Sept. 3, 1940. D. L. MEKEEL ET AL 2,213,714

ROLLING MILL

Filed Aug. 21, 1933 4 Sheets-Sheet 1

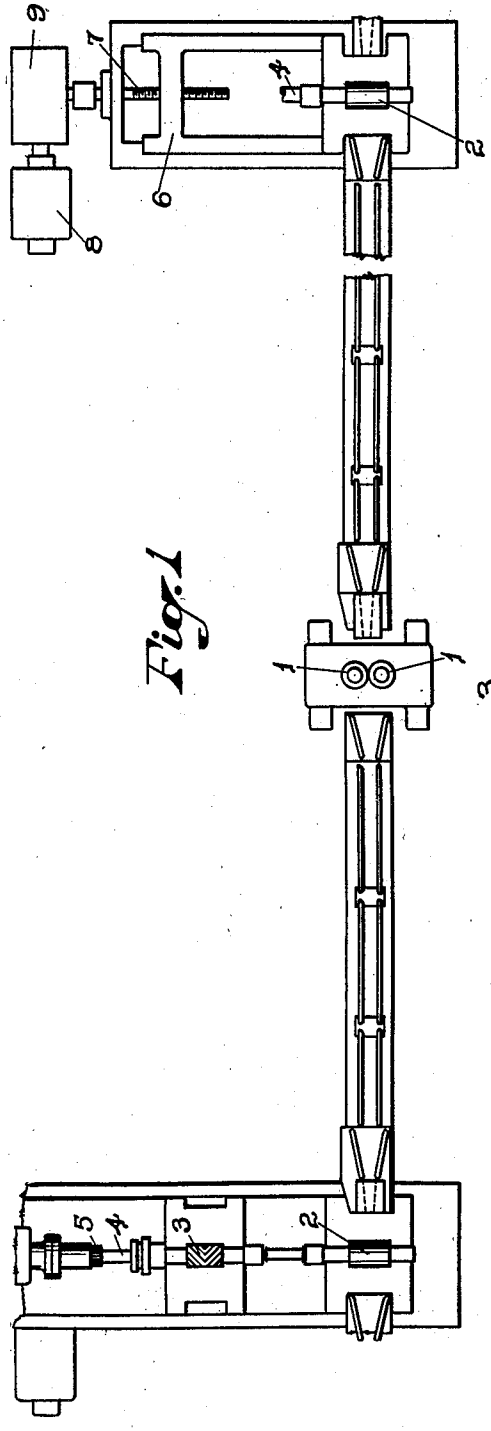


Fig. 1

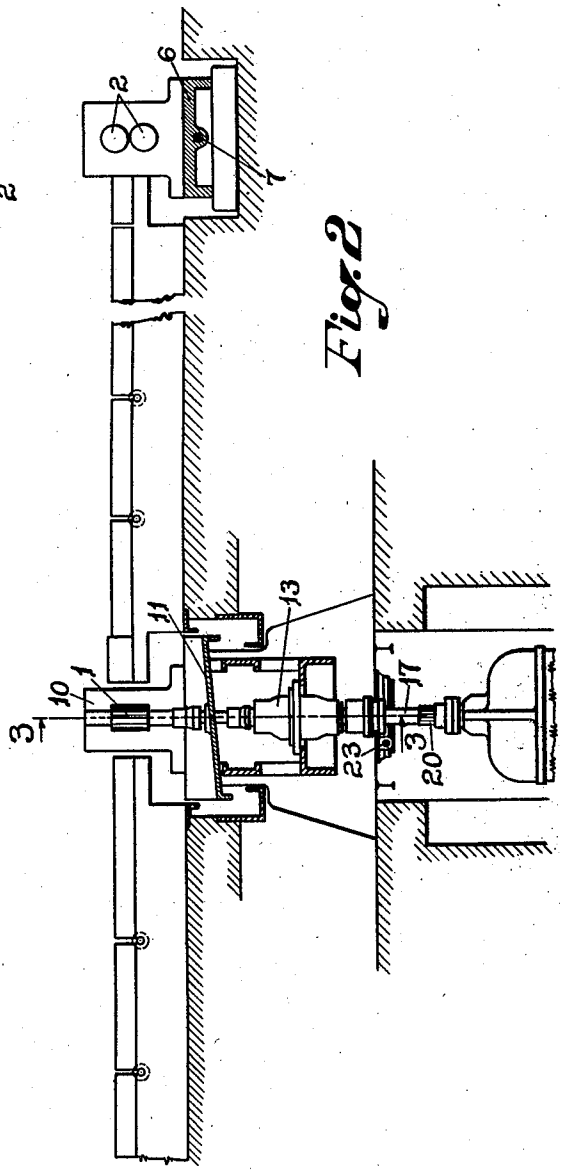


Fig. 2

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ROLLING MILL

