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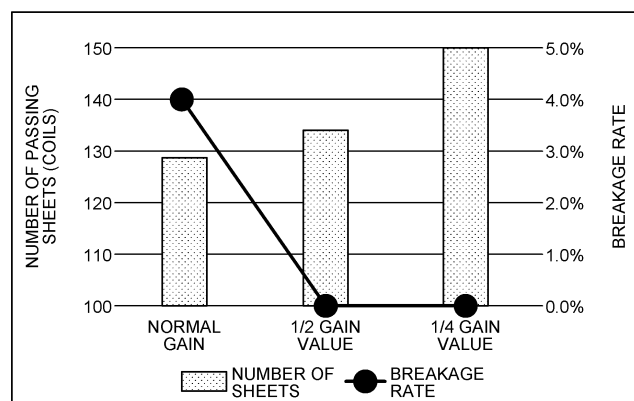
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(54) **SHAPE CONTROL METHOD FOR ROLLING MACHINE AND SHAPE CONTROL DEVICE**

(57) A method for shape control in a rolling mill according to the present invention includes: a measurement step of measuring a shape of a steel sheet on a delivery side of the rolling mill; and a control step of controlling the rolling mill in a manner that the shape of the steel sheet falls within an allowable range, based on the shape of the steel sheet measured at the measurement step,

wherein the control step includes a step of setting a control gain smaller than a control gain for a width of a steel sheet as a target for rolling being equal to or smaller than the predetermined value when the steel sheet as the target for rolling has a width greater than a predetermined value.

FIG.3



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Description

Field

[0001] The present invention relates to a method for shape control in a rolling mill and a device for shape control in the rolling mill.

Background

[0002] In rolling mills such as continuous cold rolling mills, a method is employed in which the shape of a steel sheet is measured after rolling, and then the result of the measurement is fed back to a rolling mill to control the shape of the steel sheet to within an allowable range. Furthermore, another method is employed in which a sheet thickness gauge or both a sheet thickness gauge and a sheet passing speedometer are provided in each of rolling stands to perform roll gap control or roll speed control in each of the rolling stands (see Patent Literature 1).

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Patent Application Laid-open No. 2012-110939

Summary

Technical Problem

[0004] However, the above-described methods are for controlling the thickness of a steel sheet to within an allowable range, and therefore effective in reducing sheet thickness defects, but are not effective in preventing sheet breakage. Especially, there has been the problem that, when a steel sheet has a width of 1200 mm or wider, such wide steel sheet is prone to cause breakage more easily due to a shape defect.

[0005] The present invention is proposed in view of the above-described problem, and an object of the present invention is to provide a method for shape control in a rolling mill and a device for shape control in the rolling mill, the method and the device being capable of substantially preventing the breakage of even a wide steel sheet without increasing the cost of, for example, equipment modifications.

Solution to Problem

[0006] A method for shape control in a rolling mill according to the present invention includes: a measurement step of measuring a shape of a steel sheet on a delivery side of the rolling mill; and a control step of controlling the rolling mill in a manner that the shape of the steel sheet falls within an allowable range, based on the shape

of the steel sheet measured at the measurement step, wherein the control step includes a step of setting a control gain smaller than a control gain for a width of a steel sheet as a target for rolling being equal to or smaller than the predetermined value when the steel sheet as the target for rolling has a width greater than a predetermined value.

[0007] A device for shape control in a rolling mill according to the present invention includes: a measurement unit configured to measure a shape of a steel sheet on a delivery side of the rolling mill; and a control unit configured to control the rolling mill in a manner that the shape of the steel sheet falls within an allowable range, based on the shape of the steel sheet measured by the measurement unit, wherein the control unit sets a control gain smaller than a control gain for a width of a steel sheet as a target for rolling being equal to or smaller than the predetermined value when the steel sheet as the target for rolling has a width greater than a predetermined value.

Advantageous Effects of Invention

[0008] A method for shape control in a rolling mill and a device for shape control in the rolling mill according to the present invention can prevent the breakage of even a wide steel sheet without increasing the cost of, for example, equipment modifications.

Brief Description of Drawings

[0009]

FIGS. 1(a) and 1(b) are a diagram illustrating a target shape and an actual shape of a steel sheet having a sheet width of 1200 mm or smaller and a diagram illustrating a target shape and an actual shape of a steel sheet having a sheet width greater than 1200 mm, respectively.

