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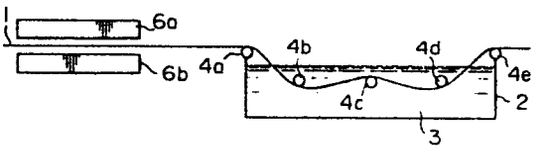
(54) Continuous picklung method and apparatus.

(57) The present invention is directed to a continuous pickling method for continuously pickling a material to be pickled, the method being characterised by heating the material up to a temperature higher than a boiling point of an acid liquid under atmospheric pressure, and then pickle the material; a continuous pickling method characterized in that in the pickling process, the acid liquid is jetted against the material, without immersing the material into the acid liquid; and a continuous pickling pretreating apparatus, used in the above mentioned continuous pickling methods, which comprises a tank for receiving herein hot water having a temperature higher than its boiling point under atmospheric pressure, a heating device for heating the hot water, and seal rolls disposed at an outlet and an inlet of the tank and the material.

FIG. 1



EP 0 225 273 A1

SPECIFICATION

1. TITLE OF THE INVENTION

Continuous Pickling Method and Apparatus

2. BACKGROUND OF THE INVENTION

(i) Field of the Invention

The present invention relates to a continuous pickling method and apparatus for metallic materials, especially steel plates.

(ii) Description of the Prior Art

One embodiment of a conventional continuous pickling apparatus is shown in Fig. 10. In this drawing, reference numeral 101 is a steel strip, numeral 102 is an acid tank, 103 is an acid liquid, and 104a, 104b, 104c, 104d and 104e are guide rolls.

The steel strip 101 having ordinary temperature is unwound from a payoff reel not shown, and is then caused to run through the acid liquid 103 in the acid tank 102, while a scale formed on the surfaces of the steel strip 4 is pickled out with the acid liquid 103. Afterward, the scale-free steel strip 101 is taken out from the acid tank 102 and is then fed to a subsequent process not shown.

In the continuous pickling apparatus, it is necessary that the steel strip surfaces are in contact with the acid

liquid for a certain period of time, and for the sake of this requirement, when the running speed of the steel strip therethrough is high, the elongated acid tank is correspondingly needful.

In recent years, however, it is strongly desired to shorten the acid tank from the viewpoints of equipment cost, installation space and the like. As means for shortening this acid tank, there are a manner of causing the steel strip to pass through a mechanical scale breaker prior to immersing it into the acid tank, in order to form fine cracks in the scale on the surfaces of the steel strip and to thereby accelerate the removal of the scale, and a manner of jetting the acid liquid against the steel strip in the acid tank so as to shorten a reaction time, and these manners can obtain expected results. Nevertheless, with regard to the acid tank, a length of no less than 50 to 100 m is required, and in the case of such a long acid tank, the high equipment cost and the extensive installation space are necessary. For this reason, it is strongly needed to shorten the acid tank.

3. OBJECT AND SUMMARY OF THE INVENTION

An object of the present invention is to provide a continuous pickling method and apparatus by which a period of time necessary for a pickling operation is curtailed, so

that a used acid tank is shortened.

In the present invention, a first means for achieving the above object is to heat a material to be pickled up to a high temperature. That is, the present invention is directed to a continuous pickling method for continuously pickling a material to be pickled, the method being characterized by heating the material up to a temperature higher than a boiling point of an acid liquid under atmospheric pressure and then pickling the material.

Now, the present invention will be described in detail. In the present invention, a heating device for heating a steel strip which is a material to be pickled is provided above an acid tank, and in the heating device, the steel strip is then heated up to a temperature higher than a boiling point of an acid liquid under atmospheric pressure. Afterward, the steel strip is introduced into the acid tank in order to be subjected to a pickling treatment.

According to the present invention, at the moment when the steel strip is immersed into the acid liquid, the steel strip having a temperature higher than the boiling point of the acid liquid is brought into contact with the acid liquid having a temperature lower than the boiling point. At this time, the acid liquid penetrates into fine cracks in a scale on the surfaces of the steel strip, and it boils to generate vapor. As a result, a gas is expanded abruptly, so that

pieces of the scale are peeled off and new cracks occurs. In this way, the pickling time is curtailed.

