(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 062 061 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
24.03.2004 Bulletin 2004/13

(21) Application number: **00901321.0**

(22) Date of filing: **07.01.2000**

(51) Int Cl.[7]: **B21B 39/12**, B21B 38/02

(86) International application number:
PCT/IT2000/000006

(87) International publication number:
WO 2000/041823 (20.07.2000 Gazette 2000/29)

(54) **HOT ROLLING MILL FOR THIN STRIP WITH HIGH-SPEED WINDING OF INDIVIDUAL STRIPS**

WARMWALZWERK FÜR DÜNNE BÄNDER ZUM AUFWICKELN EINZELNER BÄNDER UNTER HOHER GESCHWINDIGKEIT

LAMINOIR A CHAUD POUR FINES BANDES AVEC ENROULEMENT A GRANDE VITESSE DE CHAQUE BANDE

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: **11.01.1999 IT MI990021**

(43) Date of publication of application:
27.12.2000 Bulletin 2000/52

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Description

[0001] The invention relates to the hot rolling of thin strip, i.e. metal strip of a thickness of less than 1÷1.5 mm.

[0002] As is known, the production of rolled products of this type is growing in importance in the iron and steel sector since it allows to manufacture products that are conventionally produced by more costly cold working.

[0003] Hot working requires, however, particular measures: for instance the speed of output of the strip must in certain cases be kept below predetermined limits because otherwise the head of the strip might be lifted as a result of air resistance.

[0004] Indeed, if the strip advances too rapidly in the output section of the rolling mill (i.e. the part of the mill which is downstream the last rolling stand), there is a risk that its head might strike the guide rolls on which it is moving: following such impacts, it would be deflected upwards so that a part of the strip would be raised from the roll train as a result of air resistance, thereby making its control and subsequent winding on the reel problematic.

[0005] In order to remedy this drawback a continuous rolling technique has been developed (also called "endless"), in which a single initial strip is cut at the end of rolling, into sections of predetermined length which are then wound as respective coils. In particular the strip is obtained from a bar of multiple weight than that of the final coils to be produced, which may in turn be obtained either by joining smaller bars using conventional roughing plants or by thin slab casting.

[0006] It will be readily appreciated that in this case the problem of the lifting of the head of each strip is eliminated since there is no discontinuity between one strip and the next; it should however be noted that at the beginning of each production cycle the fore end of the strip is caused to move at a speed lower than the normal operating speed so that it can be wound regularly on the relative reel: it is only at this point that the speed of the strip is increased.

[0007] In order to carry out endless rolling, it is necessary, however, to use control systems and machinery that are specific or have been modified with respect to conventional control systems and machinery as a result of the continuous operation of the rolling mill; for instance, particular configurations of the reels for coiling the various strip portions (of a length of some hundreds of metres) which are gradually cut in the output section of the rolling mill, have recently been developed.

[0008] This special equipment generally entails some increase in costs, such that plants for the endless rolling of thin strip can be considered rather expensive.

[0009] Another factor also needs to be considered.

[0010] The use of special equipment is often not compatible with existing rolling mills: in such cases this means that it is not possible to carry out the hot rolling of thin strip, by adapting old plants originally intended for processing thicknesses greater than those mentioned above. Japanese patent publication JP-A-09192717 discloses a rolling mill according to this state of the art.

[0011] The technical problem underlying this invention is therefore that of providing a hot rolling mill with structural and operational features suitable to overcome the limits of the state of the art described above.

[0012] In other words, the invention aims to provide a rolling mill for hot working of thin strip, in which the strip is fed in a controlled manner in order to avoid any risk of its lifting in the case of high speeds; a rolling mill of this type is therefore an alternative to rolling mills of endless type and is able to produce successive batches of strip without the drawbacks described above.

[0013] This technical problem is resolved by a rolling mill whose features are set out in the claims accompanying this description.

[0014] For a better understanding of the invention, a preferred and non-exclusive embodiment thereof is described below and shown in the accompanying drawings wherein:

Fig. 1 is a simplified side view of the output section of the rolling mill according to the invention;
Fig. 2 shows the possible positions of a tensiometric roller in the output section of the preceding figure;
Fig. 3 shows a detail of Fig. 2 on an enlarged scale.

[0015] In the drawings, reference 1 indicates overall the output section of a rolling mill according to the invention, upstream and downstream of which there are disposed finishing stands 2 (known per se) for the final rolling of a strip N.

[0016] The section 1 comprises a series of driven rollers 3 adapted to feed the strip, and a station 4 for the detection of its geometrical characteristics (thickness, shape, width) upstream and downstream of which there are located generators of air jets 5, 6, which will be better described below.

[0017] A first drive unit 7 of the type conventionally used in rolling mills and formed by two controlled rolls which act on the strip from its opposite sides (these rolls are also known in the art as "pinch rolls"), is disposed along the feed path of the strip N, after the generator 6.

