(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 670 013 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
24.06.2020 Bulletin 2020/26

(21) Application number: **18846400.2**

(22) Date of filing: **17.08.2018**

(51) Int Cl.:
B21C 47/34 *(2006.01)* ***B21C 47/02*** *(2006.01)*

(86) International application number:
PCT/KR2018/009478

(87) International publication number:
WO 2019/035694 (21.02.2019 Gazette 2019/08)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **18.08.2017 KR 20170104875**

(71) Applicant: **POSCO**
Pohang-si, Gyeongsangbuk-do 37859 (KR)

(72) Inventor: **CHOI, Yong-Joon**
Pohang-si
Gyeongsangbuk-do 37877 (KR)

(74) Representative: **Potter Clarkson**
The Belgrave Centre
Talbot Street
Nottingham NG1 5GG (GB)

(54) **COILING DEVICE**

(57) The purpose of the present invention is to provide a coiling device in which a steel plate entering a coiler in a hot-rolling line is appropriately wound around a coiler mandrel. A coiling device according to one embodiment of the present invention may comprise: a pinch roll part provided with an upper pinch roll to bend a steel plate; a coiling-model calculator which calculates the weight and moving distance of the upper pinch roll according to material information about the steel plate, and moves the position of the upper pinch roll along the traveling direction of the steel plate; a position controller which moves the vertical position of the upper pinch roll according to the calculation values of the coiling-model calculator; and a coiler part which coils the steel plate that is bent by the pinch roll part.

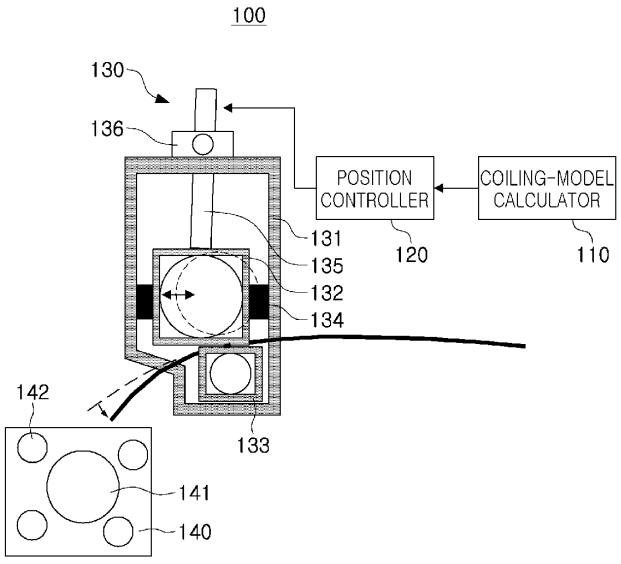

FIG. 1

EP 3 670 013 A1

Description

[Technical Field]

[0001] The present disclosure relates to a coiling device.

[Background Art]

[0002] In general, during a coiling operation in a hot-rolling line, a leading end of a strip is bent in a downward direction while passing through a pair of pinch rolls. The leading end of the bent strip then wraps around a mandrel between the mandrel and a wrapper roll surrounding the mandrel. After a certain time has elapsed, the mandrel expands in circumferential and outward directions to apply tension between the pinch roll and the mandrel, to perform the coiling operation.

[0003] Since the pair of pinch rolls, described above, are fixed regardless of a thickness, a type, an initial shape, or the like of the strip, it is difficult to obtain a desired bending shape with respect to the leading end of the strip in a case of an ultra-thin material or an ultra-thick material. Therefore, there are problems of deteriorating coiling qualities, such as the occurrence of a kink phenomenon or the like in the case of the ultra-thick material, and the occurrence of a non-tension phenomenon or the like in the case of the ultra-thin material.

[0004] The related prior art inventions may be easily understood with reference to Korea Patent Publication No. 10-2000-0043440.

[Disclosure]

[Technical Problem]

[0005] An aspect of the present disclosure is to provide a coiling device capable of effectively coiling a steel plate entering a coiler in a hot-rolling line around a coiler mandrel.

[Technical Solution]

[0006] According to an aspect of the present disclosure, a coiling device includes a pinch roll unit having an upper pinch roll to bend a steel plate; a coiling-model calculator calculating values of a load and a moving distance of the upper pinch roll in accordance with material information of the steel plate, to move a position of the upper pinch roll in a traveling direction of the steel plate; a position controller moving a vertical position of the upper pinch roll in accordance with calculated values of the coiling-model calculator; and a coiler unit coiling the steel plate bent by the pinch roll unit.

[Advantageous Effects]

[0007] According to an aspect of the present disclosure, a desired bending shape may be obtained to ensure stable coiling qualities.

