Oct. 17, 1933.

R. C. STIEFEL

1,930,698

TUBE REDUCING MILL

Filed Jan. 6, 1932

2 Sheets-Sheet 1

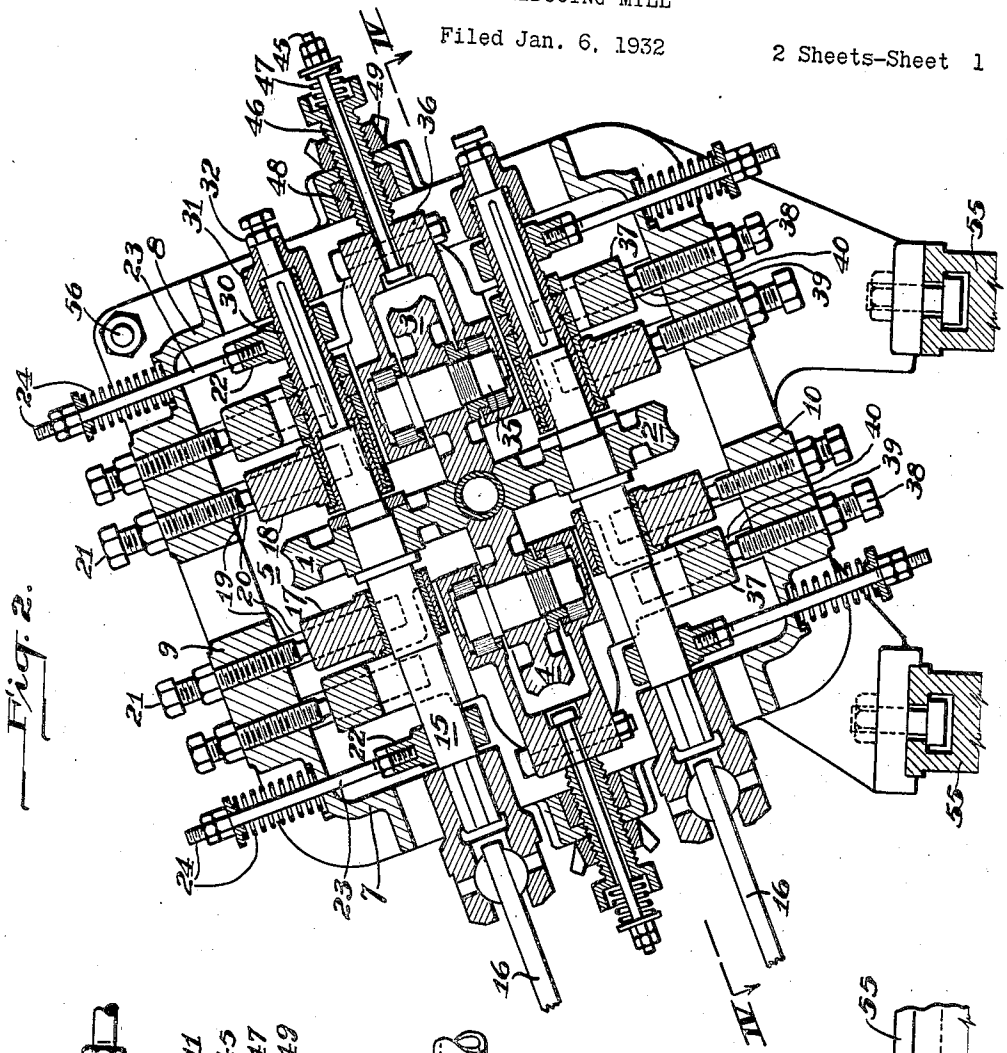


Fig. 2.

