Dec. 7, 1937. W. J. ASSEL 2,101,357

CROSS ROLL MILL

Filed May 28, 1934 3 Sheets-Sheet 1

Fig. 1.

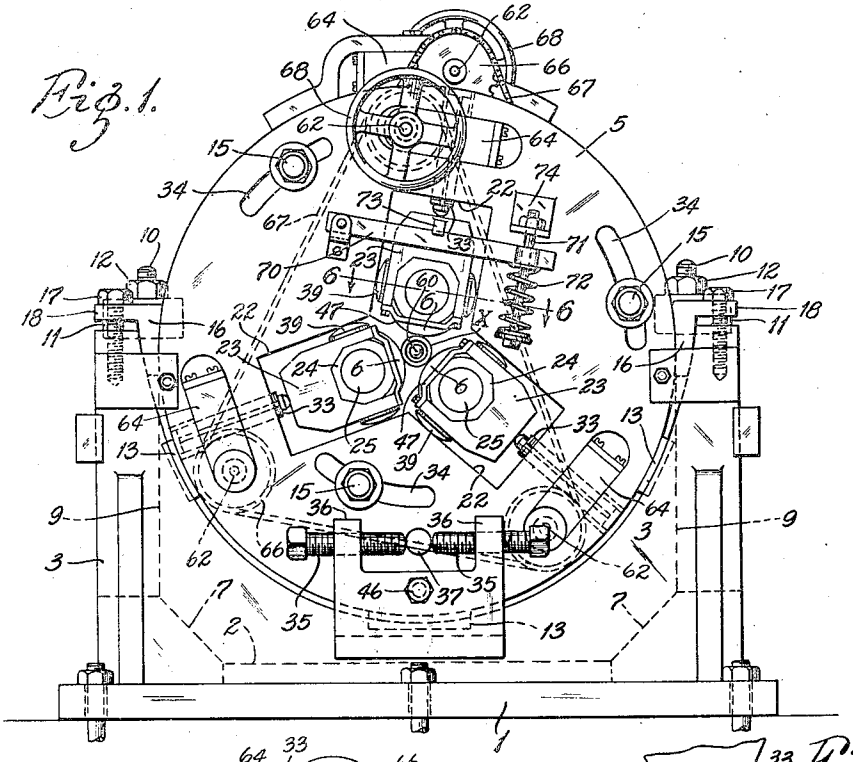


Fig. 2.

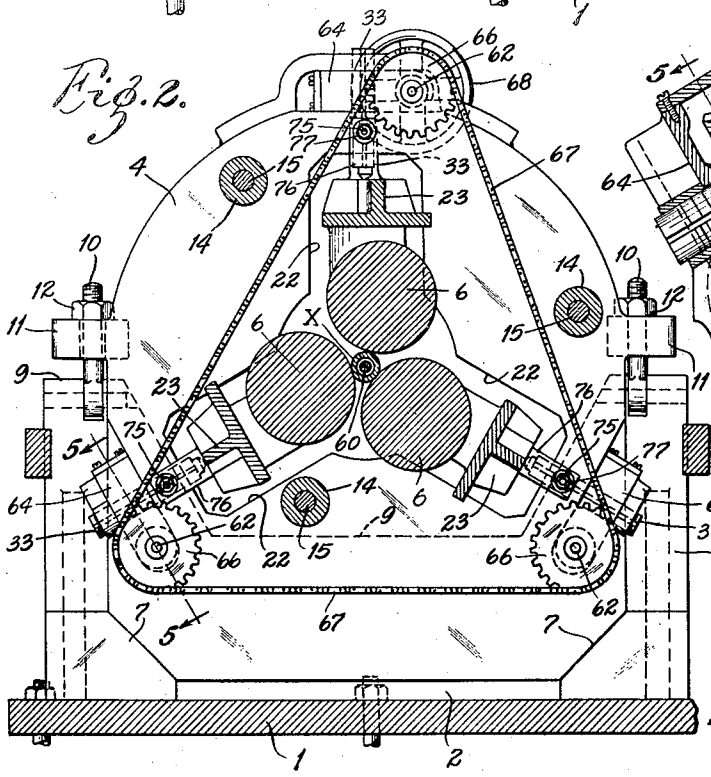
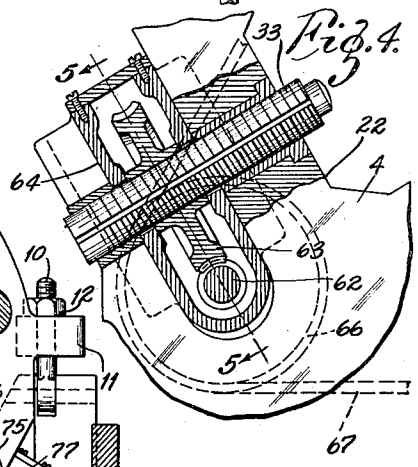


