March 4, 1924. 1,485,917

L. HARTER

METHOD OF AND APPARATUS FOR MAKING A SHEET METAL PRODUCT

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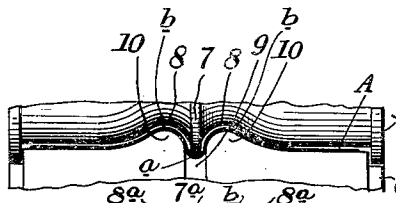



Fig. 1




Fig. 2

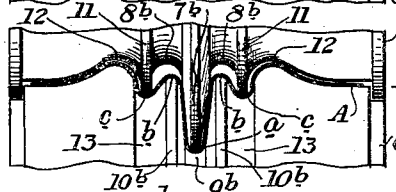



Fig. 3

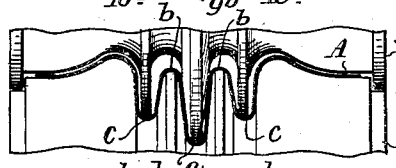



Fig. 4

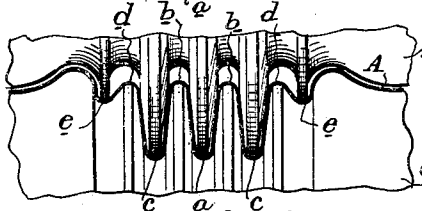



Fig. 5

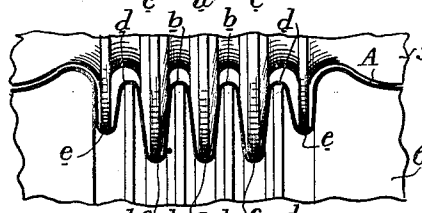



Fig. 6

