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(54) **Method for continuously manufacturing cold-rolled steel**

Verfahren zur kontinuierlichen Herstellung von kaltgewalztem Stahl

Procédé de fabrication continue d'acier laminé à froid

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EP 2 067 541 B1

Description

[0001] The invention relates to a method for continuously manufacturing cold-rolled steel, more particularly to a method for continuously manufacturing cold-rolled steel from white steel.

[0002] A conventional process for making stainless steel essentially includes casting, hot rolling, and cold rolling. A steel slab obtained from casting is hot rolled to obtain a black steel coil, which is then annealed and pickled to obtain a white steel coil. The white steel coil can be further processed by cold rolling, annealing, pickling, temper rolling, tension leveling, etc., to obtain a steel coil product. The product obtained by cold rolling, annealing, and pickling is known as a 2D steel coil, and the product obtained by further temper rolling and tension leveling the 2D steel coil is known as a 2B steel coil.

[0003] Referring to Figure 1, a conventional process for manufacturing cold-rolled steel is conducted using a multi-stage production line including a steel coil preparation installation 11, a cold rolling installation 12, an annealing-pickling installation 13, a temper rolling installation 14, and a tension leveling installation 15, which are separate from one another.

[0004] The steel coil preparation installation 11 is used for uncoiling a white steel coil 100 into a white steel strip 400, which is welded with guide portions each having a length of 8-10 meters at two ends thereof and is then coiled into a steel coil 200. The steel coil 200 is transported to the cold rolling installation 12.

[0005] The steel coil 200 is uncoiled into a steel strip 400, which passes through the cold rolling installation 12. The cold rolling installation 12 is a 20-high cold rolling mill, and is used for cold rolling the steel strip 400 to have a predetermined thickness. The steel strip 400 after cold rolling is coiled into a steel coil 200, which is transported to the annealing-pickling installation 13.

[0006] The steel coil 200 is uncoiled into a steel strip 400, which passes through the annealing-pickling installation 13, in which the steel strip 400 is annealed, and is then pickled to remove scale from the steel strip 400. The steel strip 400 after pickling is coiled into a steel coil 200, which is the 2D steel coil.

[0007] The 2D steel coil 200 can be further transported to the temper rolling installation 14. The steel coil 200 is uncoiled into a steel strip 400, which passes through the temper rolling installation 14. The temper rolling installation 14 is used for imposing gloss on the steel strip 400. The steel strip 400 after temper rolling is coiled into a steel coil 200, which is transported to the tension leveling installation 15.

[0008] The steel coil 200 is uncoiled into a steel strip 400, which passes through the tension leveling installation 15, in which the steel strip 400 is tension leveled, and is then trimmed and coiled to obtain a steel coil product 300 (i.e., the 2B steel coil).

[0009] Since the installations 11, 12, 13, 14, 15 for performing the conventional process for manufacturing a

cold-rolled steel are separate from one another, multiple packaging operations, such as intermediate coiling operations, and transfer of coils from one installation to another are required. Furthermore, it is also costly in terms of energy consumption because of multiple operations of transporting intermediate product (coils) between installations. Additionally, storage of intermediate product takes up space.

[0010] In order to overcome the aforesaid shortcomings encountered in the conventional multi-stage production line, it is desirable in the art to develop a continuous production line for manufacturing cold-rolled steel.

[0011] U.S. Patent No. 6,478,899 discloses a method and an installation for making a cold-rolled stainless steel strip, and consists of continuously executing on a single production line all the process steps for fabricating a cold-rolled stainless strip from a thin strip cast directly from liquid metal, i.e., from the casting step through finishing steps to packaging the strip in the form of a coil. However, since the method and installation disclosed therein start from casting a stainless steel strip directly from liquid metal, the operating units and steps involved are relatively complicated. Therefore, the technique disclosed therein is impractical for use in the industry.

[0012] U.S. Patent No. 6,546,771 discloses a method for manufacturing strips of stainless steel, which comprises rolling in cold condition of strips which in a foregoing process have been manufactured through strip casting and/or have been hot rolled. According to various specific wants of the final product, the stainless steel shall pass once or twice through a rolling mill line. Additionally, the rolling mill line or parts of it also can be used for processes which are aimed at manufacturing strips with various specific features that are of significant importance for some applications. Since parts of the rolling mill line should be stopped in view of the specific requirements for the final product, the utilization rate of the rolling mill line is relatively low.

[0013] It is still desirable in the art to provide an improved method for continuously manufacturing cold-rolled steel.

[0014] Therefore, the object of the present invention is to provide a method for continuously manufacturing cold-rolled steel to overcome the aforementioned shortcomings of the prior art.