[0018] Downstream the first drive unit 7 there is provided a cooling station 8 which, in accordance with a preferred embodiment of the invention, is of the ultrafast cooling type or UFC; this kind of station, indeed, is able to remove large quantities of heat by supplying relevant flows of cooling fluid and are generally used in the rolling of large thickness plates, in order to improve their mechanical properties (likewise a hardening treatment).

[0019] In this case, however, their features are used to shorten the output section 1 of the rolling mill, given that they make it possible to lower the temperature of the strip N in a smaller space than conventional cooling stations (under the same conditions obviously).

[0020] A second drive unit 9, similar to the first one but with its operating rolls oriented so as to deflect the plane of movement of the strip N towards a winding reel 10, is arranged after the cooling station 8; as can be seen from the accompanying drawings, this winding reel is advantageously disposed above the horizontal feeding direction of the strip coming out from the stands 2. This positioning allows for simple installation on the roll trains of existing plants, without the need for excessive modification of their foundations or of the collection duct for the fluid used to cool the strip.

[0021] The position of the reel could however be different from that described above; for instance it could also be disposed lower with respect to the horizontal feeding direction of the strip, as shown by the dashed line in Fig. 1.

[0022] The reel 10 comprises a spindle 11 wherein the strips arriving one after the other are wound and around which pressure rolls 12 are arranged in a known manner; between the second drive unit 9 and the reel 10 there are disposed guides 13, adapted to direct the head of each strip N towards the spindle 11 on which it is then wound.

[0023] Turning now to consider again the generators of air jets 5, 6, the may take the form of fans or compressors appropriately provided with air supply ducts, or of nozzles supplied with compressed air from the distribution network of the industrial plant in which the rolling mill is located.

[0024] The task of these generators is to exert a pressure on the upper surface of the strip N being fed along the output section of the rolling mill 1, in order to keep it flattened against the rollers way formed by the rollers 3; the air velocity thus has a vertical downwardly facing component (with reference to the drawings).

[0025] Moreover, in accordance with a preferred embodiment of the invention, the blown air may also have a horizontal velocity component parallel to the surface of the strip and greater than the feeding speed of the latter: the generators 5 and 6 thus direct the air jets in an inclined manner with respect to the strip in order to obtain the effects referred before.

[0026] The rolling mill in which the output section 1 described above is located, operates as follows; it should be stressed that the rolling mill structure upstream of this section has not been considered in detail here, since it is of secondary importance for the purposes of understanding the present invention.

[0027] For simplicity, reference could nevertheless be made to known rolling mills of non-endless type for working strips thicker than those for which the present invention is intended, wherein the initial bars are obtained by thin slab casting.

[0028] When finishing in the stands 2 is complete, a strip N being processed reaches the output section 1 on the rollers way 3 from which it is caused to advance towards the winding reel 10; at this stage the generators 5, 6 are actuated so that the air jets they produce, keep the strip pressed against the rolls 3.

[0029] The air horizontal velocity component avoids that when the head of the strip strikes the rolls 3, the fore section of the strip is lifted with all the adverse consequences mentioned above; it is important to note that this effect is achieved whatever is the feeding speed of the strip.

[0030] The movement of the strip N is thus controlled by the air in order to enable its correct engagement with the first drive unit 7, which helps to feed it in a guided manner; in this respect it should be noted that these units are provided with guide members (not shown) adapted to guide the free end of the strip towards the rolls. It should also be noted that at this stage water is sprayed on the strip in the cooling station 8, thereby helping to hold it pressed against the motor-driven rollers 3 up to the second drive unit 9.

[0031] This unit 9 then deflects the direction of feed of the strip N towards the reel 10; this result is obtained by means of the inclination of its rolls as shown in the drawings, which deflect the strip who is then conveyed by the guides 13 towards the spindle 11 and the pressure rollers 12 so that it can be wound in a manner similar to that normally used in the art.

[0032] The wound strip is then removed from the spindle and the reel is ready to receive a new strip as it arrives; it should be noted in this respect that in the rolling mill of the invention there is a dead time between a strip and the next one, during which the last coil wound can be removed.

[0033] This is due to the fact that in the case of rolling mills wherein the initial bars are obtained by continuous casting, the operating times required for the formation of each of them are long enough to enable the strip obtained from the previous bar to reach the winding reel.

[0034] The way in which the present invention solves the technical problem underlying it, can be understood from the above description.

[0035] Indeed it will be appreciated that the strip is controlled aerodynamically in the output section 1, by exerting a pressure on it that avoid separation thereof from the roller way; this solution is very efficient and operationally flexible and can be applied in the case of high strip speeds (the speed of the air flow can be adjusted at will to increase or decrease the pressure on the strip).

[0036] The aerodynamic control of the strip according to the teaching of the present invention can therefore be advantageously used in new rolling mill plant and in existing plants as well.

[0037] In the latter case, moreover, the application of means for the formation of the air jets does not entail substantial modifications of the rolling mill with the result that the costs involved by this solution are undoubtedly limited.

[0038] It must also be borne in mind that the air jets may be readily adjusted to improve the control of the strip; for instance, it is possible to adjust the pressure exerted by the air in the direction of the width of the strip so as to curve its section and make it more resistant to longitudinal bending and less sensitive to the destabilising phenomena described above.

