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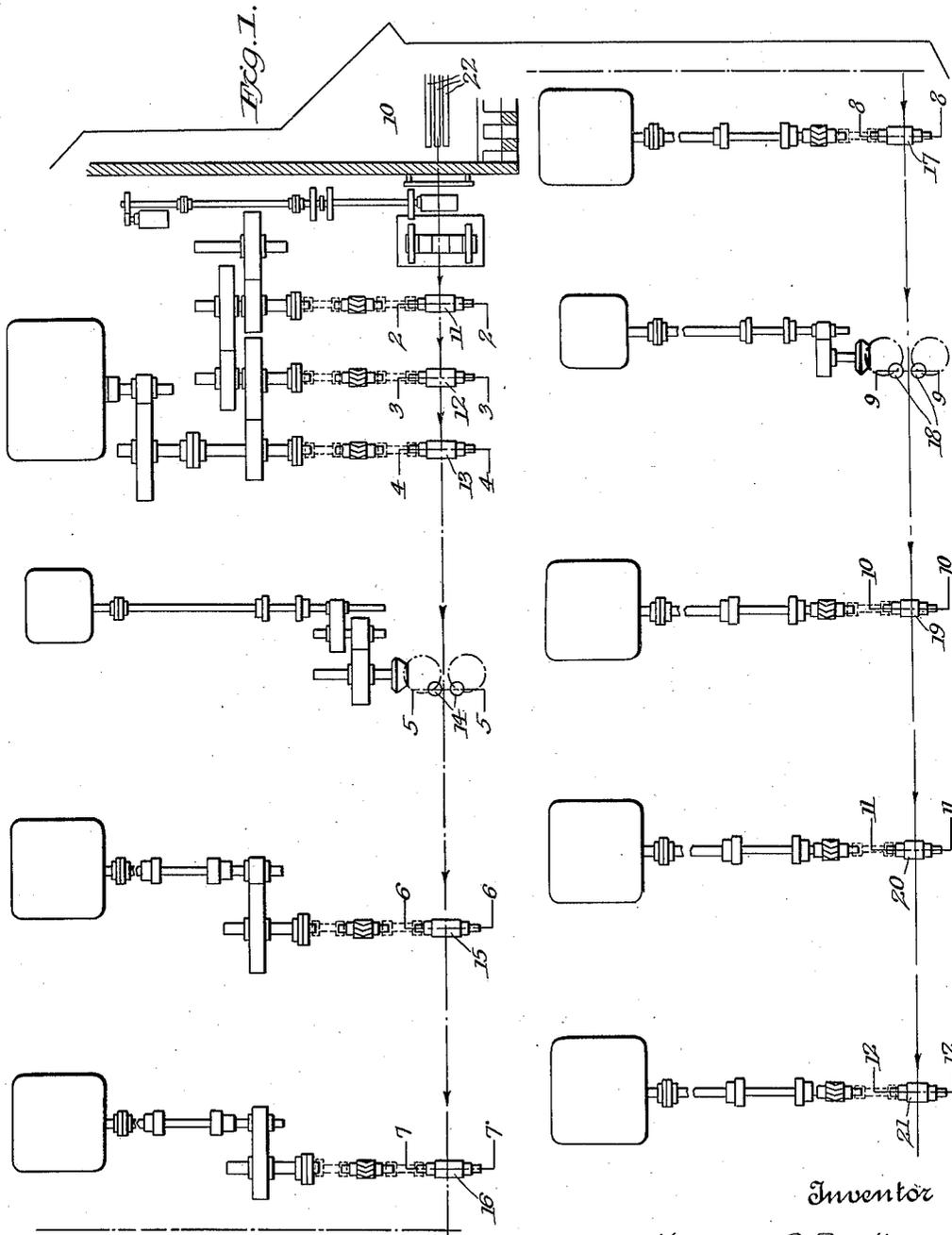
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CONTINUOUS MILL FOR ROLLING ANGLE BARS