[0015] Accordingly, the invention provides a method for continuously manufacturing cold-rolled steel as set out in claim 1.

[0016] Preferred features of the invention are set out in claims 2 to 8.

[0017] Other features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiment with reference to the accompanying drawings, of which:

Figure 1 is a schematic diagram of a conventional process for manufacturing cold-rolled steel conducted using a multi-stage production line;

Figure 2 is a schematic diagram of a preferred embodiment of a method for continuously manufacturing cold-rolled steel according to this invention; and Figure 3 is a bar chart demonstrating a production efficiency comparison of the preferred embodiment to the prior art of Figure 1.

[0018] Referring to Figure 2, the preferred embodiment of a method for continuously manufacturing cold-rolled steel according to this invention includes the steps of:

1) providing coils of white steel:

Coils 100 of white steel 400 are provided, which are manufactured by hot rolling a cast steel followed by annealing and pickling the cast steel.

2) uncoiling and welding:

The white steel is subjected to uncoiling and welding in an uncoiling-welding installation 21 where the coils 100 of white steel 400 are flattened in an uncoiling device 211 and are welded in a welding device 212. The uncoiling device 211 includes two overhang-mandrel type of uncoilers. The welding device 212 includes a first arc welder for welding a steel strip having a thickness more than 1.5 mm, preferably 1.5-6 mm, and a second arc welder for welding a steel strip having a thickness less than 1.5 mm.

3) passing through a first strip accumulator:

The flattened and welded white steel 400 is passed through a set of tension rollers 221 provided in a first strip accumulator 22.

4) cold rolling:

The white steel 400 is moved from the first strip accumulator 22 to a cold rolling device 23 for cold rolling the white steel 400 to result in a cold-rolled steel with a predetermined thickness. The cold rolling device 23 includes three cold rolling mills 231 arranged in series. The white steel 400 is cold rolled in a rolling ratio ranging from 50 to 70% and to a thickness of about 0.3 mm. The thickness of the white steel 400 as it enters the cold rolling device 23 is measured. The thickness and the shape of the white steel 400 as it exits the cold rolling device 23 are also measured and transmitted to an automatic gauge control and a shape control system so as to monitor the conditions of the cold rolling device 23 and the properties of the white steel 400 after cold rolling.

5) degreasing:

The cold-rolled steel from the cold rolling device 23 is moved to a degreasing device 24 for removing grease from the cold-rolled white steel. The degreasing device 24 includes a base solution spraying region 241 for spraying a base solution on the cold-rolled steel, a water-washing region 242 for washing the cold-rolled steel using water, and a drying region 243 for drying the cold-rolled steel after washing.

6) moving the cold-rolled steel to a second strip accumulator:

The cold-rolled steel is moved from the degreasing device 24 to a second strip accumulator 25. The second strip accumulator 25 is similar to the first strip accumulator 22 in structure, and has a set of tension rollers 251.

7) annealing and pickling:

The cold-rolled steel is moved from the second strip accumulator 25 to an annealing-pickling installation 26 for annealing the cold-rolled steel and for electrolyzing and acid-washing the cold-rolled steel after annealing so as to remove scale from the cold-rolled steel. The annealing-pickling installation 26 includes an annealing device 261 and a pickling device 262. The annealing device 261 includes a heating region 263 operating at a temperature ranging from 1000 °C to 1200 °C, a preheating region 264 which is disposed upstream of the heating region 263 and in which the cold-rolled steel is preheated by radiation heat generated by the heating region 263, and a cooling region 265 which is disposed downstream of the heating region 263 and in which the cold-rolled steel is cooled to a temperature not higher than 80 °C. The pickling device 262 includes an electrolyzing tank 266 containing a sodium sulfate solution for removing iron oxide scale from the cold-rolled steel, an acid-washing tank 267 containing nitric acid and hydrofluoric acid for removing Fe-Cr-Ni oxide scale from the cold-rolled steel, and a water-washing region 268 for washing the cold-rolled steel. The water-washing region 268 is conducted in five stages so as to ensure that the acid solutions are washed out of the cold-rolled steel completely.

8) moving the cold-rolled steel to a third strip accumulator:

The cold-rolled steel is moved from the annealing-pickling installation 26 to a third strip accumulator:

mulator 27. The third strip accumulator 27 is similar to the first strip accumulator 22 in structure, and has a set of tension rollers 271.

9) temper rolling:

The cold-rolled steel is moved from the third strip accumulator 27 to a temper rolling device 28 for imposing gloss on the cold-rolled steel. The temper rolling device 28 includes a set of work rolls 281 for imposing the gloss on the cold-rolled steel via transfer printing.

