

Description

This invention relates to a roller leveller used for levelling the surface shape of a hoop passed through a rolling process.

A roller leveller basically comprises an upper work roll group and a lower work roll group both defining a pass line, through which a rolled hoop is passed. Both of the upper and lower work roll groups are provided in a zigzag form so that three points of intersection of three adjoining upper and lower work roll axes with the plane crossing them may form three vertexes of an isosceles triangle.

The hoop passing through the pass line is bent along the cylindrical surfaces of the respective work rolls and extended up to its plastic zone. As a result, the strain of the hoop surface is removed. That is, the surface shape of the hoop is levelled.

However, on the basis of the diameters of the work rolls of a roller leveller or the respective pitches between mutual upper work rolls and between mutual lower work rolls, the thickness of the hoop which can be processed by the roller leveller is determined. If the processable range of the hoop thickness is wider, the levelling of the hoop processed by using a plurality of roller levellers can be practiced by a single roller leveller.

In a prior art, there has been proposed a roller leveller (refer to Japanese Patent Disclosure (KOKAI) No. 62-203616), in which a pair of upper and lower work rolls adjacent to each other in a diagonal direction are made movable in an upper and lower direction to the other pair of upper and lower work rolls adjacent to these work rolls, respectively, and the lower work roll group is made movable in a lateral direction which is normal to its axis.

According to this roller leveller, after moving a pair of diagonal directional upper and lower work rolls in the upper and lower direction, respectively, the lower work roll group is moved in the lateral direction so that the moved upper and lower work rolls may mutually face to the respective other fixed lower and upper work rolls. As a result, both upper and lower work roll groups having their pitches which are twice as large as those prior to their moving, are newly composed. A work roll arranged in a large pitch, in comparison with the work roll arranged in a pitch smaller than that work roll, makes it possible to level the hoop shape having a larger thickness, on the basis of the same pressure applied to the hoop.

Now, the upper and lower work roll groups defining a pass line must be accurately arranged and maintained so that these axes may pass through the vertexes of the isosceles triangle. This is indispensable for the leveling of a thin plate.

In the prior art roller leveller, however, there is a large possibility that any abrasions, rust, dust or the like produced between laterally movable supporting

means for supporting the lower work roll group and the other portions of the roller leveller may damage the accurate arrangement of the lower work roll group. Therefore, it is not desirable for maintaining the highly accurate roller leveller to make the lower work roll group movable in a lateral direction.

An object of the present invention is to provide a roller leveller for enabling to enlarge the pitches of the upper and lower work roll groups defining the pass line of a hoop, without necessarily making the lower work roll group movable in a lateral direction in the aforesaid manner.

The roller leveller according to the present invention is defined in its broadest aspects in claim 1 hereinafter and an example of a roller leveller according to the present invention comprises a first, raisable upper work roll group, and a second, lower work roll group, the upper and lower work roll groups being arranged in a zigzag form so that the axes of three work rolls adjacent to each other at upper and lower sides and three points of intersection with the plane crossing with these axes may give three vertexes of an isosceles triangle, and the lower work rolls at the odd or even number positions in the lower work roll group being raisable.

The example of roller leveller, further, comprises two rows of upper backup roll groups placed around the axis of each upper work roll at a certain angular interval and extending along each upper roll, and two rows of lower backup roll groups placed angularly around the axis of each lower work roll and extending along each lower work roll.

Additionally, the roller leveller comprises two rows of upper backup rolls angularly placed around the axis of each upper work roll and extending along each upper roll and one row of lower backup rolls placed right under each lower work roll.

According to the present invention, the raised lower work roll group can be made into the upper work roll group defining the pass line in cooperation with the unlifted remaining lower work roll group, by raising the lower work rolls at odd or even number positions. The distance between the axes of the raised mutual lower work rolls and the distance between the axes of the remaining mutual lower work rolls, that is, the pitches of the work rolls become twice as large as those in the condition before the rise of the lower work roll. In this way, it is possible to level the hoop shape with a thickness exceeding the levellable maximum thickness by both upper and lower work roll groups before such rising. In addition, as the rise of the lower work rolls are what is loosed from the original lower work roll group while maintaining the distance between the axes of the mutual lower work rolls as it is, an isosceles triangle as above-mentioned is strictly maintained between the raised lower work rolls and the remaining lower work rolls, and it is also maintained in long-term use. Therefore, according to

the present invention the precision levelling of the hoop is guaranteed for both thin and thick plates.

