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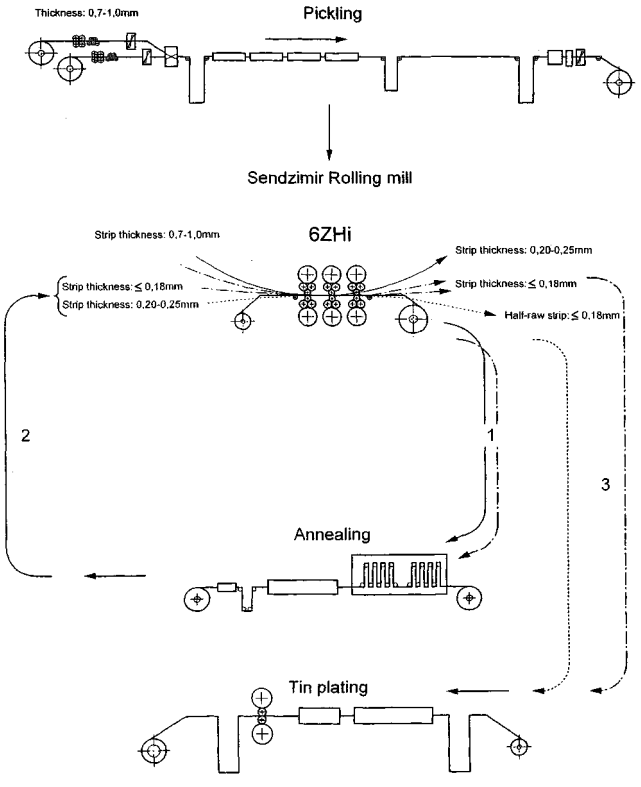
(54) Process of producing steel strips suitable for an oxidation-resisting surface coating

(57) A process is described for producing steel strips suitable for receiving a surface coating which is resisting to oxidation, in particular tin plating, of medium productivity, that does not require for its execution plants extended of a large areas or involving high economical investments. It comprises, starting from pickled hot strips having a thickness ≥ 0.7 mm, preferably obtained from thin-slab plants, a single cold rolling step by passing through not more than three stands of the Sendzimir 6Zhi type for the cold reduction of thickness to less than 0.25 mm and subsequent annealing. It is possible to obtain final thicknesses ≤ 0.18 mm both by simple reduction, which only provides subsequent skin-passing and finishing steps, and by double reduction on half-raw strip, which provides subsequent passes for thickness reduction of 30%.

Fig.3



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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 1,027,495, 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 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 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

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.

