Dec. 15, 1936. S. W. WHEELER 2,064,453

FORMING MILL

Filed March 30, 1936 3 Sheets-Sheet 1

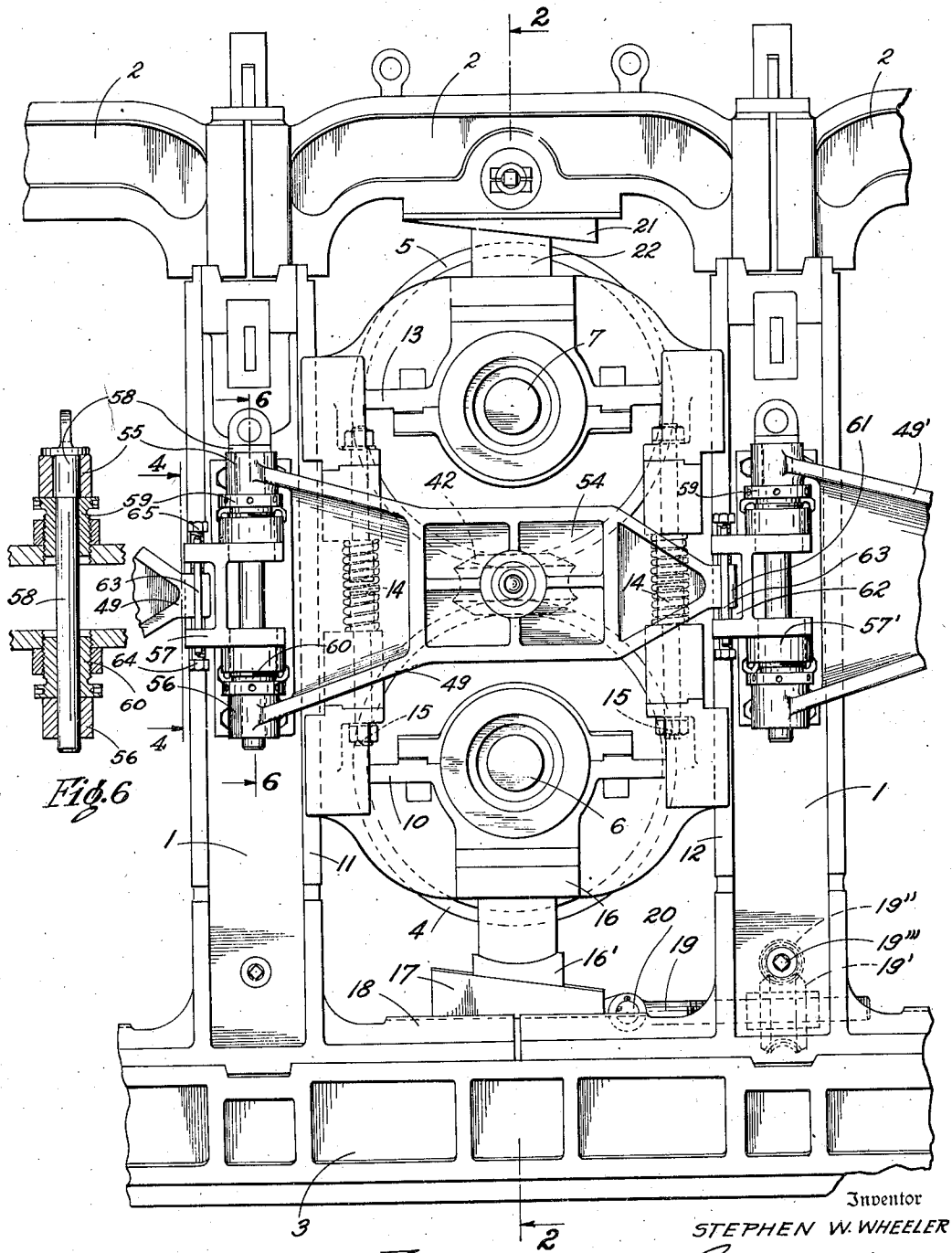


Fig. 6

Fig. 1