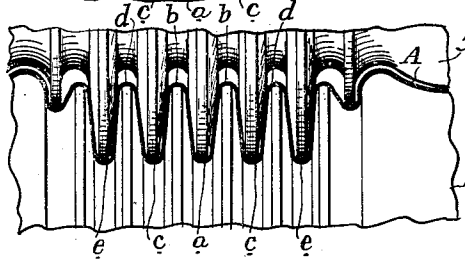



Fig. 7

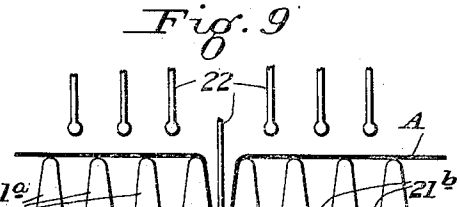



Fig. 9

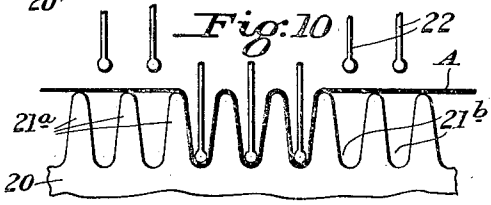



Fig. 10

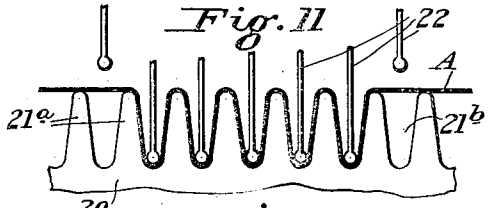



Fig. 11

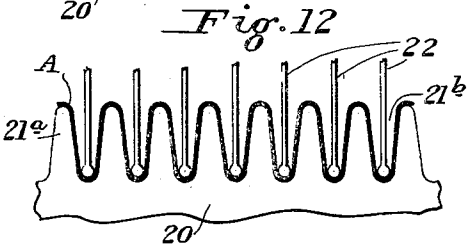



Fig. 12

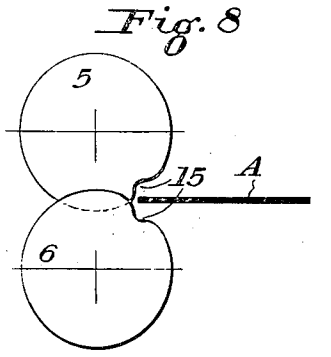



Fig. 8

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Fig. 13

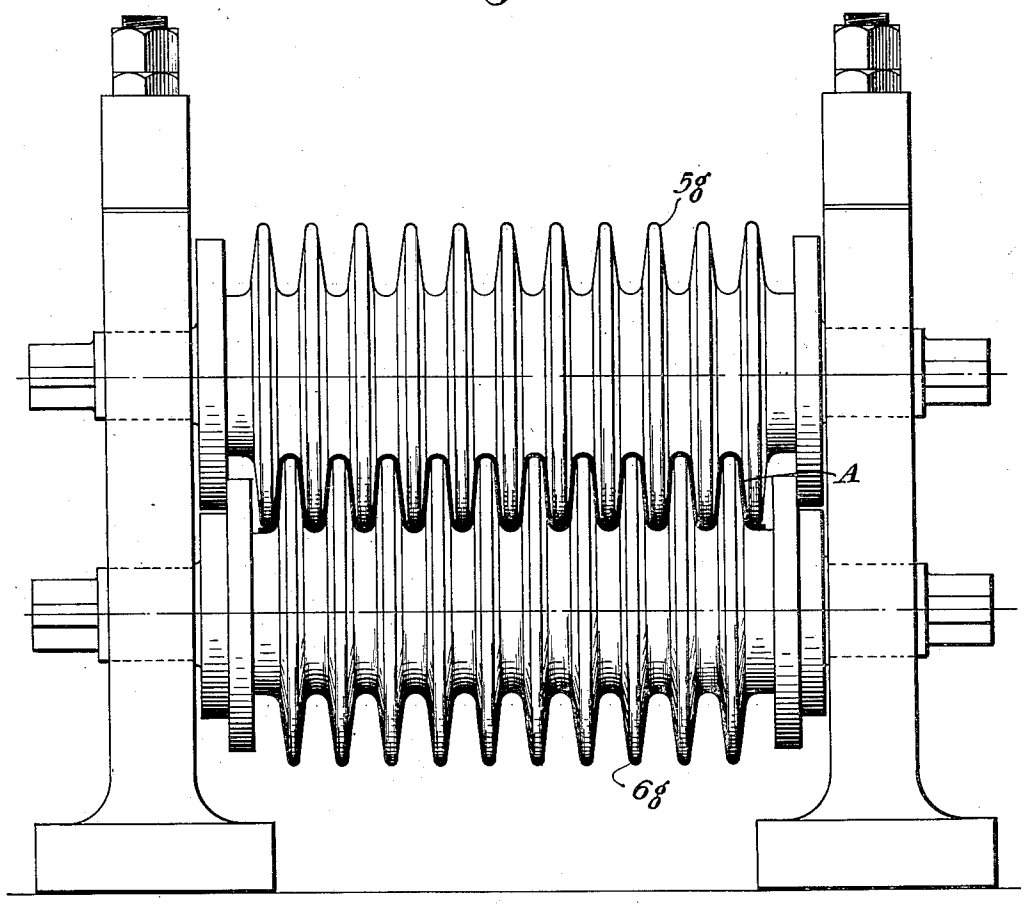
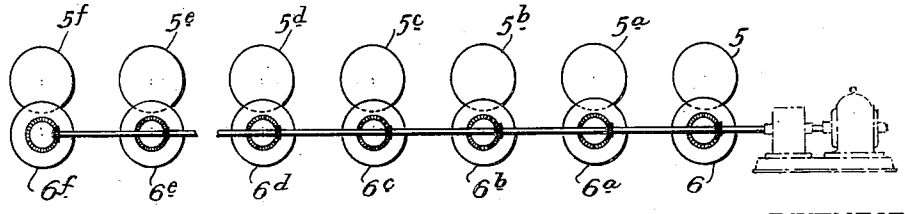



