

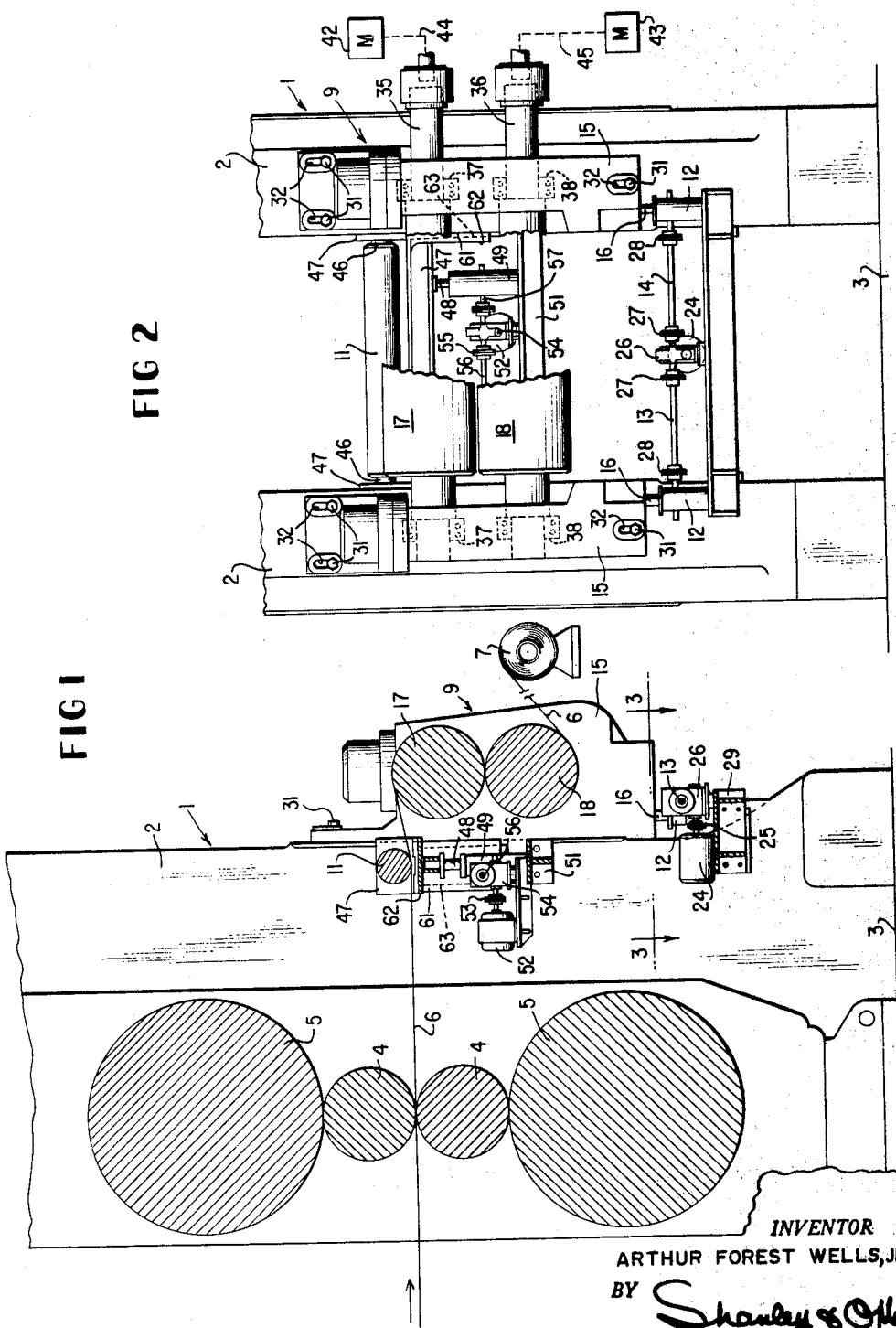
June 9, 1964

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METHOD AND APPARATUS FOR THE TREATMENT
OF COLD ROLLED METAL STRIP

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2 Sheets-Sheet 1



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FIG 3

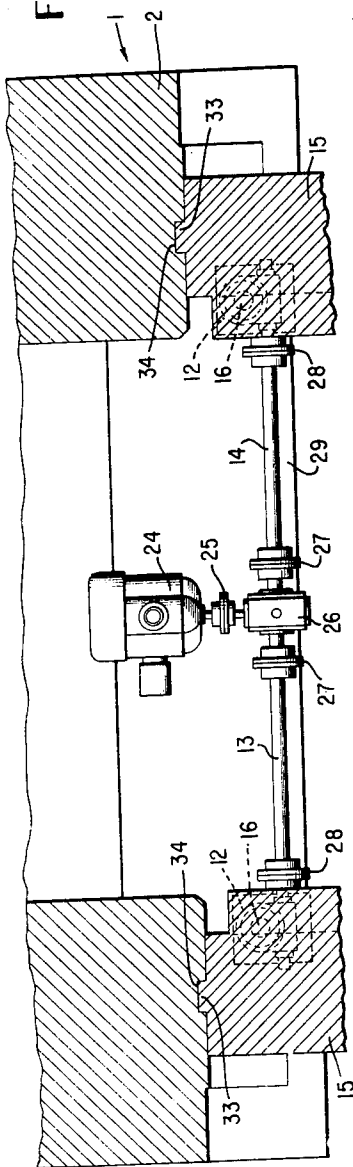


FIG 4

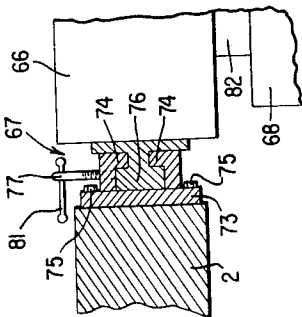
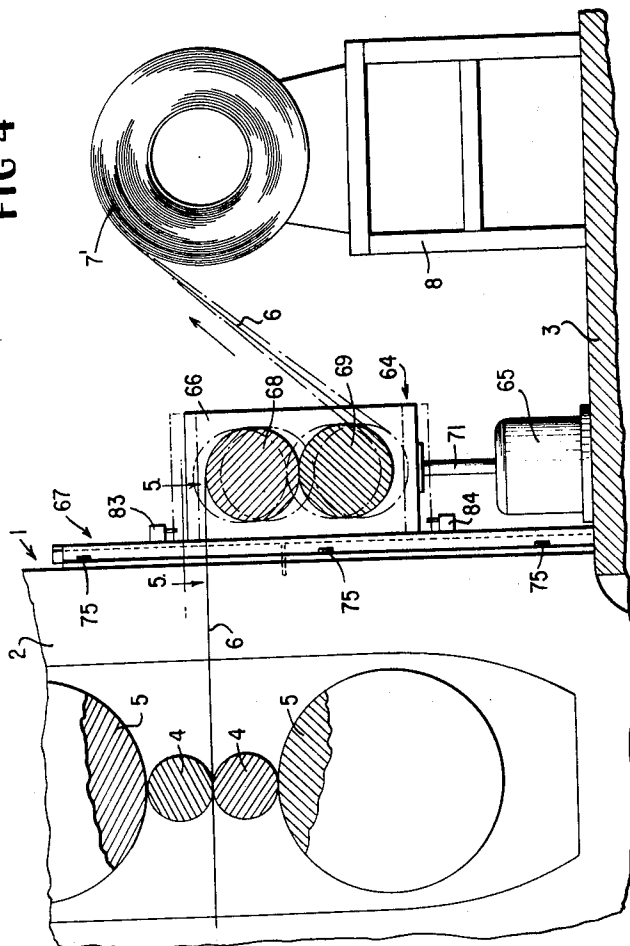


FIG 5

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METHOD AND APPARATUS FOR THE TREATMENT OF COLD ROLLED METAL STRIP

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This invention relates broadly to metal rolling and more particularly to the treatment of metal strip. The term "strip" as used herein includes any wide and thin variety of metal including the forms generally referred to in the art as "sheet" and "strip."

