March 2, 1937. D. M. SOLENBERGER 2,072,831

ROLLING MILL

Filed Feb. 26, 1935 4 Sheets-Sheet 1

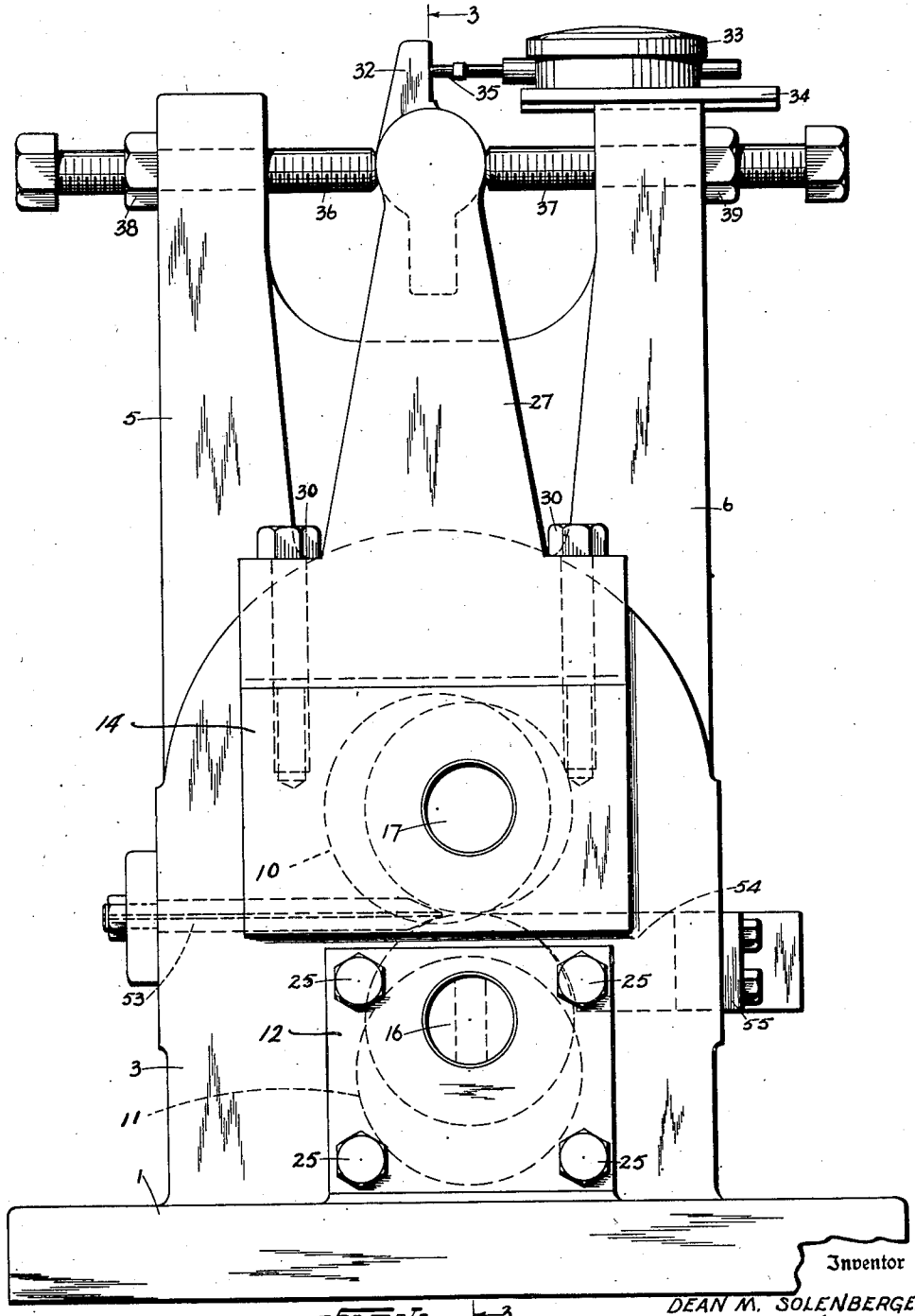

FIG. 1

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ROLLING MILL

