

[54] **METHOD AND APPARATUS FOR FINISHING A ROLLING BAR USING A DISPLACEABLE INTERMEDIATE STAND BETWEEN TWO END ROLL STANDS**

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[56]

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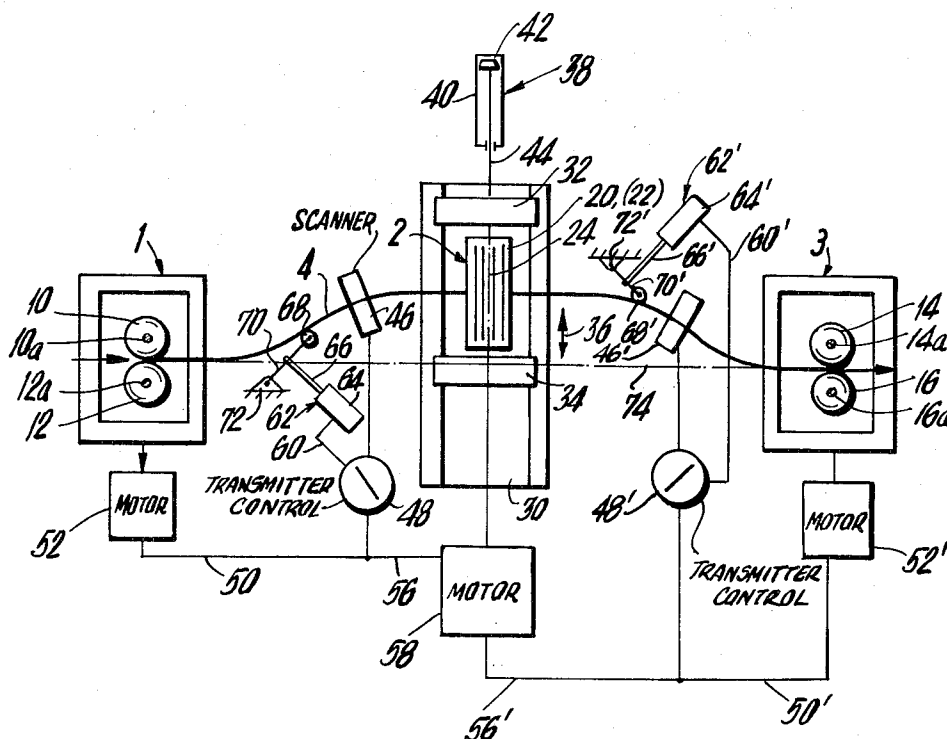
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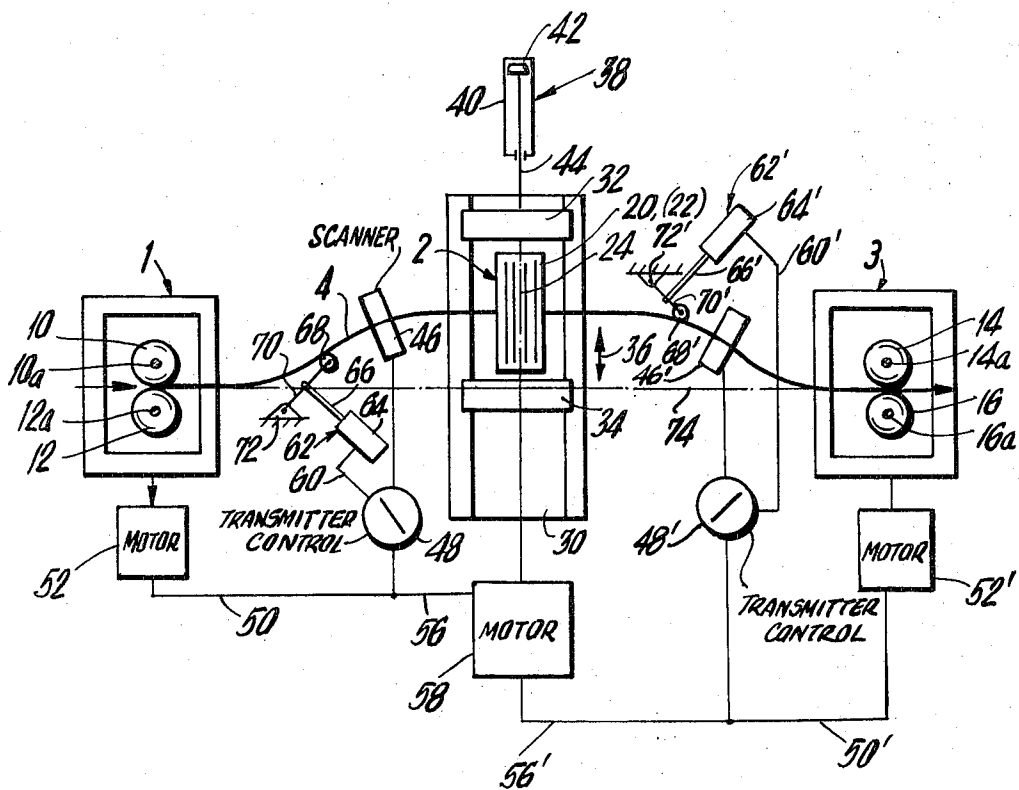
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ABSTRACT