[Description of Drawings]

[0008]

FIG. 1 is a configuration diagram schematically illustrating a coiling device according to an embodiment of the present disclosure.
FIG. 2 is a flowchart schematically illustrating an operation of a coiling device according to an embodiment of the present disclosure.

[Best Mode for Invention]

[0009] Hereinafter, embodiments of the present disclosure will be described in detail with reference to the accompanying drawings such that those skilled in the art may easily implement the present disclosure.

[0010] FIG. 1 is a configuration diagram schematically illustrating a coiling device according to an embodiment of the present disclosure.

[0011] Referring to FIG. 1, a coiling device 100 according to an embodiment of the present disclosure may include a coiling-model calculator 110, a position controller 120, a pinch roll unit 130, and a coiler unit 140.

[0012] The coiling-model calculator 110 may calculate values of a load and a moving distance of an upper pinch roll 132 of the pinch roll unit 130 in accordance with material information of a steel plate s, to adjust bending of the steel plate s.

[0013] The material information of the steel plate s may be at least one of a thickness, a type, and an initial shape of the steel plate s.

[0014] The position controller 120 may control the position of the upper pinch roll of the pinch roll unit 130 according to the calculated value of the coiling-model calculator 110.

[0015] The pinch roll unit 130 may include the upper pinch roll 132 and a lower pinch roll 133 in a housing 131. The upper pinch roll 132 and the lower pinch roll 133 may be included in separate housings, respectively. Due to rotation operations of the upper pinch roll 132 and the lower pinch roll 133, the steel plate s drawn between the upper pinch roll 132 and the lower pinch roll 133 may be bent. The pinch roll unit 130 may include a position moving cylinder 134, a vertically moving cylinder 135, and a hinged block 136.

[0016] The position moving cylinder 134 may move the upper pinch roll 132 in a traveling direction of the steel plate s, and the vertically moving cylinder 135 may move the upper pinch roll 132 in a height direction, perpendicular to the traveling direction of the steel plate s.

[0017] The coiler unit 140 may include a mandrel 141 and a unit roll 142, to coil the bent steel plate s.

[0018] FIG. 2 is a flowchart schematically illustrating an operation of a coiling device according to an embod-

iment of the present disclosure.

[0019] Referring to FIG. 2 together with FIG. 1, the coiling-model calculator 110 may obtain the material information, for example, the thickness, a type, or the initial shape of the steel plate when the steel plate s enters the pinch roll unit 130, and may use the obtained material information to calculate values of a pressure of the upper pinch roll 132 and a moving distance of the upper pinch roll in the traveling direction of the steel plate, in the bending of the steel plate (S10) . The coiling-model calculator 110 may adjusts the bending of the steel plate in accordance with the following equations:

[0020] Load of Upper Pinch Roll: $F = \alpha \times P$

$$P = \frac{t^2 \times w}{4} \times \sigma_{strip} \times \beta$$

[0021] Moving Distance of Upper Pinch Roll:

$$S = \frac{Q}{\delta}$$

$$Q = \frac{t^3 \times w}{60 \times D} \times \sigma_{strip}$$

[0022] Where α is a proportional coefficient, β is a shape coefficient of the steel plate, δ is a bending coefficient of the steel plate, t is a thickness of the steel plate, w is a width of the steel plate, σ_{strip} is yield strength of the steel plate, and D is a diameter of a mandrel of the coiler unit.

[0023] The calculated values may be used to calculate values of the load and the moving distance of the upper pinch roll for each material of the steel plate, and, based on the thus obtained values, movement of the position moving cylinder 134 in the traveling direction of the steel plate s may be controlled, to move the upper pinch roll 132 in the traveling direction of the steel plate s.

[0024] In addition, since the position moving cylinder 134 is also mounted on the housing 131 to fix the upper pinch roll 132 thereto, the coiling device may absorb impacts when entering the steel plate. In addition, the position moving cylinder 134 may be mounted on an inlet and an outlet of the upper pinch roll 132, respectively, to fix a housing of the upper pinch roll 132.

[0025] As the upper pinch roll 132 moves in the traveling direction of the steel plate, the vertically moving cylinder 135 applying pressure to the upper pinch roll may be provided with the hinged block 136, to be rotatable.

[0026] The position controller 120 may control the vertically moving cylinder 135 in accordance with the following equation, with respect to the moving distance calculated by the position moving cylinder 134, to move the upper pinch roll 132 in the height direction (S20):

[0027] Moving Distance of Vertically Moving Cylinder in Height Direction: $Y = \gamma \times \sqrt{(S^2 + G^2)}$

[0028] Where r is an adjustment coefficient, S is a moving distance of the upper pinch roll, and G is a roll gap of the vertically moving cylinder.