Further, a second means for achieving the above object is to jet an acid liquid against a previously highly heated material to be pickled. That is, the present invention is directed to a continuous pickling method for continuously pickling a material to be pickled, the method being characterized by heating the material up to a temperature higher than a boiling point of an acid liquid under atmospheric pressure, and then jetting the acid liquid againt the material in an acid tank in order to pickle the material, without immersing the material into the acid liquid.

Now, the present invention will be described in detail. In the present invention, a heating device for heating the steel strip is provided above the acid tank, and the steel strip is heated up to a temperature higher than the boiling point of the acid liquid under atmospheric pressure by the heating device. Afterward, the the steel strip is introduced into the acid tank, and the the acid liquid is jetted against the steel strip material to pickle the latter, without immersing the steel strip material into the acid liquid.

According to the present invention, at the moment when the acid liquid is jetted against the steel strip, the steel strip having a temperature higher than the boiling point of

the acid liquid is brought into contact with the acid liquid having a temperature lower than the boiling point. At this time, the acid liquid penetrates into fine cracks in a scale on the surfaces of the steel strip, and it boils to generate vapor. As a result, a gas is expanded abruptly, so that pieces of the scale are peeled off and new cracks occurs. In addition, the jetted acid liquid washes out the pieces of the scale, or the reacted acid liquid is replaced with the new acid liquid to accelerate the reaction, whereby the time necessary for the pickling treatment is curtailed.

As compared with a conventional jet manner in the acid liquid, the jet method of the present invention has a greater jet effect because of the vigor of the jet being maintained, and an advantage of decreasing a necessary amount of the acid liquid owing to immersing no steel strip into the acid liquid.

Moreover, the present invention provides an apparatus for practicing the above mentioned method.

That is, the present invention is directed to a pretreating apparatus for continuous pickling which comprises a tank for receiving herein hot water having a temperature higher than its boiling point under atmospheric pressure, a heating device for heating the hot water, and seal rolls disposed at an outlet and an inlet of the tank and a material to be pickled.

This apparatus can practice the above mentioned method effectively.

The object, characteristics and benefits of the present invention will be more clarified by the undermentioned description in reference to the accompanying drawings.

4. BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1 to 4 show schematic sectional view of embodiments of an apparatus suitable for a pickling method with regard to the present invention, and of these drawings, Fig. 1 shows the apparatus in which a heating device is provided above an acid tank, Fig. 2 shows the apparatus in which a heating water tank is provided as a heating device, Fig. 3 shows the same apparatus as in Fig. 1 with the exception that a high pressure is retained in the acid tank, and Fig. 4 shows the apparatus in which the heating water tank is used and the high pressure is retained in the acid tank;

Fig. 5 shows a relation between a temperature of a steel plate and a ratio of a pickling time;

Figs. 6 to 9 show schematic sectional view of other embodiments of the apparatus suitable for the pickling method with regard to the present invention, and of these drawings, Fig. 6 shows the apparatus in which the heating device is provided above the acid tank, Fig. 7 shows the apparatus in which the heating water tank is provided as the heating

device, Fig. 8 shows the apparatus having the acid tank portion in which shield plates are disposed confronting the upper and the lower surfaces of the steel strip, and Fig. 9 shows the apparatus having acid tank portions of box shield structures which are constituted so as to surround the steel strip; and

Fig. 10 is a schematic sectional view of a conventional pickling apparatus.

5. DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the first place, embodiments of the present invention for practicing the above mentioned first menas are shown in Figs. 1, 2, 3 and 4. In the embodiment in Fig. 1, a heating device is provided above an acid tank, and reference numeral 1 is a steel strip, numeral 2 is an acid tank, 3 is an acid liquid, 4a, 4b, 4c, 4d and 4e are guide rolls, and 6a and 6b are electric type, hot air type or other type heating devices. The steel strip 1 is heated up to a temperature higher than a boiling point of the acid liquid at atmospheric pressure by the heating devices 6a, 6b, and it is then immersed into the acid liquid 3 in the acid tank 2 to pickle the steel strip 1.