It has become common practice in the operation of metal strip rolling mills to subject the strip to front and back tensions as it passes through a cold mill stand and to maintain tension on the strip as it is wound upon and unwound from the winding reel and unwinding reel respectively. An example of the employment of tension rolling will be found in the production of steel strip for tin plating. Generally the cold rolled steel strip for this purpose is annealed after rolling which results in a condition of the strip known in the art as "dead soft." For many purposes such as the making of tin can bodies it is necessary to increase the stiffness of the metal considerably. The added stiffness or temper is commonly imparted to the metal by subjecting it to temper or skin passes through a rolling mill while the material is cold. This cold rolling also renders the surfaces of the metal very smooth and the shape flat. It is a common practice in the prior art to subject the strip to front and back tensions during temper rolling to accomplish the desired results in one pass.

Such prior art practice possesses certain inherent disadvantages with regard to a tendency toward defects in the strip known in the art as cross-corrugations, herring bone, cross buckles or bananas. These may take the form of corrugations in the metal generally transversely to the length of the strip and which may be either straight or curved, the latter type of corrugations being known as "bananas." Defects of this type will be referred to hereinafter as "cross corrugations." These cross corrugations form in the strip leaving the work rolls due to the tension on the strip and may take a permanent set. While the cross corrugations having a permanent set in the metal may be slight in depth even to the extent of being difficult to see under some light conditions, nevertheless, the product possessing these corrugations must be diverted from any use where a highly reflective surface would show.

In accordance with this invention, cross corrugations having a permanent set in metal strip which is rolled under tension by passing the metal through a rolling zone followed by passage through a tensioning zone, are avoided by controlling the relative vertical positions of the metal strip entering the tensioning zone and leaving the work rolls and thereby controlling the pass line of the metal strip between the rolling zone and the tensioning zone.

The invention may be best understood with reference to the attached drawings and the following description thereof in which:

FIGURE 1 is a sectional side elevation view, with parts removed for purposes of clarity, of a rolling mill assembly, idler and tension unit embodying the principles of this invention;

FIGURE 2 is a fragmentary end elevational view with parts removed for purposes of clarity of a portion of the apparatus of FIGURE 1 taken from the right of FIGURE 1;

FIGURE 3 is a fragmentary plan view partly in section,

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of a portion of the apparatus of FIGURE 1 taken along the line 3-3 of FIGURE 1;

FIGURE 4 is a fragmentary diagrammatic sectional side elevation view with parts removed for purposes of clarity of a modified tension unit and a coiling means embodying the principles of this invention; and

FIGURE 5 is a fragmentary plan view illustrating the guide means for the modified tension roll assembly embodying the principles of this invention taken along the line 5-5 of FIGURE 4.

With reference to the drawings and with particular reference to FIGURES 1, 2 and 3 thereof, a conventional rolling mill assembly indicated generally at 1 is shown including a frame 2 mounted on a suitable base such as a concrete floor 3, working rolls 4 and backup rolls 5.

The strip 6 enters into the work rolls 4 of the rolling mill assembly 1 in a conventional manner. In general the strip is fed from a payoff reel through a back tensioning device, both of which are conventional and accordingly are not shown or described. In addition this invention could be applied to strip which has been rolled in a plurality of rolling mill stands of which rolling mill assembly 1 is the last.

The rolled strip 6 is coiled by a suitable coiling device such as a takeup reel 7.

Between the takeup reel and the working rolls 4 of the rolling mill assembly 1 is provided a vertically adjustable tension unit 9 and in the embodiment of FIGURES 1, 2 and 3 an idler roll 11. The tension unit 9 is mounted on a pair of power driven jacking devices 12 associated with each other by means of shafts 13 and 14 to move synchronously for moving the tension unit 9 upwardly and downwardly relative to the working rolls 4.

Jacking devices 12 are conventional readily available jacking devices and accordingly will not be described in detail. The jacking devices 12 are driven by suitable means such as a motor 24 through a coupling 25, gear box 26, couplings 27, shafts 13 and 14 and couplings 28. Thus, journal frames 15 may be raised and lowered through the operation of motor 24.

