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(54) Process of producing steel strips suitable for an oxidation-resisting surface coating

Verfahren zum Herstellen von Metallband geeignet zur oxydationsbeständigen Oberflächenbeschichtung

Procédé de fabrication de bande métallique désigné pour un revêtement résistant à l'oxydation

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- **MALINGRIAUX J P ET AL: "THE NEW CONTINUOUS COLD ROLLING AND ANNEALING LINE OF UGINE AT ISBERGUES (FRANCE)" CAHIERS D'INFORMATIONS TECHNIQUES DE LA REVUE DE METALLURGIE, REVUE DE METALLURGIE. PARIS, FR, vol. 97, no. 10, October 2000 (2000-10), pages 1177-1185, XP001124150 ISSN: 0035-1563**
- **PATENT ABSTRACTS OF JAPAN vol. 007, no. 215 (M-244), 22 September 1983 (1983-09-22) & JP 58 110104 A (KAWASAKI SEITETSU KK), 30 June 1983 (1983-06-30)**
- **PATENT ABSTRACTS OF JAPAN vol. 007, no. 147 (C-173), 28 June 1983 (1983-06-28) & JP 58 058232 A (SUMITOMO KINZOKU KOGYO KK), 6 April 1983 (1983-04-06)**

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Description

[0001] The present invention relates to a process for manufacturing steel strips adapted to receive a surface coating which is resisting to oxidation by using anti-oxidizing elements such as aluminum, chromium or nickel, copper, etc., and in particular tin for producing tin-plate. As it is known, for depositing the above-mentioned coating metals use is made of the electrolytic method or, whenever possible, heat treatment methods.

[0002] High productivity, large plants of this type are known for which considerably large areas and very burdensome investments are required, while a valid alternative thereto is provided by medium-productivity plants (about 200,000 tons/year), which are suitable for being combined with Mini-Mills type plants, and this is the technology which the present invention is directed to, rather than to the plants and relevant high production processes of known type, with the strips for obtaining the tin-plate generally produced starting from hot strips having a thickness of about 2 mm and subsequently brought to the final thickness through two distinct cold rolling steps, one first of which by means of big "High-Four" tandem-type rolling mills with 4-5 stands, either aligned with the pickling line, or off-line, as disclosed by patent GB-1-A 027495, still with the same type and number of stands. The second cold rolling step occurs after annealing with 2-3 stands of the "High-Four" type to bring the strip to the final thickness of 0.14-0.18 mm before tin coating. A plant of this type is schematically shown in fig. 1 and, as already stated, its main limit is the dimensional one, as it extends over very large areas, thus rendering the investment costs particularly high.

[0003] It is true that could be advantageous to use, as starting material for the production of tin-plate, hot strips such as those preferably obtained, even not exclusively, by means of in-line systems of the thin-slab type, such as the one described in the published international patent application No. WO-A 2004/026497, in the name of the present applicant. A diagram of such a system of endless rolling is represented in fig. 2, where it is possible to recognize, downstream of the casting zone, the continuous casting with liquid core reduction (a), a first roughing (b) directly at the exit of the continuous casting, an induction heating furnace (c), a finishing mill (e) and, after a compact rapid cooling (f), a coiling reel of the "carousel" type (g). With a plant of this type in fact it is obtained the production of ultrathin hot strips with thickness of 0.7-1 mm instead of 2 mm, thus rendering simpler and less burdensome the subsequent processing steps, especially the cold rolling required to obtain final thicknesses of 0.14-0.18 mm as required by the strips ready for a surface coating, so as to become e.g. tin-plate. However, if cold rolling stands of the "High-Four" type are adopted according to the prior art, the drawbacks relating to the demand of large areas and high investment costs, as above mentioned, would be only reduced but not overcome.

[0004] Object of the present invention is that of providing a medium-productivity process for ultrathin strips adapted to receive an oxidation-resisting surface coating that does not require to be carried out in plants extended over too large areas, and consequently involving high investments costs.

[0005] This object of the present invention is obtained with a production process the steps of which are listed in claim 1.

[0006] Further objects, advantageous and features of the process according to the invention will result more clearly from the following detailed description with reference to the annexed drawings in which:

Figure 1 schematically shows the portions of a high productivity plant and relevant processing steps for obtaining a steel strip ready to be surface coated, according to the prior art, as above discussed;

Figure 2 schematically shows a "thin-slab" plant for producing hot strips as starting material for the subsequent processes, particularly according to WO-A 2004/026497, as already described above; and

Figure 3 schematically shows a plant for carrying out the process according to the invention, downstream of a thin-slab plant of the type according to figure 2.