Inventor
STEPHEN W. WHEELER
By Richey & Watts.
Attorneys

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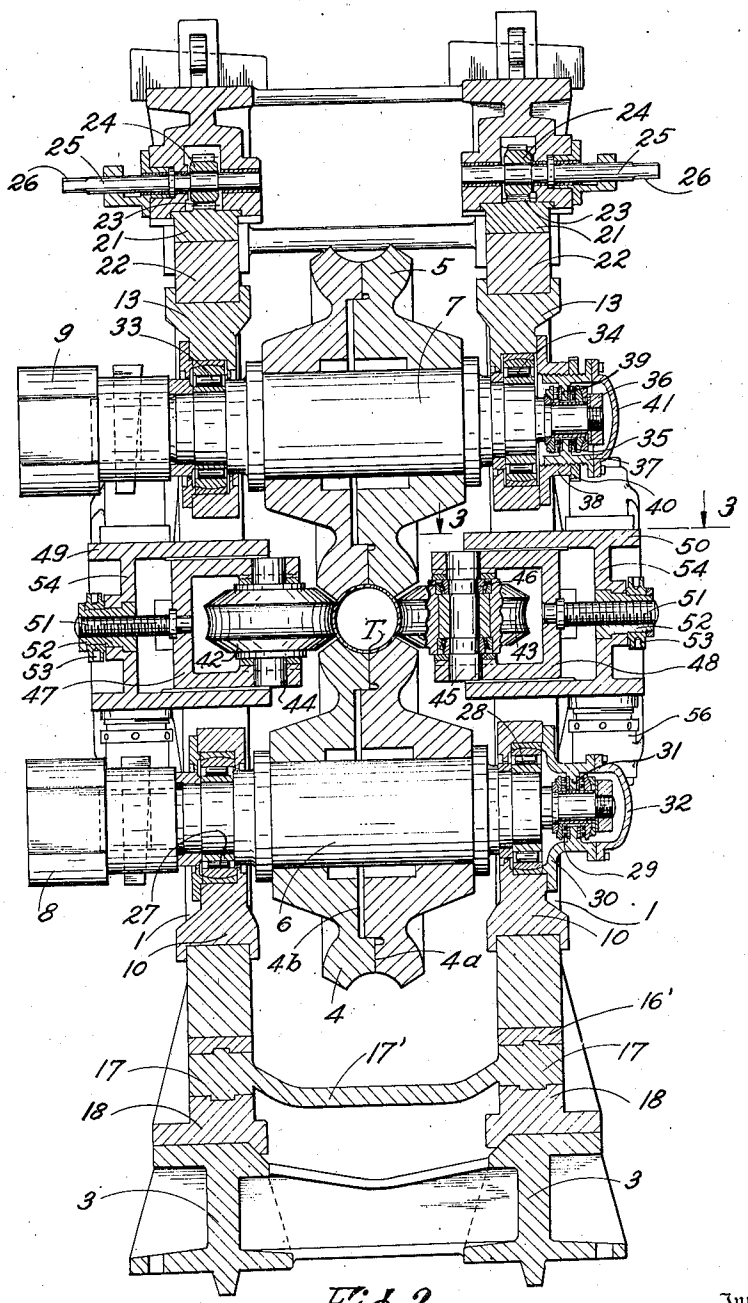