10) tension leveling:

The cold-rolled steel is moved from the temper rolling device 28 to a tension leveling device 29 for leveling the cold-rolled steel. The tension leveling device 29 includes a leveling unit 291 for leveling the cold-rolled steel, and a washing-drying device 292 for washing and drying the cold-rolled steel after leveling. The leveling unit 291 includes a set of bending rolls 293 and a set of reverse-bending rolls 294. Additionally, the cold-rolled steel is sprayed with water or lubricant by the washing-drying device 292 before it enters into the leveling unit 291.

11) moving the cold-rolled steel to a fourth strip accumulator:

The cold-rolled steel is moved from the tension leveling device 29 to a fourth strip accumulator 31. The fourth strip accumulator 31 is similar to the first strip accumulator 22 in structure, and has a set of tension rollers 311.

[0019] It should be noted that each of the first, second, third, and fourth strip accumulators 22, 25, 27, 31 adjusts the tension of the steel, and enables the speeds at which the steel moves through two adjacent devices to be independent of each other.

12) moving the cold-rolled steel to a trimming-recoiling installation:

The cold-rolled steel is moved from the fourth strip accumulator 31 to a trimming-recoiling installation 32, which includes a trimming device 321 for trimming the cold-rolled steel, and a recoiling device 322 for recoiling the cold-rolled steel to obtain a cold-rolled steel product 300 (i.e., 2B steel coil).

[0020] Additionally, when 2D steel coil is intended to be produced, it can be obtained merely by shutting down the temper rolling device 28. Therefore, the utilization rate of the production line to perform the method of the

present invention can be improved over the prior art.

[0021] Referring to Figure 3, a comparison of the cold-rolled steel product made by the method of the present invention to the cold-rolled steel product made by the conventional multi-stage process shown in Figure 1 is made in terms of equipment cost, personnel cost, operating rate, throughput, productivity, and overall production cost. As shown in Figure 3, the personnel cost, the throughput, and the productivity of the method of the present invention are improved over those of the conventional multi-stage process even though the equipment cost of the method of the present invention is relatively high and the operating rate of the method of the present invention is relatively low. Totally, the overall production cost of the method of the present invention is merely 78% of that of the conventional multi-state process.

Claims

1. A method for continuously manufacturing cold-rolled steel, which includes the steps of:

providing coils (100) of steel (400);
 subjecting the coils (100) of steel (400) to uncoiling and welding in an uncoiling-welding installation (21) where the coils (100) of the steel (400) are flattened in an uncoiling device (211) and are welded in a welding device (212);
 passing the flattened and welded steel (400) through a set of tension rollers (221) provided in a first strip accumulator (22);
 moving the steel (400) from the first strip accumulator (22) to a cold rolling device (23) for cold rolling the steel (400) to result in a cold-rolled steel with a predetermined thickness;
 moving the cold-rolled steel from the cold rolling device (23) to a degreasing device (24) for removing grease from the cold-rolled white steel;
 moving the cold-rolled steel from the degreasing device (24) to a second strip accumulator (25) having a set of tension rollers (251);
 moving the cold-rolled steel from the second strip accumulator (25) to an annealing-pickling installation (26) for annealing the cold-rolled steel and for electrolyzing and acid-washing the cold-rolled steel after annealing so as to remove scale from the cold-rolled steel;
 moving the cold-rolled steel from the annealing-pickling installation (26) to a third strip accumulator (27) having a set of tension rollers (271),
characterized in that the coils (100) of steel (400) are coils of white steel and are manufactured by hot rolling a cast steel followed by annealing and pickling the cast steel; and
in that the method further includes:
 moving the cold-rolled steel from the third strip

- accumulator (27) to a temper rolling device (28) for imposing gloss on the cold-rolled steel; moving the cold-rolled steel from the temper rolling device (28) to a tension leveling device (29) for leveling the cold-rolled steel; moving the cold-rolled steel from the tension leveling device (29) to a fourth strip accumulator (31) having a set of tension rollers (311); and moving the cold-rolled steel from the fourth strip accumulator (31) to a trimming-recoiling installation (32) for trimming and recoiling the cold-rolled steel.
2. The method as claimed in Claim 1, **characterized in that** the steel (400) is cold rolled in a rolling ratio ranging from 50 to 70% and to a thickness of about 0.3 mm.
 3. The method as claimed in Claim 1, **characterized in that** the degreasing device (24) includes a base solution spraying region (241) for spraying a base solution on the cold-rolled steel, a water-washing region (242) for washing the cold-rolled steel using water, and a drying region (243) for drying the cold-rolled steel after washing.
 4. The method as claimed in Claim 1, **characterized in that** the annealing-pickling installation (26) includes an annealing device (261) having a heating region (263) operating at a temperature ranging from 1000 °C to 1200 °C, a preheating region (264) which is disposed upstream of the heating region (263) and in which the cold-rolled steel is preheated by radiation heat generated by the heating region (263), and a cooling region (265) which is disposed downstream of the heating region (263) and in which the cold-rolled steel is cooled to a temperature not higher than 80 °C.
 5. The method as claimed in Claim 1, **characterized in that** the uncoiling device (211) includes two overhang-mandrel type of uncoilers.
 6. The method as claimed in Claim 1, **characterized in that** the welding device (212) includes a first arc welder for welding a steel strip having a thickness more than 1.5 mm, and a second arc welder for welding a steel strip having a thickness less than 1.5 mm.
 7. The method as claimed in Claim 1, **characterized in that** the annealing-pickling installation (26) includes a pickling device (262) having an electrolyzing tank (266) containing a sodium sulfate solution for removing iron oxide scale from the cold-rolled steel, an acid-washing tank (267) containing nitric acid and hydrofluoric acid for removing Fe-Cr-Ni oxide scale from the cold-rolled steel, and a water-washing region (268) for washing the cold-rolled

