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[Continued on next page]

(54) Title: SIDE TRIMMING APPARATUS FOR TRIMMING LONGITUDINAL EDGES OF A METAL STRIP

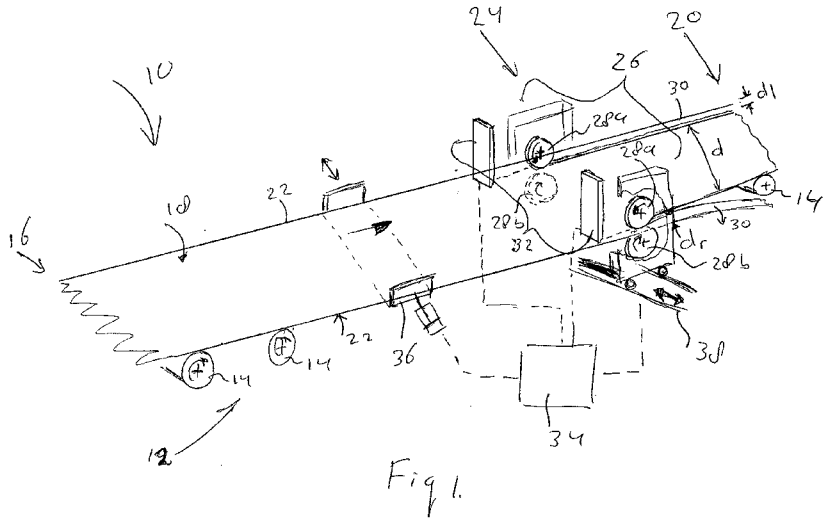

Fig 1.

(57) Abstract: The invention relates to a side trimming apparatus (10) for trimming longitudinal edges (22) of a metal strip (18) to provide a trimmed strip having a constant width (d), the apparatus comprising a conveyor means (14) for conveying the metal strip in a machine direction, a trimming means (26) for trimming both longitudinal edges by removing side scrap (30), a steering unit (36) for mutually displacing the strip and the trimming means in a direction perpendicular to the machine direction, a control means (34) for controlling movement of the steering unit, wherein the control means comprise a side scrap width measurement means (32) for measuring the width of either side scrap removed at the trimming means, and a computer means for conversion of width data received from the side scrap width measurement means into steering data for the steering unit.

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SIDE TRIMMING APPARATUS FOR TRIMMING LONGITUDINAL EDGES OF A METAL STRIP

The present invention relates to a side trimming apparatus for trimming longitudinal edges of a metal strip resulting in a trimmed metal strip having a constant width over its length.

In the art of metal strip production, e.g. steel or aluminium strip, it is customary to trim the longitudinal edges of the metal strip after rolling and/or tempering, because these processes result in a strip of which the width may vary, the edges may be irregular and the strip may not be uniformly straight. Usually the strip is deliberately oversized (also known as overage) in the rolling process, e.g. in the hot rolling mill. Trimming is intended to remove a small part at either longitudinal edge of the strip. Hereinafter, this small part is referred to as "side scrap". As the strip derived from the preceding rolling and/or tempering processes may not be uniformly straight over its length, the strip is usually centred before it is trimmed.

A side trimming apparatus comprises basically a conveyor means for conveying the metal strip in a machine direction. During movement the strip is trimmed by a trimming means for trimming both longitudinal edges by removing side scrap. The trimming means usually comprise trimming blades which are arranged at a fixed position, that is predetermined by the width of the trimmed strip that is to be achieved. In order to achieve a neatly trimmed edge the side scrap should not be too narrow, otherwise excessive tearing may result in an irregularly trimmed edge. Therefore the strip is centred against the trimming means, e.g. by measuring the edge positions using sensors, which is used as a control feedback for actuating a steering unit. This steering unit gradually or stepwise displaces the moving strip in its width direction, i.e. perpendicular to the machine direction. In a known side trimming apparatus the edge positions are determined using line scan cameras and associated light sources. These are positioned a few metres away upstream from the trimming blades. The scanned positions are fed to a steering module, comprising a controller for controlling the actual steering unit, e.g. a table or the like. Due to the mutual positions there are lags and inaccuracies associated with this known apparatus. As a result steering accuracy is at most within a few mm of the centre line of the strip.