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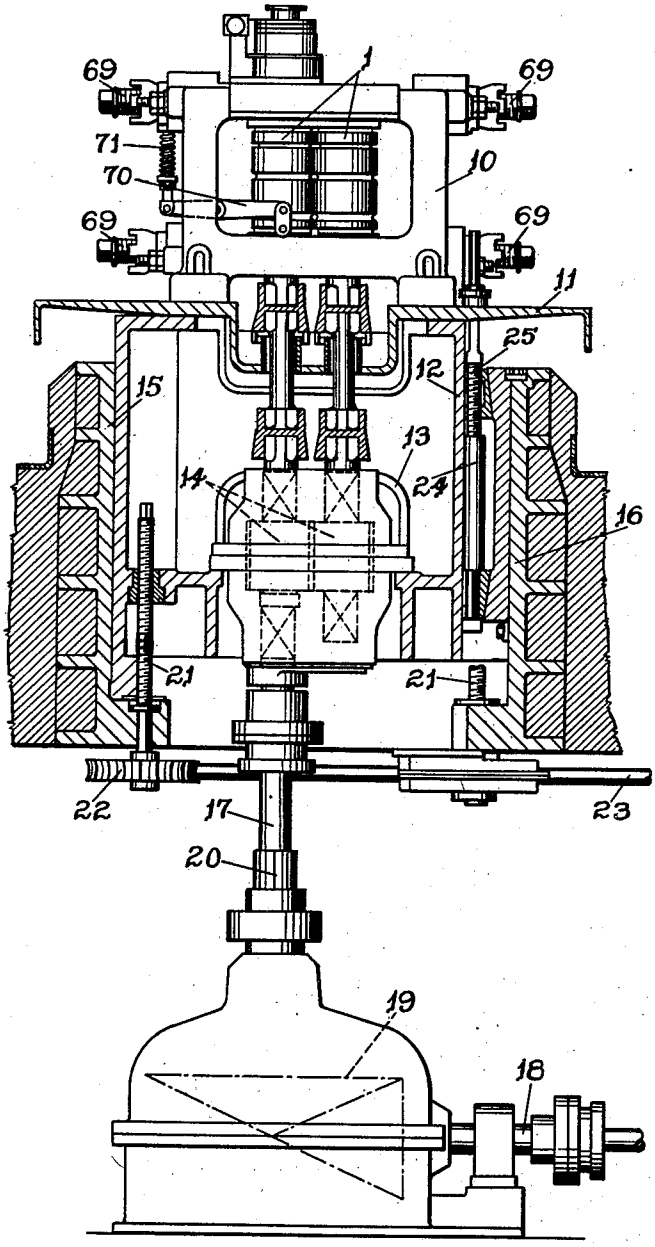


Fig. 3

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ROLLING MILL

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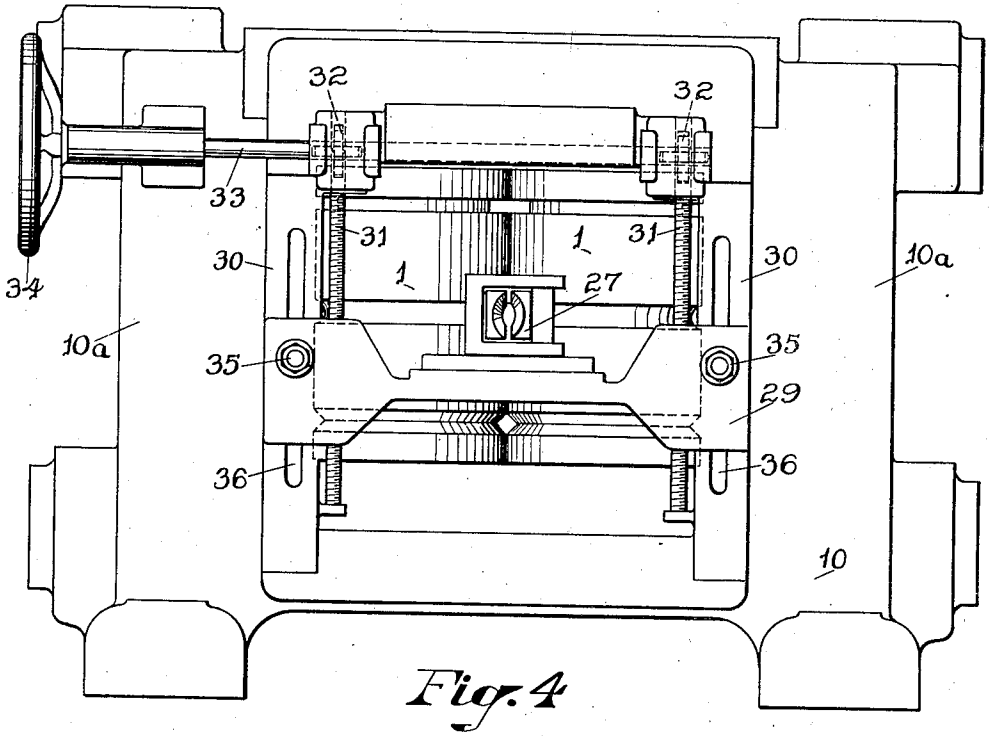