[0007] According to the present invention, as already mentioned above, the strips used as a substrate for the surface coating, preferably for producing tin-plate, are ultrathin hot strips of 0.7-1.0 mm thickness, obtained from a "thin-slab" plant, such as of the type schematically shown in figure 2.

[0008] With reference to fig. 3, the process according to the invention is illustrated in its processing steps downstream of the production of hot rolled strip having the desired thickness as above indicated; being obtained e.g. according to process and plant of figure 2. The strip, having a thickness of 0.7-1.0 mm, after pickling is fed to a cold rolling mill of the Sendzimir 6Zhi type, in particular with three stands as illustrated, which is very compact and consequently needs to occupy more reduced area, thus limiting the investment costs. With said cold rolling step the strip thickness is brought to the desired final value and thereafter the strip is subjected to either an endless or batch annealing and skin-pass with return to the same cold rolling mill.

[0009] It should be noted that, unlike as the High-Four type stands, the Sendzimir stands are more compact and allow more sensible reductions, as much smaller rolls are used to this effect, whereby the contact cross-section is reduced and the specific pressure, for the same value of applied force, is higher. On the contrary the prior art had used (while adopting the corresponding processes) plants in which, like in figure 1, the hot rolling mills are provided with a plurality of stands of the High-Four tandem-type. The reason of which resides in the technical prejudice suggesting that Sendzimir

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stands should not be used since, due to their reduced cross-section of contact, they would have enhanced the geometrical defects of the strip, instead of reducing the same, such as under the aspect of parallelism. Therefore it was preferred making use of the much larger cross-section area of contact provided by the working rolls of big diameter which are typical of the High-Four tandem-type stands which allow to correct the defects of the hot strip. This of course to detriment of the investment burden and of the area required for plant installation.

[0010] Such a technical prejudice will be fully removed when considering that the starting hot strips which are used according to the present invention and manufactured in thin-slab plants according to fig. 2, are characterized by an extremely regular geometric profile with convexities or crowns of less than 0.3% and thickness tolerances comparable with those, of reduced size, of the cold rolled products, as shown in the following table.

Thickness	Standard tolerance			Tolerance of the inventive strip	
	EN 10051 Hot Coils	EN 10031 Cold Coils		Tolerances for hot coils	Max. Crown
		Normal	Reduced		
≤1.50	+/- 0.17	+/- 0.11	+/- 0.08	+/-0.06	0.03
1.51 - 2.00	+/- 0.17	+/- 0.13	+/- 0.09	+/-0.07	0.04
2.01 - 2.50	+/- 0.18	+/- 0.15	+/- 0.11	+/-0.10	0.04
2.51 - 3.00	+/- 0.20	+/- 0.17	+/- 0.12	+/-0.11	0.05

[0011] Furthermore it is noted, still with reference to fig. 3, that with the process according to the invention, the Sendzimir 6Zhi rolling mill with three stands can be used, starting again from a hot rolled strip having thickness comprised between 0.7 and 1.0 mm to produce either directly the tin-plate strips of SR type upon simple reduction, after cold rolling up to 0.14-0.18 mm, annealing and skin-passing, or those of the DR type, half-raw or upon double reduction, preferably but not exclusively cold rolled until a thickness of 0.20-0.25 mm, annealed and thereafter reduced to a thickness ≤ 0.18 mm with reductions of about 30%.

Claims

1. A process for producing steel strips adapted to receive an oxidation resisting surface coating, in particular tin plating, **characterized by** comprising, starting from pickled hot strips having a thickness ≥ 0.7 mm, a single cold rolling step by passing through not more than three stands of the Sendzimir 6Zhi type for a cold reduction of the thickness to less than 0.25 mm, and a subsequent annealing step.
2. A process according to claim 1, **characterized by** the fact that, for producing simple reduction (SR) strips, the cold rolling of the Sendzimir 6Zhi type is carried out until a thickness ≤ 0.18 mm is reached and that said annealing step is followed by only skin-passing and finishing steps.
3. A process according to claim 1, **characterized by** the fact that, for producing half-raw strips of the double reduction (DR) type, said cold rolling step of the Sendzimir 6Zhi type is carried out initially until reaching thicknesses comprised between 0.20 and 0.25 mm and, upon annealing, through reductions of about 30%, to thickness value of less than 0.18 mm.
4. A process according to anyone of the preceding claims, wherein the starting hot strip is obtained through a thin-slab plant.

