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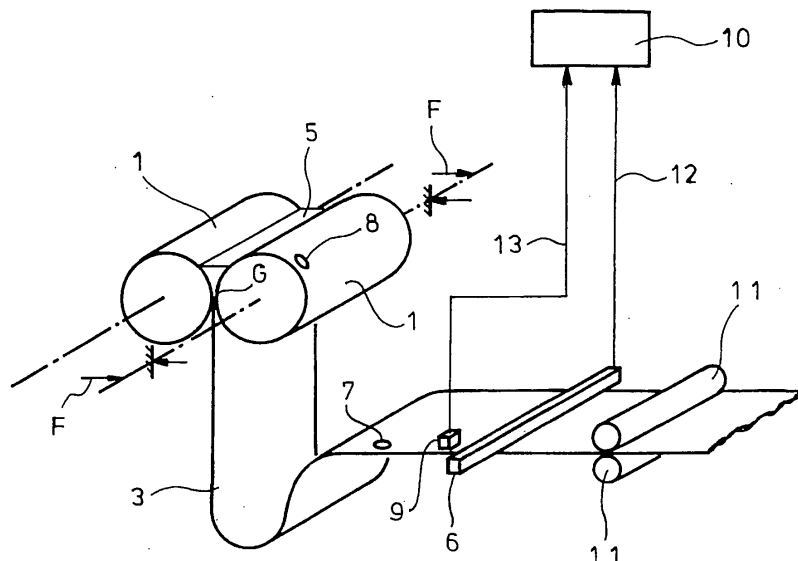
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(54) **TWIN-ROLL CASTING MACHINE**

(57) Provided are a pair of chilled rolls 1 on which molten steel solidifies for delivery of a steel strip 3 from a nip G between the rolls, a noncontact type sensor 6 for measuring thickness distribution of the strip 3 widthwise of the strip, marking means 8 for making a mark 7 on the strip 3 whenever the chilled rolls 1 make one rotation, mark detection means 9 for sensing the marks 7 on the strip 3 and nip estimating means 10. From thickness-

distribution information 12 by the sensor 6 and passed-mark information 13 by the mark detection means 9, the nip estimating means 10 calculates variation of the nip G between the rolls 1 whenever the rolls make one rotation, on the basis of variation in thickness distribution widthwise of the strip 3 between confirmed passing of the mark 7 and confirmed passing of the next mark 7, and stores the same as data.

FIG. 2



Description

Technical Field

[0001] The present invention relates to a twin roll caster.

Background Art

[0002] Fig. 1 shows an example of a twin roll caster comprising a pair of chilled rolls 1 arranged horizontally side by side and a pair of side weirs 2 associated with the rolls 1.

[0003] The rolls 1 are constructed such that cooling water passes through interiors of the rolls and that a nip G between the rolls may be adjusted to be increased or decreased depending upon thickness of a steel strip 3 to be produced.

[0004] The speed and direction of rotation of the rolls 1 are set such that the outer peripheries of the respective rolls 1 move from above towards the nip G at the same speed.

[0005] One of the side weirs 2 surface-contacts one ends of the rolls 1 and the other side weir 2, the other ends of the rolls 1.

[0006] A molten metal supply nozzle 4 is arranged between the paired side weirs 2 so as to be positioned just above the nip G. Molten metal is fed from the nozzle 4 into a space defined on all four sides by the rolls 1 and side weirs 2 to provide a molten metal pool 5.

[0007] More specifically, with the pool 5 being formed, the rolls 1 are rotated while cooled through passing of the cooling water, so that molten steel solidifies on outer peripheries of the rolls 1, a resultant steel strip 3 being delivered downward from the nip G.

[0008] A twin roll caster using chilled rolls with tapered pistons for correction of roll crown so as to equalize thickness distribution widthwise of the steel strip has been also proposed, the roll crown being corrected on the basis of a measured thickness of the steel strip delivered from the nip 1 (see, for example, Reference 1).

[Reference 1] JP60-27458A

Summary of the Invention

Problems to be Solved by the Invention

[0009] However, in the Reference 1, if thermal deformation develops peripherally non-uniformly on the chilled rolls, the current shape of the nip becomes not reflected on the measured thickness of the steel strip by virtue of the fact that a point of measuring the thickness is away from the nip; as a result, equalization of thickness distribution widthwise of the steel strip becomes difficult to attain.