However, typical customer tolerances regarding strip width are -0 mm and +1 mm with edge quality being vital. If a trimmed strip does not meet the specifications, re-processing is necessary, but costly. Moreover, due to the enormous volume of strip it would be economically interesting to approach the upper tolerance limit as much as possible, as the strip is sold per tonne.

Therefore, there is a general need to improve the accuracy of the side trimming apparatuses and processes.

It is an object of the present invention to meet this need at least partly.

The side trimming apparatus for trimming longitudinal edges of a metal strip resulting in a trimmed strip having a constant width according to the invention comprises a conveyor means for conveying the metal strip in a machine direction, a trimming means for trimming both longitudinal edges by removing side scrap, a steering unit for mutually displacing the strip and the trimming means in a direction perpendicular to the machine direction, a control means for controlling movement of the steering unit, wherein the control means comprise a side scrap width measurement means for measuring the width of either side scrap removed at the trimming means, and a computer means for conversion of width data received from the side scrap width measurement means into a steering signal for the steering unit.

In the side trimming apparatus according to the invention the conveyor means are configured for conveyance of the metal strip, e.g. derived from preceding processes like rolling and/or tempering, from a feed end for introducing the metal strip to be trimmed, past the steering unit, measurement means and trimming means, in that order, towards a discharge end, where the trimmed strip exits the side trimming apparatus for further processing, like coiling. Typically, the conveyor means comprise at least one driven roll, and a number of guiding rolls and idle rolls. The side trimming apparatus also comprises a steering unit. This steering unit operates such that the mutual position of the strip and the trimming means is adjusted in the width direction of the strip, based on data obtained from the side scrap width measurement means as will be explained in more detail below. E.g. the strip can be displaced upstream from stationary trimming means. Steering units of this kind are well known in the art and commercially available e.g. from EMG Automation GmbH. It is also possible to adjust the width position of the

trimming means, while maintaining the original position of the moving strip. The width of the trimmed strip is not changed. The trimming means can comprise pairs of (rotatable) cutting blades at both sides of the strip, wherein each pair comprises an upper cutting blade and a lower one. The strip runs between the upper and lower blades. Typically the trimming means would notch the strip first and then move into the desired width according to the specifications. Once in position, the trimming means remain in this fixed position. The position is only altered for a following different notch or coil. In the invention there is also a side scrap width measurement means for measuring the width of either side scrap removed at the trimming means. Arranging the measurement means upstream from the trimming means and determining the actual scrap side width where scrap is still under tension allows keeping the side scrap widths equal at both strip sides which is favourable in view of edge quality. Moreover, measuring side scrap widths gives an insight in the overage of the preceding processes. According to the invention the measured side scrap widths are used as feedback to control the steering unit.

Preferably the side scrap width measurement means is calibrated against the (outer) cutting edge of the trimming means. In this way an accurate measurement of strip overlap to the blade cut, i.e. the side scrap width, is obtained, which offers a more precise feedback for controlling the steering unit. A preferred measurement means is a so called LED micrometer. This kind of meters are commercially available, e.g. from Keyence Corporation.

In a further preferred embodiment of the side trimming apparatus the computer means are configured in such a way that the widths of either side scrap are mutually compared thereby establishing a difference factor and if the difference factor is above a predetermined threshold value the steering unit is actuated such that the side scrap widths are levelled. As side scrap is (semi-) continuously measured, e.g. at a sampling time of 1 sec., a corresponding frequent actuation of the steering unit would likely result in an oscillating operation. This is unnecessary and would deteriorate edge quality. Therefore only deviations between the measured scrap width that are significant (e.g. >= 0.1 mm) trigger the actuation of the steering unit.

