

Oct. 19, 1954

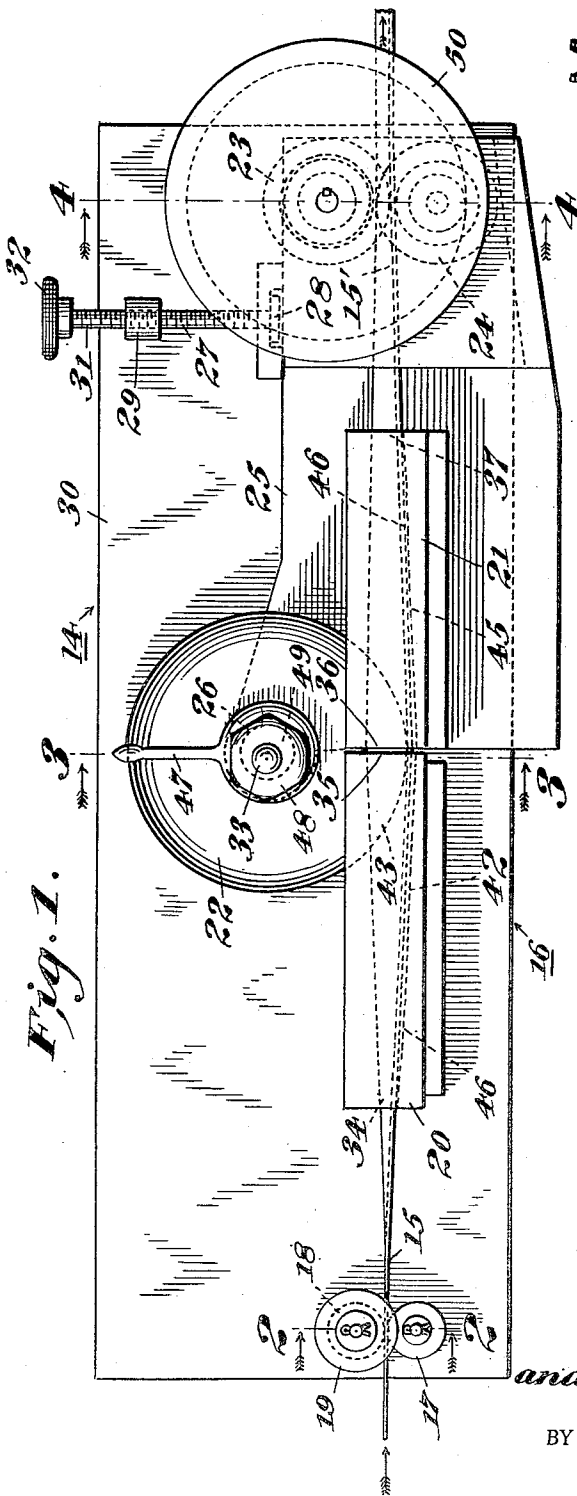
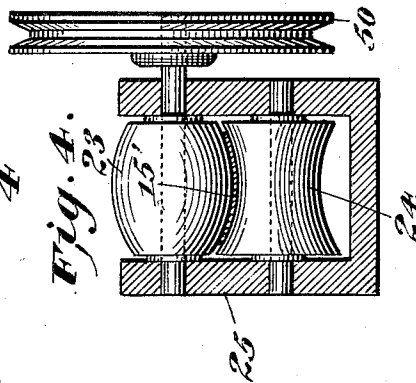
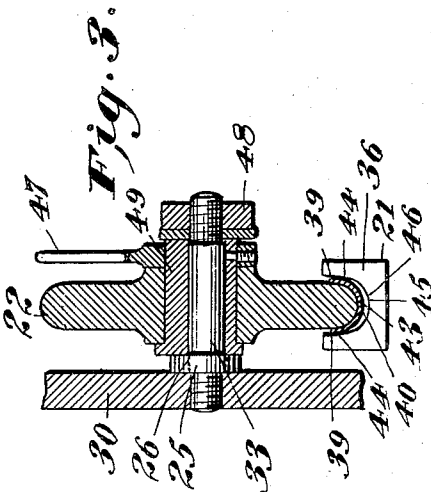
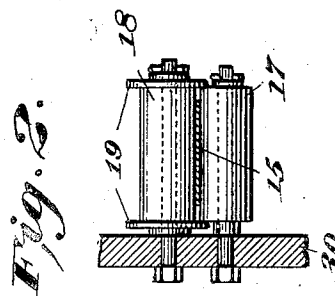
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2,692,003

APPARATUS FOR FORMING METAL STRIPS OF CURVED CROSS-SECTIONS

Filed Nov. 7, 1951

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 5.