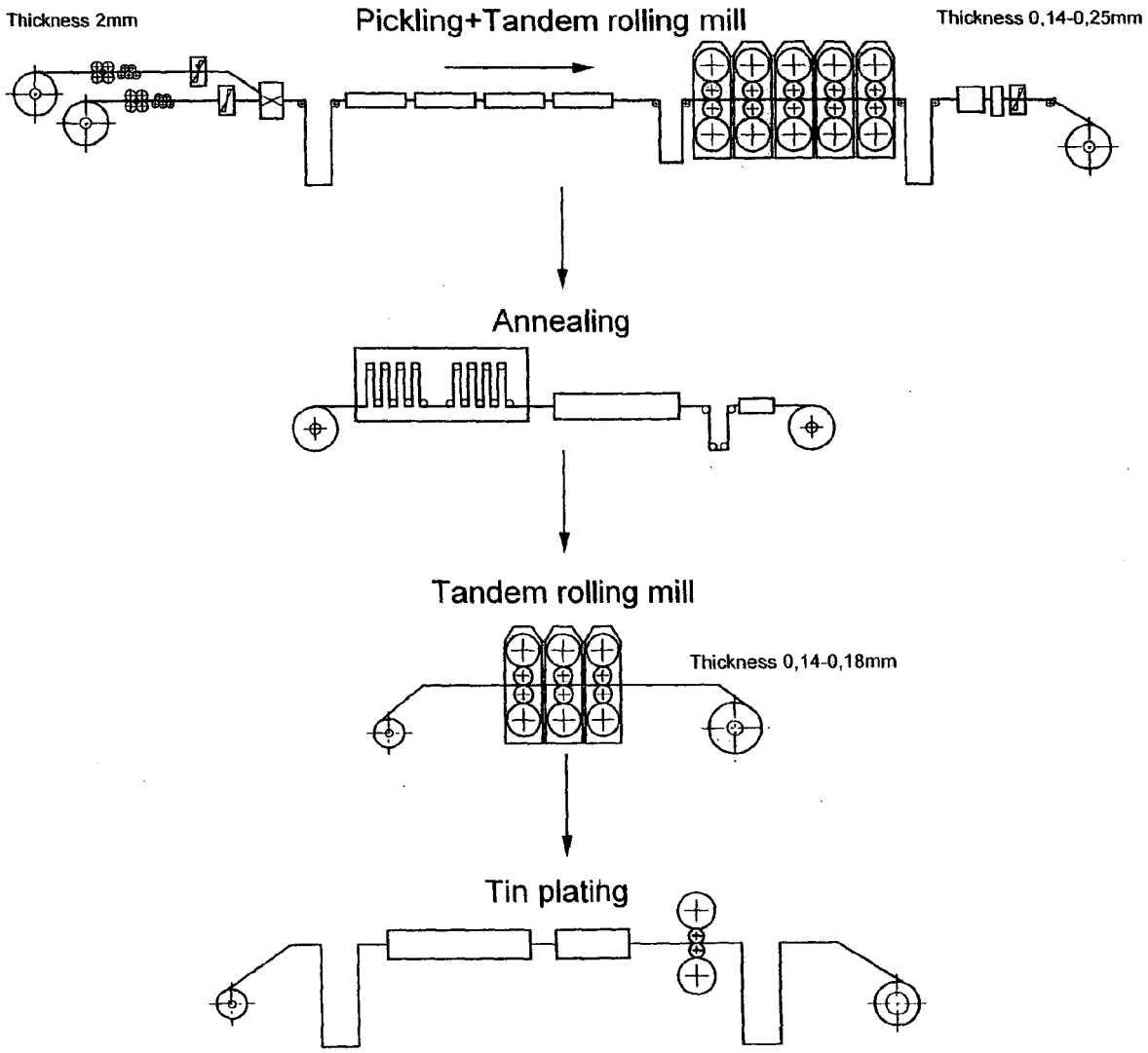
2. A process according to claim 1, **characterized by** the fact that, for producing SR (simple reduction) strips, the cold rolling of the Sendzimir 6Zhi type is carried out until a thickness ≤ 0.18 mm is reached and that said annealing step is followed by only skin-passing and finishing steps.

3. A process according to claim 1, **characterized by** the fact that, for producing half-raw strips of the DR (double reduction) 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.

