April 30, 1940. W. J. TANGERMAN 2,199,377

METHOD OF FORMING PLATES

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Fig. 1

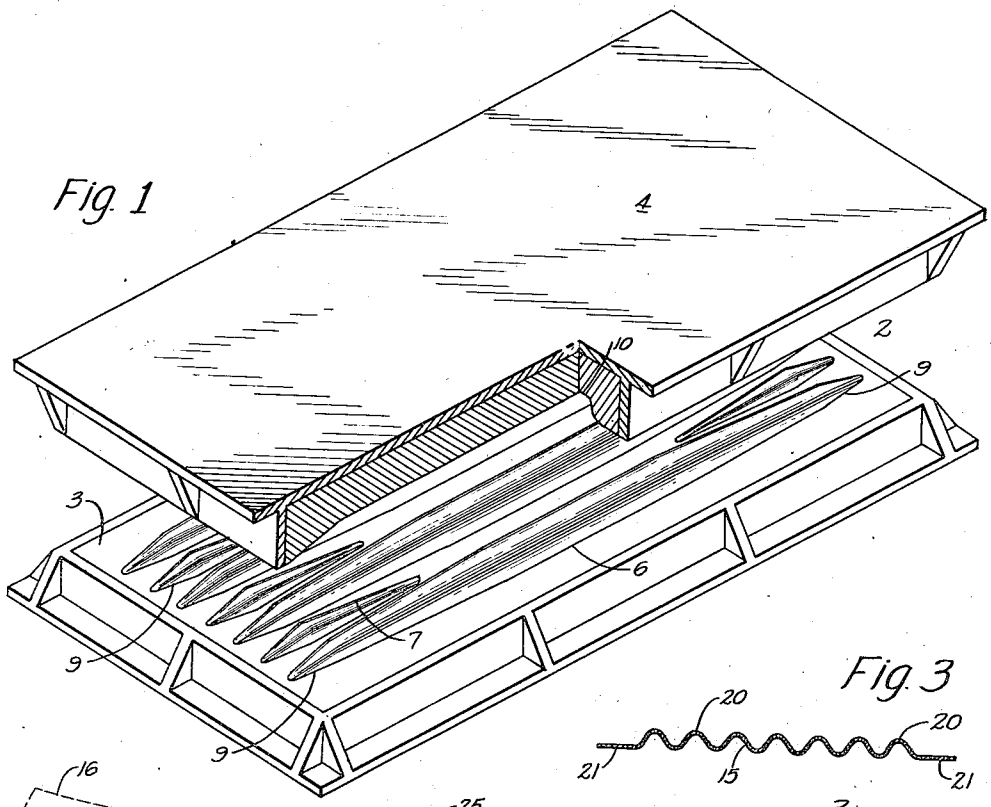


Fig. 3

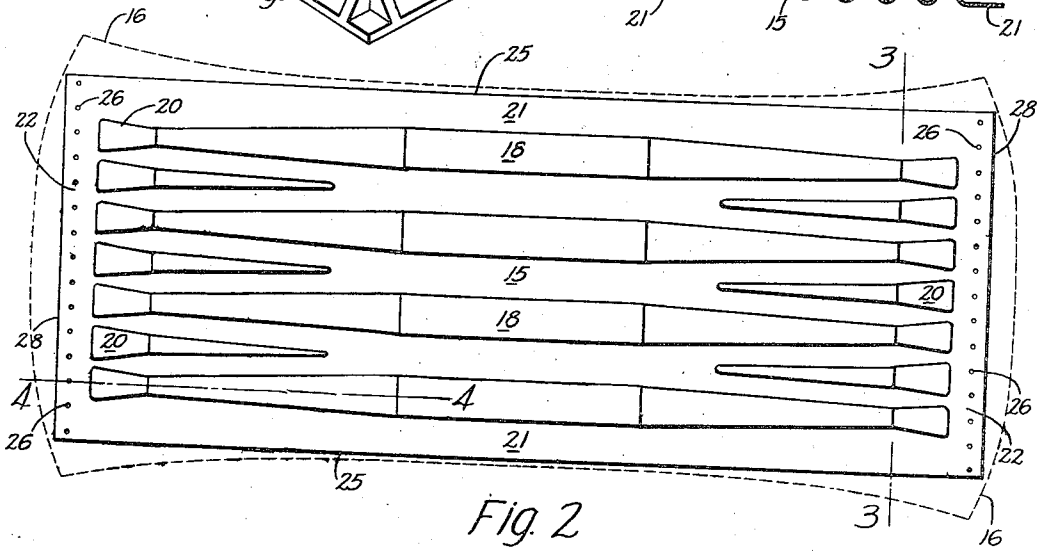


Fig. 2

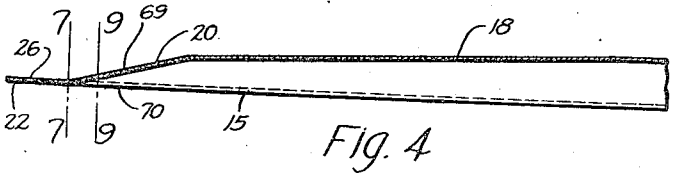


Fig. 4

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Fig. 5

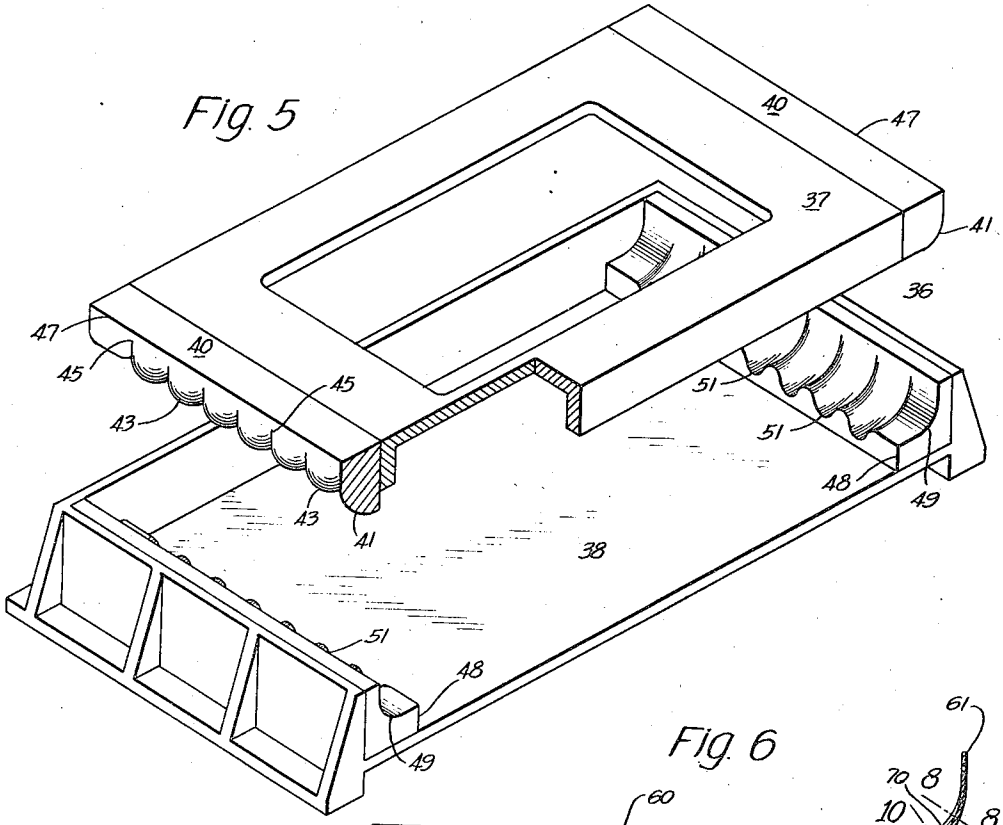


Fig. 6



Fig. 7

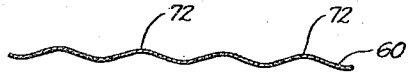


Fig. 8

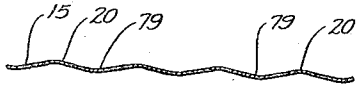


Fig. 9

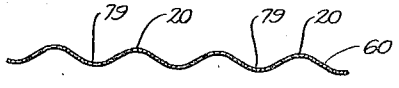


Fig. 10

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Fig. 11

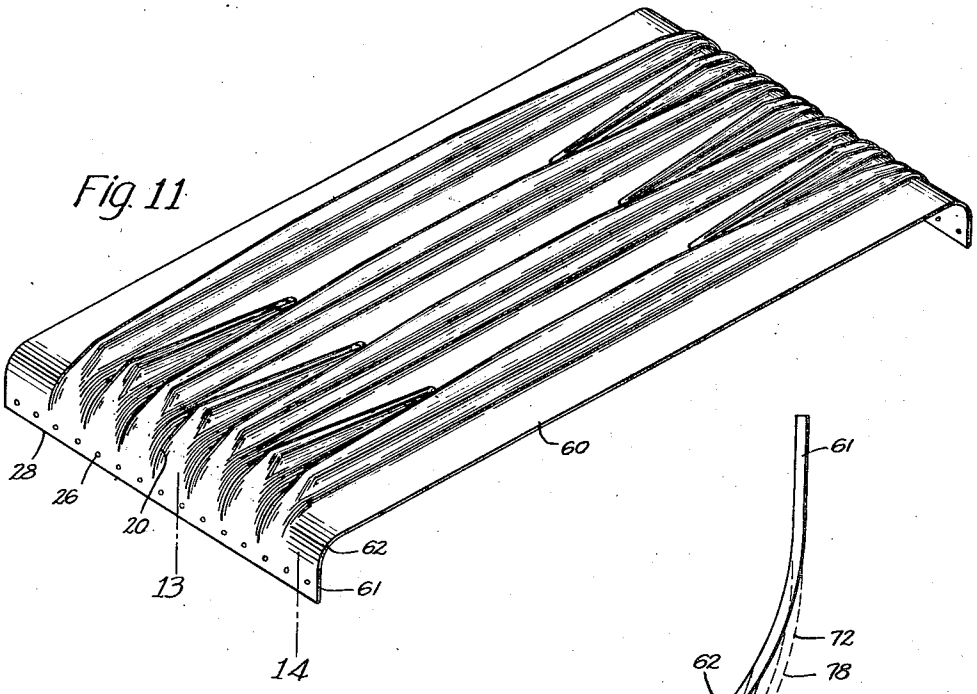


Fig. 12

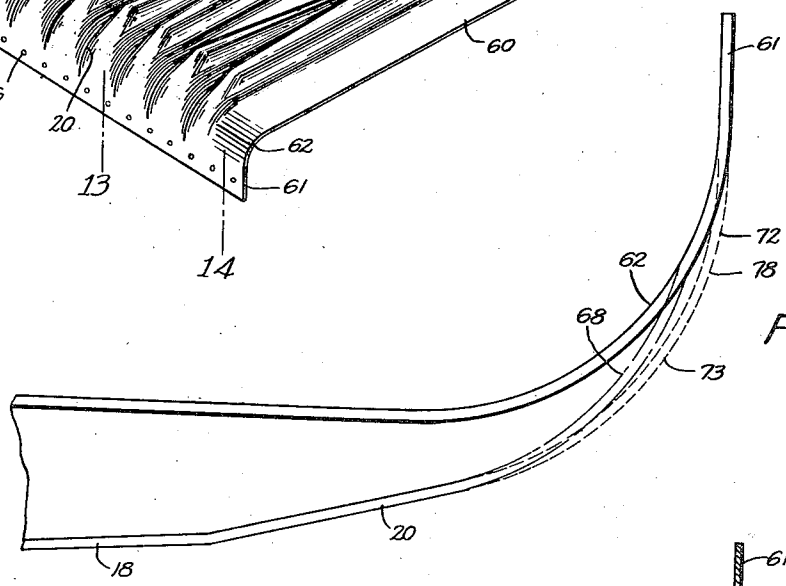


Fig. 13

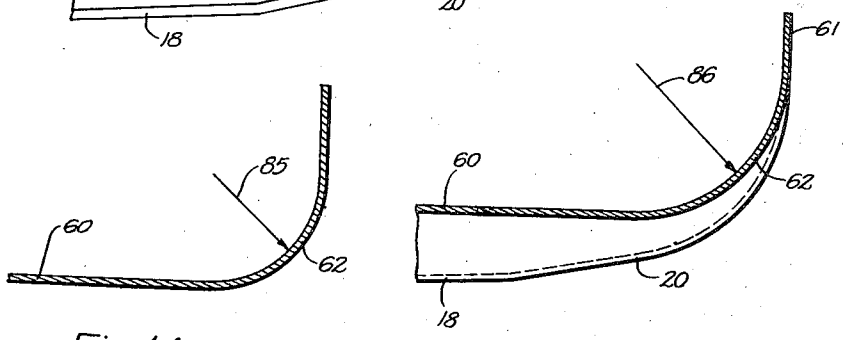


Fig. 14

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Patented Apr. 30, 1940 2,199,377

UNITED STATES PATENT OFFICE

2,199,377

METHOD OF FORMING PLATES