Patentansprüche

1. Verfahren zur Herstellung von Stahlband, das dazu eingerichtet ist, eine oxidationsbeständige Oberflächenbeschichtung, insbesondere Zinnplattierung zu erhalten, **dadurch gekennzeichnet, daß** es, ausgehend von entzündertem Warmband mit einer Dicke $\geq 0,7$ mm, einen einzigen Kaltwalzschritt umfaßt, bei dem das Band durch nicht mehr als drei Ständer des Typs Sendzimir 6Zhi hindurchläuft, zur Kaltreduktion der Dicke auf weniger als 0,25 mm, sowie

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einen nachfolgenden Schritt des Glühens.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, daß** zur Herstellung des einfach reduzierten Bandes (SR) das Sendzimir 6Zhi Kaltwalzen ausgeführt wird, bis eine Dicke $\leq 0,18$ mm erreicht ist, und daß auf den Schritt des Glühens nur Dressier- und Finish-Schritte folgen
3. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, daß** für die Herstellung von doppelt reduziertem Halbrohband (DR) der Sendzimir 6 Zhi Kaltwalzschritt am Anfang ausgeführt wird, bis eine Dicke zwischen 0,20 und 0,25 mm erreicht wird, und, nach dem Glühen, durch Reduktionen um etwa 30 %, auf Dickenwerte von weniger als 0,18 mm.
4. Verfahren nach einem der vorstehenden Ansprüche, bei dem das als Ausgangsmaterial dienende Warmband in einem Dünnbrammenwerk erhalten wird.

Revendications

1. Procédé pour produire des bandes d'acier adapté à recevoir une couche de surface résistante à l'oxydation, en particulier un plaquage d'étain, **caractérisé en ce qu'il** comprend, en partant de bandes chaudes décapées ayant une épaisseur supérieure ou égale à 0,7 mm, une seule étape de laminage à froid en passant à travers au plus trois cages de laminage du type Sendzimir 6Zhi pour une réduction à froid de l'épaisseur à moins de 0,25 mm, et une étape de recuit subséquente.
2. Procédé selon la revendication 1 **caractérisé par le fait que**, pour produire des tôles simple réduction (SR), le laminage à froid de type Sendzimir 6Zhi est effectué jusqu'à ce qu'une épaisseur inférieure ou égale à 0,18 mm soit atteinte et que ladite étape de recuit est suivie uniquement des étapes de dressage par laminage à froid et de finition.
3. Procédé selon la revendication 1, **caractérisé par le fait que**, pour produire des bandes à moitié brutes de type double réduction (DR), ladite étape de laminage à froid de type Sendzimir 6Zhi est effectuée initialement jusqu'à atteindre une épaisseur comprise entre 0,20 et 0,25 mm et, après recuit, par des réductions d'environ 30%, jusqu'à une valeur d'épaisseur de moins de 0,18 mm.
4. Procédé selon l'une quelconque des revendications précédentes, dans lequel la bande chaude de départ est obtenue par une fabrique de brames minces.

