

July 14, 1931.

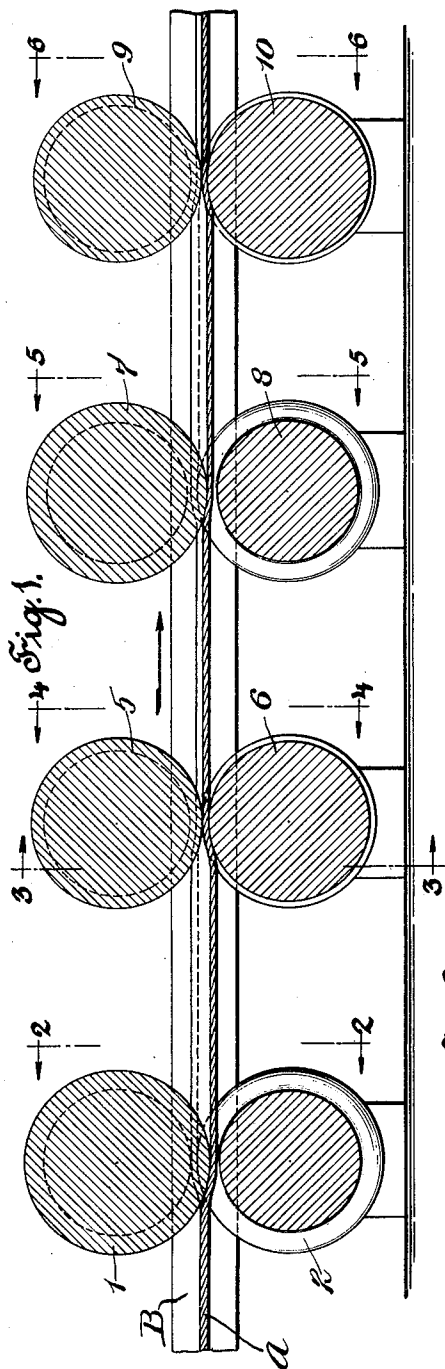
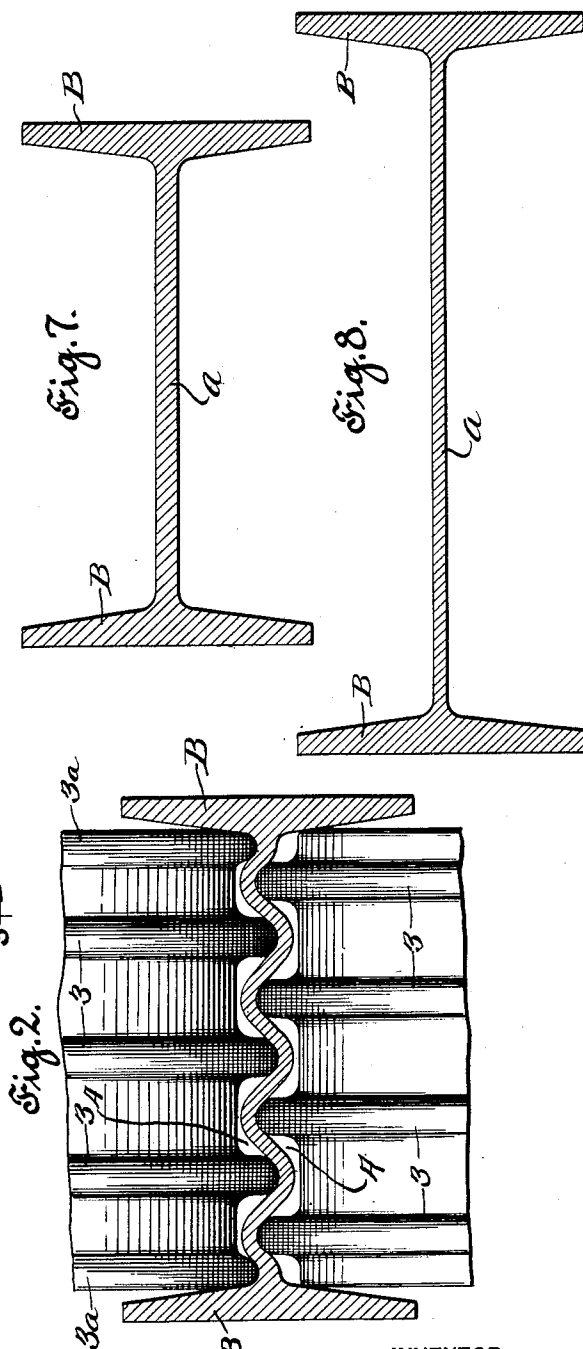
H. M. GERSMAN