William J. Tangerman, Hammond, Ind., assignor to Standard Railway Equipment Manufacturing Company, Chicago, Ill., a corporation of Delaware

Application April 6, 1939, Serial No. 266,239

9 Claims. (Cl. 153—76)

The invention relates to corrugated walls for railway cars and more particularly to the method and apparatus for manufacturing such walls.

A common type of end wall for railway cars is a relatively thin metallic plate having pressed therein a plurality of substantially parallel corrugations which merge into said plate adjacent the corner posts of the car. An end of this type has great strength when considered at a section through the corrugations. There is, however, a region of substantially flat plate near the attachment of the end wall to a corner post and the weakness of this region is indicated by bulges therein when the end wall is subjected to excessive loads. End wall plates are usually provided with flanges on the vertical margins thereof for attachment to the corner posts of the car.

It is an object of the invention to form the above mentioned flange on a curvature and carry the corrugations around the curvature. The flat region of the sheet is then disposed longitudinally of the car so that it is better positioned to resist impacts against the end wall. A preferred form of corner post for use with such an end has angularly disposed arms, one of which is attached to the flange and the other to the body part of the end wall. This forms a box type corner post in which the corrugations function as arches between the arms of the corner post.

Another object of the invention is to improve the appearance of the car to which the end wall is applied. The corners appear curved and the corrugations extending around the corner present a streamlined appearance.

An end wall of the type described above is desirable in several respects but presents difficulties in the manufacture thereof. I have invented a method and apparatus to manufacture end walls of the type described which I will describe in detail hereinafter. The objects and advantages of my invention are:

The corrugations are not wrinkled. In a structure embodying arched corrugations there is a pronounced tendency for the inner corrugations to wrinkle due to the difference in length between the inner and outer corrugations. I provide means to prevent such wrinkling.

Handling during manufacture is greatly facilitated. End plates are manufactured in large quantities, therefore, the presence of flanges of wide curvature would make it difficult to handle the plates due to the impossibility of piling them one on the other. In the method which I claim as my invention all shearing and punching is done prior to flanging so that practically all the handling is of substantially flat plates, thereby greatly eliminating the hazards of handling the flanged plates.

