Sept. 1, 1942. A. B. WILSON 2,294,434

METHOD AND APPARATUS FOR FORMING VENETIAN BLIND SLATS AND STRIP MATERIAL THEREFOR

Filed Nov. 7, 1938 2 Sheets-Sheet 1

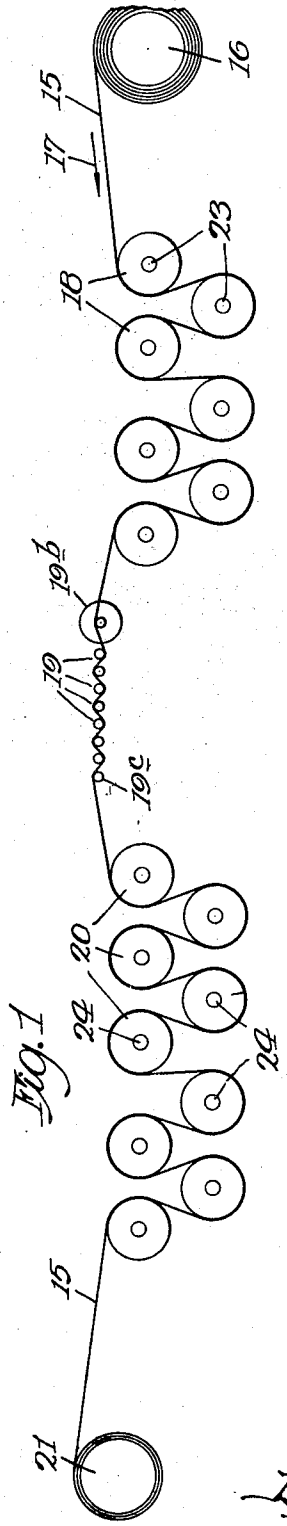


Fig. 1

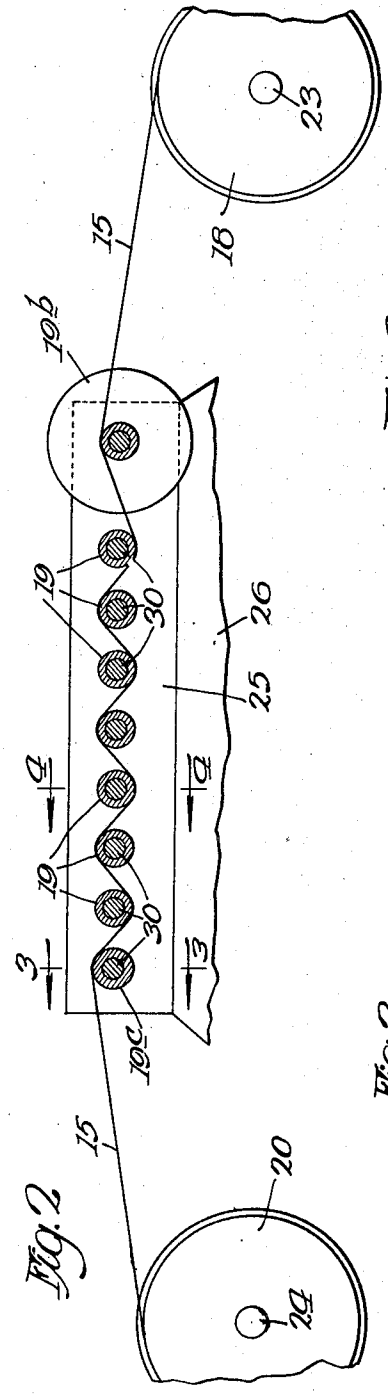


Fig. 2

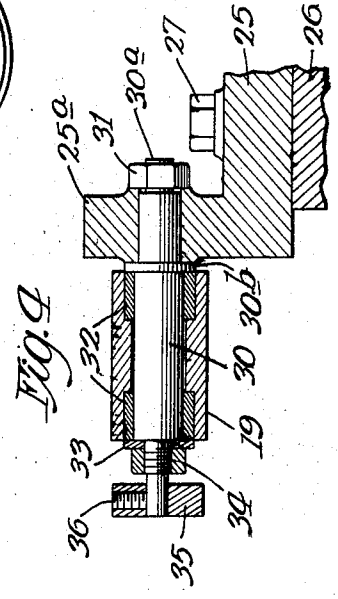


Fig. 4

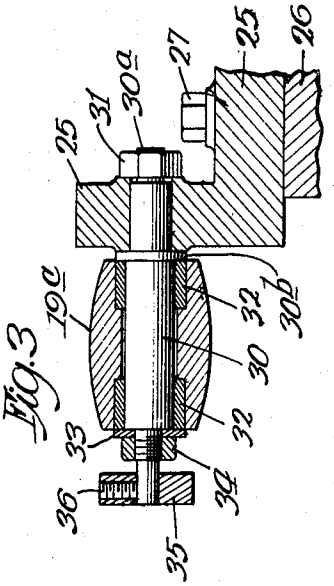


Fig. 3

Inventor:
Allen B. Wilson
By Davis, Lindsey, Smith & Shonts, Attys

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Filed Nov. 7, 1938 2 Sheets-Sheet 2