Fig. 4

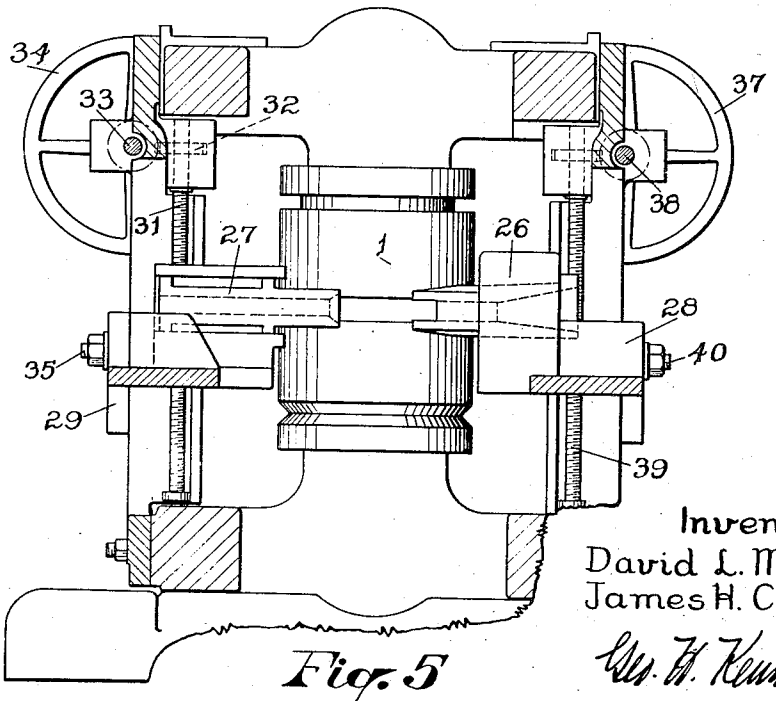


Fig. 5

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ROLLING MILL

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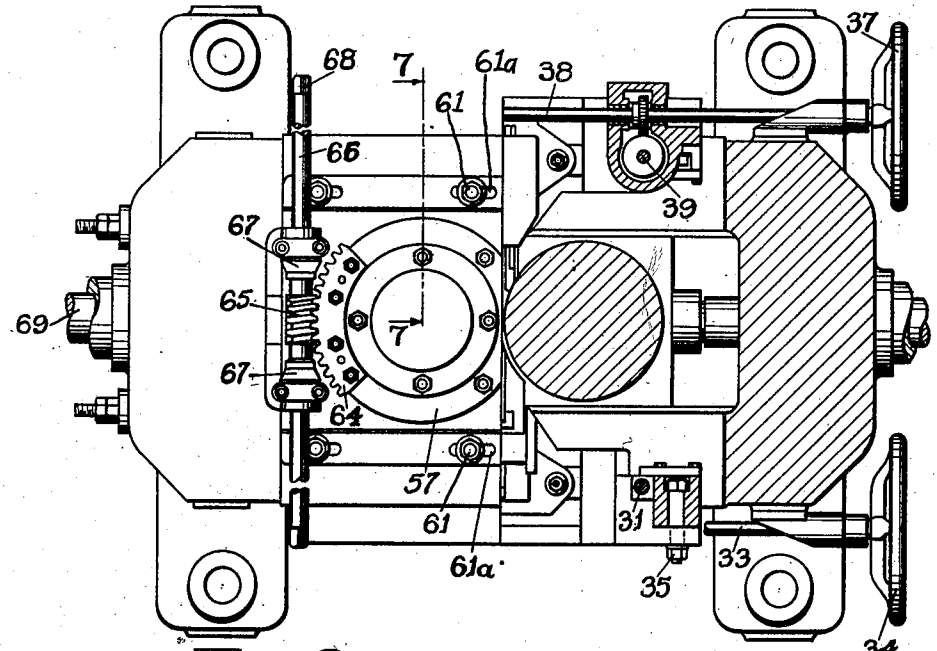


Fig. 6

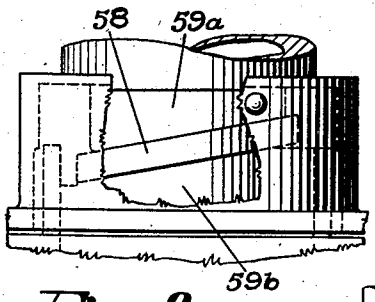


Fig. 8

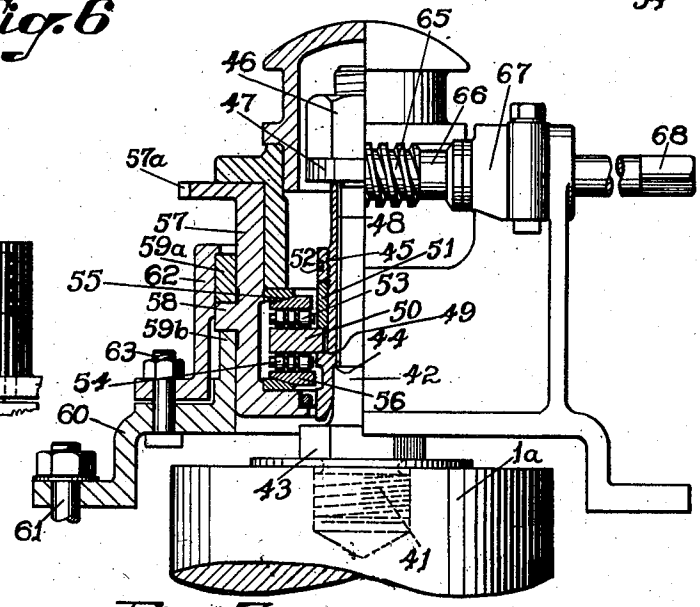


Fig. 7

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UNITED STATES PATENT OFFICE

2,213,714

ROLLING MILL

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Application August 21, 1933, Serial No. 686,004

31 Claims. (Cl. 80—31.1)

The present invention relates in one of its phases to rolling mills of the type employing vertical rolls, either alone or in conjunction with adjacent horizontal rolls, for the rolling of bars or like metal stock.

One of the objects of the invention is to provide a vertical roll stand characterized by the arrangement of the rolls, pinions and housings in a unit assembly adapted for movement vertically, so that any of the roll passes can be brought to the elevation of the pass line without disturbing the relation of the assembled parts. The invention further contemplates the utilization of this vertical roll stand in interposed relation to horizontal roll stands, the latter having provision for adjustment horizontally; as a result of such combined adjustments, it is possible to maintain the same pass line, both vertically and horizontally, through the mill.

Another object of the invention is to provide for a maximum amount of vertical adjustment of the roll guides to cover the range of roll passes, with convenient means for enabling the operator to raise, or lower, the guides.

A further object of the invention is to provide, for rolls having formed pass grooves, an improved thrust bearing construction which enables the grooves to be accurately alined, and at the same time permits adjustment of the rolls toward and from each other.

