Sept. 26, 1944. H. C. INSLEE 2,358,929

ROLL STAND

Filed May 13, 1942 2 Sheets-Sheet 1

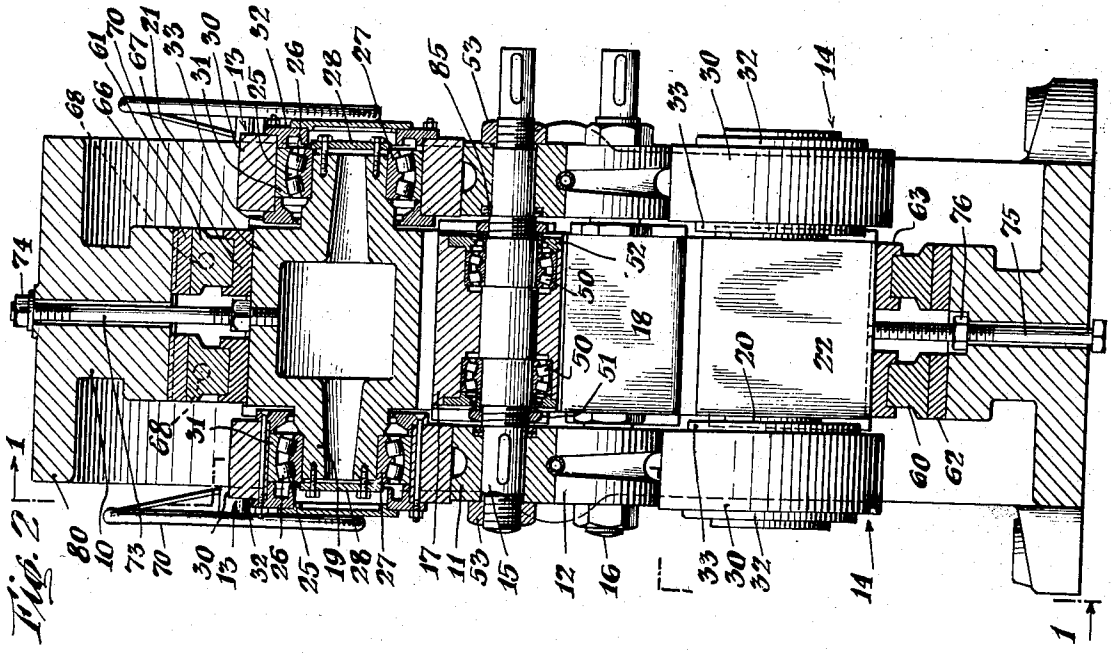

Fig. 2

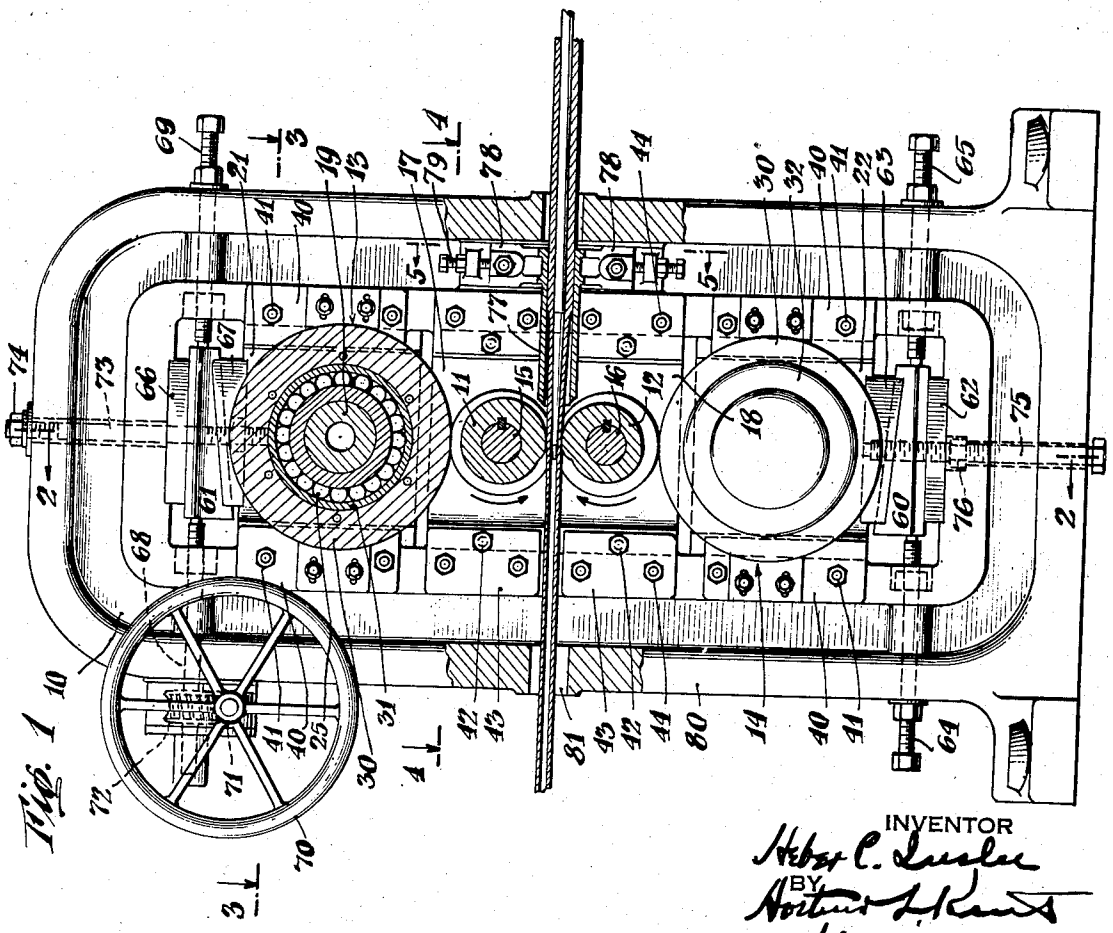

Fig. 1

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Fig. 3

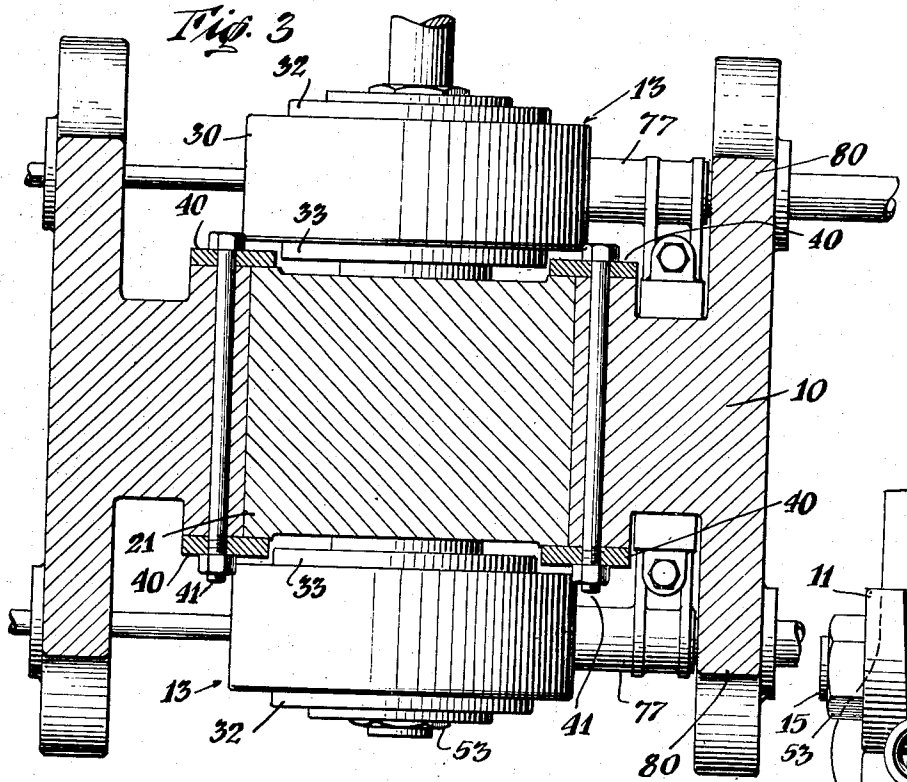


Fig. 5

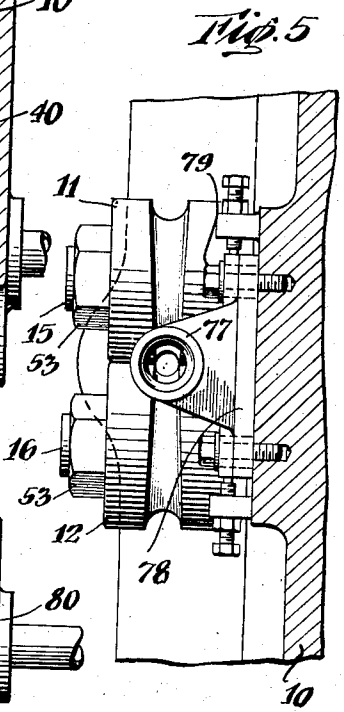
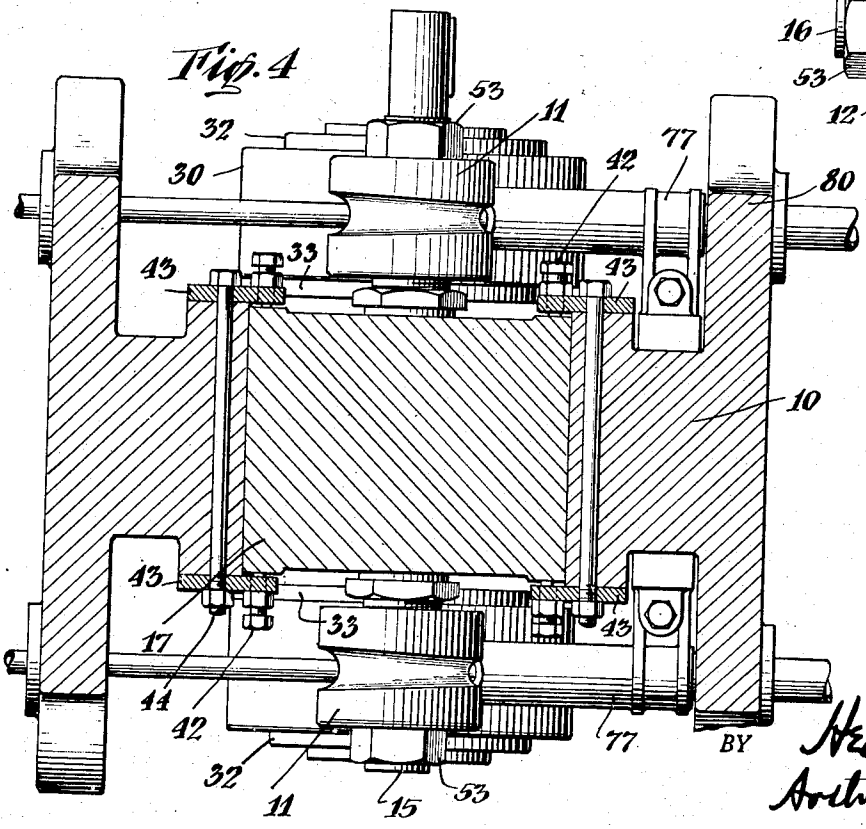


Fig. 4



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UNITED STATES PATENT OFFICE

2,358,929

ROLL STAND

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Application May 13, 1942, Serial No. 442,768

17 Claims. (Cl. 80—38)

This invention relates to roll stands for rolling mills, and more especially to an improved duplex two-high roll stand. The invention has been made especially with the idea of providing a roll stand for a new duplex step-by-step reducing mill of the pilger type for which I have filed an application for patent Serial No. 442,769, filed May 13, 1942; but roll stands according to the invention may be used in other mills for rolling tubes or solid bars or rods.

The invention aims to provide an improved roll stand, and more especially a duplex roll stand, that is, one having two pairs of working rolls, in which the rolls shall be readily accessible for removal and replacement and during operation, in which the rolls shall be so mounted and supported as to be capable of resisting very great spreading pressures in use with a minimum of displacement, and which as a whole shall be of great strength and rigidity.

A roll stand according to the invention and embodying all features of the invention in the preferred form comprises a housing in the form of a massive frame having a through opening, or window, two pairs of overhung working rolls at opposite sides of the housing fast on opposite ends of two shafts mounted in bearings in blocks adjustably held in the window of the housing, and upper and lower overhung backing, or back-up, rolls for each pair of working rolls, the backing rolls being mounted to rotate on fixed axles extending from blocks adjustably held in the window of the housing, and the bearings for the backing rolls being spherically curved bearings which permit the backing rolls to adjust themselves to bear evenly on the working rolls in spite of any possible deflection which may occur.