Fig. 2 exhibits the other embodiment in which a heating water tank 7 is equipped as the heating device. The heating water tank 7 in Fig. 2 is of a sealing type, and pairs of

seal rolls 9a, 9b and 9c, 9d are disposed at an outlet and an inlet, respectively, of the steel strip 1 in the heating water tank 7, whereby an opening space between the interior of the heating water tank 7 and the outside is minimized, and the steel strip 1 is allowed to run continuously through the heating tank 7, while a high pressure is retained in the tank 7. A pressurizing water 8 having a high temperature is placed in the heating water tank 7. Numerals 10a, 10b and 10c are guide rolls.

Incidentally, the pressurizing water 8 is heated by, for example, a disposed heating device 41 so as to provide the water 8 with a high temperature.

Fig. 3 shows the other embodiment. In this embodiment, the heating devices 6a and 6b are disposed in front of the acid tank as in the case of Fig. 1, but the acid tank 12 is pressurer-sealed by the seal rolls 5a, 5b and 5c, 5d in order to maintain the interior of the acid tank 12 at a high pressure and to maintain the acid liquid 3 at a temperature higher than its boiling point at atmospheric pressure. In this embodiment, the steel strip at the outlet of the heating device 6a, 6b has a higher temperature than the acid liquid 3. In Fig. 3, 14a, 14b and 14c are guide rolls.

Fig. 4 is the further other embodiment of the present invention. The apparatus in Fig. 4 is equipped with the same acid tank 12 as in Fig. 3, but the same heating water

tank 7 as in Fig. 2 is provided as the heating device above the acid tank. That is, numeral 8 is a pressurizing water having a high temperature, 9a, 9b, 9c and 9d are seal rolls, and 10a, 10b and 10c are guide rolls.

According to the pickling means of each embodiment just described, the steel strip is first heated up to a temperature higher than the boiling point of the acid liquid at atmospheric pressure and is then immersed into the acid liquid. Therefore, at the moment when the steel strip is immersed into the acid liquid, the latter penetrates into fine cracks in a scale on the surfaces of the steel strip, and it boils to generage vapor, which fact leads to the abrupt expansion of a gas. As a result, pieces of the scale are peeled off and new cracks occur, so that a time necessary for the pickling operation is curtailed. According to experiments made by the inventors of the present application, the higher the temperature of the steel plate is, the shorter the time necessary for the pickling operation is, as shown in Fig. 5. For example, when the pickling time necessary for the steel plate of 80°C is regarded as 100%, the pickling time for the steel plate of 200°C is 50% or less. In the case that a temperature of the acid liquid in the acid tank is higher than the boiling point thereof at atmospheric pressure, the similar effect can be obtained by heating the steel plate up to a level higher than the

liquid temperature.

Embodiments of the present invention which can practice the above mentioned second means are shown in Figs. 6 and 7. In the embodiment in Fig. 6, a heating device is provided above an acid tank, and reference numeral 1 is a steel strip, numeral 22 is an acid tank, 3 is an acid liquid, 24a, 24b, 24c and 24d are guide rolls. Numerals 6a and 6b are electric type, hot air type or other type heating devices, as shown in Fig. 3. The steel strip 1 is heated up to a temperature higher than a boiling point of the acid liquid at atmospheric pressure by the heating devices 6a, 6b, and is then introduced into the acid tank 22. Afterward, the steel strip 1 is subjected to a pickling treatment by jetting the acid liquid, fed by a pump not shown, against both the surfaces of the steel strip 1 through nozzles 11a, 11b, 11c, ... and 11ℓ, while supported by the guide rolls 24a, 24b, 24c and 24d, without being immersed into the acid liquid 3.

Fig. 7 shows the other embodiment of the present invention, and in this embodiment, the same heating water tank 7 as in Fig. 4 is equipped.

Figs. 8 and 9 show other embodiments of an acid tank portion regarding the present invention. The embodiment in Fig. 8 has shield plates 12a, 12b, 12c, ... and 12ℓ which closely confront the upper and lower surfaces of the steel

strip 1 so as to define a flow path for the acid liquid between these shield plates and the steel strip 1. In this construction, the acid liquid jetted through nozzles 11a, 11b, 11c, ... and 11ℓ flows through the aforesaid flow path, so that a contact time between the acid liquid and the steel strip 1 is prolonged, and a velocity of the acid liquid along the steel strip 1 is kept up, thereby assuring an effective pickling reaction.

