Sept. 16, 1952 M. R. HEPPENSTALL 2,610,532

RING ROLLING MILL

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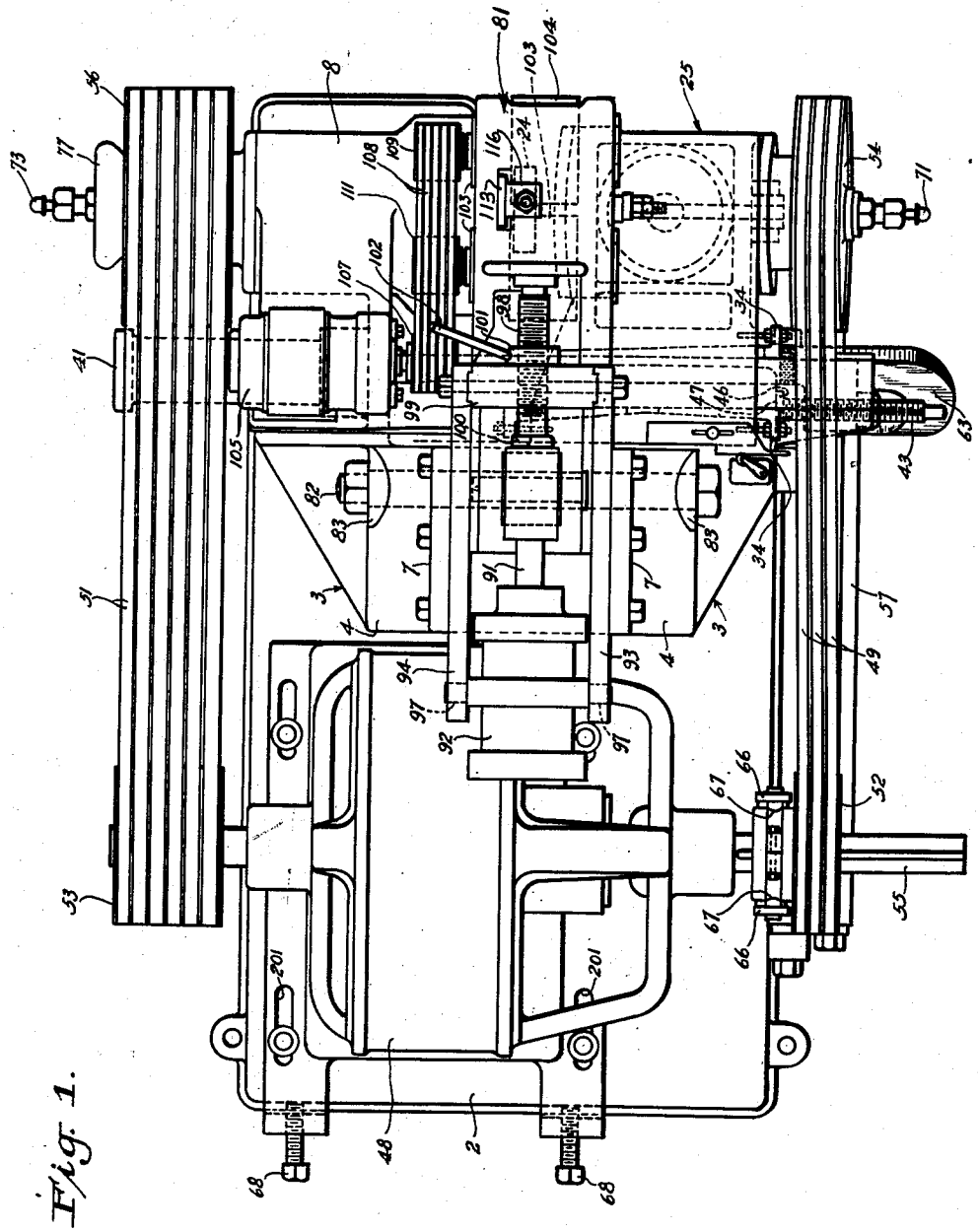


Fig. 1.

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RING ROLLING MILL

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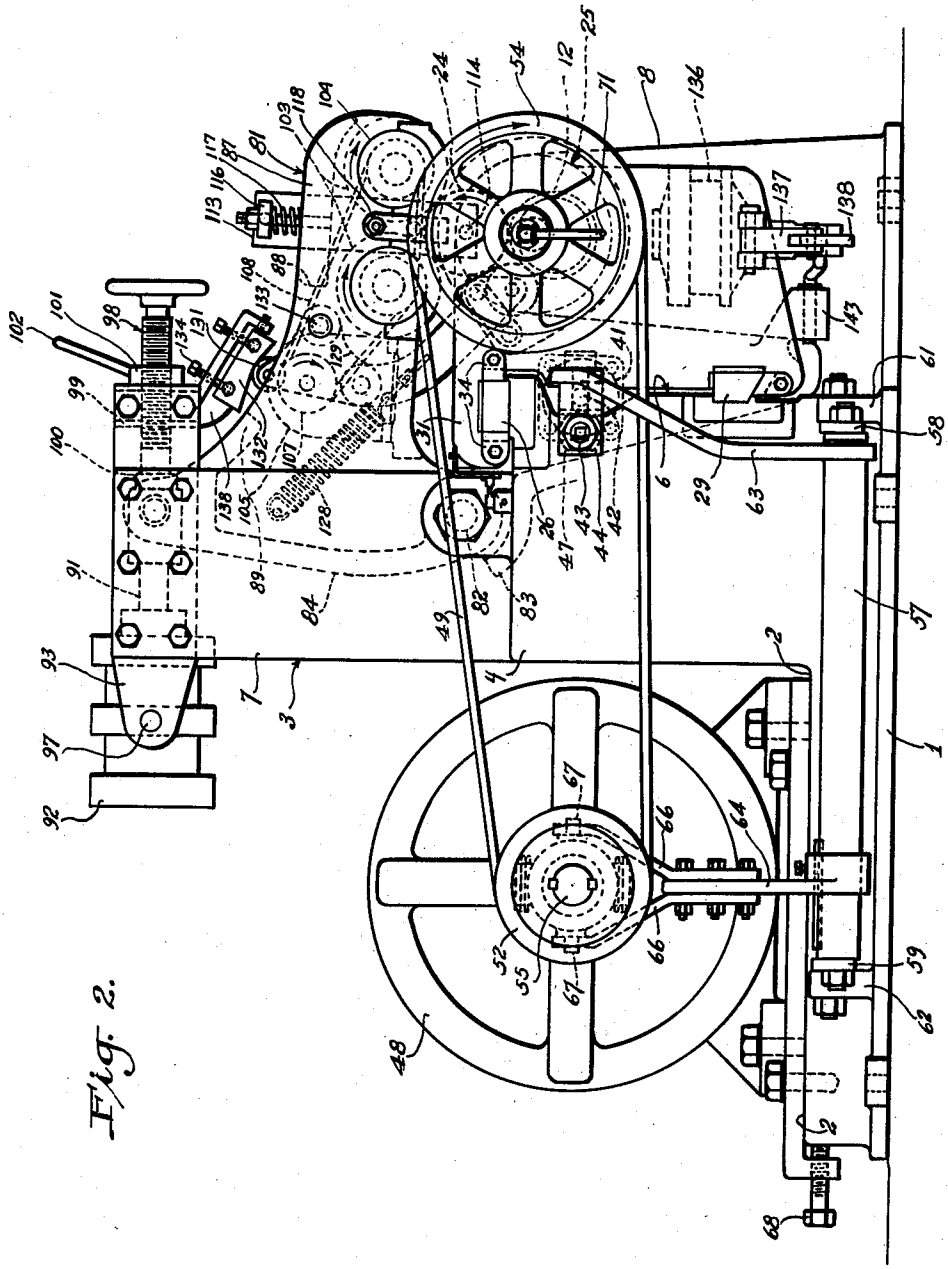


