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(11) **EP 1 125 658 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
22.08.2001 Bulletin 2001/34

(51) Int Cl.7: **B22D 11/16**, F27D 3/00,
C21D 9/00, B21B 37/68

(21) Application number: **01103052.5**

(22) Date of filing: **09.02.2001**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **15.02.2000 IT UD000032**

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(54) **Method to control the axial position of slabs emerging from continuous casting and relative device**

(57) Method and device to control the axial position of slabs emerging from continuous casting applied in rolling plants comprising at least a casting machine (11), an extraction and straightening assembly (12) with pairs of rolls (25), a heating and/or temperature maintenance furnace (15) and a roughing and pre-finishing (16) or finishing train (19), said device comprising means (26, 31a, 31b) to detect the axial position of the slab (24) arranged in at least a position upstream of or inside said

furnace (15) and a processing unit (30) able to receive from said means (26, 31a, 31b) the signal relating to the axial position of the slab (24) and to condition the activation of at least one of said pairs of rolls (25) of the extraction and straightening assembly (12) to obtain a differentiated pressing of the slab (24) in the direction of the width in order to at least partly eliminate a possible discrepancy (Δ) of the axis (28) of the slab (24) with respect to the rolling axis (27).

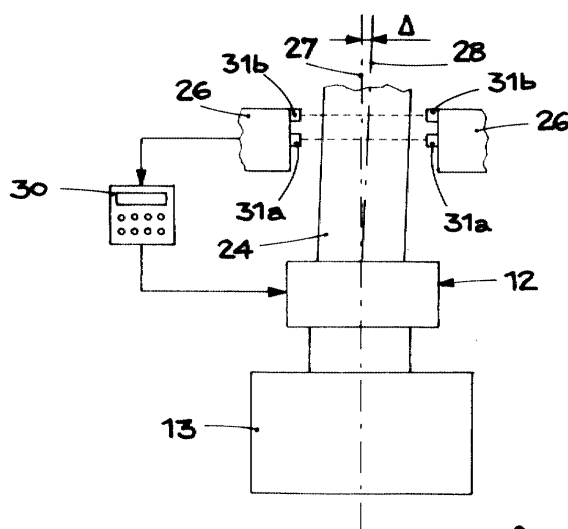


Fig. 3

Description

FIELD OF THE INVENTION

[0001] This invention concerns a method to control the axial position of slabs emerging from continuous casting, and the relative device, used in rolling plants with a rolling train located in line with the continuous casting, to obviate the problems of misalignment of the slab emerging from casting with respect to the axis of the first rolling stands.

[0002] The invention is applied both in cases where the slab is sheared to size into segments, and also in the case where the slab is worked without interruption from the casting to the train.

[0003] To be more exact, the invention is applied in conventional plants for thin slabs, in plants for long slabs from about 20 m to about 60 m, and in plants of the semi-endless type with long slabs of up to 300 m.

BACKGROUND OF THE INVENTION

[0004] One of the problems which businessmen operating in the field of rolling plants complain of is that concerning the control of the axial position of the slab with respect to the axis of the first rolling stands located downstream of the heating furnace.

[0005] For it is well-known that, since the slab emerging from the continuous casting is subjected to the steps of extraction, pre-rolling and straightening, it rarely keeps a correct alignment with respect to the axis of feed; this creates problems when it enters the rolling stands and during the rolling steps.

[0006] Moreover, as it passes inside the tunnel, heating or temperature-maintenance furnaces, the slab can be subject to lateral displacements which take it off-axis.

[0007] If the slab arrives misaligned with respect to the axis of the first stand, rolling becomes difficult, particularly in the case of rolling thin slabs.

[0008] In fact, to compensate for the misalignment after the slab has entered the stand, and to make sure that it enters the downstream stand correctly, it is necessary to level the rolls of the first stand, which has negative effects on the symmetry of the transverse section profile of the slab itself.

[0009] Although this does not create serious problems when the product is very thick, for example above 2 mm, for thin products there are serious problems regarding the guiding of the strip in the rolling mill, even though the strip is guided for only a limited segment, since making up the difference in thickness between one side and the other causes different elongations on the two sides and therefore causes the strip to bend on the horizontal plane.

[0010] Rolling becomes difficult if not impossible to manage, moreover, for thicknesses of about 0.6÷0.8 mm.

[0011] To try to solve these problems at least in part,

conventional solutions provide various means to obtain the progressive axial centering of the slab with respect to the rolling axis; these means generally act inside or downstream of the tunnel furnace.