Fig. 2

Inventor
STEPHEN W. WHEELER
By Richey & Watts.
Attorneys

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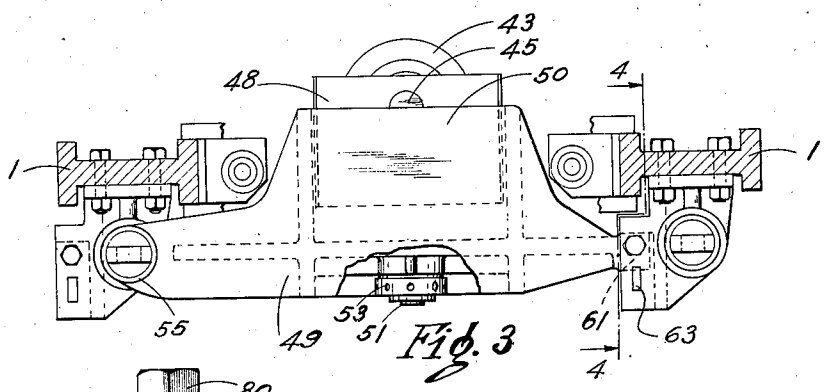


Fig. 3

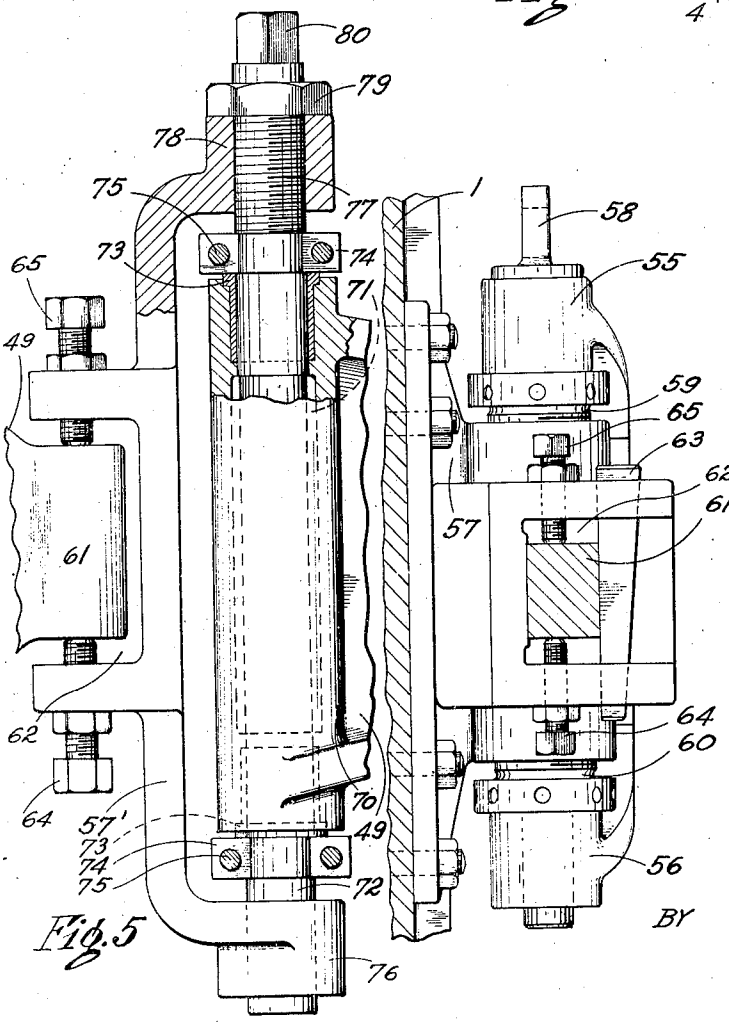


Fig. 4

Fig. 5

Inventor
STEPHEN W. WHEELER
BY Ridley & Watts
Attorneys

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UNITED STATES PATENT OFFICE

2,064,453

FORMING MILL

Stephen William Wheeler, Youngstown, Ohio, assignor to Republic Steel Corporation, Cleveland, Ohio, a corporation of New Jersey

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12 Claims. (Cl. 80—34)

This invention relates to metal forming or sizing mills and more particularly to roll stands in which more than two rolls are employed to define a single roll pass.