Other and further objects and advantages of the invention will hereinafter more fully appear from the following detailed description thereof, taken in connection with the accompanying drawings, in which:

Fig. 1 is a plan view of a portion of a rolling mill employing a vertical roll stand embodying the invention, in conjunction with adjacent horizontal roll stands.

Fig. 2 is a view in side elevation of a portion of the parts of Fig. 1, certain portions being shown in section.

Fig. 3 is an enlarged view partially in elevation and partially in vertical section along the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary view in front elevation showing the construction of the guide adjusting device on a still larger scale.

Fig. 5 is a view in side elevation of the parts shown in Fig. 4.

Fig. 6 is a plan view of the vertical roll stand, with parts broken away to show further details of the guide adjusting mechanism.

Fig. 7 is a vertical sectional view along the line 7—7 of Fig. 6, looking in the direction of the arrows.

Fig. 8 is a fragmentary view of a portion of the parts of Fig. 7, as viewed from the left.

Like reference characters refer to like parts in the different figures.

Referring first to Figs. 1 and 2, the invention is shown in connection with a mill consisting of a stand of vertical rolls 1, 1 interposed between stands of horizontal rolls 2, 2. The horizontal roll stands are of usual construction, each stand being driven by a motor, not shown, through gearing 3 and a shaft 4 coupled at 5 to the driving motor. As best shown at the right in Fig. 1, in which the roll shafts 4 are broken away, a frame 6 supporting both the roll and gear housings is shiftable in a horizontal plane by means of a screw shaft 7 driven by a motor 8 through suitable gearing 9. Thus each horizontal roll pass is shiftable horizontally with respect to the vertical roll pass.

Referring now to Figs. 2 and 3, the rolls 1 of the vertical stand are mounted within a housing generally designated by the reference character 10, the housing 10 being mounted on a platform 11. The platform 11 is in turn supported by a cage 12, within which is mounted a housing 13 enclosing the pinions 14 for driving the rolls 1. The cage 12 carrying the roll and pinion housing assemblies slidably supported on suitable vertical guides or ways 15 and 16 of the fixed framework or foundation, and is thus capable of being raised or lowered with respect to said fixed support; to permit of these adjustments, the drive for the pinions 14 is provided by a shaft 17 which, being connected to and extending downwardly from one of the pinions 14 is driven from a horizontal shaft 18 through gearing 19 and a sliding key connection 20.

As previously pointed out, the invention contemplates the arrangement of the rolls, pinions and housings of the vertical stand in a unit assembly, as described above, so that vertical movements of the cage 12 can be utilized to properly position any vertical roll pass with respect to the horizontal rolls 2, without in any way disturbing the relation between the rolls 1 and pinions 14. In order to vertically move the cage 12 carrying the roll and pinion housing assemblies, screw shafts 21 are provided on opposite sides of the cage, the shafts 21 being driven in unison through worm wheels 22 in mesh with suitable worms, not shown, carried on a motor driven shaft 23. After vertical adjustment of the rolls 1 by movement of the cage 12, the latter is adapted to be

locked in position by any suitable means, such for example as a double wedging arrangement generally indicated by the reference character 24 above the broken away portion of the right hand screw shaft 21. The details of this wedging arrangement form no part of the present invention, the wedging arrangement being fully shown and described in the Sheperdson, Morgan and O'Malley Patent No. 2,083,100, dated June 8, 1937. For the purposes of the present application, suffice it to say that the wedging arrangement 24 normally locks the cage 12 in vertical position, a screw shaft 25 being provided for unlocking and locking the wedges cooperating with the right hand way 16, in advance of and following vertical adjustment of the cage 12 by means of the shaft 23.

Referring again to Figs. 1 and 2, it is evident from the foregoing that in setting up the mill for operation, the horizontal rolls 2 can be accurately adjusted in a horizontal plane to properly aline any pass thereof with respect to the vertical rolls 1 by adjustment of the frames 6 through screw shafts 7; on the other hand, the rolls 1 can be adjusted in a vertical plane to properly aline any pass thereof with a selected pass of the horizontal rolls by means of the screw shafts 21 shifting the cage 12 carrying the roll unit assembly. These related adjustments, therefore, provide means for always maintaining the pass line through the mill at a constant height above the mill floor.

As indicated above, the invention also contemplates the provision of means whereby the receiving and delivery guides cooperating with the vertical rolls 1 may be readily adjusted to cover the full range of pass locations on the rolls 1, and this arrangement is best shown in Figs. 4 and 5. The receiving and delivery guides 26 and 27 are mounted on guide bars 28 and 29, respectively, each guide bar extending across the space between the vertical legs 10*a* of the roll housing 10. The delivery guide bar 29 shown in Fig. 4 is slidable on suitable vertical ways 30, 30 carried by the roll housing legs 10*a*, and is vertically movable with respect to the rolls 1, 1 by means of screw shafts 31 received in threaded engagement with opposite ends of the bar 29. The screw shafts 31 are connected by gearing 32 to a cross shaft 33 extending across the housing 10 above the rolls 1, see Fig. 6, rotation of the shaft 33 by a suitable hand wheel 34 causing the screw shafts 31 to turn in unison. Rotation of the hand wheel 34 is therefore adapted to raise, or lower, the guide bar 29 and the delivery guide 27 carried thereby, it being obvious from Fig. 4 that the vertical range of movement of the guide bar 29 is equal to the range of passes on the rolls 1.