1,814,593

PROCESS FOR WIDENING ROLLED METAL PRODUCTS

Filed June 21, 1926

3 Sheets-Sheet 1



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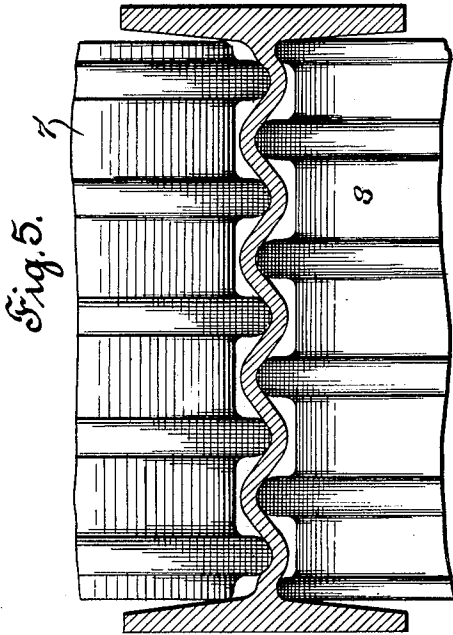
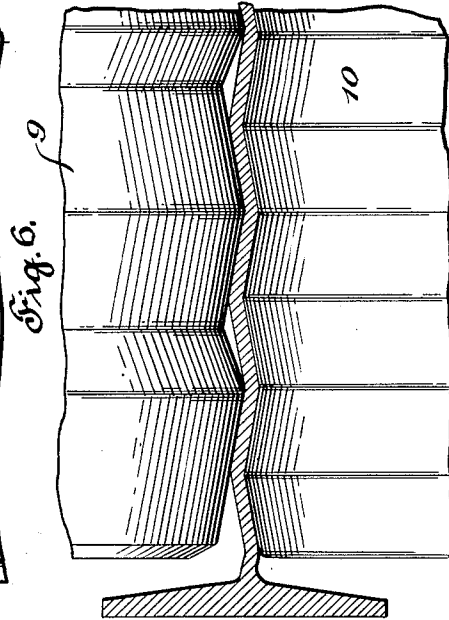
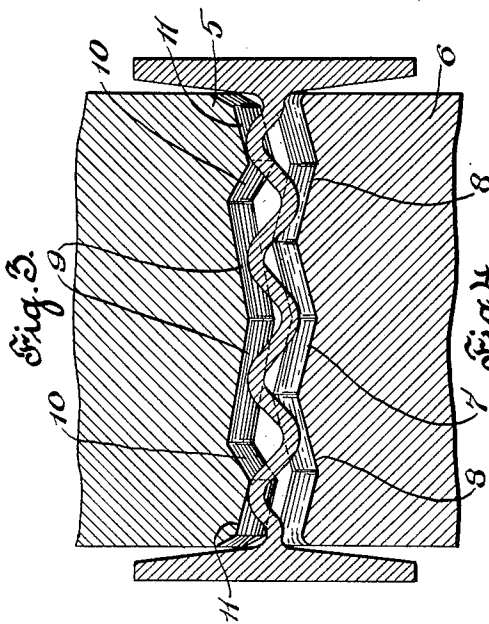
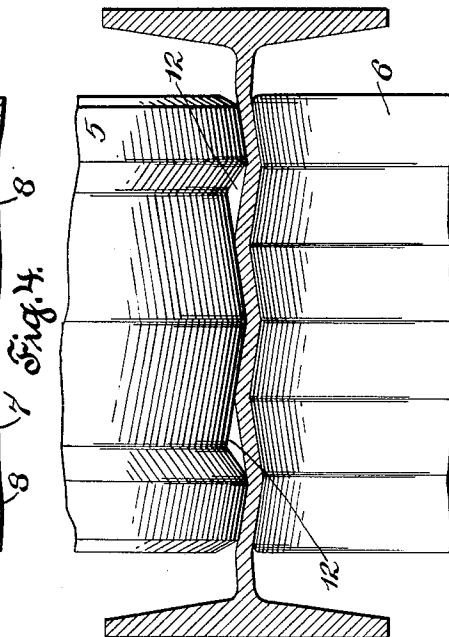
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PROCESS FOR WIDENING ROLLED METAL PRODUCTS

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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

Fig. 9.

