walls, their structures presented certain problems which the present invention is designed to overcome. Both the studs and furring channels are normally roll-formed from a single metal sheet to provide a web portion and a pair of outstanding flange portions. The outer surfaces of the stud flange portions and channel web portions are designed to be engaged and pierced by self-tapping sheet metal screws to hold the wall panels, such as gypsum boards, in place. However, these surfaces are normally smooth and the screw points tend to slip along such surfaces instead of piercing them. This undesirable situation is further aggravated by the fact that such web or flange portions tend to push away from the screw points. This is particularly disadvantageous when attempting to pierce the flange portions at points remote from the web portion of a stud.

While at first blush it might seem obvious to roughen these screw engaging surfaces to hold the screw points, the particular manner in which this is to be done is not quite so apparent. There is an important additional structural requirement which must be met by such studs and channels, and this is that they shall be free of stresses that may cause excessive twisting (i.e., rotation about their central longitudinal axes) or camber (i.e., rotation about their central transverse axes parallel and perpendicular to the web portions thereof), as well as bowing of such flange and/or web portions (which would be caused by deformation of one surface only).

For example, if one were merely to knurl the outer surfaces of the stud flanges by using a pressure roll having a series of randomly spaced or patterned protrusions thereon and a smooth back up roll against the inner surfaces, the ensuing elongation of such flanges would create excessive camber about the central transverse axis parallel to the web portion. This would cause the web portion to be unduly concave longitudinally. Likewise, the more or less random deformation of the outer flange surfaces would tend to produce substantially unequal elongation of the flanges, resulting in excessive camber about the central transverse axis perpendicular or normal to the web. In addition, deformation of the outer flange surfaces only would tend to produce uneven lateral spreading of such outer surfaces, resulting in excessive lateral convex bowing thereof. Attempts to straighten out these various deformations, as well as any twist induced by the roll-forming operations might tend to induce additional twist into the stud about its central longitudinal stud axis.

Similar undesirable stresses would be induced into a furring channel by so knurling the outer surface of the web portion. The elongation of such outer web surface would tend to produce a camber about the central transverse axis parallel thereto. Likewise, any unevenness in the elongation also would tend to produce camber about the perpendicular central transverse axis. Moreover, lateral spreading of such outer web surface would tend to bow the same in a laterally convex direction, and straightening attempts made on these various deformations and the twist resulting from the roll-forming operations, might tend to additionally twist the channel about its central longitudinal axis.

It is evident that such twist, camber and bowing not only increase the cost of manufacture of hollow metal studs and channels by requiring extensive straightening operations, but also result in inferior products, an unduly high percentage of which are so deformed as to be not useable at all in wall construction. At best, these deformed structural members make such construction considerably more difficult because they do not fit properly in or on their supports, or against the wall panels.

Accordingly, it is an object of the present invention to provide new and improved corrugated metal structural members which are substantially free of stresses that may cause such excessive twisting, camber and bowing.

Another object is to provide such metal structural members having web or flange portions which are corrugated longitudinally so as to produce substantially straight studs and channels which are not only economical to manufacture, but also are readily useable for and facilitate wall construction.

Still another object is to provide such metal structural members, the corrugated portions of which readily hold the screw points against slipping and are of substantially increased strength and rigidity for maintaining the desired interengagement with the screws, as well as a high strength to weight ratio permitting the use of light gauge sheet metal.

A further object is to provide such metal structural members, all portions of which, and especially the corrugated portions of which, are of substantially uniform wall thickness for freedom from such stresses.

These and additional objects and advantages of the invention will be more apparent upon consideration of the following detailed description and accompanying drawings wherein:

FIG. 1 is a partial perspective view of a corrugated metal stud constituting a preferred embodiment of the invention;

FIG. 2 is an enlarged transverse section of the stud of FIG. 1, and illustrates the detailed construction of the web portion, and the two outstanding corrugated flange portions;

FIG. 3 is a further enlarged fragmentary section of the right hand corrugated flange portion of FIG. 2, and illustrates the interengagement of the outer flange surface with a screw point, and

FIG. 4 is a partial perspective view on a reduced scale of a partition wall incorporating the studs of FIGS. 1–3;

FIG. 5 is a partial perspective view of a corrugated metal furring channel constistuting another preferred embodiment of the invention;

FIG. 6 is an enlarged transverse section of the channel of FIG. 5, and illustrates the detailed construction of the corrugated web portion and the two outstanding flange portions;

FIG. 7 is a further enlarged fragmentary section of the corrugated web portion and its juncture with the left hand flange portion, and

FIG. 8 is a partial perspective view on a reduced scale of a wall incorporating the channels of FIGS. 5–7.