Following an adjustment of the guide bar 29 to aline the guide 27 with a selected roll pass, the bar 29 is locked in position on the ways 30 by means of clamp bolts 35, the bolts being receivable in vertical slots 36 provided in the ways 30. Upon loosening the clamp bolts 35, the weight of the guide bar and guide is borne by the screw shafts 31, so that the guide 27 can be adjusted very accurately with respect to a roll pass by means of the hand wheel 34. The guide bar 28 carrying the receiving guide 26 is mounted on the rear of the roll housing 10 in substantially the same manner as the guide bar 29, a hand wheel 37 mounted on a cross shaft 38 serving to turn screw shafts 39, in unison, to raise, or lower the bar 28. Clamp bolts 40 lock the bar 28 in position before, or after, vertical adjustment thereof. Thus, the hand wheels 34 and 37 provide means for quickly and conveniently raising or lowering the guides 26 and 27 in conjunction with vertical adjustments of the roll and housing unit in order to keep the pass line in the established horizontal plane.

Referring now to Figs. 6, 7 and 8, there is shown in detail an improved thrust bearing for one of the vertical rolls 1, whereby the end thrust of the roll is taken in both directions by a bearing structure adjustable in such a manner as to always insure proper registration of the pass grooves on both rolls 1. To this end, the upper roll neck 1*a* provides a central opening 41 in which is secured one end of a heavy stud 42 provided with an angular enlargement 43 whereby the stud may be screwed into the opening 41. The stud 42 further provides a shoulder 44 on which is seated the lower portion of a sleeve 45 extending upwardly around the stud 42 and held in engagement with the shoulder 44 by means of a nut 46 and washer 47 cooperating with the upper threaded end portion of the stud. The sleeve 45 is also secured to the stud 42 for rotation therewith by means of a key 48.

The sleeve 45 provides a shoulder 49 on which is seated a thrust ring 50, and the ring 50 is held in engagement with the shoulder 49 by means of a collar 51 and a nut 52 cooperating with external threads on the sleeve 45. With the parts assembled as described above, the thrust ring 50 is substantially part of the stud and associated roll, and so is adapted to transmit the axial thrust of the roll to the anti-friction bearing members which will next be described.

The upper and lower annular faces of the thrust ring 50 are engaged by a series of rollers 53 and 54 respectively, the rollers being held in position by suitable races 55 and 56 enclosed within a housing 57 which forms a bearing holder arranged to carry the whole thrust bearing assembly. The housing 57 provides diametrically opposed wings 58 whereby it is supported, each wing 58 providing as shown in Fig. 8, helically formed faces held between correspondingly formed stationary guides 59*a* and 59*b*. The lower guide 59*b* is formed integrally with a bracket 60 anchored to the roll housing by bolts 61 received in slots 61*a*, see Fig. 6, the slots 61*a* being utilized to center the housing 57 with the roll stud when setting up the bearing. The bracket 60 in turn carries a clamp 62, which serves to hold in place the upper guide 59*a*, with bolts 63 securing the clamp 62 to the bracket 60. With the construction described thus far, it is apparent that the entire weight of the roll 1, as well as the axial thrust of the roll in either direction, will be borne by the sets of rollers 53 and 54 cooperating with the thrust ring 50 and that the entire roll stud and bearing assembly is carried by the housing 57. And since the housing 57 is rotatably supported between the pairs of helical guides 59*a* and 59*b* in cooperation with the projecting wings 58, it is evident that angular movement of the housing 57 about the roll axis will serve to raise, or lower, the housing and the roll assembly carried thereby.

For the purpose of turning the housing 57 and so obtaining vertical adjustment of the roll, a radially extending flange 57*a* of the housing carries a worm gear segment 64, as best shown in Fig. 6. The segment 64 is in mesh with a worm 65 mounted on a shaft 66 rotatably supported in bearings 67 mounted on the bracket 60, and the

end of the shaft 66 provides a tool receiving portion 68. By turning the shaft 66, the worm 65 is adapted to impart angular movement to the housing 57 through the segment 64, and this angular movement is in turn transformed into axial movement of the roll assembly through the cooperation of the helical wings 58 with the guides 59a and 59b. Therefore, the left hand roll 1 can be adjusted vertically to accurately register its pass grooves with the grooves of the vertically fixed right hand roll, any such adjustment being maintained by the locking action between the engaged worm 65 and worm gear segment 64.

The above described thrust bearing assembly is adaptable either to vertical rolls or to horizontal rolls. When used on one roll of a pair of cooperating rolls having formed pass grooves, it provides the means for a close endwise adjustment and positioning of the associated roll, so as to obtain and maintain accurate registry of the selected pass grooves of said rolls. Moreover, its use involves no interference with such radial adjustments of the associated roll as may be required from time to time to change its spacing, relative to the other roll. Such radial adjustments obtained (see Figs. 3 and 6) by operation of adjusting screws 69, can be made, without disturbing or affecting the thrust bearing adjustment, because of the provision of suitable clearances, as shown in Fig. 7, between the collar 51 and the upper bearing race 55, between the thrust ring 50 and the inner wall of housing 57, and between the sleeve 45 and the lower bearing race 56,—this permitting the roll and its attached parts to occupy and to operate in positions which are non-concentric to the housing 57 and its attached parts.

Referring to Fig. 7, it will be noted that the arrangement of parts is such that removal of the nut 46 permits the roll stud 42 to be withdrawn by downward vertical movement of the roll, and a new roll with a similar stud substituted therefor. Obviously, this substitution of one roll for another can be carried out without in any way disturbing the previous adjustment of the bearing assembly, so that no time is lost in making adjustments after changing the rolls of the vertical stand.