An apparatus for finish rolling a continuous bar comprises an intermediate roll stand which is mounted between two end roll stands and which is shiftable in respect to the two end roll stands. A rolling bar is finished rolled by first directing the bar through each of the roll stands with the central roll stand aligned with the two end roll stands. Thereafter the rolling operation is begun by driving the various roll stands and the intermediate roll stand is shifted either laterally or upwardly or downwardly depending upon the orientation of the rolls in the end roll stand in order to form a bulge in the rod which is being formed during the operation.

13 Claims, 1 Drawing Figure





METHOD AND APPARATUS FOR FINISHING A ROLLING BAR USING A DISPLACEABLE INTERMEDIATE STAND BETWEEN TWO END ROLL STANDS

CROSS-REFERENCE TO PRIOR APPLICATIONS

This application is a continuation-in-part of application Ser. No. 209,217 filed on Dec. 7, 1971, which in turn is a continuation of application Ser. No. 887,525 of Dec. 23, 1969, now abandoned.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

This invention relates in general to a method and apparatus for rolling metals, and, in particular, to a new and useful method and apparatus for rolling a continuous rod using a movable roll stand between two end roll stands which is shifted after initial alignment of the workpiece between all three roll stands in order to form a loop of the rod material being finish rolled.

2. DESCRIPTION OF THE PRIOR ART

In the rolling of long stock, it is necessary to provide a longitudinal compensation for the rolling material between the individual rolling stands in order to permit a distortion free rolling. In order to meet this requirement it is known to conduct a rolling material between the individual rolling stands in the forms of loops. The loop formation first of all permits the storing of some of the rolling material length so that slight speed differences are automatically compensated. The resulting change in the loop form is then used as a control quantity, mostly by electric means to control the roll speed. Provision for accommodating such loops, however, increases the distance requirement between the rolling stands. In addition, complicated straightening rollers, which are susceptible to difficulties of operation, are required to straighten the bent rolling bar before it enters the stand inlet proper. This straightening arrangement presents difficulties particularly with thicker bars and with section bars. In addition, the bars being rolled are necessarily bent off three times at relatively large angles before each rolling stand due to the formation of these loops.

SUMMARY OF THE INVENTION

In accordance with the present invention, the disadvantages of the known rolling stand arrangements are avoided by providing a simple and trouble free construction and one which also reduces the space requirements. This problem is solved according to the invention by arranging the rolling stands such that a single rolling stand is located between two rolling stands in the bulge of the loop of the rolled material. While, in the past, three rolling stands required two loops, three rolling stands can now be arranged with only one loop which is only slightly longer than in the known arrangement. In addition, three bendings of the rolling bar are eliminated by avoiding one loop. The construction is such that the rolling stand arranged between the two rolling stands can be displaced relatively to the other two, e.g. in horizontal and/or vertical directions for alignment until all rolling stands are aligned on one rolling line. After this, the stand arranged between the outside two is moved again into an operative position to provide for the formation of the bulge of the workpiece between the two end stands. In this way the complicated straightening rollers for introducing the bar to

be rolled are avoided. Because all of these stands may be aligned on one rolling line during the aligning, the bar which is to be rolled can be easily introduced into the stands. Only then is the central stand displaced transversely of the bar and/or horizontal direction. Nevertheless, a loop remains in the arrangement, which extends between the outer two stands, and this permits adjustment of the tension of the rolled material and the achieving of a control quantity for the control of the rolls.

In accordance with the invention, the apparatus may comprise end roll stands with roll pairs which are arranged for rotation about either horizontal axes or vertical axes. When the end roll stand rollers are mounted for rotation about horizontal axes, it is preferable to mount the intermediate roll stand so that the rollers are mounted for rotation about vertical axes. In addition, in such an arrangement, the loop that is formed between the end roll stands may advantageously comprise a vertically extending loop and a mounting stand for the intermediate rollers is therefore mounted for vertical displacement.