[0039] It is also important to emphasize the favourable effects that can be obtained using jets inclined with respect to the strip processed.

[0040] A velocity component of the air parallel to that of feeding the strip, is created in this way; as this component is greater than the feeding speed of the strip, it prevents the latter from being lifted since it forces the fore head thereof downwards when it is deflected upwards by the impacts with the rolls 3.

[0041] Moreover, the horizontal velocity component also makes it possible to avoid exerting an excessive pressure on the strip perpendicular thereto.

[0042] For understanding this fact reference should be made to the case wherein such component were not present; for compensating this absence, it would be necessary to increase the force of the air acting in the vertical direction, i.e. perpendicular to the strip, with the result that the strip could be bent downwards when it moves along the rollers 3. It should be taken into account that these strips are thin and can therefore be readily deformed, particularly by bending.

[0043] As a consequence it would be more difficult for the strip to slide along the rolls and its head would be more likely to impact against these rolls.

[0044] It should also be noted that the presence of a current of air with a velocity parallel to that of the feed of the strip, makes it possible to limit the number of generators of air jets. In the previous example, two generators 5 and 6 are sufficient to produce the desired horizontal air velocity component along the whole output section 1 of the rolling mill.

[0045] It will be readily appreciated, however, that when using only generators with vertical jets (and therefore without a horizontal velocity component as in the example considered above), these should be spaced in order to cover the whole length of the output section 1 of the rolling mill.

[0046] Indeed, in this case the absence of the horizontal air velocity component would have to be replaced by a uniform vertical action along the output section, that could be obtained only by providing a sufficient number of generators to cover the entire longitudinal extension thereof.

[0047] It will be appreciated that variants of the invention with respect to the above description are nevertheless possible.

[0048] At first it should be borne in mind that although reference has been made only to air jets blown onto the upper surface of the strip, the invention could also be carried out by aspirating air below the strip, thereby creating a slight vacuum preventing it from rising from the rollers 3.

[0049] In other words, in this alternative the movement of the strip would be controlled by sucking it down from below rather than pressing it down from above.

[0050] This solution seems less advantageous than the previous one because of the greater technical difficulties that it would entail as a result of having to work below the strip; indeed in this area further to the presence of the driven rollers 3, there is also the strip cooling water falling down and the space available is quite small.

[0051] It is however evident that a similar solution could be provided as an alternative to that with the air jets, or in combination therewith.

[0052] It cannot also be excluded that the horizontal component of the air velocity be obtained in a different manner from blowing inclined jets, like in the previous example.

[0053] It could indeed be envisaged to achieve this result by using separate air jets directed parallel to the speed of the strip; in this case it would then be necessary to use vertical air jets to obtain the pressure component on the strip perpendicular thereto.

[0054] It will be also appreciated that the rolling mill of the embodiment described heretofore could be integrated with other components that have not as yet been considered.

[0055] An example of this is shown in Figs. 2 and 3, wherein the first one shows a number of positions in which it is possible to locate a device for measuring planarity 20 with a tensiometric roller 21 along the output section of Fig. 1, while the second shows a particular embodiment of this roller in greater detail.

[0056] It should be noted that tensiometric rollers are already known in the field of rolling where they are used to measure the planarity of strips, i.e. the presence of undulations in their configuration due to differing deformation between their edge and their centre.

[0057] In short, tensiometric rollers are rollers split longitudinally into cylindrical sections, adjacent to one another and idle with respect to a same axis transverse to the strip; the tensiometric roller is brought into contact with the strip by urging it against the strip and slightly deflecting its run.

[0058] In this way the friction of the strip on the various cylindrical sections making up the roller, causes a different rotation between one section and another when there are undulations in the strip that locally alter the strip-roller friction conditions.

[0059] These different rotations thus provide a measurement of the planarity of the strip that can be readily detected by transducers and then corrected by adjusting the rolling conditions appropriately.

[0060] In hot rolling mills, tensiometric rollers are usually disposed between the final rolling stands (i.e., with reference to Fig. 1, between the stands 2 shown therein); this means, however, that the planarity measurement carried out does not take account of the deformation due to the final stand, which must be evaluated using theoretical models and algorithms with all the limitations arising therefrom.

[0061] It is also known to measure the planarity of strips using laser systems disposed downstream of the final stand.

[0062] This solution provides reliable data, however, only until the strip starts to be wound on the reel; indeed when this takes place the strip is put in traction by the action of the reel, so that any undulations in the strip are altered and the planarity measurements are no longer reliable.

[0063] In conventional rolling mills, where the conveyor rollers way for the strip is usually about 100 metres long, the time interval that can be used to carry out the planarity measurement and make the necessary corrections to rolling before the strip is wound on the spindle of the reel is around 10 seconds.

[0064] This situation is however not compatible with the rolling mill of Fig. 1, for which the length of the output section can be appropriately reduced to a minimum with the result that there is insufficient time available for the planarity measurement (around 1 second).