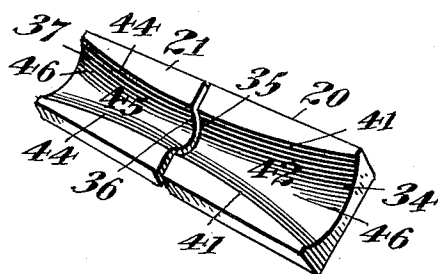


Fig. 6.

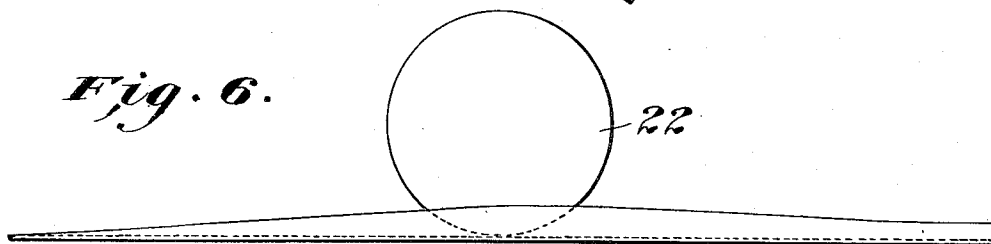


Fig. 7.

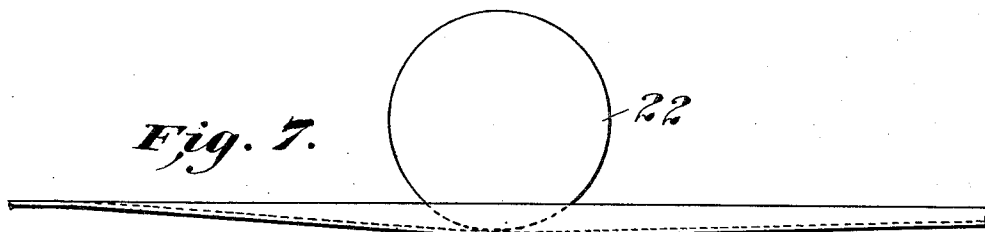


Fig. 8.

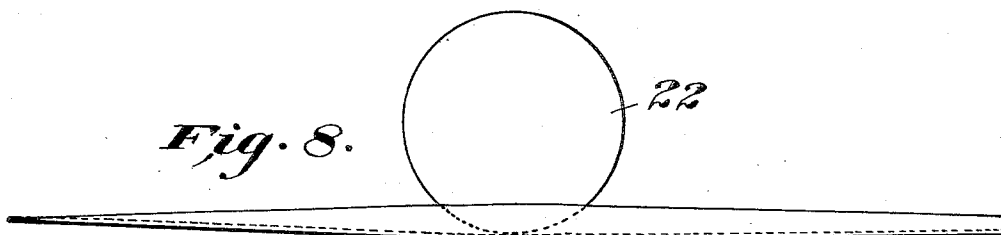


Fig. 9.

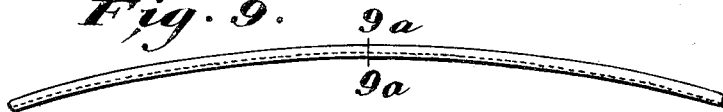


Fig. 9a.

Fig. 10a.

Fig. 10.

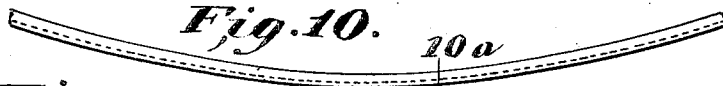


Fig. 11.

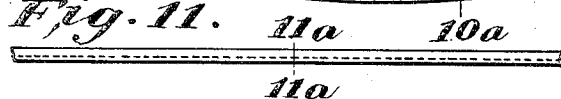


Fig. 11a.



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2,692,003

APPARATUS FOR FORMING METAL STRIPS
OF CURVED CROSS-SECTIONS

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4 Claims. (Cl. 153—32)

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Our invention relates to apparatus and method for converting flat or substantially flat material into a trough like shape and more particularly to apparatus and method for forming a relatively thin strip or sections of trough like shape which is straight lengthwise thereof and which is especially useful for making slats for Venetian blinds.

