Oct. 23, 1962 LE ROY N. HERMANN 3,059,733

REINFORCED PANEL SHEETS

Filed July 13, 1955 3 Sheets-Sheet 1

Fig. 1.

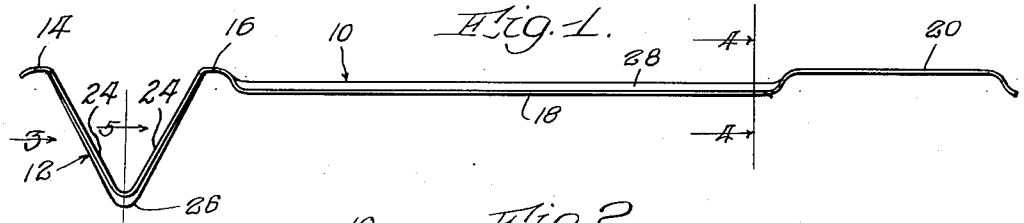


Fig. 2.

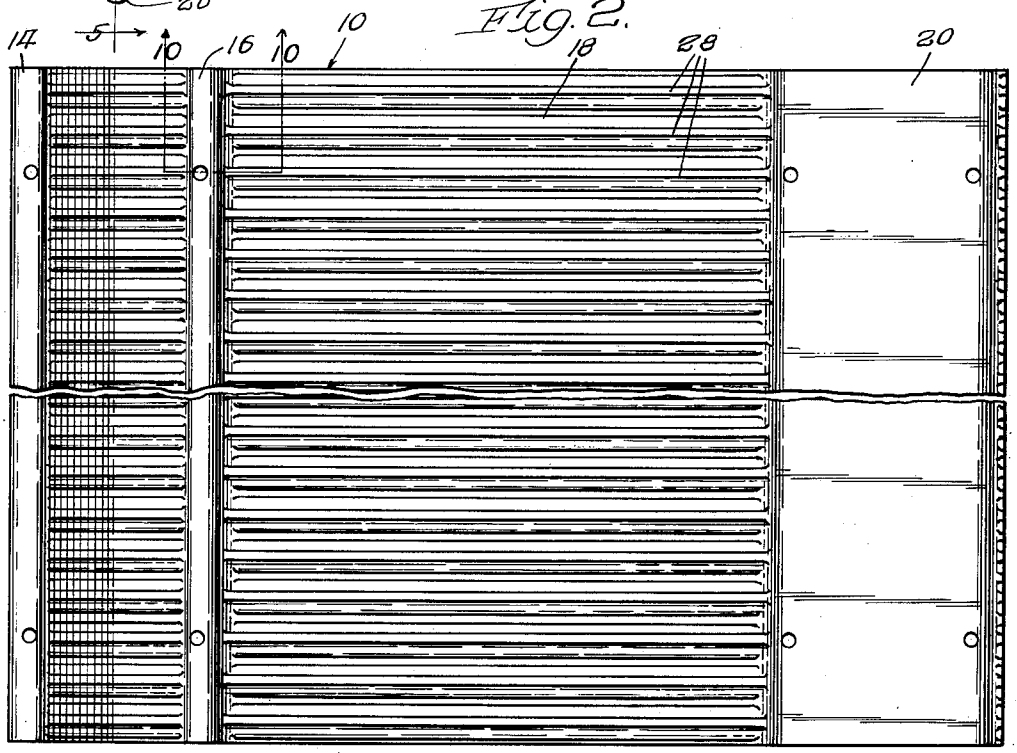


Fig. 3.