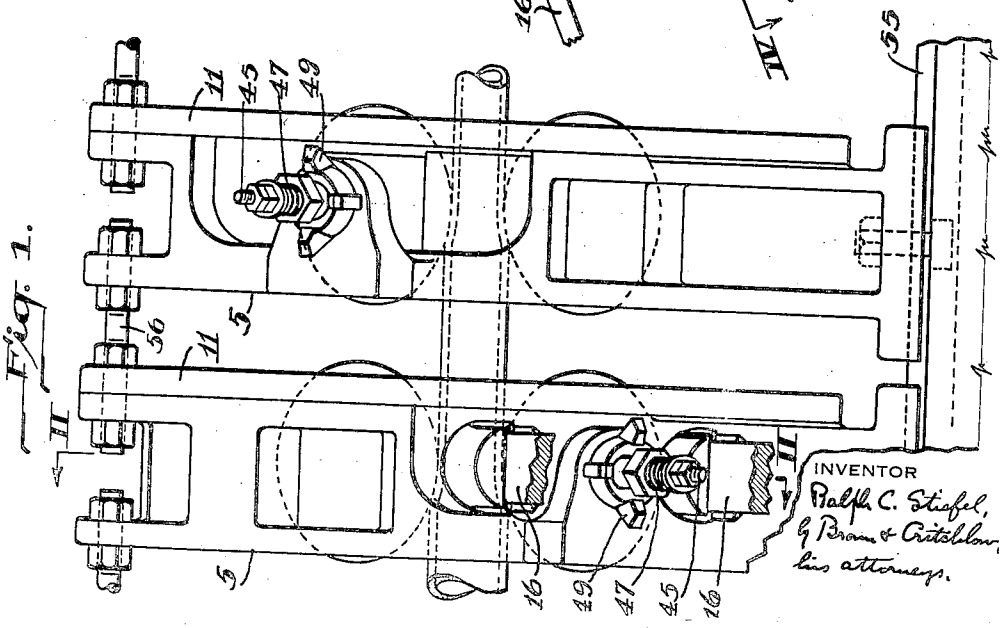


Fig. 1.

INVENTOR
Ralph C. Stiefel,
by Brown & Critchlow,
his attorneys.

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Fig. 3.

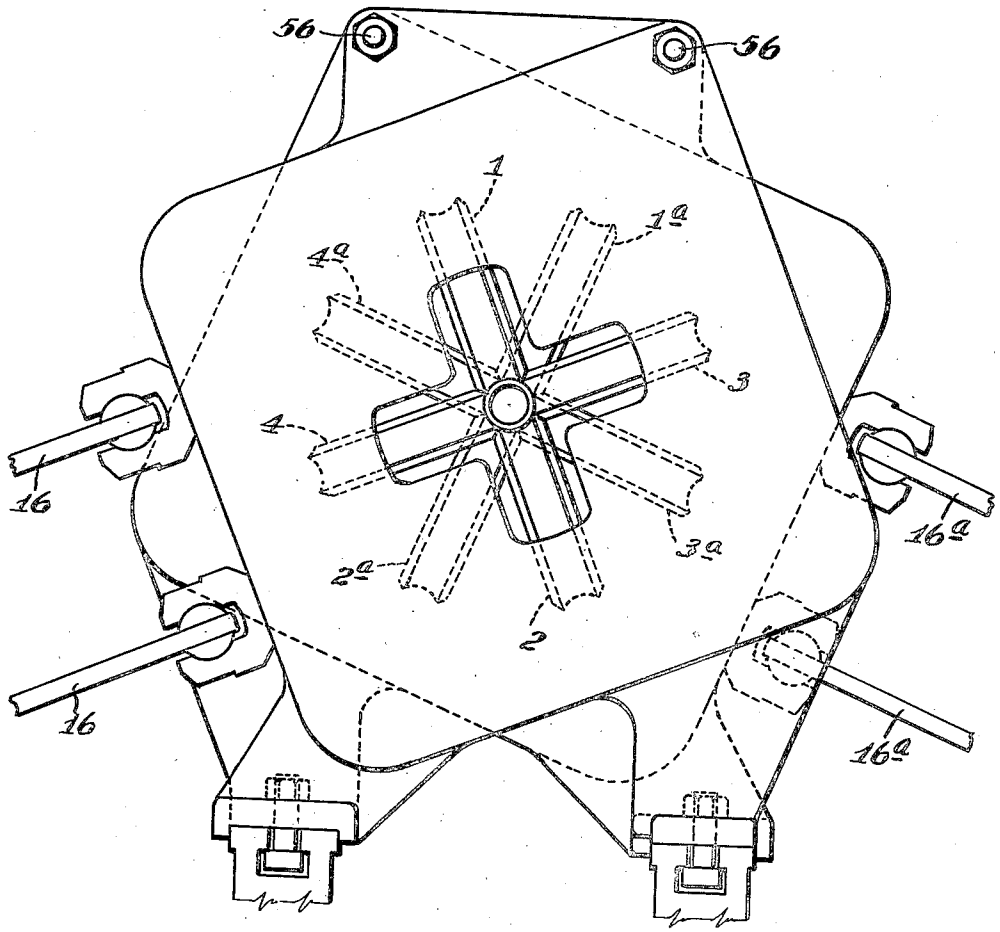
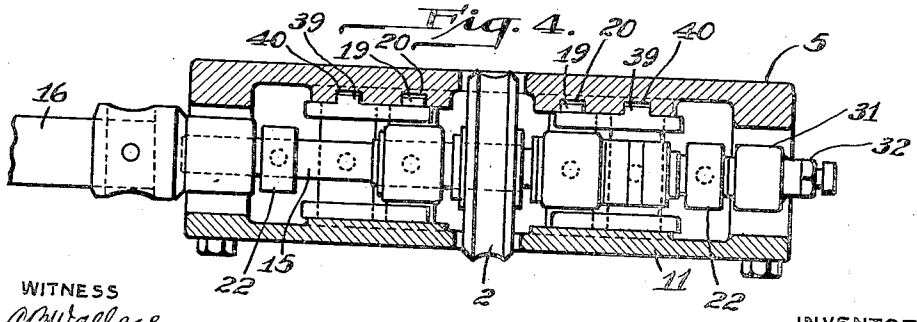