[0012] However, it sometimes happens that the slab entering the furnace is already misaligned to such an extent that it can also be subject to a progressive slipping towards the sides and the walls of the furnace, possibly causing serious damage to the furnace itself and obviously also to the slab and the entire casting process.

[0013] The present Applicant has devised and embodied this invention to overcome this shortcoming which causes serious operational, technological and quality problems in rolling plane products, particularly thin plane products.

SUMMARY OF THE INVENTION

[0014] The invention is set forth and characterised in the respective main claims, while the dependent claims describe other characteristics of the main embodiment.

[0015] The purpose of the invention is to center and axially align a slab emerging from the continuous casting machine so that it arrives at the entrance to the first stands, whether they be roughing stands, pre-finishing stands or finishing stands, perfectly aligned with the axis of said stands.

[0016] Another purpose is to obtain this alignment already upstream of the tunnel furnace in order to prevent risks of the progressive lateral displacement of the slab which can cause the advancing slab to rub or knock against the walls of the furnace.

[0017] Another purpose is to obtain this alignment with a simple solution, which can be installed on pre-existing plants too, without substantial modifications to the configuration of the plant, and which will guarantee an efficient result substantially for every rolling condition and for every type of product being worked.

[0018] The invention provides to detect a possible misalignment of the axis of the slab with respect to the rolling axis at least at one point, advantageously two or more, arranged upstream of the furnace and/or inside the furnace itself.

[0019] The misalignment signal is sent to a command and control unit which, according to the position of the leading end of the slab inside the furnace and according to the entity of said misalignment, commands a controlled and differentiated activation of at least some of the pairs of extractor rolls of the extraction and straightening assembly located downstream of the casting machine.

[0020] To be more exact, at least one pair of said extractor rolls is commanded to achieve a differentiated pressing of one side of the slab and the other, in order to progressively cancel this misalignment.

[0021] The detection of the misalignment may be carried out periodically, and in this case the intervention made by the pairs of extractor rolls to correct the misalignment will also be periodical.

[0022] In the preferential embodiment of the invention, the detection of the misalignment is continuous, and the action of the pairs of extractor rolls, in terms of differentiated pressing, is continuously modulated according to the values of misalignment which continually reach the command and control unit.

[0023] The regulation of the misalignment performed by pressing the slabs by the extractor rolls in a differentiated manner may be associated with other methods to align the slab, for example performed inside the furnace or downstream thereof, in the event that the correction made upstream of the furnace is not sufficient and such as to ensure a precise alignment of the slab with the rolling axis.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] These and other characteristics of the invention will become clear from the description of some preferential embodiments, given with reference to the attached drawings, wherein:

Fig. 1 is a schematic side view of a rolling line directly connected with the continuous casting to which the invention is applied;

Fig. 2 is a schematic view from above of a segment of the line shown in Fig. 1;

Fig. 3 shows a detail of the segment shown in Fig. 2;

Fig. 4 shows an application of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0025] The rolling line 10 shown schematically in Fig. 1 comprises a rolling train 19 arranged in line with a continuous casting 11 including a mold 13 and an extraction and straightening assembly 12 comprising a plurality of pairs of rolls 25.

[0026] Downstream of the assembly 12 there are shears for shearing to size 14 and a heating and/or temperature-maintenance furnace 15 which feeds the slabs 24 at temperature to a rolling train 16, in this case with two stands 17, which may be a roughing or pre-finishing train according to the case.

[0027] Between the train 16 and the finishing train 19, in this case, there is a system to equalize and restore the temperature 18, while downstream of the finishing train 19 there is a winding assembly 21 to wind the strip produced.

[0028] In this case, between the heating furnace 15 and the train 16 there are conventional lateral guide systems 20, a descaling assembly 22 and an edging assembly 23.

[0029] According to the invention, upstream of the furnace 15 there are means 26 to detect the axial position of the advancing slab 24, and particularly to detect the entity of the discrepancy Δ between the rolling axis 27 and the axis 28 of the slab 24.

[0030] This discrepancy, as can be seen in Fig. 2, can progressively increase inside the furnace 15 and cause a lateral sliding (shown by the arrow 29) which can take the slab 24 to rub against or knock the walls of the furnace 15, with obvious and serious damage to the furnace and to the slab, and with the risk of interrupting the casting process.