Means are provided for applying pressure to the blocks which carry the backing rolls, thereby to force the backing rolls against the working rolls and the working rolls of each pair against each other. The pressure should be sufficient to take up all clearances and harmful yields in the die rolls and the backing rolls and their mountings. Most desirably, the rolls are set up with an initial tension approximately equal to the pressure on the workpiece in actual reducing, that is, the preload on each pair of working rolls is approximately equal to the rolling load on each pair of these rolls. By such preloading, the yield under load is reduced to a minimum, and there is practically no change of stress in the mill parts when a tube or other workpiece is entered, so that the shape and dimensions of the roll passes will be maintained whether tubes are being reduced in one or both of the roll passes, and the mill will deliver almost exactly the same size tubes whether one or two tubes are in the rolls. Other novel features of the new roll stand, including means for certain necessary adjustments, will appear from the following description in connection with the drawings.

While, as stated, the invention aims especially to provide a duplex roll stand, that is, one having two pairs of die rolls, or other working rolls, one pair on each side of the housing, yet, since, as pointed out above, the shape and dimensions of the roll passes will be maintained whether tubes or other workpieces are being reduced in one or both of the roll passes, the roll stand is adapted for use with only one pair of working rolls, the corresponding pair of rolls on the other side of the housing being then not working rolls but merely coacting rolls which may have plane surfaces and which serve to maintain the stress in the mill parts in balance. The roll stand is thus adaptable for use in a single mill as well as in a duplex mill.

A full understanding of the invention can best be given by a detailed description of a roll stand embodying the various features of the invention in the form now considered best, and such a description will now be given in connection with the accompanying drawings, in which:

Fig. 1 is a side view, partly in section on line 1—1 of Fig. 2, of a roll stand for a duplex tube reducing mill of the pilger type;

Fig. 2 is a view partly in elevation and partly in section on line 2—2 of Fig. 1;

Fig. 3 is a section taken on line 3—3 of Fig. 1;

Fig. 4 is a section taken on line 4—4 of Fig. 1; and

Fig. 5 is a detail section taken on line 5—5 of Fig. 1.

Referring to the drawings, the roll stand comprises a housing, or frame, 10, and two pairs of overhung circumferentially grooved working, or die, rolls 11 and 12, and an overhung backing roll 13 for each upper die roll, and an overhung backing roll 14 for each lower die roll. The housing 10 is of massive construction, most desirably and as shown, a metal casting, in the form of an upright rectangular frame having a through opening, or window. The two pairs of die rolls are mounted at opposite sides of the housing fast on shafts 15 and 16 which are rotatably mounted and held against endwise movement in blocks 17 and 18 adjustably held in the window of the housing. The upper backing rolls 13 are rotatably mounted

on fixed axles 19 extending from a block 21 vertically adjustable in the housing window above the block 17, and the lower backing rolls 14 are rotatably mounted on fixed axles 20 extending from a block 22 vertically adjustable in the housing window below the block 18. For greatest rigidity, the axles 19 and 20 are most desirably made of one piece with the blocks 21 and 22, respectively, and the blocks 21 and 22 may be made hollow as shown for avoidance of excessive weight.

The backing rolls are mounted on their dead axles by means of spherically curved bearings 25 which permit the rolls to adjust themselves to the working rolls on which they bear so that they will always bear evenly on their respective working rolls in spite of any possible deflection which may occur. Most desirably, these backing roll bearings are spherical roller bearings of known kind as shown, the bearings for each roll having two sets of somewhat barrel-shaped rollers 26 having axially curved bearing faces and which run in oppositely inclined raceways by which the rollers are held against axial movement, these raceways being formed in an annular band 27 sleeved and secured on the axle between a shoulder on the axle and an end plate 28 secured to the end of the axle. Each backing roll consists essentially of a heavy ring 30 having an inner bearing face for the bearing rollers formed on an annular band 31 set in the ring and secured by end members 32 and 33. The bearing face of band 31 is spherically curved about a center on the axis of rotation of the roll in the middle plane of the roll, and the raceways in the band 27 are inclined so that the curved bearing faces of the bearing rollers bear uniformly against the face of band 31. The roll is thus held by its roller bearings against axial movement bodily, but is free to tilt on the bearing rollers about the center of curvature of the bearing face of band 31 so that in the event of any deflection of its working roll or of its own axle it will nevertheless always bear evenly on the rim of its working roll.