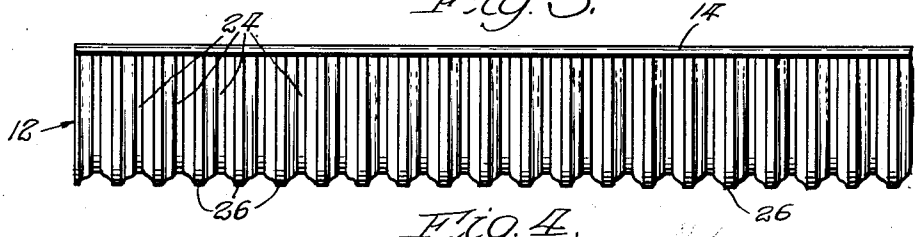
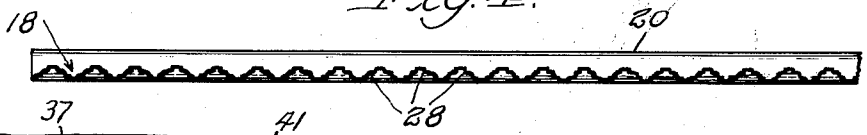


Fig. 4.



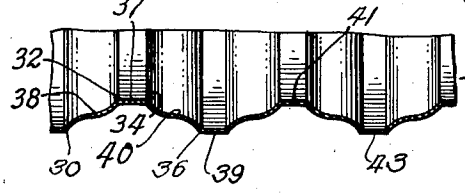


Fig. 5.

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Fig. 6.

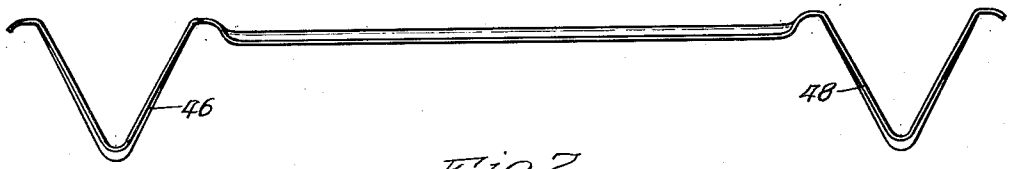


Fig. 7.

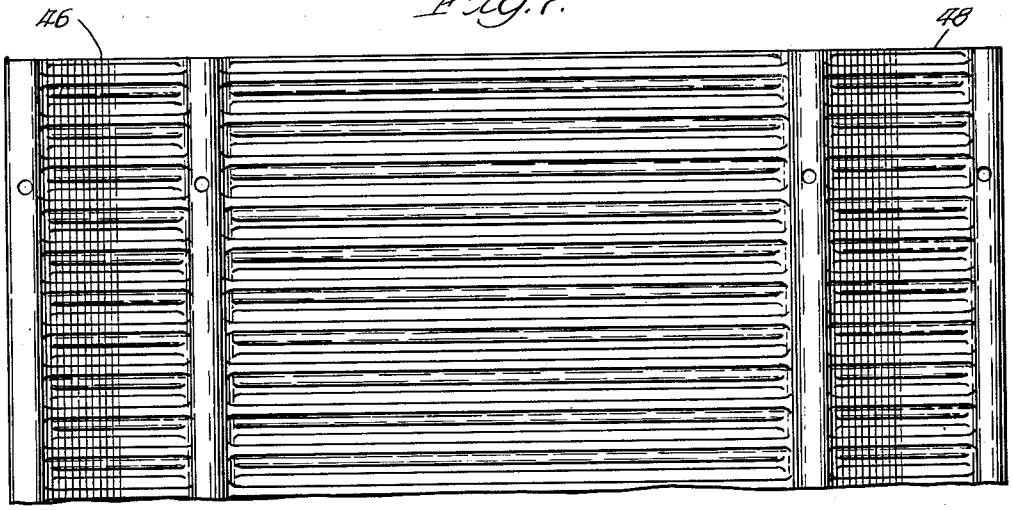


Fig. 8.



Fig. 9.