As best shown in Fig. 3, the radial or sleeve bearings for the necks of the left hand roll 1 are held in position against horizontal movement by the adjusting screws 69, and the lower neck bearing is yieldably maintained in engagement with the barrel of the rolls by means of a counterbalancing arrangement consisting of a lever 70 and spring 71. This counter-balancing arrangement forms no part of the present invention, being fully described and claimed in the aforesaid Sheperdson, Morgan and O'Malley patent. Consequently, vertical adjustment of the entire roll and thrust bearing assembly in no way disturbs the adjustment of the roll neck bearings. As also described in the aforesaid patent, the right hand roll 1 is supported against both vertical and radial thrust by roll neck bearings secured to the housing 10, so that the right hand roll 1 is substantially fixed with respect to the vertically adjustable left hand roll.

In setting up for operation a mill employing a vertical roll stand embodying the present invention, the left hand roll is initially adjusted endwise by means of the thrust bearing assembly to bring the several pass grooves on the two rolls in exact registration. The roll pinion and housing unit is then raised, or lowered as desired, to bring the selected roll pass to the elevation of the pass line through the mill, which adjustment is preceded, or followed, by lateral adjustment of the horizontal roll stands to bring the selected horizontal passes into alinement with the interposed vertical pass. After this, the receiving and delivery guide bars 28 and 29 are raised, or lowered, to bring the guides 26 and 27 carried thereby in proper alinement with the previously established pass line.

We claim,

1. A rolling mill comprising in combination, a set of rolls, power transmission for said rolls comprising intermeshing pinions, spindles and couplings between said rolls and pinions, a housing for rotatably supporting said rolls, a housing containing said power transmission, a cage movable between vertical ways for supporting both the roll and power transmission housings, with the roll housing on the top and the transmission housing within said cage and means for moving said cage to shift the roll and power transmission assembly, as a unit.

2. A rolling mill comprising in combination, a set of rolls, power transmission for said rolls comprising intermeshing pinions, spindles and couplings between said rolls and pinions, a housing for rotatably supporting said rolls, a housing containing said power transmission, a cage movable in vertical ways for supporting the roll and power transmission housings, with the roll housing on the top and the transmission housing within said cage, means for moving said cage to shift the roll and power transmission assemblies as a unit, and means for locking said cage in position between the ways with a selected pass of said rolls at the level of the pass line of the mill.

3. In a rolling mill, the combination with a pair of rolls rotatably supported about vertical axes and a guide cooperating with said rolls, of a horizontal bar carrying said guide, means comprising screw shafts geared together for vertically shifting the ends of said bar in unison to move said guide over the entire range of passes of said rolls, and means for locking said bar at its ends to position said guide in alinement with a selected roll pass.

4. In a rolling mill, a vertical roll, a housing surrounding the upper end portion of said roll and bearings carried by said housing for receiving the axial thrust of said roll in opposite directions, said housing being turnable angularly, and means for converting angular movement of said housing into axial movement of the roll assembly.

5. In a rolling mill, a vertical roll providing an upwardly extending stud, a sleeve mounted on said stud and a vertically adjustable thrust bearing assembly for supporting said roll through said sleeve, said roll being removable axially from said sleeve and thrust bearing assembly without disturbing the vertical adjustment of the same.

6. In a rolling mill, a platform located at substantially the floor level of the mill, a housing mounted on the top of said platform for rotatably supporting a pair of vertical rolls, a cage movable between vertical ways below the level of the mill floor for supporting said platform, power transmission for said rolls within said cage, comprising intermeshing pinions, spindles and couplings between said rolls and pinions and a housing for said transmission suspended from said cage, said platform, cage and housings to-

gether with said rolls and power transmission being vertically movable as a unit.

7. In a rolling mill, a vertical roll providing an upwardly extending stud, a sleeve removably mounted on said stud and carrying a thrust ring, and bearings cooperating with said thrust ring for supporting the weight of said roll as well as for taking its axial thrust in both directions, said roll being removable axially from within said sleeve and thrust bearing assembly.

8. In a rolling mill, a vertical roll providing an upwardly extending stud carrying a sleeve having a thrust ring, a housing surrounding said sleeve, bearings carried by said housing cooperating with said thrust ring for supporting the weight of said roll as well as for taking its axial thrust in both directions, means for turning said housing angularly, and means for converting angular movement of said housing into axial movement of the sleeve and roll assembly.

9. In a rolling mill, the combination with a vertical roll stand movable vertically, as a unit, to position a selected pass at the pass line of the mill, of receiving and delivery guides for the rolls of the stand, horizontal bars carrying said guides, with each guide supported at its ends by screw shafts, gearing connecting each pair of screw shafts for a bar and hand wheels operable from the same side of the roll stand for operating said gearing to raise and lower each guide supporting bar with respect to the established pass line.

10. In a rolling mill, a housing, a roll mounted for rotation about a vertical axis, a bearing holder rotatably mounted on said housing, a thrust bearing in said holder for supporting the roll, means for rotating the holder and means for converting rotary movement of the holder into axial movement of the roll.

11. A rolling mill comprising a vertically adjustable roll housing, a pair of vertically disposed rolls mounted in said housing, a power transmission below said roll housing and rigidly secured thereto, said power transmission being connected to the lower ends of said rolls to drive them, means for moving said housing and power transmission vertically as a unit and driving means mounted on a fixed base and connected to said power transmission by a shaft adapted to permit relative movement without disturbing the driving connection.

12. In a rolling mill including a mill housing, rolls rotatably mounted in radial bearings therein, and means for adjusting the spacing of the rolls, the combination with one of the rolls of adjustable thrust resisting mechanism for resisting axial thrust upon said roll and adjusting the position of the roll axially, and means holding said mechanism against movement relative to the mill housing, said mechanism providing the necessary clearance to permit radial movement of said roll relative to the mill housing incident to adjustment of the spacing of the rolls.