Fig. 4.



WITNESS

A. B. Wallace.

INVENTOR

Ralph C. Stiefel,

by Brown & Critchlow,

his attorneys.

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UNITED STATES PATENT OFFICE

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TUBE-REDUCING MILL

Ralph C. Stiefel, Ellwood City, Pa.

Application January 6, 1932. Serial No. 585,018

9 Claims. (Cl. 80—11)

The invention relates to tube-reducing mills of the quarto-pass type, by which is meant the type in which each pass is formed of two pairs of oppositely-disposed rolls, the axes of the rolls of adjacent stands being offset from each other angularly of the pass line to prevent the formation of external ridges or fins during reducing operations.

While the advantages of greater reductions and more uniformity of wall thicknesses obtainable by quarto-pass tube-reducing mills are well known, such mills are not extensively used, largely because of the complicated and expansive drives of the mills heretofore provided, and because of the difficulty, inherent in their overhanging mountings, of maintaining the rolls in their proper positions with relation to each other and to the pass line.

The objects of this invention are to improve and simplify the construction and operation of mills of the type explained, to the ends that their drives may be economically manufactured and maintained; that the rolls may be easily and accurately adjusted both transversely and longitudinally of their axes; that the rolls may be readily removed for redressing or replacement; and that each roll may be firmly supported on both of its sides.

The invention is illustrated in the accompanying drawings, of which Fig. 1 is a side view of two adjacent stands of rolls forming a part of a continuous tube-reducing mill; Fig. 2 a vertical sectional view of one of the stands, the plane of view being indicated by the line II—II, Fig. 1; Fig. 3 a face view of two adjacent stands of rolls; and Fig. 4 a sectional view taken on the plane indicated by the line IV—IV, Fig. 2.

As is usual in mills of the type herein contemplated, the mill illustrated in the drawings comprises a plurality of continuous stands of rolls arranged in tandem. All of the stands are preferably constructed alike except for the differences between adjacent stands essential to the different positions of their rolls. Some features of my invention concern the construction of a single stand of rolls, while others have to do with a continuous mill in which the several roll stands may differ, but in which they are preferably substantially the same.

According to this invention I provide a tube-reducing mill stand comprising a pair of oppositely-disposed driven rolls, and, intermediate thereof, a pair of oppositely-disposed idle rolls adapted to be rotated by frictional engagement of their faces with a blank being rolled, to which blank longitudinal movement is imparted by the driven rolls. Each roll is mounted in bearings on each side thereof, and provision is made for adjusting each roll both longitudinally and transversely of its axis. These two pairs of rolls, which form a quarto-pass, are mounted in a housing which is preferably of box-like form having a vertically-disposed face and pairs of oppositely-disposed peripheral flanges. The open face of the housing is closed by a detachable cover, the rolls being so mounted in the housing that when the cover is removed any one or all of the several rolls may be readily removed for replacement by different size rolls, or for redressing. The cover and the vertical face of the housing are preferably provided with openings through which the outer portions of the rolls protrude, thus making it possible to place successive stands of rolls closer together than could otherwise be done.