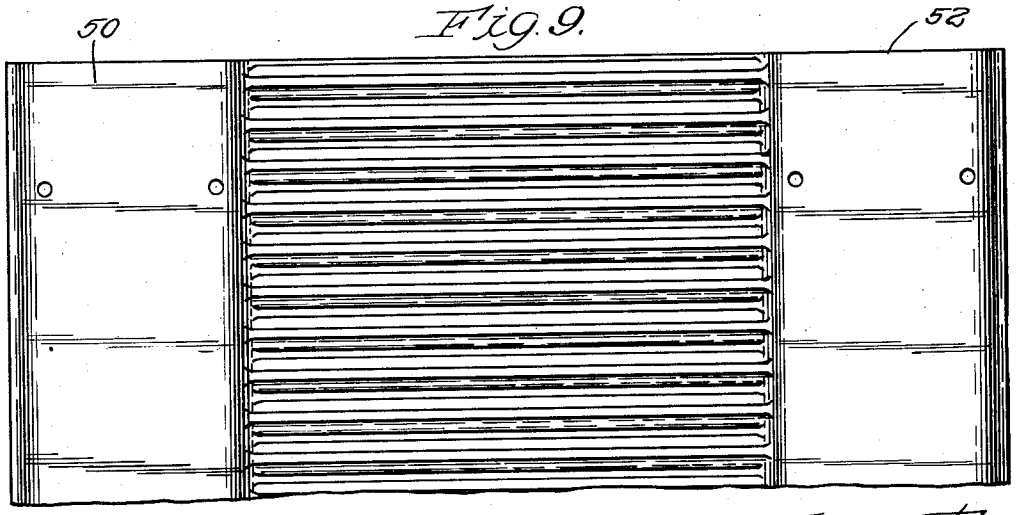
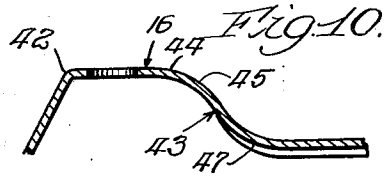


Fig. 10.



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Fig. 11.

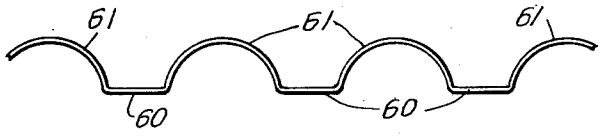


Fig. 14.

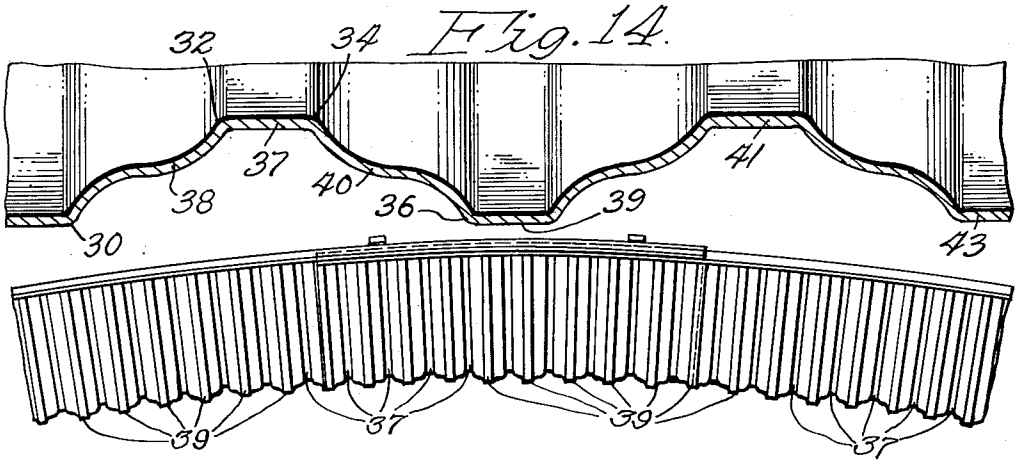
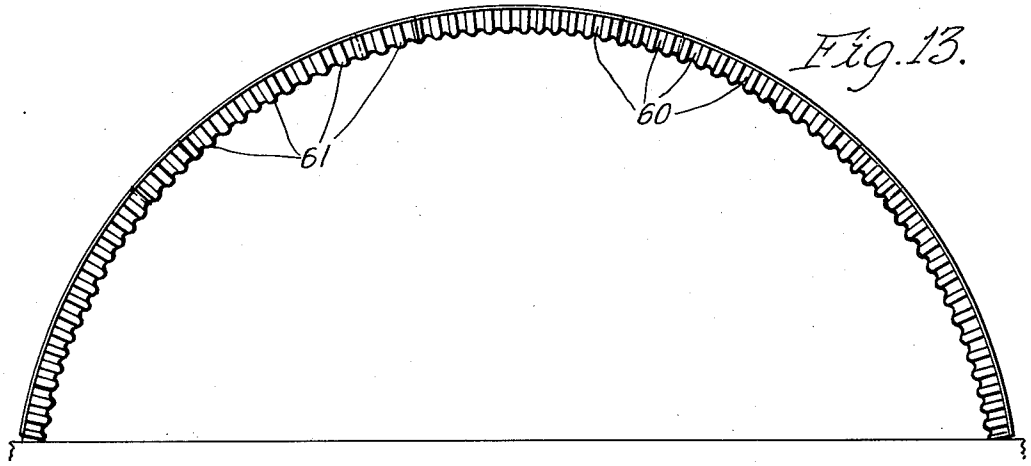


