

H. E. WHITE.
PROCESS FOR MAKING RIBBED SHEET METAL.
APPLICATION FILED FEB. 13, 1912.

1,056,871.

Patented Mar. 25, 1913.

6 SHEETS—SHEET 1.

Fig. 1.

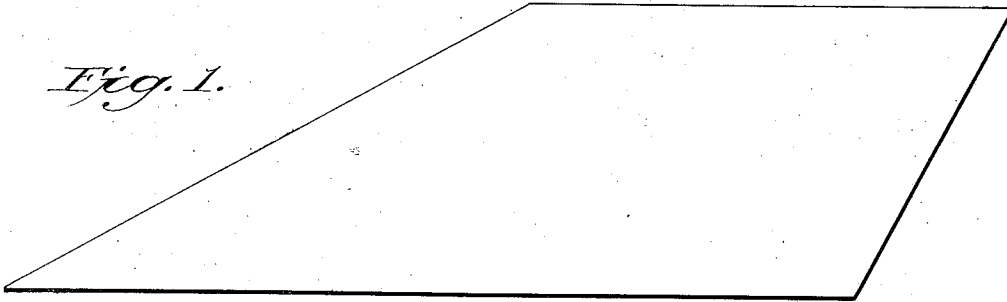


Fig. 2.



Fig. 3.



Fig. 4.



Witnesses

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6 SHEETS—SHEET 2.

Fig. 5.



Fig. 6.

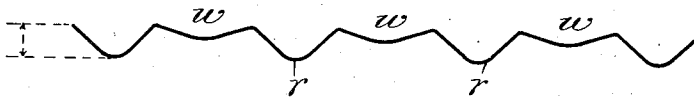


Fig. 7.

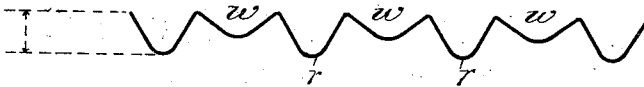


Fig. 8.

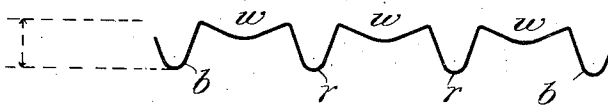
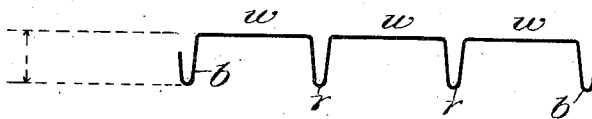


Fig. 9.