Fig. 14




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METHOD OF AND APPARATUS FOR MAKING A SHEET METAL PRODUCT

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Fig. 15

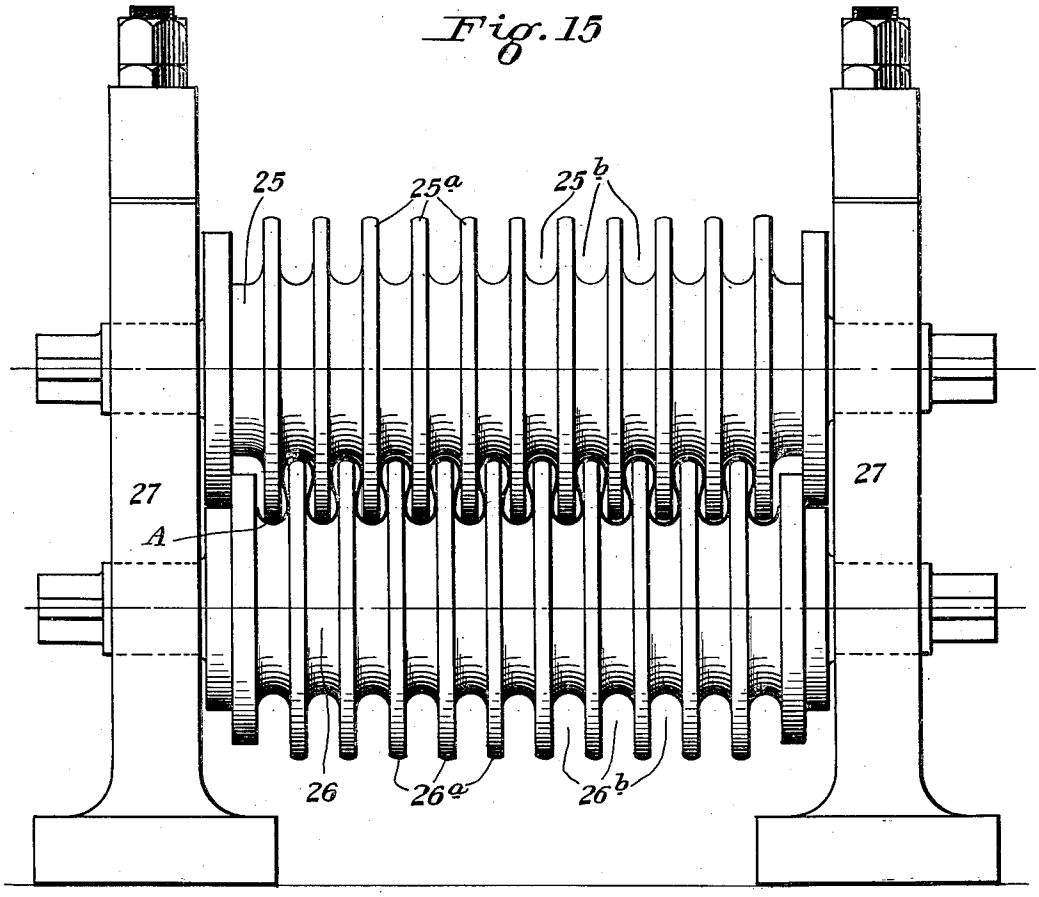
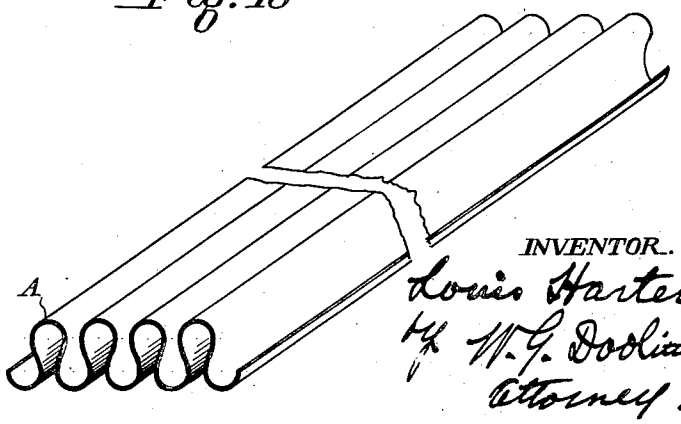



Fig. 16




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Patented Mar. 4, 1924. 1,485,917

# UNITED STATES PATENT OFFICE.

LOUIS HARTER, OF PITTSBURGH, PENNSYLVANIA.

## METHOD OF AND APPARATUS FOR MAKING A SHEET-METAL PRODUCT.

Application filed June 14, 1922. Serial No. 568,259.

*To all whom it may concern:*

Be it known that I, LOUIS HARTER, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Methods of and Apparatus for Making a Sheet-Metal Product, of which the following is a specification.

This invention relates to a method and an apparatus for forming a sheet metal product useful as a building structure, and especially as a reinforcement for concrete.