Fig. 2.

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RING ROLLING MILL

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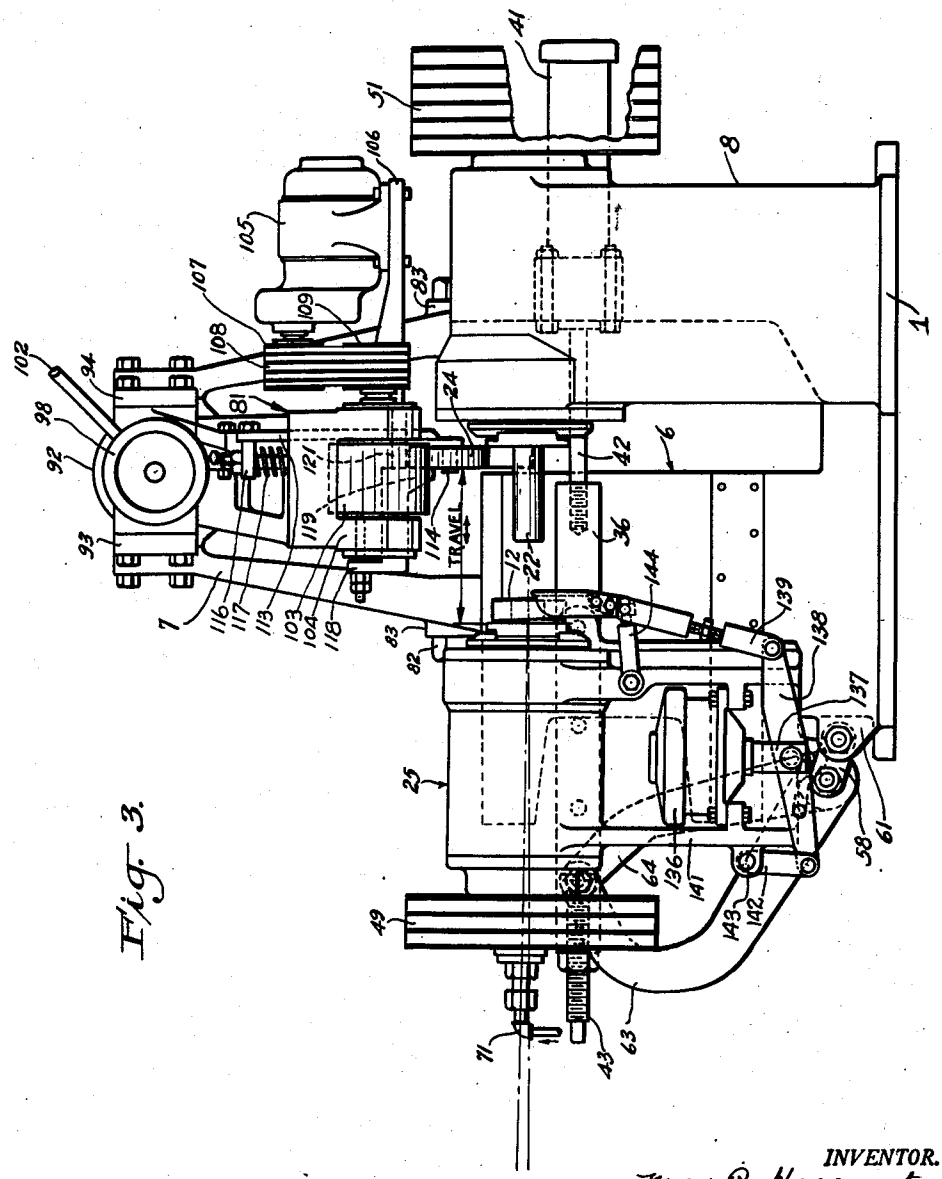


Fig. 3.