Preferably, the computer means of the control means control the steering unit with an accuracy within a range of 1 mm. In this way the accuracy required by the customers is met.

The invention is further illustrated by reference to the attached drawing showing a diagrammatic representation of an embodiment of a scrap side width controlled side trimming apparatus according to the invention.

In Fig. 1 an embodiment of a side trimming apparatus according to the invention is indicated in its entirety by reference numeral 10. The apparatus 10 comprises a conveyor 12 comprising a number of driven rolls, guide rolls and idle rolls 14. The conveyor 12 extends from a feed position 16, where strip 18 to be trimmed is introduced in the apparatus 10, to a discharge position 20, where the trimmed strip 18 leaves the apparatus 10. During its run through the apparatus 10 the edges 22 of the strip 18 are trimmed in a trimming position 24. At the trimming position 24 trimming means indicated in its entirety by 26 is arranged. In this embodiment the trimming means 26 comprise a set of cutting blades 28 at each edge 22. The strip 18 runs between the upper cutting blades 28a and the lower cutting blades 28b. The trimming means 26 remove at each edge 22 a side scrap part 30 having a side scrap width dl and dr respectively. The side scrap width is measured by measurement means 32 that is arranged upstream of the trimmer means 26. In this embodiment the measurement means 32 comprise LED micrometers near each edge 22. The position of the cutting edge of an upper cutting blade 28a is used as a zero point for calibration. The data obtained from the measurement means 32 are processed in controller means 34, such as a PLC. The processed data, e.g. $\Delta d=dl-dr$, are used to actuate a steering unit 36 if Δd exceeds a threshold value. The steering unit 36 causes a shift of the strip 18 in its cross direction to level the side scrap width dl and dr.

An alternative steering unit 38 for crosswise displacement of the trimmer means 26 with respect to the strip 18, such as a carriage on rail system, a hydraulic piston-cylinder assembly or tooth rack, controlled by control means 34 is also shown.

CLAIMS

1. Side trimming apparatus for trimming longitudinal edges of a metal strip to provide a trimmed strip having a constant width, the apparatus comprising a conveyor means for conveying the metal strip in a machine direction, a trimming means for trimming both longitudinal edges by removing side scrap, a steering unit for mutually displacing the strip and the trimming means in a direction perpendicular to the machine direction, a control means for controlling movement of the steering unit, wherein the control means comprise a side scrap width measurement means for measuring the width of either side scrap removed at the trimming means, and a computer means for conversion of width data received from the side scrap width measurement means into steering data for the steering unit.

2. Side trimming apparatus according to claim 1, wherein the side scrap width measurement means is calibrated against the cutting edge of the trimming means.

3. Side trimming apparatus according to any one of the preceding claims, wherein the computer means are configured in such a way that the widths of either side scrap are mutually compared establishing a difference factor and if the difference factor is above a predetermined threshold value the steering unit is actuated such that the side scrap widths are levelled.

4. Side trimming apparatus according to any one of the preceding claims, wherein the side scrap width measurement means comprise LED micrometers.

5. Side trimming apparatus according to any one of the preceding claims, wherein the computer means of the control means control the steering unit with an accuracy within a range of 1 mm.