Referring to the drawings, and more particularly FIGS. 1–4, the inventive stud embodiment will be described first. This elongated stud is generally indicated at **10** and includes a substantially flat web portion **11** provided with longitudinally spaced slots **12** for the passage of the usual electrical and plumbing conduits (not shown). At its sides the web portion **11** terminates in a pair of integral and preferably perpendicular flange portions **13** which are continuously and uniformly corrugated longitudinally throughout their lengths and have their outer sides bent to form inturned ears **14** with their lateral edges turned under to provide hems **15** of double thickness for increased strength. These hems also present rounded edges for ease of handling.

As best seen in FIG. 3, each flange portion **13** is provided with an outer surface **16** having a plurality of uniformly laterally spaced and longitudinally extending, V-shaped grooves **17** preferably forming an included angle of 90° and separated by substantially flat sections **18**. The opposite or inner surface **19** of each flange portion has a varying contour provided by a plurality of uniformly laterally spaced and longitudinally extending, arcuate salients **20** severally opposite grooves **17** and separated by flat sections **21** severally opposite and narrower than flat sections **18**.

In fabricating the inventive stud **10**, it is preferably formed from a single sheet of electro-galvanized steel of 25 gauge, U.S. Standard (0.022"±mill tolerances, which are about 0.003", according to page 441 of Machinery's Handbook, 13th edition, © 1946 by The Industrial Press). This sheet is passed through a first set of forming rolls (not shown) which turn over the ears **14** to form the hems **15**. Next, the corrugations are formed in the flange portions **13** by employing against surface **16** a pressure roll (not shown) having a plurality of circumferentially continuous V-shaped protrusions evenly spaced longitudinally of the roll and against surface **19** a back-up roll (not shown) having similarly spaced, circumferentially continuous arcuate depressions, thereby forming the grooves **17** and salients **20** respectively. Following this, the sheet is roll-bent to form the outstanding flange portions **13** and ears **14**, followed by passing the studs through shearing and cut-off rolls (not shown) to simultaneously form the slots **12** and cut the studs to the desired length. Typical stud sizes are 1⅝" wide (web width) x 9', 2½" x 12', and 3⅝" x 16'.

Desirably, the studs **10** are also passed through straightening rolls (not shown) to eliminate any camber, twisting or bowing introduced during the various preceding roll forming operations. While the corrugating operation does produce some elongation of flange portions **13**, this is relatively small and of even extent. Therefore, any camber about axis X—X (FIG. 2) is readily removed by straightening rolls. Camber about the axis Y—Y is no problem because of the uniformity of elongation of each flange portion **13**. Furthermore, there is no significant bowing of the flange portions **13** as they are corrugated throughout their thickness to maintain the same substantially uniform wall thickness as the rest of the stud, and any twist about the central longitudinal axis (juncture of axes X—X and Y—Y) introduced during any of the aforesaid roll forming operations can readily be removed.

As a matter of fact, it is quite feasible to hold the camber about axis X—X (measured through the Y—Y axis) to a value which does not exceed about 0.0125" per lineal foot, and thus the web portions **11** of the studs **10** will lie flat when placed on a flat surface with the X—X axis parallel to such surface.

The amount of twist of the studs **10** from a straight line is conveniently obtained when a flange portion **13** is placed on a flat surface (not shown) (i.e. Y—Y axis parallel to the surface), the twist in either direction being determined by the angle between a true perpendicular to the flat surface and the unsupported web portion **11** of the stud (i.e. one end of the flange portion held flat against the surface). The permissible twist of the inventive studs **10** does not exceed about 0.5° per lineal foot.

It is, therefore, apparent that the studs of the invention are substantially straight for all practical purposes, and will properly fit in their supports (e.g. track **22**, FIG. 4), as well as properly engage the wall panels **25**.