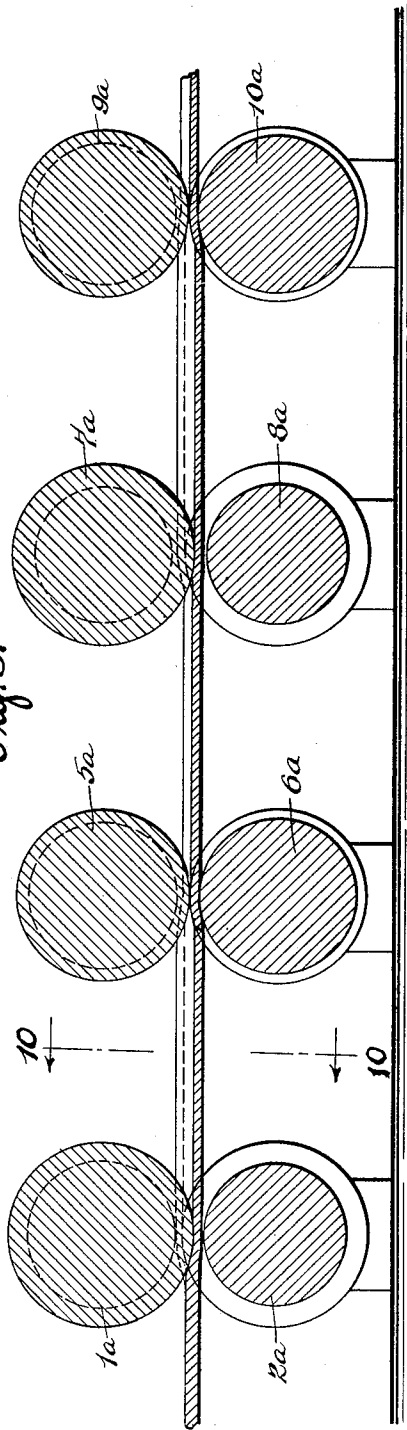
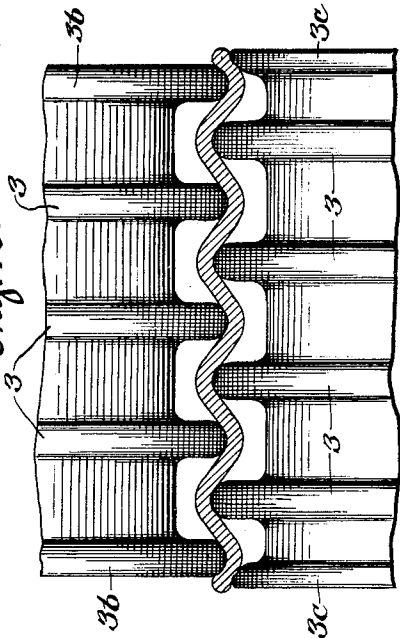


Fig. 10.



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PROCESS FOR WIDENING ROLLED METAL PRODUCTS

Continuation of application Serial No. 49,849, filed August 12, 1925. This application filed June 21, 1926.
Serial No. 117,323.

This application, in respect to any common features of patentable novelty, is a continuation of my application Ser. No. 49,849, filed August 12, 1925.

the strength is obtained by massing metal and greatly exceeds that which is required in many situations where the use of wooden load bearing members is permissible.

5 This invention relates to a process for increasing the transverse extent of rolled metal products or parts and may be advantageously employed in the manufacture of articles of various kinds such as strips, plates or load
10 bearing members of different forms. The invention is herein claimed generally for the production of metal articles derived from rolled blanks and specifically for the production of wide webbed I-beams, one of the
15 applications of the invention disclosed in the drawings.

In the rolling of metal, according to existing methods, the ultimate form is reached in progressive stages and is limited by the fact that the rolled part cannot be substantially increased in width and in the case of structural shapes by the fact that the rolled part
60 cannot be permitted to be rolled too thin relatively to other parts. These limitations are well illustrated in the case of the rolling of an I-beam. Thus the standard process starts with a hot billet and involves the longitudinal extrusion of the web and the flanges.
65 As the rolling continues there is, of course, a drop in the temperature of the billet and care must be taken that the web is not rolled too thin relative to the flanges, since, in such
70 event, radiating heat faster, it will become relatively cold while the thicker flanges are more slowly cooling from a substantially higher temperature with the result of a destructive distortion or warping, coupled with
75 the inability to force the shape through the final rolls. At the completion of the ordinary rolling operation the blank comes from the mill at a temperature which is still sufficiently high to enable further working of the
80 metal and this fact is utilized by the present invention according to which the billet is rolled by existing methods to any stage that may be desirable. In the case of an I-beam, the web of which is to be widened, the billet is
85 rolled to a point safely within the required balance, so to speak, between the proportions of the web and the flanges.

