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(54) **The rolling of metal strip.**

(57) When rolling metal strips in a rolling mill having work rolls which are considerably longer than the width of the strips, wear of the work rolls can be evened out by arranging for successive strips, or successive groups of strips, to pass between the rolls along different paths with the centre-line of some of the paths being offset from the centre-line of the mill.

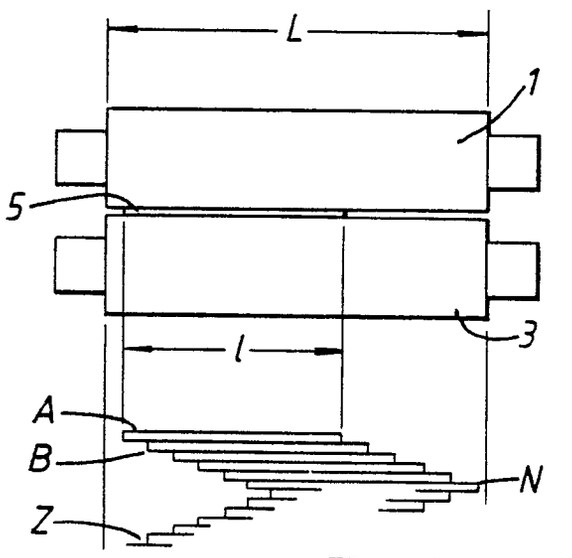

FIG. 1.

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THE ROLLING OF METAL STRIP

It is a feature of modern multi-stand hot strip rolling mills that the length of the work rolls is such that the demand for wide strip can be met. However, the mill user usually has some orders for narrower width strip and so strips of various widths up to the maximum width are rolled on different occasions in the same mill. It is usual for the strip to travel along a path which is symmetrical with respect to the centre-line of the rolls. If there is a large order for strips of the same width, but which is considerably less than the maximum width which can be rolled in the mill, then the work rolls will tend to wear over a length equal to the strip width and there is pronounced wear in the regions of the edges of the strip. This leads to the strip which is being rolled having a profile which has enlarged edges and this is known as "edge build-up".

An object of the present invention is to distribute wear on the work rolls of a rolling mill stand over an increased proportion of the length of the work rolls.

According to the present invention, in a method of rolling metal strips each being of a width less than the length of the work rolls between which they are being rolled, successive strips, or successive groups of strips, are passed between the rolls along different paths with respect to the centre-line of the rolls, such that the strips contact different portions of the roll surfaces.

The work rolls may be axially fixed and the strips are then presented to the rolls along different paths with respect to the centre-line of the rolls. The strips pass through the rolls along these different paths and the strips contact different portions of the roll surfaces.

Alternatively, the rolls may be axially movable and the strips are presented to the rolls along a common track. However, by axially moving the rolls together axially with respect to the common track, the strips pass through the rolls along different paths such that the strips contact different portions of the roll surfaces.

Conveniently, successive strips, or successive groups of strips, pass between the rolls along paths offset from the centre-line on one side of the mill, along a path through the centre-line of the mill and along paths offset from the centre-line on the other side of the mill.

In an embodiment where the rolls are axially fixed, successive strips, or groups of strips, are progressively displaced from a path off-set by a maximum amount from the centre-line on one side of the mill, through the centre-line of the mill to a path offset by a maximum amount on the other side of the mill and the progressive displacement from side-to-side is repeated until all the strips of the particular width have been rolled.

Successive strips may be rolled along different paths or a group of, say, two or three strips are passed along one path and the next group of two or three strips are passed along the adjacent path.

This method of strip rolling distributes the work roll wear across a greater part of the length of the work rolls before the rolls have to be re-ground.

In order that the invention may be more readily understood, it will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic view of the rolls of a rolling mill and a strip passing therebetween;

Figure 2 is a reproduction of part of Figure 1; and

Figure 3 is a view similar to Figure 2 but with one of the work rolls tilted with respect to the other.