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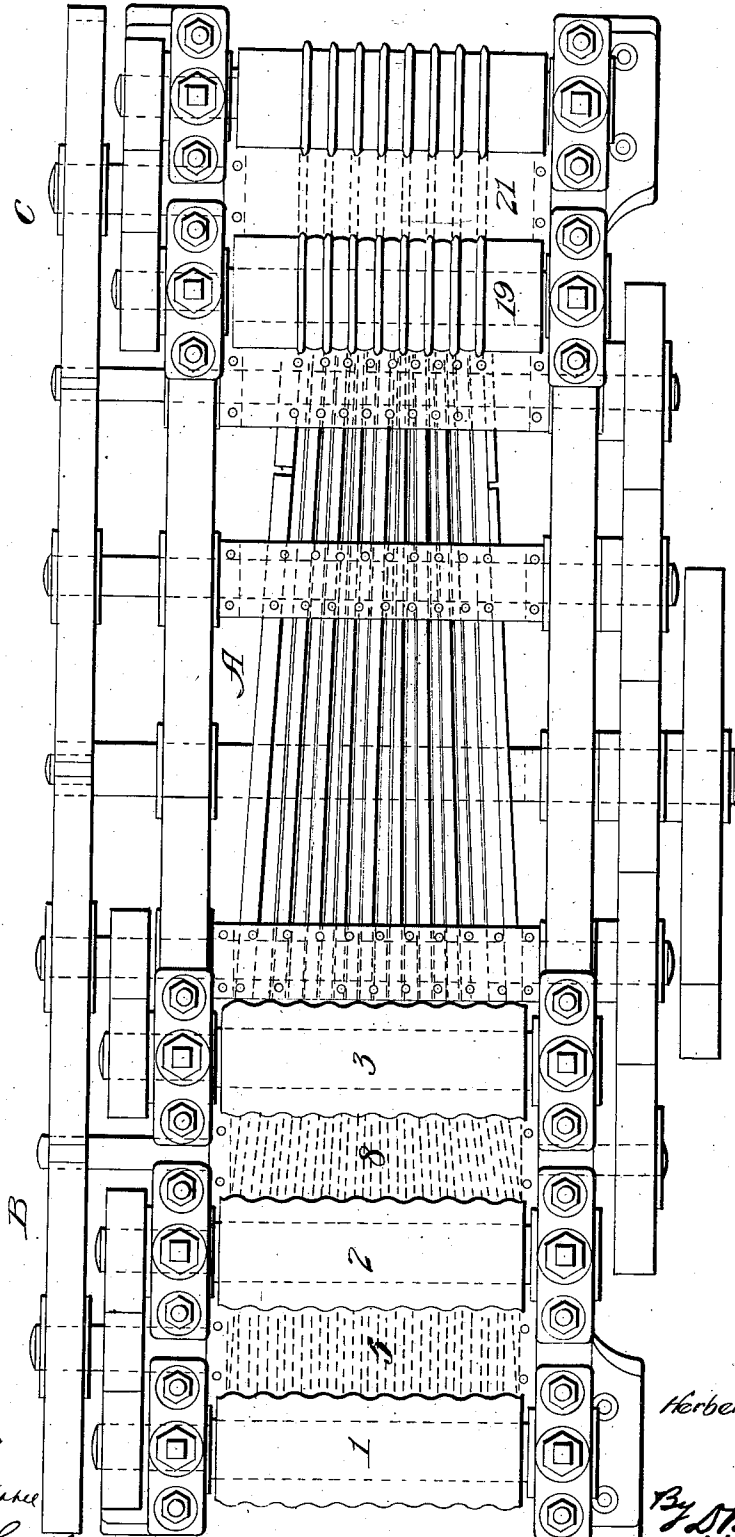
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6 SHEETS—SHEET 3.

Fig. 10.



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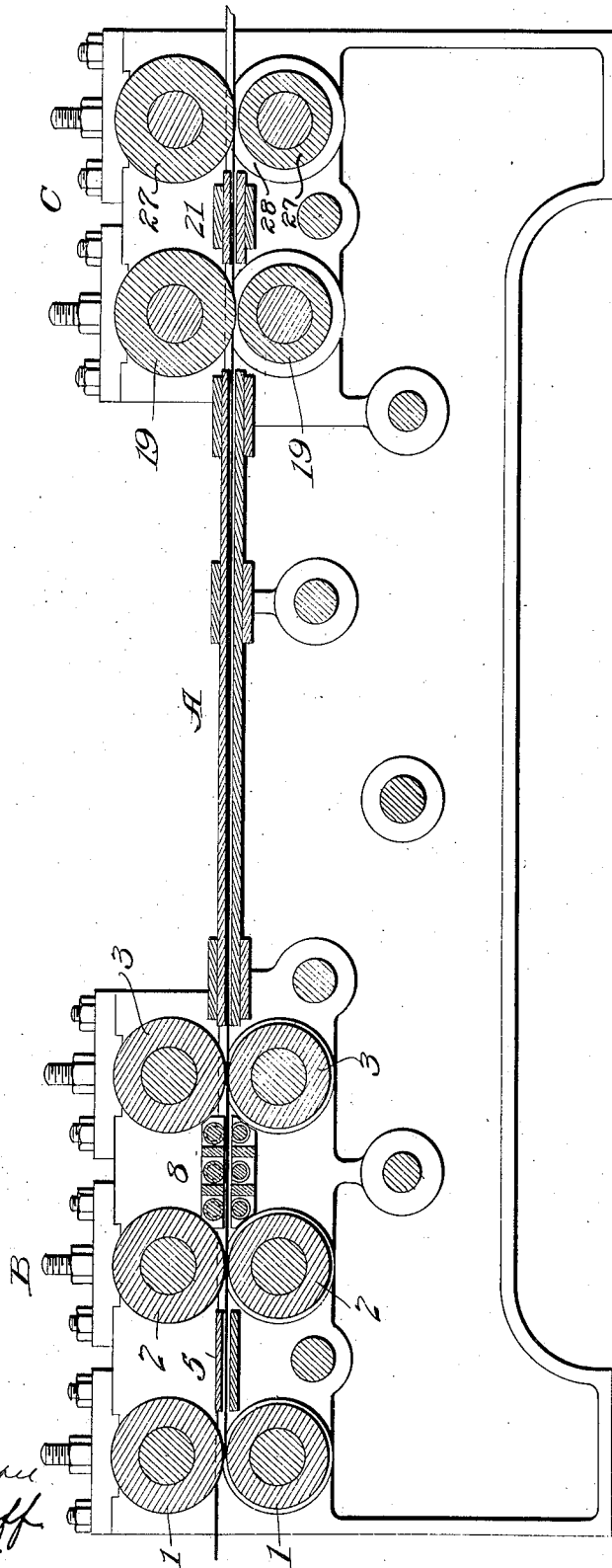
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6 SHEETS—SHEET 4.

