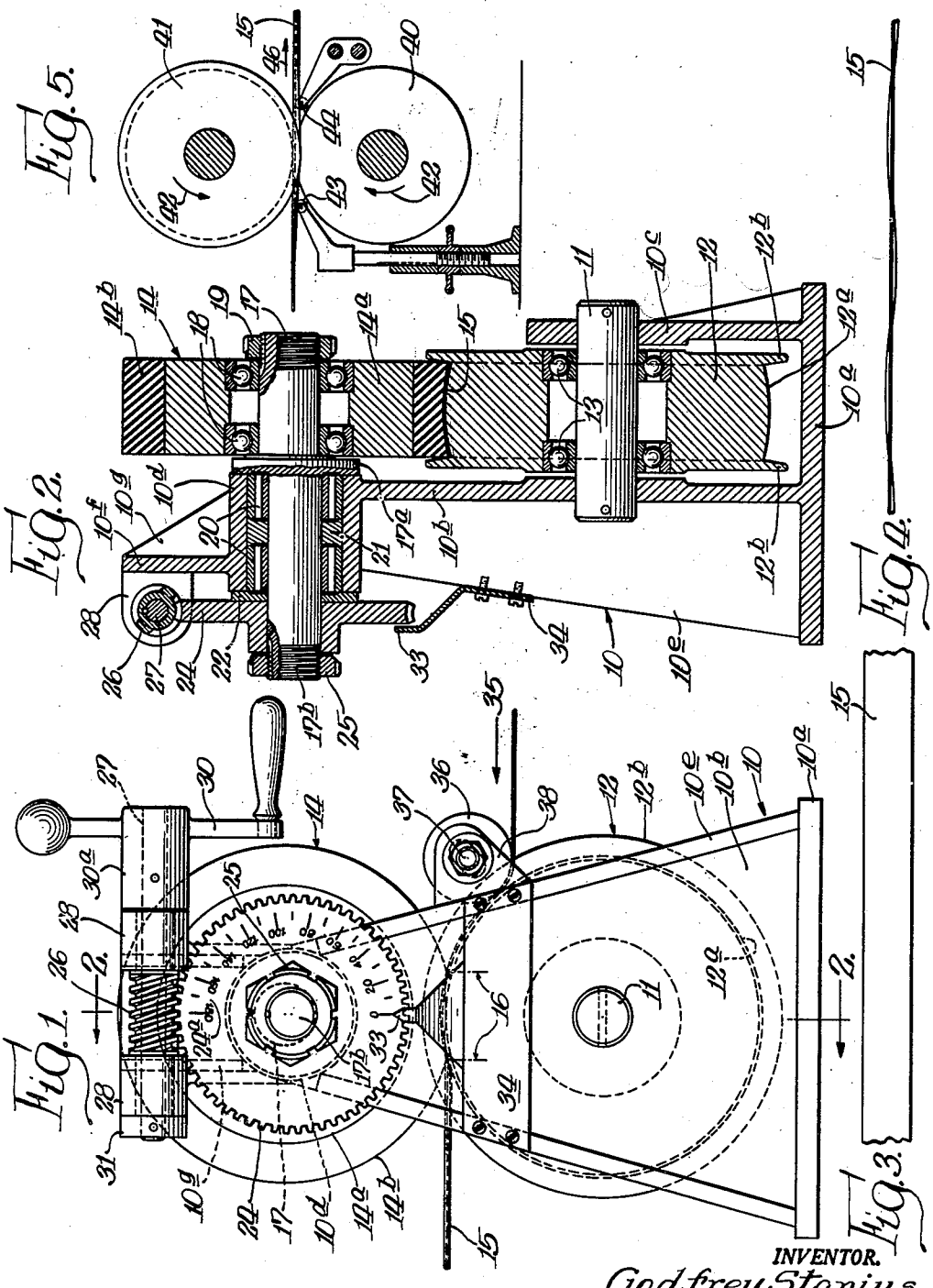
June 17, 1952 G. STANIUS 2,600,442

METHOD AND APPARATUS FOR CHANGING THE RELATIVE LENGTHS OF THE INTERMEDIATE AND EDGE PORTIONS OF METAL STRIPS

Filed July 25, 1946 2 SHEETS—SHEET 1



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Filed July 25, 1946 2 SHEETS—SHEET 2