In the prior art roller leveller, it was necessary to raise and lower the upper and lower work rolls, respectively, and therefore, a backup roll could not be placed at the back of each work roll.

However, a mechanism for raising the lower work rolls is provided in the described example of the present invention, and therefore, a backup roll can be placed at the underside of each lower work roll. In addition, as each upper work roll is not raised individually, backup rolls can be placed on the upper side thereof.

When the lower backup rolls are placed right under each lower work roll, the mill scale stripped off from the hoop passing through the pass line can be prevented from depositing on the lower backup rolls.

The foregoing and other objects and features of the invention will become apparent from the following description of preferred embodiments of the invention with reference to the accompanying drawings, in which:

Fig. 1 is a front view showing a roller leveller according to an embodiment of the present invention;

Fig. 2 is a front view showing the roller leveller in a condition after raising upper work rolls and a part of lower work roll, from the condition shown in Fig. 1;

Fig. 3 is a partial sectional view taken along the line 3-3 of Fig. 2;

Fig. 4 is a schematic perspective view showing the arrangement of the upper work roll group and the lower work roll group of Fig. 1;

Fig. 5 is a schematic perspective view showing the arrangement of the upper work roll group and the lower work roll group of Fig. 2;

Fig. 6 is a schematic view showing the arrangement of the upper work roll group as well as the upper backup roll group and the lower work roll group as well as the lower backup roll group of Fig. 1;

Fig. 7 is a schematic view showing the arrangement of the upper work roll group as well as the upper backup roll group and the lower work roll group as well as the lower backup roll group of Fig. 2;

Fig. 8 is a schematic view similar to that of Fig. 6, but showing the lower backup rolls arranged right under the lower work rolls;

Fig. 9 is a schematic view similar to that of Fig. 7, but showing the lower backup rolls arranged right under the lower work rolls;

Fig. 10 is a schematic view similar to that of Fig. 6, but showing a case where the upper backup rolls and the lower backup rolls are not so arranged; and

Fig. 11 is a schematic view similar to that of Fig.

7, but showing a case where the upper backup rolls and the lower backup rolls are not so arranged.

Referring to Fig. 1, reference numeral 10 indicates the whole of a roller leveller used for levelling the strain which is present at either central or side portion in the cross direction of the hoop after its rolling process.

The roller leveller 10 comprises a frame 12, an upper work roll group 14 supported by the frame 12 and a lower work roll group 16. Both work roll groups 14 and 16 define the pass line, through which the hoop to be leveled is passed.

The upper work roll group 14 is composed of a plurality (8 pieces in an illustrated embodiment) of upper work rolls 18 arranged in parallel with each other in a lateral row at a pitch L , and the eight upper work rolls 18 are supported rotatably by a box-like supporting body 20.

The supporting body 20 is suspended from the upper portion of the frame 12 through a plurality of suspended holding members 22. Each suspended holding member 22 passes through the upper portion of the frame 12 in its vertical direction and is screwed to the frame. The supporting body 20 is raised by rotating each suspended holding member 22 about its axis. When the upper work roll group 14 is pushed against the hoop on the lower work roll group 16 by lowering the supporting body 20, the hoop receives a pressured force which is necessary for levelling.

Each suspended holding member 22 is rotated and driven through a torque transmitting shaft 24 and a rotational direction conversion device 26 which are connected to a driving shaft of a motor (not shown) extending in parallel with the upper work rolls 18.

Two rows of upper backup roll groups 28 arranged angularly around the axis at the upper side of each upper work roll 18 are supported ascendably and descendably relative to each upper work roll 18 by the supporting body 20. The upper backup roll group 28 in each row consists of a plurality of pairs of upper backup rolls 30 placed mutually at intervals along the upper work rolls 18 and rotatably contacting with the upper work rolls 18.