The embodiment in Fig. 9 has box shields 13a, 13b, ... which are shaped so as to surround the steel strip 1, and in this case, a flow path is defined between the box shields and the steel strip 1. As compared with the embodiment in Fig. 8, the acid liquid does not flow out in a cross direction of the steel strip, so that an effect of the acid liquid increases additionally.

In the present invention, the material to be pickled, after heated up to a high temperature, is pickled, as described in detail above. Therefore, at the moment when the steel strip is immersed into the acid liquid, the latter penetrates into fine cracks in a scale on the surface of the steel strip, and it boils to generage vapor, which fact leads to the abrupt expansion of a gas. As a result, pieces of the scale are peeled off and new cracks occur, so that a time necessary for the pickling operation can be curtailed. Further, in consequence, the acid tank can be shortened.

This is an effect of the present invention.

In addition, according to the present invention, the steel strip is heated as described above, and the acid liquid is then jetted against the heated steel strip, instead of being immersed into the acid liquid. Therefore, at the moment when the acid liquid is jetted against the steel strip, the acid liquid penetrates into fine cracks in a scale on the surface of the steel strip, and it boils to generage vapor, which fact leads to the abrupt expansion of a gas. As a result, pieces of the scale are peeled off and new cracks occur, and the jet of the acid liquid washes out the peices of the scale, so that a time necessary for the pickling operation is curtailed. According to experiments made by the present inventors, the time necessary for the pickling treatment in the present invention is about 1/3 of that of the conventional pickling treatment in which neither heating nor jetting are carried out.

Furthermore, according to the pickling pretreating apparatus, the material to be pickled, for example, the steel strip can be heated up to the temperature higher than the boiling point of the acid liquid at atmospheric pressure. Therefore, the method of the present invention can surely be practiced as described above, thereby curtailing the pickling time and shortening the acid tank.

WHAT IS CLAIMED IS:

1. A continuous pickling method for continuously pickling a material to be pickled, said method being characterized by heating said material up to a temperature higher than a boiling point of an acid liquid under atmospheric pressure, and then pickling said material.

2. A continuous pickling method according to Claim 1 wherein said heating treatment prior to pickling is carried out by means of an electric type or a hot air type heating device, or a heating water tank.

3. A continuous pickling method for continuously pickling a material to be pickled, said method being characterized by heating said material up to a temperature higher than a boiling point of an acid liquid under atmospheric pressure, and then jetting said acid liquid against said material to thereby pickle said matrial, without immersing said material into said acid liquid.

4. A continuous pickling method according to Claim 3 wherein said heating treatment prior to pickling is carried out by means of an electric type or a hot air type heating device, or a heating water tank.

5. A continuous pickling method according to Claim 3 wherein in jetting said acid liquid against said material to be pickled, shield plates are disposed closely near the upper and lower surfaces of said material.

6. A continuous pickling method according to Claim 3 wherein in jetting said acid liquid against said material to be pickled, said material is surrounded by a box shield.

7. A continuous pickling pretreating apparatus, used in the above mentioned continuous pickling method, which comprises a tank for receiving herein hot water having a temperature higher than its boiling point under atmospheric pressure, a heating device for heating said hot water, and seal rolls disposed at an outlet and an inlet of said tank and a material to be pickled.