Fig. 4.



INVENTOR

W. J. Assel

by Cornell Cornell & Kennedy

HIS ATTORNEYS

Dec. 7, 1937. W. J. ASSEL 2,101,357

CROSS ROLL MILL

Filed May 28, 1934 3 Sheets-Sheet 2

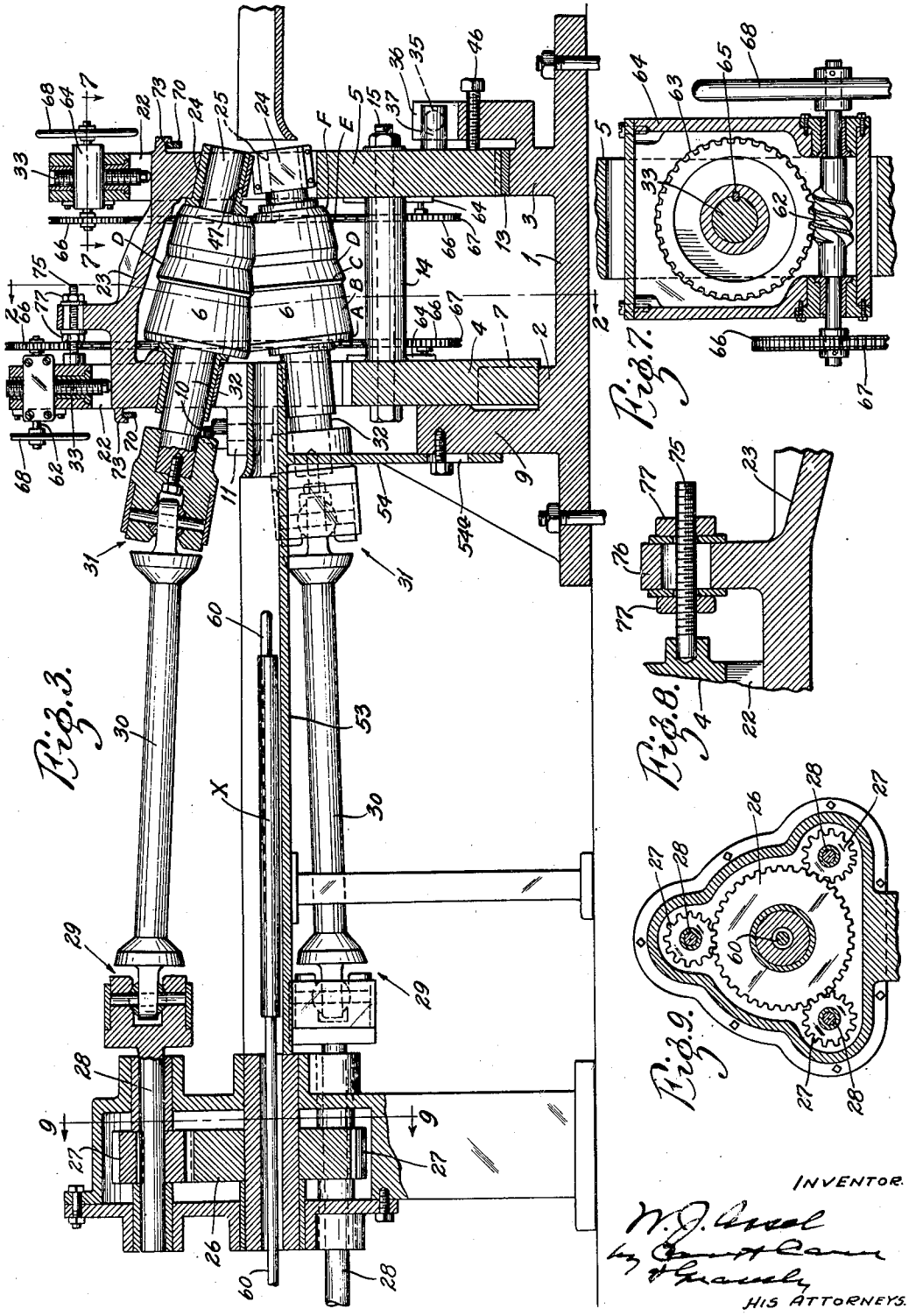


Fig. 3.

Fig. 7.

Fig. 8.

Fig. 9.

INVENTOR.

W. J. Assel

