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(54) **Four high mill of paired-roll-crossing type.**

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Description

This invention relates to improvements in a four high mill of a paired-roll-crossing type.

A mill according to the first part of the main claim is known from the JP-A-55-153 606.

In recent years the demand for accuracy of thickness in the width direction of rolled metals has become more and more exacting. The demand has been met by initial crowning of rolls for rolling mills to make up for the deflections of the rolls under rolling load. This counter-measure necessitates having a large variety of initially crowned rolls in reserve, since the rolls must be replaced by those crowned otherwise whenever the rolling condition, such as the width or thickness or both of the slab or strip, are to be changed. The replacement of rolls lowers the rate of mill operation. Moreover, the crowning effect on rolls is highly variable because of the wear and thermal expansion of the rolls with the progress of rolling operation. For these reasons there has been an incessant need in the art for means of controlling the thickness of the workpiece widthways on rolling mills without the necessity of changing the rolls.

As a solution to this control problem, bending of the work rolls has been proposed and has proved fairly effective. However, the strengths of the work roll shafts place limits upon the bending forces applicable, and the roll-bending method is not satisfactorily capable of correcting the thickness ununiformity in the width direction of the workpiece. Especially where the mill has a relatively narrow rolling width for the length of rolls, the end cannot be fully achieved in most cases because of the interference by the contacting ends of the backup rolls and work rolls.

Therefore, the introduction of a rolling mill has been urgently called for which can freely control the thickness of the metal widthwise according to changes in the given rolling conditions, while using the same rolls.

Another disadvantage of the prior art is the necessity of frequently replacing the mill rolls, especially the work rolls, due to rapid wear on rolling operations. Conventional mills are designed to receive slabs or strips in such a manner that the middle point of the roll length matches the center of width of each passing piece. Consequently, the middle portions of the rolls wear faster than the end portions, and a common practice has been to remove each roll for replacement when its middle portion has worn beyond a predetermined limit. This means that the roll must be dismounted when its both ends are yet to reach the wear limits. The short life and frequent replacement of the rolls have lowered the rate of mill operation, and this has combined with the economical loss due to roll wear to have a serious effect upon the cost of product.

Thus, with the view to eliminating the disadvantages of the conventional rolling mills, this applicant has already proposed novel four high mills, as disclosed in the specifications (with drawings) of copending Japanese Patent Application Nos. 138837/1978 Publication numbers 55064908 and 55153605) and 59327/1979, which are capable of controlling the thickness extensively widthwise of the workpiece using the same rolls and more than doubling their ordinary spans of life.

Those rolling mills, of the four high type, include means for separately setting the left and right roll gaps, oil hydraulic jacks for roll bending, and a paired-roll-crossing mechanism which can be adjusted to move the pair of the upper work roll and backup roll and the pair of the lower work roll and backup roll to cross each other at predetermined angles with respect to a line normal to the rolling direction. In this way they can attain the end described above.

However, when the paired-roll-crossing mechanism is adjusted to turn the upper and lower pairs of rolls to the points where they cross at certain angles to a line normal to the rolling direction, there will occur horizontal deviations of the center points of the upper backup roll bearings and those of the reduction screws, away from each other. Bending moments corresponding to the amounts of deviations will develop in the screws, adversely affecting the screw operation. Similarly, the center points of the lower backup roll bearings and those of reduction cylinders undergo relative horizontal deviations, producing bending moments in the cylinders, too, and thereby having unfavorable effects upon the same.

This invention is aimed at overcoming the drawbacks of the proposed mills, and it provides a four high mill according to the features of claim 1.

In a further embodiment work roll bending means may be mounted at both ends of the work rolls.

Other objects and advantages of the present invention will become apparent when an embodiment thereof is considered in connection with the accompanying drawing, in which:

Fig. 1 is a diagrammatic front view of an embodiment of the invention;

Fig. 2 is a diagrammatic side view of the embodiment; and

Fig. 3 is a sectional view taken along line III-III of Fig. 1.

Throughout the figures the numeral 1 indicates a slab or strip of steel to be rolled by a pair of work rolls 2, 2′, which are held one above another and supported, respectively, by work roll chocks 6, 6′ as shown. A pair of backup rolls 3, 3′, in rolling contact with the non-working sides of the work rolls 2, 2′, are held within upper and lower bearing cases 7, 7′ for the backup rolls. On tops of housing frames 8, joined together at the bottoms by shoe plates 9, are mounted a pair of screw-down devices 11 equipped with a screw 4 each. Near the lower ends of the housing frames 8, there are installed a pair of hydraulic reduc-

tion cylinders 10.