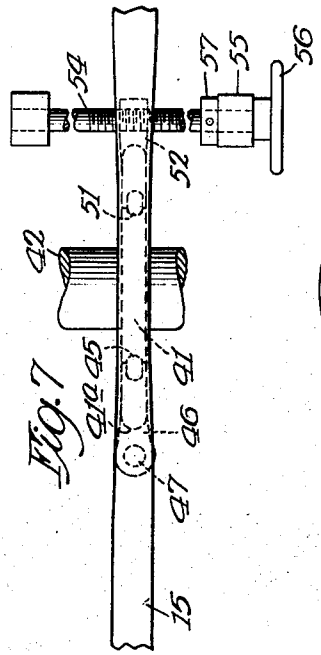


Fig. 7

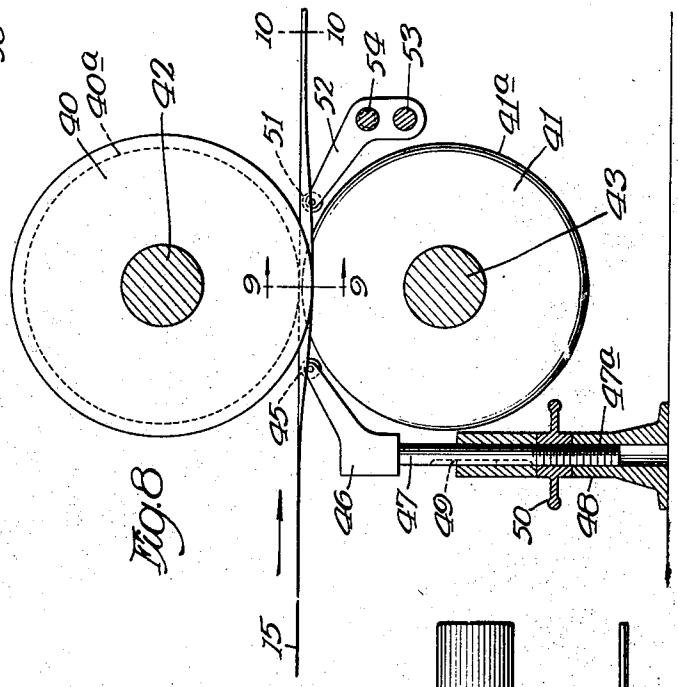


Fig. 8

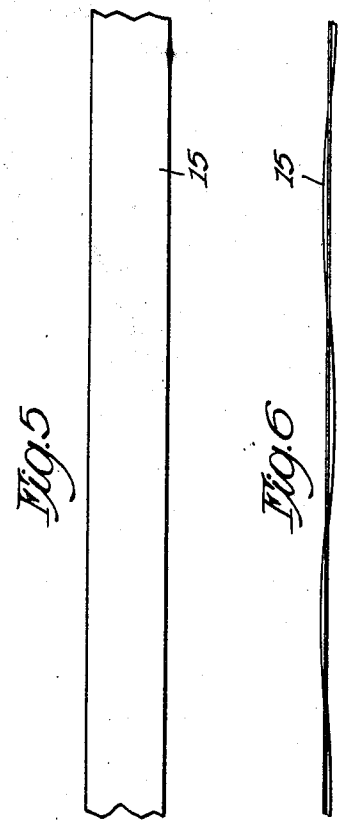


Fig. 5

Fig. 6

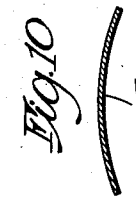


Fig. 10

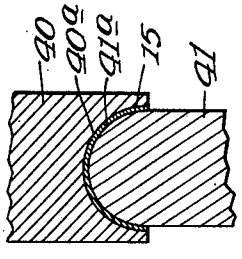


Fig. 9

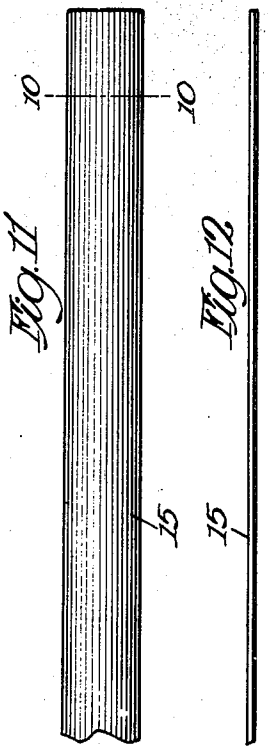


Fig. 11

Fig. 12

Inventor:
Allen B. Wilson
By Davis, Lindsey, Smith & Shute, Attys.

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UNITED STATES PATENT OFFICE

2,294,434

METHOD AND APPARATUS FOR FORMING VENETIAN BLIND SLATS AND STRIP MATERIAL THEREFOR

Allen B. Wilson, Evanston, Ill., assignor to Acme Steel Company, Chicago, Ill., a corporation of Illinois

Application November 7, 1938, Serial No. 239,229

11 Claims. (Cl. 153—2)

This invention relates to improvements in strip material for use in the manufacture of Venetian blinds and to an improved method of forming Venetian blind slats from metal strips whereby strong and durable slats of light weight and attractive appearance may be quickly and economically produced.

Venetian blinds of the type which have gone into extensive use in recent years have usually been formed of parallel wooden slats secured together in spaced relationship by flexible tapes which permit their relative and tilting movements. It has been necessary to form these wooden slats of material having considerable thickness in the effort to prevent undue sagging of the portions thereof between the supporting tapes, particularly in blinds intended for use on large windows, and the result has been that such blinds have generally been rather heavy and cumbersome and not entirely free of objectionable sagging portions.

It has been found that the difficulties arising from the use of wooden slats may be overcome by employing thin strip metal in the construction of these members, but in order to prevent sagging of the metal slats it has been necessary to form them with a concaved or other non-planar cross section to impart stiffness thereto, and the economical manufacture of such slats has presented a problem. Although a metal slat of concaved cross section may be formed by a rolling process carried out gradually in several steps if the strip is originally flat, this method of procedure is expensive, and if the full transverse concavity be imparted