Fig. 12.

Fig. 13.



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3,059,733

REINFORCED PANEL SHEETS

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Filed July 13, 1955, Ser. No. 521,797
8 Claims. (Cl. 189—34)

This invention relates to metal panels for use in prefabricated buildings and more particularly to a panel sheet which has unusual strength imparted to it during the process of formation.

This application is a continuation-in-part of my application Serial No. 437,686, filed June 18, 1954, now abandoned, and is a continuation of my application Serial No. 456,962 filed September 20, 1954, now abandoned.

Although corrugated metal panels have long been used in prefabricated buildings, they have proved insufficiently resistant to stress and have needed an excessive number of truss elements before they could be used to form a reasonably strong building.

I have, accordingly, devised a metal panel sheet which is strong enough so that interior truss elements can be virtually eliminated in buildings constructed therewith.

My panel is provided with ribs of metal having unusual hardness, produced by coining with rolling dies similar to those described in my copending application No. 322,283 now Patent No. 2,775,284 issued December 25, 1956. The coining may also be effected by dies using a brake press. I have found that by coining the metal, I can augment the Rockwell B hardness in the deformed area by several points, so that the rigidity of a building constructed with my panel is greatly increased.

Referring now to the drawings:

FIGURE 1 is an end view of one of the braced panel sheets which may be constructed according to the present invention;

FIGURE 2 is a plan view of the same;

FIGURE 3 is a side elevational view of one of the V-ridges in a panel sheet constructed in accordance with the present invention, taken in the direction 3 of FIGURE 1;

FIGURE 4 is a cross-sectional view through the flat of one of the panels taken on the line 4—4 of FIGURE 1;

FIGURE 5 is an enlarged fragmentary view of the V-shaped portion seen in FIGURE 1 taken on line 5—5 of FIGURE 1;

FIGURE 6 is an end view of a modified form of braced panel sheet which may be constructed according to the present invention;

FIGURE 7 is a plan view of the same;

FIGURE 8 is an end view of yet another form of panel which may be constructed according to the present invention;

FIGURE 9 is a plan view of the same;

FIGURE 10 is an enlarged fragmentary vertical section of a bead formed adjacent a V-ridge in a panel according to the present invention, taken on the line 10—10 of FIGURE 2;

FIGURE 11 is a cross-sectional view of another form of coined corrugation;

FIGURE 12 is a cross sectional view through the V-brace of arched building panels in partial overlapping longitudinal alignment; and

FIGURE 13 is an end view of a building formed from the arched building panels.