FIG. 2 is a schematic diagram of a configuration of a continuous cold rolling mill in Examples.

FIG. 3 is a diagram illustrating the breakage rates of Conventional Example and Invention Examples.

Description of Embodiments

[Concept]

[0010] First, the concepts of a method for shape control in a rolling mill and a device for shape control in the rolling mill according to the present invention will be described with reference to FIGS. 1(a) and 1(b).

[0011] FIGS. 1(a) and 1(b) are a diagram illustrating a target shape and an actual shape of a steel sheet having a sheet width of 1200 mm or smaller and a diagram illustrating a target shape and an actual shape of a steel sheet having a sheet width greater than 1200 mm, respectively. As illustrated in FIG. 1(a), when the sheet

width of the steel sheet is 1200 mm or smaller, the actual shape of the steel sheet is such that edge portions and a center portion in the width direction of the steel sheet have an elongated shape while intermediate portions (quarter portions) between the edge portions and the center portion have a stretched shape, and the shape of any of these portions is similar to the target shape. The steel sheet having the above-described shape distribution is less likely to break because the edge portions of the steel sheet have the elongated shape.

[0012] In contrast, as illustrated in FIG. 1(b), when the sheet width of the steel sheet is greater than 1200 mm, the actual shape of the steel sheet is such that distributions of the elongated shape and the stretched shape in the width direction do not necessarily match those in the target shape (shape irregularity), and such mismatch covers a wide region. In this case, there is a risk that an actuator of the rolling mill for adjusting the shape of the region having partial shape irregularity may be overcontrolled. Then, such overcontrol causes shape distortion in another region that is different from the region having shape irregularity, whereby, for example, the edge portions changes in shape in the stretch direction, so that the steel sheet breaks more easily.

[0013] The control gain of an actuator has conventionally been set to a constant value, regardless of the width of a steel sheet. Here, the control gain indicates an operation amount of the actuator configured to control a shape. When a deviation of a detected shape from a target shape becomes a predetermined value or larger, the actuator operates to perform shape control. The amount of this operation is defined as control gain. However, in the case where the width of a steel sheet is greater than a predetermined width, for example, greater than 1200 mm, the use of the same value of the control gain results in overcontrol, which leads to increased shape distortion, so that the risk of breakage of the steel sheet is incurred. Therefore, in the present invention, the width of a steel sheet that is prone to cause distortion of the shape of the steel sheet is defined beforehand as a predetermined sheet width. When the width of a steel sheet as a target for rolling exceeds the predetermined sheet width, the control gain of the actuator configured to control the shape of the steel sheet is made smaller than a control gain for the width of the steel sheet as a target for rolling being the predetermined sheet width or smaller. Specifically, in the case of examples illustrated in FIGS. 1(a) and 1(b), when a steel sheet having a width greater than 1200 mm is rolled, the control gain is made smaller than a control gain for the width of the steel sheet being 1200 mm or smaller. Thus, without increasing the cost of, for example, equipment modifications, the breakage of a steel sheet due to distortion of the shape of the steel sheet can be substantially prevented and the steel sheet can be stably rolled.

Examples

[0014] Next, examples of a method for shape control in a rolling mill and a device for shape control in the rolling mill according to the present invention will be described with reference to FIG. 2 and FIG. 3.

[0015] In Examples, in a continuous cold rolling mill 1 illustrated in FIG. 2, the control of the shape of a steel sheet was exemplarily performed using a result obtained by measuring the shape in the width direction of the steel sheet on the delivery side of a final rolling stand. Note that the continuous cold rolling mill 1 illustrated in FIG. 2 was a rolling mill configured to roll a steel sheet S delivered from a reel 2a by using rolling stands 3a to 3e and then wind the steel sheet S around a reel 2b. On the delivery side from the rolling stand 3e serving as a final rolling stand, a shape measuring device 10 configured to measure a shape in the width direction of the steel sheet S was disposed. Based on the shape in the width direction of the steel sheet S that was measured by the shape measuring device 10, a controller 11 controlled an actuator (for shift control or bender control of a tapered first intermediate roll) provided in each of the rolling stands, and thereby controlled the shape in the width direction of the steel sheet S to within an allowable range.