Filed Feb. 26, 1935 4 Sheets-Sheet 2

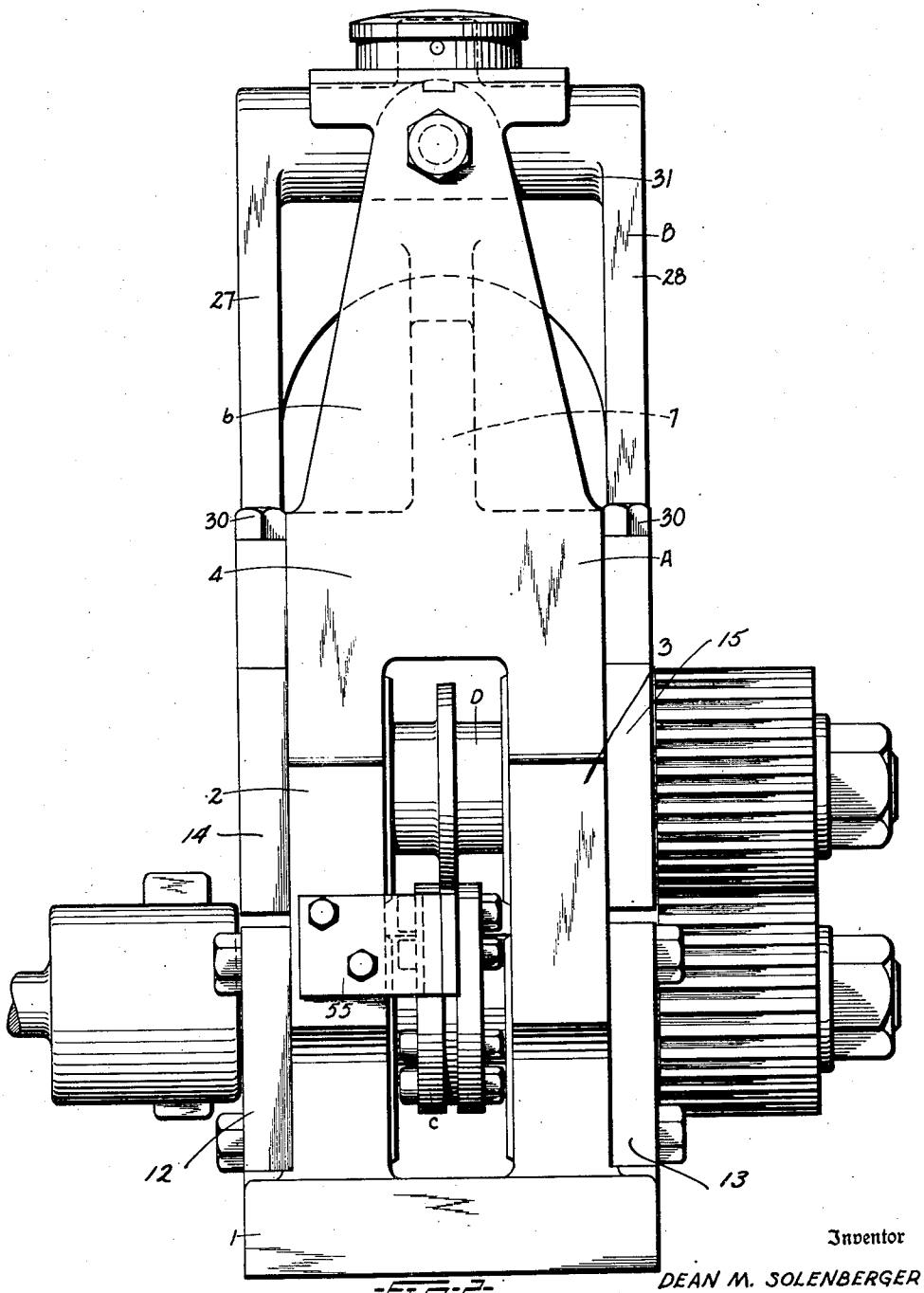

Fig-2

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March 2, 1937. D. M. SOLENBERGER 2,072,831