It is common practice in the art of rolling metal to provide a mill having a pair of horizontal rolls and a pair of vertical rolls, the center lines of all the rolls being disposed in a common plane and the vertical rolls being disposed approximately 90° from the horizontal rolls. This roll arrangement is particularly adaptable to rolling round shapes such as pipes or tubes, and it is among the objects of my present invention to provide an improved rolling mill of this general type in which roll changes may be quickly and easily effected. In tube mills it is frequently necessary to change the rolls to accommodate different size tubes and with my improved roll supporting arrangement the time and labor required for such a change is reduced to a minimum.

A further object of my invention is the provision of a forming or sizing mill in which the rolls may be accurately and readily adjusted to provide proper alignment with adjacent roll passes and to define properly the opening between the rolls of a single pass.

Another object of my invention is the provision of a mill of the type described in which both the horizontal and vertical rolls may be simultaneously removed from the mill and changed and in which inspection of the rolls is greatly facilitated.

In the accompanying drawings I have illustrated my improved mill as comprising one roll pass of a series of passes adapted to roll tubes of circular cross section. However, it will be understood by those skilled in the art that my improved roll supporting and adjusting mechanism may be utilized in other types of mills and I do not, therefore, wish to be limited to the specific application of my invention which is illustrated in the drawings and described in this specification.

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

Figure 1 is a side elevation illustrating a tube forming mill embodying my invention, said mill comprising one of a series of roll passes in a tube mill.

Figure 2 is a vertical cross sectional view, some of the parts being shown in full view for better illustration, taken on line 2—2 of Figure 1.

Figure 3 is a fragmentary plan view taken on line 3—3 of Figure 2 and illustrating the hinged vertical roll supporting housing.

Figure 4 is an enlarged end elevational view taken on line 4—4 of Figure 1 illustrating the vertical roll supporting housing pivot or hinge and the vertical adjustment means therefor.

Figure 5 is a view generally similar to Figure 4 but illustrating a modified adjustable hinge arrangement for supporting the vertical roll housing.

Figure 6 is a vertical cross section taken on line 6—6 of Figure 1.

Referring to the drawings, the roll housing includes the vertical main frame side members 1 and the transverse main frame top member 2. A suitable base 3 is provided and the frame members 1 are properly located thereon. The horizontal rolls 4 and 5 are mounted on shafts 6 and 7 which are adapted to be driven from any suitable source of power (not shown) which may be connected to the couplings 8 and 9. The horizontal rolls 4 and 5 are each preferably of the split type. Referring to roll 4, Figure 2, the two halves of the roll are split vertically at 4^a and the left hand half of the roll is recessed as at 4^b. This roll construction increases the useful life of the roll. When, due to wear, the edges of the roll pass become worn and enlarged the roll may be taken off the shaft and the vertical face 4^a of either half of the roll cut down, the roll halves reassembled and the roll profile re-formed. In this manner the roll contour can be kept at the same radius during a series of dressing operations.

The bottom roll shaft 6 is supported in bearings carried in the vertically movable bracket 10 which is guided by the vertical flanges 11 and 12 of the frame members 1. The upper roll shaft 7 is mounted in bearings carried by a similar bracket 13 which is also guided and supported for vertical movement on the flanges or guideways 11 and 12. Springs 14 are disposed between each of the brackets 10 and 13 and are held in position by pins 15. These springs 14 are under compression and at all times exert a force tending to move the brackets 10 and 13 apart. The lower bracket 10 is formed with a downwardly extending portion 16, at the bottom of which is a block 16' which has an inclined surface engaging an adjusting wedge.

This wedge member includes a pair of inclined members 17 and a connecting yoke 17'

and is supported by and has sliding movement, in direction parallel to the tube movement, upon the transverse portion 18 of the frame members 1. An adjusting screw 19 is attached to the wedge at 20 (Fig. 1) and suitable means, such as the worm gear 19', worm 19'' and square headed worm shaft 19''', may be provided for moving the screw 19 and inclined surfaces 17 along the frame 18. It will be seen that such movement of the inclined surfaces 17 will raise or lower the bracket 10 together with the shaft 6 and bottom roll 4.