The pair of screw-down devices 11 equipped with the screws 4 constitute means for separately setting the left and right roll gaps as desired between the upper and lower work rolls 2, 2′.

The upper and lower backup roll bearing cases 7, 7′ are held in a suitably spaced relation within the housing 8 so they may move upwardly and downwardly along the housing frames and also, as will be described later, they may turn about their common vertical axis. As illustrated, the upper and lower work roll chocks 6, 6′ are vertically slidably housed in the upper and lower backup roll bearing cases 7, 7′. Between the both ends of the backup roll bearing cases 7, 7′ and those of the work roll chocks 6, 6′ are interposed roll-bending devices (oil hydraulic jacks) 5, as shown in Fig. 1.

Also, between the upper backup roll bearing case 7 and the screws 4 and between the lower bearing case 7′ and the hydraulic reduction cylinders 10, there are disposed equalizer beams 21, 21′, respectively, which are movable upwardly and downwardly but are horizontally constrained unmovably by the inner walls of the housing 8.

Jacks 13a, 13b, 13c, and 13d are supported by brackets 20, 20′, which in turn are provided, as shown, on the upper and lower portions on both sides of the housing 8. These jacks are operated so as to turn the upper and lower backup roll bearing cases 7, 7′ on the same horizontal planes about their common vertical axis. The brackets 20, 20′ combine with the jacks 13a to 13d to constitute roll-crossing devices disposed in the housing 8.

The numeral 15 designates a cylinder for balancing the inner housing, mounted on top of the housing 8, with a rod 14 suspending the top roll assembly. Radial bearings 16, 16′ for the work rolls 2, 2′ are supported themselves by the work roll chocks 6, 6′. The work rolls 2, 2′ (Fig. 3 showing only the roll 2′ for simplicity) are supported at one ends by thrust pads 18 through thrust bearings 17. The thrust pads 18 are secured to the upper and lower backup roll bearing cases 7, 7′ with chock plates 19.

The construction of the four high mill of a paired-roll-crossing type embodying the invention has so far been described. Now as indicated in Fig. 3, let the line V-V be the centerline of width of a slab or strip being passed through the rolls (hereinafter called the "passing line"), the line X-X be a straight line that extends across the middle point of length of the rolls and parallel to the passing line V-V, the line Y-Y be a straight line at right angles to the line X-X, and the intersection of the passing line V-V and the line Y-Y be W. Then, the operation of the jacks 13a, 13b, 13c, and 13d for respective strokes determined by calculations will cause the upper and lower backup roll bearing cases 7, 7′ to turn horizontally with respect to the given point W on the line Y-Y, thus turning the upper and lower rolls 2, 2′ and 3, 3′ in pairs relative to each other through an angle $\alpha°$. (Refer to Fig. 3).

The initial roll gaps ε_1, ε_2 between the upper and lower work rolls 2, 2′ can be adjusted by suitably operating the left and right screw-down devices 11. Also, proper control of the roll-bending forces F_1, F_2 is made possible by the roll-bending devices 5.

Thus, by adjusting the turning angle $\alpha°$, initial roll gaps ε_1, ε_2 of the upper and lower work rolls 2, 2′, and the roll-bending forces F_1, F_2, the sectional contour across the workpiece 1 being rolled can be adjusted over a broad range of width.

Since the pairs of upper and lower rolls 2, 3 and 2′, 3′ can cross at the point W, the roll crowning effects can be made equal on the left and right portions of the rolls.

With the four high mill of a paired-roll-crossing type according to the invention, built and designed to function in the manner described above, it is possible to control the sectional contour of the workpiece over a great range of width. Further, because rolling at either end portions is possible, the work rolls may be worn while generally maintaining the original cylindrical contours. This presents practical advantages of not only more than halved intervals of work roll changing and more than doubled total tonnage of rolling but also by far the lower cost of fabricating and regrinding the rolls 2, 2′, 3, 3′, which need not be crowned but may be plain cylinders, than the cost for the ordinary crowned rolls.