Motor 24, gear box 26 and jacking devices 12 are all mounted on a platform 29 which in turn is mounted at either end on frame 2.

The tension unit 9 comprises a pair of journal frames 15 mounted on a vertical support member 16 of each jacking device 12 and slidably mounted on rolling mill frame 2 and a pair of cooperating tension rolls 17 and 18 rotatably mounted in the journal frames 15. Journal frames 15 are mounted on rolling mill frame 2 by means of bolts 31 threaded into frame 2 and passing through elongated openings 32 provided in frames 15. Vertical guide means are provided comprising projections 33 on frames 15 engaging matching grooves 34 provided in frame 2 for guiding the vertical movement of the journal frames 15. Thus, the journal frames 15 are supported against horizontal movement by bolts 31 and guided for vertical movement by projections 33 and grooves 34. In order to adjust the vertical position of tension unit 9, bolts 31 are loosened a sufficient amount to permit movement and the vertical position is adjusted by the actuation of jacking devices 12 with motor 24. When the position is adjusted, the bolts 31 are tightened to lock the journal frames 15 in a rigid fixed position.

Cooperating tension rolls 17 and 18 are mounted on shafts 35 and 36 and journaled in bearings 37 and 38 mounted in journal frames 15 with their longitudinal axes in substantially the same vertical plane and parallel to the longitudinal axes of the rolling mill rolls 4 and 5. The tension rolls 17 and 18 are both of the same diameter, made of metal, and are so constructed and arranged that the strip 6 passes over and around a por-

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tion of the surface of the upper roll 17 in one circumferential direction, i.e. clockwise in FIGURE 1, between the rolls 17 and 18 and around a portion of the surface of the lower roll 18 in the opposite circumferential direction from that of passage around the upper roll 17. Thus, the rolled strip 6 passes through a path with a double reverse curvature. After passing around rolls 17 and 18 the strip 6 passes to a takeup reel such as take-up reel 7 shown in FIGURE 4. The rolls 17 and 18 are so constructed and arranged that the strip frictionally engages the surface of the rolls over arcs subtended by angles which are generally not substantially less than 180°.

Rolls 17 and 18 of the tension unit 9 are driven in a conventional manner by conventional electric motors indicated diagrammatically at 42 and 43 which cooperate with the motor drive of the rolling mill assembly 1 so as to place the desired amount of tension on the strip 6 between the work rolls 4 and the tension unit 9. As in conventional mill practice means indicated by dashed lines 44 and 45 such as a wobbler are used to deliver power from the respective driving motors 42 and 43 to the tension rolls 17 and 18 regardless of the vertical position of the tension unit.

By the above described arrangement tension can be imparted to the strip 6 by rolls 17 and 18 as it emerges from the working rolls 5. The rolls 17 and 18 have sufficient strip engaging areas to prevent slippage of the strip relative to the surfaces and to maintain the desired amount of tension on the strip.

The metal strip passing from work rolls 4 to tension rolls 17 and 18 passes under vertically adjustable idler roll 11. The idler roll 11 is mounted on a shaft 46 which is in turn rotatably mounted in a journal frame 47. Frame 47 is mounted on and supported by vertical support members 48 on two jacking devices 49, one of which is shown in FIGURE 2, for moving the idler roll 11 upwardly and downwardly relative to the work rolls 4. Jacking devices 49 are in turn mounted on a platform 51 which is mounted at either end on the rolling mill frame 2. Jacking devices 49 are conventional readily available jacking devices and accordingly will not be described in detail. The jacking devices 49 are driven by suitable means such as a motor 52 through a coupling 53, gear box 54, couplings 55 and shafts 56 and 57. Vertical guide means including elongated members 62 affixed to either end of journal frame 47 and projections 63 on rolling mill frame 2 engaging matching grooves 61 provided in elongated members 62 are provided for guiding the vertical movement of the frame 2. In order to adjust the vertical position of idler roll 11, the frame 47 may be raised and lowered by the operation of motor 52 through gear box 54 and jacking devices 49.