[0031] Said means 26 in this case comprise two detector units, respectively 31a and 31b, able to detect in two different points the axial position of the slab 24 upstream of the furnace 15, which then send said signal to a processing unit 30.

[0032] In one embodiment of the invention, the detectors could also be located inside the furnace 15 or immediately at the outlet thereof.

[0033] The processing unit 30 is able to continuously acquire the signal indicating the position of the slab 24 and to calculate the exact position, in terms of distance and discrepancy Δ of its axis 28 with respect to the rolling axis 27, of the leading end of the slab 24 inside the furnace 15.

[0034] According to this calculation, the processing unit 30 is able to regulate the activation of at least some of the pairs of rolls 25 of the extraction and straightening assembly 12 in order to achieve a differentiated pressing in the direction of the width, between one side and the other of the slab 24, in order to at least partly eliminate this misalignment.

[0035] To be more exact, as shown in Fig. 4, the processing unit 30 commands actuators 32 to be activated, able to incline a relative roll 25 with respect to the nominal position of its own axis 33, normally substantially horizontal, in order to achieve a differentiated pressing on the sides of the slab 24.

[0036] This correction of the reciprocal position of the rolls 25 can also occur starting from a situation in which the rolls, in their nominal position, are not parallel, for example, due to thermal dilation or other factors beyond the control of the system.

[0037] The control system detects in this case a situation of misalignment, and corrects it by progressively pressing more or less on one side of the rolls 25 of the extraction assembly 12.

[0038] The differentiated pressing action may concern one, some or all the pairs of rolls 25 of the assembly 12 according to the entity of the discrepancy Δ detected; the pressing action may also be continuously modulated according to the continuous detections of the means 26 and according to the calculations and data processing made by the unit 30.

[0039] Since the differentiated pressing action is made on the product emerging from the mold 13, the differences in thickness created on the width of the slab 24 do not cause problems and can be recovered during the first rolling steps - roughing or pre-finishing - when the lateral sliding of the material is not constrained by the rolling rolls.