In corrugating the flange portions **13**, the depth *d* of the V-shaped grooves **17** is controlled so as to be within the preferred range of from a minimum of about 0.010" to about 0.015", while the lateral groove spacing S_g center to center is controlled so as to be preferably about 0.062"±about 0.005" with the maximum being about 0.067" for the gauge (i.e., wall thickness) specified. This inherently produces an approximate ratio of 0.067"/0.019", where the gauge is minimum, within negative mill tolerance, providing inherently for a maximum groove spacing of about three and one-half times the wall thickness, whatever such wall thickness is. Likewise, and as also evident from FIG. 3, the groove width, W_g, is preferably about twice the groove depth, *d*, because of the aforesaid preferably 90° included angle formed by grooves **17**.

The minimum lateral groove spacing, S_g, inherently must be sufficiently greater than the groove width, W_g, to permit formation of flat sections **18**. Otherwise, it would be impossible to produce the profile of varying contour shown in FIG. 3, because if there were no flat sections **18**, there could be no narrower flat sections **21**. On the other hand, the maximum groove depth, *d*, inherently has two limits, depending upon the groove spacing, W_s. In the one instance, the maximum groove depth can be about the wall thickness of the corrugated portion when the maximum groove spacing is employed, in order to permit formation of flat sections **21**. But, in the second instance, the maximum groove depth must be sufficiently less than such wall thickness to permit formation of sections **21** when the minimum groove spacing is employed. If these limits on maximum groove depth were not observed, the profile of varying contour shown in FIG. 3 could not be produced, because no flat sections **21** would be permitted to form in either instance. Rather, the arcuate salients **20**, which have a width, W_s, greater than the groove width, W_g, would merely join or overlap, and create additional points of undesired stress concentration.

This uniform longitudinal corrugated construction has the following advantages. First, it provides as large a number and as close a spacing as possible of grooves **17** having adequate depth for holding the screw points **27** (FIG. 3) against slipping, and facilitates proper piercing and tapping of the flange portions, by helping to maintain the desired perpendicular relationship between the axes of the screws **26** and the flange portions **13**; while maintaining such varying contour. Secondly, this corrugated construction effectively retards the introduction of undesirable stresses which would tend to induce excessive camber and twisting, or bowing, the arcuate salients **20** being most effective in relieving concentration of stress caused by forming grooves **17**. In this connection it is to be noted that the height *h* (FIG. 3) of such salients is preferably about the same as depth *d* of the grooves **17**, while the lateral width W_s of the former is preferably sufficiently greater than the width W_g so as to maintain substantially the same uniform wall thickness throughout each flange portion. Thirdly, the aforesaid corrugated construction significantly increases both the strength and rigidity of the flange portions **13** for maintaining the desired engagement with the screw points, and substantially eliminating any significant tendency of the flange portions to push away from the screw points when piercing such flange portions at points remote from the web portion.

As shown in FIG. 4, the inventive studs are readily adapted for use in constructing walls and facilitate the construction thereof. The studs **10** are erected and their lower ends are designed to fit within the channel shaped sheet metal track **22**, which is roll-formed from the same gauge steel and in a manner similar to the studs to provide the usual web **23** and outstanding flanges **24**. While only the lower or floor track **22** is illustrated, it will be evident that the upper ends of the studs **10** will fit in an oppositely disposed ceiling track, and the studs may be rigidly secured in the tracks in any suitable manner, not shown. It is then but a simple matter to complete the wall construction by affixing the wall panels, such as gypsum boards 25, to the flange portions 13 by means of the self-tapping sheet metal screws 26.

FIG. 3 clearly shows the desired interengagement of a screw receiving groove 17 with the point 27 of a screw. It is worthy of note that the outer diameter of such screw is usually slightly more than twice as large as the groove spacing Sg, a suitable screw diameter for use with the inventive studs being about 0.136″.

Referring now to FIGS. 5–8, the preferred furring channel embodiment of the invention will be described in detail. The inventive channel is generally indicated at 30 and includes the web portion 31 which is continuously and uniformly corrugated longitudinally throughout its length and terminating in a pair of integral and outstanding, outwardly diverging flange portions generally indicated at 32. At their outer lateral edges, these flange portions are bent to form ears 33 extending outwardly substantially parallel to web portion 31 and turned under at their outer edges to form hems 34 of double thickness. Like the hems 15 or studs 10, the hems 34 provide increased strength and smooth exposed edges for ease of handling.