In the event that the end roll stands are constructed so that the rollers therein are mounted for rotation about vertical axes then it is preferable to mount the rollers of the intermediate roll stand for rotation about horizontal axes and to make the intermediate roll stand movable on a supporting base in a transverse direction.

The apparatus of the invention also advantageously includes deflecting rollers which may be applied against the rolling stock on respective sides of the intermediate rollers of the intermediate roll stand after the bulge is initially formed in order to insure a proper guidance of the material being finish rolled. The arrangement also advantageously includes a scanner such as a photoelectric cell scanner arranged on each side of the intermediate roll stand in a position to sense the location of the rod being rolled in order to control the orientation of the loop in accordance with the drive of the end rollers of each end roll stand. In addition, the same scanner may advantageously be employed to shift the deflection rollers for the adequate control of the rolling operation.

Accordingly, it is an object of the invention to provide a method for finishing of metal bars using spaced apart fixed end roll stands and a central displaceable roll stand between the end roll stands which comprises feeding the workpiece to be rolled between the three roll stands after they are first aligned and thereafter shifting the intermediate roll stand out of alignment with the two end roll stands in order to form a bulge in the rod being formed or to accommodate the natural formation of the bulge of the rod as the rod is rolled between the end roll stands.

A further object of the invention is to provide a roll stand arrangement particularly for finish rolling of elongated rods which comprises an intermediate roll stand arranged between two end roll stands and means mounting said intermediate roll stands so that it may be shifted so that the nip between the rollers of the intermediate roll stand may be moved out of alignment with the nip between the rollers of the end roll stands to accommodate a bulge in the workpiece being rolled between the end roll stands during the rolling operation.

A further object of the invention is to provide a roll stand arrangement which includes two end roll stands with pairs of rollers forming a nip therebetween in each stand having axes which are arranged to rotate about a first rotational axis and an intermediate roll stand mounted on a guideway for displaceable movement into and out of alignment with a central line between the nips of the roll stands of each end roll stand and which includes cooperable intermediate rollers having axes of rotation which are disposed substantially perpendicular to the axes of rotation of said the end roll stands.

A further object of the invention is to provide an improved roll finishing arrangement which includes an intermediate roll stand arranged between two outer roll stands which may be displaced in vertical and/or horizontal directions and which may be initially positioned to align the nips of the cooperative rollers carried by the roll stand with the rollers of the end roll stands.

A further object of the invention is to provide a roll stand arrangement which includes a displaceable intermediate roll stand located between two outer roll stands and which is simple in design, rugged in construction and economical to manufacture.

For an understanding of the principles of the invention, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The only FIGURE of the drawing is a schematic end elevational view of an apparatus for finish rolling elongated workpieces constructed in accordance with the invention and which may be also arranged in the same arrangement as a top plan view, as an alternate embodiment of the invention.

GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing in particular, the invention embodied therein comprises a continuous finishing roll system for finish rolling a bar or similar workpiece 4 and which includes end roll stands generally designated 1 and 3 arranged on each side of an intermediate roll stand generally designated 2. Roll stand 1 includes cooperable roller pairs 10 and 12, having axes 10a and 12a, respectively, which are rotatable about a first rotational axis, for example a horizontal axis when the figure is considered as a side elevational view. Similarly the roll stand 3 includes cooperable rollers 14 and 16 having respective roller axes 14a and 16a which permit rotation of the respective rollers about the same first axes, namely horizontal axes.

The roll stand 2 includes cooperable rollers 20 and 22 with only the near one, the roller 20, being visible in the figure. The rollers 20 and 22 are rotatable about a second axis of rotation, namely a vertical axis 24 which is substantially at 90° to the first rotational axis in respect to the rollers of the end roll stands 1 and 3. The intermediate roll stand 2 may advantageously be centered between the end roll stands 1 and 3 and it is mounted on a base or guideway 30 so that the roller blocks 32 and 34 may be shifted vertically in the directions of double arrow 36. Intermediate roll stand shifting means, generally designated 38, comprises a fluid pressure cylinder 40 having a piston 42 movable therein which is connected to a piston rod 44 which is

connected to the roll stand 2 for shifting it along the guideway 30. It should be appreciated that it is essential that the intermediate roll stand be shiftable in respect to the end roll stands 1 and 3 in order to accommodate a bulge or loop formation of the workpiece 4 which forms between the roll stands 1 and 3. In the arrangement shown, in the drawing, the rollers and their axes are indicated in a preferred orientation for the shifting movement, but of course the shifting movement of the intermediate rollers can be in any direction to accommodate a bulge between the end roll stands and, in fact, the rollers of the various roll stands may be mounted for rotation about any axes as desired.