Fig. 11.



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6 SHEETS—SHEET 5.

Fig. 12.



Fig. 13.



Fig. 14.

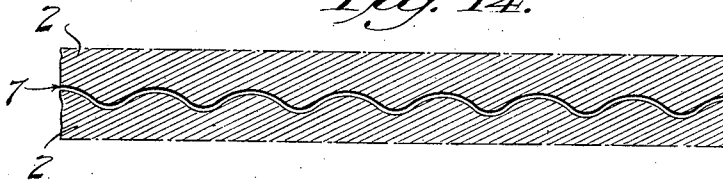


Fig. 15.

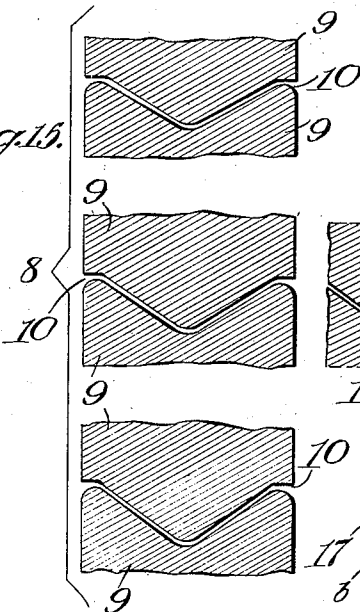


Fig. 16.

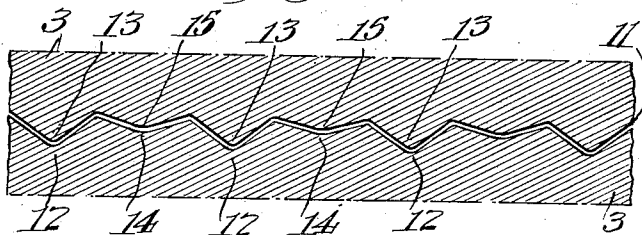
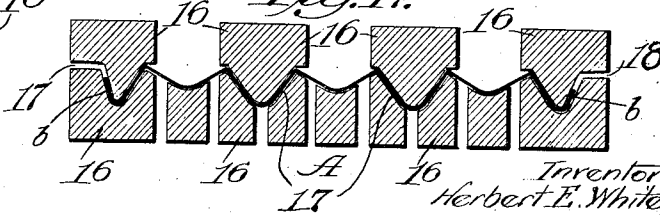


Fig. 17.