Filed June 6, 1925

3 Sheets-Sheet 1



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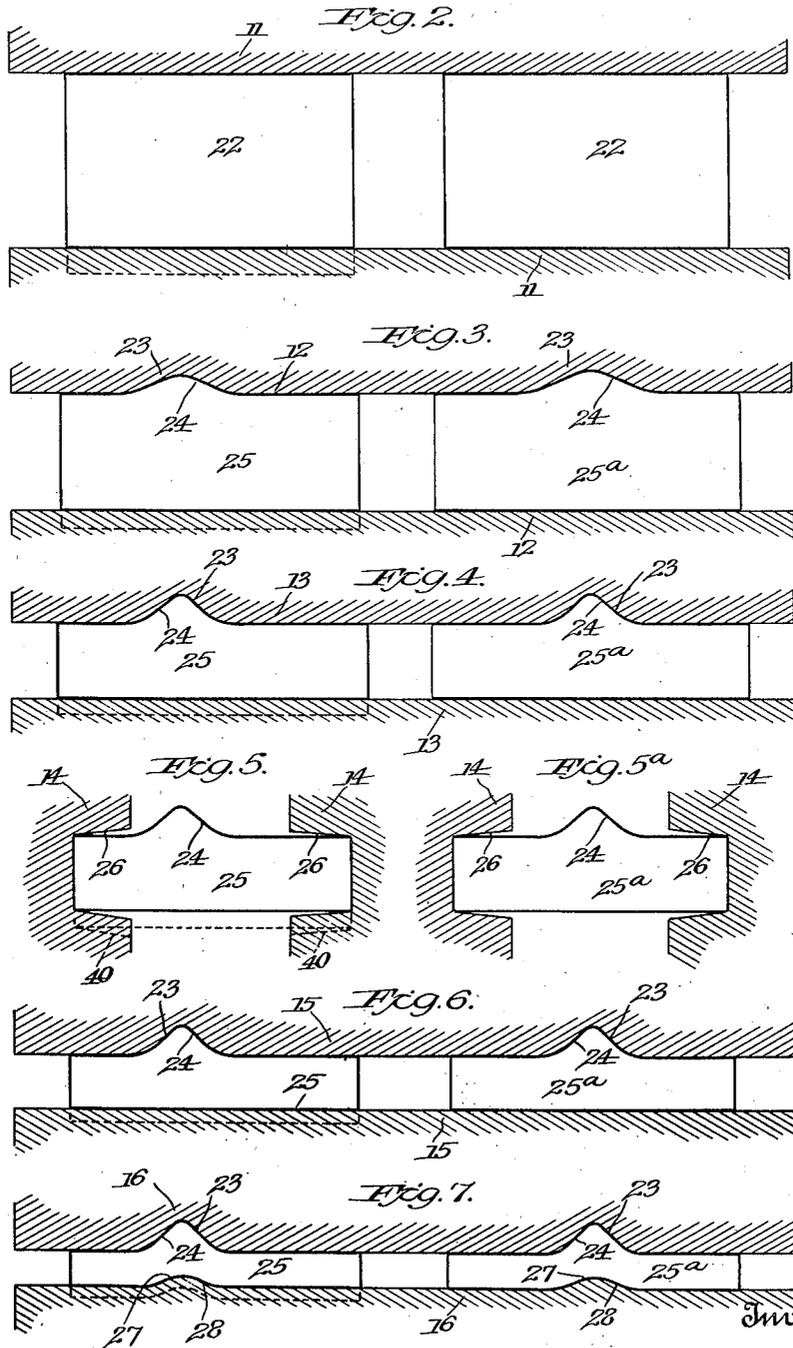
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3 Sheets-Sheet 2