by Cushman, Darby & Cushman

HIS ATTORNEYS.

Dec. 7, 1937. W. J. ASSEL 2,101,357

CROSS ROLL MILL

Filed May 28, 1934 3 Sheets-Sheet 3

Fig. 5.

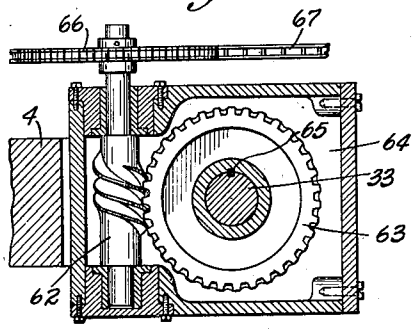
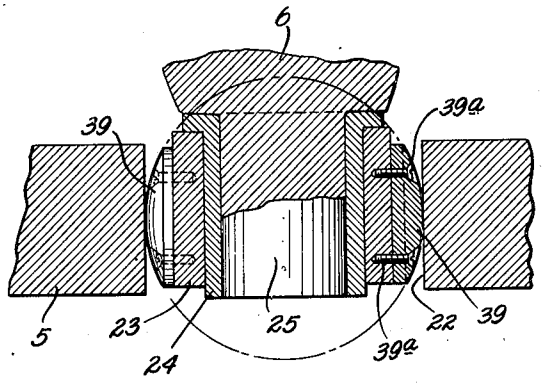


Fig. 6.



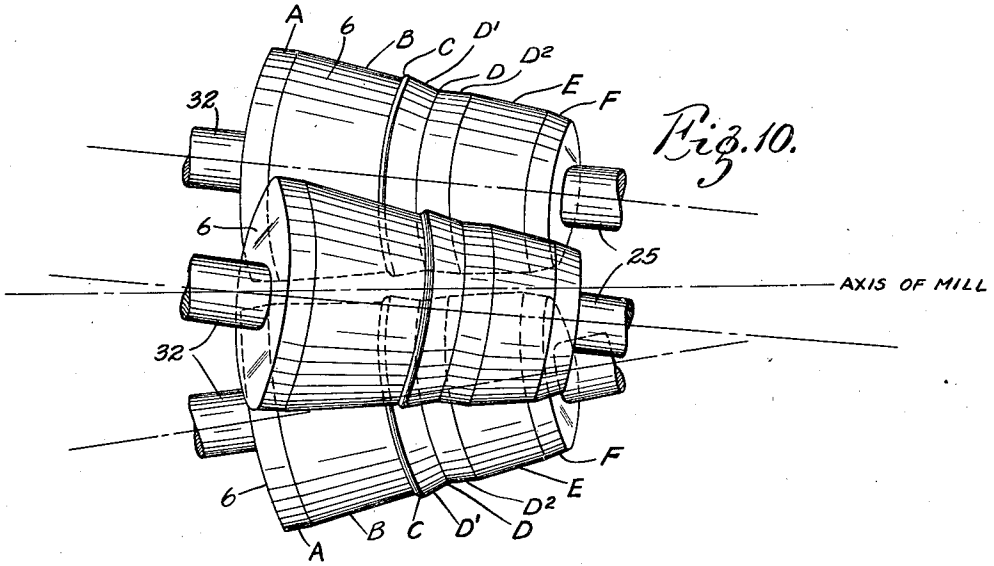


Fig. 10.