ROLLING MILL

Filed Feb. 26, 1935 4 Sheets-Sheet 3

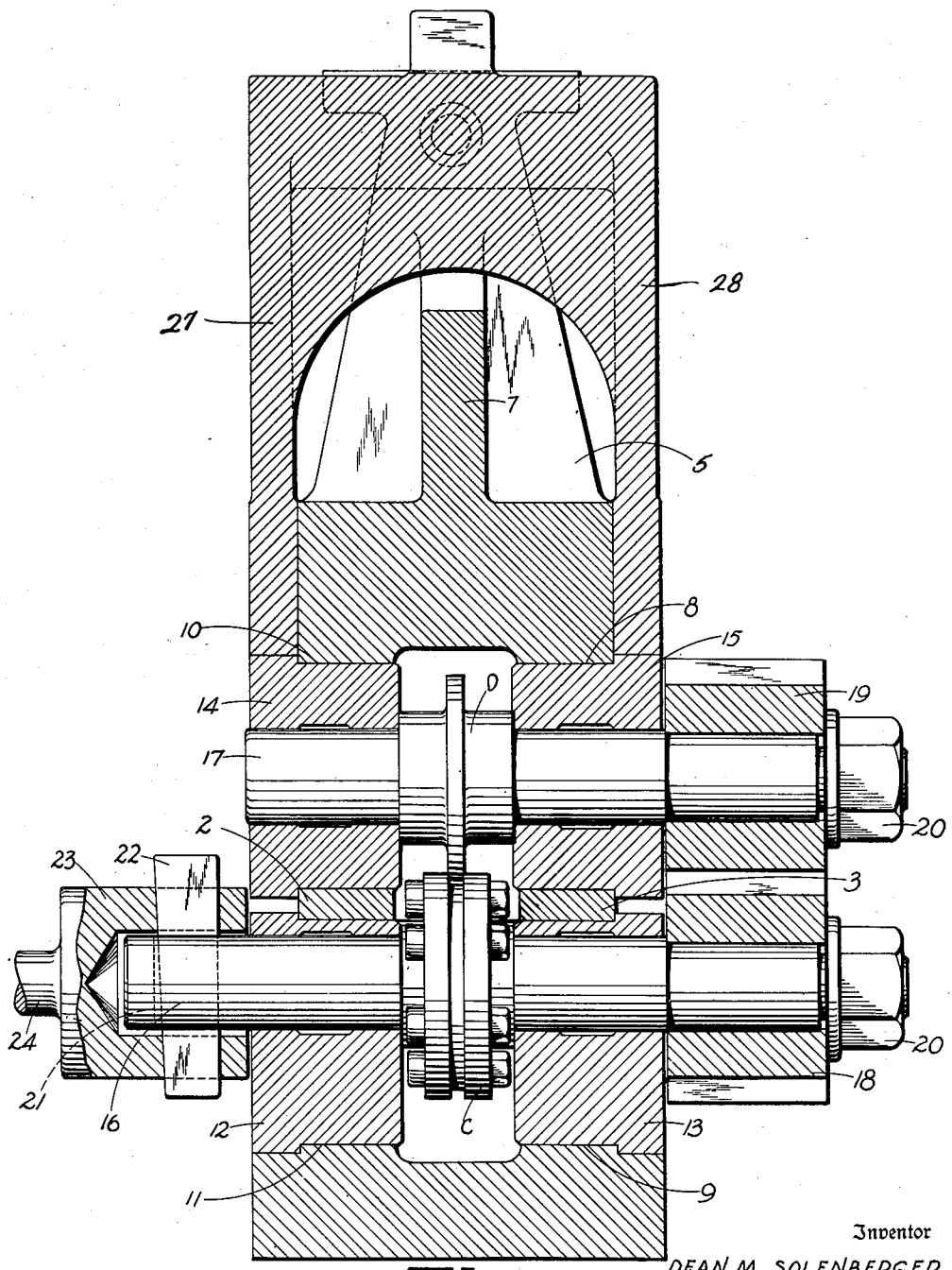

FIG 3

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March 2, 1937. D. M. SOLENBERGER 2,072,831

ROLLING MILL

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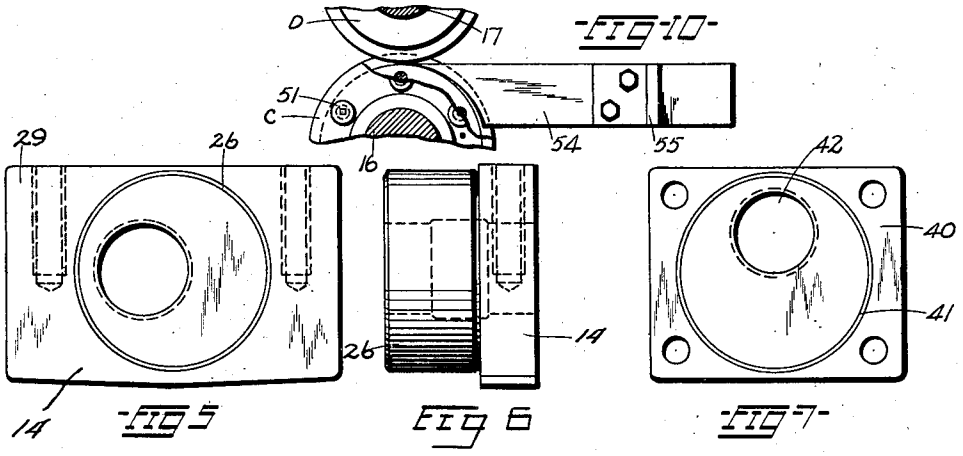