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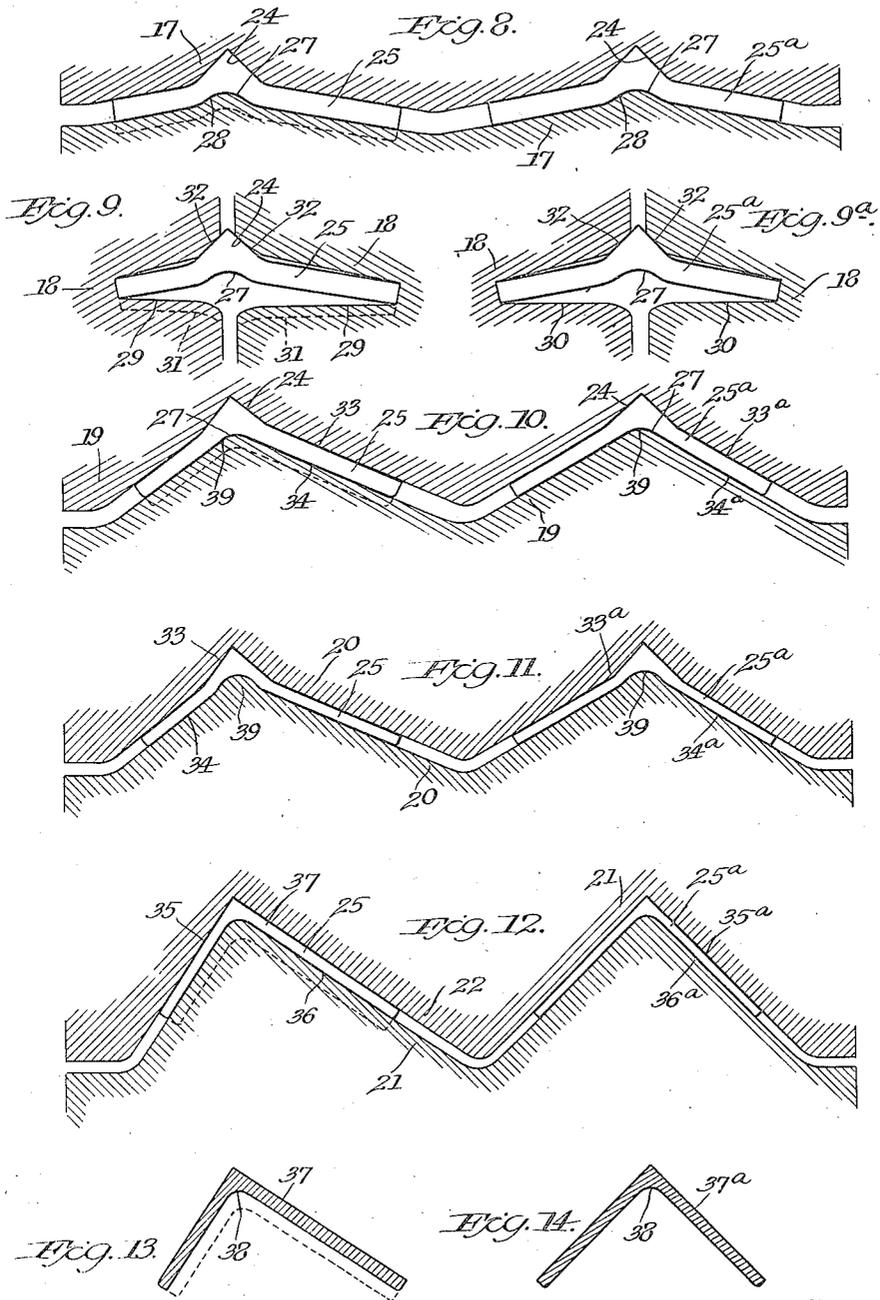
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

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CONTINUOUS MILL FOR ROLLING ANGLE BARS.

Application filed June 6, 1925. Serial No. 35,372.

My invention aims to provide improved means for rolling angle bars of all sizes and proportions from billets. Among the advantages are increased output per turn, decreased cost of manufacture, and freedom from liability of interruption on account of jams, breakdowns and changing rolls.

Further aims and advantages will be apparent from the following description of the illustrative embodiment of the invention shown in the drawings, wherein—

Fig. 1 is a plan view of a continuous rolling mill of well known type of drive adapted for producing angles of all sizes and proportions from billets of usual sizes;

Figs. 2 to 12, inclusive, are vertical cross-sections through the successive stands of rolls, on the lines 2—2, 3—3, 4—4, 5—5, 6—6, 7—7, 8—8, 9—9, 10—10, 11—11, and 12—12, respectively, in Fig. 1, showing the shapes of suitable roll passes for rolling angle bars with equal legs and angle bars with unequal legs, and showing the outline of the shape of the billet or blank with reference to the rolls in each pass, excepting that Figs. 5 and 9 show only the pass for rolling angles with unequal legs;

Figs. 5^a and 9^a are similar cross-sectional views to Figs. 5 and 9, on the lines 5—5 and 9—9 in Fig. 1, respectively, showing additional grooves on the vertical rolls for rolling angles with equal legs; and

Figs. 13 and 14 are cross-sectional views of finished shapes produced by the mill having rolls with grooves as illustrated in the drawing, the shape shown in dotted lines in Fig. 13 being produced by a different setting of the horizontal rolls and different grooves in the vertical rolls, as indicated in dotted lines in Figs. 2, 3, 4, 5, 6, 7, 8, 9, 10 and 12.