The particular form of metal structure which the invention proposes to produce comprises a metal sheet of the desired gauge and dimensions, having longitudinal corrugations therein, the ribs of which are so shaped as to form channels having outwardly converging side portions, so that the width of the intervening space between the side walls is reduced toward the face of the sheet, somewhat similar to a dovetail groove, in order that the element will have an interlocking engagement with concrete or other plastic or earthen material applied thereto.

An element having this shape is necessarily somewhat difficult to form on a large commercial scale, especially in pieces of the desired length. The present invention has for its primary object to provide a cheap, simple means and process for making such reinforcing sheets on a commercially practical scale.

A further object of the invention is to provide a novel method of treating the sheets of metal in the preliminary stages of formation in such manner as to avoid stretching or tearing the metal.

The invention consists broadly in corrugating the metal in such manner as to form ribs and channels of considerable depth, without injury to the metal, and in then subjecting the opposite faces of corrugated sheet to pressure to decrease the depth of the corrugations by bulging the metal which forms the ribs outwardly, to produce ribs and channels of the desired shape.

My invention may be readily understood by reference to the accompanying drawings, in which:

Figs. 1 to 7 are diagrammatic views showing successive steps in the preliminary formation of the metal by a rolling process;

Fig. 8 is a diagrammatic view, showing how the rolls may be formed to properly bite the metal;

Figs. 9 to 12 inclusive are views corresponding to views 1 to 7 inclusive, showing how the preliminary steps may be effected in a press;

Fig. 13 is a front view of the last pair of corrugating rolls for final formation of the corrugations in the sheet;

Fig. 14 shows one way of arranging the corrugating rolls to the finishing rolls;

Fig. 15 is a front view of the finishing rolls; and

Fig. 16 is a perspective view of the finished product.

In the formation of ordinary corrugated sheet metal, the metal is passed through rolls having longitudinal ribs on their peripheries. The sheet of metal passing between these rolls is corrugated transversely to its direction of travel. Obviously, the length of the rolls limits the length of a sheet which could be corrugated. In the present invention, it is contemplated that the sheets be corrugated when rolled in the direction of their travel through the rolls, or that the ribs be formed in them longitudinally instead of transversely.

When corrugating sheet metal lengthwise, the width of the strip decreases with the increase in the number and depth of the corrugations, and if all the corrugations were formed at the same time, the metal would be stretched and torn.

Referring to Fig. 1 of the drawings, 5 and 6 designate upper and lower rolls respectively, and A represents the sheet of metal. Upper roll 5 has a central peripheral rib 7, at each side of which are rounded depressions 8. The lower roll 6 has a peripheral groove 9 into which the rib 7 projects, and at each side of the groove is a rib 10 having rounded surfaces and adapted to engage in depressions 8 of the upper roll.

The sheet A, emerging from the first roll, has a central depressed rib *a*, at each side of which are slightly raised rounded ribs *b*, the outer sides of which taper off very gradually into the plane of the sheet. The shapes of the various parts of the rolls allow the metal to draw inwardly from the sides, so that in forming the ribs, the metal is not stretched.

In Fig. 2, the upper and lower rolls $5^a$ and $6^a$ correspond to rolls 5 and 6, but the rib and groove $7^a$—$9^a$, corresponding to

parts 7—9 of rolls 5 and 6, are of greater height and depth respectively. Portions $8^a$ and $10^a$ correspond to parts 8 and 10 of rolls 5 and 6.

Substantially the only change which will occur in the sheet A, therefore, will be the increase in depth of the central groove.

In Fig. 3, rolls $5^b$ and $6^b$ correspond to rolls 5 and 6, respectively. The upper roll $5^b$ has a central peripheral rib $7^b$ of considerable height, with a rounded periphery and flat tapered sides, and at each side of this rib are curved recesses or grooves $8^b$ of slightly less width than the corresponding recess 8 and $8^a$ of the preceding rolls. At the side of each of recesses $8^b$ are ribs 11, corresponding exactly to ribs 7, and at the side of which is recess 12, similar to recesses 8 and $8^a$.

The lower roll $6^b$ is correspondingly modified, having the central groove $9^b$ shaped to correspond to the shape of rib $7^b$. At each side of the groove $9^b$ are ribs $10^b$ which are less decidedly rounded than the corresponding ribs $10^a$ of the preceding pass. To the sides of these ribs are recesses 13, corresponding exactly to the central groove 9 of the first pass.