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RING ROLLING MILL

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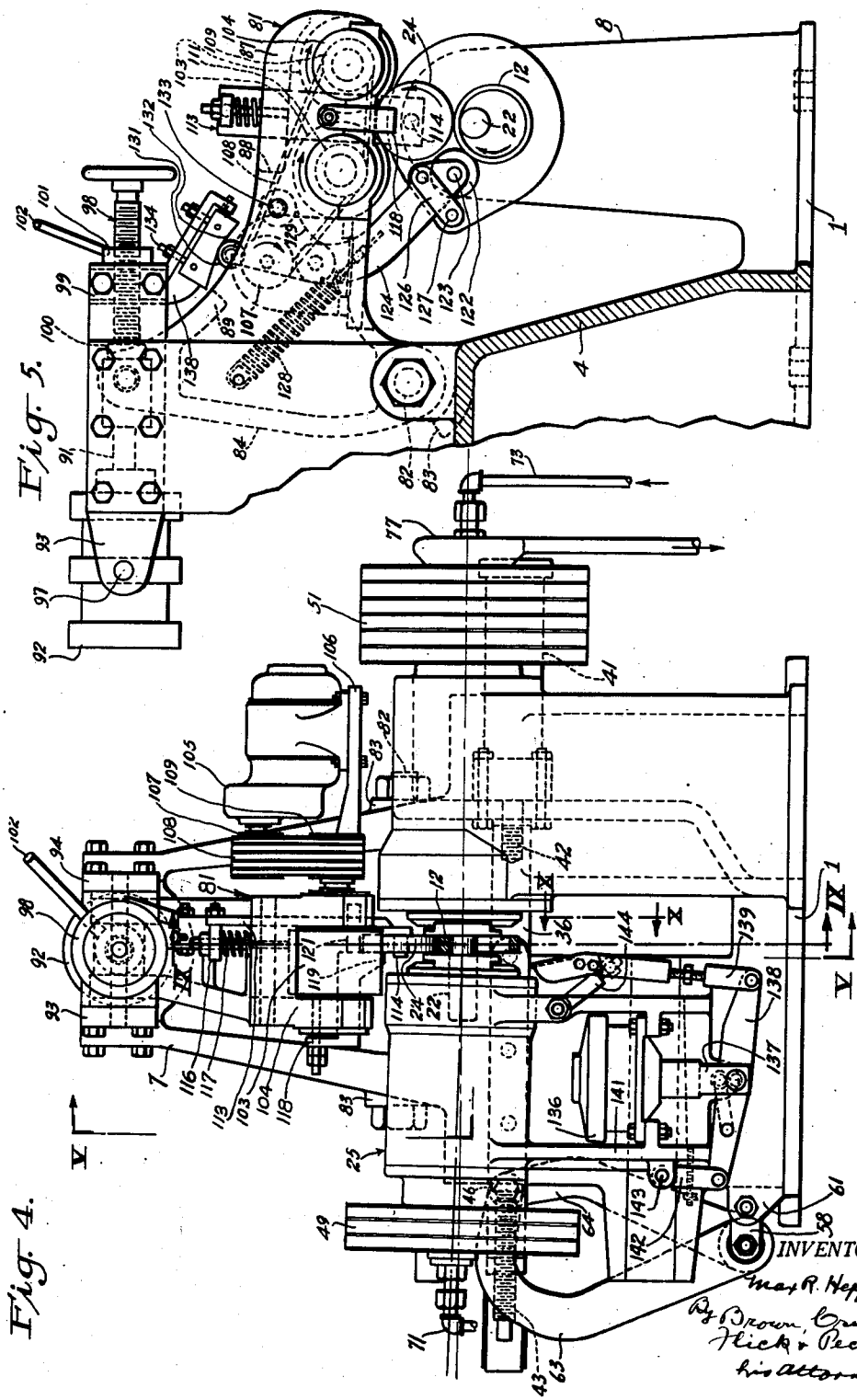


Fig. 5.

Fig. 4.

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RING ROLLING MILL

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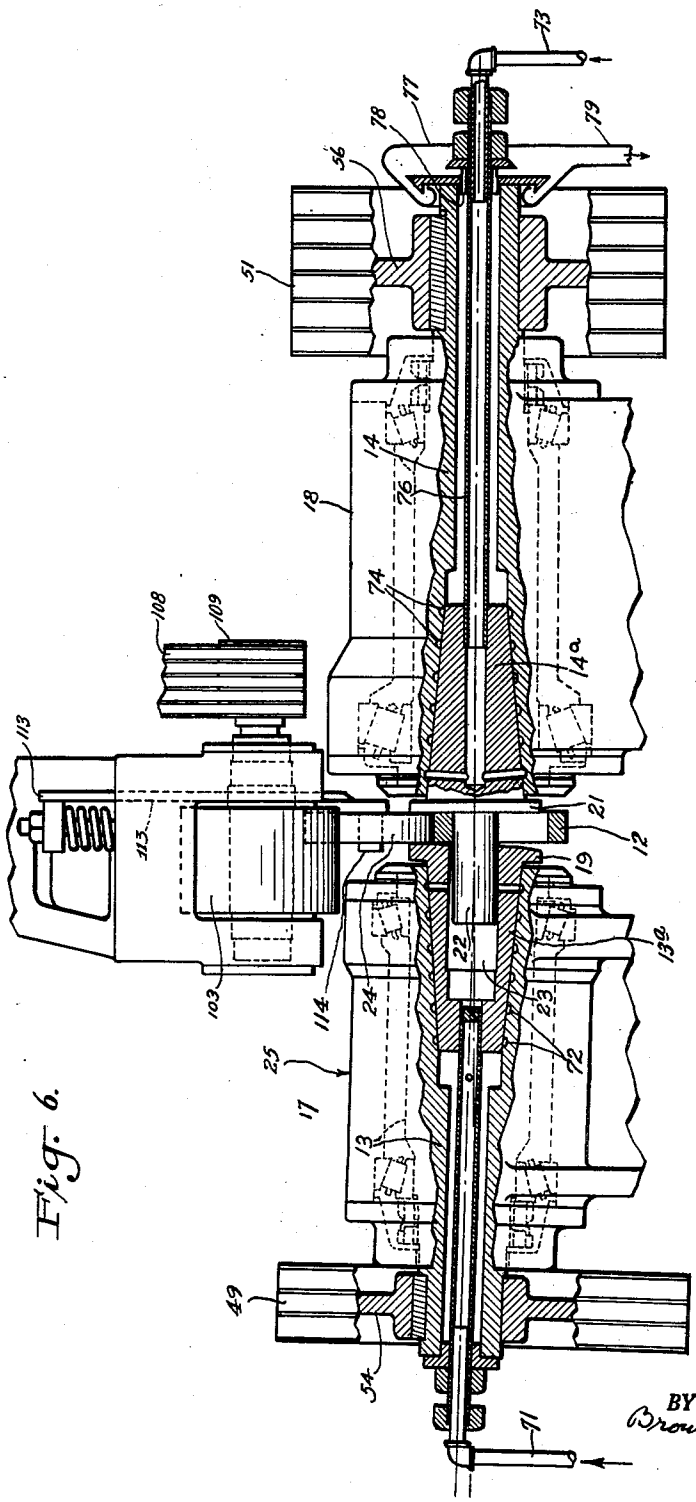


Fig. 6.

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RING ROLLING MILL

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Fig. 7.