The lower work roll group 16 is supported at the lower portion of the frame 12. The lower work roll group 16 consists of a plurality (9 pieces in the illustrated embodiment) of lower work rolls 32 having the same diameter as that of the upper work rolls 18. These lower work rolls 32 are placed horizontally in a row and in parallel with each other at the same pitch L as that between the upper work rolls 18, and they are also arranged in parallel with the upper work rolls 18.

At the lower portion of the frame 12, two rows of lower backup roll groups 34 placed angularly around the axis at the lower side of each lower work roll 32 are supported ascendably and descendably relative

to each lower work roll 32. The backup roll group 34 in each row consists of a plurality of pairs of lower backup rolls 36 placed at intervals along the lower work rolls 32 and rotatably contacting the lower work rolls 32.

The upper backup rolls 30 prevent the deflection of the upper work rolls 18 when a hoop 38 (Figs. 6 and 8) is passed between both work roll groups 14 and 16. In addition, the lower backup rolls 36 are set up so as to limit deflection in the lower work rolls 32.

When the hoop 38 is passed between the upper and lower work roll groups 14 and 16, the hoop 38 is bent repeatedly along circumferential surface portions of each upper and lower work roll 18, 32 and receives a tension, and in this way, a plastic elongation is given to cancel the surface strain. That is, the surface shape is levelled. The plastic elongation becomes, in particular, maximum at the largest flexure portion of the lower work rolls 32, respectively.

Both of the upper and lower work roll groups 14 and 16 are positioned in a zigzag way so that the axes of three work rolls 18 and 32 adjoining mutually at upper and lower positions and three points of intersection with the plane crossing these axes may make three vertexes of an isosceles triangle T, and this relation is maintained.

It is required that this array relation of both work roll groups 14 and 16 be maintained strictly for the levelling of relatively thinner hoops.

In this example of the present invention, the lower work rolls at odd or even number positions are raisable.

In the illustrated embodiment, the four lower work rolls 32 at even number positions are supported at both their ends by a pair of movable plate members 40 forming a part of the lower portion of the frame 12 and facing to each other.

Each plate member 40 is pivotally attached to and held by a pair of hydraulic cylinders or air cylinders 43 fixed to the base of the frame 12 and expandable in the vertical direction.

As a result, the four lower work rolls 32 at the even number positions can be raised together with the plate member 40 by causing the air cylinder 42 act to extend (refer to Fig. 2). When the lower work rolls 32 are raised or in advance of this, the supporting body 20 of the upper work rolls 14 is also raised.

Referring now to Fig. 2, the four lower work rolls 32 raised at even number positions define the pass line for a thicker hoop 46 (refer to Figs. 3, 5, 7 and 11), in cooperation with the five lower work rolls 32 at odd number positions, supported by a pair (only one of them is shown) of fixed plate members 44 which make a part of the lower portion of the frame 12.

The lower work roll group 48 (to be designated as "a first lower work roll group" hereafter) raised at even number positions and the lower work roll group 50 (to be designated as "a second lower work roll group"

hereafter) at the odd number positions as it was, have an array relation in a zigzag form that the axes of the three lower work rolls 32 adjacent to each other and the three points of intersection with the plane crossing with these axes may make three vertexes of an isosceles triangle T' (Fig. 2). Therefore, a precise modification of the shape of a hoop 46 passing through the pass line is possible.

The first lower work roll group 48 acts as an upper work roll group to the second lower work roll group 50, and the upper work roll group 14 acts as an intermediate roll group between the first lower work roll group 48 and the upper backup roll group 28.

Also, the pitches of the first and second lower work roll groups 48 and 50 become twice as large as those of the in work roll group 14 and the lower work roll group 16 in the original condition shown in Fig. 1, that is, $2L$.

Each work roll of the first and second lower work roll groups 48 and 50 with enlarged pitches gives a larger bending and a larger tension to the hoop under the same pressure, in comparison with each work roll of the upper work roll group 14 and the lower work roll group 16 before the pitches are enlarged. Therefore, the thickness of the hoop for enabling to bending and extension as to be able to cancel the strain of the hoop under the maximum pressure is larger after the pitches are enlarged (Fig. 2) than before those are enlarged (Fig. 1). This means that the shape levelling of the hoop with a wider range of thickness dimension can be made by a single roller leveller than hitherto.