FIG. 1

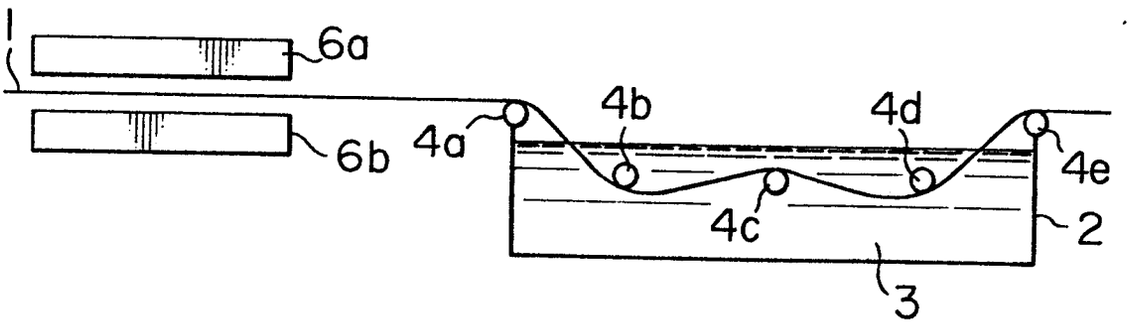

1
6a
6b
4a
4b
4c
4d
4e
2
3

FIG. 2

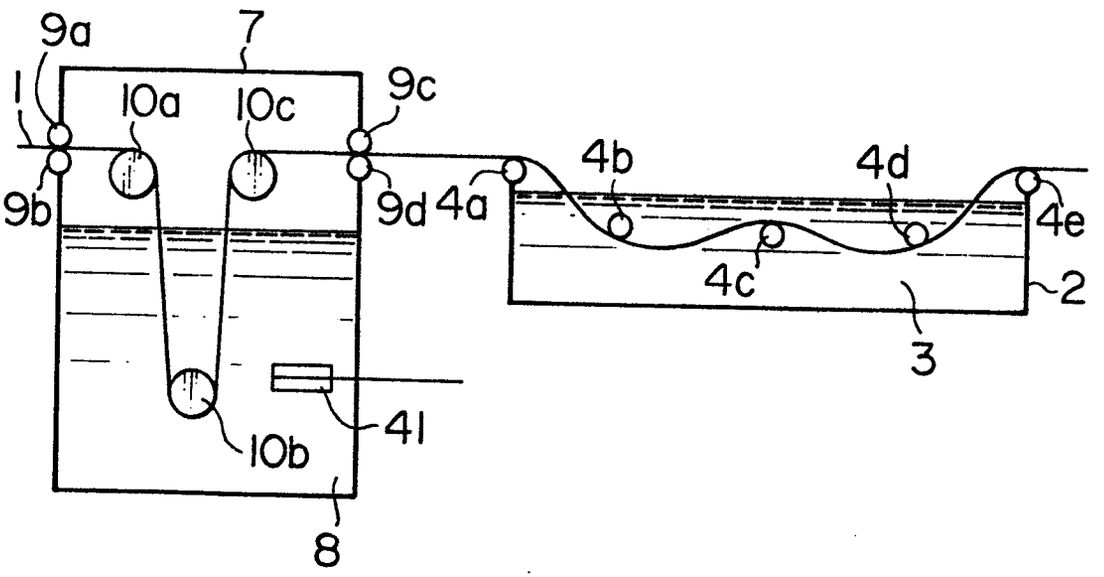

9a
7
1
10a
10c
9c
9b
9d
4a
4b
4d
4e
4c
2
3
41
10b
8

FIG. 3

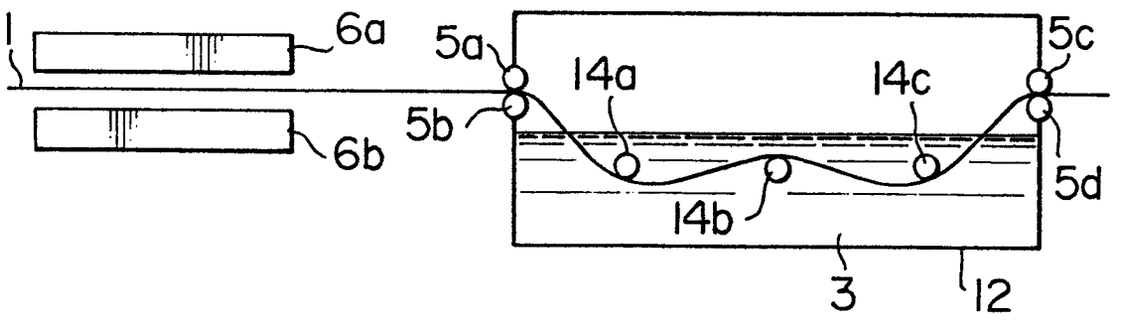

1
6a