FIG 10 FIG 5 FIG 6 FIG 7

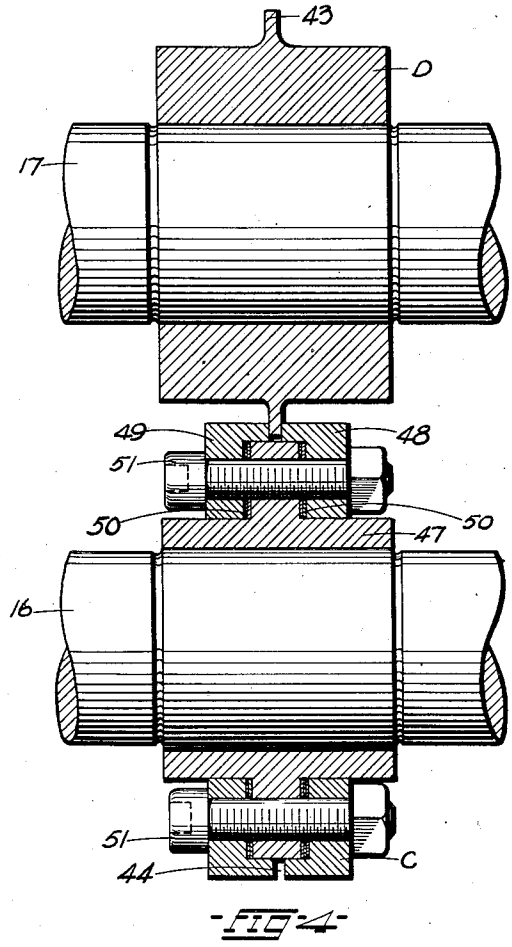

FIG 4

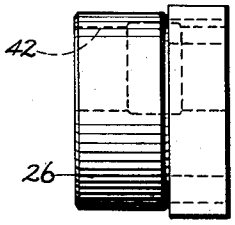

FIG 8

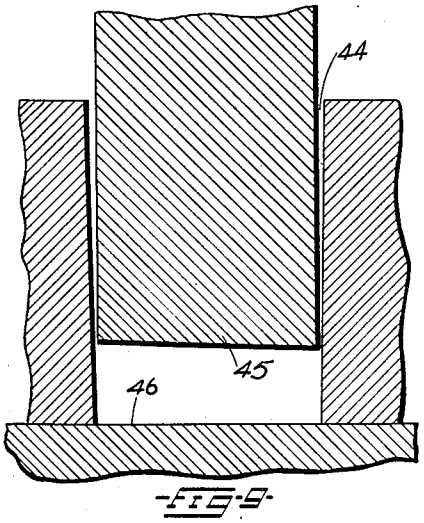

FIG 9

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Patented Mar. 2, 1937 2,072,831

UNITED STATES PATENT OFFICE

2,072,831

ROLLING MILL

Dean M. Solenberger, Cleveland, Ohio, assignor to Simplex Products Corporation, a corporation of Ohio

Application February 26, 1935, Serial No. 8,322

13 Claims. (Cl. 80—31.1)

This invention relates to rolling mills and more particularly to an improved type of rolling mill which is adapted to roll metal strips or ribbons to extremely close width and thickness tolerances.

In the manufacture of laminated piston rings of the type described in my co-pending United States patent application, Serial No. 56,570 filed December 28, 1935, it is advisable to first form a metallic ribbon of the proper cross sectional width and thickness. I have found that this type of ribbon may be advantageously made by rolling a round wire between two rolls whereby the wire is flattened into ribbon form. It is absolutely essential, in the manufacture of laminated piston rings, to maintain the thickness of the ribbon within plus or minus .0001" of the desired dimension. Likewise, the width of the ribbon must be maintained within plus or minus .0002". None of the usual types of rolling mills, with which I am familiar, can be properly adjusted to maintain these tolerances and it is among the objects of my invention to provide a rolling mill having simple but extremely accurate means for adjusting the thickness of the material rolled.

Other objects of my invention are the provision of a rolling mill in which the rolls are supported in an integral one-piece frame or housing which will not give or spring appreciably during the rolling operation and which is not subject to objectionable expansion and contraction due to temperature changes; the provision of a rolling mill in which the distance between rolls can be readily and accurately adjusted and in which means are provided for indicating the degree of adjustment of the rolls toward or away from each other; the provision of a ribbon rolling mill in which effective means are provided for preventing the ribbon from sticking in a roll groove; and the provision of a simple, rugged and inexpensive rolling mill which is particularly adapted for rolling metallic ribbon within very close width and thickness tolerances.

The above and other objects of my invention will appear from the following description of one embodiment thereof, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of my improved rolling mill.

Figure 2 is an end elevation looking at the take-off side of the rolls.

Figure 3 is a vertical cross section taken on line 3—3 of Figure 1.