Having reference to the illustrative embodiment of the invention, and particularly to the roll stand shown in Fig. 2, a pair of oppositely-disposed driven rolls 1 and 2, and a pair of intermediate and oppositely-disposed idle rolls 3 and 4 are mounted in an upright housing having a vertically disposed face 5 and oppositely-disposed peripheral flanges 7, 8, 9 and 10. The open face of the housing is closed by a cover 11 (Figs. 1 and 4) suitably bolted to the flanges of the housing and cooperating with face 5 of the housing to hold the bearing blocks of the several rolls against lateral movements in the direction of the pass line. The construction, mounting and adjustments of each of the driven rolls 1 and 2 are preferably alike, which is also true of the idle rolls 3 and 4. As to the driven rolls, roll 1 is mounted on a shaft 15 provided at one of its ends with a wabbler for connecting it through a spindle 16 to a suitable driving pinion stand, not shown in the drawings. At each side of this roll, shaft 15 is mounted in a bearing carried by blocks 17 and 18, each of which is provided with a laterally extending rib 19 (Fig. 4) slidably mounted in a slot 20 formed in face 5 of the housing. Blocks 17 and 18 are backed by adjusting screws 21 which extend through flange 9 of the housing, the ends of shaft 15 beyond blocks 17 and 18 being engaged by saddles 22 in which the spindles are rotatably mounted. To the saddles there are attached rods 23 extending through housing flange 9 and yieldingly urged outwardly by springs 24, shaft 15 being thus urged in the direction to hold blocks 17 and 18 against adjusting screws 21. To

adjust roll 1 transversely of its axis, it is only necessary to turn the adjusting screws 21 in the proper direction to cause blocks 17 and 18 to move, the tension in springs 24 being variable to properly urge blocks 17 and 18 into firm contact with the adjusting screws at the variable positions of the roll.

Provision is made for adjusting shaft 15 longitudinally of its axis to bring and maintain roll 1 in proper registration with the other rolls forming the pass. For this purpose the undriven end of shaft 15, shown as the right end in Fig. 2, is surrounded by a sleeve 30 which is rotatable with but longitudinally movable on the shaft, the sleeve being suitably splined to the shaft for this purpose. Sleeve 30 lies within, and is engaged by, the shaft bearing formed in block 18, the construction and arrangement being such that block 18, through the engagement of its rib 19 with slot 20 in housing face 5, holds the sleeve against longitudinal movement. At its outer end, sleeve 30 is engaged by a nut 31 which is provided interiorly with a flange adapted to seat upon a shoulder formed on the outer end of shaft 15. A reduced portion of shaft 15 projects beyond this shoulder and beyond the outer end of flanged nut 31, and is threaded for engagement by a nut 32. To adjust roll 1 to the left, as viewed in Fig. 2, flanged nut 31 is screwed upon sleeve 30 the amount of the desired adjustment, nut 32 being first backed off the threaded extension of shaft 15 so that the flange of nut 31 will move shaft 15 to the left. When it is desired to adjust roll 1 to the right, nut 32 is backed off the extension of shaft 15 and flanged nut 31 backed off the end of sleeve 30 the desired amount, after which nut 32 is screwed upon the extension of shaft 15 to bring its shoulder against the interior flange of nut 31 which may be held against rotation by a wrench.

Having reference now to idle rolls 3 and 4, the construction, mountings and adjustments of which are alike, roll 3 is mounted on a short shaft 35, each end of which is rotatably mounted in a block 36, roller bearings being preferably used to reduce frictional resistance to the rotation of this idle roll. Bearing upon each side of block 36 there is a shoe 37 which is forked at its inner end to straddle shaft 15 and the sleeve 30 and lock nuts surrounding this shaft. Each of these shoes is backed by an adjusting screw 38, and, like blocks 17 and 18, each shoe is provided with a rib 39 (Fig. 4) slidably mounted in a slot 40 formed in housing face 5, the arrangement being such that by turning both of the adjusting screws 38 in the same direction block 36 may be moved longitudinally of the axis of shaft 35 to adjust roll 3, which is then held in its desired adjusted position by and between the inner ends of shoes 37.