Claims

1. A four high mill of a paired-roll-crossing type which comprises a housing (8), an upper and a lower backup roll bearing case (7,7′) held within the housing (8), an upper and a lower equalizer beam (21, 21′) in contact, respectively, with the uppermost and lowermost surfaces of said backup roll bearing cases (7, 7′) and made both movable upwardly and downwardly, pairs of work rolls (2, 2′) and backup rolls (3, 3′) in four high arrangement, upper and lower work roll chocks (6, 6′), roll-crossing means (13a to d) mounted in said housing (8) to turn said work roll chocks and said bearing cases (6, 6′) and (7, 7′) about a common vertical axis on the same horizontal plane so that said upper and lower pairs of rolls can cross each other, and means (4, 11) for separately setting the left and right roll gaps (E_1, E_2) between said upper and lower work rolls (2, 2′),
characterized in that there are disposed such equalizer beams (21, 21′), respectively, which are horizontally constrained immovably by the inner walls of the housing (8) whereby said bearing cases (7, 7′) are guided in the moving direction of the steel to be rolled, and in that the roll-crossing means (13a to d) directly act on the bearing cases (7, 7′) of the backup

rolls (3, 3′) and via the bearing cases (7, 7′) indirectly on the chocks (6, 6′) of the work rolls (2, 2′).

2. A four high mill according to claim 1, which further comprises work roll-bending means (5) mounted at both ends of said work rolls.

Patentansprüche

1. Quartowalzwerk mit paarweise schrägstellbaren Walzen bestehend aus einem Walzenständer (8), Lagergehäusen für eine obere und untere Stützwalze (7,7′) die im Walzenständer (8) gehalten werden, einem oberen und einem unteren Querbalken (21,21′), der mit der obersten bzw. der untersten Fläche der Lagergehäuse (7,7′) in Kontakt steht und sowohl nach oben als auch nach unten bewegbar ist, Arbeits- und Stützwalzenpaaren (3,3′) in Quartoanordnung, oberen und unteren Arbeitswalzen-Einbaustücken (6,6′), Walzen-Schrägstellmitteln (13a-d) im Walzenständer (8), um die Einbaustücke und die Lagergehäuse (6,6′) und (7,7′) um eine gemeinsame, auf derselben horizontalen Ebene liegende Achse zu drehen, so daß das obere und das untere Walzenpaar schräg zueinander stehen können, und Mittel (4,11), durch die der linke und der rechte Walzenspalt (E_1, E_2) unabhängig voneinander zwischen den oberen und unteren Arbeitswalzen (2,2′) einstellbar sind,
dadurch gekennzeichnet, daß die Querbalken (21,21′) so angeordnet sind, daß sie horizontal durch die inneren Wände des Walzenständers (8) unbeweglich gehalten sind, wobei die Lagergehäuse (7,7′) in der Bewegungsrichtung des zu walzenden Stahles geführt sind, und daß die Walzen-Schrägstellmittel (13a-d) direkt auf die Lagergehäuse (7,7′) der Stützwalzenpaare (3,3′) und über die Lagergehäuse (7,7′) indirekt auf die Einbaustücke (6,6′) der Arbeitswalzen (2.2′) wirken.

2. Quartowalzwerk nach Anspruch 1, gekennzeichnet durch an beiden Enden der Arbeitswalzen angeordnete Walzenbiegemittel (5).

Revendications

1. Laminoir quarto du type à cylindres appariés croisés, comprenant un bâti (8), des boîtiers de support (7,7′) pour des cylindres d'appui inférieur et supérieur maintenus dans le bâti (8), des poutres de compensation supérieure et inférieure (21,21′) en contact, respectivement, avec les surfaces les plus supérieures et les plus inférieures desdits boîtiers de support (7,7′) et conçues toutes les deux mobiles vers le haut et vers le bas, des paires de cylindres de travail (2,2′) et de cylindres d'appui (3,3′) dans un agencement quarto, des empoises (6,6′) de cylindres de travail inférieure et supérieure, des moyens de croisement des cylindres (13a à d) montés dans ledit bâti (8) pour faire tourner lesdites empoises et lesdits boîtiers de support (6,6′) et (7,7′) autour d'un axe vertical commun dans le même plan horizontal, de sorte que lesdites paires de cylindres supérieure et inférieure peuvent se croiser, et des moyens (4,11) pour régler séparément les intervalles à gauche et à droite (E_1,E_2) entre lesdits cylindres de travail inférieur et supérieur (2,2′),
caractérisé en ce que l'on dispose de telles poutres de compensation (21,21′), respectivement, qui sont, horizontalement, retenues immobiles par les parois internes du bâti (8), lesdits boîtiers de support (7,7′) étant guidés dans la direction de déplacement de l'acier à rouler, et en ce que les moyens de croisement des cylindres (13a à d) agissent directement sur les boîtiers de support (7,7′) des cylindres d'appui (3,3′) et, via les boîtiers de support (7,7′), indirectement sur les empoises (6,6′) des cylindres de travail (2,2′).