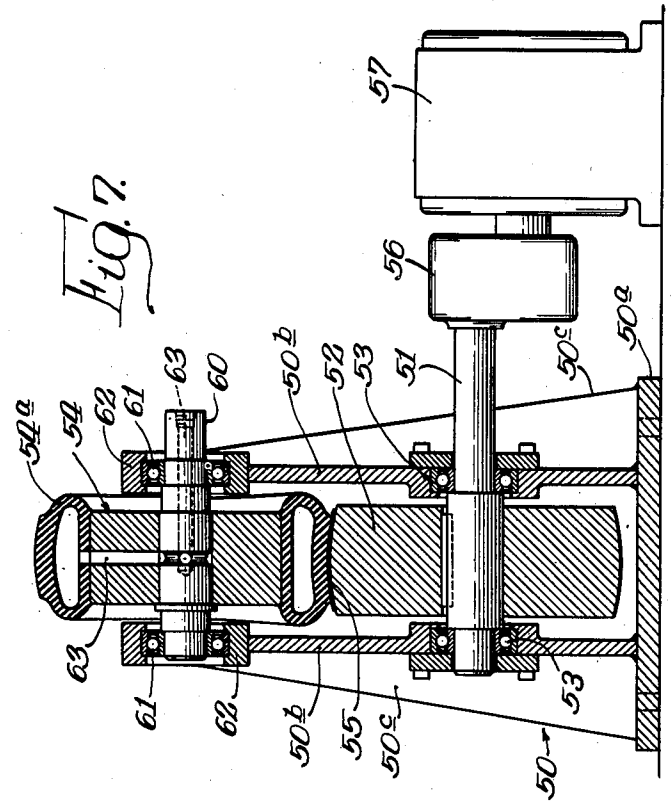


Fig. 7.

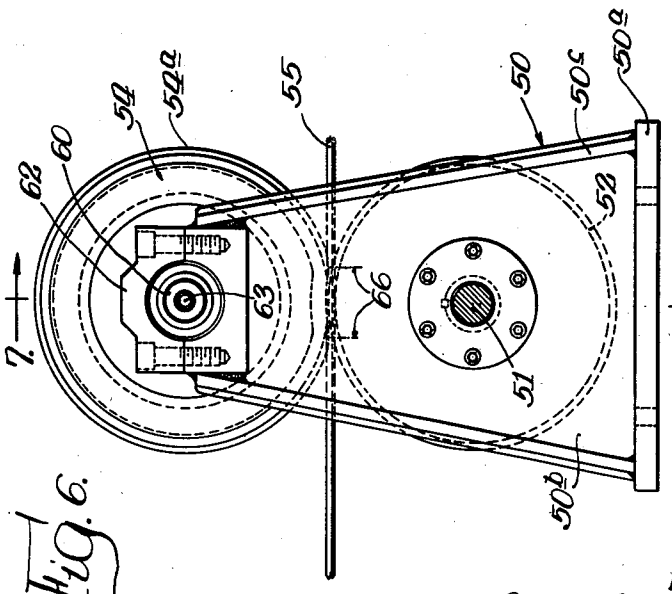


Fig. 6.

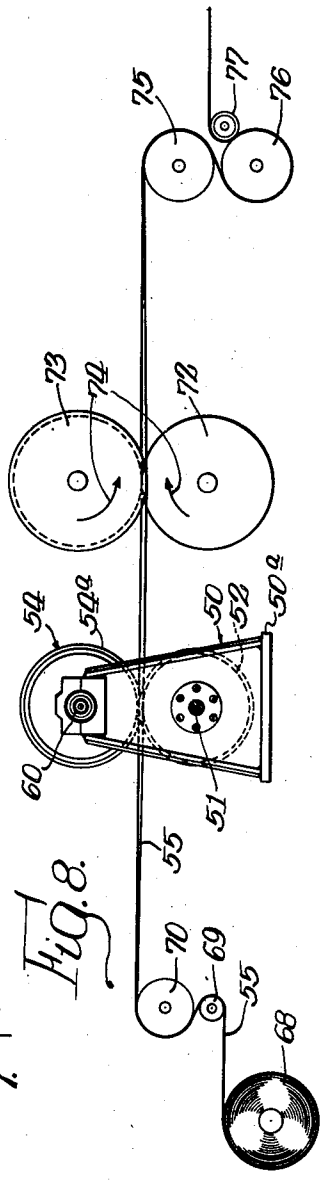


Fig. 8.