FIGURE 14 is an enlarged fragmentary vertical section of the shaped portion shown in FIGURE 5.

In the embodiment of the invention herein described, the sheet 10 seen in FIGURE 1 has a V-shaped brace portion 12 along one edge terminating in beads 14 and 16

along the edges thereof, an adjoining wall portion 18 and a dished brace portion 20 along the opposite parallel edge.

Corrugations or pleats may be formed on the surface of the wall portion 18 and in the V-shaped brace portion 12 by means of rolling dies such as described in my copending application No. 332,283 now Patent No. 2,775,284 issued December 25, 1956, or by a press brake with suitable dies. As seen in FIGURES 2 and 3, the V-shaped brace will have grooves or pleats 24 formed on its sides normal to its longitudinal axis, and complementary pleats are coined on the apex 26 of the ridge. At the same time, the surface 18 of the panel will have similar pleats 28 formed therein, as seen in FIGURES 2 and 4, preferably extending across the entire expanse thereof.

The increased strength imparted to the panel by coining the lateral corrugations in the V-brace is of the greatest significance in connection with the arched panels shown in FIGURES 12 and 13. In the coining process the metal is displaced from the thickness of certain areas into that of adjacent areas, resulting in alternating thinned and thickened regions of the blank. (Vide: Sheet-Metal Fabricating, Sachs, Reinhold, 1951, at page 166.) This is cause it is well recognized that an arched structural member does not possess the strength of a straight structural member of the same cross section. This is true irregardless of whether the member is in tension or compression but it would seem more pronounced in the latter. Through coining I am able to provide an arched V-brace panel with lateral corrugations in the V having over 80% of the expected strength of a straight V-braced panel; uncoined arched V-brace panels with lateral corrugations in the V would have significantly less than 80% strength.

In the formation of the laterally corrugated V-brace by coining the outermost areas of the corrugations as shown by 30, 36, 39 and 43 of FIGURE 5 and 26 of FIGURE 3 are stretched (true coining) as seen or viewed from outside the V and the metal in the valley of the corrugations when viewed from outside the V as shown by 32, 37, 34 and 41 of FIGURE 5 is thickened (commonly called upsetting). Such areas become stronger and hardened and enhance the strength of the arched panel at points where greatest stress occurs.

The deformation produced by the coining process is considerable, as seen particularly in FIGURES 4 and 5. The stress thus suddenly exerted on the metal, as seen, for example, at the edges 30, 32, 34 and 36 and along the sinuous pleating sides 38 and 40, seen in FIGURE 5, effects a marked change in the hardness of the metal, so as to provide ribs extending along the edges and sides of each pleat.

The lateral pleats or corrugations in the V-brace are, in a particular example of a suitable construction, approximately three fourths of an inch in width from one marginal edge 30 to the next marginal edge 36, and approximately one fourth of an inch deep. The sides 38 and 40 are substantially three eighths of an inch in width, while the flat strips 37, 39, 41 and 43 may be one fourth inch across. The edges 30, 32, 34 and 36 accordingly provide ribs of hardened metal substantially an eighth of an inch in width, where metal of about 18 gauge thickness is used, since the coining produces a rounded configuration in actual practice. As the corrugations proceed up the sides of the V-brace they decrease in depth or taper until they vanish at the top.

Another example or formation of a coined corrugation is shown in FIGURE 11 wherein the coined area 60 is stretched and the area 61 is thickened in a gradual manner.

The increase in hardness will, of course, vary with the type of material from which the panels are formed

and the initial hardness thereof. Thus, where the initial Rockwell B hardness is 50, the coining is preferably such as to provide an increase of about four points plus or minus one point. With a 71 hardness sheet, an increase of from two to three points is preferred.