to the strip in a single rolling and bending step, an excessive stretching of the edge portions of the strip is produced so that the resulting product is unsatisfactory, and it is necessary to use material which is relatively thick and soft and thus unsuitable for Venetian blind slats. These slats must be formed of strip material which is thin and hard in order to have the requisite lightness in weight in the finished product and sufficient springiness to cause the slats to return to their original shapes when bent therefrom during use.

The present invention involves the discovery that metal Venetian blind slats having a concaved cross section may be quickly and economically formed by a rolling and bending process which is carried out in two stages, in the first of which the metal strip is stretched in the region between its edges, leaving the edges substantially unstretched, while in the second stage the metal is bent transversely and the edges are stretched, thus producing a properly concaved straight strip having parallel edges. Broadly speaking, the invention contemplates the successive stretching of different longitudinal portions of a metal strip coupled with a transverse bending of the strip during the latter stretching operation. One object of the invention is to provide an elongated metal strip having one longitudinal portion thereof stretched with respect to the remaining portions so that it may be subjected to a single rolling, bending and stretching operation by a Venetian blind manufacturer in order to produce a Venetian blind slat having the required strength and stiffness. Another object is to provide a new method of forming a metal Venetian blind slat by a two-stage process having the general characteristics pointed out above. A further object is to provide an improved method by which Venetian blind slats having a concaved cross section and parallel edges may be formed by a rolling and bending process beginning with a substantially flat metal strip which may or may not have lateral curvature or "camber" therein. Still another object of the invention is to provide improved apparatus for forming Venetian blind slats and strip material for use in the manufacture of those slats. Other features and advantages of the invention will appear more fully hereinafter.