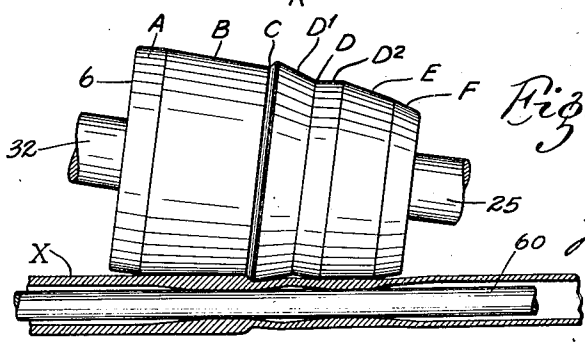


Fig. 11.

INVENTOR:

Walter J. Assel

by Cook Cook & Frank

HIS ATTORNEYS.

Patented Dec. 7, 1937 2,101,357

UNITED STATES PATENT OFFICE

2,101,357

CROSS-ROLL MILL

Walter J. Assel, Canton, Ohio, assignor to The Timken Roller Bearing Company, Canton, Ohio, a corporation of Ohio

Application May 28, 1934, Serial No. 727,934

9 Claims. (Cl. 80—13)

My invention relates to mills of the type wherein the working rolls are disposed equidistantly around an axis and askew relative thereto. The principal objects of the present invention are to devise means for effecting various adjustments of the rolls with great facility to suit work of different sizes and of different character and to take up wear. Another principal object is to organize the rolls, together with all adjusting mechanism, into a unit that is capable of being adjusted on the bench and applied as a preassembled and adjusted unit to the permanent framework and driving mechanism of the mill.

The invention consists in the parts, arrangement and combination of parts hereinafter described and claimed.

In the accompanying drawings, wherein like numerals refer to like parts wherever they occur,

Fig. 1 is an elevation of my mill facing the rear or delivery end thereof and with the outlet guide removed;

Fig. 2 is a vertical cross-section of the mill on the line 2—2 of Fig. 3;

Fig. 3 is mainly a longitudinal vertical sectional view but showing some of the parts, including the rollers, in side elevation;

Fig. 4 is a fragmentary sectional view illustrating the worm gearing for rotating the cradle adjusting screw;

Fig. 5 is a cross-section on the line 5—5 in Fig. 4;

Fig. 6 is a fragmentary section on the line 6—6 in Fig. 1;

Fig. 7 is a horizontal section on the line 7—7 in Fig. 3;

Fig. 8 is an enlarged fragmentary sectional view illustrating the arrangement for adjusting the cradle endwise;

Fig. 9 is a vertical cross-sectional view of the driving mechanism, the section being taken on the line 9—9 in Fig. 3;

Fig. 10 is a diagrammatic top plan view showing the grouping of the working rolls; and

Fig. 11 is a longitudinal sectional view along the line of contact of one roll with the work piece.

The base 1 of my machine has upstanding members spaced apart and constituting the end frames 2, 3 on which the housing members 4, 5 for the working rolls 6 of the mill are supported. The front roll housing member 4 is a thick vertically disposed plate with vertical ends and with a horizontal bottom and beveled lower corners 7 that fit in a correspondingly shaped seat provided therefor on said frame.