The process is applicable to the production of integral imperforate articles which are of substantially greater width and proportionately less thickness than can be obtained
20 practically by either standard or special rolling operations and are available for various purposes of utility for which articles made by the processes heretofore known are not
25 suited or which cannot be served with the same economy or facility by articles produced altogether by rolling processes.

The process is such that the form of the widened product derived from a rolled blank
30 is not dependent on or limited to particular rolling possibilities of the blank and thus enables the form of the blank to be so selected as to permit the greatest economy in the antecedent rolling operation.

35 In the production of structural shapes the process may be applied to the web or to the flanges or to both and makes possible novel and advantageous special shapes which cannot be produced by existing methods and
40 also special shapes which, as available for production by existing methods, can only be made by extremely expensive special mills.

By virtue of the present process shapes
45 may be produced which, while available for the same uses as ordinary rolled structural shapes, will also be useful and desirable in various structural operations in which wooden load bearing members are ordinarily employed and may not be economically replaced
50 by ordinary rolled structural shapes in which

According to the invention the blank is rolled to a suitable stage and being at working temperature is first treated to stretch and proportionately reduce the thickness of the part to be widened. This part may be the entire blank or a flange or web or other part thereof, depending on the character of the
95 article which is to be produced. The stretching is accomplished by holding the said part at its opposite sides, thereby to prevent any alteration in their mutual spacing, and tensioning the part between adjacent points of
100

a series of points lying in a tortuous path extending between said sides and of greater extent than the original dimension of the part with the result that the part is sectionally altered or distorted to conform to said longer tortuous path and its total transverse extent is thereby increased while its thickness is proportionately decreased and its length remains unaltered.

After the stretching step the stretched part is subjected to a further step by which the sectional alteration or deformation is eliminated without altering its thickness or length with the result that it is extended to the full width made possible by the previous stretching, i. e., the full width which conforms to the extent of the aforesaid tortuous section given said part by the stretching operation. The method is preferably practiced by means of suitably formed rolls which, however, do not perform a rolling operation but which tension the part in the manner described; and in proceeding in this manner the distortion of the part is confined to a degree such that the part may be readily passed through the stretching rolls and from them to and through the widening and flattening rolls. Where required by the extent of widening determined upon, the article may be brought to its final form by progressive operations, that is to say, the widening operation above described may be followed by a further stretching operation and a complementary widening operation.

In the production of a wide webbed I-beam the stretching rolls react against the flanges at the opposite sides of the web so as to hold them and thus prevent any alteration in their spacing while the web is stretched to conform to the tortuous path within which lie the points at which it is engaged by the rolls. An I-beam may be thus produced having strong and comparatively thick flanges and a web as wide and as thin, relatively to the flanges, as may within practical limits be desired with regard to the particular use for which the shape may be intended.

In addition to articles for the completion of which the flattening and transverse extension step above referred to is required or desirable the invention is applicable to a range of articles for which a corrugated form is desired, such as corrugated plates or sheets, in which case the flattening and transverse extension step is not required and the operation is substantially completed by the stretching step having the characteristics indicated.

While a substantial advantage in economy is gained by practicing the process in connection with the delivery of the blank from the mill by which the blank has been brought to the form desired, thereby utilizing the heat of the blank as it comes from the mill, it will be understood that the process may also be practiced with blanks which have been

allowed to cool and are thereafter reheated to a suitable degree.

The practice of the process is illustrated in the accompanying drawings, wherein:

Figure 1 is a longitudinal sectional view of the apparatus for the production of an I-beam having a widened web.

Figure 2 is a sectional view on the line 2—2 of Figure 1 showing the first stretching rolls.

Figure 3 is a sectional view on the line 3—3 of Figure 1 showing the first flattening rolls.

Figure 4 is a sectional view on the line 4—4 of Figure 1 showing the first flattening rolls and the blank as it emerges from the same.

Figure 5 is a sectional view on the line 5—5 of Figure 1 showing the second stretching rolls.

Figure 6 is a sectional view on the line 6—6 of Figure 1 showing the second flattening rolls.

Figure 7 is a cross-section of the blank with which the process starts.

Figure 8 is a cross-section of the finished I-beam.

Figure 9 is a longitudinal sectional view of the apparatus for widening metal strips.

Figure 10 is a cross-sectional view on the line 10—10 of Figure 9 showing the stretching rolls.