The function of the permanent elongation of the intermediate portion of the strip, which is effected during the first stage of the improved process, is to transform the irregularities in the strip into irregularities of a uniform kind or character so that the operations which are performed during the second stage of the process will produce predetermined results. It has been found that commercial strip steel, although substantially flat, has present therein a great number of irregularities of varying magnitude and character, such as relatively long edges, pockets or depressions at intermediate points and the like, even when the strip material is manufactured with the greatest of care and with the best available equipment, and these varying irregularities make it impossible to produce with certainty a straight slat having parallel edges, or other predetermined shape, by bending and rolling the strip. However, if the commercial strip is first stretched longitudinally between its edges sufficiently to stretch the metal to such an extent that all longitudinal elements of the metal between the edges of the strip are elongated as compared with the length of the edges, a uni-

form kind or character of irregularity is produced which enables the operations of the second stage of the process to produce a strip having the desired predetermined longitudinal shape. The necessary elongation of the intermediate portion of the strip will be effected when it is subjected to sufficient tension to cause a condition of the stresses in the metal such that if the tension were relieved, all of the said intermediate portions of the strip would be under compression. That condition of the stresses may, of course, result in part from a previous relative elongation of individual portions of the strip in the process of its original manufacture but it is brought about mainly by the elongation effected by the tension to which the strip is subjected in the first stage of the process. When that condition has been created in the strip, the second stage of the process will cause the strip to assume with certainty a curved or other selected non-planar cross section and a predetermined longitudinal shape, such as a straight form with parallel longitudinal edges.

The nature of the invention will be understood from the following specification taken with the accompanying drawings in which one embodiment of the improved strip material for Venetian blinds and one example of the improved method of forming the strip material and the completed slat are set forth in connection with the disclosure of one form of the improved apparatus. In the drawings,

Figure 1 shows a somewhat diagrammatic side elevation of one form of the improved apparatus, constituting a part of the present invention, which may be employed in straightening a metal strip and stretching portions thereof between its edges preliminary to imparting to the strip a continuous transverse curvature;

Fig. 2 shows an enlarged vertical section through a portion of the apparatus illustrated in Fig. 1, illustrating the straightening and stretching rolls and portions of adjacent friction rolls;

Fig. 3 shows an enlarged vertical section on the line 3—3 of Fig. 2, illustrating the roll by which the metal strip is stretched between its edges;

Fig. 4 is an enlarged vertical section taken on the line 4—4 of Fig. 2 illustrating one of the rolls for straightening the metal strip;

Fig. 5 shows a top plan view of the metal strip after it has passed through the apparatus shown in Figs. 1 and 2 with a resulting stretching of the metal between its edges;

Fig. 6 shows a side elevation of the strip illustrated in Fig. 5;

Fig. 7 shows a top plan view of one form of the improved apparatus of the present invention which is employed for stretching the lateral edges of the strip and bending it transversely to impart a continuous transverse curvature thereto after the middle portions of the strip have been stretched by the apparatus illustrated in Figs. 1 and 2;

Fig. 8 shows a side elevation of the apparatus illustrated in Fig. 7 with parts thereof illustrated in section;

Fig. 9 shows an enlarged detail section taken on the line 9—9 of Fig. 8;

Fig. 10 shows an enlarged section through the metal strip. taken on the line 10—10 of Fig. 8;

Fig. 11 shows a top plan view of the completed slat after the second stage of the operation of stretching the metal strip has been completed; and

Fig. 12 shows a side elevation of the strip or slat illustrated in Fig. 11.