13. A rolling mill including mill housings, rolls having at least one formed pass rotatably mounted in the mill housings, at least one of the rolls having substantially cylindrical necks and an extension on one of the necks providing opposed end thrust receiving surfaces and means for adjusting the spacing of said rolls, radial bearings for the cylindrical necks carried by the mill housings, opposed thrust bearings cooperating with said thrust receiving surfaces and affording sufficient radial clearance to permit movement of the rolls incident to adjustment of the spacing of the rolls, and adjustable supporting means for said opposed thrust bearings secured to the mill housing and adapted to shift the roll neck axially to true the roll pass.

14. In a rolling mill including a mill housing, rolls rotatably mounted in radial bearings therein, at least one of the rolls having a roll neck extension provided with opposed end thrust receiving surfaces and means for adjusting the spacing of the rolls, the combination with said roll neck extension of adjustable means fixed to the mill housing for positioning the roll axially relative to the mill, said means comprising thrust bearings cooperating with the opposed end thrust receiving surfaces and affording sufficient radial clearance to permit movement of said roll incident to adjustment of the spacing of the rolls.

15. In a rolling mill including a mill housing, rolls rotatably mounted in radial bearings therein, at least one of the rolls having a roll neck extension providing a radial flange with opposed end thrust receiving surfaces, and means for adjusting the spacing of the rolls, the combination with said roll neck extension of adjustable means fixed to the mill housing for positioning the roll axially relative to the mill, said means comprising antifriction thrust bearings cooperating with the opposed end thrust receiving surfaces on said flange and slidable radially on said flange during rotation of the roll neck extension so as to provide the necessary clearance permitting adjustment of the rolls in the mill toward and from each other.

16. In a rolling mill including a mill housing, rolls rotatably mounted in radial bearings therein, at least one of the rolls having a roll neck extension provided with opposed end thrust receiving surfaces, and means for adjusting the spacing of the rolls, the combination with said roll neck extension of thrust bearings cooperating with the opposed end thrust receiving surfaces and affording sufficient radial clearance to permit movement of said roll incident to adjustment of the spacing of the rolls, a housing carrying said thrust bearings, a support fixed to the mill housing and providing guideways for axial movement of the thrust bearing housing relative thereto, and means for adjusting the position of the thrust bearing housing along said guideways.

17. In a rolling mill including a mill housing and rolls mounted therein in radial bearings, at least one of the rolls having a roll neck extension, and a radial flange on said extension, and means for adjusting the spacing of the rolls, the combination with said roll neck extension of adjustable means cooperating therewith to accurately position the roll axially relative to the mill, said means comprising a support fixed to the mill housing, a thrust bearing housing slidably carried by said support for movements axially of the roll neck extension, means for adjusting the thrust bearing housing axially of the roll neck extension, and thrust bearings mounted in said thrust bearing housing on opposite sides of said flange, said thrust bearings being adapted to slide radially on said flange during rotation of the latter so as to provide the necessary clearance for permitting radial movement of said roll incident to adjustment of the spacing of the rolls.

18. In a rolling mill including mill housings, radial bearings therein, rolls having at least one

formed pass and necks on opposite sides of the formed pass rotatably mounted in said radial bearings, the necks of at least one of the rolls being substantially cylindrical, and means for adjusting the spacing of the rolls, the combination with one of said cylindrical necks of thrust resisting mechanism at the respective end only of the roll and outside the radial bearing for said neck for taking axial thrust upon the roll and for axially adjusting the position of the roll to true the roll pass, said thrust resisting mechanism being capable of thus cooperating with said neck both when coaxial therewith and when offset from coaxial relation, whereby radial movement of the neck in adjusting the spacing of the rolls is permitted.

19. In a rolling mill including mill housings, rolls having at least one formed pass and necks on opposite sides of the formed pass, brasses for the necks mounted in the mill housings, and means cooperating with said brasses for adjusting the spacing of the rolls, at least one of the rolls having substantially cylindrical necks, the combination with said last mentioned roll of means at one end only of the roll for axially adjusting the position of said roll relative to the other roll to true the roll pass comprising a thrust bearing for taking axial thrust upon said roll, said thrust bearing being capable of cooperating with said roll both when coaxial therewith and when offset from coaxial relation whereby the spacing of the rolls may be adjusted without disturbing the position of said thrust bearing, and means carried by the mill housing for axially adjusting said thrust bearing.

20. In a rolling mill including a mill housing, rolls having at least one formed pass, brasses carried by the mill housing for rotatably mounting the rolls and means for adjusting the spacing of the rolls, the combination with one of the rolls of adjustable thrust resisting mechanism for resisting axial thrust upon said roll and adjusting the position of the roll axially relative to the other roll, and means holding said mechanism against movement relative to the mill housing, said mechanism providing the necessary radial clearance to permit movement of said roll relative to the mill housing incident to adjustment of the spacing of the rolls.

21. Adjusting mechanism for attachment to a rolling mill having mill housings and rolls mounted in radial bearings therein and cooperating to provide a formed pass, comprising a roll neck extension adapted to be secured to the neck of one of the rolls providing the formed pass, said extension having opposed thrust receiving surfaces, a support adapted to be fixedly secured to the mill housing adjacent thereto, and a thrust bearing unit adjustably carried by the support for movement axially of the roll, said unit including thrust bearings cooperating with the opposed thrust receiving surfaces of said roll neck extension and affording clearance for permitting radial movement of the respective roll neck extension, whereby the spacing of the roll of the mill connected to said extension may be adjusted without disturbing the position of said support on the mill housing.