steel.

8. The method as claimed in Claim 1, **characterized in that** the tension leveling device (29) includes a washing-drying device (292) for washing and drying the cold-rolled steel after leveling.

Patentansprüche

1. Verfahren zur kontinuierlichen Herstellung von kaltgewalztem Stahl, das die folgenden Schritte umfasst:

Bereitstellen von Spulen (100) aus Stahl (400); Abwickeln und Schweißen der Spulen (100) aus Stahl (400) in einer Abwickel-Schweißanlage (21), wo die Spulen (100) aus Stahl (400) in einer Abwickelvorrichtung (211) abgeflacht und in einer Schweißvorrichtung (212) geschweißt werden;

Führen des abgeflachten und geschweißten Stahls (400) durch einen Satz Spannrollen (221), die in einer ersten Bandspeichervorrichtung (22) vorhanden sind;

Bewegen des Stahls (400) von der ersten Bandspeichervorrichtung (22) zu einer Kaltwalzvorrichtung (23) für das Kaltwalzen des Stahls (400), um einen kaltgewalzten Stahl mit einer vorgegebenen Dicke zu erhalten;

Bewegen des kaltgewalzten Stahls von der Kaltwalzvorrichtung (23) zu einer Entfettungsvorrichtung (24) für das Entfernen von Fett vom kaltgewalzten weißen Stahl;

Bewegen des kaltgewalzten Stahls von der Entfettungsvorrichtung (24) zu einer zweiten Bandspeichervorrichtung (25) mit einem Satz Spannrollen (251);

Bewegen des kaltgewalzten Stahls von der zweiten Bandspeichervorrichtung (25) zu einer Glüh-Beisanlage (26) für das Glühen des kaltgewalzten Stahls und für das Elektrolysieren und Säurewaschen des kaltgewalzten Stahls nach dem Glühen, um so Zunder vom kaltgewalzten Stahl zu entfernen;

Bewegen des kaltgewalzten Stahls von der Glüh-Beisanlage (26) zu einer dritten Bandspeichervorrichtung (27) mit einem Satz Spannrollen (271),

dadurch gekennzeichnet, dass die Spulen (100) aus Stahl (400) Spulen aus weißem Stahl sind und durch Warmwalzen eines Gussstahls, gefolgt vom Glühen und Beizen des Gussstahls, hergestellt werden; und

dadurch, dass das Verfahren außerdem umfasst:

Bewegen des kaltgewalzten Stahls von der

- dritten Bandspeichervorrichtung (27) zu einer Nachwalzvorrichtung (28) für das Aufbringen von Glanz auf den kaltgewalzten Stahl;
Bewegen des kaltgewalzten Stahls von der Nachwalzvorrichtung (28) zu einer Streckrichtvorrichtung (29) für das Richten des kaltgewalzten Stahls;
Bewegen des kaltgewalzten Stahls von der Streckrichtvorrichtung (29) zu einer vierten Bandspeichervorrichtung (31) mit einem Satz Spannrollen (311); und
Bewegen des kaltgewalzten Stahls von der vierten Bandspeichervorrichtung (31) zu einer Putz-Wiederaufwickelanlage (32) für das Putzen und Wiederaufwickeln des kaltgewalzten Stahls.
2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** der Stahl (400) mit einem Walzverhältnis kaltgewalzt wird, das sich von 50 bis 70 % bewegt, und bis zu einer Dicke von etwa 0,3 mm.
3. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Entfettungsvorrichtung (24) umfasst: einen Basislösungsspritzbereich (241) für das Spritzen einer Basislösung auf den kaltgewalzten Stahl; einen Wasserwaschbereich (242) für das Waschen des kaltgewalzten Stahls bei Benutzung von Wasser; und einen Trocknungsbereich (243) für das Trocknen des kaltgewalzten Stahls nach dem Waschen.
4. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Glüh-Beisanlage (26) umfasst: eine Glühvorrichtung (261) mit einem Heizbereich (263), der bei einer Temperatur funktioniert, die sich von 1000 °C bis 1200 °C bewegt; einen Vorwärmbereich (264), der stromaufwärts vom Heizbereich (263) angeordnet ist, und in dem der kaltgewalzte Stahl durch Strahlungswärme vorgewärmt wird, die vom Heizbereich (263) erzeugt wird; und einen Abkühlungsbereich (265), der stromabwärts vom Heizbereich (263) angeordnet ist, und in dem der kaltgewalzte Stahl auf eine Temperatur von nicht höher als 80 °C abgekühlt wird.
5. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Abwickelvorrichtung (211) zwei Überhang-Dorn-Abwickelvorrichtungen umfasst.
6. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Schweißvorrichtung (212) umfasst: eine erste Lichtbogenschweißvorrichtung für das Schweißen eines Stahlbandes mit einer Dicke von mehr als 1,5 mm; und eine zweite Lichtbogenschweißvorrichtung für das Schweißen eines Stahlbandes mit einer Dicke von weniger als 1,5 mm.

7. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Glüh-Beisanlage (26) umfasst: eine Beizvorrichtung (262) mit einem Elektrolysebehälter (266), der eine Natriumsulfatlösung für das Entfernen des Eisenoxidzunders vom kaltgewalzten Stahl enthält, einem Säuzewaschbehälter (267), der Salpetersäure und Fluorwasserstoffsäure für das Entfernen von Fe-Cr-Ni-Oxidzunder vom kaltgewalzten Stahl enthält, und einem Wasserwaschbereich (268) für das Waschen des kaltgewalzten Stahls.
8. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Streckrichtvorrichtung (29) eine Wasch-Trockenvorrichtung (292) für das Waschen und Trocknen des kaltgewalzten Stahls nach dem Richten umfasst.

Revendications

1. Procédé de fabrication continue d'acier laminé à froid, englobant les étapes ci-dessous :
- fourniture de bobines (100) d'acier (400) ;
exposition des bobines (100) d'acier (400) à un déroulement et un soudage dans une installation de déroulement et de soudage (21), dans laquelle les bobines (100) d'acier (400) sont aplaties dans un dispositif dérouleur (211) et sont soudées dans un dispositif de soudage (212);
passage de l'acier aplati et soudé (400) à travers un ensemble de rouleaux tendeurs (221) agencés dans un premier dispositif de stockage de bandes (22) ;
déplacement de l'acier (400) du premier dispositif de stockage de bandes (22) vers un dispositif de laminage à froid (23) en vue du laminage à froid de l'acier (400), pour produire un acier laminé à froid ayant une épaisseur prédéterminée ;
déplacement de l'acier laminé à froid du dispositif de laminage à froid (23) vers un dispositif de dégraissage (24), pour éliminer la graisse de l'acier blanc laminé à froid ;
déplacement de l'acier laminé à froid du dispositif de dégraissage (24) vers un deuxième dispositif de stockage de bandes (25), comportant un ensemble de rouleaux tendeurs (251) ;
déplacement de l'acier laminé à froid du deuxième dispositif de stockage de bandes (25) vers une installation de recuit et de décapage (26), en vue du recuit de l'acier laminé à froid, ainsi que de l'électrolyse et du lavage à l'acide de l'acier laminé à froid après le recuit, de sorte à éliminer la calamine de l'acier laminé à froid ;
déplacement de l'acier laminé à froid de l'instal-

lation de recuit et de décapage (26) vers un troisième dispositif de stockage de bandes (27), comportant un ensemble de rouleaux tendeurs (271) ;

caractérisé en ce que les bobines (100) d'acier (400) sont des bobines d'acier blanc et sont fabriquées par laminage à chaud d'un acier coulé, suivi par un recuit et un décapage de l'acier coulé ; et

en ce que le procédé englobe en outre les étapes ci-dessous :

déplacement de l'acier laminé à froid du troisième dispositif de stockage de bandes (27) vers un dispositif d'écrouissage à froid (28) pour lustrer l'acier laminé à froid ;

déplacement de l'acier laminé à froid du dispositif d'écrouissage à froid (28) vers un dispositif de planage par étirage (29) pour soumettre l'acier laminé à froid à un planage ;

déplacement de l'acier laminé à froid du dispositif de planage par étirage (29) vers un quatrième dispositif de stockage de bandes (31), comportant un ensemble de rouleaux tendeurs (311) ; et

déplacement de l'acier laminé à froid du quatrième dispositif de stockage de bandes (31) vers une installation d'ébarbage et de rembobinage (32), pour ébarber et rembobiner l'acier laminé à froid.