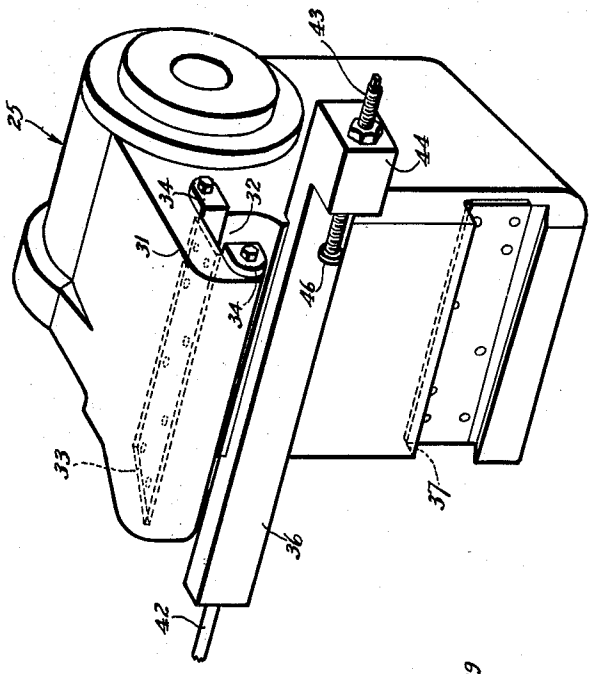
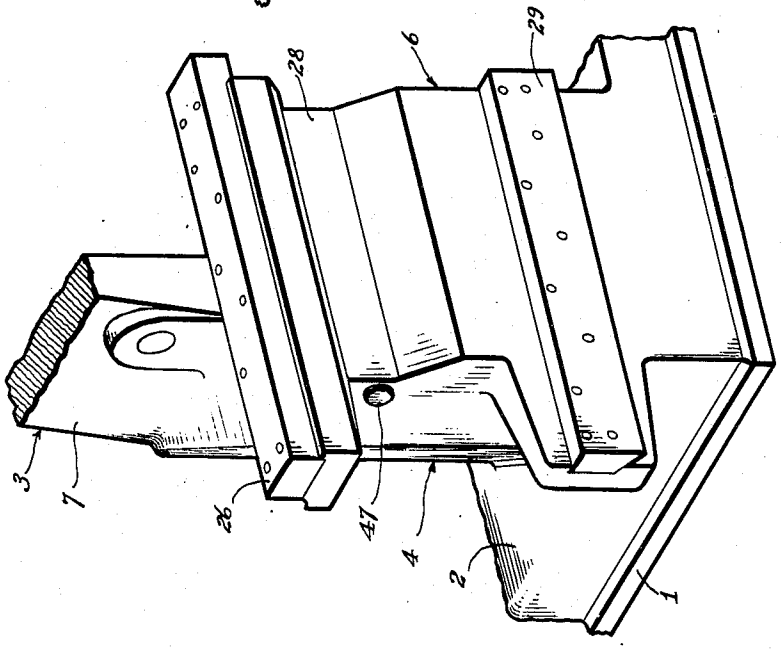


Fig. 8.



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RING ROLLING MILL

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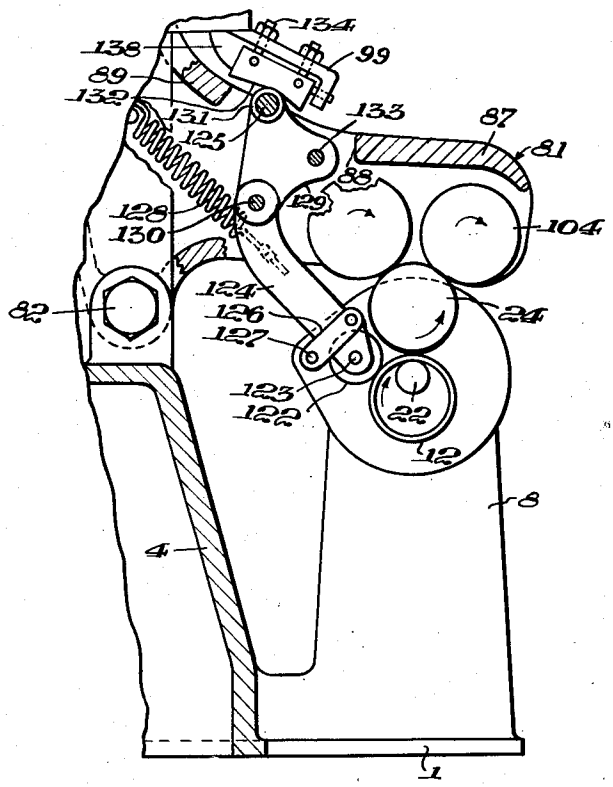


Fig. 9.

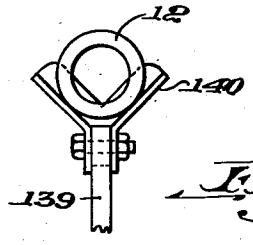


Fig. 10.

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Patented Sept. 16, 1952

2,610,532

UNITED STATES PATENT OFFICE

2,610,532

RING ROLLING MILL

Max R. Heppenstall, Pittsburgh, Pa., assignor to Heppenstall Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application September 27, 1947, Serial No. 776,546

6 Claims. (Cl. 80—5)

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This invention relates to ring-rolling mills and, in particular, to mills for forming and finishing articles such as roller bearing races and the like.

It is among the objects of the invention to provide a mill which, as compared to the other mills of its type, is relatively small and compact so as to occupy minimum floor space, which produces an improved product at an unusually high production rate, which reduces the number of workmen required to operate it, and which has various features that facilitate loading, control the rolling pressure, and permit a quick change of mill settings for various ring sizes.

The mill provided comprises a frame in which are rotatably mounted a pair of horizontal shafts which have vertically disposed faces at their inner ends that are formed to engage the sides of a ring blank during the rolling and finishing operations. A common source of power for rotating the shafts is provided which preferably is a single motor having separate belt drive connections to each shaft, and one of the shafts is mounted for reciprocal movement to and from blank engaging position, the belt drive for this shaft being carried by the shaft's reciprocating mechanism so as to reciprocate with the shaft. During the rolling, the blank is supported on and rotated by a mandrel which is rigidly carried at the inner end of one of the shafts, the other shaft having a mandrel-receiving recess formed at its inner end. Most suitably, because of a particular apparatus for automatically loading blanks, the shaft which is reciprocated is provided with the recess and the stationary shaft bears the mandrel.

The diameter of the blank is increased and its thickness reduced principally by a driven work roll which is pressed against the outer periphery of the blank by mechanism which acts on the roll support. In the preferred form the work roll is driven frictionally by a pair of backing rolls, and all of the rolls are mounted in a pivotal or rockable bracket. The backing rolls have a belt drive from a motor supported by the bracket, and the bracket also carries a guide roll which is constantly urged against the outer periphery of the blank and functions principally to maintain the blank continuously circular as its diameter increases. The bracket rocking mechanism most suitably is a pressure driven piston, the cylinder for which is pivotally carried by a vertically extended yoke member of the main frame, and the cylinder rocks with the bracket. Control mechanism is included for limiting the downward pivoting of the bracket, and this mechanism is

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adjustable so that the mill can be set a desired ring size.