Fig.1

PRIOR ART



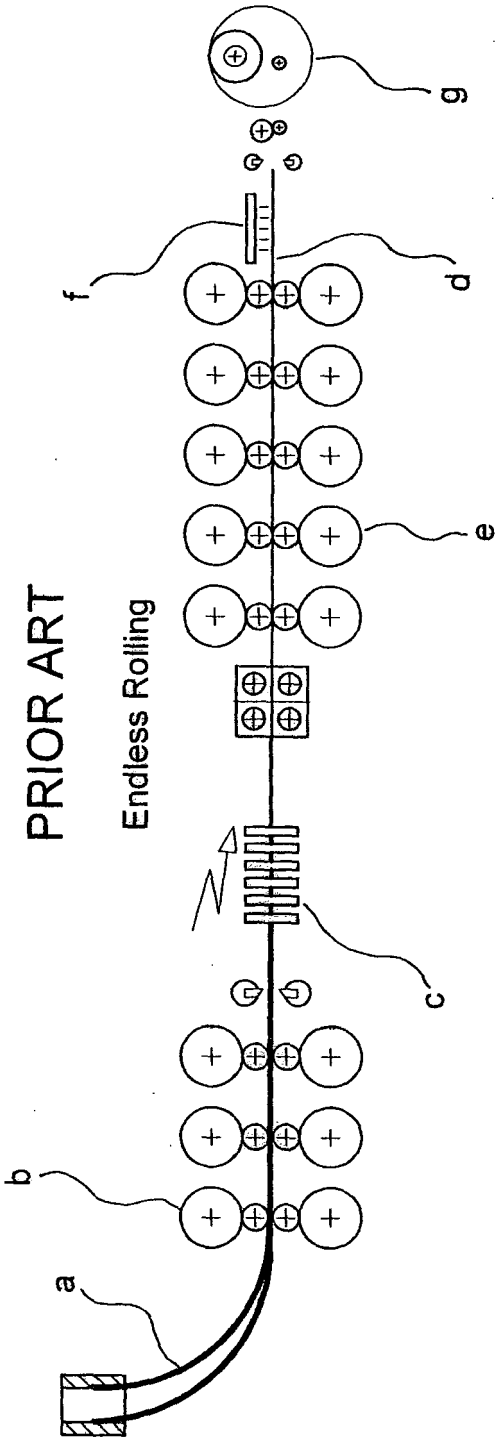
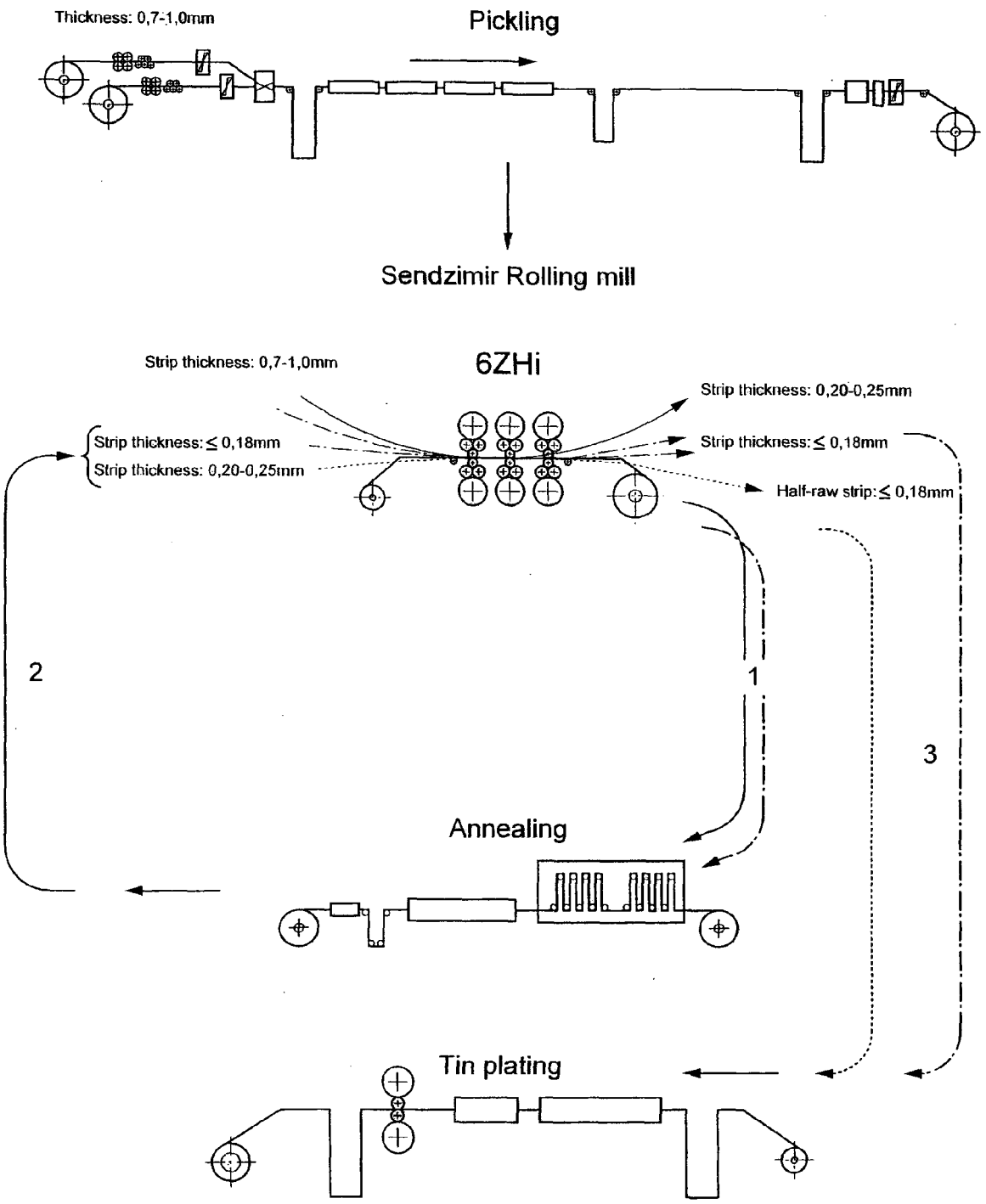


Fig.2
PRIOR ART
Endless Rolling

Fig.3


Thickness: 0,7-1,0mm
Pickling
Sendzimir Rolling mill
Strip thickness: 0,7-1,0mm
6ZHi
Strip thickness: 0,20-0,25mm
Strip thickness: ≤ 0,18mm
Strip thickness: ≤ 0,18mm
Strip thickness: 0,20-0,25mm
Half-raw strip: ≤ 0,18mm
2
1
3
Annealing
Tin plating

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 42 5880

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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A	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 * page 1177 - page 1179 *	1-4	
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A	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) * abstract *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 April 2005	Forciniti, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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12-04-2005

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82