Welded to or otherwise mounted on the base 1 forward of the front roll housing member 4 is a thick forked plate 9 whose sides extend upwardly about as high as the longitudinal axis of the mill; and at the top of each of said sides is pivotally mounted a threaded eyebolt 10 in position to swing into a slot provided therefor in a lug 11 on the side edge of said front roll housing member. When said bolts are engaged in said slots and their nuts 12 tightened, the front housing member 4 is firmly clamped against its seat. The rear roll housing member 5 is preferably made of a thick disk or circular plate, whose periphery is seated on arcuate seats provided therefor on the base or preferably on three arcuate bearing blocks 13 detachably provided therefor in said base. The end members of the housing are spaced apart preferably by tubular spacing members 14 welded to the front housing member 4. Extending through said spacing members are threaded through bolts 15 which serve to clamp the rear end housing member 5 against said spacing members, whereby the two end housings 4 and 5, together with the rolls 6, are adapted to be mounted on and removed from the base 1 as a unit, thus facilitating roll changing by substituting one preassembled unit for another.

The rear end frame 3 of the base 1 extends upwardly at its sides above the horizontal diameter of the rear roll housing member 5, which is firmly clamped in place by means of wedge blocks 16 interposed between the periphery of said housing member and the edges of said rear end frame. The upper portion of said wedge blocks are located above the horizontal diameter of the rear end frame 3 and are secured to the top of the main frame by cap screws 17 that extend through perforated lugs 18 provided therefor on said wedges into threaded holes in the top of said rear end frame. Thus, both end members of the housing are firmly clamped in place.

Each roll housing member is provided with equidistant radially disposed slots or windows 22 constituting guideways for the cradle members 23. These cradle members extend from the front roll housing member 4 to the rear roll housing member 5 and their ends have sliding engagement in the outer portions of said guideways. As shown in Fig. 6, the inner faces of the end portions of said cradle members 23 are shaped to form seats for bearing members 24 for the necks 25 of working rolls 6 hereinafter described. Preferably there are three working rolls 6, each being mounted in the radial guideways 22 in the front and rear roll housing members. These rolls are equidistant from one another and from the longitudinal axis of the mill. The axes of the working rolls 6 are not parallel with one another and are not in the plane of the longitudinal axis of the mill; but they all incline rearwardly toward the longitudinal axis of the mill and they all skew a few degrees from any plane through said axis. This skew setting in operation is known as the

feed angle and controls the speed of the work through the mill.

Each of the tapered working rolls 6 is operatively connected to a driving means common to them all. As illustrated, the driving means comprises a large driven gear 26, having pinions 27 meshing therewith, one of these pinions constituting a drive gear. The shaft 28 of each pinion 27 is connected by a universal joint 29 to one end of a spindle 30, whose other end is connected by a universal joint 31 to an extension 32 of the neck of one of the working rolls 6. In this way, the working rolls are all driven at the same speed and in the same direction and may be shifted without affecting the drive.

Provision is made for adjusting the working rolls to accommodate work of different diameters, also to adjust the angular setting of the rolls and also to adjust the skew thereof. Adjustment for work of different sizes is readily effected by means of screws 33 extending radially through the outer end walls of the guideways of the respective housing members 4 and 5 and constituting movable abutments for the ends of the respective cradle members 23. In order to adjust the longitudinal inclination of the axes of the working rolls, it is only necessary to change the setting of the screws 33 on one end housing member relative to the screws 33 on the other end member, thereby shifting the relative position of the two ends of the cradle members 23.

Each adjusting screw 33 of each roll housing member is adjusted by means of a worm 62 and a worm wheel 63 mounted in a suitable gear housing 64 fixed to said roll housing member. The adjusting screw slidably engages the bore of the worm wheel 63; and a key 65 is fixed in the bore of said worm wheel and slides in a keyway cut through the threads of said screw. By this arrangement, the worm wheel and screw rotate together, but the screw is free to slide longitudinally through the bore of the worm wheel. As it is desirable to adjust the respective ends of all the rolls 6 an equal amount, a single means is provided for simultaneously adjusting the three adjusting screws of each roll housing. Said means preferably comprises sprocket wheels 66 mounted on the inner ends of the shafts of the worm 63, an endless sprocket chain 67 passing around said sprocket wheels, and a hand wheel 68 fixed to the outer end of one of the worm shafts. By this arrangement, rotation of the hand wheel 68 on each roll housing member brings about an equal adjustment of the three roll adjusting screws thereon.