The preferred embodiment of the invention is illustrated in the accompanying drawings, of which Fig. 1 is a plan view of the mill; Fig. 2 a side elevation; Fig. 3 a front end view showing the reciprocating mandrel-receiving portions of the mill moved away from the mandrel into blank loading and unloading position; Fig. 4 a view similar to Fig. 3 showing the mill in ring-rolling position; Fig. 5 a section along the line V—V of Fig. 4; Fig. 6 a fragmentary front end view partially sectioned to show the rotated shafts and their housings; Figs. 7 and 8 are trimetric views showing, respectively, the sliding or reciprocating portion of the mill and that portion of the main frame which slidably supports it; Fig. 9 a vertical section along lines IX—IX of Fig. 4; and Fig. 10 a view taken along lines X—X of Fig. 4.

Referring to the drawings, and in particular to Fig. 2, the mill frame, which preferably is a hollow casting, includes a base 1 which supports on its rear portion, in a manner to be described, a platform 2. Forward of this platform the frame has a central transverse elevated section 3, the lower and front part of which, as seen in Fig. 8, is in the form of a rectangular block 4 which has a specially shaped front face 6, the purpose of which is to be described. The portion above this block forms a yoke 7, while the forward end of the base is provided with another elevated section 8.

These various frame sections are specially shaped to receive and support the elements for rolling a ring blank, which elements include a pair of tubular shafts 13 and 14 which, as shown in Fig. 6, are rotatably mounted in housings 17 and 18, respectively. The adjacent ends of shafts 13 and 14 are equipped centrally with blocks 13a and 14a, respectively, whose outer ends are provided with heads 19 and 21, respectively, having vertical faces that form edging rolls to prevent a ring blank from spreading while being rolled. Block 14a is equipped with a mandrel 22, and block 13a is provided with a recess 23 for receiving and supporting the outer end of the mandrel during rolling operations. The reduction in wall thickness and the corresponding increase in diameter of a ring blank 12 is effected between the face of mandrel 22 and a work roll 24 that is supported in a manner hereinafter explained.

Housing 17, which rotatably carries shaft 13, is a part of a sliding or reciprocable head 25, (Figs. 3 and 4) that is slidably supported on face

6 of the frame's central block section. Figs. 7 and 8 show this sliding fit, the corresponding sliding parts being apparent if Fig. 7 is visually inverted upon Fig. 8. Briefly, the sliding surfaces of face 6 (Fig. 8) consists of a wear plate 26, bolted to the top of the face, the portion of the frame below the wear plate being indented in the manner shown to form a recess 28, below which is bolted another wear plate 29 having a tapered bottom surface. Sliding head 25 (Fig. 7) is provided with an overhanging flange 31 provided with a groove or track 32 to which is bolted another wear plate 33 which slides upon wear plate 26 of the stationary frame section. To assure a tight fit of wear plate 33 in the track, wedges 34 may be driven along its sides. Below flange 31 of the sliding head, there is bolted an elongate reciprocating member 36 which rides in recessed portion 28 of face 6, and which is secured in a manner to be described to mechanism which reciprocates the sliding head, and below reciprocating member 36 there is another groove 37 shaped to receive wear plate 29. It will thus be seen that the sliding head is solidly supported to slide smoothly and evenly.

The mechanism for reciprocating the sliding head, as most clearly seen in Fig. 3, consists of a pressure cylinder 41 having a piston connected to a piston rod 42 whose outer end is connected to reciprocating member 36 so that the latter becomes a part of the piston rod and is so considered in the following description. The purpose of reciprocating the sliding head by the pressure cylinder is primarily to permit loading and unloading of rings.

The extent of the inward sliding movement of the head is adjustable to make provision for rolling blanks of varying widths. Referring to Figs. 7 and 8, this adjustment mechanism is a setscrew 43, which is threaded through a lug 44 formed on the outer end of piston rod 42, the screw being provided at its inner end with a head 46 which, when the sliding head is reciprocated inwardly to the desired extent, abuts a hardened circular stop disc 47 secured to the stationary section of the frame. When the sliding head is reciprocated inwardly to the full extent permitted by screw 43, the upper portion of a ring blank 12 is engaged between the heads 19 and 21 of rotatable shafts 13 and 14, after which work roll 24 may be lowered upon the periphery of the ring blank and the ring rolling operation commenced by the rotating shafts.

It is a feature of the invention that shafts 13 and 14 are rotated by separate connections from a single motor 48 mounted on platform 2 at the rear of the frame, the driving connections preferably consisting of two series of V-belts 49 and 51 which pass around grooved hubs 52 and 53 (Fig. 1) on the armature shaft 55 of the motor and around grooved wheels 54 and 56 attached to the outer ends of the shafts. To maintain the grooves of hub 52 continuously in alignment with those of wheel 54 in all positions of the reciprocable head 25, hub 52 is splined on armature shaft 55 for rotation thereby and for movements longitudinally thereof, and link mechanism is provided to move the hub on its shaft as the reciprocable head is moved. As shown in Figs. 2 and 3, such mechanism includes a rock shaft 57 whose ends are supported by short links 58 and 59 that are pivotally connected to lugs 61 and 62, respectively, of frame base 1. An arm 63 is rigidly connected at its lower end to rock shaft 57 and is pivotally connected at its upper end to piston rod 42 which actuates the reciprocable head. Similarly, a second arm 64 is rigidly connected at its lower end to the rock shaft and is provided at its upper end with yoke arms 66 equipped with pins 67 whose inner ends lie in a groove formed at a side of hub 52. Thus, any longitudinal movement of piston rod 42 results in a like movement of hub 52 on armature shaft 55, the linkage connection being from the piston rod through swinging arm 63, rock shaft 57, swinging arm 64 and yoke 66 which engages the hub, and in such connections the short links 58 and 59 that support the rock shaft permit it to float to compensate for the straight line movements of the piston rod and hub.

Proper tightening of drive belts 49 and 51 is accomplished by providing slots 201 (Fig. 1) in motor platform 2, bolting the platform to the base through these slots, and providing a pair of setscrews 68 which bear against the rear ends of the frame.

For cooling the rotating shafts during the rolling operation, shaft 13 is cooled by water supplied through a pipe 71 and openings 72 (Fig. 6), the water pouring out of the mandrel-receiving recess of this shaft when the shaft is reciprocated outwardly at the completion of a rolling operation. Shaft 14 has a similar water supply pipe 73 and openings 74 but, in addition, a return line 76 is provided which discharges into a splash plate 77 through openings 78 and then escapes through a pipe 79.