The upper roll 5 is adjusted by moving the wedge members 21, which have inclined surfaces engaging correspondingly inclined surfaces on the blocks 22 carried by the brackets 13. The springs 14 normally hold the brackets 13 and blocks 22 up against the wedges 21. Movement of the wedges 21 to the left in Figure 1 will cause the brackets 13 and the roll 5 to move downwardly. When the wedges 21 are moved to the right the springs 14 will lift the brackets 13 and the roll 5. Thus, the roll 5 is supported by the transverse frame member 2 against all upward forces which occur during operation of the mill.

Referring to Figure 2, the means for adjusting the wedges 21 are clearly shown and include racks 23 formed on the wedges 21 and pinions 24 engaging the racks 23 and mounted on shafts 25. These shafts are supported for rotation in suitable brackets and are provided with squared ends 26, in the same manner as worm shaft 19''', to accommodate a wrench (not shown) whereby the pinions 24 may be rotated causing the racks 23 and the wedges 21 to move parallel to the direction of movement of the tube. The block members 22 are supported in the brackets 13 and provide a convenient means for spacing the brackets 13 from the wedges 21. Larger or smaller blocks 22 may be employed, depending on the size of the top roll being used, without making it necessary to change the wedges 21 or the supporting brackets 13.

The bottom horizontal roll shaft 6 is mounted on one side in a roller bearing 27 and on the other side in a similar roller bearing 28 and a ball thrust bearing 29. The cap member 30 is provided with an inwardly extending flange 31 which is disposed between the two rows of balls of the bearing 29 and thus positively locks the shaft 6 from axial movement. A closure cap 32 is provided to retain lubricant in the bearings 28 and 29. Thus, it will be seen that the bottom roll 4 may be adjusted vertically by means of the wedge 17 but is not provided with any lateral adjustment and it will be understood that the other three rolls which make up the complete roll pass will be adjusted relative to the bottom roll 4 to provide the desired form of roll pass.

The upper roll shaft 7 is supported at its left hand end (Fig. 2) by a roller bearing 33 and at its right hand end by a roller bearing 34 and a double row ball thrust bearing 35. The ball thrust bearing is held in position on the reduced end of the shaft 7 by a nut 36 and a threaded adjusted sleeve 37 engages corresponding threads in the housing 38. The adjusting sleeve 37 is also provided with an inwardly extending flange or web 39 which fits between the two rows of balls which make up the thrust bearing 35.

As the roller bearings 33 and 34 are adapted to permit a limited axial movement of the shaft 7 it will be seen that, when the adjusting sleeve 37 is turned, the shaft 7 and the roll 5 will be moved axially. A lock nut 40 is provided for locking the adjusting sleeve 37 in the desired position. A cap member 41 is provided which is generally similar and serves the same function as the cap 32 on the lower roll shaft 6.

By means of the wedges 21 and the adjusting sleeve 37 the roll 5 can be adjusted both vertically and horizontally and thus can be accurately positioned relative to the bottom roll 4 so that the profile or contour of the roll 5 will constitute a portion of the same circle as roll 4, regardless of minor variations in the rolls due to discrepancies in machining or to wear.

The vertical or idler rolls 42 and 43 are mounted on shafts 44 and 45 respectively. As illustrated in Figure 2, antifriction bearings 46 are employed so that the rolls 42 and 43 rotate freely on their shafts. The shafts 44 and 45 are carried by brackets or sub-housings 47 and and 48 respectively, which brackets are supported on suitable guideways in the main idler roll housings 49 and 50 in such a manner that they may be moved toward or away from the center of the tube T as seen in Figure 2. Each bracket 47 and 48 carries a screw 51 which extends through a threaded bushing 52. Adjusting nuts 53 are secured to each bushing 52 and are adapted to hold them in position in the vertical webs 54 of the main side roll housings 49 and 50. As the bushings 52 are rotatably mounted in the webs 54 it will be seen that rotation of the nuts 53 will rotate the bushings 52 and cause the screws 51 to move in or out, depending upon the direction of rotation. As the screws 51 are secured to the sub-housings or brackets 47 and 48, the above described mechanism provides means for adjusting the idler rolls 42 and 43 horizontally toward and away from the center of the roll pass.