Referring to Figures 1 to 8:

Figure 7 shows a blank A of I-cross-section which has been brought to the form desired by existing rolling methods involving the longitudinal extrusion of the metal. The blank comes from the rolling mill (not shown) at a temperature of about 1400° F. and starting at or substantially at this temperature is thereupon treated to obtain the desired increase of the width and proportionate reduction of the thickness of the web. The first step, generally stated, is to deform the cross-section of the web in such a manner as to stretch it transversely without altering the spacing and dimensions of the flanges while so controlling the deformation and transverse stretching of the web that the reduction in thickness is substantially uniform at all points. The procedure preferably employed is to force the web between opposed rolls 1 and 2 which hold the blank at its sides and operate to stretch the web between adjacent points in a tortuous or sinuous line which cuts the original plane of the web. In the present example the blank has flanges B along its sides and the function of holding the blank at its sides is served by forming the rolls 1 and 2 to bear at their ends against said flanges, thereby to prevent any alteration in the mutual spacing of the flanges. The rolls serve their stretching function by virtue of peripheral ribs 3, those of one roll being staggered relatively to those of the other roll. These ribs extend through the original plane of the web and hence displace be-

yond said pane the web parts which they engage. Since the ribs of the two rolls lie alternately at opposite sides of the original plane of the web a line made up of straight components drawn between their highest points will have a tortuous or sinuous outline and will, of course, be of greater length than a straight line drawn between the sides of the blank. Since the stretching rolls cause the web to conform in cross-section to the said tortuous or sinuous line or path the web is stretched throughout its transverse extent and is thereby widened to the full extent of the tortuous line, the stretching being by components conforming to the straight line components of the said tortuous path.

In order that the web may be stretched uniformly, as well over the ribs as between them, the rolls 1 and 2 are formed to provide clearances 4 between the ribs. The ribs of each roll project into the clearances of the opposed roll and said clearances are of such width and depth as to avoid contact throughout their extent with the web. Thus no resistance is opposed to the stretching of the parts of the web which are engaged by the ribs and no squeezing action is exerted upon the web at any point. Hence the reduction of the thickness of the web is limited entirely by the stretching operation and no elongation of the web is effected. In order to avoid any liability of cutting or scoring the web and also to provide adequate bearing surfaces and easy bending moments the ribs 3 preferably have their engaging surfaces rounded through approximately a half circle of suitable extent whereby the parts of the web in contact with the ribs may readily move or shift incident to the stretching and may be stretched with substantially the same facility and to the same degree as the parts which extend between the ribs.

In order that the web may be passed through the operating rolls it is necessary that the angle of the ribs at the roll pass be suitably restricted and be comparatively narrow. This angle should be limited substantially to thirty degrees. With a greater angle it would be difficult to force the web through the stretching rolls, at least without injury to the web, and with deeper web corrugations conforming to such greater angle it would be difficult to force the web through the flattening rolls to be later described. It follows that the corrugations formed in the web incident to its stretching are comparatively shallow. The total stretch will, of course, be proportionate to the number and depth of the corrugations and the number of ribs on the stretching rolls is determined with reference to the dimension of the blank and to the total stretch to be effected in one roll pass, it being easily practical by the employment of a suitable number of ribs to increase the extent of the web by one-third or

more in one roll pass. In Figure 2 the roll 2 is shown with four ribs 3 and the roll 1 is shown with three intermediate ribs 3 and with end ribs 3a of less depth which bear against the flanges of the blank and also cooperate with the end ribs 3 of the roll 2 in stretching the portions of the blank adjacent the flanges. The number of ribs may, of course, be varied as circumstances may require and a greater number or a lesser number than that shown may be employed if so desired.

After the above described stretching operation the stretched part may be acted on to flatten out the corrugations formed by the stretching rolls and thereby to extend it transversely to or substantially to the width which conforms to the increase in extent due to the stretching, i. e., to the straight or substantially straight transverse extent which conforms to the extent of the tortuous path along which the part was stretched. In the case of articles in which the flattening of the stretched part is required or desirable, said part, in this instance the web, therefore, passes from the stretching rolls to opposed cooperating flattening rolls 5 and 6. With reference to practical maximum depths of the web corrugations the rolls 5 and 6 are preferably of the construction shown and operate to flatten the corrugations nearly but not quite to the full extent whereby the web upon its emergence from the flattening rolls is ready either for a progressive repetition of the stretching operation or for treatment by cylindrical finishing rolls by which the corrugations are completely flattened and the part is completely widened and given a rolled finish. It should be noted that the rolls 5 and 6 by virtue of the features to be described avoid any compression of the web and resultant loss of stretch which might be incident to the use of cylindrical flattening rolls with web corrugations exceeding a certain degree of depth.