[0040] In this way, the slab 24 entering the furnace 15

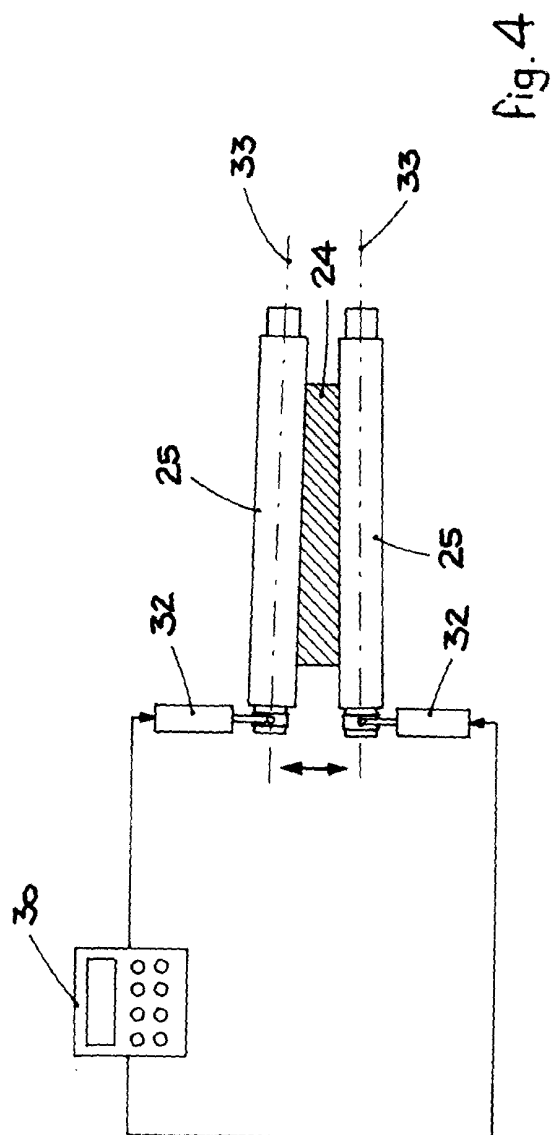
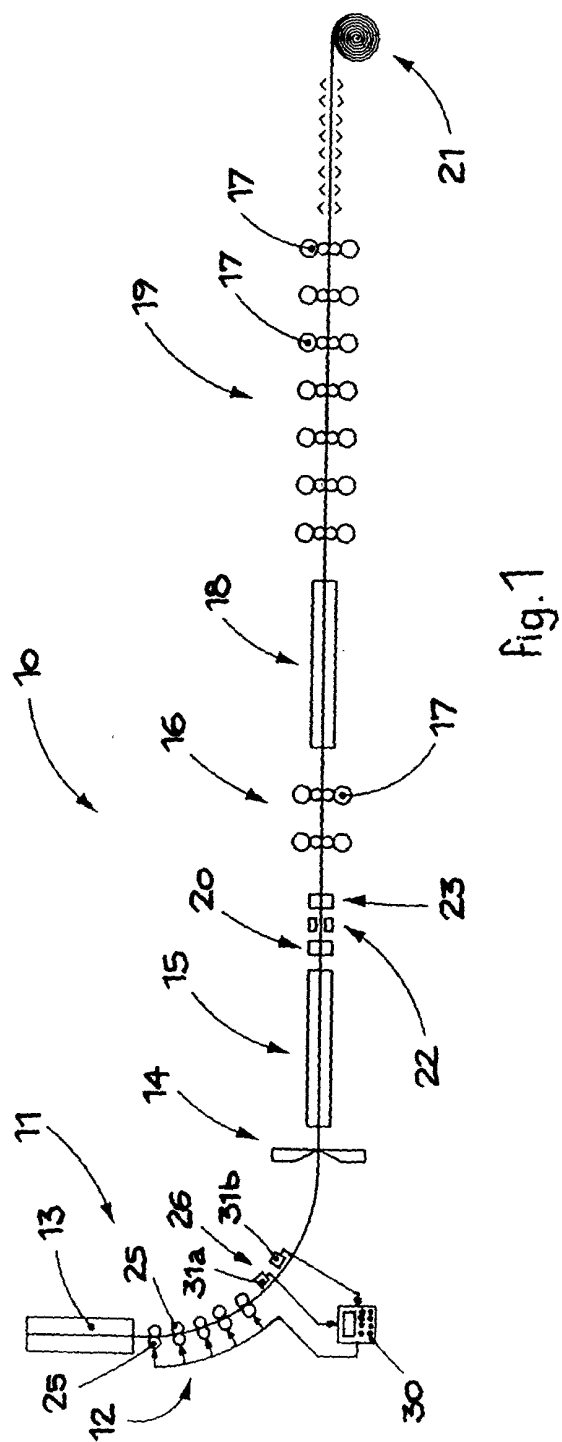
arrives substantially aligned with the rolling axis 27, and the risks of progressive slipping towards the walls of the furnace are avoided.

[0041] In the event that the discrepancy Δ is too great, and cannot be corrected by means of the differentiated pressing action alone, this action can be combined with other alignment systems which act inside or downstream of the furnace.

[0042] Although the invention has been described with reference to several preferential embodiments, it is obvious that modifications and variants may be made thereto by a person skilled in this field, but these shall remain within the field of protection defined by the attached claims.