Referring now particularly to Figures 1, 3 and 4, the main housings 49 and 50 have hinged connection at one end to the frame members 1. As the construction of the housing 50 is identical with that of the housing 49 only the housing 49 will be referred to in the following description as this is clearly seen in Figure 1.

The left hand end of the housing 49 (Fig. 1) carries spaced bearing portions 55 and 56 disposed above and below the outwardly projecting bracket 57 which is bolted to the frame member 1, as shown in Figure 4. A pin 58 extends through the bearing portions 55 and 56 and the bracket 57, thus forming a hinge which supports the housing 49 in such a manner that it may be swung about the pin 58 as a pivot.

In order to provide means for vertically adjusting the idler roll 42, threaded bushings 59 and 60 are mounted on the pin 58 and serve to space the bearing portions 55 and 56 of the housing 49 from the supporting bracket 57. These bushings 59 and 60 are threaded into the bracket 57 and it will be clearly seen from Figure 4 that by turning the bushings 59 and 60 simultaneously the bearing portions 55 and 56 may be raised or lowered relative to the bracket 57 and thus the idler roll 42 may be adjusted vertically.

In Figure 5 an optional form of adjustable hinge is illustrated for supporting the housing 49. In this embodiment the housing 49 is formed with a sleeve portion 70 which is suitably bored, as seen at 71, for the hinge shaft or pin 72. Bushings 73 are secured in the ends of the bore

71 by means of the split clamps or collars 74. These collars 74 are each formed in two halves which may be secured together by screws 75 and serve to prevent movement of the sleeve portion 70 and the housing 49 axially of the pin 72 while permitting the sleeve 70 and housing 49 to swing about the pin 72 as a pivot. The bottom end of the pin 72 is supported in a suitable aperture in the lower end 76 of the bracket 57' while the upper end is threaded at 77 and has threaded engagement in the portion 78 of the bracket 57'. A lock nut 79 serves to hold the pin 72 in adjusted position. It is seen that clearance is provided between the portions 76 and 78 of the bracket 57' and the split collars 74. Thus, by loosening the lock nut 79 and applying a suitable wrench to the squared end 80 of the pin 72, this pin may be turned and, due to its threaded engagement with the portion 78 of the bracket 57', the pin 72, together with the vertical roll housing 49, may be accurately adjusted in a vertical direction. Of course, this vertical adjustment will not interfere with the free swinging or hinge action of the housing 49 about the pin 72.

The right hand end of the housing 49 is reduced as seen at 61 (Figs. 1 and 3) and, when the roll 43 is in operating position, lies in a recess 62 in the bracket 57'. This bracket 57' may conveniently be similar to bracket 57 and in addition to serving as means for latching the swinging housing 49 in position, it is adapted to carry the side roll housing 49' of the next roll pass. A wedge 63 serves to firmly secure and yet permit ready release of the end 61 of the housing 49 in position and the end 61 may be supported and adjusted vertically by means of set screws 64 and 65.

From the above description of the illustrated embodiment of my invention it will be seen that the bottom horizontal roll may be adjusted vertically by means of the wedge 17 but is fixed insofar as horizontal movement is concerned. The top horizontal roll 5 may be adjusted vertically by means of the wedges 21 operated by racks and pinions 23 and 24 and may be adjusted horizontally by means of the threaded adjusting sleeve 37. The vertical idler rolls 42 and 43, when in operating position with the housings 49 and 50 locked in the position shown in Figure 1, may be adjusted horizontally by means of the screws 51 and adjusting nuts 53 acting through the bushings 52. These idler rolls may also be adjusted vertically by proper setting of the adjusting bushings 59 and 60 at the hinged end of the supporting frames. Thus, the rolls may be easily and accurately maintained in the proper positions to form a pass of the desired contour regardless of wear of the rolls or inaccuracies in finishing the rolls.