The blocks 21 and 22 from which the axles for the backing rolls extend are fitted within the window of the housing so as to be vertically adjustable therein, being held against movement longitudinally of the axles by plates 40 secured to the sides of the housing by bolts 41 extending through the housing, the plates extending inward over the edges of the blocks. The blocks 17 and 18 in which the die roll shafts 15 and 16 are journaled are fitted to be vertically slidable within the window of the housing, and these blocks are adjustable horizontally axially of the shafts by means of set screws 42 carried by the inwardly extending portions of plates 43 which are secured to the sides of the housing by bolts 44 extending through the housing.

The roll shafts 15 and 16 are rotatably mounted and held against endwise movement within their blocks 17 and 18, most desirably by spherical roller bearings 50 similar to the bearings for the backing rolls, there being two of these bearings for each shaft spaced apart as far as possible. The inner raceway of each bearing unit is held against a shoulder on the shaft by means of a holding ring 51 screwed on the shaft, and the outer raceway of each bearing unit is held between a shoulder of the block and a clamping ring 52. These spherical bearings 50 not only hold the shafts against endwise movement, but they also take care of any horizontal flexure of the shafts resulting from tangential forces on the die rolls, all binding at the bearings due to such flexure of the shafts being avoided. Each of the die rolls is keyed on one of the shaft ends and clamped between a shoulder of the shaft and a clamping nut 53. On one side of the roll stand, the die roll shafts 15 and 16 are extended to be connected by means of suitable coupling units to driving shafts by which the rolls are rotated in opposite directions at uniform speed.

The vertical dimensions of the blocks 17, 18, 21 and 22 are such that these blocks do not come into bearing contact with each other when the rolls are set up in contact. The blocks and rolls are adjusted vertically and subjected to preloading pressure by means of a pair of bottom wedges 60 and a pair of top wedges 61. Each bottom wedge 60 lies between a lower wedge block 62 set on the frame and an upper wedge block 63 set in the bottom of the block 22, and is moved horizontally by a screw 64 to raise the block 22 and by a screw 65 to lower the block. Each of the upper wedges 61 lies between an upper wedge block 66 set in the frame and a lower wedge block 67 set in the top of the block 21, and is moved to force the block downward by a screw 68 and by a screw 69 to permit the block to be raised. The preloading pressure may be applied to the rolls by either the upper or lower wedges, preferably the upper wedges, and any suitable means may be provided for operating the wedge screws to apply the necessary pressure to the wedges. As shown, each of the upper screws 68 is turned by means of a hand wheel 70 on a worm shaft 71 by which a worm wheel 72 splined on the screw 68 is turned. A bolt 73 extending vertically through the top of the frame and adjustably held by a nut 74 and having its lower end screwed into the block 21 serves to support this block in position when the lower block is lowered or any of the rolls removed. A bolt 75 is also provided which extends vertically through the bottom part of the frame and through a nut 76 set in the frame and which bears at its upper end against the bottom of block 22 to hold this block up if for any purpose its wedges are moved out of holding position or removed from the mill.

For each pair of die rolls, a tubular guide 77 is mounted on the frame for guiding the tubular blanks or other workpieces to the pass between the die rolls. Each guide is carried by a short bracket extending from a plate 78 removably seated in the vertical recess in the side of the frame and vertically adjustable by screws 79 and secured by cap screws extending through vertical slots in the plate.

In order that the housing or frame 10 shall have the required strength and rigidity with a minimum of weight and bulk, the sides, top and bottom of the frame are made of T shape in cross-section, having massive laterally projecting outer flanges 80. These flanges 80 are, mostly desirably, of a width such that the over-all width of the frame at these flanges is approximately equal to the distance from the outer side of the die rolls on one side of the frame to the outer side of the die rolls on the other side of the frame. The flanges of the sides of the frame thus extend across the lines of travel of the workpieces advancing to and from the two pairs of die rolls. Therefore, the flanges on each side of the frame have openings 81 therein in line with the pass between the die rolls for the passage therethrough of the workpieces, as shown on one side of the frame in Fig. 1.