Claims

1. Method to control the axial position of slabs emerging from continuous casting applied in rolling plants comprising at least a casting machine (11), an extraction and straightening assembly (12) with pairs of rolls (25), a heating and/or temperature maintenance furnace (15) and a roughing and pre-finishing (16) or finishing train (19) comprising at least one rolling stand (17), said method serving to substantially align the axis (28) of a slab (24) entering said furnace (15) with the axis (27) of the first rolling stand (17), the method being characterized in that it provides a first step to control the axial position of the slab (24) carried out in at least one position upstream of or inside said furnace (15), to detect a possible discrepancy (Δ) of the axis (28) of the slab (24) with respect to the rolling axis (27), and a second step to activate in a controlled manner at least a pair of rolls (25) of said extraction and straightening assembly (12) to perform a differentiated pressing in the direction of the width of the slab (24) in order to at least partly eliminate said discrepancy (Δ).
2. Method as in Claim 1, characterized in that said first step of controlling the axial position of the slab (24) is performed at least in two different positions upstream of or inside the furnace (15).
3. Method as in Claim 1 or 2, characterized in that said step of controlled activation of at least one pair of rolls (25) is continuously modulated according to the continuous control of the axial position of the slab (24).
4. Method as in any claim hereinbefore, characterized in that said step of controlling the axial position of the slab (24) provides to calculate the exact position, in terms of distance and discrepancy (Δ), of the leading end of the slab (24) inside the furnace (15).
5. Method as in any claim hereinbefore, characterized in that said step of differentiated pressing of the slab (24) carried out by at least one pair of rolls (25) of the extraction and straightening assembly (12) is associated with at least an alignment procedure carried out inside the furnace (15) or downstream thereof.
6. Device to control the axial position of slabs emerging from continuous casting, applied in rolling plants comprising at least a casting machine (11), an extraction and straightening assembly (12) with pairs of rolls (25), a heating and/or temperature maintenance furnace (15) and a roughing and pre-finishing (16) or finishing train (19), the device being characterized in that it comprises means (26, 31a, 31b) to detect the axial position of the slab (24) arranged in at least a position upstream of or inside said furnace (15) and a processing unit (30) able to receive from said means (26, 31a, 31b) the signal relating to the axial position of the slab (24) and to regulate the activation of at least one of said pairs of rolls (25) of the extraction and straightening assembly (12) to obtain a differentiated pressing of the slab (24) in the direction of the width in order to at least partly eliminate a possible discrepancy (Δ) of the axis (28) of the slab (24) with respect to the rolling axis (27).
7. Device as in Claim 6, characterized in that it comprises at least two detector means (31a, 31b) arranged in two different positions upstream of or inside said furnace (15).
8. Device as in Claim 6, characterized in that said processing unit (30) is able to act on actuators (32) suitable to incline a relative roll (25) of at least one of said pairs of rolls (25) with respect to its substantially horizontal nominal position in order to achieve a differentiated pressing on the sides of said slab (24).
9. Device as in Claim 6, characterized in that said processing unit (30) is able to act on actuators (32) suitable to act on a relative roll (25) in the event that the rolls (25) of a pair are not parallel, due to thermal dilation or other factors.
10. Device as in Claim 6, characterized in that said detector means (31a, 31b) are able to continuously detect the axial position of said slab (24) and said processing unit (30) is able to continuously regulate the activation of said pairs of rolls (25) to at least partly eliminate said axial discrepancy (Δ).



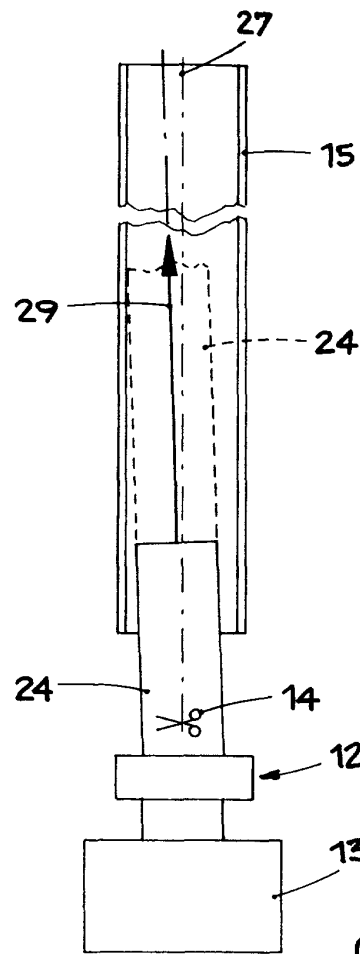


Fig. 2

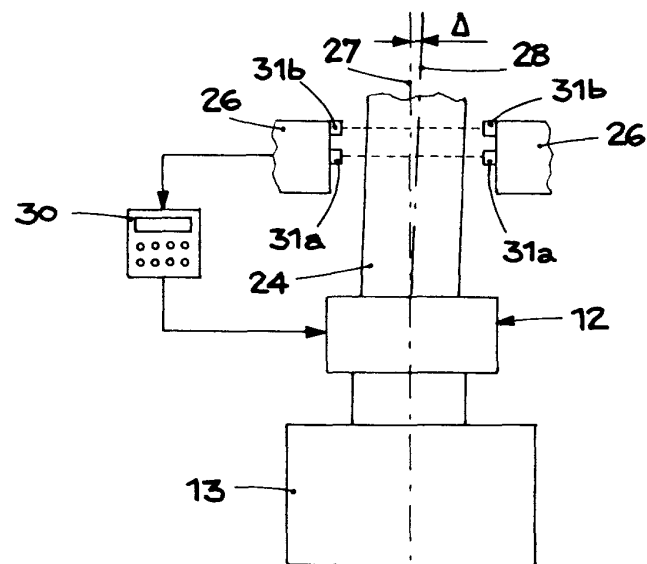


Fig. 3



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