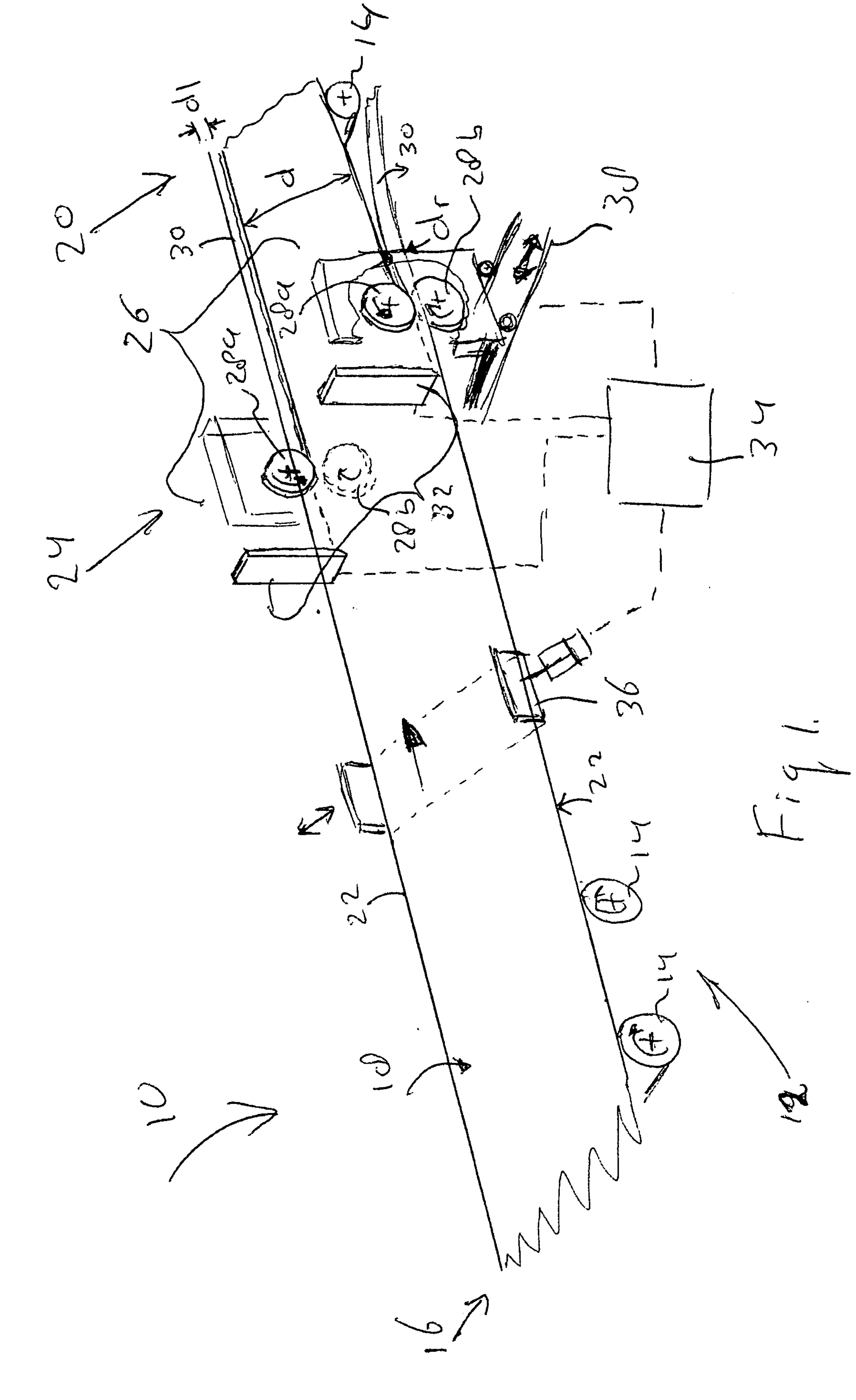

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. B23D33/02
ADD.

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)
B23D

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 306 154 A1 (BWG BERGWERK WALZWERK [DE]) 2 May 2003 (2003-05-02) paragraph [0005]	1-4
A	JP 8 267309 A (KAWASAKI STEEL CO) 15 October 1996 (1996-10-15) abstract	1-4
A	DE 23 41 621 A1 (SACK GMBH MASCHF) 20 March 1975 (1975-03-20) the whole document	1-4
A	US 3 662 638 A (FRIES GUNTER KARL ET AL) 16 May 1972 (1972-05-16) abstract	1-4

☐ 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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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