6b
5a
5b
14a
14c
14b
5c
5d
3
12

FIG. 4

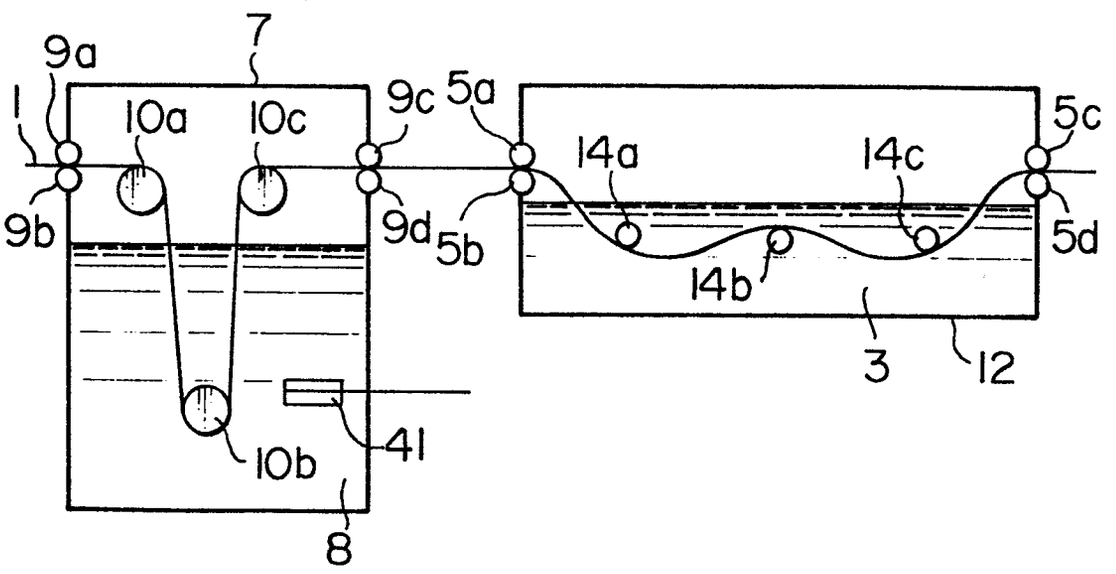

9a
7
1
10a
10c
9c
5a
5c
14a
14c
9b
9d
5b
5d
14b
3
12
10b
41
8

FIG. 5

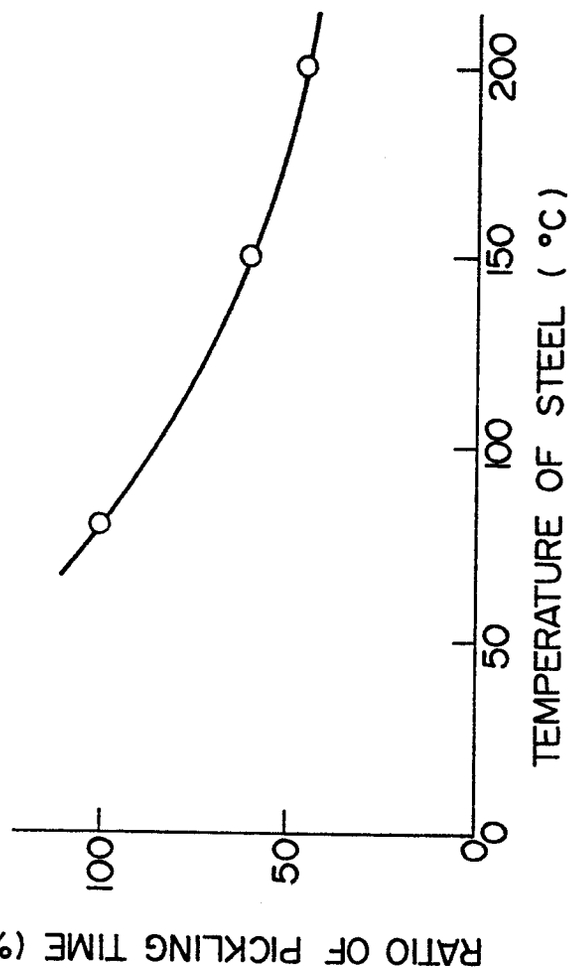
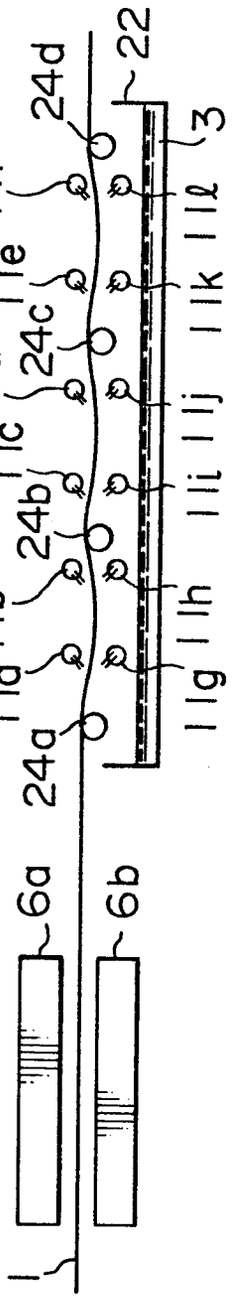