The particular embodiment of my invention selected for illustration herein and shown in the drawings comprises a furnace 10 and successive stands of rolls 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 and 21 through which billets 22 of suitable dimensions are passed in substantially a straight line, as shown by the arrows in Fig. 1 and herein-after described. A suitable billet may be about 30 feet long and of convenient cross-

sectional size to form the finished product with a minimum number of passes.

The billet 22 is heated and passed through a series of horizontal slabbing or roughing rolls 11, 12 and 13 (see Fig. 1 and Figs. 2, 3 and 4) which may be adjusted vertically in their housings to reduce the billet as much as desired in thickness and correspondingly increase its length, there being little or no spreading of the billet or blank in these rolls, notwithstanding it is not confined at the sides. One roll of each of the sets of roughing rolls 12, 13, preferably the upper roll, may advantageously be provided with a shallow groove 23 for forming a rib 24 on one side of the blank 25 as it emerges from the roughing rolls (see Fig. 4). In practice it is desirable to form the rolls 12, 13 with a series of grooves 23, any one of which may be used for forming the rib 24 on the blank.

Following the roughing rolls the blank is passed through a set of vertical edging rolls 14 (see Figs. 1 and 5) provided with slightly tapered grooves 26 preferably having flat bottoms to determine the width and true the edges of the blank. These edging rolls are adjustable toward and from each other to control the width of the blank to suit the size of angle bar which it is desired to produce.

Further reduction in thickness of the blank may be secured by additional passes through the horizontal intermediate rolls 15, 16 and 17, wherein the rib 24 is preferably given a square corner (see Figs. 6, 7 and 8); and a groove 27 may also advantageously be formed in the blank opposite the rib 24 by suitable collars 28 on the lower roll of each set of rolls 16 and 17 (see Figs. 7 and 8). The last set of intermediate rolls 17 may advantageously be provided with shallow grooved passes for bending the legs slightly from the plane of the blank toward its final angular position.

A second edging pass in vertical rolls 18 having slightly tapered grooves 29 (see Fig. 9) follows the intermediate rolling to true up the edges of the blank to their final width and shape preparatory to the finishing passes. These grooves 29 may be shaped so

as to round the edges of the blank, if desired, and each roll of the set is preferably provided with a number of cooperating grooves (see Figs. 9 and 9^a). Preferably the rolls 18 are mounted so as to be readily removable and inter-changeable with similar sets of rolls having narrower or wider or shallower or deeper grooves for rolling different flange thicknesses, thereby enabling a wide range of sizes of angles to be rolled. For example, the grooves 30, shown in Fig. 9^a, for shaping angles with equal legs, and the grooves 31, shown in dotted lines in Fig. 9 for shaping heavy sections, may be on the same set of rolls, or on different rolls, as desired. These grooves 29 and 30 of the vertical edging rolls 18 may advantageously be provided with shoulders 32 at one edge to receive and guide the square cornered rib 24 on the blank, and to cooperate respectively with the bottoms of the opposite grooves for controlling the width of each leg.

Additional sets of horizontal reducing rolls 19 and 20 (see Figs. 10 and 11) precede the set of finishing rolls 21 (see Fig. 12), all of which are adjustable vertically still further to reduce the thickness of the blank and increase its length. The reducing rolls 19 and 20 are provided with grooves 33 and collars 34 to form open bending passes wherein the blank 25 is bent lengthwise to an obtuse angle in cross-section (see Fig. 11), the rib 24 and groove 27 facilitating this operation; and in the final pass the blank is bent to a right angle in cross-section (see Fig. 12), the grooves 35 and collars 36 on the finishing rolls 21 being shaped to produce angle bars 37 with any desired style of root 38 (see Fig. 13). Preferably these grooves are so shaped and disposed as to equalize the side thrust due to rolling angles with unequal legs as illustrated in Figs. 10, 11 and 12.