Figure 4 is a fragmentary detached cross section illustrating the ribbon forming rolls.

Figure 5 is a detached elevation of the adjustable top roll bearing block.

Figure 6 is an end view of the bearing block of Figure 5.

Figure 7 is a detached elevation of the stationary bottom roll bearing block.

Figure 8 is an end view of the bearing block of Figure 7.

Figure 9 is an fragmentary enlarged sectional view of the roll pass illustrating the top roll shaped to roll a taper on the ribbon.

Figure 10 is a detached view of my improved stripper device.

Referring now particularly to Figures 1, 2, and 3, my improved rolling mill consists of a main roll supporting frame or housing generally indicated at A and a roll adjusting yoke generally indicated at B. These parts can be conveniently made by casting steel or iron in the illustrated forms. The frame A includes a base portion 1 from which spaced leg portions 2 and 3 extend upwardly defining a vertically extending space in which the forming rolls C and D are disposed. These leg portions 2 and 3 are connected across their top ends, as indicated at 4, and adjusting screw supporting arms 5 and 6 extend upwardly from the connecting portion 4. A web 7 extends between and braces the arms 5 and 6.

Circular holes 8 and 9 are located one above the other in the leg 3 of the housing A and corresponding circular holes 10 and 11 are formed in the leg 2. The bearing blocks 12 and 13 for the bottom roll shaft fit into the holes 9 and 11 and the bearing blocks 14 and 15 for the top roll shaft fit into the holes 8 and 10. The bottom roll C is mounted on a shaft 16 and the top roll D is mounted on the shaft 17. Gears 18 and 19 may be keyed to and are held on the shafts 16 and 17 respectively by the nuts 20. The gears 18 and 19 are preferably of the long tooth type and mesh, as is clearly seen in Figure 3, so that the rolls C and D will rotate together. The left hand end of the shaft 16 (Figures 2 and 3) extends out from the bearing block 12 and is slotted at 21 to accommodate the wedge key 22. This wedge key 22 forms a driving connection between the end 23 of the drive shaft 24 and shaft 16. It will be understood that the drive shaft 24 can be connected to any suitable source of power (not shown).

The bottom roll bearing blocks 12 and 13 are rigidly secured to the legs 2 and 3 of the frame A by means of suitable screws 25. The upper bearing blocks 14 and 15, however, are not secured to the frame A but rather the cylindrical bushing portions 26 thereof (see Figures 5 and 6) have a

close sliding fit in the holes 8 and 10 of the legs 2 and 3 of the frame A. The yoke shaped adjusting member B includes a pair of downwardly extending arms 27 and 28, the bottom ends of which are secured to the flanges 29 of the top roll bearing blocks 14 and 15 by screws 30 (see Figures 1 and 2). The upper ends of the yoke arms 27 and 28 are connected by a transverse member 31 on which is formed an upwardly projecting lug 32. A sensitive gauge or indicator 33 is mounted on an adjustable slide 34 on the top of the arm 6 of frame A. The spring pushed finger 35, which actuated the gauge 33, is adapted to contact with the side of the upwardly extending lug 32.

Adjusting screws 36 and 37 are threaded through the upper ends of the arms 5 and 6 and lock nuts 38 and 39 are preferably provided to maintain the adjusting screws 36 and 37 in position.

It will be seen that if the screws 36 and 37 are backed away from the transverse portion 31 of the yoke member B, this yoke member may be swung about the centers of the bearing bushings 26 which are rotatable in holes 8 and 10 of the main frame A. As the bearings in which the top roll shaft 17 is supported are eccentrically disposed in relation to the centers of the bushings 26 of the bearing blocks 14 and 15, as is clearly seen in Figures 1 and 5, such swinging movement of the yoke B will cause the shaft 17 to move up or down. The linear movement of the longitudinal axis of the shaft 17 will, of course, be very small compared to the movement of the upper end of the yoke B and a considerable movement of the upper end of the yoke B will result only in a very small vertical movement of the roll shaft 17. By means of the adjusting screws 36 and 37 the yoke B can be moved to give extremely small variations in the vertical position of the shaft 17 and the top roll D, and when the screws are locked in position against the sides of portion 31 of the yoke, the top roll D will be securely held in the desired position relative to the bottom roll C.

The movement of the upper end of the yoke B is indicated by the gauge 33 and, knowing the distance from the center of the cylindrical bushings 26 to the point of contact of the gauge operating finger 35 and the distance from the center of the bushings 26 to the center of the shaft 17, the vertical movement of the shaft 17 for any given lateral movement of the yoke B can be readily calculated and the gauge 33 calibrated accordingly.