During the rolling of the ring blank it is desirable to use "edging" or "side rolls" to finish the sides of the ring and to prevent it from spreading. This is accomplished by mounting the axis of one of shafts 13 and 14 at an angle to the other, and in providing a conical working face on one or both of the opposed vertical faces of heads 19 and 21. As seen in Fig. 6, shaft 13 is mounted at a slight upward tilt from the horizontal axis of shaft 14, and the blank engaging surface of head 19 at the end of shaft 13 lies in a cone of such angularity as to bring it into a vertical plane when in engagement with the blank. As shown, the entire working face of head 21 preferably lies in a vertical plane. It is apparent that, with such an arrangement, during the rolling of the blank the only time that any portion of the blank will be engaged on both sides by the working faces of heads 19 and 21 is when the blank is being rolled between mandrel 22 and roll 24. Thus, the pressure which the shaft head exerts against the sides of the blanks is exerted simultaneously with the downward pressure of the work roll.

Work roll 24, through which the ring-forming pressure is applied, is mounted in a bracket 81 (Figs. 2 and 5) which, in turn, is pivotally or rockably attached to central yoke 7 of the mill frame by means of a pivot rod 82 which extends through openings provided in the lower portion of the bracket, the rod being received in a pair of lugs 83 formed on the central yoke of the main frame. The bracket preferably is a single hollow casting and includes a pair of upwardly extending bent arms 84, sides 87 and top cross braces 88 and 89. The bracket is rocked by means of pressure mechanism, which includes a piston rod 91 to the outer end of which the upper end of the bracket is pivotally attached, the rod being connected to a piston in a pressure cylinder 92. The cylinder is pivotally supported by the upper ends of yoke 7, and, for this purpose, a pair of side plates 93 and 94 are rigidly secured

to the yoke's upper ends, the rear portion of each of the plates being provided with openings that form bearings for a pair of trunnions 97 formed at the rear of the cylinder.

The bracket, therefore, is supported in the main frame at its rear portion only, and consequently the weight of its forward portion tends to swing it downwardly. To swing it upwardly, pressure is supplied to the front side of the piston, while, to swing it downwardly, controlled exhaust pressure acts on the opposite side. During each rolling operation, positive steady pressure is applied behind the piston to press the working roll in against a ring blank. However, it is desirable to provide a limit to the downward rocking of the bracket to control the diametrical thickness of the finished ring, and, for this purpose, adjustable stopping means are provided which include setscrew 98 threaded through an opening provided in a cross piece 99 attached to and extending between plates 93 and 94. The inner end of the setscrew is provided with a stopping head 100 which is disposed in the path of the forwardly moving piston rod, and the position of this head can be changed by turning the screw further toward or away from the piston rod. To lock the setscrew in position a lock nut 101 is provided to which is attached handle 102 for facilitating turning.

In the forward portion of bracket 81 are mounted a pair of horizontal, cluster-type backing rolls 103 for the working roll, and both the working and the backing rolls are so mounted that they can be easily detached for repair or replacement. The necks of the backing rolls are mounted in chocks 104 arranged in openings in the sides of the bracket. As seen in Figs. 3 and 4, the backing rolls have considerably wider faces than the work roll, so that they can be used to support working rolls of the required face widths to roll rings of different sizes.

Work roll 24 is suspended by a support the outline of which is shown in Figs. 4 and 5. This support consists of a roll suspension member 113 having formed at its lower end an inwardly extending pin 114 which projects through a central opening provided in the work roll rotatably to support it. The suspension member extends vertically upward through and above the forward end of the bracket where it is provided with a laterally extending bearing plate 116 that supports a roll-balancing spring 117 in the customary manner to hold the work roll against its backing rolls. An auxiliary supporting member 118 assists in holding the work roll, and is seen bolted to a side of bracket 81 and extending downwardly and then inwardly, its inner end being provided with a downwardly extending flange 119 the inner surface of which, in operative position, is disposed adjacently to the upper outer surface of the work roll. Just above flange 119 there is a trunnion 121 which extends through an opening in the lower part of suspension member 113. With this arrangement, when it is desired to substitute a different sized work roll for rolling rings of a different width, it can be accomplished easily by removing auxiliary member 118.

The backing rolls serve in the customary manner to enable the use of a small diameter work roll and also to frictionally drive that roll at a rotational speed no greater than the rotational speed imparted to the roll through its frictional contact with the rotating mandrel, or in other words, at a speed which is just sufficient to keep the work roll rotating in response to the friction between it and the mandrel. The drive for the backing rolls is provided by a motor 105 which is mounted on a platform 106 rigidly secured to bracket 81. A shaft driven by the motor is connected to a grooved wheel 107, which drives a single set of V-belts 108 that extend around driven wheels 109 and 111 attached to the ends of the backing roll necks 104.

A feature of the invention is the provision of a guide roll 122, the principal purpose of which is to maintain contact with the gradually expanding periphery of the ring blank during the rolling operation. The practical necessity for such a guide roll readily can be appreciated when it is considered that, if such a roll were not used, the rotary motion imparted to the blank would tend to swing it upwardly at the entering sode of the pass and distort it from the desired circular form into a possibly ovular, or otherwise irregular, form. Also, without the use of the guide roll, the blank would swing rather freely, and by bumping into other surrounding structural elements, would produce a noisy and inefficient rolling operation. By the use of a guide roll, mounted in the manner to be described, the blank, as it increases in diameter, is held in a position in which its rotational axis is held in vertical alignment with the rotational axis of both mandrel 22 and work roll 24, a position which can be defined as a truly circular position.

Generally described, the guide roll 122 is secured to bracket 81 which, it will be recalled, is rocked forwardly and downwardly to apply pressure to work roll 24. However, the guide roll is so mounted that the rocking of bracket 81 on its pivotal rod 82 does not cause the guide roll to swing the expanding blank to the right (Fig. 9) out of its so-called truly circular position. If the blank were so swung, there would be as great a possibility of producing ovular, or otherwise irregularly shaped, rings as was the situation described when no guide roll was used. To insure the production of perfectly round rings, the guide roll is mounted, and its position during the rolling controlled, in the manner to be described.

Referring to Fig. 9, guide roll 122 is rotatably mounted on a pin 123 which is supported between the lower bifurcated end of a guide roller arm 124. In close proximity to the roll, arm 124 is secured to an adjacent portion of the main frame by means of a link 126 pivotally attached at one end to the frame at 127, and at its other end to the guide roller arm. The purpose of link 126 primarily is simply to support the lower end of the arm. Centrally, the arm is attached to a tension spring 128 which in turn is secured to rocking bracket 81.