[0029] For example, the position moving cylinder 134 and the vertically moving cylinder 135 may be provided to move the upper pinch roll 132 on two axes, to adjust the bending of the steel plate (s) in the desired position (S30).

[0030] As described above, according to the present disclosure, a desired bending shape may be obtained by moving the upper pinch roll in the coiling direction to adjust the bending from the material information such as a thickness, type, or the like of the steel plate material entering the hot-rolled coiler, to ensure stable coiling qualities.

[0031] While example embodiments have been shown and described above, it will be apparent to those skilled in the art that modifications and variations could be made without departing from the scope of the present disclosure as defined by the appended claims.

Claims

1. A coiling device comprising:

   a pinch roll unit having an upper pinch roll to bend a steel plate;
   a coiling-model calculator calculating values of a load and a moving distance of the upper pinch roll in accordance with material information of the steel plate, to move a position of the upper pinch roll in a traveling direction of the steel plate;
   a position controller moving a vertical position of the upper pinch roll in accordance with calculated values of the coiling-model calculator; and
   a coiler unit coiling the steel plate bent by the pinch roll unit.

2. The coiling device according to claim 1, wherein the material information of the steel plate is at least one of a thickness, a type, and an initial shape of the steel plate.

3. The coiling device according to claim 2, wherein the coiling-model calculator calculates values of the load and the moving distance of the upper pinch roll in accordance with the following equations:

   Load of Upper Pinch Roll: $F = \alpha \times P$

$$P = \frac{t^2 \times w}{4} \times \sigma_{strip} \times \beta$$

Moving Distance of Upper Pinch Roll:

$$S = \frac{Q}{\delta}$$

$$Q = \frac{t^3 \times w}{60 \times D} \times \sigma_{strip}$$

Where α is a proportional coefficient, β is a shape coefficient of the steel plate, $\delta$is a bending coefficient of the steel plate, *t* is a thickness of the steel plate, *w* is a width of the steel plate, σ_{strip} is yield strength of the steel plate, and *D* is a diameter of a mandrel of the coiler unit.

4. The coiling device according to claim 1, wherein the pinch roll unit further comprises:

a position moving cylinder moving the upper pinch roll in the traveling direction of the steel plate; and
a vertically moving cylinder moving the upper pinch roll in a height direction, perpendicular to the traveling direction of the steel plate.

5. The coiling device according to claim 4, wherein the position controller controls a moving distance of the vertically moving cylinder in accordance with the following equation:
Moving Distance of Vertically Moving Cylinder in Height Direction: $Y = \gamma \times \sqrt{\left(S^2 + G^2\right)}$

Where *r* is an adjustment coefficient, *S* is a moving distance of the upper pinch roll, and *G* is a roll gap of the vertically moving cylinder.

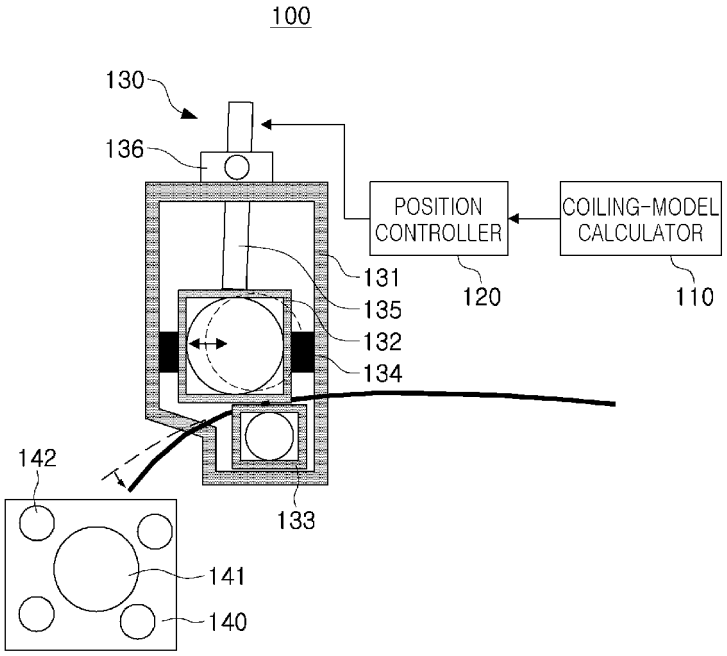
100
130
136
POSITION CONTROLLER
COILING-MODEL CALCULATOR
131
135
132
134
120
110
142
133
141
140

