Fig. 6.

Fig. 9.

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The present invention has for its object to provide a universal rolling mill which is more useful in several respects than those heretofore used. As the vertical rolls of the universal rolling mills generally are positively driven with a shaft which is parallel with the rolls and mounted topmost in the rolling stand, it meets with extremely great difficulties to equip these stands with a detachable top. On the other hand, in the roller bearing means heretofore used it is necessary to use a detachable top because there is very seldom sufficient space in the axial direction for drawing out the rolls. However, constructions disclosed lately (in my United States Patents Nos. 2,506,681 and 2,506,682 and 2,506,687) and including horizontal roll bearings freely accessible on the exit side or on the entry side, offer new possibilities for mounting the vertical rolls with drive device directly on the bearing boxes or housings of the horizontal rolls. With such an arrangement said vertical rolls become easily accessible, easy to mount and easy to adjust during operation. Furthermore, together with the horizontal rolls, guides and rest bars they form a unit, the different parts of which may be mounted, adjusted, overhauled, and so on in a special workshop in which this work can be done with greater speed and precision than in the rolling mill hall and without disturbing the work there.

The invention also offers other advantages which will be clear from the following description.

The invention is exemplified in the annexed drawings as applied to a three-high rolling mill.

Fig. 1 is a front view, Fig. 1A is a top view and Fig. 2 is an end view of a three-high rolling mill. In the last figure coupling elements connecting two stands are cut on the line II—II of Fig. 1. Vertical rolls can be built into such a rolling mill. Such a vertical roll mounting is shown in Figs. 3 to 10.

Fig. 3 is a front view, partly in section, on the line III—III in Fig. 4, Fig. 4 is a section on the line IV—IV in Fig. 3, Fig. 5 is a top view, partly in section on the lines VA—VA and VB—VB in Fig. 4.

Fig. 6 is a section on the line VI—VI in Fig. 7, and the last-mentioned figure is a view of the rolling mill from the exit side. Fig. 8 is a plan view of the rolling mill, Fig. 9 is a section on line IX—IX in Fig. 7 and Fig. 10 is a view of the rolling mill taken at a right angle to the view in Fig. 7, the views in Figs. 6—10 being on a scale smaller than that used for Figs. 3—5.

In Figs. 3, 4, 5 most parts of the rolling mill are assembled; the other figures show but parts of the rolling mill, in order not to be overcrowded with details.

In the various views, similar elements have been assigned similar characters of reference.

Fig. 1 shows diagrammatically two pairs of housings placed side by side in a train. The left pair of housings is shown only in profile since this pair is similar to the right pair. The horizontal rolls 1, 2, 3 are mounted in bearing boxes 1a, 2a, 3a respectively, as seen in Fig. 2, by means of roller bearings one of which is shown at 2b in Fig. 5, and these bearing boxes are supported and guided by posts in accordance with my U. S. Patent No. 2,506,681. One such post numbered 1r is shown in Figs. 1, 1A, 2, 4 and partly in Fig. 5. Each post 1r with its base plate is used instead of a bearing casing or a usual frame, and is provided with a vertical guide, in the first place for the bearing boxes which are situated at the same side of the pair of rolls and of the post. However, the post can at the same time form a similar guide at its other side for the bearing boxes of another pair of rolls for instance in three-high mills according to the Figures 1, 1A, 2, 4 and 5.

The profile of the post 1r is best shown in Fig. 1A, which is a top view of the same together with a bearing box 1a at each side. As shown, a vertical flange constituting each guide engages a recess or a groove 26b in the bearing box. Such grooves are cut also in the boxes 2a and 3a corresponding to the respective flanges, see also Fig. 10.

It may be observed that Fig. 1A is intended just to show principally how the post and bearing boxes may be provided to engage each other.

Due to said flanges and grooves, the bearing boxes and rolls will obtain a good guidance, and will be movable up and down between the posts when the rolling mill is dismounted or mounted. This arrangement will be of great importance for universal rolling mills as will be obvious from the following specification. As most practical the middle roll is stationary during adjustment operations and the other two rolls adjustable in relation to it.

The bearing 2a for the middle roll 2 is fixed in the post and connected with the bearing 1a by means of stay screws 15, 16 (Figs. 2 and 4) which support the latter. These stay top screws are adjusted as shown in Fig. 4 by means of gear wheels 15a, 16b and 16a, 16b, and worm gears 18 meshing with worm gears on a shaft 20 (Figs. 3 and 4) driven by an electric motor 22 through a transmission 21. The two uppermost rolls are adjusted mutually by this motor. The gear wheels
are encased as indicated at 16b in the drawings. In rolling mills having three horizontal rolls (as shown in the drawings) the bearing boxes 2a and 3a are inter-connected by means of screws 2c and 3c, which are vertically adjustable and being fixed with screw bolts 2f each in a groove 2g in the roll bearing box 2a. Such grooves 2g are cut also in bearings 1a and 3a. A longitudinal shaft 7 mounted in one of the bearing boxes 2a and passing through bearing boxes 4a, 5a of the vertical rolls, see Fig. 5, is drivenly connected with the roll 2 by means of a pair of gears 4c, 5c, one gear 4c of which is fixed to the coupling head 2b of the roll 2, the gear being fixed to the shaft 7. Each vertical roll is drivenly connected with the shaft 7 by means of mete gears 5g, 5d. In order that the gear 5d shall always be in driving connection with the shaft 7 but move along the same, the shaft is splined, see Fig. 3. The input guides 4f, 5e (Fig. 5) are displacedly fixed to a guide rest bar 2d which is adjustable in the vertical direction with respect to the bearing boxes 2a also by means of anchoring bolts 2i which are displaceable along the bearing 2a, each in its respective groove 2g therein.