In order to adjust the skew or lateral angularity of the axes of the work rolls relative to the axis of the mill, the front and rear end members of the roll housing are made relatively rotatable to a limited extent. For this purpose, the rear housing member 5 is provided with elongated arcuate slots 34 through which the through bolts 15 inside the tubular spacing members 14 extend. When these through bolts 15, wedges 16 and screws 35 and 46 hereinafter referred to are loosened, the rear housing member 5 of the roll housing may be turned enough relative to the front housing member 4 to give the axes of the working rolls the required degree of skew, whereupon the through bolts 15, wedges 16 and screws 35 and 46 are tightened to clamp the parts of the roll housing in adjusted position. This rotary or turning movement is facilitated by the screws 35 which work in lugs 36 on the frame on opposite sides of a pin 37 or lug provided therefor on said rear end member of the roll housing.

In order to accommodate adjustment of the skew and inclination of the working rolls, spherical bearings are interposed between the ends of the respective cradle members 23 and the slots or guideways 22 in the end members of the roll housing members. Each of such bearings comprises spherical faced plates 39 interposed between each side of the cradle member and the adjacent wall of the guideway 22 in the housing members. Plates 39, which are attached to the ends of the cradle member by means of countersunk screws 39*a*, have their convex faces disposed in a spherical surface about a center on the axis of the roll. By this arangement, each cradle member is pivotally or universally connected at its ends to the respective end members of the roll housing, thereby permitting the crade member to slide and to cock as far as the various adjustments may require.

In order to keep the rolls in proper position, suitable straps 47 are mounted on the ends of the cradles inwardly of the bearing members or boxes 24 of the roll necks 25. Likewise, to support the weight of the top roll and spindle, a bar 70, which is pivoted at one end and supported by a bolt 71 and a spring 72 at the other end, bears against a lug 73 on the cradle member. By tightening up the bolt and the spring against a lug 74, which is fixed to the housing member, the cradle is held against the screw.

Each cradle member, together with the roll therein, is properly adjusted and fixed longitudinally, preferably by means of a screw 75, which is fixed to the front housing member 4 and passes through an enlarged hole in a lug 76 on the cradle member. Nuts 77 are threaded on the screw on opposite sides of the lug 76. By adjusting and tightening these nuts against the lug 76, the longitudinal position of the cradle member may be fixed. A horizontal screw or screws 46 are provided in the rear of the base member opposite the rear end member of the roll housing so as to constitute an adjustable abutment therefor.

The mill is provided with a feed trough 53 which supports the work and centers it in the mill. In order to adapt this feed trough to work of different sizes, the delivery end thereof is vertically adjustable. For this purpose, said end is supported by a plate 54 which is provided with an elongated vertical slot or slots 54*a* through which extend locking screws or bolts arranged to clamp said plate to the frame of the mill. By this arrangement, the trough supporting plate may be adjusted to higher or lower positions as occasion requires.

The particular rolls shown herein and the pass formed thereby are not claimed herein but are fully described and claimed in my copending application Serial No. 94,841 filed August 7, 1936. They are illustrated herein as merely typical of the class of work rolls that may be used in cross-rolling mills in connection with the invention covered thereby.

What I claim is:

1. A tube rolling mill comprising a frame, a housing for the working rolls mounted on said frame and comprising end members, which are substantially parallel and relatively angularly adjustable, cradle members having universal connections with said end members and constituting seats for the working rolls, working rolls with their necks in said seats and arranged with their axes askew with relation to the planes of the axis

of the mill, said housing also comprising spacing members between said end members and detachable means for securing said members together, one of said end members having an arcuate bottom fitting arcuate seats on said frame, and means for turning said end member on said seat to change the angular relation of said end member with relation to the other end member of the housing.

2. A tube rolling mill comprising a frame, a housing for the working rolls mounted on said frame and comprising end members which are substantially parallel and relatively angularly adjustable, cradle members having universal connections with said end members and constituting seats for the working rolls, working rolls with their necks in said seats and arranged with their axes askew with relation to the planes of the axis of the mill, said housing also comprising spacing members between said end members and detachable means for securing said members together, one of said end members having an arcuate bottom fitting arcuate seats on said frame, and means for turning said end member on said seats to change the angular relation of said end member with relation to the other end member of the housing, said means comprising screws on said frame in operative relation to and on opposite sides of a lug on said end member.