The material usually employed in the making of Venetian blind slats is a hard rolled relatively thin steel strip or a strip of other metal with a hard temper, the physical characteristics of the material being such that straightening after the forming operation is either impracticable or if practicable requires additional undesirable operations. Heretofore in the common forming practice it has been found impossible to produce under normal conditions straight products of this character in one operation and therefore it has been the usual practice to employ either before or after the forming operation other operations comprising various mechanical steps to physically work the material. By the use of our invention all such steps can be dispensed with and straight products of the desired transverse shape can be obtained in a single operation.

One object of our invention is to provide a forming die assembly of such configuration that it will form in one operation a straight strip or section longitudinally and of trough shaped cross section from a relatively thin flat or substantially flat metal strip or section.

Another object of our invention is to provide a forming device through which a flat or substantially flat rolled metal strip is passed and in one operation is formed into a straight strip longitudinally of curved cross section and which requires no further shaping or straightening when used as slat material for Venetian blinds.

A specific object of our invention is to provide the forming dies of a configuration which will support the strip while it is being acted upon to transversely bend the same so that its edges and center while traveling in different paths during such bending operation will travel in paths of approximately the same length and produce a strip of a curved cross section which is straight longitudinally thereof.

The novel features of our invention will be more fully understood from the following description and drawings in which

Fig. 1 is a side elevation of an apparatus embodying the forming device of our invention;

Fig. 2 is a section taken on line 2—2 of Fig. 1 and showing the guiding rolls of our device;

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Fig. 3 is a section taken on lines 3—3 of Fig. 1;

Fig. 4 is a section taken on lines 4—4 of Fig. 1 and showing the pulling rolls of the device;

Fig. 5 is a view of the grooved forming dies of our invention;

Fig. 6 shows diagrammatically a bending operation where the center of the strip passes in a straight path and the edges thereof pass in a longer path;

Fig. 7 shows diagrammatically a bending operation where the edges of the strip pass in a straight path and the center passes in a longer path;

Fig. 8 shows diagrammatically the bending operation of our invention where the edges and the center of the strip while passing in different paths pass in paths of approximately the same length;

Figs. 9 and 9a show the strip made by the bending operation of Fig. 6;

Figs. 10 and 10a show a strip made by the bending operation of Fig. 7;

Figs. 11 and 11a show a strip made by the bending operation of Fig. 8.

Referring to the drawings, 14 designates an apparatus with which the forming device 16 embodying our invention is shown assembled. Our improved forming device 16, as shown in the drawings, comprises guiding rolls 17 and 18 through which the flat or substantially flat strip 15 passes, the roll 18 being provided with guiding flanges 19, which serve to center the entering strip in the forming device, a pair of grooved forming dies 20 and 21, a convex roller die 22 cooperating with the dies 20 and 21 to transversely bend the flat strip into a strip 15' of curved cross section and driven pinch rolls 23 and 24, having cooperating contour surfaces matching the shape of the formed strip 15', which are shown provided with a pulley 50 which is driven by any well known driving means, such as an electric motor operatively connected to the pulley 50 by means of a belt and pulley to draw the strip material through the apparatus. Other means, which may be supplementary to or alternative to the pinch rolls may be used to apply force to the end of the strip to pull it through the forming device. A bracket 25, upon which the forming die 21 and the rolls 23 and 24 are mounted, is shown pivotally mounted at 26 on the apparatus approximately concentric with the axis of the roller 22 and is capable of vertical adjustment by means of the adjusting device 27 which has its end 28 mounted on the bracket 25 and its upper threaded end 31 cooperating with a threaded member 29 attached

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to the frame 30. The upper end of the adjusting device 27 is provided with means 32 to rotate the adjusting device 27 to raise or lower the bracket 25. The roller die 22 is adjustably mounted on the frame 30 by means of the member 32 upon which the bearing 49 of the roller die 22 is eccentrically mounted so that the roller may be adjusted with relation to the forming dies 20 and 21. The member 33 is provided with a nut 43 to retain the roller die 22 and its bearing 49 upon the member 33. A lever 47 which is mounted on the bearing 49 is provided for adjusting the roller die 22 upon the loosening of the nut 43.