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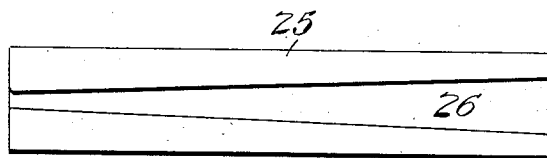
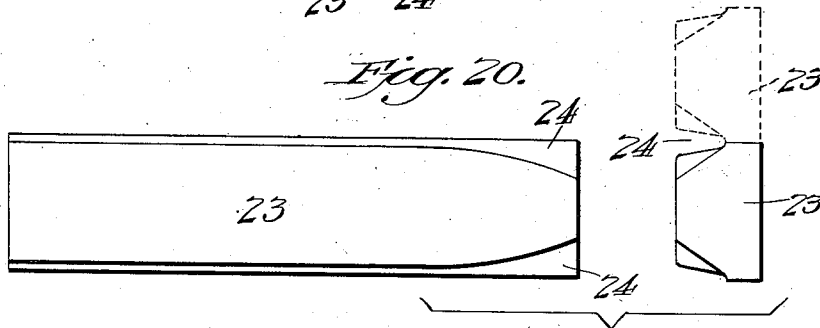
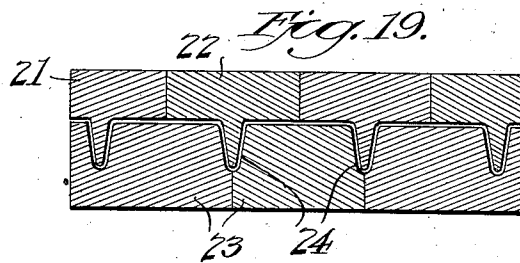
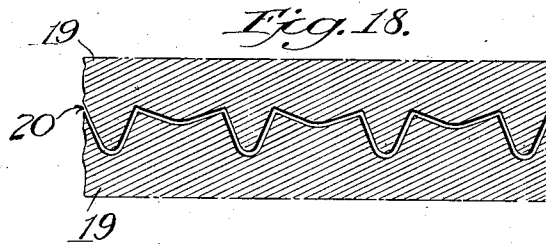
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6 SHEETS—SHEET 6.



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UNITED STATES PATENT OFFICE.

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PROCESS FOR MAKING RIBBED SHEET METAL.

1,056,871.

Specification of Letters Patent.

Patented Mar. 25, 1913.

Application filed February 13, 1912. Serial No. 677,372.

To all whom it may concern:

Be it known that I, HERBERT E. WHITE, a citizen of the United States, residing at Youngstown, in the county of Mahoning and State of Ohio, have invented certain new and useful Improvements in Processes for Making Ribbed Sheet Metal, of which the following is a specification.

This invention relates to a novel process for the manipulation of metal to produce ribbed sheet-metal blanks possessing special utility in their application to the manufacture or fabrication of expanded metal structures.

To this end the invention has in view a process which provides for expeditiously forming, in a thoroughly practical manner, grooved ribs in metal sheets, which are characterized by deep grooves, and which have a variety of uses, though being especially adapted for the use above indicated, viz., in the fabrication of expanded metal structures adapted to support and reinforce concrete and other cementitious bodies.

The improved process, claimed herein, by which the rib-forming grooves are made in the metal sheet, is primarily intended to be employed in connection with the expanded metal structure shown in my pending application, Serial No. 634,617, filed June 21, 1911, and for other articles of sheet-metal having the deep-grooved ribs; and it consists in the performance of several novel steps the precise advantages of which will hereinafter more fully appear.

Certain distinguishing and cardinal features of the process reside in the fact that the desired blank is formed without any waste of the material; in the fact that it provides a blank of sufficient stiffness and reinforcement so that it is possible to push the metal through the dies instead of by the customary method of drawing it through, and, in the further fact that, in consequence of the reversal of the usual procedure, sheets of very short length can be shaped into the ribbed article without the loss incident to the usual drawing operations. By way of emphasizing the importance of these results it may be noted that the sheet-metal blanks are usually made in comparatively short lengths, ordinarily not exceeding twelve feet, and hence the saving of waste

on the individual sheets results in a very material total saving.