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METHOD AND APPARATUS FOR CHANGING THE RELATIVE LENGTHS OF THE INTERMEDIATE AND EDGE PORTIONS OF METAL STRIPS

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3 Claims. (Cl. 153—54)

1

This invention relates to improvements in methods and apparatus for treating a metal strip and its purpose is to provide means for effecting a permanent change in the relative lengths of two or more longitudinally extending portions of the strip which are displaced laterally of the strip with respect to each other.

The present invention may be used with particular advantage in the manufacture of Venetian blind slats in a manner similar to the method which is described and claimed in the United States Letters Patent of Allen B. Wilson No. 2,294,434, dated September 1, 1942. In the practice of the first stage of that patented method, a long metal strip is progressively stretched longitudinally in its middle portion so that the central part of the strip becomes permanently elongated with respect to its lateral edge portions, thereby forming a product known in the trade as slat stock, and this center stretched material is then subjected to a second stage operation in which the strip is moved longitudinally under tension through crowned working rolls and supported immediately in advance of and following the rolls, with the result that a permanent transverse curvature is imparted to the strip and its edge portions are stretched longitudinally so that the strip emerges from the second stage operation longitudinally straight and transversely curved and with all portions thereof permanently stretched longitudinally. By this two stage operation the unequal stresses which may have existed in the original metal strip are removed and a substantially uniform condition with respect to the stresses in the strip is obtained so that a straight and flexible but self-sustaining transversely curved slat is obtained even though it be formed of thin steel or other metal.

In said Wilson Letters Patent there is disclosed one method of carrying out the first stage of said process by pulling the metal strip endwise under tension over a crowned roll and depressing the strip on opposite sides of the roll in such a manner that the central portion of the strip, being caused to traverse a path of greater length than that travelled by its edge portions, is progressively and permanently stretched longitudinally.

2

The present invention involves the discovery that a product which is the equivalent of that produced by the first stage of the two stage process discussed above may be produced by passing the metal strip endwise over a crowned roll and pressing the strip against the crowned roll by means of a compressible member such as a cylinder having a peripheral portion formed of rubber whereby the metal strip is caused to conform to the curvature of a portion of the roll both laterally and circumferentially so that the middle portion of the strip is compelled to travel a path of greater length than that travelled by its edge portions, or may be said to travel at a faster rate than the edge portions so that the middle portion may be thereby stretched longitudinally and the edge portions are permanently compressed and shortened longitudinally so that the resulting product has an intermediate portion which is longer than its edge portions. This specific method of forming the slat stock has the advantage that it may be easily controlled and may be readily adjusted to vary the degree of the center stretch effect in the product while the operation is in progress. In one embodiment of the invention the compressible member may be formed as an annular inflated tube or pneumatic tire which may be inflated to various degrees to regulate the compressive force which is exerted upon the metal strip and consequently the extent of the change in the relative lengths of the intermediate and lateral edge portions, i. e., center stretch effect, which is brought about by the passing of the strip between the rolls. By suitably regulating the extent of the center stretch effect in the metal strip in this first stage of the process it is possible to employ this method of practicing the first stage in conjunction with the stretching of the edge portions of the strip during a second stage like that disclosed in said Wilson patent, when carried on in a continuous procedure, in such a way that the metal strip will emerge in its final form from the second stage transversely curved and longitudinally straight.

The nature of the invention will be understood from the following specification taken with the

accompanying drawings in which two embodiments of the improved apparatus are disclosed.