The upper end of guide roller arm 124 is pivotally connected to the lower end of a bell crank lever 129 which is bifurcated to receive the arm, the arm being swung on a pin 130 supported in the bifurcated portion of the lever. Actually, the lever is a triangularly shaped member formed of two opposed and interconnected plates, the corner portions of the triangular lever being the bifurcated portions in which arm 124 and other members to be described, are mounted. The upper end of the lever also is bifurcated as described and is provided with openings to receive a pin 125 upon which a cam roll 131 is rotatably mounted, this roll riding on the surface of a cam 132 which, in turn, is rigidly, although adjustably secured to cross piece 99 carried between stationary side plates 93 and 94 (Fig. 5). The triangular bell crank is pivotally supported at its right-hand

corner by means of a pin 133 carried by the side walls of the bracket, so that as the bracket rides forwardly and downwardly to exert pressure on the blank, it carries the guide roll on an arc toward the blank. More specifically, as the rocking motion of bracket 81 commences, the movement of the roller along the face of the cam may cause pressure to be exerted upon cam roll 131, or, it may be found desirable to so shape the cam face that the pressure normally placed upon it will be relaxed. In either event, triangular bell crank lever 129 pivots on the axis of its supporting pin 133 and, in so doing, either presses guide roller arm 124 toward the blank or allows it to retreat from the blank. If the cam is so shaped that the guide roller retreats from the blank, the retreating action is under the influence of tension spring 128 and the cam roller is held against the cam.

From the above, it may be gathered that during the rocking of the bracket 81, location of guide roller 122 with respect to the blank is a function of the contour of the face of cam 132. This face is so contoured that, as the diameter of the blank gradually is increased, the guide roll exerts a constant pressure upon the periphery of the blank and holds the blank in a truly circular position which is the position in which the rotational axis of the blank is in alignment with the axis of the mandrel and the work roll. Of course, in determining the cam contour, consideration is given to the swinging of bracket 81 on its fixed pivot 82, the swinging of bell crank lever 129 on its pivot 133 carried by the bracket, and the swinging of the lower end of arm 124 on its supporting link 126. The contour of the face of the cam therefore is a matter which must be determined specially for the conditions of each different ring rolling operation.

It is desirable to mount cam 132 in such a manner that it can be adjusted vertically away from or toward its cam roller, tension spring 128 operating at each such adjustment to again press the roller against the cam face. Also, the cam is mounted so that it can be adjusted to and fro along stationary cross piece 99 which supports it. By such adjustments, a cam of a certain contour is made suitable for use in rolling a large number of different sized blanks. Since adjustable mountings of the types described are well known and can be carried out in any number of ways, it is not believed that a showing of them is necessary.

The mill is provided with mechanism for preliminarily positioning blanks for rolling, which, as shown in Fig. 3 or 4, includes a solenoid 136, having a vertically reciprocating armature 137 that is pivotally connected to a floating rocker arm 138. This arm carries at its forward end a loading arm 139, the upper end of which is provided with a yoke shaped to receive and support a ring blank. As shown in Fig. 10, the yoke is formed of a pair of angles 140 adjustably secured by a bolt and slot connection to the upper end of loading ram 139, the adjustable mounting permitting the yoke to be raised or lowered to support different sized blanks in the proper position for the reception of mandrel 22. The solenoid and its connected parts are carried by and reciprocated with sliding head 25, the solenoid being mounted in a bracket 141 extending downwardly from the head which supports rocker arm 138 and loading arm 139. The rocker arm is connected at its rearward end by a link 142 pivotally mounted on a pin carried in a lug 143 which extends outwardly from one side of bracket 141, and the loading arm is held upwardly by a swinging link 144, attached to the bracket's other side. As will be appreciated, when the loading arm is raised into blank loading position, swinging link 144 causes the arm and its yoke to move upwardly in an arc and the yoke is so mounted on the arm that when it reaches its uppermost position, its angles lie in a vertical plane. To further adapt the loading arm for use with different blank sizes, it also is desirable to adjustably secure link 144 to the loading arm, the adjustment desired being such as would increase the outward swing of the loading arm as it is raised into blank loading position, this adjustment being to vary the position of the yoke for handling blanks of different width.

In the operation of the mill, motor 48 is normally driven continuously to drive belts 49 and 51 which rotate shafts 13 and 14, Fig. 6, and motor 105 carried by swinging bracket 81 is similarly rotated continuously to drive belt 108 for rotating the backing rolls 103 and 104 which support and frictionally drive working roll 24 at substantially the peripheral rolling speed of a ring blank 12 so that such roll will not slip on the blank as it is rotated by mandrel 22 and heads 19 and 21 of shafts 13 and 14.

At the beginning of a rolling operation, sliding head 25 is moved away from the stationary head to the position shown in Fig. 3 in which mandrel 22 is entirely outside of recess 23 in shaft 13. With solenoid 136 energized to elevate its armature 137, and in consequence thereof to hold loading arm 139 upwardly, a preformed ring blank is placed upon the yoke at the upper end of such arm which so positions the blank that its central opening is in alignment with mandrel 22. Sliding head 25 then is moved to the position shown in Fig. 4, such movement being effected by supplying pressure fluid to cylinder 41 which moves piston rod 36 inwardly, the outer end of which is attached to sliding head 25. During such movement of head 25 the ring blank is slid upon mandrel 22, and solenoid 136 is deenergized, by means of any suitable limiting switch actuated by contact with the mandrel, to permit loading arm 139 to move downwardly to the position shown in Fig. 4. Each ring blank 12 preferably is preshaped to the required size by forging it from a section of a round, such section containing the required amount of metal, usually steel, for forming a ring of the desired dimensions. The central opening in the ring blank is sufficiently large freely to permit the blank to be pushed upon mandrel 22 by head 19 of shaft 13, as just explained.

In all of the reciprocating movements of head 25, hub 52 for driving belt 49 is slid longitudinally upon armature shaft 55 (Fig. 1) in direct proportion to the movements of the head. This is done by rotating rock shaft 57 (Fig. 2) which is connected to piston rod 36 by arm 63 and is connected to hub 52 by arm 64. The extent of movement of sliding head 25 to the position shown in Fig. 4 is determined by the adjustment of screw 43 (Fig. 7) to such position that its head 46 engages stop disc 47 (Fig. 8) when head 19 of shaft 13 is in the required position for a rolling operation.

Simultaneously with the movement of head 25 to the rolling position shown in Fig. 4, the outer end of swinging bracket 81 is lowered to bring working roll 24 to its rolling position shown in Figs. 4 and 6, such lowering being controlled by pressure cylinder 92. When the working roll is so

positioned, fluid pressure is applied to the rear of the piston in cylinder 92 gradually to lower the working roll as the wall thickness of the ring blank is reduced between the roll and mandrel 22. The required limit of the downward movement of the working roll is controlled by setscrew 98 (Fig. 2), against the head 100 of which the outer end of piston roll 91 is adapted to abut.