Referring to Figure 1, a rolling mill stand of a hot strip mill has a pair of work rolls 1, 3. The length L of the barrel of each roll is such that the mill stand can roll strip of the required maximum width. When this width of strip is being rolled, the strip is passed between the rolls along a path which is substantially symmetrical with respect to the centre-line of the work rolls. However, when a strip 5 of a length l is to be rolled, where l is considerably less than L, then the strip can be passed between the rolls along a number of different paths which are offset from the centre-line of the rolls.

In the arrangement shown in Figure 1, the first strip A is rolled along a path where the strip is offset from the centre-line of the mill by a maximum distance towards the left-hand side of the mill. The second strip B is displaced by the side guides by a small amount so that its centre is slightly closer to the centre-line of the mill and it is rolled along this path. Successive strips are displaced relative to the path taken by the preceding strip until the path taken by strip N is displaced from the mill centre-line by a maximum amount towards the right-hand side of the mill. In this way, substantially the entire length of the rolls has been used to roll the strips A -N. For the next strips to be rolled, the path taken by each one is displaced slightly relative to that of the preceding strip such that strip Z is displaced to the same position as strip A relative to the work rolls. This is repeated as necessary until all the strips have been rolled.

Clearly, successive strips can be displaced relative to each other or successive groups of strips, where a group consists of two or three strips, can be displaced relative to the path taken by the preceding group of strips.

The work rolls can be shifted axially by a small amount, say 10 mm, between the successive strips or groups of strips. Thus, if the work rolls have a length which is greater than the width of the strip by, say, 75 mm, then, by displacing the rolls by, say, 10 mm increments, and keeping the same track for the strip, the cyclical pattern can be maintained in order to distribute wear.

The rolling mill may be a conventional four-high mill or a six-high mill or it could be what is known as a "Pair Crossed Mill". The invention can also be used in conjunction with a mill which includes one or more hydraulically expandable backing rolls known as "VC Rolls".

The actuating mechanism for moving the rolls may be mounted either on the drive side or on the operator's side of the mill. Separate actuating devices may be used for each work roll or, if the work roll chocks at one end of the rolls are attached to one another, it may be possible to use only one actuating mechanism to one of the rolls and the other roll will be moved by virtue of its attachment at the roll chock.

It is now common practice to incorporate roll bending cylinders in the work roll chocks and, because the work rolls may be moved off-centre in the mill, it will be necessary to adjust the forces applied by the bending cylinders at each end of the mill to compensate for this effect.

In Figure 2, a workpiece 5 is shown being rolled between the rolls 1, 3 and it is passed along a path in which its left-hand edge is spaced from the left-hand end of the rolls 1, 3 by a distance a. If, during rolling, the strip moves sideways so that the actual position of the left-hand edge of the strip is spaced by a distance b from the left-hand end of the work rolls then, by differentially adjusting the gap between the rolls 1, 3 along the length of the rolls, the workpiece can be forced back to its required position. To this end, the position of the strip at one or more stands of the mill is detected by means of a non-contact device, such as a laser or photocell, or by means of a contact device, such as a roller, carrying a position transducer. If the strip begins to move away from the chosen path, an error signal will be developed.

In the arrangement shown in Figure 2, the error signal is representative of the distance (b -a). The signal is employed to differentially vary the roll gap along its length. It is known that a tapered roll gap, as shown in Figure 3, causes the strip to move sideways in the mill towards the side which applies the smaller reduction in strip thickness, i.e. towards the side having the larger roll gap. Thus, by differentially adjusting the roll gap the strip is steered back on to the required path.

Claims

1. A method of rolling metal strips each being of a width less than the length of the work rolls between which they are being rolled, in which successive strips, or successive groups of strips, are passed between the rolls along different paths with respect to the centre-line of the rolls, such that the strips contact different portions of the roll surfaces.

2. A method as claimed in claim 1, in which successive strips, or successive groups of strips, pass between the rolls along paths offset from the centre-line on one side of the mill, along a path through the centre-line of the mill and along paths offset from the centre-line on the other side of the mill.