In the drawings,

Figure 1 shows a side elevation of one form of apparatus embodying the features of the present invention;

Fig. 2 shows a vertical section taken on the line 2—2 of Fig. 1;

Fig. 3 shows a plan view of the metal strip which is operated upon by the apparatus shown in Figs. 1 and 2;

Fig. 4 shows a side elevation of the strip or slat stock which is produced by the operation of the apparatus shown in Figs. 1 and 2;

Fig. 5 shows a side elevation of the apparatus which may be employed in carrying on the second stage of the process mentioned above with the use of the slat stock shown in Fig 4:

Fig. 6 shows a side elevation of a modified form of apparatus embodying the features of the present invention wherein one of the rolls is provided with an annular pneumatic member capable of being inflated in varying degrees for the purpose of varying the extent of the contact of the metal strip with the complementary rolls;

Fig. 7 shows a vertical section on the line 7—7 of Fig. 6; and

Fig. 8 shows a side elevation of an arrangement of apparatus, including the form of rolls shown in Figs. 6 and 7 whereby the first and second stages of the method of forming Venetian blind slats may be carried out in a continuous process.

As illustrated in Figs. 1 to 5 of the drawings, the improved apparatus comprises a frame or standard 10 having a base plate 10^a from which extend two vertically extending parallel plates 10^b and 10^c. The plate 10^b carries at its upper end a hub portion 10^d and these parts are reinforced and united with the base plate 10^a by side flanges 10^e. A plate 10^f extends upwardly from the hub 10^d and is united therewith by flanges 10^g.

The vertical plates 10^b and 10^c of the frame have mounted therein a fixed shaft 11 upon which is mounted a crowned roll 12 formed of hard steel having an outwardly convex or crowned surface 12^a which is preferably bounded on its lateral edges by the flanges 12^b which are formed on the side portions of the roll. This roll is journalled on the shaft 11 by ball bearing units 13 and it is adapted to cooperate with a pressure roll or cylinder 14 which is normally of cylindrical form. The pressure roll 14 comprises an inner cylindrical part 14^a formed of hard steel or other metal and an outer annular portion 14^b which is formed of rubber or other compressible resilient material adapted to be deformed when the roll 14 is compressed against the strip of metal engaging the surface of the roll 12 so that a portion of the compressible part 14^b of the pressure roll will conform to the contour of the crowned roll 12 both laterally and longitudinally. In Fig. 1 the metal strip 15 is shown passing between the rolls 12 and 14 and in contact with the crowned annular surface of the roll 12 between the flanges 12^b. The compressible portion 14^b of the pressure roll extends inwardly between the flanges 12^b and is compressed against the metal strip 15 so that the strip is caused to conform to the contour of the crowned roll 12 through a substantial annular distance in the zone 16. Inasmuch as the metal strip 15 is thus curved both longitudinally and transversely as it passes through the zone 16, it will be apparent that the middle portion of the metal strip is necessarily stretched in order to permit it to pass through this longer path of travel while the edge portions of the strip are following the shorter paths adjacent to the edges of the crown of the roll 12, but it has been found that the intermediate portion is or may be only temporarily stretched below the elastic limit of the metal and that the edge portions are permanently compressed and shortened longitudinally so that the resulting product exhibits a center stretch effect, i. e., its middle portion is longer than its edge portions. The metal strip 15 may be moved through the rolls 12 and 13 either by pulling endwise on the strip or by rotating one of the rolls through the agency of a positive drive, inasmuch as tension in the strip is not essential to create the center stretch effect which is brought about while the strip is passing through the zone 16.

In order that the degree of relative change in the lengths of the intermediate portion and the edge portions of the strip, i. e., center stretch effect, may be varied as desired, the roll 14 is mounted upon a shaft 17 through the agency of two ball bearing units 18. The roll 14 is held in position on this shaft by a nut 19 and the inner end of the shaft 17 is formed integrally with a collar 17^a against which the inner ball bearing unit 18 seats. The shaft 17 and the collar 17^a are formed integrally with and in eccentric relation to the shaft 17^b which is journaled in roller bearing units 20 mounted in the hub portion 10^d of the frame. These roller bearing units are separated by a collar 21 and another collar or washer 22 is mounted on the shaft 17^b at the end of the hub portion 10^d. It will be apparent that by rotating the shaft 17^b in its bearings, the position of the eccentric shaft 17 may be varied in order to vary the compression of the annular part 14^b of the roll 14, thereby varying the extent of the zone 16 in which the metal strip is compelled to conform laterally and longitudinally to the curvature of the outer crowned surface of the roll 12.