3. A tube rolling mill comprising a base having end frames with seats at the tops thereof, one of said seats being in the form of a circular arc, and a mechanical unit removably mounted on said end frames, said unit comprising end plates fitting on the respective seats and having bearings for the necks of work rolls, means for spacing said end plates apart, means for clamping said end plates against said spacing means, adjusting means for partially rotating one of said end plates relative to the other about the axis of the mill when the clamping means are loosened, and work rolls journaled in said bearings.

4. A tube rolling mill comprising a base having end frames with seats at the tops thereof, one of said seats being in the form of a circular arc, and a mechanical unit removably mounted on said end frames, said unit comprising end plates fitting on the respective seats and having bearings for the necks of work rolls, means for spacing said end plates apart, means for clamping said end plates against said spacing means, adjusting means for partially rotating one of said end plates relative to the other about the axis of the mill when the clamping means are loosened, and work rolls journaled in said bearings, whereby said mechanical unit may be quickly replaced with a similar unit whose work rolls may be already mounted and adjusted before assembling said unit on the seats provided therefor.

5. A tube rolling mill comprising a base having end frames with seats at the tops thereof, one of said seats being in the form of a circular arc and the other seat being noncircular, and a mechanical unit removably mounted on said end frames, said unit comprising end plates fitting on the respective seats and having bearings for the necks of work rolls, means for spacing said end plates apart, means for clamping said end plates against said spacing means, adjusting means for partially rotating one of said end plates relative to the other about the axis of the mill, and work rolls journaled in said bearings, whereby said mechanical unit may be quickly replaced with a similar unit whose work rolls may be already mounted and adjusted before assembling said unit on the seats provided therefor.

6. A cross-rolling mill for elongating and reducing the wall thickness of a tubular blank comprising a frame, a housing for the working rolls removably mounted on the frame, working rolls supported by said housing and arranged to form a pass whose axis is disposed longitudinally with relation to said rolls, a feed trough on the entering side of the pass for centering the work between said working rolls and means for adjusting said feed trough vertically, said means comprising a vertically slotted section and a detachable fastening device extending through such slot, said housing being detachably secured to said frame so that it and the working rolls are removable as a unit from said frame.

7. A cross-rolling mill for elongating and reducing the wall thickness of a tubular blank comprising a frame, a housing for the working rolls removably mounted on the frame, working rolls supported by said housing and arranged to form a pass whose axis is disposed longitudinally with relation to said rolls, a longitudinally extending feed trough on the entering side of the pass for centering the work between said working rolls and means for adjusting said feed trough vertically, said means comprising a lower section adapted and arranged to be secured at various heights and an upper section conforming to the work, said housing being detachably secured to said frame so that it and the working rolls are removable as a unit from said frame.

8. A tube rolling mill comprising a frame, a housing for the working rolls mounted on said frame and having end members spaced apart and provided with radially disposed guideways for the respective ends of cradles, longitudinally disposed cradles with their ends slidably mounted in said guideways, working rolls with their ends journaled in the ends of said cradle members, and means for simultaneously adjusting like ends of all said cradles radially with relation to said mill axis.

9. A tube rolling mill comprising a frame, a housing for the working rolls mounted on said frame and having end members spaced apart and provided with radially disposed guideways, for the respective ends of cradles, cradles with their ends slidably mounted in said guideways, tapered working rolls with their necks seated in the ends of said cradle members with their axes askew with relation to the planes of the axis of the mill and inclining rearwardly toward the axis of the mill, and means for simultaneously adjusting the corresponding ends of said cradles radially with relation to said mill axis, said means comprising screws on the housing disposed opposite the ends of said guideways and constituting movable abutments for said ends of said cradle members and a single means for simultaneously operating all the screws at one end of the cradles and another single means for simultaneously operating all the screws at the other end of said cradles.

WALTER J. ASSEL.