The leader pass (see Fig. 11) has a bead 39 on the collar 34 of the bottom roll to reduce the amount of metal at the root of the blank for thin gauges. This pass is not necessary for rolling the heavier gauges of angle bars. For the heavier gauges of angle bars the several sets of reducing rolls may be opened up, as shown in dotted lines in Figs. 2 to 10, inclusive, as it is not necessary to reduce the blank to the same thinness, and for some sizes one or more sets of reducing rolls may be left out. Opening the reducing rolls to accommodate the thicker flanges of heavier sizes has no effect on the width of the flanges because the passes are open at the sides, but slightly increases the amount of metal in the root of the angle with reference to the increase in gauge, as is desirable. Likewise, changes in the length of the legs may be made by merely adjusting the distance apart of the vertical rolls 14, and to a lesser extent similar changes may be made in the adjust-

ment of the vertical rolls 18. Additional grooves 40 wider than the grooves 26 may be provided on the vertical rolls 14 for cooperating with the reducing rolls in rolling the heavier gauges.

In the drawings the horizontal reducing rolls are shown provided with additional series of grooves 23 and collars 28 for lengthening the serviceable life of the rolls, as all sizes of angle bars, both with equal and unequal legs, may be rolled in the same line of grooves by suitably adjusting the guides (see Figs. 4, 6, 7 and 8), as will be understood by those skilled in the art.

Likewise additional sets of grooves 33^a and 35^a and collars 34^a and 36^a may be provided on the bending rolls 20 and finishing rolls 21, respectively, for rolling angle bars 37^a having equal legs, one of the bending rolls also being provided with a bead 39^a like the bead 39. These several sets of grooves are suitable for producing all sizes of angle bars having legs proportional in width (or nearly so) to those in the specimens illustrated in Figs. 13 and 14.

One of the advantages of my invention is that all of the reduction in thickness is made in open passes, thereby enabling all sizes of angle bars to be rolled on the same rolls and in one or the other of two sets of grooves, depending on whether the legs are equal or unequal, and thus doing away with changing these rolls, for different sizes and gauges of angles, the only rolls needing to be changed being the second set of vertical edging rolls 18.

Other advantages follow from the high speed at which angles may be rolled in a continuous mill of the character described, thereby permitting the use of larger billets and more reductions at one heat, and enabling the production of a larger output of angle bars than with the types of mills heretofore in use for rolling angle bars.

My invention obviously is not restricted to the particular embodiment thereof herein illustrated and described.

Having disclosed an illustrative embodiment of my invention, without restricting my invention thereto, I claim and desire to secure by Letters Patent the following:

1. A continuous mill for rolling angle bars having power driven rolls arranged in three groups, the first group comprising a plurality of sets of horizontal reducing rolls having open passes followed by a set of grooved vertical edging rolls, the second group comprising similar horizontal rolls having shallow grooves to form the blank with a ridge and a groove oppositely disposed and followed by a second set of grooved edging rolls, and the third group comprising bending and finishing rolls having open passes.

2. A continuous mill for rolling angle bars having power driven rolls arranged

in three groups, the first group comprising a plurality of sets of horizontal reducing rolls having open passes followed by a set of grooved vertical edging rolls, the second group comprising similar horizontal rolls having shallow grooves to form the blank with a ridge and a groove oppositely disposed and followed by a set of interchangeable grooved edging rolls, and the third group comprising bending and finishing rolls having open passes.

3. A continuous mill for rolling angle bars having power driven rolls arranged in three groups, the first group comprising a plurality of sets of horizontal reducing rolls having open passes followed by a set of adjustable grooved vertical edging rolls, the second group comprising similar horizontal rolls having shallow grooves to form the blank with a ridge and a groove oppositely disposed and followed by a set of grooved edging rolls, and the third group comprising adjustable bending and finishing rolls having open passes.

4. A continuous mill for rolling angle bars having power driven rolls arranged in three groups, the first group comprising a plurality of sets of adjustable horizontal reducing rolls having open passes followed by a set of adjustable grooved vertical edging rolls, the second group comprising similar horizontal rolls having shallow grooves to form the blank with a ridge and a groove oppositely disposed and a set of adjustable grooved edging rolls, and the third group comprising adjustable bending and finishing rolls having open passes.

5. A continuous mill for rolling angle bars having power driven rolls arranged in three groups, the first group comprising a plurality of sets of adjustable horizontal reducing rolls having open passes followed by a set of adjustable grooved vertical edging rolls, the second group comprising similar horizontal rolls having shallow grooves to form the blank with a ridge and a groove oppositely disposed and a set of adjustable and interchangeable grooved edging rolls, and the third group comprising adjustable bending and finishing rolls having open passes.