2. Procédé selon la revendication 1, **caractérisé en ce que** l'acier (400) est laminé à froid avec un taux de laminage compris entre 50 et 70% et avec une épaisseur d'environ 0,3 mm.

3. Procédé selon la revendication 1, **caractérisé en ce que** le dispositif de dégraissage (24) englobe une région de pulvérisation d'une solution de base (241), pour pulvériser une solution de base sur l'acier laminé à froid, une région de lavage à l'eau (242), pour laver l'acier laminé à froid avec de l'eau, et une région de séchage (243) pour sécher l'acier laminé à froid après le lavage.

4. Procédé selon la revendication 1, **caractérisé en ce que** l'installation de recuit et de décapage (26) englobe un dispositif de recuit (261) comportant une région de chauffage (263), fonctionnant à une température comprise entre 1000°C et 1200°C, une région de préchauffage (264) agencée en amont de la région de chauffage (263), et dans laquelle l'acier laminé à froid est préchauffé par la chaleur de rayonnement produite par la région de chauffage (263), et une région de refroidissement (265) agencée en aval de la région de chauffage (263) et dans laquelle l'acier laminé à froid est refroidi à une température non supérieure à 80°C.

5. Procédé selon la revendication 1, **caractérisé en ce que** le dispositif dérouleur (211) englobe deux dérouleurs du type à mandrin en porte-à-faux.

6. Procédé selon la revendication 1, **caractérisé en ce que** le dispositif de soudage (212) englobe une première machine de soudage à l'arc pour souder une bande d'acier ayant une épaisseur supérieure à 1,5 mm, et une deuxième machine de soudage à l'arc pour souder une bande d'acier ayant une épaisseur inférieure à 1,5 mm.

7. Procédé selon la revendication 1, **caractérisé en ce que** l'installation de recuit et de décapage (26) englobe un dispositif de décapage (262) comportant un réservoir d'électrolyse (266) contenant une solution de sulfate de sodium pour éliminer la calamine à base d'oxyde de fer de l'acier laminé à froid, un réservoir de lavage à l'acide (267), contenant de l'acide nitrique et de l'acide fluorhydrique, pour éliminer la calamine à base d'oxyde de Fe-Cr-Ni de l'acier laminé à froid, et une région de lavage à l'eau (268) pour laver l'acier laminé à froid.

8. Procédé selon la revendication 1, **caractérisé en ce que** le dispositif de planage par étirage (29) englobe un dispositif de lavage et de séchage (292) pour laver et sécher l'acier laminé à froid après le planage.