[0010] The invention was made in view of the above and has its object to provide a twin roll caster in which a

nip can be properly estimated.

Means or Measures for Solving the Problems

[0011] In order to attain the above object, the invention comprises a pair of chilled rolls with outer peripheries on which molten steel solidifies for delivery of a steel strip from a nip between the rolls, a noncontact type sensor for measuring thickness distribution widthwise of the strip, marking means for making a mark on the strip whenever the rolls make one rotation and mark detection means for sensing the marks on the strip.

[0012] Specifically, any variation of the nip per rotation of the rolls is estimated on the basis of the thickness distribution widthwise of the strip continuously obtained by the sensor and passing of the marks on the strip sensed by the mark detection means.

[0013] Alternatively, it comprises a pair of chilled rolls with outer peripheries on which molten steel solidifies for delivery of a steel strip from a nip between the rolls and noncontact type sensors each for each roll for measuring distance distribution from a reference position to an outer periphery of the roll axially of the roll.

[0014] Specifically, any variation of the nip per rotation of the rolls is estimated on the basis of the distance distribution to the outer periphery of each of the rolls axially of the roll obtained by the sensor.

Effects of the Invention

[0015] According to a twin roll caster of the invention, either having a noncontact type sensor for detecting thickness distribution widthwise of a steel strip or having a noncontact type sensor for detecting distance distribution to an outer periphery of each of chilled rolls axially of the roll, can exhibit excellent effects or advantages that any variation of a nip per rotation of the rolls can be properly estimated and that correction of roll crown and/or phase adjustment of the rolls on the basis of the estimation can attain equalization of thickness distribution widthwise of the steel strip.

Brief Description of the Drawings

[0016]

Fig. 1 is a schematic view showing an example of a conventional twin roll caster;

Fig. 2 is a schematic view showing a first embodiment of a twin roll caster according to the invention; and

Fig. 3 is a schematic view showing a second embodiment of a twin roll caster according to the invention.

Explanation of the Reference Numerals

[0017]

- 1 chilled roll
- 3 steel strip
- 6 noncontact type sensor
- 7 mark
- 8 marking means
- 9 mark detection means
- 14 noncontact type sensor
- G nip

Best Mode for Carrying Out the Invention

[0018] Embodiments of the invention will be described in conjunction with the drawings.

Fig. 2 shows a first embodiment of a twin roll caster according to the invention comprising a pair of chilled rolls 1 for casting a steel strip 3, a noncontact type sensor 6 for measuring thickness distribution widthwise of the strip 3, marking means 8 for making a mark 7 on the strip 3 whenever the rolls 1 make a rotation, mark detection means 9 closely adjacent to the sensor 6 and nip estimating means 10.

[0019] Side weirs and a molten metal supply nozzle (not shown) are associated with the rolls 1, a molten metal pool 5 being formed between the rolls 1.

[0020] In order to resiliently deform one of the rolls 1, roll-shape-correction means such as cylinders (not shown) are adapted to apply horizontal pushing force F to necks of the roll.

[0021] The steel strip 3 delivered downwardly from the nip G between the rolls 1 is guided horizontally by table rolls (not shown) via pinch rolls 11 to a horizontal rolling mill (not shown).

[0022] The noncontact type sensor 6 comprises three or more thickness gauges arranged widthwise of the strip 3 and upstream of the pinch rolls 11 in the direction of movement of the strip 3.

[0023] The marking means 8 is a concave or a convex on an outer periphery of one of the rolls 1 adjacent to its roll edge. Whenever the rolls 1 make a rotation, a concave mark 7 is applied on the strip 3 delivered from the nip G when the means 8 is convex; a concave mark 7 is applied on the strip 3 delivered from the nip G when the means 8 is concave.

[0024] The mark detection means 9 employed may be, for example, of a type where the mark 7 on the strip 3 is detected as variation of distance from reference position to a surface of the strip 3 or of a type where a surface portion on the strip 3 with extreme variations in shape is detected through image processing.