As is well known in the metal-working art, dies are employed to draw metal into required forms, but by the usual method of operation, the first portion of the metal attacked is not completely formed, because in starting the metal through the dies it is necessary to graduate the resultant distortion—that is to say, it is necessary to bring the dies into action gradually in a progressive operation, until they are asserting their full formative effect, but until this complete assertion occurs, the metal does not assume the required final shape. Accordingly, this first portion which has gone through, before the dies are operating with full effect, is simply distorted and it is utilized for a gripping engagement, to pull or draw the metal through the dies. This is one of the distinctions of the process of the present invention which comprehends first distorting the metal sheet and then pushing the distorted portion through the shaping dies, with the result that the distorted portion after final passage through the dies enters into the finished product and there is no waste.

Referring again to the ordinary methods in vogue, and familiar to those skilled in the art, it is of course possible, by bending and folding, to form a sheet-metal blank into the ribbed configuration above mentioned, but that method is slow, mechanically crude, and altogether unsatisfactory for the production of these articles on the large scale in which they now go into commerce. Also, it will be understood, that the rib-forming grooves can be made by drawing the ribs down into dies, but this method is not rapid and it also involves great strain on the metal. Furthermore, in the use of the ribbed blanks for the purpose already explained, the flat web-portion of the sheet between the grooved ribs is slitted and opened out into reticulated configuration, and in order to slit and stretch this part of the blank into the expanded form, it is necessary to select sheets of soft annealed metal which meets all of the requirements for this part of the structure, but the ribs being the factors of strength relied on to support heavy loads of plastic material and to provide permanent reinforcing means for the concrete, call pref-

erably for hard metal having the quality of stiffness. Taking into consideration these conditions the present invention provides for hardening the grooved or ribbed portions, as will hereinafter appear, and at the same time leaving the web portion between the ribs soft enough to be readily slitted and opened out into the configuration commonly known as expanded metal, but the present process has no reference to the slitting and expanding operations.

In brief, the improved process involves, among other features, a reversal of the usual procedure and it consists chiefly in the employment of well known types of mechanism in a new and peculiar manner, the result which is achieved depending both on the order and arrangement of the steps and on the effect produced on the metal, as will be seen.

By way of illustrating the various steps of the process in the development of the material from the plain blank of sheet metal to the finished ribbed product, reference will be had to the accompanying illustrative drawings, in which—

Figures 1 to 9, inclusive, are projected diagrammatic views illustrating the various forms assumed by the material in its development from the original blank to the finished product. Fig. 10 is a top plan view of one form of machine or mechanism that may be employed in carrying out the process. Fig. 11 is a vertical longitudinal sectional view of the same machine. Fig. 12 is a detail sectional view showing the roll-pass formation of the first pair of rolls included in the feeding mechanism of the machine selected for illustration. Fig. 13 is a detail sectional view of a corrugated guiding die included in the feeding mechanism of the machine. Fig. 14 is a view similar to Fig. 12, showing the roll-pass formation of the second pair of rolls in the feeding mechanism. Fig. 15 is a detail view showing the roll-pass formation of the several pairs of roller dies in the guiding roller die of the machine selected for illustration. Fig. 16 is a detail sectional view showing the roll-pass formation of the third pair of rolls in the feeding mechanism of the machine, and also at the entrance to the main die set. Fig. 17 is a cross-sectional view of the main die-set near the delivery end thereof. Fig. 18 is a detail sectional view showing the roll-pass formation of the first pair of rolls of the delivery mechanism. Fig. 19 is a detail sectional view of the finishing die of the machine selected for illustration. Fig. 20 is a plan and projected end view of one of the die members of the finishing die illustrating the means that are provided for the final folding step in the formation of the grooved ribs. Fig. 21 is a detail plan view of one of the die members of the marginal section of the finishing die.