As previously stated, provision is made for adjusting each idle roll transversely of its axis. For this purpose block 36 is engaged by the inner end of a rod 45 which extends through an externally threaded sleeve 46 and is urged outwardly by a spring 47 acting between the outer end of sleeve 46 and a shoulder formed on the outer end of the rod. The outer end of block 36 is thus yieldingly urged against the inner end of sleeve 46, which has threaded engagement with a nut or bushing 48 held in a casing formed integrally with the housing. To adjust block 36 in a direction transversely of the axis of roll 3, and in turn to similarly adjust this roll, it is only necessary to turn sleeve 46 in one direction or the other, a lock nut 49 on the sleeve being first loosened or backed from its locking position. During such adjustment of block 36, its parallel sides which are perpendicular to the axis of roll 3, slide upon the inner faces of shoes 37, which may be loosened somewhat to facilitate the adjustment.

As indicated above, when the several rolls are assembled in the housing in the manner shown in Fig. 2, and cover 11 is bolted or otherwise attached to the housing, the several bearing blocks 17, 18 and 36, and the several shoes 37, are held by and between cover 11 and housing face 5.

In continuous quarto-pass tube-reducing mills of the type herein contemplated, the rolls of successive stands normally have their axes offset 45° from each other angularly of the line of pass. To thus position successive stands of rolls provided according to this invention, and to simplify the drives, the axes of each pair of driven rolls are preferably inclined 22½° to the horizontal, and in adjacent stands these rolls are driven from opposite sides of the mill. This construction and arrangement is illustrated in Fig. 3 which shows the driving spindles 16 of one stand of rolls at the left and driving spindles 16*a* of an adjacent stand of rolls at the right of the mill. In the stand driven from the left, the driven rolls 1 and 2, and the idle rolls 3 and 4 are shown in the same positions in which they appear in Fig. 2, and in the stand driven from the right, driven rolls 1*a* and 2*a*, and idle rolls 3*a* and 4*a* are shown as being offset 45° angularly of the pass and with relation to the rolls of the first-mentioned stand. The rolls, roll shafts, bearing blocks, and other elements of their construction, mounting and adjustment, may be the same in each stand, and the roll housings may also be the same with the exception that adjacent housings are right and left-hand with relation to each other.

In the assembly of a continuous mill of roll stands provided according to this invention, all of the stands may be suitably anchored upon a single bed 55, and the upper ends of the stands may be suitably tied together by rods 56, Fig. 1. While the drives for the mills are not shown, it will be understood that any suitable or well known form of drives may be provided to the end that the speed of each stand may be varied with relation to the preceding stand with due allowance for the elongation of a blank effected in each pass. The reducing action of each roll pass is the same as if both pairs of rolls were driven, there being less tendency of a blank to slide upon the faces of the idle than upon those of the driven rolls because the moment tending to resist rotation of the idle rolls is much less than that tending to rotate them by the frictional engagement of a blank with the faces of the driven rolls.

Among the advantages of the tube-reducing mill which I have provided is the simplicity of its drive, there being no complicated trains of bevel pinions and gears interconnecting the rolls. Also, each roll is mounted in bearings on its opposite side so that the difficulties incident to overhanging rolls is eliminated. Furthermore, simple adjustments, both longitudinally and transversely of the axis of each roll, are provided, and the rolls may be easily removed from a housing after its cover has been removed.

According to the provisions of the patent statutes, I have explained the principle and operation of my invention, and have illustrated

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 as my invention:

1. A mill comprising a pair of oppositely-disposed rolls rigidly mounted on parallel shafts, a second pair of oppositely-disposed rolls mounted at substantially right angles to said first pair between said shaft, means mounted on each of said shafts for adjusting them axially, means for adjusting them toward and away from each other, and means for adjusting said second pair of rolls both transversely and longitudinally of their axes of rotation.

2. A mill comprising a pair of oppositely-disposed rolls rigidly mounted on parallel shafts, a second pair of oppositely-disposed rolls mounted at substantially right angles to said first pair between said shafts, means rotatable with each of said shafts for adjusting it axially, means for adjusting each of said shafts toward and away from the other, and means for adjusting said second pair of rolls both transversely and longitudinally of their axes of rotation.