[0065] It has therefore been envisaged to design the new measuring device 20 with a tensiometric roller adapted to be used downstream of the rolling stands, i. e. in a position where the "pull" on the strip exerted by the operating cylinders of the stands and used for planarity measurements in known rolling mills, is absent.

[0066] This device may preferably be disposed immediately after the final rolling stand 2 or immediately before the second drive unit 9, as shown in Fig. 2 in which the tensiometric roller is shown respectively by 21' in the former case and by 21" in the latter case.

[0067] In practice, the above-mentioned device is formed by the tensiometric roller 21 and by a returning roller 22 which is disposed on the opposite side of the former with respect to the strip N, in a position facing the adjacent motor-driven roll 3.

[0068] In the rest position, both rollers 21 and 22 are spaced from the strip; when the planarity measurement is to be carried out the tensiometric roller 21 is urged upwards and the returning roller 22 downwards so as to bring the strip immediately back into the normal plane of feed.

[0069] In this condition, the tensiometric roller 21 provides the desired measurement according to its normal operation.

[0070] A possible embodiment of the device 20 is shown on an enlarged scale in Fig. 3, where reference is made to its position immediately downstream of the final stand 2.

[0071] In this case the tensiometric roller 21 is mounted together with a roller 3' of the type of those forming the rollers way 3, on a frame 23 that can oscillate with respect to a fixed axis 24 under the action of a hydraulic jack 25.

[0072] When it is not necessary to measure the planarity of the strip, the roller 3' is in the position aligned with the other adjacent rollers 3 (as shown in dashed lines in Fig. 3) and the strip slides on it while the tensiometric roller is distanced; vice versa, when this measurement is to be carried out the tensiometric roller 21 is raised causing the frame 23 to oscillate, and at the same time distancing the roller 3'.

[0073] It should lastly be noted that the returning roller 22 is mounted on an arm 28 that also oscillates with respect to a base 29 secured to the bearing structure S of the rolling stand 2.

[0074] The planarity measurement device as designed above has the advantage of limiting the wear of the tensiometric roller, thereby ensuring that the measurements provided are reliable; it will be appreciated that this device may also he subject to many variants.

[0075] It should be borne in mind in this respect that it would be possible to locate a planarity measurement device immediately after the second drive unit 9, as an alternative to the previous two positions; in this case the device 20 could be subject to further modifications linked to the different position of the tensiometric roller with respect to the strip, i.e. above rather than below it (see Fig. 3 in which the tensiometric roller is shown by 21'"), and to the absence of the rollers 3 of the strip rollers way.

[0076] These and other modifications nevertheless fall within the scope of the following claims.

Claims

1. A hot rolling mill for thin strips (N), comprising an output section (1) extending between a final rolling stand (2) and at least one winding reel (10), a driven rollers way (3) disposed longitudinally with respect to this section and along which the strip is fed, means (5, 6) of the aerodynamic type provided along said output section to prevent the strip from being lifted from the rollers way, **characterized in that:**

    the output section comprises a drive unit (9) disposed along the rollers way (3) and before said at least one winding reel (10), and wherein
    the winding reel (10) is disposed at a greater height than the rollers way (3) and the drive unit is of the type that can be oriented to deflect the strips (N) towards the winding reel.

2. A rolling mill as claimed in claim 1, wherein the means of aerodynamic type comprise gaseous fluid jets directed onto the upper surface of the strip (N) moving along the rollers way (3).

3. A rolling mill as claimed in claim 2, wherein the gaseous fluid jets are inclined with respect to the upper surface of the strip (N) and the component of the fluid velocity parallel to the moving velocity of the strip, is greater than the latter.

4. A rolling mill as claimed in claim 3, wherein there

are provided fluid jets directed perpendicular to the upper surface of the strip (N) and fluid jets directed parallel thereto, the latter having a fluid velocity greater than that of the strip (N).

5. A rolling mill as claimed in any one of claims 2 to 4, wherein the gaseous fluid is air.

6. A rolling mill as claimed in any one of the preceding claims, wherein the means of aerodynamic type adapted to prevent the strip (N) from being lifted from the rollers way (3) comprise means for producing a vacuum below the strip.

7. A rolling mill as claimed in any one of the preceding claims, wherein the output section (1) comprises a cooling station (8) of ultra-fast type.

8. A rolling mill as claimed in claim 7, wherein the output section (1) comprises a first drive unit (7) located upstream of the cooling station (8) along the rollers way (3).

9. A rolling mill as claimed in any one of the preceding claims, wherein a measuring device (20) that measures the planarity of the strips (N), comprising a tensiometric roller (21), is arranged in the output section (1).

10. A rolling mill as claimed in claim 9, wherein the measuring device (20) is disposed at the beginning of the output section (1) in a position adjacent to the final rolling stand (2).

11. A rolling mill as claimed in claim 9, wherein the measuring device (20) is disposed at the end of the output section (1) before the second drive unit (9).

12. A rolling mill as claimed in claim 9, wherein the measuring device (20) is disposed downstream of the second drive unit (9).