In accordance with this invention the relative vertical position of the tension rolls 17 and 18 and the idler roll 11, in the embodiment of FIGURES 1-3, relative to the work rolls of the rolling mill 1 and accordingly the pass line of the metal strip are controlled. Periodic adjustment of the position of the tension rolls 17 and 18 and the idler roll 11 is necessary when rolling strip since the work rolls 4 wear in use and have to be periodically reground or replaced with new rolls. When they are reground their diameter is decreased. When smaller work rolls replace larger work rolls the tension rolls 17 and 18 have to be adjusted in position, usually lowered, to maintain the proper configuration of the pass line of the strip from the nip of the work rolls 4 and conversely when larger work rolls replace smaller work rolls the tension rolls 17 and 18 have to be adjusted in position in the reverse direction. In addition when the backup rolls 5 are changed shims are used to raise all the rolls 4 and 5 and accordingly a new position of the tension rolls 17 and 18 is required. Control of the vertical position of tension rolls 17 and 18 is accomplished by the operation of motor 24 through jacking devices 12 to raise or

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lower journal frames 15. Control of the vertical position of idler roll 11 is accomplished by the operation of motor 52 through jacking devices 49 to raise or lower frame 47.

By way of example with an apparatus of the type shown in FIGURES 1, 2 and 3, the position of the tension rolls 17 and 18 and the idler roll 11 was adjusted to provide a straight horizontal pass for the strip leaving the work rolls 4 with the strip passing upwardly between idler roll 11 and tension roll 17. The strip produced was free from any permanently set cross corrugations.

With reference to FIGURE 4 of the drawings a modified tension roll assembly generally indicated at 64 is shown.

Only one side of the apparatus is shown in FIGURE 4 and since both sides are identical a description of one will suffice for both.

The strip 6 enters into the work rolls 4 of the rolling mill assembly indicated generally at 1 in a conventional manner and is coiled by takeup reel 7' provided with operating means such as an electric motor (not shown).

Vertically adjustable tension unit 64 is provided between takeup reel 7' and the working rolls 4 of the rolling mill assembly 1. The tension unit 64 is mounted on a pair of power driven jacking devices 65 associated with each other in any suitable manner so as to move synchronously for moving tension unit 64 upwardly and downwardly relative to the working rolls 4. A shaft (not shown) connecting the jacking devices can be used for this purpose.

Jacking devices 65 are conventional readily available jacking devices and accordingly will not be described in detail. The jacking devices include a vertical support member 71 which may be moved vertically upward or downward by the jacking mechanism. The jacking mechanism is driven by suitable means such as a motor and gear box (not shown) similar to the embodiment shown in FIGURE 1. Thus support member 71 may be raised and lowered through the operation of the motor.

Tension unit 64 comprises a journal frame 66 which is mounted on each jacking device 65. A vertical guiding device indicated generally at 67 is associated with each journal frame 66 for guiding the vertical movement of the journal frame. A pair of cooperating tension rolls 68 and 69 are rotatably mounted in the journal frames 66.

Referring now to FIGURE 5 as well as FIGURE 4 it will be seen that guiding device 67 comprises a base member 73 and a pair of elongated right angle members 74 with one leg of each member affixed to base member 73 by suitable means, such as welding, with the free legs of the angle members 74 opposed and spaced to define with the base member 73, a recess with a T-shaped cross section. Base member 73 is mounted on frame 2 of rolling mill 1 by suitable means such as bolts 75.

An elongated slide member 76 with a T-shaped cross section of approximately the same cross sectional size and shape as the recess defined by right angle members 74 is affixed to one side of journal frame 66 and slidably disposed within the T-shaped recess defined by the right angle members 74. In order to lock the journal frame 66 in a fixed position relative to the vertical guiding device after adjustment to the desired height, a lock screw 77 is provided which is threaded through one of the right angle members 74. Lock screw 77 is provided with a handle 81 whereby through rotation of lock screw 77 in the proper direction into tight engagement with T-shaped member 76 the desired fixed positioning may be obtained. When it is desired to adjust the position of journal frame 66 lock screw 77 is rotated in the opposite direction and out of engagement with T-shaped member 76.