2. Laminoir quarto selon la revendication 1, qui de plus comprend des moyens (5) de cintrage des cylindres de travail montés aux deux extrémités desdits cylindres de travail.

FIG.1

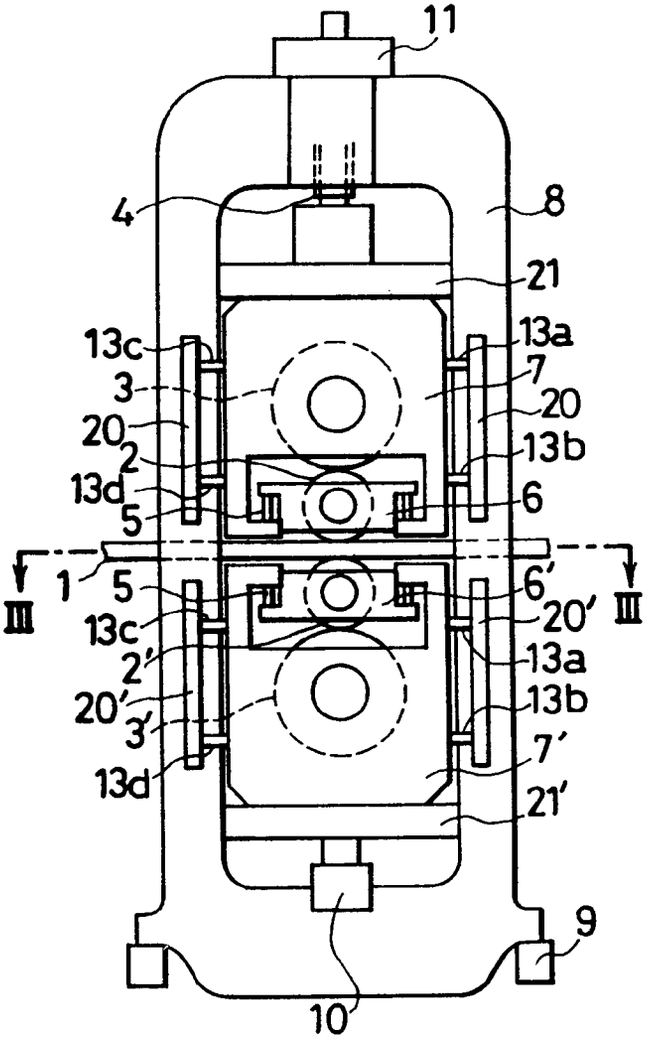

FIG.2

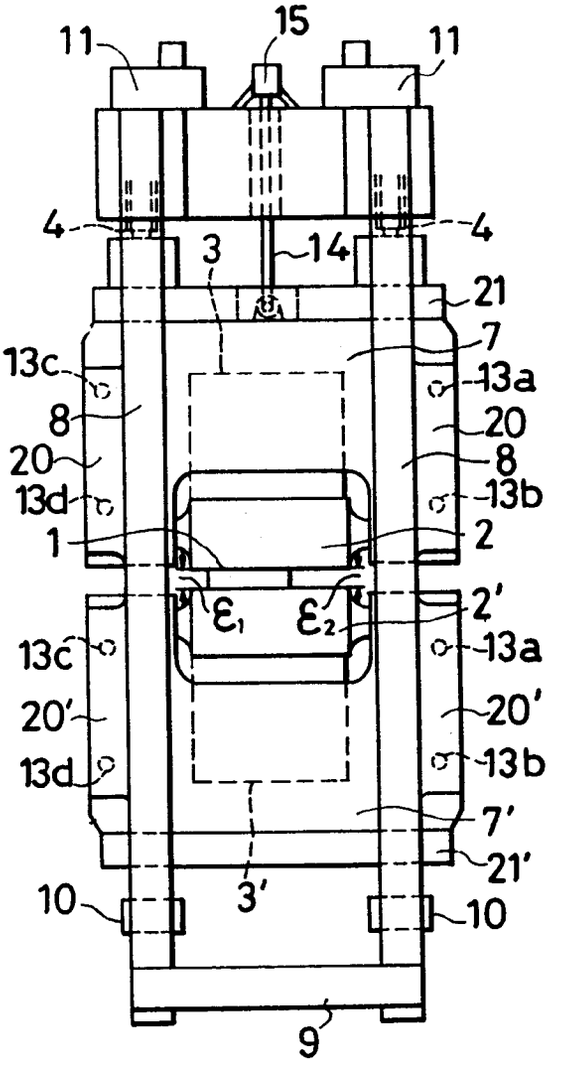

FIG.3