[0016] In Examples, the thickness of the steel sheet S was 0.1 to 3.5 mm and the rolling speed thereof was 30 to 2000 rpm. The width of the steel sheet S was within a range of 600 to 1300 mm. Furthermore, based on past operational performance, the width of the steel sheet S subjected to the change of control gain was set to 1200 mm, which was a limit beyond which the risk of breakage caused by shape distortion increased. Then, rolling with the same control gain as that in the case of a sheet width of 1200 mm or smaller (Conventional Example: normal gain), rolling with one-half of the control gain in the case of a sheet width of 1200 mm or smaller (Invention Example 1: 1/2 gain value), and rolling with one-quarter of the control gain in the case of a sheet width of 1200 mm or smaller (Invention Example 2: 1/4 gain value) were performed in terms of the respective numbers of passing sheets (the number of coils) illustrated in FIG. 3. As a result, as illustrated in FIG. 3, the breakage rate in Conventional Example was approximately 3.9%, while the breakage rate of any of Invention Examples was 0%. It was confirmed that, according to the present invention, without increasing the cost of, for example, equipment modifications, the breakage of a steel sheet due to distortion of the shape of the steel sheet can be substantially prevented, so that the steel sheet can be stably rolled.

[0017] Embodiments to which the invention established by the inventors were described above. However, the invention is not limited by the description and drawings that constitute a part of the present disclosure according to the present embodiments. For example, the invention is applicable to single-stand rolling mills such as a Sendzmir mill. In other words, other embodiments, examples, and operational techniques, and the likes

made by those skilled in the art, based on the present embodiments, should be all included in the scope of the present invention.

Industrial Applicability

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[0018] According to the present invention, a method for shape control in a rolling mill and a device for shape control in the rolling mill can be provided, the method and the device being capable of substantially preventing the breakage of even a wide steel sheet without increasing the cost of, for example, equipment modifications.

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Reference Signs List

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[0019]

1 continuous cold rolling mill

2a, 2b reel

3a to 3e rolling stand

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10 shape measuring device

11 controller

S steel sheet

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Claims

1. A method for shape control in a rolling mill, the method comprising:

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a measurement step of measuring a shape of a steel sheet on a delivery side of the rolling mill; and

a control step of controlling the rolling mill in a manner that the shape of the steel sheet falls within an allowable range, based on the shape of the steel sheet measured at the measurement step, wherein

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the control step includes a step of setting a control gain smaller than a control gain for a width of a steel sheet as a target for rolling being equal to or smaller than the predetermined value when the steel sheet as the target for rolling has a width greater than a predetermined value.

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2. A device for shape control in a rolling mill, comprising:

a measurement unit configured to measure a shape of a steel sheet on a delivery side of the rolling mill; and

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a control unit configured to control the rolling mill in a manner that the shape of the steel sheet falls within an allowable range, based on the shape of the steel sheet measured by the measurement unit, wherein

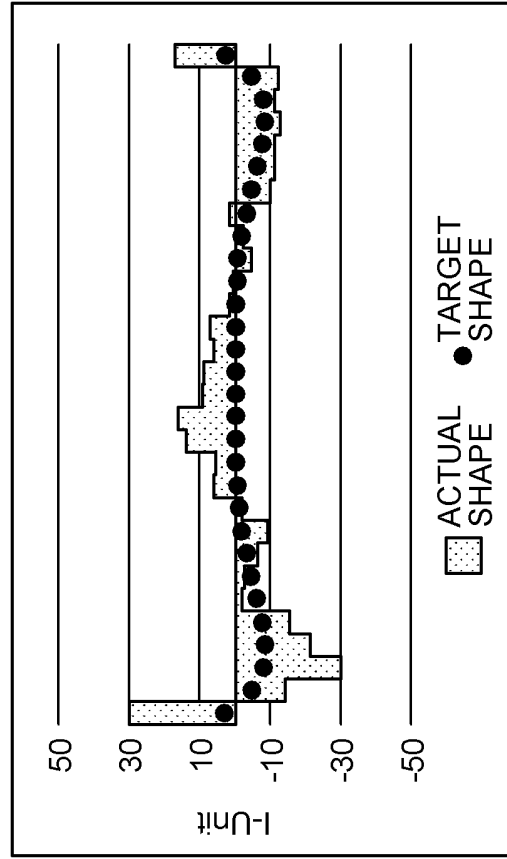
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the control unit sets a control gain smaller than a control gain for a width of a steel sheet as a

target for rolling being equal to or smaller than the predetermined value when the steel sheet as the target for rolling has a width greater than a predetermined value.