Although the strip material of the present invention may, of course, be formed from strip metal which is initially in a substantially perfect condition with its surface flat and its edges parallel to each other, it frequently happens that strip metal has a lateral curvature in its own plane and the apparatus of the present invention is therefore preferably constructed to eliminate this camber in the strip preliminary to stretching the intermediate portions of the strip in the first stage of the process. The method and apparatus for removing camber in the metal strip do not in themselves constitute a part of the present invention as they are claimed in the copending application of Chester M. MacChesney, Serial No. 87,140, filed June 25, 1936 (Patent No. 2,140,533, granted Dec. 20, 1938). In the apparatus shown in Figs. 1 to 4, inclusive, of the drawings, the elongated metal strip 15, of steel or the like, is shown as being withdrawn from a reel 16 and moved in the direction of the arrow 17 by means of a series of driven friction rolls 18 which are comparatively large in diameter and which are arranged in zig-zag fashion so that the strip is compelled to follow an irregular path when passing through this series of rolls, thereby obtaining a large area of contact between the strip and the surface of each roll. The strip 15 then passes in zig-zag fashion through a series of parallel straightening rolls 19 which are comparatively small in diameter and which operate as idler rolls, being arranged with their axes in one plane, so that the strip is bent back and forth between these rolls as it passes through them. Although the strip is preferably restrained against lateral movement as it passes through these rolls, as explained in the said application of Chester M. MacChesney, it has been found desirable when operating upon strip metal of very fine gauges, which are preferably used in the manufacture of slats for Venetian blinds, to permit some lateral movement of the strip while it is being straightened. After passing through the rolls 19, the strip 15 then passes through a series of friction rolls 20 which are power driven and which pull the strip 15 under tension through the rolls 19. Upon emerging from the rolls 20, the strip 15 is wound upon a reel 21 which maintains the strip under sufficient tension in the process of winding to hold it in contact with the friction rolls 20. The friction rolls 20 are preferably slightly larger in diameter than the rolls 18, if the rolls of these two series are driven at the same angular speed, or the rolls 20 are driven slightly faster than the rolls 18, so that the peripheral speeds of the rolls 20 are greater than the peripheral speeds of the rolls 18, thereby creating a substantial tension in a longitudinal direction in the strip 15 as it passes through the intervening idler rolls 19. Some slippage is provided in the driving mechanism of the friction rolls so that the tension created in the strip 15 is not sufficient to elongate the strip generally throughout its width and the result is that, as the strip passes through the rolls 19, the tension therein is sufficient to stretch the shorter edges of the strip until these shorter edges are of the same length as the opposite longer edge portions. A brake is applied to the supply reel 16 to prevent the metal strip from being drawn therefrom too rapidly, thereby maintaining it in close contact with the rolls 18, and the driving mechanism which is connected to the winding reel 21 is pro-

vided with a friction clutch which is adapted to slip when required so that, if the reel 21 be driven at a greater speed than the friction rolls 20, as is the preferred practice, the friction clutch may slip and at the same time maintain the metal strip sufficiently taut between the rolls 20 and the reel 21 to bring about a tight winding of the strip in the coil and at the same time to keep the strip in close contact with the surfaces of the rolls 20.

The friction rolls 18 are mounted on shafts 23 which are preferably geared together so that they rotate in unison at the same speed and the friction rolls 20 are mounted on shafts 24 which are also preferably geared together so that they are driven in the proper direction at the same speed. Each series of shafts is power driven and the driving mechanism of the two series of shafts may be connected together by a belt or the like so that they will operate in unison, although the arrangement is preferably such that the rolls 20 are driven at a slightly greater speed than the rolls 18 and some slippage in the belt or other connecting mechanism is provided to take care of the difference in the driving speeds so that tension will at all times be maintained in the strip passing through the rolls.

The straightening rolls 19 are carried by a frame member 25 which is in the form of a heavy angle bar mounted upon a base 26 by means of studs 27. The frame 25 has an upwardly extending flange 25*a*, shown in Figs. 2 and 4, in which are secured the inner reduced ends 30*a* of a series of stationary spindles or axles 30 upon which the rolls 19 revolve. These spindles are provided adjacent their inner ends with integral surrounding collars 30*b* which coact with the outer face of the frame member 25 and their inner threaded ends are engaged by nuts 31 by which the spindles are clamped securely in position on the frame. Each roll 19, except the last roll of the series at the left as viewed in Fig. 2, is in the form of a cylindrical sleeve adapted to revolve about the body portion of one of the spindles 30. Bushings 32 are mounted in each of the rolls 19 to coact with the supporting spindle 30 and the outer reduced end of each spindle is threaded to receive a washer 33 and a nut 34 by which the roll is held in place on the spindle. The extremity of each spindle, outwardly of the threaded portion, has a smooth cylindrical surface to engage one of a series of apertures in a supporting frame member 35 which is provided with transversely extending threaded holes to receive a number of set screws 36 by which this frame member is clamped in position on the outer ends of the spindles to hold them against vibration and in their proper spaced relation. The spindles 30 are located with their axes in a single horizontal plane and the metal strip 15 is carried under one roll and over the next one throughout the series of rolls so that the strip is compelled to follow a sinuous path which results in stretching the shorter edge portions of the strip whereby the edges assume the desired parallel relationship and the surface of the strip becomes substantially flat and free of irregularities. The rolls 19 are of the same size and in alignment with each other but they may be replaced by other rolls of different sizes when it is desired to operate upon metal strips of different widths. The roll 19 which is located nearest to the friction rolls 18 is provided with end flanges or collars 19*b* which are comparatively large in diameter so that the strip 15 is properly guided in its passage to the rolls 19 from the rolls 18.