13. A rolling mill as claimed in any one of claims 9, 10 and 11, wherein the measuring device (20) comprises a frame (23) moving with respect to the strip (N) to be measured, on which the tensiometric roller (21) and a roller (3') similar to the rollers (3) that form the rollers way along which the strip is fed, are mounted.

14. A rolling mill as claimed in any one of claims 9, 10, 11 and 13, wherein the tensiometric roller (21) operates on the lower surface of the strip (N) to be measured and the measuring device (20) further comprises a returning roller (22) operating on the upper surface of the strip opposite a roller (3) of the rollers way along which the strip is fed.

Patentansprüche

1. Warmwalzwerk für dünne Bänder (N), mit einem Ausgabebereich (1), welcher sich zwischen dem letzten Walzgerüst und wenigstens einem Aufspulhaspel (10) befindet, und einem Rollgang (3) mit angetriebenen Transportrollen, der sich über die Länge des Ausgabebereichs (1) erstreckt, entlang welchem das Band geführt ist, wobei entlang dem Ausgabebereich (1) aerodynamisch wirkende Vorrichtungen (5, 6) vorgesehen sind, die ein Abheben des Bandes von dem Rollgang (3) unterbinden, **dadurch gekennzeichnet, dass** der Ausgabebereich (1) eine Antriebseinheit (9) aufweist, die entlang dem Rollgang (3) vor dem wenigstens einmal vorhandenen Aufspulhaspel (10) angeordnet ist, wobei der Aufspulhaspel (10) in einer größeren Höhe als der Rollgang (3) angeordnet ist und die Antriebseinheit (9) derart ausgestaltet und angeordnet ist, dass sie die Bänder (N) in Richtung auf den Aufspulhaspel (10) umlenkt.

2. Warmwalzwerk nach Anspruch 1, bei welchem die aerodynamisch wirkenden Vorrichtungen mit Gasströmungsdüsen versehen sind, die auf die obenliegende Oberfläche des entlang des Rollgangs (3) bewegten Bandes (N) gerichtet sind.

3. Warmwalzwerk nach Anspruch 2, bei welchem die Gasströmungsdüsen in Bezug auf die obenliegende Oberfläche des Bandes (N) geneigt verlaufen, wobei die parallel zum Band verlaufende Komponente der Strömungsgeschwindigkeit größer als die Bewegungsgeschwindigkeit Bandes (N) ist.

4. Warmwalzwerk nach Anspruch 3, bei welchem Gasströmungsdüsen senkrecht und parallel zur obenliegenden Oberfläche des Bandes (N) angeordnet sind, wobei letztere eine Strömungsgeschwindigkeit haben, die größer als die Bandgeschwindigkeit ist.

5. Warmwalzwerk nach einem der Ansprüche 2 bis 4, bei welchem die Gasströmung aus Luft besteht.

6. Warmwalzwerk nach einem der vorhergehenden Ansprüche, bei welchem die aerodynamisch wirkende Vorrichtung, die ein Abheben des Bandes (N) von dem Rollgang (3) verhindert, Einrichtungen zur Erzeugung eines Vakuums unter dem Band aufweisen.

7. Warmwalzwerk nach einem der Ansprüche 1 bis 6, bei welchem der Ausgabebereich (1) eine Kühl-Station (8) für die Ultra-Schnellkühlung aufweist.

8. Warmwalzwerk nach Anspruch 7, bei dem der Ausgabebereich (1) eine erste Antriebseinheit (7) aufweist, welche sich stromaufwärts der Kühl-Station (8) am Rollgang (3) befindet.

9. Warmwalzwerk nach einem der vorstehenden Ansprüche, welche mit einer Messeinrichtung (20) versehen ist, die die Ebenheit der Bänder (N) mißt, eine Spannungsmeßrolle (21) aufweist und innerhalb des Ausgabereiches (1) angeordnet ist.

10. Warmwalzwerk nach Anspruch 9, bei welchem die Messelnrichtung (20) im vorderen Teil des Ausgabebereiches (1), angrenzend an das letzte Walzengerüst (2), angeordnet ist.

11. Warmwalzwerk nach Anspruch 9, bei welchem die Messeinrichtung (20) im hinteren Teil des Ausgabereiches (1) vor einer zwelten Antriebseinheit (9) angeordnet ist.

12. Warmwalzwerk nach Anspruch 9, bei welchem die Messeinrichtung (20) stromabwärts einer zweien Antriebseinheit (9) vorgesehen ist.

13. Warmwalzwerk nach einem der Ansprüche 9, 10 und 11, bei welchem die Messeinrichtung (20) mit einem Rahmen (23) versehen ist, der relativ zum zu vermessenden Band (N) beweglich ist und auf welchem die Spannungsmeßrolle (21) und eine Rolle (3') montiert sind, die den Rollen ähnlich ist, die den Rollgang (3) bilden, entlang welchem das Band geführt ist.