The lower roll 6 supports the web during the widening operation and its cross-sectional contour determines the cross-sectional contour of the widened web and is such as to permit the various parts of the web readily to shift in connection with the flattening of the corrugations. The upper roll 5 applies the pressure to the web in such a way as to bend downward the parts of the corrugations which extend outwardly upward and to shift outward and also bend downward the parts of the corrugations which extend outwardly downward. With the ribs 3 of the stretching rolls 1 and 2 arranged as shown in the drawings the corrugation at the center of the stretched web has its sides extending outwardly upward and to support this corrugation the roll 6 is provided with a central groove 7 of shallow V outline. Beyond the groove 7 the lower roll 6 is provided with sim-

ilar grooves 8 which cooperate with the remaining corrugations. The upper roll 5 is formed with a low central ridge which aligns with the valley of the central corrugation of the web and is provided by inclined faces 9. These are of greater transverse extent than the sides of the groove 7 to which they are opposed and terminate in inactive shoulders 10 beyond which are provided inclined faces 11 similar to the faces 9.

The widening of the web is commenced as soon as its corrugations engage the several inclined faces 7, 8, 9, and 11, this occurring at a point in advance of the center of the roll pass, and is completed when the center of the roll pass is reached. During the travel from the point of initial engagement by said inclined surfaces to the center of the roll pass the components of the corrugations are free to shift laterally under the pressure of the cooperating rolls, the flattening and redistribution of the corrugations taking place outward from the longitudinal center of the web which at all times during the operation coincides with the center of the groove 7. In detail the action of the flattening rolls is that the inclined surfaces 9 bend downward from the center of the web the portions which overhang the sides of the groove 7 and shift laterally outward the portions which overhang the inner sides of the groove 8 and at the same time bend these same portions downward while the inclined surfaces 11 perform similar operations with the parts which they engage, the flanges B of the blank being without any lateral obstructions and hence being free to move laterally outward in connection with the flattening operation. In addition to the foregoing characteristics of operation the apices of the corrugations are moved inward toward the original plane of the web, that is to say, the upper apices are pushed downward and the lower apices are pushed upward. The extension of the inclined surfaces 9 beyond the inclined sides of the groove 7 is for the purpose of providing clearances 12 above the portions of the web which are shifted laterally between the rolls so that there can be no obstruction to their lateral displacement. The initial engagement of the stretched web by the flattening rolls is shown in Figure 3 while the completion of the operation as effected by said rolls is shown in Figure 4; and it will be observed that at the center of the roll pass, as shown in Figure 4, the web conforms in cross-section to the cross-sectional contour of the supporting roll 6 and uniformly rests upon the same, having, however, free unsupported portions projecting beyond the ends of the rolls and carrying the flanges. It will also be noted that a mean plane taken through the extremely shallow redistributed corrugations resulting from the operation of the flattening rolls coincides or substantially coincides with the original plane of the

straight web of the blank with which the operation started.

If the determined widening of the web may not be practically completed in a single roll pass a progressive stretching and complementary widening operation may be performed. These operations are shown in the drawings. Thus the web on emergence from the flattening and widening rolls 5 and 6 may be passed through a second pair of stretching rolls 7 and 8. These are shown in detail in Figure 5 and conform exactly in structure and mode of operation to the rolls 1 and 2 so that no description thereof will be required beyond the statement that they further stretch in the manner described the widened and nearly completely flattened web delivered by the rolls 5 and 6. From the stretching rolls 7 and 8 the web passes to a second pair of flattening rolls 9 and 10, shown in Figure 6, which are generally similar in construction and mode of operation to the rolls 5 and 6 and require no description beyond the statement that they act in the manner above described to widen and nearly completely flatten the stretched web delivered by the rolls 7 and 8. At the completion of the operation of the second flattening rolls 9 and 10 the web may be passed through cylindrical finishing rolls (not shown) by which all cross-sectional irregularities are eliminated and it is completely flattened as indicated by Figure 8.