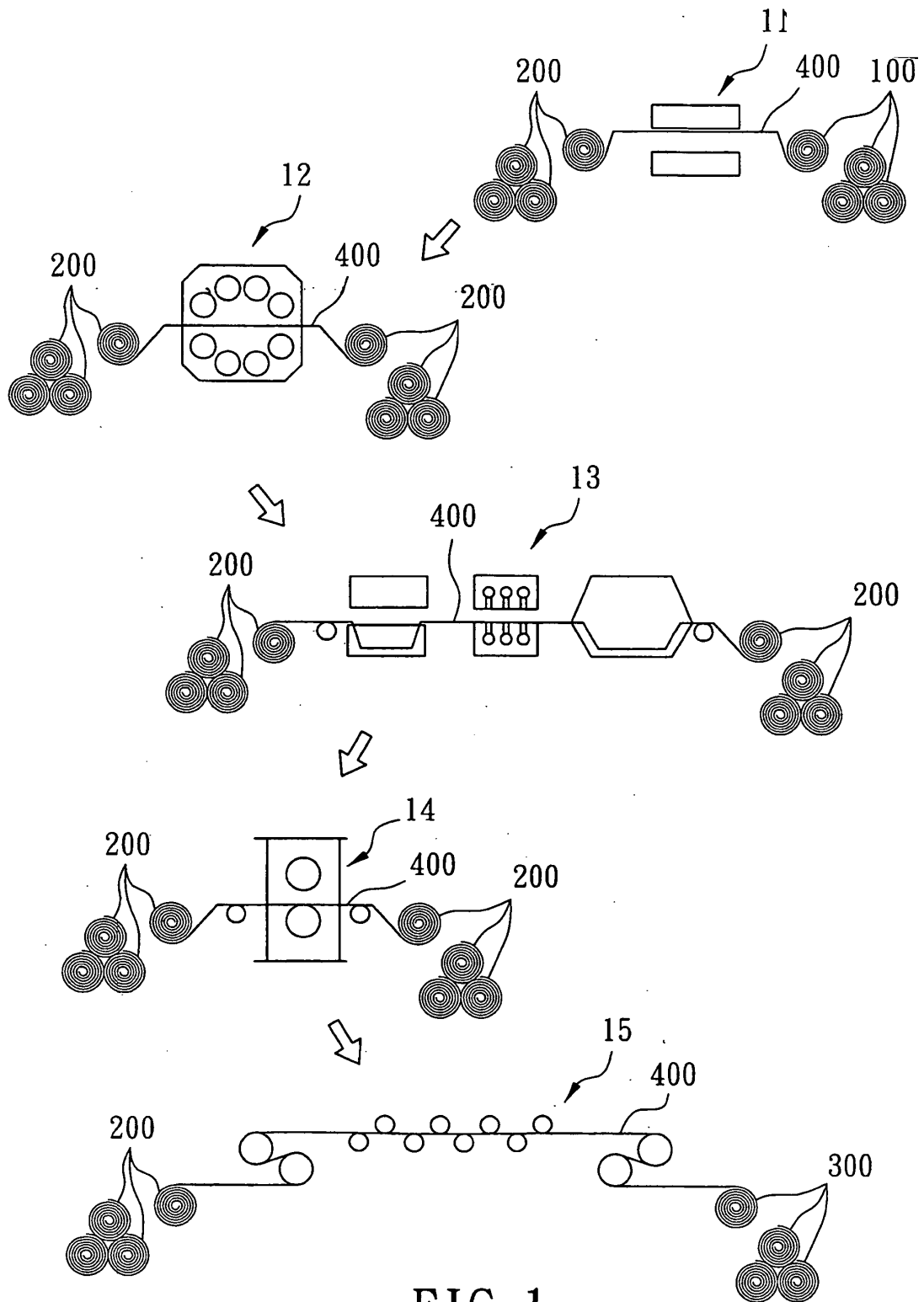


FIG. 1
PRIOR ART

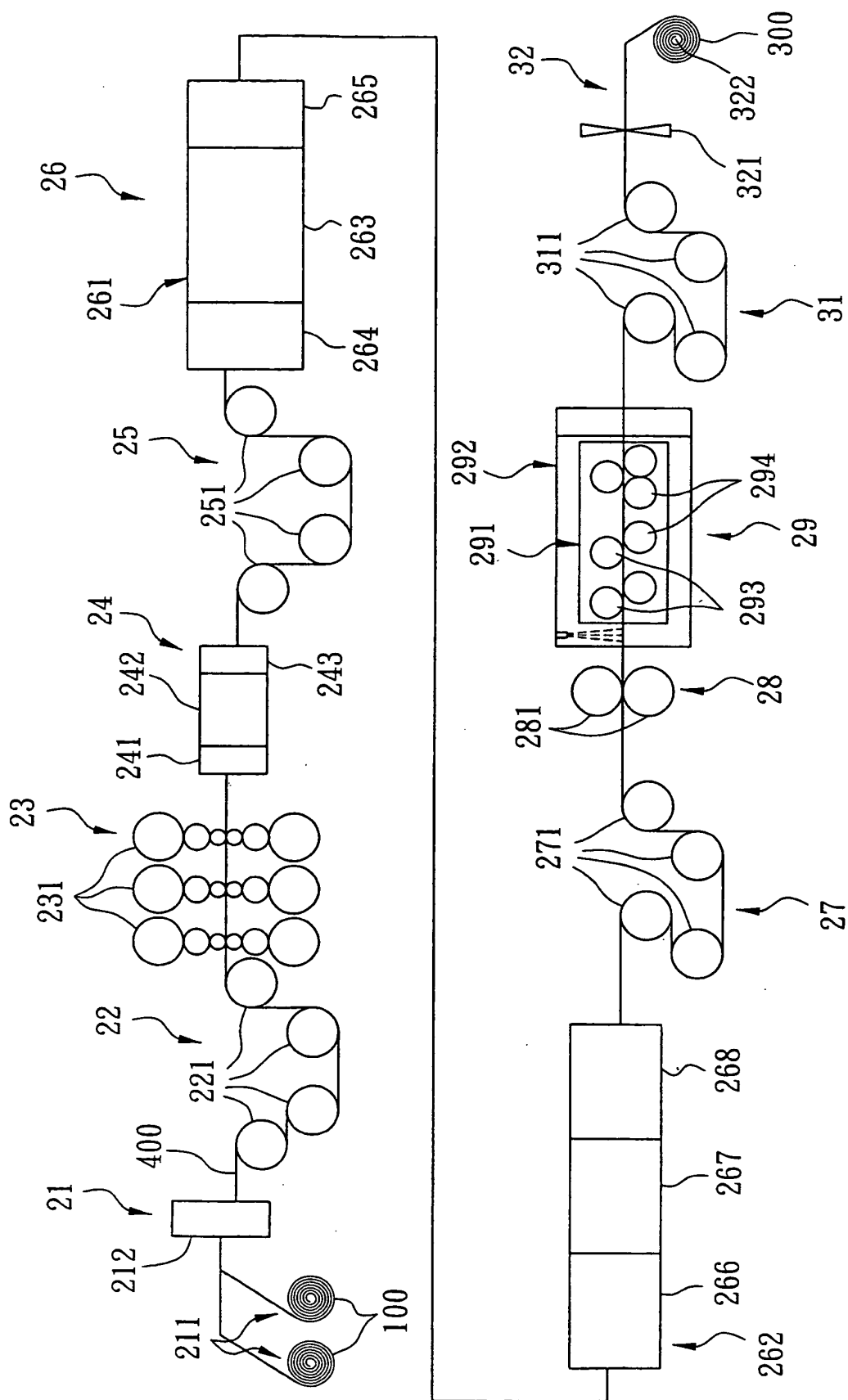


FIG. 2