[0025] The nip estimating means 10 calculates any variation of the nip G per rotation of the rolls 1, from thickness distribution information 12 widthwise of the strip 3 obtained by the sensor 6 and from mark passing information 13 transmitted from the mark detection means 9, on the basis of variation in thickness distribution widthwise of the strip 3 between confirmed passing of the mark 7 and confirmed passing of the next mark 7, and stores the same as data.

[0026] The data of the nip estimating means 10 are also indicative of variation of longitudinal thickness distribution of the strip 3, so that elastic deformation of the roll 1 by the roll-shape-correction means on the basis of the data so as to eliminate variation of the nip G due to the rotation of the rolls 1 can uniformize longitudinal and widthwise thickness distributions of the strip 3 delivered hereafter.

[0027] As the roll-shape-correction means, not only the roll bending type may be applied, but also tapered piston type may be employed so as to correct the roll crown by little and little during a rotation of the rolls 1.

[0028] When periodic variation is continuously seen in longitudinal thickness distribution of the strip 3, phase of the rolls 1 may be adjusted on the basis of the data before a next casting so as to suppress variation of the nip G; then elastic deformation of the roll 1 by means of the roll-shape-correction means may be lessened.

[0029] Fig. 3 shows a second embodiment of a twin roll caster according to the invention comprising a pair of chilled rolls 1 for casting a steel strip 3, noncontact type sensors 14 each for each roll for measuring distance distribution from a reference position to an outer periphery of the roll 1 axially of the roll and nip estimating means 15. In the figure, parts similar to those in Fig. 2 are represented by the same reference numerals.

[0030] The noncontact type sensor 14 comprises three or more distance gauges arranged in position in parallel with the axis of the roll 1 and peripherally 180° away from the nip G.

[0031] The nip estimating means 15 calculates any variation of the nip G per rotation of the rolls 1, from distance distribution information 16 from a reference position (position of the sensor) to the outer periphery of the roll 1 axially of the roll obtained by each of the noncontact type sensors 14, on the basis of variations in distance distribution from the reference positions to the outer peripheries of the rolls 1 axially of the rolls, respectively, and stores the same as data.

[0032] The data of the nip estimating means 15 are also indicative of variation of longitudinal thickness distribution of the strip 3, so that elastic deformation of the roll 1 by the roll-shape-correction means on the basis of the data so as to eliminate variation of the nip G due to the rotation of the rolls 1 can uniformize longitudinal and widthwise thickness distributions of the strip 3 delivered hereafter.

[0033] As the roll-shape-correction means, not only the roll bending type may be applied, but also tapered piston type may be employed so as to correct the roll crown by little and little during a rotation of the rolls 1.

[0034] When periodic variation is continuously seen in distance distributions from the reference positions to the outer peripheries of the rolls 1 axially of the rolls, respectively, phase of the rolls 1 may be adjusted on the basis of the data before a next casting so as to suppress variation of the nip G; then, elastic deformation of the roll 1 by means of the roll-shape-correction means may be

lessened.

[0035] It is to be understood that a twin roll caster according to the invention is not limited to the above embodiments and that various changes and modifications may be made without departing from the scope of the invention. 5

Industrial Applicability

[0036] A twin roll caster according to the invention is applicable to production of steel strips with various ratios of components. 10

Claims 15

1. A twin roll caster, comprising a pair of chilled rolls (1) with outer peripheries on which molten steel solidifies for delivery of a steel strip (3) from a nip (G) between the rolls (1), a noncontact type sensor (14) for measuring thickness distribution of the strip widthwise of the strip (3), marking means (8) for making a mark (7) on the strip (3) whenever the rolls (1) make one rotation and mark detection means (9) for sensing the marks (7) on the strip (3). 20 25
2. A twin roll caster as claimed in claim 1, wherein the outer periphery of the roll (1) is provided with the marking means (8) which is concave or convex. 30
3. A twin roll caster comprising a pair of chilled rolls (1) with outer peripheries on which molten steel solidifies for delivery of a steel strip (3) from a nip (G) between the rolls (1) and noncontact type sensors (6) each for each roll (1) for measuring distance distribution from a reference position to an outer periphery of the roll (1) axially of the roll (1). 35 40
4. A twin roll caster as claimed in any one of claims 1 to 3, further comprising roll-shape-correction means for elastically deforming the roll (1). 45 50 55