For example, when each of work rolls 18 and 32 is 50 mm in diameter and has a pitch L of 53 to 55 mm, the thickness dimension of hoop 38 that can be levelled by the roller leveler 10 in the condition shown in Fig. 1 ranges from 0.5 mm to 3.2 mm.

When the roller leveler is in the condition shown in Fig. 2 where the pitch L is doubled, the levelling of a hoop 46 with a thickness ranging from 2.0 mm to 6.0 mm, is possible.

Therefore, for the roller leveller 10 shown in the illustrated embodiment, the levelling of hoop 46 with the thickness ranging from 0.5 mm to 6.0 mm is possible.

Referring now to Fig. 3, each pair of lower backup rolls 36 in each row is interconnected through a shaft member 52, which is also supported rotatably by an elongate and plate-like bearing member 54. The bearing member 54 extends in the horizontal direction perpendicular to these axes at the underside of all lower work rolls 32.

A key member 56 and a base member 58 having the inclined face contacting each other and also having the almost same width and length dimension, are arranged on the underside of the bearing member 54.

The base member 58 is fixed to a plurality of the opposite plate members 60 (only one of them is shown) forming a part of the lower portion of the

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frame 12. The bearing member 54 is movable only in the vertical direction and the key member 56 is movable only in the vertical direction and in its longitudinal direction, and both ends of them are held by the plate members 60 through a pair of holding members 62. Furthermore, a screw rod 64 passing through one holding member 62 is screwed into one end of the key member 56. When the screw rod 64 is turned, the key member 56 moves along the inclined face in its longitudinal direction and vertical direction. As a result, a plurality of pairs of lower backup rolls 36 supported by the bearing member 54 move vertically.

The raising mechanism of the lower backup rolls 36 is applied similarly to the upper backup rolls 30. To avoid a repetition of the explanation, the raising mechanism of the upper backup rolls 30 is partially shown, and only the corresponding symbol to each portion of the raising mechanism of the lower backup rolls 36 is given.

However, as will become clear by a comparison respectively between Figs. 4 and 5, Figs. 6 and 7, Figs. 8 and 9 and Figs. 10 and 11, the direction of the rotation of each lower work roll 32 (Figs. 4, 6, 8 and 10) prior to raising, is clockwise, whereas that of each lower work roll 32 (Figs. 5, 7, 9 and 11) of the first lower work roll group 48 is counterclockwise. In consideration of the variation of the rotational direction before and after raising, it is desirable to arrange that only the raisable lower work rolls in the lower work rolls are driven to rotate.

As shown in Figs. 8 and 9, the lower backup rolls 66 may be placed right under each lower work roll 32. It is desirable that the lower backup rolls 66 have the same diameter as that of each lower work roll 32. According to this, the hard mill scale that tends to peel off from the surface of the hoop when the hoop 38 or 46 is bent, can be prevented from depositing on the lower backup rolls 66, since the scale can pass between the lower backup rolls 66.

Furthermore, as shown in Figs. 10 and 11, the present invention can be applied to the roller leveller having no backup rolls.

Claims

1. A roller leveller for producing surface levelling of strip material (38) moving longitudinally along a path, including a first roll group (14) disposed along one side of the path, a second roll group (16) disposed along the other side of the path, characterised in that a selected plurality of some of the rolls (32) of the second roll group (16) are movable transversely away from other ones of the rolls of the second roll group whereby to define an alternative path for strip material (46) between rolls of the second roll group.

2. A roller leveller according to claim 1 wherein the first roll group (14) includes a set of working rolls (18) that define one side of said path, and at least one row of backup rolls (30) that support the working rolls in use.
3. A roller leveller according to claim 2 wherein the second roll group (16) includes a set of working rolls (32) that define the other side of said path, and at least one set of backup rolls (36) that support the working rolls of said second group in use.
4. A roller leveller according to claim 1 or 2 including means (20,22) for raising and lowering the first group (14), means (40,42) for raising and lowering the entire second group (16), and means for selectively raising and lowering said selected plurality of the rolls (32) of the second group.