The flanges for attachment to the corner posts are maintained as formed by varying the radius of curvature of the flanges. This eliminates the necessity of forming the flange (i. e., shearing and punching the flange) after flanging with the consequent disadvantages enumerated above.

The length of the end may be easily adjusted for adoption to various widths of cars. Such adjustment would be difficult with complex die assemblies but the dies which I claim as my invention may be easily adjusted.

Existing equipment may be utilized. The primary operation may be performed on dies which are normally used for the manufacture of conventional end walls wherein the corrugations merge into the end wall plate in the plane of said wall. Furthermore, existing reciprocating presses can be used, the presses having been in use for the manufacture of the aforementioned conventional end walls.

Other objects and advantages of my invention will be apparent from the following detailed description by referring to the accompanying drawings.

In the drawings:

Fig. 1 is a perspective view of a set of dies used to perform the primary pressing operation.

Fig. 2 is a plan view of a plate as pressed by the dies shown in Fig. 1.

Fig. 3 is a section on line 3—3 of Fig. 2.

Fig. 4 is a section to an enlarged scale on line 4—4 of Fig. 2.

Fig. 5 is a perspective view of the set of dies used to perform the final pressing operation.

Fig. 6 is a section, similar to Fig. 4, showing the plate as pressed by the dies of Fig. 5.

Figs. 7 and 9 are sections on lines 7—7 and 9—9 respectively of Fig. 4.

Figs. 8 and 10 are sections on lines 8—8 and 10—10 respectively of Fig. 6.

Fig. 11 is a perspective view of a finished end wall plate as it comes from the dies shown in Fig. 5.

Fig. 12 is a schematic diagram showing the method of carrying the corrugations around the curved surface.

Figs. 13 and 14 are sections through the curved surface as indicated by the lines 13 and 14 respectively of Fig. 12.

Fig. 1 shows the primary die assembly 2 which comprises a male block 3 and a female block 4. The male block 3 has secured thereto a plurality

of substantially parallel raised members 6 and a plurality of minor members 7 positioned between the members 6. The members 6—7 have end sections 9 which slope so as to merge into the block 3. The female block 4 is provided with recesses 10 in one face thereof which substantially conform to the raised members 6—7 and are adapted to engage therewith.

The blocks 3—4 are secured to the lower and upper platens respectively of a reciprocating press, the blocks having substantially the relative positions shown in Fig. 1. A substantially flat, relatively thin metallic plate 15, preferably heated to a red color, is placed between the blocks 3—4 and the blocks are pressed together by a large force. A force of two thousand tons is sometimes used for this purpose. After the blocks have been forced together as tightly as possible they are drawn apart and the plate 15 is removed.

Figs. 2 to 4 show the plate 15 as removed, the dotted lines 16 in Fig. 2 showing the outline of the plate. The plate has pressed therein a plurality of corrugations 18 having end sections 20 conforming to the members 6—7 and sections 9 of the block 3. The outline 16 is curved because some of the plate was drawn inwardly to form the corrugations 18 and end sections 20. The plate 15 is originally provided with enough area to leave margins 21 parallel to the corrugations 18 and marginal regions 22 adjacent and transverse to the sections 20. The edges of the plate 15 are then formed to some predetermined configuration which, in the example illustrated, comprises shearing the straight edges 25 on the margins 21, punching aligned holes 26 in the regions 22 and shearing the straight edges 28 on the regions 22.

Fig. 5 shows the secondary die assembly 36 which performs the final, or flanging operation, upon the plate 15. The assembly 36 comprises an interior piece 37 and an exterior piece 38. The interior piece 37 comprises spaced apart end portions 40 having exterior convex surfaces 41. A plurality of spaced apart ridges 43 extend around the surfaces 41 and merge thereinto (45) toward the ends 47 of the interior piece 37. The exterior piece 38 comprises spaced apart end blocks 48 having concave surfaces 49 adapted to engage the convex surfaces 41. The convave surfaces 49 are provided with grooves 51 substantially conforming to and adapted to engage the ridges 43.