14. Warmwalzwerk nach einem der Ansprüche 9, 10, 11 und 13, bei welchem die Spannungsmeßrolle (21) an der unterseltigen Oberfläche des zu vermessenden Bandes (N) arbeitet und die Messeinrichtung (20) weiterhin eine an der oberseitigen Bandes (N) arbeitende Rückführrolle (22) aufweist, die gegenüber einer Transportwalze des Rollganges (3) angeordnet ist, entlang weichem das Band (N) geführt ist.

Revendications

1. Laminoir à chaud pour fines bandes (N), comprenant une section de sortie (1) s'étendant entre une cage de laminoir finale (2) et au moins un enrouleur (10), un chemin de rouleaux commandés (3) disposé longitudinalement par rapport à cette section et le long duquel la bande est avancée, des moyens (5, 6) du type aérodynamique disposés le long de ladite section de sortie pour empêcher la bande d'être soulevée du chemin de rouleaux, **caractérisé en ce que**
la section de sortie comprend une unité d'entraînement (9) disposée le long du chemin de rouleaux (3) et avant ledit au moins un enrouleur (10), et dans lequel
l'enrouleur (10) est disposé à une hauteur supérieure à celle du chemin de rouleaux (3) et l'unité d'entraînement est d'un type qui peut être orientée pour dévier les bandes (N) vers l'enrouleur.

2. Laminoir selon la revendication 1, dans lequel les moyens du type aérodynamique comprennent des jets de fluide gazeux dirigés sur la surface supérieure de la bande (N) se déplaçant le long du chemin de rouleaux (3).

3. Laminoir selon la revendication 2, dans lequel les jets de fluide gazeux sont inclinés par rapport à la surface supérieure de la bande (N) et la composante de vitesse du fluide parallèle à la vitesse de déplacement de la bande est supérieure à cette dernière.

4. Laminoir selon la revendication 3, dans lequel il y a des jets de fluide dirigés perpendiculairement à la surface supérieure de la bande (N) et des jets de fluide dirigés parallèlement à celle-ci, ces derniers ayant une vitesse du fluide supérieure à celle de la bande (N).

5. Laminoir selon l'une quelconque des revendications 2 à 4, dans lequel le fluide gazeux est de l'air.

6. Laminoir selon l'une quelconque des revendications précédentes, dans lequel les moyens du type aérodynamique adaptés pour empêcher la bande (N) d'être soulevée du chemin de rouleaux (3) comprennent des moyens destinés à produire le vide sous la bande.

7. Laminoir selon l'une quelconque des revendications précédentes, dans lequel la section de sortie (1) comprend un poste de refroidissement (8) du type ultra-rapide.

8. Laminoir selon la revendication 7, dans lequel la section de sortie (1) comprend un première unité d'entraînement (7) située en amont du poste de refroidissement (8) le long du chemin de rouleaux (3).

9. Laminoir selon l'une quelconque des revendications précédentes, dans lequel un dispositif de mesure (20) qui mesure la planéité des bandes (N) et qui comprend un rouleau tensiométrique (21), est agencé dans la section de sortie (1).

10. Laminoir selon la revendication 9, dans lequel le dispositif de mesure (20) est disposé au début de la section de sortie (1) dans une position adjacente à la cage de laminoir finale (2).

11. Laminoir selon la revendication 9, dans lequel le dispositif de mesure (20) est disposé à la fin de la section de sortie (1) avant la seconde unité d'entraînement (9).

12. Laminoir selon la revendication 9, dans lequel le dispositif de mesure (20) est disposé en aval de la seconde unité d'entraînement (9).

13. Laminoir selon l'une quelconque des revendications 9, 10 et 11, dans lequel le dispositif de mesure (20) comprend un cadre (23) mobile par rapport à la bande (N) devant être mesurée, sur lequel sont montés le rouleau tensiométrique (21) et un rouleau (3') similaire aux rouleaux (3) qui forment le chemin de rouleaux le long duquel la bande est avancée.

14. Laminoir selon l'une quelconque des revendications 9, 10, 11 et 13, dans lequel le rouleau tensiométrique (21) agit sur la surface inférieure de la bande (N) devant être mesurée et le dispositif de mesure (20) comprend en outre un rouleau de retour (22) agissant sur la surface supérieure de la bande, en face d'un rouleau (3) du chemin de rouleaux le long duquel la bande est avancée.