The forming dies 20 and 21, shown in Figs. 1 and 5, which constitute a die assembly, have a passageway 46 in the upper surface thereof extending from end to end of the dies and are clearly shown in Fig. 5. The die 20 is broadly flared at its entrance end 34 where the flat or substantially flat strip enters the passageway 46 of the die 20, the walls 41 forming the sides of the passageway rapidly converge from the entrance end 34 to the opposite end 35 of the die 20 and the inner bottom portion 42 of the die is gradually relieved an increasing amount along its center portion from the flared end 34 to the opposite end 35, thus producing at its end 35 a die portion of U-shaped formation. The end 36 of the die 21 which is adjacent the end 35 of the die 20 has a U-shaped die portion of approximately the same shape and dimensions as the die portion at the end 35 of the die 20. The roller die 22 extends within the U-shaped die portions of the dies 20 and 21. Adjacent the ends 35 and 36 of the dies 20 and 21, respectively, the radius of the dies as well as the radius of the forming face 43 of the roller die 22 is considerably smaller than the required radius of the finished formed product so that the strip when it is being formed beneath the roller 22 is depressed a greater amount than required for the finished shape of the strip 15' so as to allow for the natural spring back of the material after it passes from beneath the roller 22. The side walls 44 of the die 21 diverge from its end 36 to its exit end 37 and the bottom wall 45 tapers gradually upwardly from its end 36 to its exit end 37 and forms an arcuate portion adjacent said end 37 which conforms approximately to the shape of the finished strip 15'.

In forming a substantially straight longitudinal strip or section curved in cross section from a flat or substantially flat rolled relatively thin strip in accordance with our invention, the forming dies 20 and 21 are as shown in Fig. 1, so that the strip in passing through the dies 20 and 21 with its center portion depressed out of its normal path beneath the roller 22 during the transverse bending of the strip has its edges 39 supported by the side walls 41 and 44 of the dies 20 and 21, respectively, so that said edges travel in a predetermined path and the edges 39 and the center 40 of the strip while shown following different paths during the bending of the strip are shown traveling in paths of approximately the same length, as diagrammatically shown in Fig. 8, and produces a strip which is straight longitudinally as shown in Figs. 11 and 11a.

In dies with their bottom surfaces in a straight line the length of the paths traveled by the edges of the strip are longer than the path traveled by the center portion of the strip during the bending operation as diagrammatically shown in Fig. 6, and a strip with a longitudinal bend as shown in Fig. 9 will be produced and in dies where the

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edges of the strip travel in a substantially straight path and the center travel in a longer path during the bending operation as diagrammatically shown in Fig. 7, the opposite effect on the strip to that shown in Fig. 6 will take place and the formed strip will have a longitudinal bend as shown in Fig. 10.

It is essential in a product such as a trough shaped section for a Venetian blind slat that all longitudinal elements of the section be of the same length so that the slat will be straight longitudinally. Therefore, since a curved section is formed from a flat or substantially flat strip the strip must undergo some local changes during the transverse bending operation and since the final formed curved product must be straight lengthwise any changes lengthwise in one portion of a section of the strip must be balanced by an equivalent change lengthwise throughout the other portions of the section. The assembly of our invention as shown in Fig. 1, which includes our novel grooved die assembly 20 and 21 as clearly shown in Fig. 5, is particularly adaptable for forming strips or sections curved in cross section which are useful for making Venetian blind slats, as the forming dies of the assemblage are so constructed and positioned that in the transverse bending of the strip any changes lengthwise in the center and the edges of the strip must be equivalent due to the edges and the center of the strip passing through paths of approximately equal length, as diagrammatically shown in Fig. 8, thereby producing a strip curved in cross section and straight lengthwise in one operation from a flat or substantially flat strip or section of metal.

Even though the paths of the edges and center of the strip are of equal length from the entrance to the exit end of the dies, during the bending local differentials of length are bound to occur between these points and the strip must undergo some local shortening or lengthening in the forming operation. Since the final formed product must be straight the shortening or lengthening must be balanced by an equivalent amount of shortening or lengthening throughout the section. Considering the piece of relatively thin strip in the process of forming between the roller die and the grooved dies, the center material is disposed naturally to accept compressive stress without buckling and the edges must also be carefully supported as shown in Fig. 8 to accept compressive stress without buckling, otherwise differential changes in length between the center and edge portions may occur to cause the edge portions to be relatively longer than the center portion in the finished material, as shown in Fig. 6, without the possibility of any correction of this condition by adjustment of the dies since such correction would necessitate the application of tension to the center portions and corresponding compression to the edges. The success of our forming operation is therefore dependent on the particular type of die members and their proper relation as shown in Fig. 1 of the drawings so that any edge and center changes of length of the material being acted upon shall be equivalent, as disclosed in Fig. 8.