3. A method as claimed in claim 1, in which the rolls are axially fixed and successive strips, or succesive groups of strips, are progressively displaced from a path offset by a maximum amount from the centre-line on one side of the mill, through the centre-line of the mill to a path offset by a maximum amount from the centre-line on the other side of the mill, and the progressive displacement from side-to-side is repeated until all the strips of the particular strip width have been rolled.

4. A method as claimed in claim 1, in which the strips approach the rolls along a common track and between the rolling of successive strips, or groups of strips, both work rolls are displaced axially in the same direction.

5. A method as claimed in any preceding claim, in which the path followed by each strip is monitored and a signal representative of any error between the actual path taken by the strip and the chosen path is employed to differentially adjust the roll-gap along the length of the work rolls in the sense to divert the strip towards the chosen path.

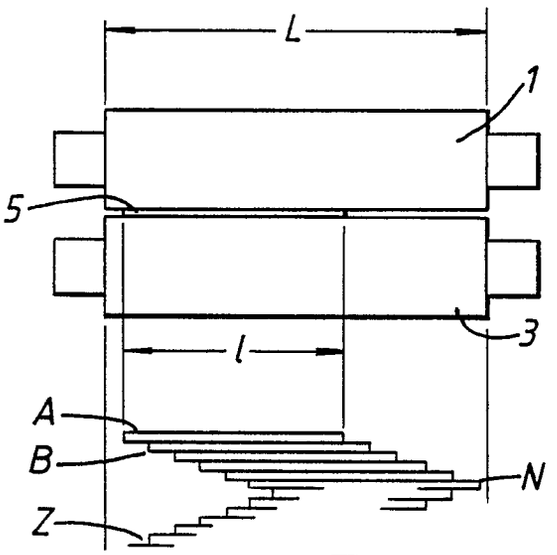

FIG. 1.

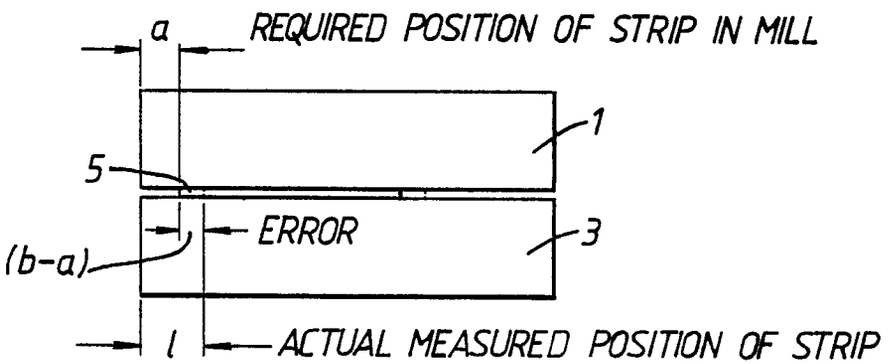

FIG. 2.

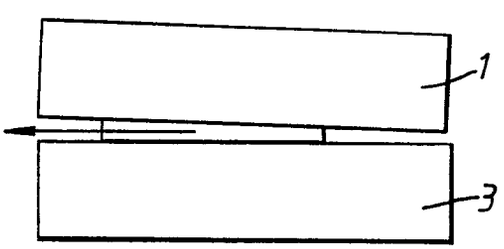

FIG. 3.

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EUROPEAN SEARCH REPORT

Application number

EP 86 30 9421

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	PATENTS ABSTRACTS OF JAPAN, vol. 8, no. 258 (M-340)[1695], 27th November 1984; & JP-A-59 130 604 (HITACHI) 27.07.1984	1-5	B 21 B 1/22 B 21 B 37/00
X	PATENTS ABSTRACTS OF JAPAN, vol. 9, no. 57 (M-363)[1780], 13th March 1985; & JP-A-59 193 704 (KAWASAKI) 02.11.1984; & EP-A-179 172 (KAWASAKI) 30.04.86	1-3	
A	FR-A-2 504 415 (V.D.E.H.) * Figures 1,5,6; Claims 1,9,11 *	5	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)
B 21 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27-01-1987	VERMEESCH,P.J.C.C.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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