The interior piece 37 and the exterior piece 38 are attached to the upper and lower platens respectively of a reciprocating press which may be similar to the one used in conjunction with the primary die assembly 2. The plate 15 is placed on top of the exterior piece 38 with the opposite side uppermost from its position in the primary die assembly 2. The plate 15 is positioned so that the end sections 20 of the corrugations 18 are substantially aligned with the grooves 51 in the blocks 48. The interior (37) and exterior (38) pieces are then forced together by a large force and after they have been forced as closely together as possible, they are drawn apart. The plate which is then removed represents the finished product, being shown in section in Fig. 6 and in perspective in Fig. 11.

The finished end wall plate 60 has flanges 61 joined to the plate 60 by a curvature 62 which comprises portions of the sections 20 carried therearound. Merely bending a corrugated plate on a curvature would wrinkle the corrugations disposed on the interior of the curvature. I provide means to eliminate this wrinkling, which means may be best understood by referring to Figs. 4, 6 to 10 and 12.

Fig. 12 shows by the broken lines 68 the position which would be taken by the outermost area 69 of Fig. 4 if it were practical to bend the plate in a simple bending operation. When a corrugated plate is bent transverse to the corrugations, the neutral axis of the plate remains unchanged in length, the neutral axis being, in this case, substantially equidistant from the inner (70) and outer (69) areas of the plate. If the neutral axis is to remain unchanged, the inner area 70 must decrease in length and the outer area 69 must increase in length. Since the increases and decreases involved are relatively great, deformation would occur in the wrinkling of the inner area 70 and the inward collapse of the outer area 69. To prevent said wrinkling and collapse, the peripheral area of the outwardly projecting sections 20 is increased, thereby drawing from the innermost plate 70 enough material to permit it to form a radius without wrinkling. The increase in peripheral area may be accomplished by increasing the length of the section 20, as indicated by the dotted lines 72 of Fig. 12, by increasing the depth of the sections 20, as indicated by the dotted lines 73 of Fig. 12, or by increasing the width of the sections 20 as shown in the comparison of Figs. 9 and 10. The preferable method is to increase length, depth and width of the sections 20, thereby drawing material from the inner areas 70 and redistributing it at the outer areas 69.

Figs. 7 to 10 inclusive show the changes in the plate caused by flanging. Figs. 7 and 8, which show the contour of the plate before and after flanging respectively, are at the same section of plate; i. e., the original section of mergence of the sections 20 into the plate 15. The corrugations 72 are formed by the extension of the section 20 during flanging. Figs. 9 and 10 show the contour of the plate 15 through the sections 20 before and after flanging respectively showing the increase in the height and width of the sections. This increase in length, height and width of the sections 20 increases the peripheral area thereof and utilizes material which normally lies between (79) the sections 20 and would cause wrinkles during flanging if not drawn therefrom.

In the claims, the term "substantially," as applied to the increase of peripheral area of the corrugations, is used to indicate that the increase is materially greater than that inherent in the outer portions of a plate due to the increase in stress which accompanies a flanging operation.

Increasing the length and depth of the sections 20 as explained above not only draws material from the inner surface 70 but also from the flange 61. This would distort the edge 28 which had been sheared straight prior to flanging. The edge 28 would be bowed inwardly at the center opposite the sections 20 but not appreciably deformed opposite the margins 21. The row of holes 26 would assume a similar contour. To overcome this effect, the radius of curvature 15 at the margins 21 is made smaller than the radius 86 adjacent the sections 20. The additional material required to form a curvature on the radius 85 should be approximately equal to that drawn from the flange 61 by the increase in peripheral area of the sections 20 so that the shape of the edge 28 and holes remains substantially as originally formed. It is undesirable to punch the holes 26 and shear the edges 28 after

flanging on account of the difficulty of handling.