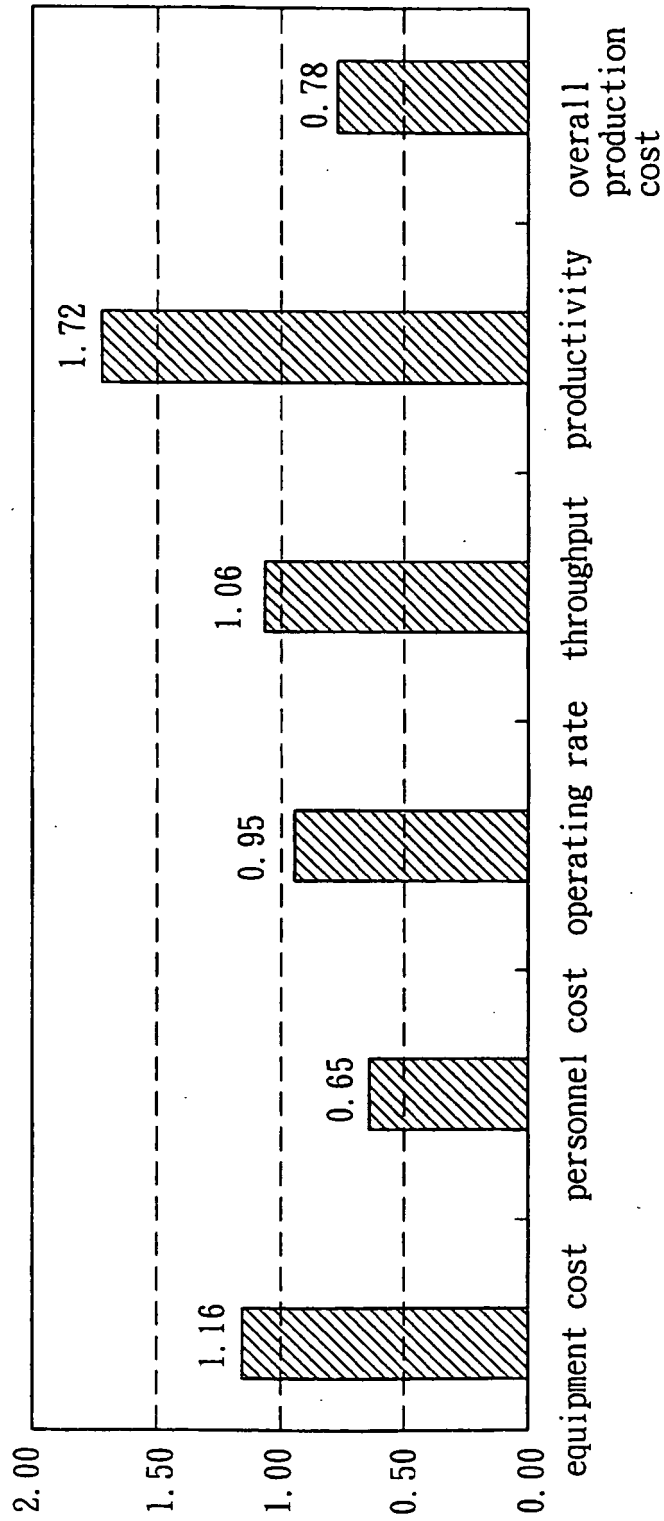


FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6478899 B [0011]
- US 6546771 B [0012]