As most clearly illustrated in FIG. 7, the juncture of the web portion 31 and each flange portion 32 is reinforced by a U-shaped boss or ridge 35 extending the length of the channel. These ridges are effective in preventing excessive spreading of flange portions 32 and also present a smooth surface for intimate and continuous seating engagement with the wall panels 44 (FIG. 8). At the same time, the ridges 35 space the corrugated web portion from the panels so that when pierced and tapped by the metal screws, a force is placed on the web portion tending to draw it toward the panels for a tight joint therewith.

Continuing with FIG. 7, the web portion 31 is provided with an outer surface 36 having a plurality of uniformly laterally spaced and longitudinally extending, V-shaped grooves 37 separated by flat sections 38, each of the same size and shape as grooves 17 and sections 18 respectively. The opposite or inner surface 39 has a plurality of uniformly laterally spaced and longitudinally extending, arcuate salients 40 severally opposite grooves 37 and separated by flat sections 41 severally opposite and narrower than flat sections 38, the salients 40 and sections 41 being identical to salients 20 and sections 21.

The inventive channel 30 is fabricated from the same material and gauge and roll-formed in substantially the same way as the inventive stud 10, allowing for the diverging flange portions 32 and ears 33. However, following the hemming operation, web portion 31 is corrugated instead of flange portions 32. A typical channel size is 1⅜″ wide (web width) x 12′ long. The uniform longitudinal corrugated construction of the web portion 31 thus produces a substantially straight channel with the same twist and camber tolerances as stud 10, and similarly avoids inducing undesirable bowing of the web portion, as well as excessive camber about axis X′—X′ or Y′—Y′ and twisting about the central longitudinal channel axis (juncture of axes X′—X′ and Y′—Y′), just as the corrugated flange construction of stud 10. While camber is measured the same as for stud 10, the twist determination is somewhat different because of the diverging flange portions 32 and outwardly extending ears 33 which prevent seating a flange portion on a flat surface. In this instance the ridges are placed on a flat surface (not shown, X′—X′ axis parallel to the surface) and the twist is determined in either direction by the angle between the surface and the unsupported web portion (i.e. a straight line tangent to ridges 35, one end of the web portion being held flat against the surface). Alternatively, the ears 33 could be placed on the flat surface and the measurement taken between the surface and a straight line connecting the ears. Likewise, a substantially uniform wall thickness is maintained throughout the channel, and especially the web portion by the same groove depth, width and spacing, and salient height and width, as in the stud form of the invention, thereby producing therein equivalent freedom from stress, increase in strength and rigidity, holding of the screw points, and proper piercing and tapping of the web portion.

It will be evident therefore, that the furring channel embodiment of the invention is equally adapted for ready use in constructing walls and in facilitating such construction. Referring to FIG. 8, a typical load supporting wall construction is illustrated as including the outside concrete wall 42 to which the inventive channels 30 may be readily attached by suitable masonry nails 43 passing through ears 33. Once the channels 30 are rigidly secured in the desired spaced relationship as shown, it is then but a simple matter to affix the wall panels, such as gypsum boards 44, thereto by means of the self-tapping sheet metal screws 26.

While not shown in FIG. 7, the same holding of the screw points by grooves 37 is obviously obtained as with the stud grooves 17 illustrated in FIG. 3.

It will now be seen how the invention accomplishes its various objects. While only two preferred embodiments of the invention have been described and illustrated in detail herein, it is to be understood that these embodiments are to be considered in an illustrative and not limiting sense, and that the scope of the invention is to be determined by the appended claims. For example, it should be quite evident that both the stud and furring channel forms of the invention are readily adapted for use in constructing suspended ceilings and other types of walls besides those illustrated.