The bottom roll bearing blocks 12 and 13 include flange portions 40 and bearing bushing portions 41. As is seen in Figures 7 and 8 the bearing surfaces 42 are eccentrically located in the bushings 41. The object of this eccentric location of the bearing surfaces of the bottom roll shaft bearing blocks 12 and 13 is to make it possible to install the rolls C and D in proper operating position in the housing A while maintaining the size of the holes 9 and 11 at a minimum value in order to maintain the greatest strength and rigidity in the frame A. In my preferred construction the holes 9 and 11 are made just large enough so that the roll C can be slipped therethrough into the space between the vertical legs 2 and 3. Now, in order to cause the rolls C and D to have the proper engagement it is necessary to lift the roll C so that the longitudinal axis of its shaft 16 will lie above the center of the holes 9 and 11. This is accomplished by slipping the bearing blocks 12 and 13 into position over the ends of the shaft 16 and causing the cylindrical bushing portions 41 thereof to fit part way into the holes 9 and 11. These bushings 12 and 13 are then rotated into the positions seen in Figures 1, 2, and 3 and are held in place by the screws 25. The grooved bottom roll C is preferably installed after the flanged top roll D has been mounted in the bearing blocks 14 and 15 as in this way the grooved roll C may be moved upwardly by rotation of the bushing portions 41 until the flange 43 of the top roll D fits into the groove 44 of the bottom roll C approximately the desired distance. Fine adjustment of the distance between the surface 45 of the top roll and the surface 46 of the bottom roll (see Figure 9) is provided by the yoke B and the adjusting screws 36 and 37. As is seen in Figure 4 my upper roll may conveniently be made in one piece and shrunk on or otherwise secured to the shaft 17. The bottom roll C is made up of a central flanged member 47, shrunk on or otherwise secured to the shaft 16, and two side members 48 and 49 (see Figure 4). Shims 50 may be utilized to adjust the side members 48 and 49 and give the desired width to the groove 44. Bolts 51 extend through the flange member 47 and the side pieces 48 and 49 and hold the roll assembly together.

As is best seen in Figure 9 the sides of the groove 44 are preferably slightly relieved to avoid wear and friction due to contact with the sides of the flange 43. The surface 45 of the flange 43 of the top roll is slightly tapered as is seen in Figure 9 and thus the ribbon which is rolled will be slightly thicker at one edge than at the other. This is important in forming ribbon which is to be later bent in an edgewise direction into rings for laminated piston ring purposes as it is desirable to provide a tapered ribbon so that the thickening of the inside edge of the ring due to the compression thereof during the ring forming operation will result in a ring of uniform thickness.

I prefer to make the diameters of the rolls C and D slightly different so that when these rolls are rotated together, due to their geared connection, there will be a slight slipping of the rolls on the surface of the stock which will result in an ironing or burnishing and will give the desired surface finish to the rolled ribbon. I have found that a difference in diameter of 2% to 3% gives a satisfactory finish.

As is best seen in Figure 1 I have provided a slotted guide member 53 which extends in between the rolls C and D and serves to guide the entering stock up to a point closely adjacent to the roll pass. On the take-off side of the rolls (as is seen in Figure 1) I have provided a stripping device 54 which is supported on the leg 2 of the frame A by the bracket 55 (see Figures 1 and 2). This stripper member 54 consists of a thin pointed blade which extends into a groove 44 in the bottom roll C (see Figure 10). The inner end of the stripper 54 is tapered to a point and rests upon the bottom of the groove 44. As the ribbon leaves the roll pass it will be prevented from sticking in the groove 44 and winding about the bottom roll C by the stripper 54. By resting the inner end of the stripper 54 on the bottom surface 46 of the groove 44 the inner end of the stripper 54 can be tapered to a knife edge without danger of breakage and the ribbon will be freed from the groove 44 almost immediately after it leaves the roll pass.

Although I have illustrated and described my improved rolling mill particularly as adapted to roll a ribbon for use in the manufacture of laminated piston rings, it will be understood that my

improved rolling mill construction and means for adjusting the position of the rolls can be readily adapted to any use where it is desired to roll metal within extremely accurate tolerances.

Although I have described in considerable detail the illustrated embodiments of my invention it will be understood by those skilled in the art that modifications and variations in the specific arrangement of parts and details of the apparatus may be made without departing from the spirit of my invention. I do not, therefore, wish to be limited to the specific form herein described and illustrated but claim as my invention all embodiments thereof coming within the scope of the appended claims.