FIG.1

(a)



(b)

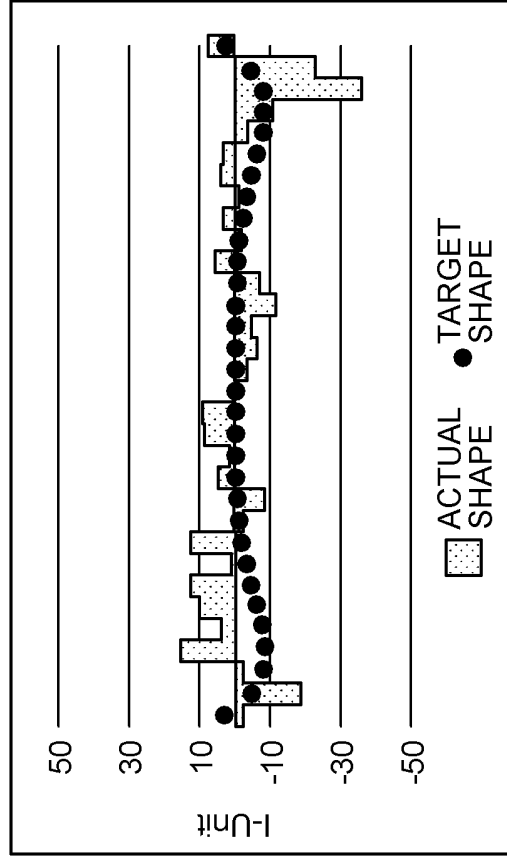


FIG.2

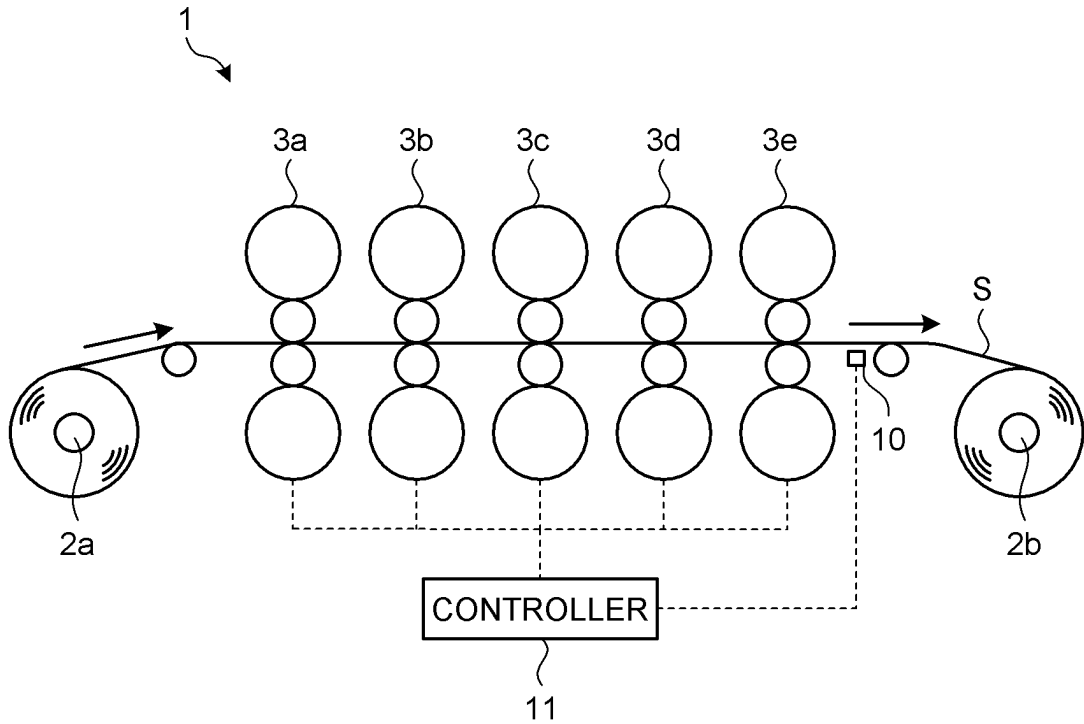
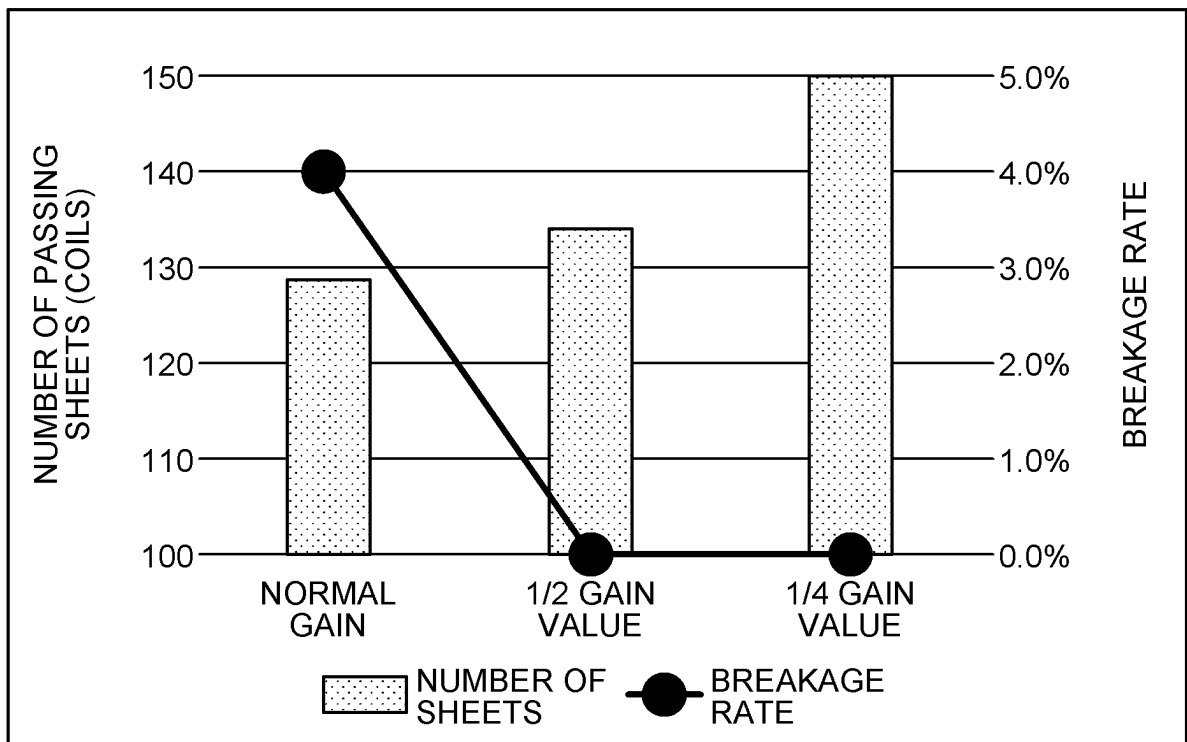


FIG.3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/005355

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. B21C51/00 (2006.01) i, B21B37/28 (2006.01) i, B21B38/02 (2006.01) i
 FI: B21B37/28130, B21B38/02, B21C51/00L

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. B21C51/00, B21B37/28, B21B38/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2021

Registered utility model specifications of Japan 1996-2021

Published registered utility model applications of Japan 1994-2021

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2017-064790 A (JFE STEEL CORPORATION) 06 April 2017 (2017-04-06), claims, paragraphs [0003], [0021]-[0065], fig. 1	1-2
A	JP 2005-313190 A (NITTETSU ELEX CO., LTD.) 10 November 2005 (2005-11-10), claims, paragraphs [0033]-[0084]	1-2
A	JP 53-048057 A (SHIN NIPPON SEITETSU KK) 01 May 1978 (1978-05-01), page 2, lower left column, line 17 to page 2, lower right column, line 12	1-2



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search
02 March 2021

Date of mailing of the international search report
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Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No. PCT/JP20217005355
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JP 2017-064790 A	06 April 2017	(Family: none)
JP 2005-313190 A	10 November 2005	(Family: none)
JP 53-048057 A	01 May 1978	(Family: none)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2012110939 A [0003]