In setting up the rolls, the die roll blocks are adjusted axially of the shafts by means of the screws 42 to bring the die grooves of one pair of the die rolls into vertical alignment. To align the other pair of die rolls, it is necessary to adjust one of the rolls on its shaft. To provide for such adjustment, the roll to be so adjusted is mounted on its shaft with a number of thin collars 85 between the roll and the shoulder on the shaft, the required number of these collars being inserted to bring the roll into proper alignment with the other roll of the pair. Most desirably, all of the die rolls are mounted with these collars. The die rolls having been adjusted axially and being in proper vertical position supported by the lower backing rolls, the upper backing rolls are forced down by means of the wedges 61 to press the upper backing rolls against the die rolls and the die rolls of the two pairs together, against the resistance of the lower backing rolls. The preloading pressure thus applied to the rolls should be sufficient to take up all clearances and harmful yields in the rolls and their mountings, and, as stated, is most desirably approximately equal to the pressure on the rolls in the operation of reducing a tubular blank or other workpiece. The wedges 60 and 61 and their operating screws 64 and 68 thus serve not only as adjusting means for positioning the die rolls vertically but also as preloading means.

If the roll stand is to be used in a single mill, having, therefore, only one pair of working rolls, it is not necessary accurately to align the coacting rolls of the pair on the other end of the die roll shafts.

The die rolls, whether the roll stand is fitted with two pairs of die rolls or with one pair of die rolls and a pair of stress-balancing coacting rolls of the same diameter, are easily accessible for removal and replacement, and may be replaced by others of the same diameter or all of a different diameter within a limited range. Change in roll size requires no other change excepting proper adjustment of the bearing blocks by means of the wedges 60 and 61, and possibly the substitution of wedges or wedge blocks of different thickness. Also, rolls grooved for reducing different size tubular blanks and for reducing blanks to different final diameters may, obviously, be used. Whether the rolls of both pairs carried by the shafts 15 and 16 are working rolls, that is, rolls which apply working pressure to a tube or other workpiece, or the rolls of one pair are merely stress-balancing rolls, the rolls of both pairs are coacting rolls.

What is claimed is:

1. A duplex roll stand, comprising a housing, two pairs of overhung working rolls mounted at opposite sides of the housing fast on two driven shafts journalled within the housing, and an overhung backing roll for each of said working rolls.

2. A duplex roll stand, comprising a housing, two pairs of overhung working rolls mounted at opposite sides of the housing fast on two driven shafts journalled within the housing, and an overhung backing roll for each of said working rolls, said backing rolls being mounted to rotate on fixed axles extending from within the housing.

3. A duplex roll stand, comprising a housing having a window therein, two pairs of overhung working rolls mounted at opposite sides of the housing fast on two driven shafts journalled in blocks vertically slidable in said window, and an overhung backing roll for each of said working rolls, said backing rolls being mounted to rotate on fixed axles extending from blocks vertically adjustable in said window.

4. A duplex roll stand, comprising a housing having a window therein, two pairs of overhung working rolls mounted at opposite sides of the housing fast on two driven shafts journalled in blocks vertically slidable in said window, an overhung backing roll for each of said working rolls, the backing rolls for the upper working rolls being mounted to rotate on fixed axles extending from and integral with a block vertically adjustable in said window and the backing rolls for the lower working rolls being mounted to rotate on fixed axles extending from and integral with a block vertically adjustable in said window.

5. A duplex roll stand, comprising a housing, two pairs of overhung working rolls mounted at opposite sides of the housing fast on two driven shafts journalled within the housing, and an overhung backing roll for each of said working rolls, each backing roll being mounted to rotate on a fixed axle extending from within the housing and each being mounted on its axle by means of a spherical bearing permitting the backing roll to adjust itself to bear evenly on its working roll.

6. In a rolling mill, the combination with an overhung working roll, of an overhung backing roll mounted to rotate on a fixed axle by means of a spherical bearing permitting the backing roll to adjust itself to bear evenly on the working roll.

7. In a rolling mill, the combination with a working roll, of a backing roll mounted to rotate on a fixed axle by means of a spherical bearing permitting the backing roll to adjust itself to bear evenly on the working roll.

8. A duplex roll stand, comprising a housing having a window therein, two pairs of overhung working rolls mounted at opposite sides of the housing, the two upper working rolls being fast on a shaft journalled in a block vertically slidable in said window and the two lower working rolls being fast on a shaft journalled in a block vertically slidable in said window, means for adjusting one of said blocks axially of its shaft, overhung backing rolls for the upper working rolls carried by a block vertically adjustable in said window, and overhung backing rolls for the lower working rolls carried by a block mounted in said window.