I claim:

1. In a rolling mill, a one-piece frame including a base and spaced leg portions extending upwardly from said base, each of said leg portions having spaced holes formed therein to accommodate roll shaft bearing blocks, roll shaft bearing blocks having cylindrical bushing portions and bearing surfaces eccentrically disposed in said bushing portions, rolls disposed between said spaced leg portions of the base and carried by shafts mounted in said eccentrically disposed bearings in said bearing block bushings, said bushings being supported in said holes in said leg portions, the bearing blocks for one roll being fixed to said frame and the bearing blocks for the other roll being rotatable in said holes in said legs whereby said last mentioned roll may be moved toward and away from the other roll.

2. In a rolling mill, a one-piece frame including a base and spaced leg portions extending upwardly from said base, each of said leg portions having spaced holes formed therein to accommodate roll shaft bearing blocks, roll shaft bearing blocks having cylindrical bushing portions and bearing surfaces eccentrically disposed in said bushing portions, rolls disposed between said spaced leg portions of the base and carried by shafts mounted in said eccentrically disposed bearings in said bearing block bushings, said bushings being supported in said holes in said leg portions, the bearing blocks for one roll being fixed to said frame and the bearing blocks for the other roll being rotatable in said holes in said legs whereby said last mentioned roll may be moved toward and away from the other roll, and means for accurately adjusting the angular positions of said rotatable bearing blocks.

3. In a rolling mill, a one-piece frame having a base and spaced leg portions extending upwardly from said base, each of said leg portions having spaced holes formed therein to accommodate roll shaft bearing blocks, roll shaft bearing blocks having cylindrical bushing portions and bearing surfaces eccentrically disposed in said bushing portions, rolls disposed between said spaced leg portions of the base and carried by shafts supported in said bearings in said bearing block bushings, said bushings being supported in said holes in said leg portions, the bearing blocks for one roll being fixed to said frame and the bearing blocks for the other roll being rotatable in the holes in said legs whereby said last mentioned roll may be moved toward and away from the other roll, means for accurately adjusting the angular positions of said rotatable bearing blocks, and means for indicating the position of said adjustable roll.

4. In a rolling mill, a one-piece frame having a base and leg portions extending upwardly from said base, each of said leg portions having similarly arranged spaced holes formed therein to accommodate roll shaft bearing blocks, roll shaft bearing blocks having bushing portions adapted to fit in said holes and bearing surfaces eccentrically disposed in said bushing portions, rolls rotatably supported between said spaced leg portions of the frame on shafts having bearings in said bearing blocks, said bearing blocks for one roll being fixed to said frame legs so that the center to center distance between the roll shafts will be less than the center to center spacing of the holes in each leg.

5. In a rolling mill, a one-piece frame having a base and leg portions extending upwardly from said base, each of said leg portions having similarly arranged spaced holes formed therein to accommodate roll shaft bearing blocks, roll shaft bearing blocks having bushing portions adapted to fit in said holes and bearing surfaces eccentrically disposed in said bushing portions, rolls rotatably supported between said spaced leg portions of the frame on shafts having bearings in said bearing blocks, said bearing blocks for one roll being fixed to said frame legs so that the center to center distance between the roll shafts will be less than the center to center spacing of the holes in each leg, the bearing blocks for the other roll being rotatable in the holes in said legs whereby the distance between rollshafts may be varied.

6. In a rolling mill of the type described, a one-piece integral main frame having a base portion and spaced leg portions extending upwardly therefrom, said spaced leg portions being joined at their upper ends and having adjusting screw supporting arms extending upwardly from the ends of said leg portions, said leg portions each being formed with a pair of similarly disposed vertically spaced holes, a bottom roll mounted between said legs on a shaft having bearings in bushings supported in the bottom holes in said legs and a co-acting roll mounted on a shaft having bearings eccentrically located in bushings rotatably supported in the upper holes of said legs a yoke member secured to said upper roll shaft bushing and extending upwardly between said main frame adjusting arms, and means for moving said yoke toward and away from one of said main frame arms whereby the top roll shaft bushings will be rotated in said upper holes in the main frame legs and the eccentrically disposed top roll shaft will be moved in a substantially vertical direction toward or away from said bottom roll.

7. In a rolling mill of the type described, a one-piece integral main frame having a base portion, spaced leg portions extending upwardly therefrom, said spaced leg portions being joined at their upper ends and having adjusting screw supporting arms extending upwardly from the ends of said leg portions, said leg portions each being formed with a pair of similarly disposed vertically spaced holes, a bottom roll mounted between said legs on a shaft having bearings in bushings supported in the bottom holes of said legs and a co-acting roll mounted on a shaft having bearings eccentrically located in bushings rotatably supported in the upper holes of said legs, a yoke member secured to said upper roll shaft bushings and extending upwardly between said main frame adjusting screw supporting arms, adjusting screws extending through said arms of said main frame and adapted to clamp the upper ends of said yoke member between their ends whereby the position of said upper end of said

yoke member may be adjusted, and means for locking said adjusting screws in position.