Figures 9 and 10 illustrate the application of the method to the widening of metal strips. These are delivered by the strip mill and are passed through stretching and flattening rolls which operate similarly to those described. Two stages of stretching and flattening are shown, the first stage being carried out by the stretching rolls 1a and 2a and the flattening rolls 5a and 6a and the second stage being carried out by the stretching rolls 7a and 8a and the flattening rolls 9a and 10a. The only difference in the equipment is in the form of the stretching rolls. When operating on the web of an I-beam the stretching rolls could react against the flanges in order to hold the blank at its sides. In the case of metal strip, however, no flanges are available and hence the stretching rolls are formed at their ends to cooperate in holding the sides of the strip. With this exception the stretching rolls are similar to those described. Figure 10 may be taken as applicable to the stretching rolls of either pair and shows the variation mentioned. Thus the upper roll has at its ends ribs 3b similar to the intermediate ribs 3 and the lower roll has at its ends ribs 3c which are of restricted diameter and lie partially under and partially beyond the ribs 3b so as to cooperate with the same in gripping the sides of the strip and in directing the marginal portions outward in directions reverse to those of the adjacent stretched parts, such gripping of the mar-

ginal portions and alteration of their transverse direction preventing any displacement thereof either inward or outward and hence insuring that the distance between the sides of the strip remains unaltered during the stretching operation.

While in both of the examples illustrated and described the stretching rolls have also been utilized to hold the sides of the blank against lateral displacement and hence to maintain the mutual spacing which they had at the beginning of the stretching operation, it will be understood that this holding function may be performed by other suitable mechanical means or arrangements and the function of stretching rolls restricted to the stretching operating in which they cooperate with the mechanical holding means.

The novel features of the apparatus herein disclosed form the subject of a copending application Ser. No. 117,327.

Having fully described my invention, I claim:

1. The method of increasing the transverse extent of rolled metal products which consists in holding the sides of an imperforate heated blank to prevent any diminution of the distance between them and simultaneously stretching the blank between its sides by so stretching the same by components between adjacent points of a series of points lying in a transverse tortuous path of greater extent than the original transverse extent of the blank as to avoid alteration in the length of the blank but proportionately to reduce its thickness and to form it into a sinuous cross-section with resultant corrugations.

2. The method of widening rolled metal products which consists in holding the sides of an imperforate heated blank to prevent any diminution of the distance between them and simultaneously stretching the blank between its sides by so stretching the same by components between adjacent points of a series of points lying in a transverse tortuous path of greater extent than the original transverse extent of the blank as to avoid alteration in the length of the blank but proportionately to reduce its thickness and to form it into a sinuous cross-section with resultant corrugations and then flattening the corrugations and thereby widening the blank substantially to the full extent of the said tortuous path along which it was stretched.

3. The method of producing metal members which utilizes an imperforate heated blank rolled from a billet and having a portion of straight cross-section and consists in substantially maintaining the original spacing of the sides of the portion of straight cross-section while bodily deforming the portion between said sides into a transverse sinuous cross-section of greater extent than the original straight extent, thereby to stretch

the same transversely without altering its length, and thereafter flattening and thereby transversely extending the stretched portion and bringing it to a plane which coincides with its original plane.

4. The method of increasing the transverse extent of rolled metal products, which consists in holding the sides of an imperforate heated blank to prevent any diminution of the distance between them and simultaneously bodily displacing parts of said blank in one direction from its original plane and alternate parts in the opposite direction from said plane, thereby to stretch the blank by components between adjacent points of a series of points lying in a transverse tortuous path of greater extent than the original transverse extent of the blank and proportionately to reduce the thickness of the blank without altering its length.

5. The method of widening rolled metal products which consists in holding the sides of an imperforate heated blank to prevent any diminution of the distance between them and simultaneously bodily displacing parts of said blank in one direction from its original plane and alternate parts in the opposite direction from said plane, thereby to stretch the blank by components between adjacent points of a series of points lying in a transverse tortuous path of greater extent than the original transverse extent of the blank and proportionately to reduce the thickness of the blank without altering its length and thereafter flattening and thereby transversely extending the stretched portion and bringing it to a plane which substantially coincides with its original plane.

6. The method of widening rolled metal products which consists in holding the sides of an imperforate heated blank to prevent any diminution of the distance between them and simultaneously stretching the blank between its sides by so stretching the same by components between adjacent points of a series of points lying in a transverse tortuous path of greater extent than the original transverse extent of the blank as to avoid alteration in the length of the blank but proportionately to reduce its thickness and to form it into a sinuous cross-section with resultant corrugations and then flattening the corrugations by pressing their apices back toward the original plane of the blank while causing their sides to be bent toward such plane and permitting certain of said apices, according to the location thereof, to shift laterally outward incident to the bending of said sides and thereby widening the blank substantially to the full extent of the said tortuous path along which it was stretched.

7. The method of increasing the transverse extent of rolled metal articles which consists in passing an imperforate heated rolled

blank through opposed ribbed rolls and holding the blank at its sides and by means of said rolls stretching it between its sides by displacing and stretching successive transverse components alternately in opposite directions and without squeezing the blank.