The spacing between the vertical rolls 4, 5 is adjusted by means of three screws 9 having right and left hand threads (Figs. 3, 4) which pass through bush nuts secured respectively on the vertical rolls 4a, 5a and are journaled in the bearing boxes 2a (e.g. to the left of Figs. 3 and 5). The screws 8 are connected to gear wheels at 10 close to the end wall of the bearing box. The gear wheels are driven through a chain transmission 1oa by a motor with gearing not shown. Thus the horizontal spacing of the vertical rolls can be adjusted for each pass.

When the vertical rolls are adjusted in this manner, the input guides 4e, 5e also participate in the movement which takes place. This is done through a system of pull rods 4f, 5f and 5i, 4h (see Fig. 8) and a lever device 4g and 5g respectively at each end wall where each lever device is mounted at its centre on its respective bearing box 2a. The pull rod 4f is connected with the bearing box 4a of the vertical roll 4 with the bearing box 5a. The position of the input guide 4e is controlled by movement of the bearing box 4a of the vertical roll 4 and the position of input guide 5e is controlled by movement of the bearing box 4a of the vertical roll 4 as will be seen from Fig. 8. The rods 4h and 5h are connected with the input guides 4e, 5e each by means of its lever arms 4o and 5o, which by means of a resilient connection 4p and 5p respectively push one input guide away from the other. In the opposite direction the lever arms actuate the input guides by means of set screws 4k, 5k.

The above described system of guiding the vertical rolls and the input guides make it possible to roll with a strong edging press (slag cleaning press) and with normal edging presses on the same piece (stock). When a slag cleaning press is used, the input guides 4e, 5e must be opened still more which may be made manually with the set screws 4k, 5k.

An upper and a lower guide device, a so-called scraper device 1g, 2g (Figs. 4, 6, 7) are provided between the horizontal rolls and the vertical rolls. The scraper 2g rests on the bearing boxes 4a, 5a of the vertical rolls. The scraper 1g is associated with the roll 1 is mounted on a member 1e by means of a rod 1f provided with spring loading. The member 1e is fixed to a guide rest bar 1d attached on the bearing boxes of the top horizontal roll. Consequently, the upper scraper 1g is adjusted in height with the top roll 1. The details are best shown in Fig. 6. For three-high rolling mills, lateral guides 4m, 5m, 4n, 5n (Figs. 7, 9) being required below the vertical rolls when rolling between roll 3 and the middle roll 2. The lateral guides 4m, 4n are connected to the bearing box 4a and the lateral guides 5m, 5n to the bearing box 5a of the vertical rolls and follow the same when the vertical rolls 4, 5 are adjusted. The usual known construction comprises ordinary lateral guides which are fixed on a guide rest bar and which must be displaced manually each time the width dimension is to be changed. However, the supports and the lateral guides have been designed in such a manner that rolling beds 12 and 13 respectively are obtained in the lower position on each side of the middle rolling bed 11 situated between the vertical rolls 4 and 5 (Fig. 7). The lateral guides are shown in Fig. 9, and the supports in the left bearing box 4a have been sectioned in the one direction and the supports in the other box 5a have been sectioned in the other direction. From Fig. 7 it will also be seen that the output guides 4m and 4n and 5m and 5n in the lower position follow the respective middle roll 2 and bottom roll 3 at the adjustment.

In order to obtain a box with the rolled flat strip, the vertical rolls 4, 5 slant with their axes outwards at an angle of 2° to the vertical, which causes the strip automatically to be forced downwards. The bearing boxes of the vertical rolls carry rollers 4z, 5r, Figs. 3, 7, which support the strip and absorb the downwardly directed forces on the edges of the hot stock, and the upward reaction pressure against the rolls 4z and 5r, hold the hot stock exactly at right-angles to the plane containing the axes of the vertical rolls 4, 5. The scraper 1g and lower scraper 2g serve substantially to guide the leading end of the hot stock to the correct position between the vertical rolls 4, 5.

Special improvements in the present construction are obtained by the bearing block arrangement, viz., these bearings, rolls and all elements which are built together with the rolls can, as a unit, be raised between the posts and removed for replacement by another unit to roll a different size stock. This idea is disclosed in my previous U. S. Patent No. 2,506,681. Thus far as is known was never earlier applied to universal rolling mills. At this special type of rolling mills the invention will be of very great importance by facilitating and simplifying the adjustment oper.