Although in the apparatus illustrated and described herein the bottom roll 4 is adjustable only in the vertical direction it will be understood by those skilled in the art that, if desired, this roll may also be made adjustable horizontally in the manner of roll 5. Further, although a procedure for setting the rolls has been described in which all of the rolls are adjusted relative to the bottom horizontal roll 4, it will be understood that any or all of the rolls may conveniently be adjusted relative to any one of the rolls which is retained in fixed position. For example, the rolls might be adjusted to one of the vertical rolls rather than to one of the horizontal rolls and thus my arrangement provides great flexibility, accuracy and ease of adjustment.

If it becomes necessary or desirable for any reason to change the rolls of the mill the wedges 63 will be removed thus permitting the idler roll housings 49 and 50 to be swung back completely out of the way. When in this position the sub-housings 47 and 48 may be readily removed and new rolls, of the proper size, placed in the sub-housings. If desired entirely new assemblies of sub-housings and rolls may be inserted in the main housings 49 and 50. While the side rolls are swung back out of the way the main rolls may be much more readily removed and replaced than is the case where the side rolls are mounted on immovable brackets. My improved hinged side roll supports also greatly facilitate changing the side rolls which may become worn or damaged in use and speeds up the entire roll changing procedure. Moreover, an extremely simple and rigid support for the side rolls is provided as it will be seen that when the wedges 63 are driven into place and the set screws 64 and 65 tightened the supporting frames 49 and 50 will be very rigidly held in place.

Although I have described the illustrated embodiment of my improved mill in considerable detail it will be understood by those skilled in the art that numerous variations and modifications may be made without departing from the spirit of my invention. For example, as noted above, the bottom roll 4 might also be made adjustable axially if such an arrangement should be deemed desirable. Therefore, I do not wish to be limited to the specific arrangement herein shown and described, but claim as my invention all embodiments thereof coming within the scope of the appended claims.

I claim:

1. In apparatus of the type described, a frame structure comprising a pair of horizontally spaced uprights supporting horizontal rolls therebetween, a vertical roll housing, hinge means for securing said housing to the outer side of one of said uprights, whereby said housing may swing clear of the frame structure, and means for adjusting said housing in a vertical direction.

2. In apparatus of the type described, a frame structure, a pair of horizontal rolls mounted on shafts rotatably supported in said frame structure, means for adjusting each of the said horizontal rolls and shafts vertically in said frame, means for adjusting one of said horizontal rolls axially, a vertical roll housing hinged to said frame and extending between said horizontal roll shafts, said housing being adapted to be swung about its hinge to bring its vertical roll either into rolling position or clear of the frame structure, a vertical roll carried by said hinged housing, and means for adjusting said vertical roll in a vertical direction.

3. Apparatus of the type described including a frame structure, a pair of horizontal rolls mounted on shafts and supported by said frame structure, means for adjusting said horizontal rolls in a vertical direction, a pair of vertical rolls, housings for said vertical rolls, said housings being hinged at one end to said frame structure, means for adjusting said housings vertically, sub-housings carried by said vertical roll housings, shafts for said vertical rolls, bearings in said sub-housings adapted to support said shafts, and means for adjusting said sub-housings horizontally.

4. In apparatus of the type described, a base, spaced vertically extending frame members mounted on said base, a pair of horizontal rolls, bearings for said rolls mounted on brackets for vertical adjustment relative to said vertical frame members, spring means extending between said roll bearing brackets and adapted to exert a force tending to move said horizontal rolls apart, means for adjusting the vertical position of said horizontal rolls and brackets, a vertical roll, a vertical roll housing hinged at one end to one of said vertical frame members and extending to an adjacent vertical frame member, means for detachably securing said roll housing to said last named frame member, means for adjusting said hinged vertical roll housing in a vertical direction, and a sub-housing carrying said vertical roll and mounted for horizontal adjustment in said hinged housing.