In operation a strip of flat or of substantially flat formation is threaded through the guiding rolls 17 and 18, the forming dies 20 and 21 beneath the roller die 22 and through the pinch rolls 23 and 24 which are driven through the pulley 50 by suitable means to pull the strip

through the forming dies to form the strip into a strip straight lengthwise and of curved cross section. During the passage of the strip through the forming dies its center portion is depressed beneath the roller die 22 to transversely bend the strip and the edge portions of the strip are supported by the side walls 41 and 44 so that the edges and the center of the strip will pass through the dies during the bending thereof in different paths, but in paths of approximately equal lengths, as shown diagrammatically in Fig. 8, and the strip produced in said dies will be straight longitudinally thereof. The strip formed in this single operation of the desired transverse form and straight lengthwise is especially adaptable for use as slat material for Venetian blinds without any further forming or straightening operations.

From the foregoing, it is evident that we have devised an efficient forming device which, in one operation, transforms a flat or substantially flat relatively thin strip material into a strip straight lengthwise thereof and of curved cross section, which is especially adaptable for Venetian blind slats.

While we have shown our invention in one form, it will be obvious to those skilled in the art that it is not so limited but is susceptible to various changes and modifications without departing from the spirit thereof.

We claim:

1. An apparatus for forming in one operation a substantially flat rolled metal strip into a substantially straight longitudinal trough shaped section, comprising a forming die assembly having a substantially U-shaped die portion and a broadly flared guiding portion adjacent the entrance end of said die assembly merging into said U-shaped portion and an arcuate flared portion adjacent the exit end of the forming die and merging into the U-shape portion and a die having a convex portion extending into the U-shaped die portions to force the center portion of the strip being formed from its normal path into a path beneath the convex portion of the die to transversely bend said strip, said die assembly comprising supporting means for the edges of the strip to retain said edges in a path approximately the same length as the path through which the center portion of the strip travels during the transverse bending of the strip.

2. A forming die assembly comprising a pair of members disposed in end to end relation and having passageways in their faces extending from end to end of the members, one of said die members having a broadly flared entrance, side walls along its passageway converging from said flared entrance to the opposite end of said member, the bottom of the die being of arcuate formation and tapering downwardly from the flared entrance to the end of the die member and together with the side walls forming a die portion adjacent said end of approximately U-shape formation, the other of said die members having a die portion adjacent the first mentioned die portion of the same dimensions and shape as the first mentioned U-shaped die portion, and an arcuate exit portion, side walls di-

verging from the inner end and merging into the arcuate end portion of said die member, the bottom of the die member being of arcuate formation and tapering upwardly from the inner end thereof and merging into the arcuate exit end of said die member, and a bending member having a convex portion extending into said U-shaped portions of the aforementioned pair of members.

3. The combination in an apparatus for forming, in one operation, a straight metal strip of curved cross section of an elongated stationary forming die through which an elongated substantially flat relatively thin metal strip is passed, said forming die comprising a broadly flared entrance portion, a flared exit portion, and a U-shaped portion intermediate said flared portions into which said entrance portion and said exit portion merge and a die having a convex portion cooperating with the U-shape portion to transversely bend said strip and to force said center portion of the strip out of its normal plane beneath the convex portion of said die, and supporting means integral with said forming die for supporting the edges of the strip to retain the edges of the strip in a path of a length approximately equal to the length of the path of travel of the center portion of the strip during the transverse bending of the strip, whereby the edge portions of the strip can accept compressive stress without buckling during the deflection of the center portion of the strip by the convex portion of said die.

4. An apparatus for forming in one operation from a substantially flat rolled relatively thin metal strip a section or strip having a straight longitudinal shape and a curved cross section comprising a die having a concave forming portion adjacent the center thereof and flared supporting portions adjacent each end thereof and merging into said concave portion and a die having a convex portion extending into said concave portion to force said strip out of its normal path and to bend said strip transversely, and means constituting supports for the edges of the strip adjacent the flared portions and the concave portions to retain said edges in a predetermined path while the center portion is being deflected from its normal path during the transverse bending of the strip and thereby forming a strip straight longitudinally and of curved cross section.

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