22. In a rolling mill which includes a pair of rolls cooperating to provide a formed pass, a roll housing supporting the necks of said rolls in opposition to the radial load of the rolling operation and adjusting means associated with one of said rolls to shift its axis radially toward and from the other roll, the combination with said radially adjustable roll of a neck extension providing a thrust flange substantially concentric with said roll, anti-friction bearing elements disposed on opposite sides of said flange, a radially-fixed bearing housing for said elements, retaining them in operative relation to said flange to hold the roll against endwise movement, said bearing housing surrounding said flange and sufficiently spaced radially therefrom to avoid interference with said flange when said roll, by said adjusting means, is shifted into non-concentric relation to said bearing housing, means carried by the roll housing for supporting said bearing housing independently of said rolls, and means for moving said bearing housing endwise in said supporting means, to obtain corresponding endwise roll movement for the truing of said pass.

23. In a rolling mill which includes a pair of rolls cooperating to provide a formed pass, a roll housing supporting the necks of said rolls in opposition to the radial load of the rolling operation and adjusting means associated with one of said rolls to shift its axis radially toward and from the other roll, the combination with said radially adjustable roll of a neck extension providing oppositely facing thrust-transmitting surfaces, an outboard thrust bearing assembly associated with said neck extension and cooperating with said surfaces to hold said roll against endwise movement, said assembly including a radially-fixed bearing housing surrounding said neck extension and sufficiently spaced radially therefrom to permit said roll, by operation of said adjusting means, to occupy a non-concentric position relative to said thrust bearing assembly, a supporting bracket for said bearing housing, said bracket being adjustably secured to the roll housing and restrained from endwise movement relative thereto, and means for adjusting said bearing assembly endwise in said supporting bracket, to obtain corresponding endwise roll adjustment for the truing of said pass.

24. In a rolling mill which includes a pair of rolls cooperating to provide a formed pass, a roll housing supporting the necks of said rolls in opposition to the radial load of the rolling operation and adjusting means associated with one of said rolls to shift its axis radially toward and from the other roll, the combination with a neck extension of said radially adjustable roll, of an outboard thrust bearing unit cooperating with said neck extension to hold said roll against endwise movement, means for supporting said unit from the roll housing and for holding it against movement in response to the aforesaid radial adjustment of said roll, there being sufficient radial clearance between said unit and said neck extension to permit said roll's adjustment into positions non-concentric with said unit, and means for adjusting said unit endwise in said supporting means to obtain corresponding endwise roll movement for the truing of said pass.

25. In a rolling mill, a set of rolls, power transmission for said rolls, comprising intermeshing pinions connected thereto, a housing wherein said rolls are rotatably supported, a second housing containing said power transmission, a vertically movable cage supporting both of said housings, means for moving said cage to shift the roll and power transmission assembly as a unit, driving means for said assembly mounted on a fixed base, and a shaft connecting said driving means with said power transmission and permitting said

movement without disturbance of the driving connection.

26. In a rolling mill, a set of rolls, power transmission for said rolls, comprising intermeshing pinions connected thereto, a housing wherein said rolls are rotatably supported, a second housing containing said power transmission, a vertically movable cage supporting both of said housings, means for moving said cage to shift the roll and power transmission assembly as a unit, means for locking said cage to position a selected pass of said rolls at the level of the pass line of the mill, driving means for said assembly mounted on a fixed base, and a shaft connecting said driving means with said power transmission and permitting said movement without disturbance of the driving connection.

27. In a rolling mill, a platform at substantially the floor level of the mill, a housing mounted on said platform for rotatably supporting a pair of vertical rolls, a vertically moving cage below the mill floor level for supporting said platform, power transmission for said rolls within said cage and comprising intermeshing pinions connected to said rolls, a housing for said power transmission carried by said cage, means for vertically moving said cage, to shift as a unit said platform and the roll and power transmission assemblies, driving means for said assemblies mounted on a fixed base, and a shaft connecting said driving means with said power transmission and permitting said movement without disturbance of the driving connection.

28. A rolling mill comprising a vertically adjustable roll housing, a pair of rolls mounted in said housing, a power transmission below said roll housing and rigidly secured thereto, said power transmission being operatively connected to said rolls for driving the latter, means for moving said housing and power transmission vertically as a unit, driving means for said power transmission mounted on a fixed base, and a shaft connecting said driving means to said power transmission and permitting said movement without disturbance of the driving connection.

29. A rolling mill comprising a mill housing adjustably supported for movement transversely of the path of the material to be rolled in the mill, a pair of vertically disposed rolls having spaced working pass grooves mounted in said housing, a gear drive connected to the lower end of said rolls, means for moving said housing and gear drive vertically as a unit, and driving means for said rolls mounted on a fixed base and connected to said gear drive by a shaft adapted to permit said movement without disturbing the driving connection.

30. A rolling mill comprising a mill housing adjustably supported for movement transversely of the path of the material to be rolled in the mill, a pair of rolls mounted for rotation on vertical axes in said housing, means for adjusting said rolls to vary the roll pass therebetween, a gear drive for said rolls movable transversely with said housing, means for vertically moving said housing to adjust the operative position of said rolls, and driving means for said rolls mounted on a fixed base and connected to said gear drive by a shaft adapted to permit said adjusting movement without disturbing the driving connection.

31. A rolling mill comprising a vertically disposed supporting frame, a mill housing mounted for vertical movement in said frame transversely of the path of the material to be rolled in the mill, screw means for vertically adjusting said mill housing in said frame, a pair of vertical working rolls mounted in said housing, a gear train for actuating said rolls also mounted in said frame and connected to the lower ends of the rolls, and driving means mounted on a fixed base and connected to said gear train by a shaft adapted to permit said vertical adjusting movement without disturbing the driving connection.

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