Patentansprüche

1. Walzenrichteinrichtung zur Erzeugung einer Oberflächenebnung von Bandmaterial (38), das sich in Längsrichtung längs eines Wegs bewegt, mit einer ersten Walzengruppe (14), die längs einer Seite des Wegs angeordnet ist, einer zweiten Walzengruppe (16), die längs der anderen Seite des Wegs angeordnet ist, dadurch gekennzeichnet, daß eine ausgewählte Mehrzahl einiger der Walzen (32) der zweiten Walzengruppe (16) transversal weg von anderen der Walzen der zweiten Walzengruppe verstellbar ist, wodurch ein Alternativweg für Bandmaterial (46) zwischen Walzen der zweiten Walzengruppe definiert wird.
2. Walzenrichteinrichtung nach Anspruch 1, bei der die erste Walzengruppe (14) einen Satz Arbeitswalzen (18), die eine Seite des Wegs definieren, und wenigstens eine Reihe Stützwalzen (30), die die Arbeitswalzen im Gebrauch abstützen, enthält.
3. Walzenrichteinrichtung nach Anspruch 2, bei der die zweite Walzengruppe (16) einen Satz Arbeitswalzen (32), die die andere Seite des Wegs definieren, und wenigstens einen Satz Stützwalzen (36), die die Arbeitswalzen der zweiten Gruppe im Gebrauch abstützen, enthält.
4. Walzenrichteinrichtung nach Anspruch 1 oder 2, mit einer Einrichtung (20, 22) zum Anheben und Absenken der ersten Gruppe (14), einer Einrichtung (40, 42) zum Anheben und Absenken der gesamten zweiten Gruppe (16) und einer Einrichtung zum wahlweisen Anheben und Absenken der ausgewählten Mehrzahl der Walzen (32) der zweiten Gruppe.

frame 12. The bearing member 54 is movable only in the vertical direction and the key member 56 is movable only in the vertical direction and in its longitudinal direction, and both ends of them are held by the plate members 60 through a pair of holding members 62. Furthermore, a screw rod 64 passing through one holding member 62 is screwed into one end of the key member 56. When the screw rod 64 is turned, the key member 56 moves along the inclined face in its longitudinal direction and vertical direction. As a result, a plurality of pairs of lower backup rolls 36 supported by the bearing member 54 move vertically.

The raising mechanism of the lower backup rolls 36 is applied similarly to the upper backup rolls 30. To avoid a repetition of the explanation, the raising mechanism of the upper backup rolls 30 is partially shown, and only the corresponding symbol to each portion of the raising mechanism of the lower backup rolls 36 is given.

However, as will become clear by a comparison respectively between Figs. 4 and 5, Figs. 6 and 7, Figs. 8 and 9 and Figs. 10 and 11, the direction of the rotation of each lower work roll 32 (Figs. 4, 6, 8 and 10) prior to raising, is clockwise, whereas that of each lower work roll 32 (Figs. 5, 7, 9 and 11) of the first lower work roll group 48 is counterclockwise. In consideration of the variation of the rotational direction before and after raising, it is desirable to arrange that only the raisable lower work rolls in the lower work rolls are driven to rotate.

As shown in Figs. 8 and 9, the lower backup rolls 66 may be placed right under each lower work roll 32. It is desirable that the lower backup rolls 66 have the same diameter as that of each lower work roll 32. According to this, the hard mill scale that tends to peel off from the surface of the hoop when the hoop 38 or 46 is bent, can be prevented from depositing on the lower backup rolls 66, since the scale can pass between the lower backup rolls 66.

Furthermore, as shown in Figs. 10 and 11, the present invention can be applied to the roller leveller having no backup rolls.

Claims

1. A roller leveller for producing surface levelling of strip material (38) moving longitudinally along a path, including a first roll group (14) disposed along one side of the path, a second roll group (16) disposed along the other side of the path, characterised in that a selected plurality of some of the rolls (32) of the second roll group (16) are movable transversely away from other ones of the rolls of the second roll group whereby to define an alternative path for strip material (46) between rolls of the second roll group.