After passing through the rolls $5^b$ and $6^b$, the first preliminary rib or corrugation *a* is complete, and the formation of reverse ribs *b* are well under formation, and ribs *c* corresponding to rib *a* are started. The rolls are so shaped that the metal can always move in from the sides, so that the metal need not be stretched or ruptured while bending.

The next rolls $5^c$ and $6^c$ do not change the center groove, but are shaped to increase ribs *b* and *c*, rib *c* in this pair of rolls being shaped to the dimension of rib *a* after passing through the second rolls $5^a$ and $6^a$.

In Fig. 5, rolls $5^d$ and $6^d$ complete ribs *b* and *c*, and begin the formation of additional ribs *d* and *e* at each side of ribs *c*. The rolls $5^e$ and $6^e$ of Fig. 6 do not change ribs *a*, *b*, *c*, but increase the rib formation of ribs *d* and *e* to the same extent that ribs *b* and *c* are formed by the rolls of Fig. 4.

The rolls $5^f$ and $6^f$ of Fig. 7 complete the preliminary formation of ribs *d* and *e*, and begin the first bending of additional ribs to the sides of ribs 8.

By a sufficient number of rolls formed along this line, the entire width of a sheet of metal of the desired dimensions may be progressively corrugated, and the metal will not be subjected to undue stretching, and will not be liable to be torn, while corrugations of considerable depth may be formed. The first rib need not necessarily be formed at the middle, but this is desired because the progressive formation of the corrugations may be continued at both sides of the central groove, thereby reducing the number of rolls necessary considerably below the number needed if the first corrugations were formed at the side. If necessary, certain other rolls may be employed in addition to those shown in Figs. 2 to 7 inclusive, and disposed between such rolls.

Fig. 13 shows the last rolls $5^g$ and $6^g$ of the series for forming the preliminary corrugations, the emerging sheet A being shown with a plurality of corrugations of considerable depth therein.

The various pairs of rolls are set rather closely together, and, in order that, with their respective ribs and recesses, the rolls may get a bite on the metal to feed it through, notches 15 as shown in Fig. 8 are cut in the peripheral portions of the two rolls, which are adapted to come opposite each other at the same time. These notches allow the sheet A to slip in between the rolls sufficiently far to enable the rolls to bite the metal and pull it through. As the ribs and grooves are formed, the metal will crease back in the sheet, so that the notches 15 will not destroy the continuity of the ribs or grooves.

While rolls are particularly useful in effecting the preliminary stages of corrugating where extremely long sheets are treated, presses may be used on sheets of certain sizes up to a given maximum. Figs. 9 to 12 illustrate diagrammatically how this may be done.

In Fig. 9, 20 designates an end view of a portion of a press bed or platen, having a series of longitudinal ribs $21^a$ on its upper face, between which are channels $21^b$. Disposed over the table is a series of longitudinally extending pressing bars 22, each one of which may be raised and lowered by a suitable mechanism, such as one or more pressure cylinders. The bars 22 are in alinement with channels $21^b$ in the bed 20, and are adapted to be projected into such channels.

The sheet of material A is first properly positioned on the table. Then one of the pressing bars 22, preferably the central one, is forced downwardly, to the position shown in Fig. 9. One corrugation is completely formed by this operation. During the formation of the first corrugation, the metal is free to move in from each side to thereby prevent stretching of the metal. While the first bar remains down, the next adjacent plunger comes down. When the central bar is the first one lowered, then the adjacent plunger at each side is forced down, as shown in Fig. 10, and the next two corrugations are shown. While these plungers remain down, the plungers adjacent them are lowered, completing two more corrugations, as shown in Fig. 11. In this way, the sheet is corrugated until all of the plungers are down, as shown in Fig. 12. As thus

formed, the metal is not stretched or ruptured, as the sheet is free to contract its width from the edges inwardly with the formation of each corrugation.

It may thus be seen that the metal may be given the preliminary treatment in rolls or in a suitable press to form longitudinal grooves of substantial depth, by progressively forming the corrugations across the sheet while allowing the sheet to contract laterally, and while holding the corrugation first formed against distortion while adjacent corrugations are being made. The holding of the corrugations against distortion after once formed is accomplished in the rolling operation by providing the successive rolls with the corresponding ribs and grooves. As an example, after the first corrugation is completed, and the formation of adjacent corrugations begun, a rib is retained on the rolls for engaging in the first corrugation to prevent it from pulling out. In the pressing operation, the plungers remain down while the adjacent grooves are being formed.