Referring now to FIGURE 10, wherein is shown a section of the bead **16**, seen in FIGURE 1, it will be noted that the edge **42** immediately adjacent the ridge and the configured side **43** of the bead **44** are also points where great stress has been produced during coining with a corresponding increase in hardness to provide ribs transverse to the ribs first described. The rib along edge **42** will preferably be about an eighth of an inch in width, while the side **43** will have two ribs **45** and **47** formed therein, each substantially one fourth inch in width. The panel will thus be braced against strain in two directions.

As seen in FIGURES 6 and 7, the panels may be formed with a V-shaped portion **46** and **48** at each edge thereof. Or, as seen in FIGURES 8 and 9, dished brace elements **50** and **52** may be formed at each end of a panel. The dished brace portions may be formed with partial folds, or without such folds, as in FIGURES 8 and 9, as may the V-shaped portions.

Other constructions may likewise be employed within the spirit and scope of this invention, and I do not intend to limit the invention to the embodiments shown, which are for purposes of illustration only.

I claim:

1. In an arcuate sheet metal structural unit longitudinally curved in a segment of an arch comprising a trough-shaped sheet metal brace having the part of the trough farthest from the terminal extremities thereof on the inside of the arch, said trough-shaped brace having transverse, uniformly shaped and spaced corrugations terminating in the legs forming the side walls of the trough whereby the longitudinally curved configuration is produced, the improvement which comprises the corrugations formed at the part of the trough farthest from the extremities thereof being coined and having alternating thinned and thickened regions whereby the compressive strength of said structural unit is increased, said thinned and thickened regions being free from laterally depending strengthening elements and being substantially positioned, respectively, at the nadir portion and zenith portion of the corrugations when viewed from the inside of the arch.

2. In an arcuate sheet metal structural unit longitudinally curved in a segment of an arch comprising a trough-shaped sheet metal brace having the part of the trough farthest from the terminal extremities thereof on the inside of the arch, said trough-shaped brace having transverse, uniformly shaped and spaced corrugations terminating in the legs forming the side walls of the trough whereby the longitudinally curved configuration is produced, the improvement which comprises the corrugations formed at the part of the trough farthest from the extremities thereof being coined, said corrugations comprising alternating sigmoid sections inter-connected by alternating thinned and thickened webs, said webs being free from laterally depending strengthening elements and being substantially position, respectively, at the nadir and zenith of the corrugations when viewed from the inside of the arch.

3. In a rectangular sheet metal panel longitudinally curved in a segment of an arch comprising a central longitudinal body area, an integral trough-shaped brace formed along the full length of one longitudinal edge of the panel, said brace having the part of the trough farthest from the terminal extremities thereof on the inside of the arch and substantially below the surface of the central body area, and an offset portion along the other longitudinal edge of the panel forming an inverted, shallow trough the full length of the panel, said trough-shaped brace having transverse, uniformly shaped and spaced corrugations terminating in the legs forming the side walls of the trough whereby the longitudinally curved configuration is produced, the improvement which comprises the corrugations formed at the part of the trough farthest from the extremities thereof being coined and having alternating thinned and thickened regions whereby the compressive strength of said panel is increased, said thinned and thickened regions being substantially positioned, respectively, at the nadir and zenith portions of the corrugations when viewed from the inside of the arch.

4. A rectangular sheet metal panel in accordance with claim 3 in which said central body area has formed therein transverse corrugations which terminate adjacent said trough-shaped brace and said offset portion, respectively.

5. In an arcuate sheet metal structural unit in accordance with claim 2 longitudinal beads disposed adjacent the top of each leg of the trough-shaped brace.

6. In an arcuate sheet metal structural unit in accordance with claim 2 coined areas in said corrugations having 2–5 points of Rockwell "B" hardness more than uncoined areas.

7. In a rectangular sheet metal panel in accordance with claim 3 longitudinal beads disposed adjacent the top of each leg of the trough-shaped brace raised above the surface of the central body area.

8. In a rectangular sheet metal panel in accordance with claim 3 coined areas in said corrugations having 2–5 points of Rockwell "B" hardness more than uncoined areas.

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