This rotation of the shaft 17^b is effected by a worm wheel 24 secured on the end of the shaft 17^b by a lock nut 25. The worm wheel 24 meshes with a worm 26 mounted on a shaft 27 which is journaled in bearings 28 formed on the upper flange 10^f of the frame. An operating crank 30 has a hub portion 30^a secured on one end of the shaft 27 and bearing against one of the bearing members 28, and a collar 31 is secured to the other end of the shaft 27 to bear against the other bearing member 28 so that the shaft 27 is thereby held against endwise movement. The worm wheel 24 secured on the shaft 17^b has a series of graduations 24^a on its front face which are adapted to move in proximity to a stationary index pointer 33 carried by a plate 34 attached to the webs 10^e of the frame. By noting the position of the graduations 24^a with respect to the pointer 33, the operator may determine in advance the degree of relative changes in the lengths of different portions of the strip which will be effected by its passage between the rolls.

For the purpose of guiding the strip 15 as it passes toward the roll 12 in the direction indicated by the arrow 35, there is mounted on the frame 10 an entering or guide roll 36 which is journaled on a short shaft 37 secured in the bearing flange 38 projecting laterally from one of the webs 10^e of the frame. In the drawings, the roll 36 is shown as being mounted with its lower part somewhat below the horizontal plane

of the zone of contact of the roll 12 with the metal strip for more effectively guiding the strip to the region where the changes in the relative lengths of its parts are effected, but this is not essential to the operation since the guide roll 36 might, if desired, be positioned with its lower strip engaging part substantially in the horizontal plane of the zone of contact of the roll 12 with the metal strip. As the metal strip passes to the apparatus shown in Figs. 1 and 2, as shown at the right of the roller 36 in Fig. 1, it is flat or substantially so, but when it emerges from the roll 12 at the left-hand side of the apparatus as viewed in Fig. 1, the edge portions have been permanently shortened with respect to the intermediate portion without imparting a permanent transverse curvature thereto, so that the strip has the characteristics which are illustrated in Fig. 4 where the strip is illustrated as being buckled between its edges in order to accommodate the greater length of the intermediate portion of the strip.

After the strip having the form illustrated in Fig. 4 has been produced by the operation of the apparatus shown in Figs. 1 and 2, it may be acted upon by forming rolls, such as those shown in Fig. 5, in order to perform the second stage of the operation which is described in the above-mentioned Letters Patent of Allen B. Wilson. These forming rolls comprise a lower crowned roll 40 and an upper convex roll 41 having a peripheral transverse curvature which is complementary to the convex curvature of the roll 40, and the strip 15 having the center stretch effect is then moved endwise under tension between the rolls 40 and 41 which rotate in the direction of the arrows 42 and which impart to the strip 15 a permanent transverse curvature. The metal strip 15 is supported in advance of and immediately following the place of engagement therewith of the rolls 40 and 41, by two supporting rollers 43 and 44, respectively, which hold the center portion of the strip substantially in the same horizontal plane as the uppermost part of the central peripheral portion of the roll 40. This arrangement makes it necessary for the edges of the metal strip to follow paths of travel of greater length than that followed by the middle portion of the strip as it passes between the rolls 40 and 41 so that the edge portions of the strip are thereby stretched or permanently elongated, with the result that the strip emerges from the rolls 40 and 41 in the direction of the arrow 46 in a longitudinally straight and transversely curved condition, as more fully described in said Letters Patent of Allen B. Wilson.