As a ring blank is being rolled, between mandrel 22 and roll 24, it is edged and prevented from spreading by the vertical working faces of heads 19 and 21 borne by shafts 13 and 14, respectively, and the blank is continuously maintained in circular form by guide roll 122 borne by the lower end of arm 24. The position of this arm for thus holding guide roll 122 in its required position is controlled by cam 132 (Fig. 5) through roller 131, bell crank 129 and pivoted link 126, roller 131 being maintained in contact with the cam by tension spring 128.

At the completion of a rolling operation, head 25 is moved to the position shown in Fig. 3 to permit the rolled ring to be removed from the mandrel, this being done by pressure fluid applied to cylinder 41, and the working roll 24 is elevated by causing bracket 81 to swing upwardly, this being done by supplying pressure fluid to cylinder 92. In such position of the mill units the mill is ready to start another rolling operation.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A ring-rolling mill comprising a pair of rotatably mounted horizontal and substantially axially aligned shafts having vertically disposed faces formed to engage the sides of a ring blank, a motor for rotating said shafts, a separate belt connecting each of said shafts with said motor, mechanism for reciprocating one of said shafts horizontally and axially to and from blank engaging position thereby shifting one end of its belt, linking mechanism actuated by said reciprocating mechanism to reciprocate the other end of the belt for said reciprocated shaft, a mandrel rigidly borne by one shaft, the other having a mandrel receiving recess formed in it, a horizontal work roll, and mechanism for pressing said roll against the periphery of said blank to roll the blank between it and said mandrel.

2. A ring-rolling mill comprising a frame, a pair of rotatably mounted horizontal and substantially axially aligned shafts having vertically disposed faces rigidly carried at the adjacent ends of said pair and formed to engage the sides of a ring blank, driving means connected to both of said shafts for synchronously rotating both the shafts, mechanism for reciprocating one of said shafts horizontally to and from blank engaging position, a mandrel rigidly borne by one shaft, the other having a mandrel receiving recess formed in it, a bracket mounted on said frame, a horizontal work roll, wide-faced backing rolls for frictionally driving said work roll, driving means for said backing rolls, mechanism for pressing said work roll against the periphery of said blank to roll the blank between it and said mandrel and a two-part suspension member providing the sole support for said work roll, said suspension member, backing rolls and backing roll driving means being mounted on said bracket, one part of said suspension member rotatably supporting said work roll and resiliently pressing said roll against the backing rolls and the other part having an end detachably secured to said bracket and the other end securing the support of the work roll, whereby said other detachable part can be removed and a work roll of a different size readily substituted.

3. A ring-rolling mill comprising a pair of rotatably mounted horizontal and substantially axially aligned shafts having vertically disposed faces rigidly carried at the adjacent ends of said pair and formed to engage and edge the sides of a ring blank, driving means connected to both of said shafts for rotating the shafts, mechanism for reciprocating one of said shafts horizontally to and from blank engaging position, a mandrel rigidly borne by one shaft, the other shaft having a mandrel receiving recess formed in it, a horizontal rotatably-mounted and frictionally-driven work roll, and mechanism for pressing said roll against the periphery of said blank to roll the blank between it and said mandrel, the axis of one of said shafts being tilted upwardly from the horizontal axis of the other shaft and having a conical edging face, said shaft being tilted to position the tapered portion of said conical face in a vertical plane as said tapered portion is passing between said mandrel, and said work roll, whereby the blank is engaged by both of said faces only as it passes between said mandrel and said work roll.

4. A ring-rolling mill comprising a frame provided with a pair of rotatably mounted horizontal and substantially axially aligned shafts having vertically disposed end faces formed to engage and edge the sides of a ring blank, driving means for rotating said shafts, mechanism for reciprocating one of said shafts horizontally to and from blank engaging position, a mandrel rigidly borne by one shaft, the other shaft having a mandrel-receiving recess formed in it, a bracket pivotally mounted on said frame to swing in a substantially vertical direction, a horizontal work roll borne by the outer portion of said bracket and adapted to cooperate with said mandrel to reduce the wall thickness of the ring, an arm pivotally supported by said bracket and provided at one end with a guide roll for engaging the periphery of the blank while it is being rolled between said work roll and mandrel and at its other end with a cam roller, a cam borne by said frame and means urging said cam roller into contact with said cam, said cam engaging said cam roller and being formed to control the pivotal movement of said arm to cause said guide roll to maintain a constant and sufficient pressure on the blank to hold the blank with its rotational axis constantly parallel to the rotation of the axis of the work roll whereby a circular blank may be formed.

5. A ring-rolling mill comprising a stationary frame, a horizontally reciprocating block slidably mounted on said frame, a shaft rotatably mounted in said sliding block and reciprocable with it, a second shaft rotatably mounted in said frame substantially in axial alignment with said first shaft, both shafts having heads provided with vertically disposed faces formed to engage the sides of a ring blank, a motor for rotating said shafts, separate drive connections from said motor to each of said shafts, mechanism for reciprocating said sliding block and moving its shaft horizontally and axially to and from blank engaging position and thereby shifting one end

of its driving connection, means actuated by said reciprocating mechanism for reciprocating the other end of the driving connections for the shaft borne by said sliding block, a mandrel rigidly borne by one shaft, the other shaft having a mandrel receiving recess formed in it, a bracket pivotally mounted on said frame, a horizontal work roll, driven backing rolls frictionally engaging said work roll, said backing and work rolls being carried in said bracket, and mechanism for rocking said bracket downwardly and pressing said work roll against the outer periphery of said blank to roll the blank between it and said mandrel.

6. A ring-rolling mill comprising a frame provided with a pair of rotatably mounted horizontal and substantially axially aligned shafts having vertically disposed end faces formed to engage and edge the sides of a ring blank, driving means for rotating said shafts, mechanism for reciprocating one of said shafts horizontally to and from blank engaging position, a mandrel rigidly borne by one shaft, the other shaft having a mandrel-receiving recess formed in it, a bracket pivotally mounted on said frame to swing in a substantially vertical direction, a horizontal work roll borne by the outer portion of said bracket and adapted to cooperate with said mandrel to reduce the wall thickness of the ring, an arm pivotally supported by said bracket and provided at one end with a guide roll for engaging the periphery of the blank during rolling, a cam for controlling the pivotal movements of said arm, and resilient means urging said guide roll away from said engagement and into engagement with said cam, said cam being formed to cause said guide roll to maintain a constant and sufficient pressure on the blank to hold the blank with its rotational axis constantly parallel to the rotational axis of the work roll.

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