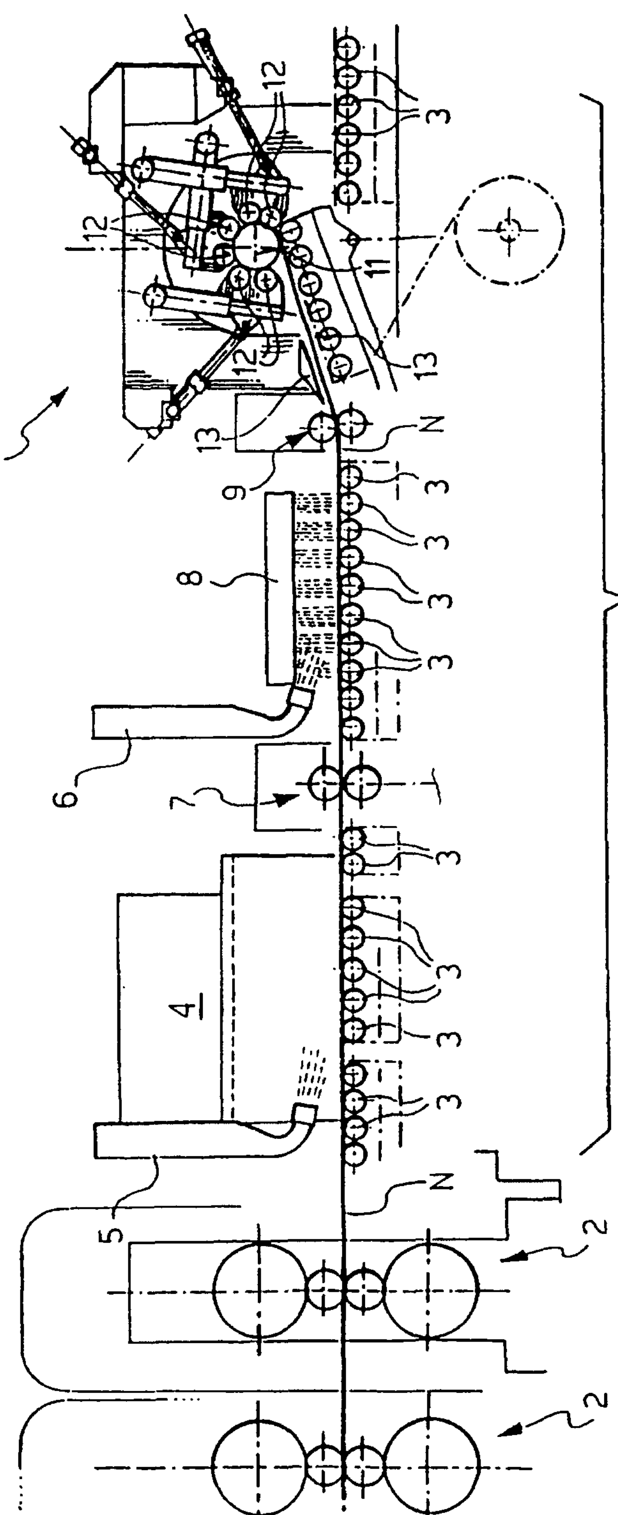

FIG.1

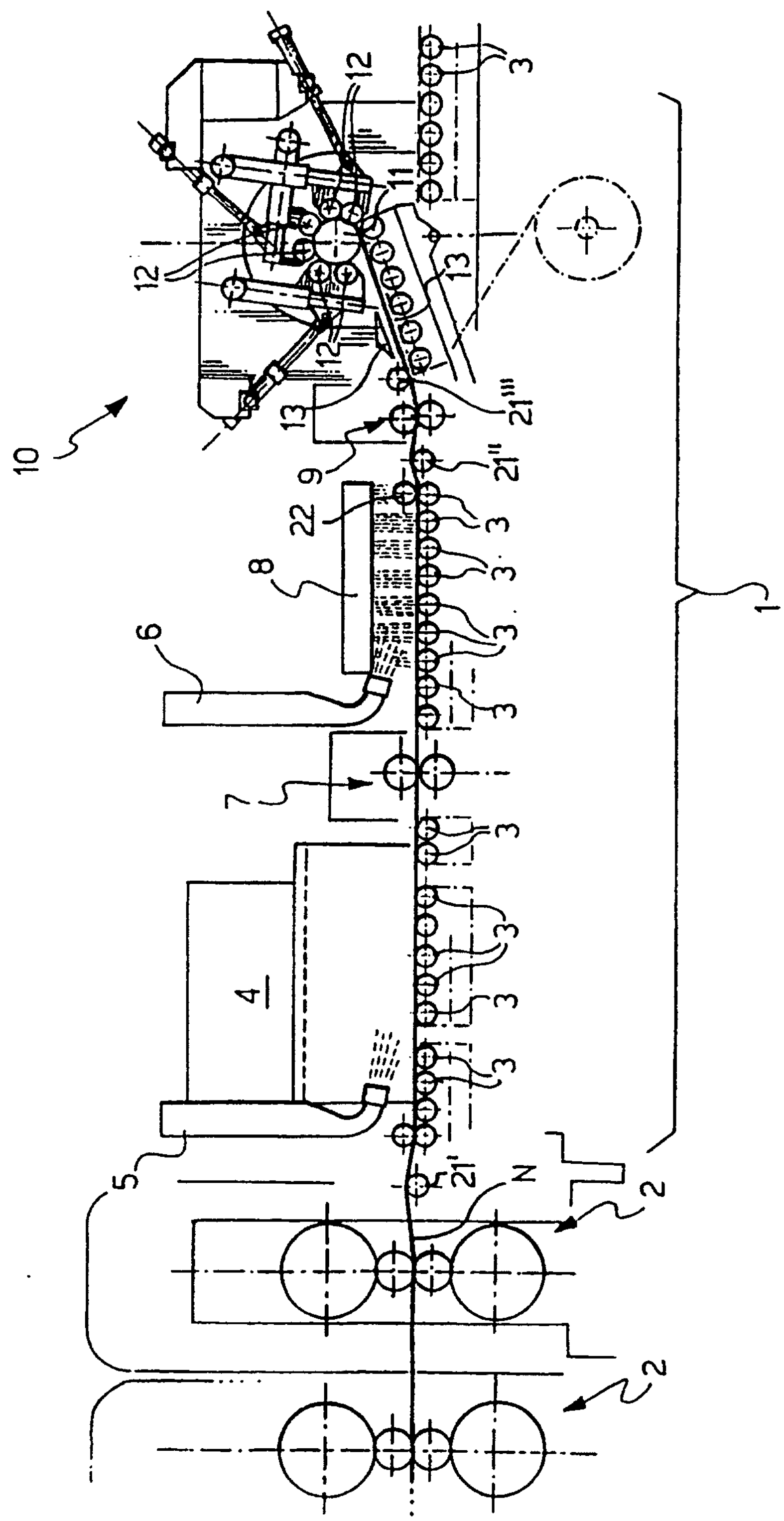