The apparatus also advantageously includes a scanner 46 such as a photoelectric cell arrangement for sensing the position of the workpiece 4 and for communicating the sensed information to a control or transmitter 48 which is electrically connected through a connection 50 to a motor 52 for driving the rollers of the first roll stand 1. A similar arrangement is located between the intermediate roll stand 2 and the end roll stand 3 for driving a motor 52' for the rollers of the roll stand 3. Additional connecting lines 56, 56' are connected between transmitters 48, 48' and a motor 58 which is connected to drive the roller 20, 22 of the roll stand 2. The transmitter controls 48, 48' are also connected electrically and mechanically through a schematically indicated connections 60 and 60' to fluid drive motors 62 and 62' each of which includes a piston, movable in a cylinder 64, 64', which is connected to a respective connecting rod 66, 66' to control the position of an associated deflecting roller 68, 68' which deflecting rollers are arranged to contact the workpiece 4 between the intermediate roll stand and the respective end roll stands 1 and 3. The deflecting rollers 68, 68' are indicated as being mounted on rod members 70, 70' which is pivoted to respective fixed supports 72, 72'.

In accordance with the method of the invention, roll stock 4 enters between the nips of the rollers 10 and 12 and then the nip between the rollers 20 and 22 of the intermediate roll stand 2 and subsequently between the nip formed between the rollers 14 and 16 of the roll stand 3 after the nips of all three roll stands are first aligned along a common axis 74. As soon as the stock 4 passes through the roll stand 3, the roll stand 2 is shifted by the fluid drive motor 38 in an upwardly vertically extending direction, in the arrangement shown in the figure, or in any direction to accommodate a loop formation which forms in the workpiece 4 between the roll stands 1 and 3. The amount of deflection of the loop formation of the workpiece 4 is controlled by the deflection rollers 68 and 68' and it may be adjusted by the fluid drive motors 62, 62'. The scanners 46, 46' monitor the location of the loop formation and, in accordance with the position sensed, they actuate the fluid drives 62, 62' for the deflection rollers 68, 68' and also the motors 52, 52' and 58 for each of the roll stands 1, 3 and 2 respectively. When the scanner 46 determines for example that the rolled stock is leaving the roller pair 10 and 12 of the roll stand 1 faster than specified, the loop will increase and the scanner 46 will give a signal to the transmitter control 48. The transmitter control 48 would then have an effect on the motor 52 to slow down the driving speed of the rollers 10 and 12. The scanner 46' between the roll stand 2 and the roll stand 3 operates in the same manner on the motor 52'.

for the rolls 14 and 16 and also the motor 58 for the rolls 20 and 22.

It should be appreciated that, in accordance with the method of the invention, it may be carried out simply by first aligning a movable intermediate roll stand so that the rollers thereof form a nip which aligns with the nips of the rollers carried on two end roll stands. The working stock is then fed between the nips of the rollers of each roll stand while they are aligned and immediately after the workpiece passes through the nip of the rollers of the end most roll stand, the intermediate roll stand is displaced so that the nip of its rollers is no longer aligned with the nip of the rollers of the other two roll stands and the amount of displacement is such that it accommodates a loop formation of the workpiece between the two end roll stands.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A method of tension-free finish rolling a long metal workpiece, such as a continuous bar, using spaced-apart finish roll stands including cooperable roll pairs defining a nip therebetween through which the workpiece is fed, and deflecting the workpiece into a bulge or loop between successive finish roll stands to compensate for any difference in speed of the successive finish roll stands, comprising the steps of aligning a roll stand intermediate two roll stands, constituting end roll stands with respect to the intermediate roll stand, so that the nips of the three roll stands are in alignment and feeding the workpieces between the nips of the three roll stands, and thereafter shifting the intermediate roll stand so that the nip of the rollers thereof is moved out of alignment with the nips of the rollers of the end roll stands in order to deflect the workpiece, between the end roll stands, to form a bulge of the workpiece between the two end roll stands while the rolling operation is continued.

2. A method according to claim 1, wherein the end roll stand rollers are mounted for rotation about a first axis and the rollers of the intermediate roll stand are mounted for rotation about an axis which is 90° from said first said axis.

3. A method according to claim 2, wherein the roller pairs of the end roll stands are mounted for rotation about a horizontal axis and the roller pairs of the intermediate roll stand are mounted for rotation about a vertical axis, said intermediate roll stand being shiftable vertically in respect to the end roll stands in order to accommodate the bulge of the workpiece.

4. A method according to claim 1, wherein the workpiece is deflected between the intermediate roll stand and the last end roll stand in order to maintain the workpiece in a predetermined position therebetween.