As already indicated, various instrumentalities may be employed for carrying out the invention, but in order to facilitate a full and comprehensive understanding thereof, there has been selected for illustration one form of machine that may be advantageously employed to perform thereon the various steps of the process, and general reference will, therefore, be now made to the principal and characteristic features of this machine. In the first place this machine may be conveniently divided into three principal parts, viz., a main die-set for grooving and contracting the corrugated sheet, a feeding mechanism embodying push feed dies that progressively corrugate the sheet and push the same into and through the main die-set, and a delivery mechanism including means for giving final form and set to the grooved and contracted sheet. These several divisions of the machine may be respectively designated the main die-set A, the push-feed feeding mechanism B, and the delivery mechanism C.

Referring now to the various parts of the machine in the order of the steps of the process, the feeding mechanism includes a plurality of pairs of roll dies 1, 1, 2, 2, and 3, 3, the first pair of which rolls has a gently curving corrugating pass 4 that starts and impresses the corrugations in the plain blank of sheet-metal. Between the first and second pairs of rolls, 1, 1, and 2, 2, there is arranged a stationary corrugated guiding die 5 having therein a corrugated die-pass 6, whose corrugations are slightly deeper than the corrugations of the first roll pass 4, and also having a slight or gentle forward convergence to compensate for the natural contraction of the sheet.

The second pair of rolls 2, 2, are provided with a corrugated roll or die-pass 7, the ridges and valleys of the corrugations of which pass are more pronounced than those of the stationary dies 5, and consequently provide for the further contraction of the sheet. Between this second pair of rolls 2, 2, and the third pair of rolls 3, 3, there is arranged a guiding roller die 8 embodying a plurality of die-roller units 9, 9, (see Fig. 15) that are provided with progressively deepening substantially V shaped die-passes 10 which serve to gradually though progressively increase the depth of certain of the corrugations for the purpose of starting the deep grooves in the sheet which produce the stiffening ribs thereof. Also the effect of these die elements is to harden the metal in the walls of the grooves.

The third pair of rolls 3, 3, of the feeding mechanism is illustrated as provided with a roll or die-pass 11 formed by relatively deep die elements 12 and 13 spaced at suitable intervals apart to maintain and further advance those corrugations destined to form

the deep grooves which produce the stiffening ribs of the sheet, and other die elements 14 and 15 (see Fig. 16), which are shallower and wider than the said elements 12 and 13 and serve to tend to flatten or widen alternate corrugations to leave the intermediate bowed or bulged web *w* between the ribs *r* of the metal sheet, according to the illustration thereof appearing in Fig. 6 of the drawings. The sheet, as thus preliminarily shaped is received by the main die-set A, the effect of which die-set is to advance the longitudinal rib-forming grooves in the sheet, and simultaneously contract the sheet, so that the same as acted upon by the said main die-set possesses exceptional stiffness and rigidity. According to the suggested illustration, the said main die-set A includes a plurality of guiding die units 16 arranged longitudinally of the machine and converging in a forward direction, the individual units of this main die-set having die-passes 17 conforming to the V-shape of the ribs *r* and the marginal units of said main die-set having passes 18 conforming to the angular edge bend or head *b* at the edge of the sheet. The sheet as it passes through this main die-set is uniformly contracted laterally with the result that the bulge or dish of the bowed web *w* is quite prominent in the sheet as it leaves the main die-set.

The ribbed sheet is discharged from the narrow end of the main die set to the first pair of rolls 19, 19 of the delivery mechanism, which rolls are provided with a roll or die-pass 20 having substantially the configuration of the die passes of the delivery end of the main die-set, and serve to initiate the final set of the ribbed product. The said rolls 19, 19, discharge the product into a stationary finishing die 21 including a plurality of die units 22 and 23 having tapered passages or passes 24 at and between the same at the receiving side of the die to provide for a definite folding-in action on the side walls of the grooves to give to the ribs *r* their final narrow form shown in Fig. 9 of the drawings. The marginal die units 25 of the said finishing die also include tapered die-passages 26 that serve to close up and finish the edge bend or head *b*.