3. A mill comprising a pair of oppositely-disposed rolls rigidly mounted on parallel shafts, a second pair of oppositely-disposed rolls mounted at substantially right angles to said first pair between said shafts, means adjacent to one end of each of said shafts for adjusting it axially, means for biasing the rolls of each pair away from each other, means for adjusting them toward each other, and means for adjusting said second pair of rolls longitudinally of their axes of rotation.

4. A mill comprising a pair of oppositely-disposed rolls rigidly mounted on parallel shafts, a second pair of oppositely-disposed rolls mounted at substantially right angles to said first pair between said shafts, means connected to said shafts for adjusting them axially, means for adjusting them toward and away from each other, and means for adjusting said second pair of rolls both transversely and longitudinally of their axes of rotation, the longitudinally adjusting means also serving as guides between which the rolls of said second pair are moved transversely of their axes of rotation.

5. A tube-reducing mill comprising a pair of oppositely-disposed driven rolls rigidly mounted on parallel shafts, a pair of oppositely-disposed idle rolls intermediate thereof and adapted to be rotated by frictional engagement with a blank being rolled, means connected to the free ends of said shafts for adjusting them axially, means for adjusting them transversely of their axes, means for adjusting said idle rolls transversely of their axes of rotation, and bifurcated means for also adjusting them longitudinally of said axes of rotation, said shafts extending through said bifurcated means.

6. A tube-reducing mill comprising a pair of oppositely-disposed driven rolls rigidly mounted on parallel shafts, a pair of oppositely-disposed idle rolls intermediate thereof and adapted to be rotated by frictional engagement with a blank being rolled, means connected to the free ends of said shafts for adjusting them axially, means for adjusting them transversely of their axes, means for adjusting said idle rolls transversely of their axes of rotation, and means for also adjusting them longitudinally of said axes of rotation, the longitudinally-adjusting means extending transversely of said shafts and forming guideways for the transverse adjustment of the idle rolls.

7. A tube-reducing mill comprising a pair of oppositely-disposed driven rolls rigidly mounted on parallel shafts, a pair of oppositely-disposed idle rolls intermediate thereof and adapted to be rotated by frictional engagement with a blank being rolled, bearing blocks carrying said shafts and adjustable transversely of the axes thereof, saddles surrounding the shafts, resilient means connected to the saddles for biasing the shafts away from each other, means connected to the free ends of the shafts for adjusting them axially, means for adjusting said idle rolls toward and away from each other, shoes straddling said shafts, and means for adjusting the shoes transversely of said shafts to move the idle rolls longitudinally of their axes of rotation.

8. A tube-reducing mill comprising a pair of oppositely-disposed driven rolls mounted on parallel shafts having the tips of their free ends threaded and reduced to form shoulders, a pair of oppositedly-disposed idle rolls intermediate said driven rolls and adapted to be rotated by frictional engagement with a blank being rolled, means for adjusting said shafts transversely of their axes, a sleeve slidably splined on the free end-portion of each shaft and anchored against longtiudinal movement, an internally threaded nut threaded on the outer end of each sleeve and having an internal flange encircling said reduced tip of the shaft and abutting against said shoulder formed on the shaft, a second nut threaded on the end of said reduced threaded tip and bearing against said flanged nut, and means for adjusting said idle rolls both transversely and longitudinally of their axes of rotation.

9. A tube-reducing mill comprising a housing, a pair of oppositely disposed driven rolls rigidly mounted on parallel shafts within the housing, a pair of oppositely-disposed idle rolls intermediate said driven rolls and adapted to be rotated by frictional engagement with a blank being rolled in said housing, bearing blocks carrying said shafts and adjustable transversely of the axes thereof, saddles surrounding the shafts, resilient means connected to the saddles for biasing the shafts away from each other, means connected to the free ends of the shafts for adjusting them axially, means for adjusting said idle rolls toward and away from each other, shoes straddling said shafts, and means for adjusting the shoes transversely of said shafts to move the idle rolls longitudinally of their axes of rotation, said bearing blocks and shoes being provided with ribs extending axially of their lines of movement and registering with cooperating guide-grooves in one wall of said housing, whereby said blocks and shoes are maintained in position.

RALPH C. STIEFEL.