5. A method for finishing a long metal workpiece, such as a continuous bar, using spaced apart fixed end roll stands and an intermediate displaceable roll stand located between the end rolls and all of which include cooperating roll pairs defining a nip therebetween through which the workpiece is fed, comprising aligning the intermediate roll stand with the two end roll stands so that the nips of the roll stands are in alignment and feeding the workpiece between the nips of

each roll stand, and thereafter shifting the intermediate roll stand so that the nip of the rollers thereof is moved out of alignment with the nips of the rollers of the end roll stands in order to accommodate and permit the formation of a bulge of the workpiece between the two end roll stands while the rolling operation is continued, the workpiece at the location of the bulge immediately before the intermediate roll stand being sensed and the speed of the rollers of the first roll stand being controlled in accordance with the sensing.

6. A method according to claim 5, including deflecting the workpiece between the end roll stands and the intermediate roll stand to maintain the workpiece in a predetermined position between the first roll stand and the intermediate roll stand.

7. An apparatus for tension-free finish rolling a metal workpiece, such as a continuous rod, comprising spaced-apart finish roll stands each having a pair of cooperable rollers defining a nip therebetween through which the workpiece is adapted to be fed, and which are rotatable about a first axis of rotation, the workpiece, between successive finish roll stands, being deflected into a bulge or loop to compensate for any difference in speed of the successive finish roll stands, an intermediate roll stand located between successive roll stands constituted by first and second roll stands, the intermediate roll stand having a pair of cooperable rollers forming a nip therebetween, mounting means supporting said intermediate roll stand to provide for displaceable movement of said intermediate roll stand so that the nip of the rollers thereof may be shifted out of alignment with the nips of said first and second roll stands, the nips of said first and second roll stands being aligned along a common axis.

8. An apparatus according to claim 7, wherein the rollers of the intermediate roll stand have a nip which is arranged at a second axis which is at an angle of substantially 90° from the common axis of the nips of the rollers of said first and second roll stands.

9. An apparatus for finishing a long metal workpiece, such as a continuous rod, comprising first and second end roll stands each having a pair of cooperable rollers defining a nip therebetween through which the workpiece is adapted to be fed and which are rotatable about a first axis of rotation, an intermediate roll stand located between said first and second roll stands having a pair of cooperable rollers forming a nip therebetween, mounting means supporting said intermediate roll stand permitting the displacement movement of said intermediate roll stand so that the nip of the rollers thereof may be shifted out of alignment between the nips of said first and second roll stands, said first and second roll stands having the nips of the rollers being aligned along a common axis, scanning means located between said intermediate roll stand and said first roll stand for locating the position of the workpiece, and a motor driving said rollers of said first roll stand connected to said scanning means and being controlled in speed thereby to vary the speed of said rollers of said first roll stand.

10. An apparatus for finishing a long metal workpiece, such as a continuous rod, comprising first and second end roll stands each having a pair of cooperable rollers defining a nip therebetween through which the workpiece is adapted to be fed and which are rotatable about a first axis of rotation, an intermediate roll stand located between said first and second roll stands having

a pair of cooperable rollers forming a nip therebetween, mounting means supporting said intermediate roll stand permitting the displaceable movement of said intermediate roll stand so that the nip of the rollers thereof may be shifted out of alignment between the nips of said first and second roll stands, said first and second roll stands having the nips of the rollers being aligned along a common axis, a deflector engageable with the workpiece between said first and second roll stands, and means for shifting said deflector to cause positioning of said workpiece to maintain a predetermined bulge of the workpiece between said first and second roll stands.

11. An apparatus according to claim 10, wherein said deflector is arranged between said intermediate roll stand and at least one of said end roll stands.

12. An apparatus according to claim 11, including scanner means for scanning the position of the workpiece and being connected to said deflector for shifting said deflector in accordance with the position of the

workpiece.

13. An apparatus for finishing a long metal workpiece, such as a continuous rod, comprising first and second end roll stands each having a pair of cooperable rollers defining a nip therebetween through which the workpiece is adapted to be fed and which are rotatable about a first axis of rotation, an intermediate roll stand located between said first and second roll stands having a pair of cooperable rollers forming a nip therebetween, mounting means supporting said intermediate roll stand permitting the displacement of said intermediate roll stand so that the nip of the rollers thereof may be shifted out of alignment between the nips of said first and second roll stands, said first and second roll stands having the nips of the rollers being aligned along a common axis, said means for shifting said roll stand comprising a guideway on which said roll stand is movable and a fluid drive motor connected to said roll stand to shift said roll stand along said guideway.

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