In Figs. 6 and 7 of the drawings there is illustrated a modified form of apparatus for carrying out the first stage of the process of the present invention referred to above. This apparatus comprises a frame 50 having a base plate 50a and two upwardly extending parallel standards 50b which are reinforced and united with the base plate by integral webs 50c. In the lower portions of these standards 50b there is mounted a horizontal shaft 51 upon which there is fixed a roll 52. The shaft 51 is journalled in ball bearing units 53 mounted in the standards 50b and the roll 52 is adapted to cooperate with another roll 54 in effecting a change in the relative longitudinal dimensions of the metal strip 55 passing between the rolls. Although the metal strip might be pulled endwise between the rolls, the present embodiment of the invention is shown as comprising means for driving the shaft 51

through a speed reducer 56 from an electric motor 57 so that the metal strip is rolled through the apparatus, as distinguished from being pulled therethrough. The upper roll 54 is mounted on a shaft 60 journalled in ball bearing units 61 which are mounted in the bearing members 62 carried by the upper parts of the standards 50b.

The roll 54 comprises an annular compressible member 54a in the form of a rubber tube or pneumatic tire which is capable of being inflated through the passages 63 extending through the shaft 60 and through the body portion of the roll. The usual valve member is mounted at the mouth of these passages so that any desired degree of inflation of the annular compressible member 54a may be maintained. The outer portion of the member 54a is preferably of increased thickness as compared with the remaining portions thereof and this thickened portion is adapted to engage the upper part of the metal strip 55 and to force it against the lower roll 52, thereby causing the intermediate portion of the strip to be curved both longitudinally and transversely during its passage through a zone 66, shown in Fig. 6, whereby the intermediate portion of the strip is compelled to travel a path of greater length than that traversed by the edge portions of the strip so that the intermediate portion of the strip may be stretched longitudinally and the lateral edge portions are permanently compressed and shortened in length, to produce the center stretch effect; as in the form of the invention previously described. This form of the invention has the advantage that the pressure exerted by the rolls upon the strip may be varied readily by adjusting the degree of inflation of the annular pneumatic portion 54a of the upper roll and there is the further advantage that as the rubber of the tube 54a wears away, this wear may be compensated for by increasing the inflation of the member.

With either form of the apparatus herein illustrated for carrying on a process capable of producing a product which is the equivalent of that produced by the first stage of the process described and claimed in the above-mentioned Wilson Letters Patent, it is possible to adjust the extent of the relative change in the length of the edge portions with respect to the intermediate portion of the strip in such a way that the subsequent stretching of the edge portions of the strip would cause the strip to emerge from the second stage in a longitudinally straight form without the use of the supporting rollers 43 and 44 which have heretofore been described in connection with the second stage apparatus illustrated in Fig. 5. If the first stage rolls are properly adjusted, the second stage operation may immediately follow the first stage and the whole operation of forming the completed slat carried on as a continuous process, similar to that described and claimed in the United States Letters Patent of Allen B. Wilson No. 2,370,215, dated February 27, 1945. In Fig. 8 there is illustrated a form of apparatus which may be thus arranged for carrying on both stages of the process in a continuous operation with the use of the form of rolls illustrated in Figs. 5 and 6. As shown in Fig. 8, the apparatus comprises a reel 68 from which the metal strip 55 is drawn around an idler roller 69 and thence around a friction drag roller 70 which may be adjusted for varying the resistance to the rotation of this roller for retarding the movement of the metal strip 55 as it is unwound from the coil. The strip 55 then passes

through the rolls 52 and 54 which have the construction previously described and the strip, having its intermediate portion longer than its edge portions which have been compressed and shortened, then passes through the forming rolls 72 and 73 which are rotated in the direction indicated by the arrows 74 through suitable power driven mechanism, not shown. The transversely curved complementary peripheral surfaces of the rolls 72 and 73 impart a transverse curvature to the metal strip 55 as it passes between them. At the same time, the edge portions of the strip are stretched longitudinally so that the strip emerges from the discharge sides of the rolls 72 and 73 transversely curved and longitudinally straight.

Although the rolls 72 and 73 may supply the power for moving the strip 55 through these rolls and also through the rolls 52 and 54, the strip may be withdrawn through both of these sets of rolls under tension by means of power actuated driving rolls 75 and 76 which engage opposite sides of the strip and which have cylindrical peripheral surfaces. These rolls 75 and 76 are preferably formed of steel and the metal strip, after passing around substantially one half of the peripheral surface of the roll 75, is reversed and passed around the major portion of the roll 76 with which it is maintained in close contact by a pressure roll 77 having a peripheral portion formed of rubber or the like. The rolls 75 and 76 are of the same diameters and are power driven, being geared together so that their peripheral portions travel at the same speed. In passing around these rolls 75 and 76, the concave strip is temporarily flattened but promptly resumes its normal transverse curvature due to the resilience of the hard thin metal of which the strip is formed.