Cooperating tension rolls 68 and 69 are mounted on shafts 82 and journaled in journal frames 66 with their longitudinal axes in substantially the same vertical plane and parallel to the longitudinal axes of the rolling mill rolls 4 and 5. The tension rolls 68 and 69 are both of the same diameter, made of metal, and are so constructed

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and arranged that the strip 6 passes over and around a portion of the surface of the upper roll 68 in one circumferential direction, i.e. clockwise in FIGURE 1 between the rolls 68 and 69 and around a portion of the surface of the lower roll 69 in the opposite circumferential direction from that of passage around the upper roll 68. Thus the rolled strip 6 passes through a path with a double reverse curvature. After passing around rolls 68 and 69 the strip 6 passes to the takeup reel 7'. The rolls 68 and 69 are so constructed and arranged that the strip frictionally engages the surface of the rolls over arcs subtended by angles which are generally not substantially less than 180°.

Rolls 68 and 69 of the tension roll assembly 64 are driven in a conventional manner by electric motors which cooperate with the motor drive of the mill stand 1 so as to place the desired amount of tension on the strip 6 between the work rolls 4 and the tension roll assembly 64. As in conventional mill practice, a wobbler can be used to deliver power from the driving motor to the tension rolls 68 and 69 regardless of the vertical position of the tension unit.

By the above described arrangement tension can be imparted to the strip 6 by rolls 68 and 69 as it emerges from the working rolls 4. The rolls 68 and 69 have sufficient strip engaging areas to prevent slippage of the strip relative to the surfaces and to maintain the desired amount of tension on the strip.

In accordance with one feature of this invention the length of travel of the vertically adjustable tension rolls may be automatically limited to a predetermined maximum and minimum elevation by electric limit switches 83 and 84 as shown in FIGURE 4 in the circuit of the motor driving the jacking devices 65. The maximum and minimum positions are shown in phantom in FIGURE 4. Switches 83 and 84 are mounted on guiding device 67 by any suitable means in a manner whereby vertical movement of the journal frame 66 to the position of a limit switch 83 or 84 activates the switch by contact therewith, opening the switch and stopping the motor. Movement of the journal frame 66 out of contact with the limit switch 83 or 84 closes the switch.

It is to be understood that various changes and modifications may be made in the foregoing without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A method of preventing cross corrugations in cold rolled metal strip comprising cold rolling metal strip by

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passing the metal strip between a pair of pinch rolls, bending the moving cold rolled strip about deflector means, and moving the deflector means until the strip emerging from between the pinch rolls is perpendicular to the plane of the axes of the pinch rolls at the same time that the moving strip is bent about the deflector means.

2. A method of preventing cross corrugations in cold rolled metal strip comprising cold rolling metal strip by passing the metal strip between a pair of pinch rolls, bending the moving cold rolled strip about first deflector means having a line of initial contact with the strip that is spaced from the plane that is perpendicular to the plane of the axes of the rolls and that includes the pinch roll nip, bending the moving strip about second deflector means between the pinch rolls and the first deflector means, and moving the second deflector means until the line of initial contact between the strip and the second deflector means lies on said perpendicular plane at the same time that the metal strip is bent about both of the first and second deflector means.

3. A method as claimed in claim 2, the strip being bent in opposite directions about said first and second deflector means.

4. In a cold rolling mill comprising a pair of pinch rolls for cold rolling metal strip between them, deflector means on the exit side of the pinch rolls for changing the direction of the metal strip, and means for moving the deflector means to a position such that the strip emerging from between the pinch rolls is perpendicular to the plane of the axes of the pinch rolls, the deflector means including means for maintaining the strip deflected in said position of the deflector means.

5. In a cold rolling mill as claimed in claim 4, the deflector means comprising a pair of rolls about which the strip is bent.

6. In a cold rolling mill as claimed in claim 5, said deflector rolls being mounted for conjoint bodily movement parallel to the plane of the pinch roll axes.

7. In a cold rolling mill as claimed in claim 5, said deflector rolls being mounted for individual bodily movement parallel to the plane of the pinch roll axes.

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