8. The method of widening rolled metal articles which consists in passing an imperforate heated rolled blank through opposed ribbed rolls and holding the blank at its sides and by means of said rolls stretching it between its sides by displacing and stretching successive transverse components alternately in opposite directions and without squeezing the blank and then passing the blank through rolls which press the stretched components back toward the original plane of the blank and permit certain of said components to shift laterally outward, incident to the inward displacement of adjacent components, thereby to widen the blank to the extent which conforms to the extent of stretch.

9. The method of widening rolled metal products which consists in holding the sides of an imperforate heated blank to prevent any diminution of the distance between them and simultaneously stretching the blank between its sides by so stretching the same by components between adjacent points of a series of points lying in a transverse tortuous path of greater extent than the original transverse extent of the blank as to avoid alteration in the length of the blank but proportionately to reduce its thickness and to form it into a sinuous cross-section with resultant corrugations, and then releasing the sides of the blank and applying pressure to the corrugations to flatten the blank and extend it transversely.

10. The method of widening rolled metal products which consists in holding the sides of an imperforate heated blank to prevent any diminution of the distance between them and simultaneously stretching the blank between its sides by so stretching the same by components between adjacent points of a series of points lying in a transverse tortuous path of greater extent than the original transverse extent of the blank as to avoid alteration in the length of the blank but proportionately to reduce its thickness and to form it into a sinuous cross-section and then releasing and laterally extending the sides previously held with resultant reduction of the corrugations.

11. The method of increasing the transverse extent of imperforate metal products which consists in rolling a blank, and while the blank is heated holding its sides to prevent any reduction in their mutual spacing and simultaneously stretching the blank between its sides by so stretching the same by components between adjacent points of a series of points lying in a transverse tortuous

path of greater extent than the original transverse extent of the blank as to avoid alteration in the length of the blank but proportionately to reduce its thickness and to form it into a sinuous cross-section with resultant corrugations.

12. The method of widening imperforate metal products which consists in rolling a blank, while the blank is heated holding its sides to prevent any reduction in their mutual spacing and simultaneously stretching the blank between its sides by so stretching the same by components between adjacent points of a series of points lying in a transverse tortuous path of greater extent than the original transverse extent of the blank as to avoid alteration in the length of the blank but proportionately to reduce its thickness and to form it into a sinuous cross-section with resultant corrugations and then releasing the sides of the blank and transversely extending the same to eliminate the corrugations and widen the blank substantially to the full extent of the said tortuous path along which it was stretched.

13. The method of producing an imperforate structural shape from a heated rolled blank having a web and flanges which consists in holding the flanges to prevent any reduction in their mutual spacing and deforming the web to stretch it transversely and reduce its thickness without altering the length of the blank and then extending and flattening the web whereby its width will equal its transverse extent as produced by the stretching.

14. In the method of producing an imperforate structural shape from a heated rolled blank having a web and flanges, holding the flanges to prevent any reduction in their mutual spacing and deforming the web to stretch it transversely and reduce its thickness without altering the length of the blank.

15. The method of producing an imperforate structural shape from a heated rolled blank having a web and flanges which consists in holding the flanges to prevent any reduction in their mutual spacing and simultaneously stretching the web by components between adjacent points of a series of points lying in a transverse tortuous path of greater extent than the original transverse extent of the web while avoiding alteration in the length of the blank but proportionately reducing its thickness and forming it into a sinuous cross-section with resultant corrugations, and then releasing the flanges and flattening the corrugations and thereby widening the web substantially to the full extent of the said tortuous path along which it was stretched.

16. In the method of producing an imperforate structural shape from a heated rolled blank having a web and flanges, passing the web through opposed ribbed rolls and pre-

venting any reduction in the mutual spacing of the flanges and by means of said rolls stretching the web by displacing and stretching transversely successive transverse components alternately in opposite directions and without squeezing the web.

17. The method of producing an imperforate structural shape from a heated rolled blank having a web and flanges which consists in passing the web through opposed ribbed rolls and preventing any reduction in the mutual spacing of the flanges and by means of said rolls stretching the web by displacing and stretching transversely successive transverse components alternately in opposite directions and without squeezing the web and then passing the web through rolls which press the stretched components back toward the original plane of the web and permit certain of said components to shift laterally outward, incident to the inward displacement of adjacent components, thereby to widen the web to the extent which conforms to the extent of stretching.

In testimony whereof I hereby affix my signature.

HARVEY M. GERSMAN.