FIG.2

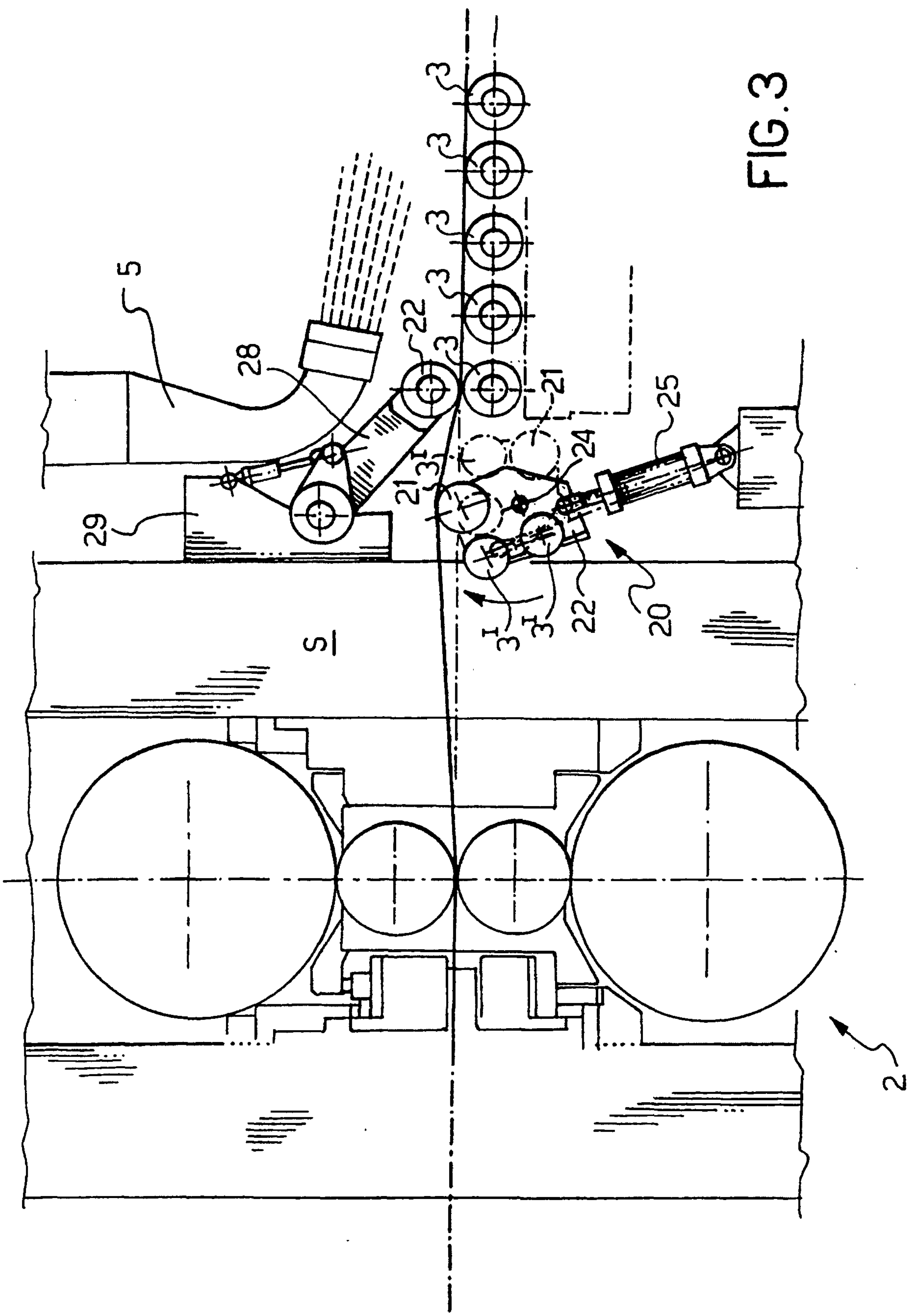

FIG. 3