5. In apparatus of the type described, a frame including a pair of vertical members spaced in the direction of rolling, a pair of horizontal rolls supported in said frame, means for adjusting said horizontal rolls toward and away from each other, a vertical roll adapted to cooperate with said horizontal rolls in forming a roll pass, a vertical roll housing pivotally secured at one end to one of said vertical frame members for swinging movement to a position outside of said frame, said housing being adapted, when in rolling position, to extend to another of said vertical frame members, means for detachably securing the other end of said vertical roll housing to said last named frame member, and means for adjusting said vertical roll in a vertical direction.

6. In apparatus of the type described, a frame including spaced pair of vertical members, a pair of horizontal rolls supported in said frame, means for adjusting said horizontal rolls toward and away from each other, a vertical roll adapted to cooperate with said horizontal rolls in forming a roll pass, a vertical roll housing pivotally secured at one end to one of said vertical frame members and detachably secured at the other end to an adjacent frame member, said housing and its vertical roll being swingable about its pivot to a position outside said frame, and means for adjusting the vertical position of said hinged housing.

7. In apparatus of the type described, a frame including vertical members spaced along the path of the work, a pair of horizontal rolls supported in said frame, means for adjusting said horizontal rolls toward and away from each other, a vertical roll adapted to cooperate with said horizontal rolls in forming a roll pass, a vertical roll housing pivotally secured at one end to one of said vertical frame members and adapted, when in rolling position, to extend to another of said vertical frame members, means for detachably securing the other end of said vertical roll housing to said last named frame member, means for effecting vertical adjustment of said hinged vertical roll housing, and means, carried by said hinged housing, for horizontally adjusting said vertical roll.

8. In apparatus of the type described, a frame, a housing for a vertical roll, a vertical roll in said housing, said housing being pivotally attached at one end to the frame and detachably connected at the other end to the frame and being swingable about its pivot to swing the roll clear of the frame, and means for vertically adjusting the position of the vertical roll.

9. In apparatus of the type described, a frame, a housing for a vertical roll, and vertically adjustable hinge means for supporting said housing on said frame, said hinge means including a bracket on said frame, spaced bearing portions on said housing adapted to be disposed on opposite sides of said frame bracket, a pin extending through said bearing portions and said bracket to complete the hinged connection, and threaded bushings disposed between said bracket and said bearing portions and having threaded engagement with said bracket whereby said bearing portions and said housing may be adjusted relative to said frame bracket.

10. In apparatus of the type described, a frame, a housing for a vertical roll, and vertically adjustable hinge means for supporting said housing on said frame, said hinge means including a bracket on said frame, said bracket having apertured end portions, a sleeve carried by said housing, a pin or shaft extending through said sleeve and into said apertured end portions of said housing, means for preventing substantial movement of said sleeve axially of said pin while permitting rotation of said sleeve about said pin, one end of said pin having threaded engagement with said bracket whereby rotation of said pin will effect vertical adjustment of said pin, sleeve and bracket.

11. In apparatus of the type described, a frame, a housing for a vertical roll, and vertically adjustable hinge means for supporting said housing on said frame, said hinge means including a bracket on said frame, said bracket having apertured end portions, a sleeve carried by said housing, a pin or shaft extending through said sleeve and into said apertured end portions of said housing, means for preventing substantial movement of said sleeve axially of said pin while permitting rotation of said sleeve about said pin, one end of said pin having threaded engagement with said bracket whereby rotation of said pin will effect vertical adjustment of said pin, sleeve and bracket, and means for locking said pin in adjusted position.

12. In apparatus of the type described, a frame structure comprising a pair of oppositely disposed, horizontally spaced uprights supporting horizontal rolls therebetween, vertical roll housings disposed adjacent to the ends of the horizontal rolls, hinge means securing said housings to oppositely disposed uprights of each pair of uprights, said housings being swingable about said hinge to a position clear of the frame structure, and means for adjusting the vertical position of each vertical roll housing.

STEPHEN WILLIAM WHEELER.