9. A duplex roll stand, comprising a housing having a window therein, two pairs of overhung working rolls mounted at opposite sides of the housing, the two upper working rolls being fast on a shaft journalled in a block vertically slidable in said window and the two lower working rolls being fast on a shaft journalled in a block vertically slidable in said window, means for adjusting each of said blocks axially of its shaft, means for adjusting one of said rolls axially on its shaft, overhung backing rolls for the upper working rolls carried by a block vertically adjustable in said window, and overhung backing rolls for the lower working rolls carried by a block mounted in said window.

10. A duplex roll stand, comprising a housing having a window therein, two pairs of overhung working rolls mounted at opposite sides of the housing fast on two shafts journalled in blocks slidable in said window, overhung backing rolls for the upper working rolls carried by a block slidable in said window, overhung backing rolls for the lower working rolls carried by a block

slidable in said window, and means for applying preloading pressure to one of the backing roll blocks to force the backing rolls against the working rolls and the die rolls of each pair against each other.

11. A duplex roll stand, comprising a housing, two pairs of overhung working rolls mounted at opposite sides of the housing, an overhung backing roll for each of said working rolls, and means for applying preloading pressure to force the backing rolls against the working rolls and the working rolls of each pair against each other.

12. A duplex roll stand, comprising a cast rectangular frame having a window therein, two pairs of overhung working rolls mounted at opposite sides of the frame fast on two driven shafts journalled in blocks vertically slidable in said window, and an overhung backing roll for each of said working rolls, said backing rolls being carried by blocks mounted in said window, one of which last mentioned blocks is vertically adjustable, said frame having on each side outer laterally extending massive flanges of such width that the over-all width of the frame at said flanges is approximately equal to the distance from the outer side of the working rolls on one side of the frame to the outer side of the working rolls on the other side of the frame.

13. A roll stand, comprising a housing having a window therein, a pair of overhung working rolls on one side of the housing, a pair of overhung coacting rolls on the other side of the housing, the upper rolls of said pairs being fast on a shaft journalled in a block vertically slidable in said window and the lower rolls of said pairs being fast on a shaft journalled in a block vertically slidable in said window, means for adjusting one of said blocks axially of its shaft, overhung backing rolls for the upper rolls of said pairs carried by a block mounted in said window, and overhung backing rolls for the lower rolls of said pairs carried by a block mounted in said window, one of said backing roll blocks being vertically adjustable.

14. A roll stand, comprising a housing having a window therein, a pair of overhung working rolls on one side of the housing, a pair of overhung coacting rolls on the other side of the housing, the upper rolls of said pairs being fast on a shaft journalled in a block slidable in said window and the lower rolls of said pairs being fast on a shaft journalled in a block slidable in said window, overhung backing rolls for the upper rolls of said pairs carried by a block slidable in said window, overhung backing rolls for the lower rolls of said pairs carried by a block slidable in said window, and means for applying preloading pressure to one of the backing roll blocks to force the backing rolls against the rolls of each pair and the rolls of said pairs against each other.

15. A roll stand, comprising a housing having a window therein, a pair of overhung working rolls on one side of the housing, a pair of overhung coacting rolls on the other side of the housing, the upper rolls of said pairs being fast on a shaft journalled in a block slidable in said window and the lower rolls of said pairs being fast on a shaft journalled in a block slidable in said window, overhung backing rolls for the upper rolls of said pairs carried by a block slidable in said window, backing rolls for the lower rolls of said pairs, and means for applying preloading pressure to the block which carries the upper backing rolls to force the backing rolls against the rolls of said pairs and the rolls of each pair against each other.

16. A roll stand, comprising a housing having a window therein, a pair of overhung working rolls on one side of the housing, a pair of overhung coacting rolls on the other side of the housing, an overhung backing roll for each of the rolls of said pairs, and means for applying preloading pressure to force the backing rolls against the rolls of said pairs and the rolls of each pair against each other.

17. A roll stand, comprising a cast rectangular frame having a window therein, a pair of overhung working rolls on one side of the frame, a pair of overhung coacting rolls on the other side of the frame, the rolls of said pairs being fast on two driven shafts journalled in blocks slidable in said window, and an overhung backing roll for each roll of each of said pairs, said backing rolls being carried by blocks adjustable in said window, said frame having on each side outer laterally extending massive flanges of such width that the over-all width of the frame at said flanges is approximately equal to the distance from the outer side of the rolls of the pair on one side of the frame to the outer side of the rolls of the pair on the other side of the frame.

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