What is claimed is:

1. An elongated and substantially straight structural member formed from a thin metal sheet to provide a web portion and an outstanding flange portion, one of said portions being of substantially uniform wall thickness and corrugated longitudinally to produce inner and outer opposite surfaces of varying contour, said outer surface being adapted to be engaged by the point of a screw and including a plurality of laterally spaced and longitudinally extending V-shaped grooves severally forming an included angle of about 90° and separated by first substantially flat sections, said inner surface including a plurality of laterally spaced and longitudinally extending arcuate salients severally opposite said grooves and separated by second substantially flat sections severally opposite and narrower than said first substantially flat sections, said grooves having a width of about twice their depth because of said included angle, a lateral spacing, center to center ranging from a minimum sufficiently greater than said width to permit formation of said first substantially flat sections to a maximum of about three and one half times said wall thickness, and a depth ranging from a minimum of about 0.010″ to a maximum which is about said wall thickness to permit formation of said second substantially flat sections when said lateral spacing is said maximum, but which is sufficiently less than said wall thickness to permit formation of said second substantially flat sections when said lateral spacing is said minimum, in order to provide as large a number and as close a spacing as possible of said grooves having adequate depth for holding said screw point against slipping and for facilitating proper piercing of said one portion by helping to maintain the desired perpendicular relationship between the axis of said screw and said one portion, while maintaining said varying contour, and said arcuate salients having about the same depth as said grooves but a sufficiently greater width to maintain said substantially uniform wall thickness of said one portion, and thereby relieve concentration of stress caused by forming said grooves.

2. The structural member of claim 1 in the form of a stud formed from said thin metal sheet to provide said

web portion and a pair of said outstanding flange portions, each of said oustanding flange portions being of said substantially uniform wall thickness and corrugated longitudinally to produce said inner and outer surfaces of said varying contour.

3. The structural member of claim 1 in the form of a furring channel formed from said thin metal sheet to provide said web portion and a pair of said outstanding flange portions, said web portion being of said uniform wall thickness and corrugated longitudinally to produce said inner and outer surfaces of said varying contour.

4. The structural member of claim 1 in combination with a screw having an outer diameter more than twice as large as said lateral spacing between said grooves, said screw piercing said one portion with its point having been received in one of said grooves and its axis being in said substantially perpendicular relationship with said one portion.

5. An elongated and substantially straight structural member formed from a substantially 25 gauge metal sheet to provide a web portion and a pair of outstanding flange portions, each of said web and flange portions being of the same substantially uniform wall thickness, one of said portions being continuously and uniformly corrugated throughout its length to produce inner and outer surfaces of varying contour, said outer surface being adapted to be engaged by the point of a self-tapping sheet metal screw and including a plurality of uniformly laterally spaced and longitudinally extending, V-shaped grooves severally forming an included angle of about 90° and separated by first substantially flat sections, said inner surface including a plurality of uniformly laterally spaced and longitudinally extending, arcuate salients severally opposite said grooves and separated by second substantially flat sections severally opposite and narrower than said first substantially flat sections, said grooves having a width of about twice their depth because of said included angle, a lateral spacing, center to center of about 0.062" to about 0.005", and a depth ranging from about 0.010" to about 0.015", in order to provide as large a number and as close a spacing as possible of said grooves having adequate depth for holding said screw point against slipping and for facilitating proper piercing and tapping of said one portion by helping to maintain the desired perpendicular relationship between the axis of said screw and said one portion, while maintaining said varying contour, and said arcuate salients having about the same depth as said grooves but a sufficiently greater width to maintain said substantially uniform wall thickness of said one portion and thereby relieve concentration of stress caused by forming said grooves, said member having a twist of not more than about 0.5° per lineal foot and a camber about a central transverse axis parallel to said web portion of not more than about 0.0125" per lineal foot.

6. The structural member of claim 5 in the form of a stud wherein each of said flange portions is continuously and uniformly corrugated throughout its length to produce said inner and outer surfaces of said varying contour.

7. The structural member of claim 5 in the form of a furring channel wherein said web portion is continuously and uniformly corrugated longitudinally throughout its length to produce said inner and outer surfaces of said varying contour.

8. The structural member of claim 5 in combination with a self-tapping sheet metal screw having an outer diameter more than twice as large as said lateral spacing between said grooves, said screw piercing and tapping said one portion with its point having been received in one of said grooves and its axis being in said substantially perpendicular relationship with said one portion.

References Cited by the Examiner

UNITED STATES PATENTS

2,020,502	11/1935	Goddard	52—238
2,268,517	12/1941	Small	52—481
2,664,179	12/1953	Gwynne	189—36

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