If, during the operation of the apparatus shown in Fig. 8, it is found that the portion of the strip on the discharge side of the rolls 72 and 73 is not longitudinally straight, or does not have any other longitudinal shape which is desired, this may be corrected by adjusting the inflation of the peripheral portion of the upper roll 54 to effect an adjustment of the change in the relative longitudinal dimensions of different laterally displaced portions of the strip as it passes through the rolls 52 and 54. The major portion of the longitudinal stretching and compression of the strip, by which the inequalities in the internal stresses in the metal are removed in the final product, may be effected largely or wholly by the rolls 52 and 54 but, in general, there will be some longitudinal stretching of the lateral edge portions of the strip as it passes through the forming rolls 72 and 73, by reason of the fact that, due to the increased concavity of the strip at the place where it contacts the forming rolls as compared with its shape at places in advance of and following said forming rolls, the edge portions of the strip are compelled to travel longer paths than the intermediate portions of the strip as the strip passes through the region which includes the forming rolls. In any case, the entire operation is carried on as a continuous process and when the parts are adjusted to produce a final product which is longitudinally straight, it is believed that all parts of the strip will have been worked longitudinally either by compression or stretching to substantially the same degree.

Although two forms of the apparatus of the present invention have been shown and described in connection with the disclosure of the preferred practice of the improved method of producing a metal strip having an intermediate portion longer than its edge portions, it will be understood that both the method and the apparatus may be modified in various ways without departing from the scope of the appended claims.

I claim:

1. The method of treating a long, thin metal strip in a continuous process without imparting a permanent transverse curvature to the strip, which comprises continuously and progressively moving the strip longitudinally in the same direction along a path a portion of which is curved longitudinally and transversely of the strip, exerting pressure continuously on opposite sides of said strip at said curved path, said pressure being exerted transversely to said sides of the strip to flex that part of the strip in said curved portion, and moving the intermediate portion of the strip in said curved portion through a longer path and therefore at a faster rate than the edge portions to permanently longitudinally stress the strip as it moves along said curved path portion to produce in the strip a condition wherein said intermediate portion of the strip is longer than its edge portions, thereby leaving the strip in a buckled condition between its edges.

2. The combination in apparatus for treating a long metal strip, of a crowned roll over which the strip is adapted to be passed endwise continuously in the same direction, a deformable compressible member engaging the strip under pressure on the side thereof opposite said roll at the place of contact with said roll, means for holding the strip contacting portion of said deformable member in a deformed shape corresponding to the transverse curvature of a substantial annular distance of said crowned roll, and means for passing said strip continuously in the same direction over said crowned roll while it is being held in contact with said roll by the deformed portion of said member, whereby said member is deformed and compressed and said strip is caused to conform to the longitudinal curvature of said roll through a substantial annular distance and also to conform to the transverse curvature of said roll, thereby longitudinally stressing said strip and producing a condition wherein the intermediate portion of the strip is longer than its edges.

3. The combination in apparatus for treating a long metal strip, of a crowned roll over which the strip is adapted to be passed endwise continuously in the same direction, a second roll having a deformable and resilient annular portion engaging said strip under pressure on the side thereof opposite said crowned roll at the place of contact with said crowned roll, means for holding the strip contacting portion of said second roll under pressure to hold a portion thereof in a deformed shape corresponding to the transverse curvature of a substantial annular portion of said crowned roll, and means for passing said strip continuously in the same direction over said crowned roll while a portion of said second roll is so deformed, whereby said second roll is deformed and compressed and said strip is caused to conform to the longitudinal curvature of said crowned roll through a substantial annular distance and also to conform to the transverse curvature of said crowned roll, thereby longitudinally stressing said strip and producing a condition wherein the intermediate portion of the strip is longer than its edges.

GODFREY STANIUS.

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