The roll 19 which is nearest to the friction rolls 20, being the last roll of the series of rolls 19, is constructed and mounted in the same manner as the other rolls 19 except that its outer peripheral surface is transversely curved, as shown at 19*c* in Fig. 3, thus giving this roll a convex outer surface which is symmetrical on opposite sides of a plane passing through its middle point so that as the metal strip 15 passes over this roll the portion of the strip between its lateral edges is stretched to give it a greater length than the edge portions of the strip. The strip thus assumes the form shown in Figs. 5 and 6, wherein, the portions of the strip between its lateral edges are adapted to buckle out of a plane containing the edges of the strip due to their gerater length. This strip material, having one longitudinal portion stretched, may be supplied in coils to Venetian blind manufacturers, who subject it to the second stage of the process now to be described.

In the second stage of the process, which may follow immediately, the metal strip 15, having its intermediate portion elongated, is subjected to a transverse bending action by a continuous rolling operation which stretches the edges of the strip to a greater extent than the intermediate portions and bends the strip transversely with the result that the strip finally assumes a form having a transverse curvature and having its longitudinal elements lying in parallel straight lines. For the purpose of thus treating the metal strips shown in Figs. 5 and 6, it is passed through a pair of rolls 40 and 41, shown in Figs. 7, 8 and 9, which are mounted one above the other and which are so constructed that an annular groove 40*a* formed in the outer periphery of the upper roll is engaged by the peripheral portion of the lower roll 41 as the rolls rotate. The rolls 40 and 41 are mounted upon shafts 42 and 43, respectively, which are power driven so that they rotate in unison with the same peripheral speeds. The groove 40*a* in the roll 40 may be substantially semicircular in cross section and the outer surface 41*a* of the roll 41 may have a corresponding curvature. The transverse curvature of the peripheral portions of the rolls is preferably greater than the resulting curvature which is desired in the finished slat. The spacing of the rolls is such that they are adapted to receive between them the metal strip 15 which assumes the form shown in Fig. 9 as it passes between the rolls. Due to the downward bending of the lateral edges of the strip about the curved surface of the roll 41, a transverse curvature is imparted to the strip but the lateral edges of the strip tend to stretch more than the intervening portions as referred to above, and, for the purpose of regulating the relative variation of the degrees of stretching of the lateral edge portions and the intermediate portions of the strip, to determine the character of the final product, and for the purpose of providing proper support for the strip during the rolling operation, guide rolls are provided in advance of and following the rolls 40 and 41. The guide roll 45, in advance of the place of engagement of the strip with the peripheral surfaces of the rolls 40 and 41, is carried by the upwardly projecting arm of a bracket 46 which is carried on the upper end of a rod 47 mounted to slide vertically in a stationary standard 48. The rod 47 and the standard 48 have a splined con-

nection, as shown at 49, which allows vertical movement of the rod without permitting rotation thereof about its axis. The lower portion of the rod is threaded, as shown at 47a for engagement by the threaded hub portion of an adjusting wheel 50 which revolves in a recess formed in the standard. By adjusting this wheel, the rod 47 and the bracket 46 may be adjusted vertically for the purpose of causing the guide roll 45 to vary the elevation of the strip in advance of the rolls 40 and 41. By thus varying the elevation of the strip, the degree of stretching of the lateral edges of the strip, as compared with the degree of stretch of the intermediate portions, may be varied in order to cause the metal strip to assume any desired transverse curvature after it has passed through the apparatus. The stretching effected may be confined to the edge portions of the strip which are stretched to substantially the same degree that the intermediate portion has previously been stretched in the first stage of the process, or there may be some stretching of the intermediate portion in the second stage, in which case the stretching of the edge portions must be sufficient to equal the total stretching of the intermediate portion brought about in both stages of the process.