RATIO OF PICKLING TIME (%)
100
50
0
0
50
100
150
200
TEMPERATURE OF STEEL (°C)

FIG. 6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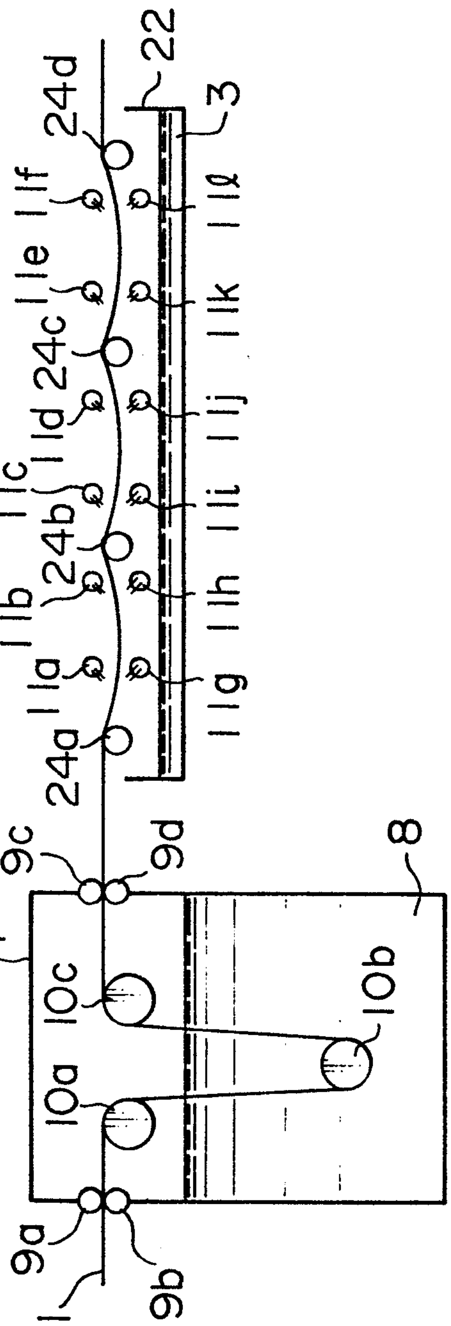
24d
3
11f
11e
24c
11d
11c
24b
11b
11a
24a
11g
11h
11i
11j
11k
11ℓ
6a
6b
1