The sheet as it issues from the finishing die 21 may be discharged by a pair of rolls 27 having a roll or die-pass 28 conforming to the die-pass of the finishing die at the delivery side thereof. It will be observed that as the finishing die folds or closes the side walls of each groove, the bulge or bow in the webs *w* is flattened and straightened out.

The foregoing description illustrates very plainly the general progress of the sheet-metal blank through the machine, but by way of accentuating the various functions and advantages involved, reference is made

again to the desirability of having soft metal for the web part of the blank between the ribs thereof. The softness of the metal naturally adds to the difficulty of forcing the same through the dies by a pushing action, so in order to adapt the sheet to withstand the pushing action without causing it to buckle, I first stiffen the sheet by passing it through corrugating rolls according to the kind of corrugation required, such, for instance, as through the rolls 1, 1 of the machine selected for illustration, and which rolls may preferably be used, as described, in the capacity of feed rolls to assist in pushing the sheet through dies after being stiffened by the corrugations, but it will, of course, be understood that my process is not restricted to this particular combination of rolls and dies, as the sheet may be first corrugated and then in a separate operation pushed through the dies with separate feeding rolls, suitably shaped to engage the sheet without disturbing the previous arrangement of the corrugations, the effect of which corrugations, as stated is to adapt the sheet into a form to be pushed into dies and also to stiffen the sheet so that it can be pushed through. At the same time the sheet is being also contracted in width, which is the effect also of the several subsequent operations before the sheet assumes its final form. Accordingly, it will be understood that the corrugating and stiffening and simultaneous contracting of the sheet gradually and progressively occurs in the stages represented in Figs. 2, 3, and 4, but in connection with the form shown in Fig. 5, and as provided for by the roller dies 9, it will be observed that the action of these roller dies is to harden as well as to further stiffen and further shape the sheet. This die, particularly, (though the same action in a less degree occurs throughout the feeding mechanism of the machine shown) pinches or squeezes the portions of the sheets which are to constitute the ribs, which action may be effected by putting the rolls slightly closer at the points that treat the portions of the sheet that go into the grooves and shaping the dies correspondingly; hence, the effect of this step in the process is not only to harden the metal, as described, but also to deepen those corrugations which are to become the rib-forming grooves and to give the sheet itself a form in which it is further stiffened and thus adapted to be pushed through additional dies. However, by having hardened the metal in these places, its ductility is diminished, and consequently it is necessary to make provision for shaping it into the finished grooved ribs without relying solely on the distorting die-drawing effect of the subsequent dies, as this usual kind of drawing is attended by stretching and distortion which would cause the hardened

sheet to break, unless such provision be made. This will be hereinafter more particularly referred to.

The next step in the process results in the form of the sheet shown in Fig. 6 of the drawings, which may be given thereto by the third pair of rolls shown in Fig. 16 of the drawings, which serve to advance the formation of the grooves to the state where it is desirable to take care of and define the bulging of the webs *w* between the ribs. The next step is that of pushing the sheet through more dies, as for instance the main die-set A herein referred to, and the bowing or bulging is arranged for in these dies by the curving of the metal between the grooves of the sheet, and this requirement is met by the convergent arrangement of the die units already referred to. The travel of the sheet through the converging die units is for a considerable distance so as not to make a too quick or sudden approach of ribs *r* toward one another. At this stage of the process, that is, when the sheet leaves the main die-set A, the grooves as shown in Fig. 7 of the drawing, will have wide openings where their sides connect with the web portions *w*, and their sides will still show a marked angular inclination, distinctively V-shaped, with the web portion *w* between the grooves bowed or bulged. The next step in the process consists in taking out the bow or bulge in the webs *w*, and at the same time narrowing the ribs *r* by a folding-in of the walls of the individual grooves, thus producing the final form of the ribs *r*. This may be started in the rolls 19, 19, and completed on the several units of the finishing die, as previously explained. This folding-in action of the side walls of the groove is permitted by the bowed or bulged webs *w* which are flattened and straightened out simultaneously with the said folding action.