As the strip emerges from the rolls 40 and 41, it is engaged between its edges by another guide roll 51 which is carried by a bracket 52 mounted on a horizontal rod 53 and a horizontal adjusting screw 54, both of which are mounted in upright supporting members 55, shown in Fig. 7. The roll 51 serves with the rolls 40 and 41 and the roll 45 to give a three-point support to the strip during the stretching operation. The bracket 52 is adapted to slide freely on the rod 53 but it has a threaded engagement with the adjusting screw 54 which has an adjusting wheel 56 mounted on the end thereof to permit it to be turned for the purpose of shifting the guide roll 51 laterally of the strip, which may be necessary to keep the strip moving in the proper direction as it emerges from the rolls 40 and 41. A collar 57 is secured on the screw 54 adjacent the supporting member 55 against which the adjusting wheel 56 is located so that endwise movement of the screw 54 is prevented during its rotation. The guide roll 51 occupies a position within the concave under side of the strip and this roll may be adjusted laterally to cause the strip to travel in a straight line through the rolls 40 and 41.

After passing through the second stage of the process, the strip material will be straight with all of its elements lying parallel to each other and it will have sufficient stiffness to prevent bending when cut up into proper lengths and used to form the slats of a Venetian blind. Either before or after cutting the strip, it may be coated by paint, enamel, or the like, to render it attractive. The strip material produced by the first stage of the process and the product of the second stage may be employed to advantage in the manufacture of articles other than Venetian blinds.

Although a certain form of the improved strip material and one embodiment of the improved method have been disclosed by way of example in connection with the description of one form of the improved apparatus, it will be understood that the article, the method, and the apparatus may be modified in various ways without departing from the scope of the appended claims.

In certain of the claims the condition of the metal strip at the end of the first stage of the process is defined by reference to the stresses existing therein, which is merely one way of defining the elongation of a portion of the strip which is effected by that stage, and the portion which is elongated is defined as the portion between the edges or as an intermediate portion but it will be understood that these definitions are to be construed in the light of the practical results to be accomplished and that a process or apparatus is to be considered as within the scope of such claims even though the elongation effected in the first stage is not precisely co-extensive with the width of the strip and even though slight portions of the original irregularities may still remain in the strip, as it has been found that satisfactory straight slats may be produced when substantial portions at the edges of the metal strip are not elongated in the first stage of the process and when slight original irregularities still remain.

In connection with the appended claims, and the operation of the apparatus, it should be noted that the metal strip does not necessarily have a linear path of travel in passing through the rolls which perform the second stage of the process and that it is only necessary that the strip follow a path of travel which will cause certain portions of the metal to stretch longitudinally in the second stage of the process to a sufficient extent to produce the desired predetermined longitudinal shape; since the path of the metal between the forming rolls and the places of support may vary considerably from an exact straight line path of travel, because of the tendency of the metal to spring back part way from any position to which it is bent and the consequent necessity of supporting it in a manner to bend it beyond the desired ultimate position or form it is to have, it is usually not literally true that the metal strip has a linear path of travel when passing through the second stage of the process.

I claim:

1. The method of forming a longitudinally straight metal strip of non-planar cross section, which comprises the operations of stretching longitudinally the metal of an elongated substantially flat strip between its edges by subjecting the strip between its edges to longitudinal tension of such magnitude that if the tension were released all parts of the metal between said edges would be under compression, and then bending the strip transversely and effecting a stretching of the edge portions of the strip until all portions of the strip have been stretched longitudinally to substantially the same extent.

2. The method of forming a longitudinally straight metal Venetian blind slat having a cross section adapted to impart stiffness to the slat, which comprises the operations of stretching an intermediate longitudinal portion of the metal of a substantially flat elongated strip by subjecting said portion to longitudinal tension of such magnitude that if the tension were released all parts of said portion would be under compression, and then bending the strip transversely and simultaneously effecting a longitudinal stretching of the side portions of the strip until all portions of the strip are stretched longitudinally to substantially the same extent.