FIG. 1

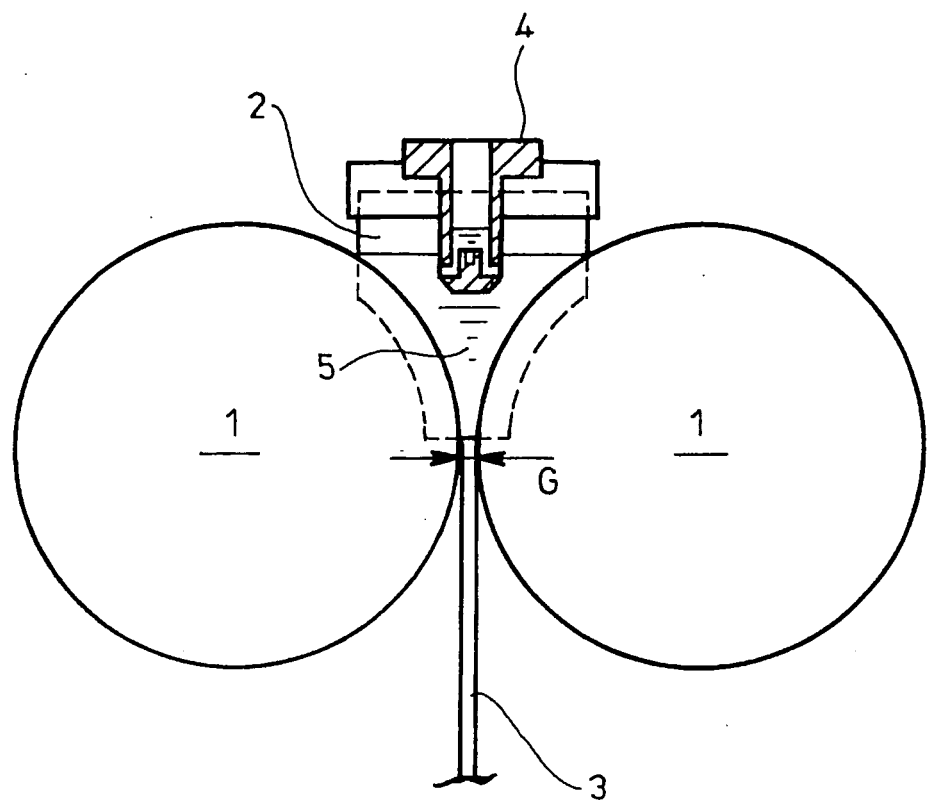


FIG. 2

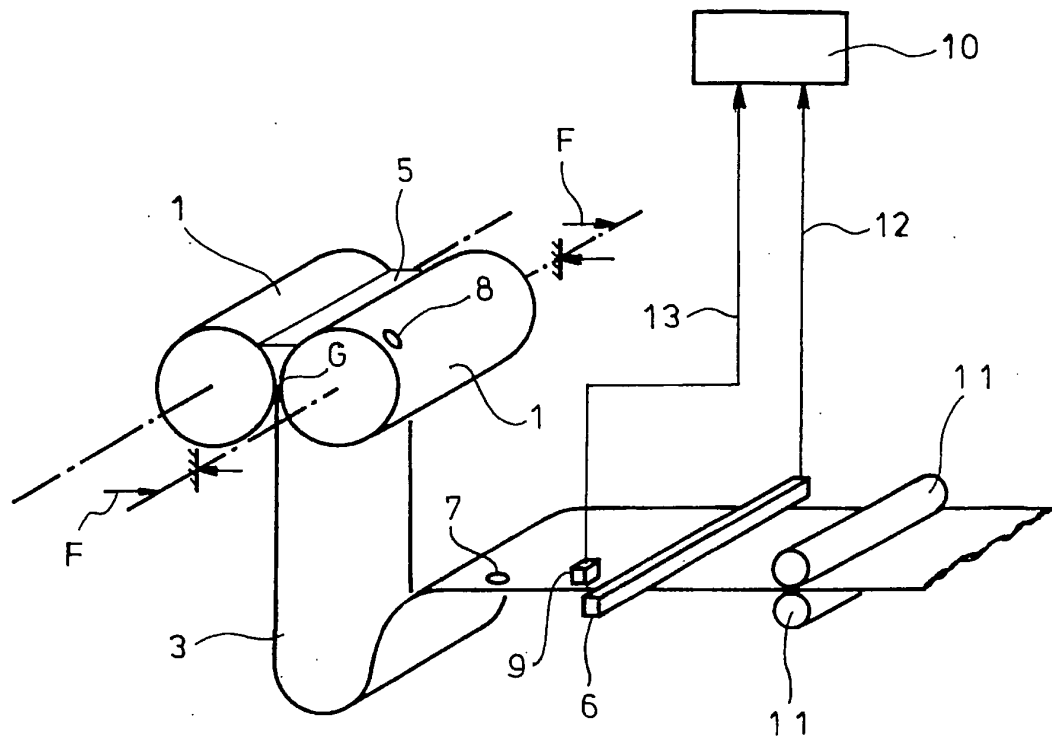
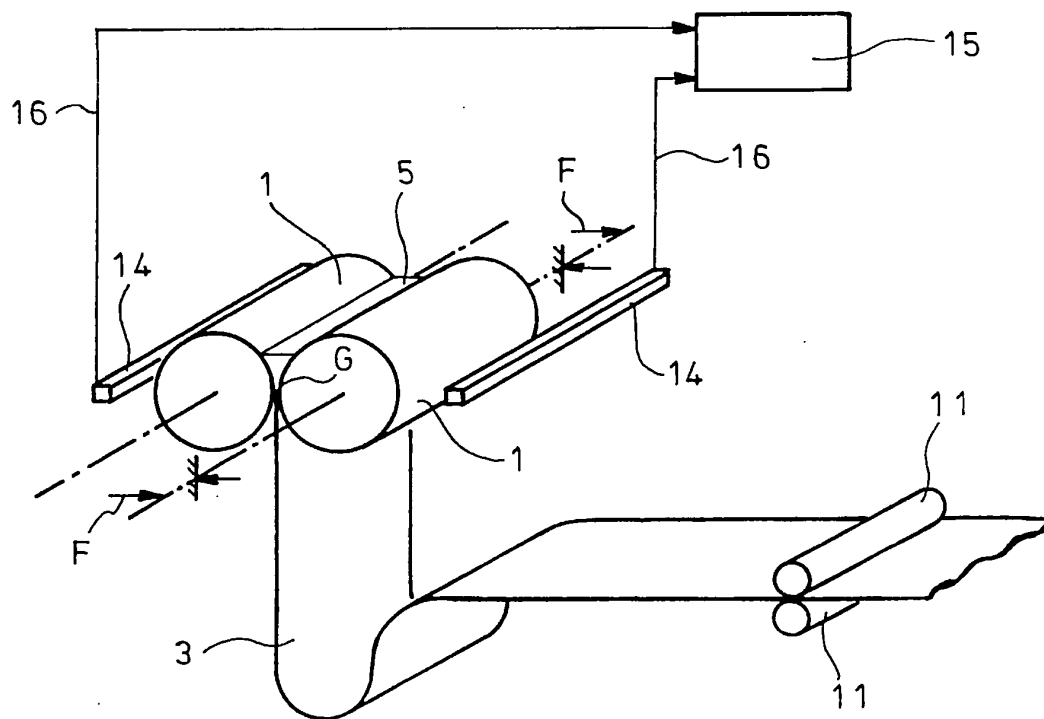


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/308708

A. CLASSIFICATION OF SUBJECT MATTER

B22D11/16(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)

B22D11/16

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2006

Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006

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.
X	JP 2002-066704 A (NKK Corp.), 05 March, 2002 (05.03.02), Par. No. [0020]; Fig. 2 (Family: none)	3
Y	JP 60-027458 A (Ishikawajima-Harima Heavy Industries Co., Lt), 12 February, 1985 (12.02.85), Page 2, lower left column, line 14 to lower right column, line 3 (Family: none)	1, 2, 4
Y	JP 06-134554 A (Nippon Steel Corp.), 17 May, 1994 (17.05.94), Par. No. [0014] (Family: none)	1, 2, 4

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

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Date of the actual completion of the international search
08 August, 2006 (08.08.06)Date of mailing of the international search report
15 August, 2006 (15.08.06)Name and mailing address of the ISA/
Japanese Patent Office

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 60027458 A [0008]