Fig.1

PRIOR ART

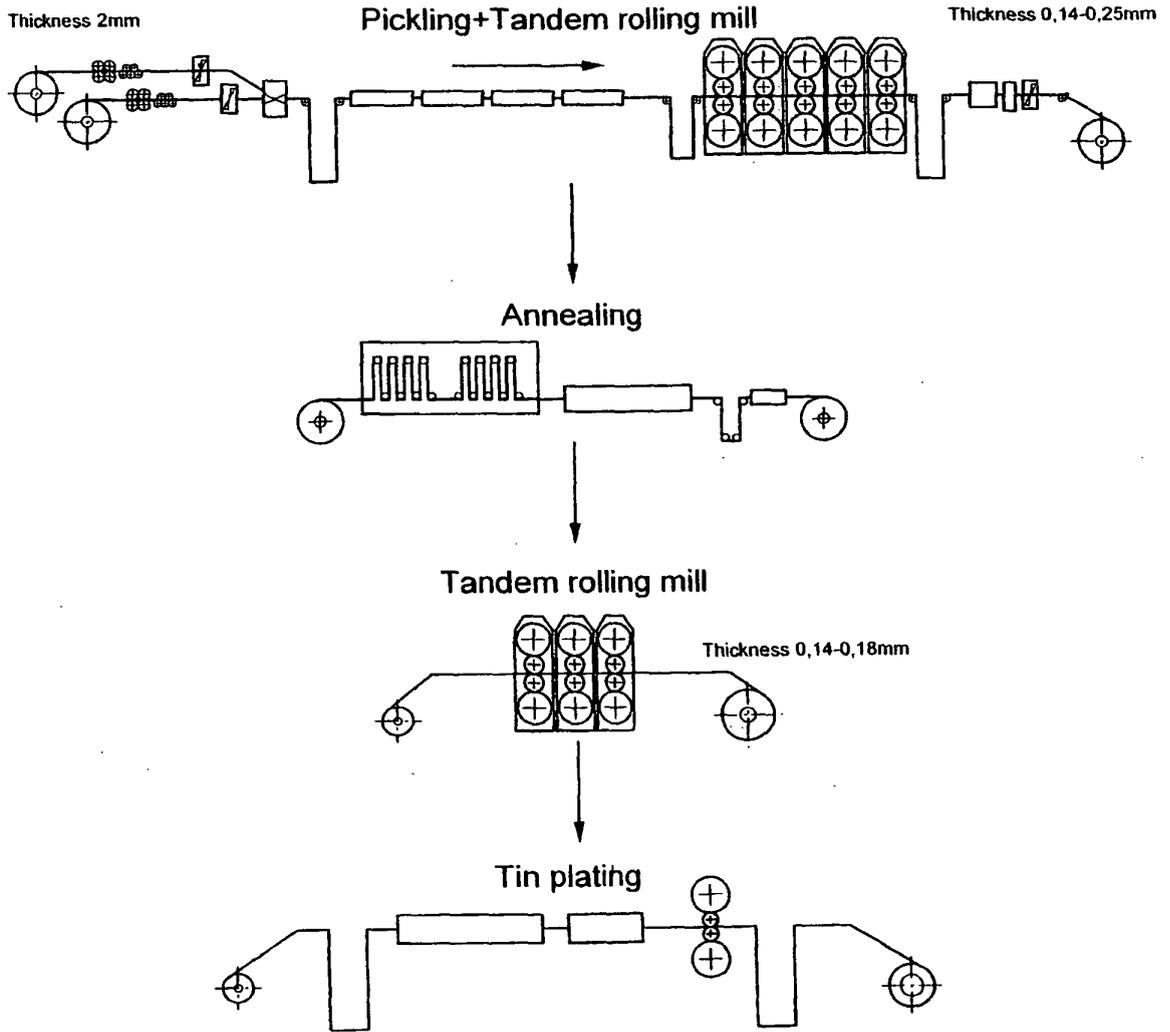


Fig.2

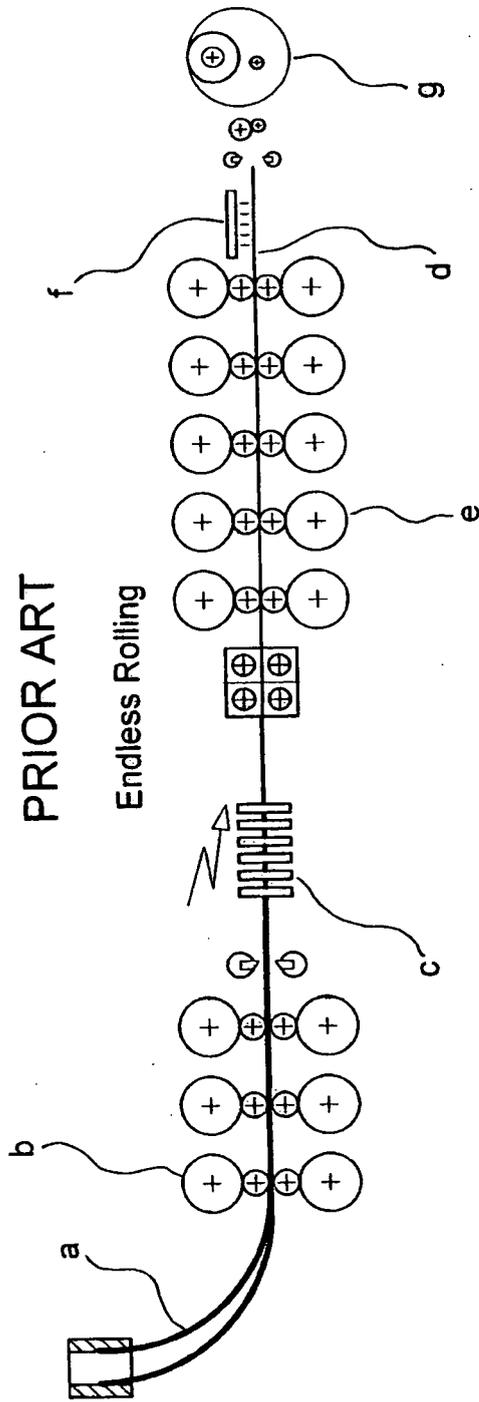


Fig.3