2. A roller leveller according to claim 1 wherein the first roll group (14) includes a set of working rolls (18) that define one side of said path, and at least one row of backup rolls (30) that support the working rolls in use.
3. A roller leveller according to claim 2 wherein the second roll group (16) includes a set of working rolls (32) that define the other side of said path, and at least one set of backup rolls (36) that support the working rolls of said second group in use.
4. A roller leveller according to claim 1 or 2 including means (20,22) for raising and lowering the first group (14), means (40,42) for raising and lowering the entire second group (16), and means for selectively raising and lowering said selected plurality of the rolls (32) of the second group.

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1. Walzenrichteinrichtung zur Erzeugung einer Oberflächenenebnung von Bandmaterial (38), das sich in Längsrichtung längs eines Wegs bewegt, mit einer ersten Walzengruppe (14), die längs einer Seite des Wegs angeordnet ist, einer zweiten Walzengruppe (16), die längs der anderen Seite des Wegs angeordnet ist, dadurch gekennzeichnet, daß eine ausgewählte Mehrzahl einiger der Walzen (32) der zweiten Walzengruppe (16) transversal weg von anderen der Walzen der zweiten Walzengruppe verstellbar ist, wodurch ein Alternativweg für Bandmaterial (46) zwischen Walzen der zweiten Walzengruppe definiert wird.
2. Walzenrichteinrichtung nach Anspruch 1, bei der die erste Walzengruppe (14) einen Satz Arbeitswalzen (18), die eine Seite des Wegs definieren, und wenigstens eine Reihe Stützwalzen (30), die die Arbeitswalzen im Gebrauch abstützen, enthält.
3. Walzenrichteinrichtung nach Anspruch 2, bei der die zweite Walzengruppe (16) einen Satz Arbeitswalzen (32), die die andere Seite des Wegs definieren, und wenigstens einen Satz Stützwalzen (36), die die Arbeitswalzen der zweiten Gruppe im Gebrauch abstützen, enthält.
4. Walzenrichteinrichtung nach Anspruch 1 oder 2, mit einer Einrichtung (20, 22) zum Anheben und Absenken der ersten Gruppe (14), einer Einrichtung (40, 42) zum Anheben und Absenken der gesamten zweiten Gruppe (16) und einer Einrichtung zum wahlweisen Anheben und Absenken der ausgewählten Mehrzahl der Walzen (32) der zweiten Gruppe.



Revendications

1. Machine à dresser à rouleaux pour aplanir un feuilard (38) se déplaçant longitudinalement le long d'un trajet, comportant un premier groupe de rouleaux (14) disposés le long d'un côté du trajet, un second groupe de rouleaux (16) disposés le long de l'autre côté du trajet, caractérisé en ce qu'un ensemble sélectionné de certains des rouleaux (32) du second groupe de rouleaux (16) est mobile transversalement pour s'écarter de certains autres des rouleaux du second groupe de rouleaux afin de définir un autre trajet pour le feuilard (46) entre des rouleaux du second groupe de rouleaux. 5
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2. Machine à dresser à rouleaux selon la revendication 1, dans laquelle le premier groupe de rouleaux (14) comporte un jeu de rouleaux de travail (18) qui définissent un côté dudit trajet, et au moins une rangée de rouleaux d'appui (30) qui supportent les rouleaux de travail lors de l'utilisation. 20
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3. Machine à dresser à rouleaux selon la revendication 2, dans laquelle le second groupe de rouleaux (16) comporte un jeu de rouleaux de travail (32) qui définissent l'autre côté dudit trajet, et au moins un jeu de rouleaux d'appui (36) qui supportent les rouleaux de travail dudit second groupe lors de l'utilisation. 30
4. Machine à dresser à rouleaux selon la revendication 1 ou 2, comportant un moyen (20,22) pour soulever et abaisser le premier groupe (14), un moyen (40,42) pour soulever et abaisser la totalité du second groupe (16), et un moyen pour soulever et abaisser sélectivement ledit ensemble sélectionné de rouleaux (32) du second groupe. 35
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