FIG. 7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9c
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7
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10a
10b
10c
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24b
24c
24d
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11b
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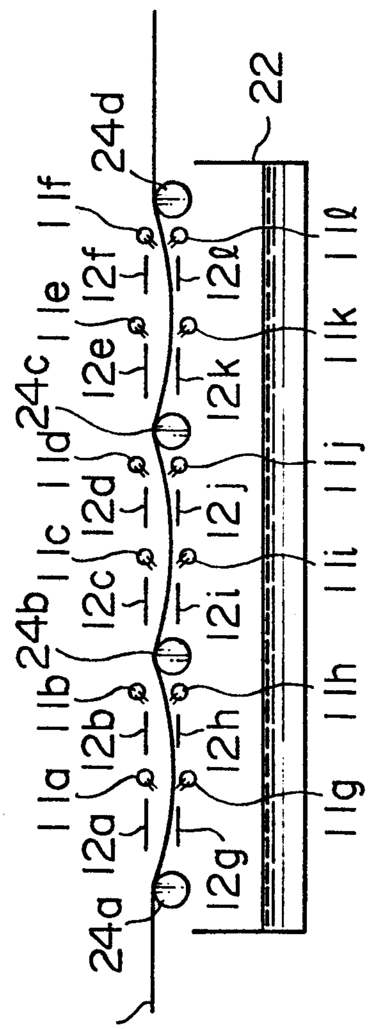
11d
11e
11f
11g
11h
11i
11j
11k
11ℓ
22
3

FIG. 8


1
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24b
24c
24d
11a
11b
11c
11d
11e
11f
12a
12b
12c
12d
12e
12f
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11g
11h
11i
11j
11k
11ℓ
22

FIG. 9

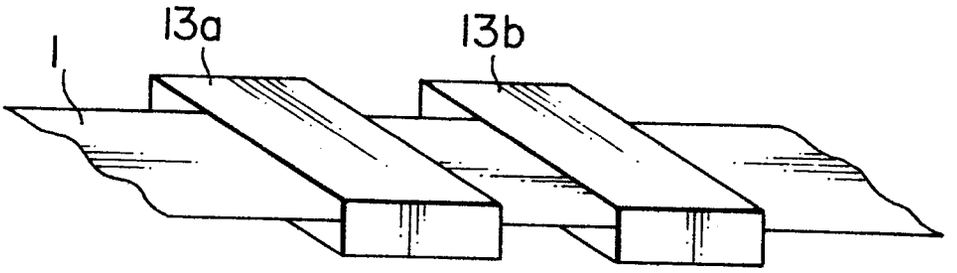
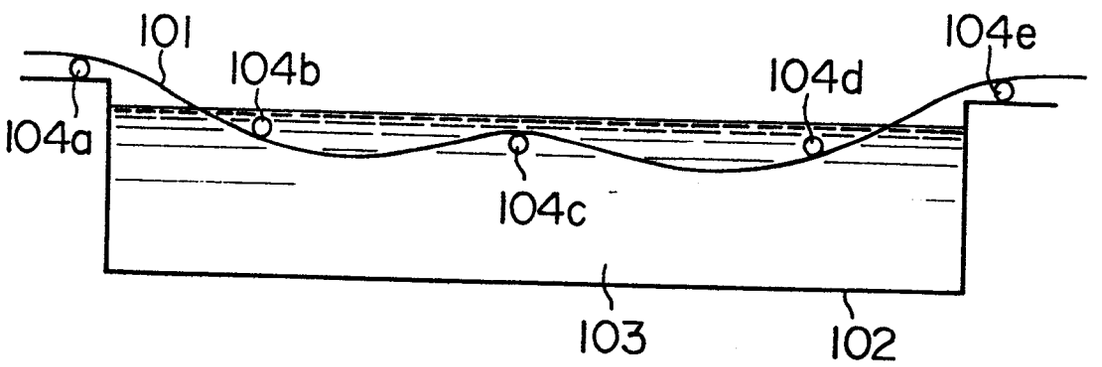


FIG. 10



European Patent Office

EUROPEAN SEARCH REPORT

0225273

Application number

DOCUMENTS CONSIDERED TO BE RELEVANT

EP 86730180.6

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	AT - B - 294 523 (MITSUBISHI JUKOGYO KABUSHIKI KAISHA) * Fig.; claims * --	1-4	C 23 G 3/02 C 23 G 1/02
A	US - A - 3 439 907 (J.R.GUINGAND) * fig. 1; claims * ----	1-7	

TECHNICAL FIELDS SEARCHED (Int Cl.4)

C 23 G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	05-03-1987	SLAMA

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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