6. A continuous mill for rolling angle bars having power driven rolls arranged in groups, the first group comprising a plurality of sets of horizontal reducing rolls followed by a set of edging rolls, a second group having similar horizontal and vertical rolls, and a third group comprising a plurality of sets of bending and finishing rolls having open passes, one of said sets of bending rolls having a collar with a rib at its apex for reducing the thickness of the metal in the root of the shape.

7. A continuous mill for rolling angle bars having power driven rolls arranged in

groups, the first group comprising a plurality of sets of horizontal reducing rolls followed by a set of edging rolls, and a group comprising a plurality of sets of bending and finishing rolls having open passes, one of said sets of bending rolls having a collar with a rib at its apex for reducing the thickness of the metal in the root of the shape.

8. A continuous mill for rolling angle bars having power driven reducing rolls and edging rolls, in combination with finishing rolls having open passes adjustable toward and from each other and rolls arranged in advance of said finishing rolls for reducing the thickness of the blank in the root angle to produce angles of various sizes and gauges without changing any of the horizontal rolls.

9. A continuous mill for rolling angle bars having power driven reducing rolls with open passes and adjustable toward and from each other to produce bars of various sizes and gauges, in combination with vertical edging rolls for shaping the edges of the angle bars, and a set of leader rolls having a rib for reducing the amount of metal in the root for producing light gauge angle bars of various sizes without changing any of the horizontal rolls.

10. A continuous mill for rolling angle bars having power driven reducing rolls with open passes and adjustable toward and from each other in combination with edging rolls for shaping the edges of the angle bars, and finishing rolls with open passes adjustable toward and from each other to produce angle bars of various sizes and gauges without changing any of the horizontal rolls.

11. A continuous mill for rolling angle bars having power driven reducing rolls with open passes and adjustable toward and from each other in combination with vertical edging rolls for shaping the edges of the angle bars to produce angle bars of various sizes and gauges without changing any of the horizontal rolls.

12. A continuous mill characterized by a series of sets of horizontal reducing and finishing rolls having open passes for rolling angle bars of various sizes and gauges without changing any of the horizontal rolls, substantially as described.

13. A continuous mill for rolling angle bars having power driven reducing rolls with open passes and provided with a groove to form a rib on the partly finished shape, vertical edging rolls adjustable toward and from each other and provided with grooves to receive the edges of the shape, said edging rolls having beveled shoulders adjacent said grooves adapted to engage the rib on said shape to position it in said edging grooves and cooperating to produce angle bars of various sizes and gauges to commercial require-

ments, without changing the horizontal rolls.

5 14. A continuous mill for rolling angle bars having power driven reducing rolls with open passes and provided with a groove to form a rib on the partly finished shape, vertical edging rolls adjustable toward and from each other and provided with tapering grooves to receive the edges of the shape, 10 said edging rolls having beveled shoulders adjacent said grooves adapted to engage the rib on said shape to position it in said edging grooves and cooperate therewith in fixing the width of each leg of the shape.

15 15. A continuous mill for rolling angle bars having power driven reducing rolls with open passes and provided with a groove to form a rib on the partly finished shape, vertical edging rolls adjustable toward and 20 from each other and provided with grooves to receive the edges of the shape, said edging rolls having beveled shoulders adjacent said grooves adapted to engage the rib on said shape to position it in said edging 25 groove, and the adjacent walls of said

grooves being at a small angle with the perpendicular from the axis of said rolls to engage and support the outer sides of the legs of said shape.

16. A continuous mill for rolling angle 30 bars having power driven reducing rolls with open passes and provided with a groove to form a rib on the partly finished shape, one of said passes having wide shallow grooves to give said shape a slight angular 35 form, vertical edging rolls receiving the shape from said last mentioned pass and adjustable toward and from each other and provided with grooves to receive the edges 40 of the shape, said edging rolls having beveled shoulders adjacent said grooves adapted to engage the rib on said shape to position it in said edging groove, and the adjacent walls of said grooves being at a small 45 angle with the perpendicular from the axis of said rolls to engage and support the outer sides of the legs of said shape.

In testimony whereof, I have signed my name to this specification.

NORMAN C. RENDLEMAN.