Having indicated certain instrumentalities or means that might be selected for use in carrying out the process of the present invention, attention is now directed to some of the salient or characteristic features of this process. In order to accentuate the same, the following explanation is made: Inasmuch as a very important use is made of the ribbed metal to facilitate the quick and economical production of expanded sheet metal, and also since a product of this kind has gone into extensive use, by reason of its important advantages in concrete structures, the simplification and cheapening of the cost of producing this fabric has been made a consideration of great importance, and it will be seen from the present invention that the same comprises a method which provides not only a novel, but also a very quick and cheap way of forming the rib metal blanks.

In further explanation of the distinguish-

ing features of the present invention, it should be observed that the usual method of simultaneously making a plurality of rib-forming grooves in sheet metal requires that the sheet or plate be similarly acted upon at one time over the whole area which is to be formed into the ribs or grooves, for if the grooves be started from one end of the sheet, the metal must either be stretched sufficiently to permit of the ribs being formed, or the sheet must be contracted in width as the formation of the grooves starts, or a combination of the two effects may take place. Light sheet steel such as that contemplated to be used in the present invention will not stand stretching to form relatively deep ribs, and no sheets or plates can be contracted in width beginning at one end, under the ordinary methods without serious buckling.

Accordingly, it is to be understood that a distinguishing feature of the present invention resides in a process by which it is impossible to start the grooves in the blank at one end of the sheet and carry the same rapidly and progressively through the body, to the other end of the sheet, and this, of course, must provide a way of disposing of the natural impediment to this operation, due to the tendency of buckling of the portion of the sheet in advance of the grooves. Accordingly, it will be seen that I have conceived a way of overcoming this impediment by breaking up the preliminary buckle, and distributing the metal in it into a plurality of non-adjacent small buckles, between the alternate rib-forming grooves, in order to get the metal out of the way, and then later utilizing the distributed buckles (which assume the form of bowed webs between the alternate grooves) to permit the employment of a folding action to bring the side walls of the said alternate grooves together and thus give the ribs their final shape, instead of subjecting the metal involved in the formation of the grooves, to the usual harsh die drawing and stamping action. In this connection it will be observed that the process involves the shaping of alternate corrugations at the same side of the sheet into the ribs and flattening the intervening corrugations between the ribs.

It is evident from the description of the process that it can be carried out by different organizations of mechanism; that each die operation may be performed by a separate machine having suitable dies and feeding rolls to push the sheet through them, or in any suitable way without affecting the essentials of the invention or sacrificing any of the advantages thereof.

I claim—

1. The herein described process which consists in progressively developing corru-

gations throughout the entire sheet, and subsequently shaping alternate corrugations at the same side of the sheet into ribs, and flattening the intervening corrugations between the ribs.

2. The herein described process, which consists in progressively developing and deepening corrugations in a metal sheet, shaping alternate corrugations at the same side of the sheet into rib-forming grooves, and subsequently folding the walls of said rib-forming grooves toward each other to produce ribs, and flattening the intervening corrugations between the ribs.

3. The herein described process, which consists in progressively developing and deepening corrugations in the metal sheet and simultaneously contracting the same, shaping alternate corrugations at the same side of the sheet into rib-forming grooves, and subsequently folding the walls of said rib-forming grooves toward each other to produce ribs, and flattening the intervening corrugations between the ribs.

4. The herein described process which consists in progressively developing and deepening corrugations in a metal sheet, and simultaneously effecting a hardening of the metal in some of the corrugations, and subsequently shaping alternate corrugations at the same side of the sheet into narrow stiffening ribs, and flattening the intervening corrugations between the ribs.

5. The herein described process which consists in progressively developing alternate rib-forming grooves at the same side of a metal sheet and simultaneously producing intervening bowed portions between the grooves, and subsequently folding the walls of the said alternate grooves toward each other and simultaneously flattening said intervening bowed portions between the ribs.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

HERBERT E. WHITE.

Witnesses:

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EMORY L. GROFF.