3. The combination in apparatus for forming a straight metal strip of non-planar cross section, of means for stretching longitudinally the metal of an elongated substantially flat metal strip between its edges, and means for thereafter bending the strip transversely and effecting a stretch-

ing of the edge portions of the strip to substantially the same extent as said portion between said edges was previously stretched.

4. The combination in apparatus for forming a straight metal Venetian blind slat having a curved cross section, of means for stretching the intermediate portion of an elongated substantially flat metal strip, rolls having complementary concave and convex surfaces for thereafter bending said strip transversely, and means cooperating with said rolls for stretching the edge portions of said strip longitudinally.

5. The combination in apparatus for forming a straight metal Venetian blind slat having a curved cross section, of means for stretching the intermediate portion of an elongated substantially flat metal strip, rolls having complementary concave and convex surfaces for thereafter bending said strip transversely, means cooperating with said rolls for stretching the edge portions of said strip longitudinally, and means for varying the degree of stretching of said edges of the strip.

6. The combination in apparatus for producing a straight Venetian blind slat having a curved cross section, of a pair of rolls having complementary surfaces adapted to bend transversely an elongated metal strip passing between them, means for supporting said strip in advance of said rolls, other means for supporting said strip as it emerges from said rolls, means for adjusting one of said supporting means vertically, and means for adjusting the other of said supporting means laterally, said last-mentioned supporting means contacting with the middle portion only of the concave side of said strip.

7. The method of forming a straight metal Venetian blind slat having a bowed cross section, which comprises the operations of running an elongated metal strip endwise and stretching the intermediate portion of the strip by subjecting the strip between its edges to longitudinal tension of such magnitude that if the tension were released all parts of the metal between said edges would be under compression, and then running the strip endwise while bending the strip transversely and supporting the strip in advance of and following the place of bending to cause the strip to stretch in its lateral edge portions and to assume a straight form having a transverse curvature.

8. The method of forming a straight metal Venetian blind slat of bowed cross section which comprises the operations of stretching the intermediate portion of an elongated metal strip to cause the intermediate portion to be of greater length than the lateral edge portions by subjecting said first-mentioned portion to longitudinal tension of such magnitude that if the tension were released all parts of that portion would be under compression, and then running the strip endwise through means adapted to bend the strip transversely and simultaneously supporting the middle portion only of the strip at points immediately in advance of and immediately following the place of transverse bending, whereby stresses are set up in the strip between the points of support and the edges of the strip at the place of bending, thereby stretching the edge portions of the strip.

9. The method of forming a metal strip having a predetermined longitudinal shape and a non-planar cross section, which comprises the operations of stretching an intermediate portion of an elongated metal strip to cause said intermediate portion to be of greater length than the lateral edge portions by subjecting said intermediate portion to longitudinal tension of such magnitude that if the tension were released all parts of that portion would be under compression, and then bending the strip transversely and simultaneously stretching the lateral edge portions longitudinally to the extent required to produce said predetermined longitudinal shape.

10. The method of forming from thin hard strip material a metal slat having a predetermined longitudinal shape and a non-planar cross section, which comprises the operations of running an elongated metal strip endwise and stretching an intermediate longitudinal portion of the strip endwise by subjecting that portion of the strip to longitudinal tension of such magnitude that if the tension were released all parts of the metal in said longitudinal portion would be under compression, and then running the strip endwise while bending the strip transversely and supporting the strip in advance of and following the place of bending to cause other longitudinal portions of the strip to be stretched longitudinally to the extent required to produce said predetermined longitudinal shape.

11. The method of producing in a continuous process a metal strip having an intermediate portion which is permanently stretched longitudinally relatively to other longitudinal portions thereof, which consists in continuously pulling a metal strip endwise in contact with a crowned roll, maintaining in the strip adjacent said roll a transverse shape of less curvature than that of said roll and maintaining the strip offset with respect to the peripheral surface of said roll in advance of and following the roll, and maintaining longitudinal tension in said strip by a braking action exerted on the strip in advance of said roll, whereby the said strip is urged against a substantial arcuate portion of said roll and the intermediate portion of the strip is permanently elongated.

ALLEN B. WILSON.