FIG. 1

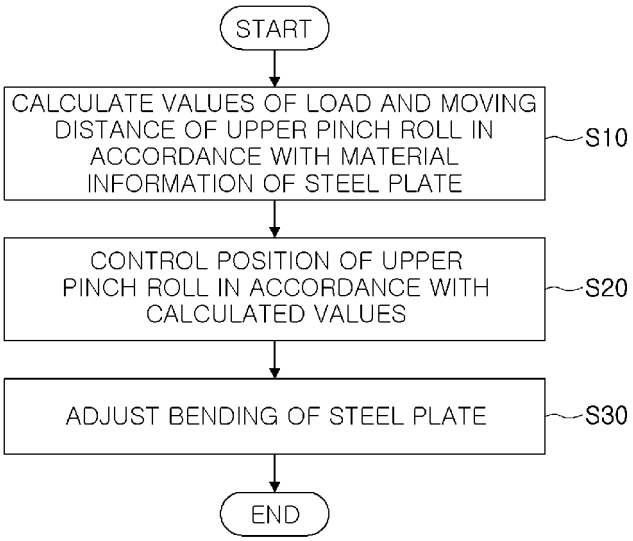
START
CALCULATE VALUES OF LOAD AND MOVING DISTANCE OF UPPER PINCH ROLL IN ACCORDANCE WITH MATERIAL INFORMATION OF STEEL PLATE
S10
CONTROL POSITION OF UPPER PINCH ROLL IN ACCORDANCE WITH CALCULATED VALUES
S20
ADJUST BENDING OF STEEL PLATE
S30
END

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2018/009478

A. CLASSIFICATION OF SUBJECT MATTER

B21C 47/34(2006.01)i, B21C 47/02(2006.01)i

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)
B21C 47/34; B21B 1/32; B21C 47/00; B21C 47/02; B21C 47/06; B21C 47/10; B21C 47/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS (KIPO internal) & Keywords: pinch roll part, coiling model calculator, position controller, coiler part, coiling apparatus

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2016-0077257 A (POSCO) 04 July 2016 See paragraphs [0006], [0021]-[0042]; and figure 1.	1-2,4
A		3,5
Y	KR 10-2009-0102858 A (SMS SIEMAG AKTIENGESELLSCHAFT) 30 September 2009 See paragraphs [0042]-[0044]; claims 1-9; and figures 1-3.	1-2,4
Y	JP 2006-130568 A (NIPPON STEEL CORP.) 25 May 2006 See paragraphs [0011]-[0019]; and figures 1-2.	4
A	KR 10-2009-0069594 A (RESEARCH INSTITUTE OF INDUSTRIAL SCIENCE & TECHNOLOGY et al.) 01 July 2009 See paragraphs [0011]-[0029]; and figure 1.	1-5
A	JP 05-069041 A (SUMITOMO METAL IND., LTD. et al.) 23 March 1993 See paragraphs [0007]-[0015]; and figures 1-10.	1-5

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 NOVEMBER 2018 (26.11.2018)	**26 NOVEMBER 2018 (26.11.2018)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex Daejeon Building 4, 189, Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2018/009478

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-2016-0077257 A	04/07/2016	KR 10-1647216 B1	10/08/2016
KR 10-2009-0102858 A	30/09/2009	AT 481187 T	15/10/2010
		BR PI0807869 A2	17/06/2014
		CA 2679434 A1	02/10/2008
		CN 101687238 A	31/03/2010
		CN 101687238 B	10/10/2012
		DE 102008016314 A1	02/10/2008
		EP 2129479 A1	09/12/2009
		EP 2129479 B1	15/09/2010
		ES 2353044 T3	24/02/2011
		JP 2010-522084 A	01/07/2010
		JP 4988916 B2	01/08/2012
		KR 10-1121999 B1	09/03/2012
		RU 2403112 C1	10/11/2010
		UA 96482 C2	10/11/2011
		US 2011-0138870 A1	16/06/2011
		US 9238259 B2	19/01/2016
		WO 2008-116666 A1	02/10/2008
JP 2006-130568 A	25/05/2006	NONE	
KR 10-2009-0069594 A	01/07/2009	KR 10-0939269 B1	29/01/2010
JP 05-069041 A	23/03/1993	AU 1825092 A	21/01/1993
		AU 643143 B2	04/11/1993
		CA 2071720 A1	22/12/1992
		CA 2071720 C	06/02/1996
		DE 69229896 T2	04/05/2000
		EP 0519470 A2	23/12/1992
		EP 0519470 A3	30/06/1993
		EP 0519470 B1	01/09/1999
		JP 05-000201 U	08/01/1993
		JP 05-131216 A	28/05/1993
		JP 05-200403 A	10/08/1993
		JP 2612792 B2	21/05/1997
		JP 2676287 B2	12/11/1997
		JP 2717891 B2	25/02/1998
		JP 8007921 Y2	06/03/1996
		US 5673584 A	07/10/1997

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR 1020000043440 **[0004]**