I have shown and described the preferred form of the end wall plate as well as the preferred method and apparatus for manufacturing the same. It is obvious that other products can be manufactured by the same method and that the same and other products can be manufactured by variations of the method described. It is intended that the invention include all such variations of product and method as defined by the appended claims.

I claim:

1. The method of forming a metallic plate comprising pressing therein a plurality of substantially parallel alternating and oppositely projecting corrugations, flanging said plate so as to form an arch of each of said corrugations and simultaneously with said flanging substantially increasing the peripheral area of the outer corrugations only at said arch.

2. The method of forming a metallic plate comprising pressing therein a plurality of corrugations having end sections which merge into said plate, flanging said plate on a curvature so that each of said sections is carried therearound on the exterior thereof and simultaneously with said flanging substantially increasing the peripheral area of said sections without altering the unflanged portions of said corrugations.

3. The method of forming a metallic plate comprising pressing therein a plurality of corrugations having end sections which merge into said plate, flanging said plate on a curvature so that a portion of each of said sections is carried partially therearound on the exterior thereof and simultaneously with said flanging substantially increasing the peripheral area of said portions of said sections without altering the unflanged portions of said corrugations.

4. The method of forming a metallic plate comprising pressing therein a plurality of corrugations having end sections which merge into said plate, flanging said plate on a curvature so that a portion of each of said sections is carried partially therearound on the exterior thereof and simultaneously with said flanging increasing the depth of said portions of said sections without altering the unflanged portions of said corrugations.

5. The method of forming a metallic plate comprising pressing therein a plurality of corrugations having end sections which merge into said plate, flanging said plate on a curvature so that a portion of each of said sections is carried partially therearound on the exterior thereof and simultaneously with said flanging increasing the length of said sections without altering the unflanged portions of said corrugations.

6. The method of forming a metallic plate comprising pressing therein a plurality of corrugations having end sections which merge into said plate, flanging said plate on a curvature so that a portion of each of said sections is carried partially therearound on the exterior thereof and simultaneously with said flanging increasing the length and depth of said sections without altering the unflanged portions of said corrugations.

7. The method of forming a metallic plate comprising pressing therein a plurality of substantially parallel corrugations leaving a margin of said plate parallel therewith, said corrugations having end sections which merge into said plate leaving a region adjacent and transverse to said sections, shearing a straight edge on said region and forming a flange from a portion of said region by flanging said plate on a curvature so that portions of said sections are carried partially therearound on the exterior thereof and the peripheral area of parts of said sections is increased thereby drawing some plate from said region, said curvature being sharper at said margin than adjacent said sections so as to substantially maintain said edge straight.

8. The method of forming a metallic plate comprising pressing therein a plurality of substantially parallel corrugations leaving a margin of said plate parallel therewith, said corrugations having end sections which merge into said plate leaving a region adjacent and transverse to said sections, punching a plurality of substantially aligned holes in said region and forming a flange from a portion of said region by flanging said plate on a curvature so that portions of said sections are carried partially therearound on the exterior thereof and the peripheral area of parts of said sections is increased thereby drawing some plate from said region, said curvature being sharper at said margin than adjacent said sections so as to substantially maintain said holes aligned.

9. The method of forming a metallic plate comprising pressing therein a plurality of substantially parallel corrugations leaving a margin of said plate parallel therewith, said corrugations having end sections which merge into said plate leaving a region adjacent and transverse to said sections, forming said region to a predetermined configuration and forming a flange from a portion of said region by flanging said plate on a curvature so that portions of said sections are carried partially therearound on the exterior thereof and the peripheral area of parts of said sections is increased thereby drawing some plate from said region, said curvature being sharper at said margin than adjacent said sections so as to substantially maintain said configuration.

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