After the sheet A has been corrugated as shown in Fig. 13 entirely across its width, pressure is applied to its faces to decrease the depth of the corrugations by compressing and bulging the sides thereof outwardly. This is preferably accomplished by rolling, as illustrated in Fig. 15. The upper and lower rolls 25 and 26 are journalled in a housing 27. Each roll is provided with a series of peripheral ribs $25^a$ and $26^a$ respectively, which are of less height than the ribs of the preliminary corrugations of sheet A. They are of less width than the corrugations in sheet A and instead of having tapered sides, they have straight sides. The ribs of the respective rolls are staggered, so that the ribs of one extend into the spaces between the ribs of the other. These spaces or channels, designated $25^b$ on the upper roll and $26^b$ on the lower, are wider at their innermost portions than the corresponding grooves of rolls $5^g$ and $6^g$ of Fig. 13 or of table 20, and the bottoms of the grooves are more rounded.

When the sheet A, having the high ribbed corrugations, is passed between rolls 25 and 26, the faces of the sheet, or the tops of the ribs, are compressed and their height decreased. This compression of the ribs bulges them out to form a product of the shape shown in Fig. 16.

All of the steps, especially with heavier stock, are preferably carried out when the sheet is heated, to give the best results with the least strain on the metal.

When carrying out the preliminary steps by a rolling process, all of the rolls, together with the finishing rolls, may be embodied in a single unitary construction, all of the rolls being driven at constant speed, so that a flat sheet may be put in at one end and emerge at the other end of the mill a finished product.

I claim as my invention:

1. The process of forming a sheet metal product which consists in corrugating a sheet of metal and then applying pressure to opposite faces of the sheet in the direction of the height of the ribs to bulge the sides of the corrugations outwardly transversely of their height.

2. The process of forming a sheet metal product which consists in forming a plurality of alternately disposed ribs thereon, and then applying pressure to said ribs in the direction of the height of the ribs to cause the ribs to bulge.

3. The process of forming a sheet metal product which consists in forming a plurality of corrugations therein, and subjecting the sheet while hot to pressure applied to the corrugations in the direction of their height to decrease the height thereof and bulge the metal outward.

4. The method of forming a sheet metal article having an outwardly bulged rib thereon which consists in first forming a rib in said sheet by pressing the metal outwardly, then applying pressure to the rib in the direction of its height to upset the rib and cause its walls to bulge outwardly.

5. The method of forming a sheet metal product which consists in corrugating a sheet of metal in such manner as to produce corrugations of substantial depth while preventing the metal from being stretched to any appreciable extent, then applying pressure to the corrugations in the direction of their height to cause them to bulge at the desired point.

6. The method of forming a sheet metal product which consists in corrugating the sheet to produce longitudinally extending ribs, then passing the sheet through transversely corrugated rolls, the ribs and channels of which are of less depth than the depth of the corrugations in the sheet whereby the height of the corrugations of the sheet are decreased and the walls thereof caused to bulge.

7. The process of forming a sheet metal article which consists in forming a rib on one face of a sheet of metal which forms a channel in the other face of the sheet, and passing said sheet between a pair of rolls adapted to decrease the height of said rib and thereby bulge the walls thereof outwardly between the top and the bottom thereof in a direction at right angles to the height of the ribs.

8. The process of forming a sheet metal article which consists in corrugating a sheet of metal, passing said sheet through corrugated rolls, the corrugations of which rolls correspond in position with the corrugations of the sheet, the ribs on said corru-

gated rolls being of less width and less depth than the corrugations of the sheet, and the grooves in the rolls being wider than the corresponding grooves of the sheet, whereby certain parts of the ribs of the sheet are caused to bulge.

9. The method of forming a sheet metal article which consists in corrugating a sheet of metal and then subjecting it to pressure in the direction of the height of the ribs between corrugated shaping members, the ribs of which are of less depth than the ribs of the sheet and wherein the space between adjacent ribs at their bases is considerably greater than the width of the corrugation of the sheet which they enter, and thereby upsetting the ribs of the sheet and expanding them laterally into the space between adjacent ribs of the corrugated shaping members.

In testimony whereof I affix my signature.

LOUIS HARTER.