8. In a rolling mill of the type described, a one-piece integral main frame having a base portion, spaced leg portions extending upwardly therefrom, said spaced leg portions being joined at their upper end and having adjusting screw supporting arms extending upwardly from the ends of said leg portions, said leg portions each being formed with a pair of similarly disposed vertically spaced holes, a bottom roll mounted between said legs on a shaft having bearings in bushings supported in the bottom holes of said legs and a co-acting roll mounted on a shaft having bearings eccentrically located in bushings rotatably supported in the upper holes of said legs, a yoke member secured to said upper roll shaft bushing and extending upwardly between said main frame adjusting screw supporting arms, adjusting screws extending through said arms of said main frame and adapted to clamp the upper end of said yoke member between their ends whereby the position of said upper end of said yoke member may be adjusted, means for locking said adjusting screws in position and gauge means for accurately indicating the position and movement of the upper end of said yoke.

9. In a rolling mill, a frame having a base and leg portions extending upwardly from said base, each of said leg portions having similarly arranged spaced holes formed therein to accommodate roll shaft bearing blocks, roll shaft bearing blocks having bushing portions adapted to fit in said holes, rolls rotatably supported between said spaced leg portions of the frame on shafts having bearings in said bearing blocks, said bearing blocks and one roll being fixed to said frame legs for said bearing blocks for the other roll having bearing portions eccentrically disposed in the bushing portions thereof, and means for rotating said last named bearing blocks whereby the roll shaft supported therein may be adjusted toward and away from the other roll.

10. In a rolling mill, a one-piece frame having a base and leg portions extending upwardly from said base, each of said leg portions having similarly arranged spaced holes fomed therein to accommodate roll shaft bearing blocks, roll shaft bearing blocks having bushing portions adapted to fit in said holes, rolls rotatably supported between said spaced leg portions of the frame on shafts having bearings in said bearing blocks, said bearing blocks for one roll being fixed to said frame legs and said bearing blocks for the other roll having bearing portions eccentrically disposed in the bushing portions thereof, and means for rotating said last named bearing blocks whereby the roll shaft supported therein may be adjusted toward and away from the other roll, said rotating means including a yoke member secured to said last named bearing blocks and pair of screws adapted to engage opposite sides of said yoke member and locking means for said screws.

11. In a rolling mill, a frame having upwardly extending leg portions, each of said leg portions having spaced holes formed therein to accommodate roll shaft bearing blacks, roll shaft bearing blocks having cylindrical bushing portions and bearing surfaces disposed in said bushing portions, rolls disposed between said spaced leg portions and carried by shafts mounted in said bearings in said bearing blocks, said bearings for one of said roll shafts being eccentrically disposed in their bearing blocks relative to the bushing portions of the bearing blocks, said last named bearing blocks being rotatable in their holes in said legs, and the bearing blocks for the other roll shaft being fixed to said legs.

12. In a rolling mill of the type described, a main frame having a base portion and spaced leg portions extending upwardly therefrom, said spaced leg portions being joined at their upper ends and having adjusting screw supporting arms extending upwardly from the ends of said leg portions, said leg portions each being formed with a pair of similarly disposed vertically spaced holes, a bottom roll mounted between said legs on a shaft having bearings in bushings supported in the bottom holes in said legs and a co-acting roll mounted on a shaft having bearings eccentrically located in bushings rotatably supported in the upper holes of said legs, a yoke member secured to said upper roll shaft bushings and extending upwardly between said main frame adjusting arms, and means for moving said yoke toward and away from one of said main frame arms whereby the top roll shaft bushings will be rotated in said upper holes in the main frame legs and the eccentrically disposed top roll shaft will be moved in a substantially vertical direction toward or away from said bottom roll.

13. In a rolling mill, a frame having a base and leg portions extending upwardly from said base, each of said leg portions having similarly arranged spaced holes formed therein to accommodate roll shaft bearing blocks, roll shaft bearing blocks having bushing portions adapted to fit in said holes, rolls rotatably supported between said spaced leg portions of the frame on shafts having bearings in said bearing blocks, said bearing blocks for one roll being fixed relative to said frame legs and said bearing blocks for the other roll having bearing portions eccentrically disposed in the bushing portions thereof, and means for rotating said last named bearing blocks whereby the roll shaft supported therein may be adjusted toward and away from the other roll, said rotating means including a yoke member secured to said last named bearing blocks and a pair of screws adapted to engage opposite sides of said yoke member and locking means for said screws.

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