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tion also of the vertical rolls. As shown in Fig. 10, the rolls 1, 2, 3, the bearing boxes 1a, 2a and 3a are connected to each other and to the vertical rolls by means of the stay screws 15, 16. One of the vertical rolls is visible and indicated by 5. Bars 30, 31 and 32 connect the bearing boxes 2a and 3a, respectively. The whole unit may be handled by a crane like the unit shown in my U. S. Patent No. 2,506,681 for which purpose it may be provided with a yoke like the unit shown in that patent.

The invention is not limited to the described and disclosed details but may be altered in accordance with the local conditions and the requirements of the work, using different constructional elements. The above described devices may be used e.g. in two-high mills in as far as they are not dependent upon more than two horizontal rolls. Alternatively with the use of posts approximating the horizontal roll, through which the bearing boxes become freely accessible on the entry side or the exit side (compare my United States Patent No. 2,506,681), the further simplification may be made that the bearing boxes of the horizontal rolls are arranged to engage one another, as shown in Fig. 2. At the same time their stay screws are utilized for the stabilizing of the bearings. By this arrangement the bearings get the required guiding and anchoring so as to resist forces acting radially as well as axially on the rolls (compare my United States Patent No. 2,506,681), and they can together with all rolls, rest bars, guides and other accessories be detachably mounted on the fundament as described in my United States Patent No. 2,500,557.

The vertical rolls may be arranged to be dismounted and mounted in such a manner that the horizontal rolls can be used as an ordinary roll pair in two-high, three-high and similar rolling mills, see Fig. 2.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A universal rolling mill comprising superposed horizontal rolls having end journals, a pair of horizontally aligned bearing blocks for each of said rolls having journal bearings receiving the end journals of the rolls therein, vertically extending stay screws mounted on the bearing blocks of one or both of said rolls, the bearing blocks of the other of said rolls being mounted on said stay screws, adjusting means including said stay screws for adjusting the roll pressure and retaining the bearing blocks in position with respect to each other, said bearing blocks having vertically aligned guides on the outer end faces thereof offset from the axis of the journals bearing therein for engagement with complementary vertical guides on supporting standards to removably support the roll assembly on such standards, rigid horizontal guide rail members mounted directly on and between one of said pairs of bearing blocks, a pair of vertical roll journal housings slidably mounted on said horizontal guide rails, a vertical roll journal in each of said vertical roll journal housings in opposed relation to each other, horizontal right and left hand threaded adjusting screw rods journaled in said last mentioned pair of bearing blocks and in threaded engagement with said vertical roll journal housings for adjusting the same toward and away from each other, a horizontally extending vertical roll drive shaft extending between and journaled in the last mentioned pair of bearing blocks, and means for driving said vertical rolls from said vertical roll drive shaft.

2. A universal rolling mill as claimed in claim 1, and a driving connection between the horizontal roll journaled in the last mentioned pair of bearing blocks and the vertical roll drive shaft journaled therein.

3. A universal rolling mill as claimed in claim 2, in which the means for driving the vertical rolls from the vertical roll drive shaft includes a mitre gear on each of said vertical rolls and a meshing-mitre gear mounted with each of said vertical roll journal housings and slideable on said vertical roll drive shaft with a splined connection for transmitting the drive thereto.

4. A universal rolling mill as claimed in claim 1, and a rigid horizontal guide rail member mounted directly on and between the bearing blocks of said last mentioned pair thereof on the side of the horizontal roll journaled therein at the opposite side of the horizontal rolls in relation to the guide rail members for the vertical roll journal housings, horizontally adjustable input guides mounted on said guide rail member, and rod and lever adjusting connections between said vertical roll journal housings and said input guides for adjusting the latter in accordance with the adjustment of said vertical roll journal housings, said rod and lever adjusting connections being cross-connected such that the left input guide is adjusted by adjustment of the journal housing for the right vertical roll, and vice versa.

5. A universal rolling mill as claimed in claim 4 in which the adjusting connections between said vertical roll journal housings and said input guides includes set screw connections between the rod and lever connections and said input guides for individual adjustment of each of said input guides with respect to the rod and lever connections.

6. A universal rolling mill as claimed in claim 1 in which the mill is a three high mill having two lower roll beds and one upper roll bed and in which input guides are provided for the lower roll beds and mounted in dependent relation directly on the vertical roll journal housings whereby to be automatically adjusted upon adjustment of the vertical roll journal housings, and in which the upper roll bed is centered between the vertical roll journal housings and immediately above the space between the lower roll beds.

7. A universal rolling mill as claimed in claim 1 in which the vertical roll journal housings are demountable from the rolling unit independently of the mounting of the horizontal rolls whereby to permit utilization of the horizontal rolls as an ordinary rolling mill.

8. A universal rolling mill as claimed in claim 1 in which the vertical rolls are journaled in said vertical roll journal housings at an angle to the vertical to exert a downward force on the work and stock supporting rollers journaled on said vertical roll journal housings in position to support the work passing between said vertical rollers.

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