United States Patent

Gay

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[54] METHOD AND DEVICE FOR THE CONTINUOUS ROLLING OF THIN STRIPS

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[51] **Int. Cl.** **B21b 1/28**

[58] **Field of Search** 72/205, 234, 199; 29/17, 18

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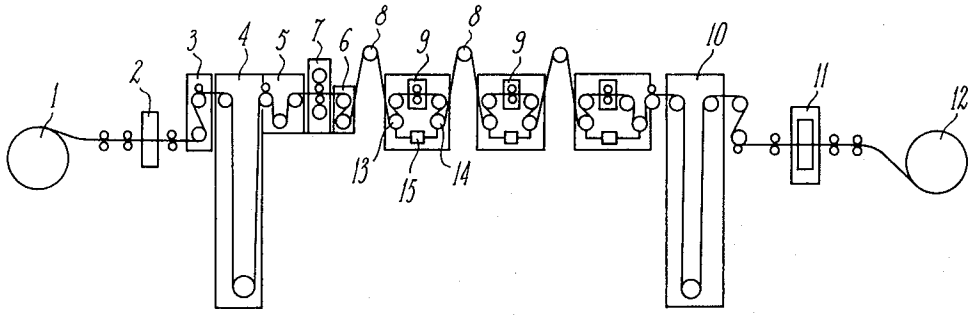
[57] **ABSTRACT**

A previously hot-rolled strip is subjected to a first thickness-regularizing pass in the cold state through a mill permitting of not maintaining to a constant value the thickness variations of the strip before and after the rolling operation, that is, imparting to the strip an elongation to which a constant value is not imposed, that first pass being followed by several rolling passes performed in rolling stands in which a predetermined elongation is imparted to the strip.

3 Claims, 4 Drawing Figures



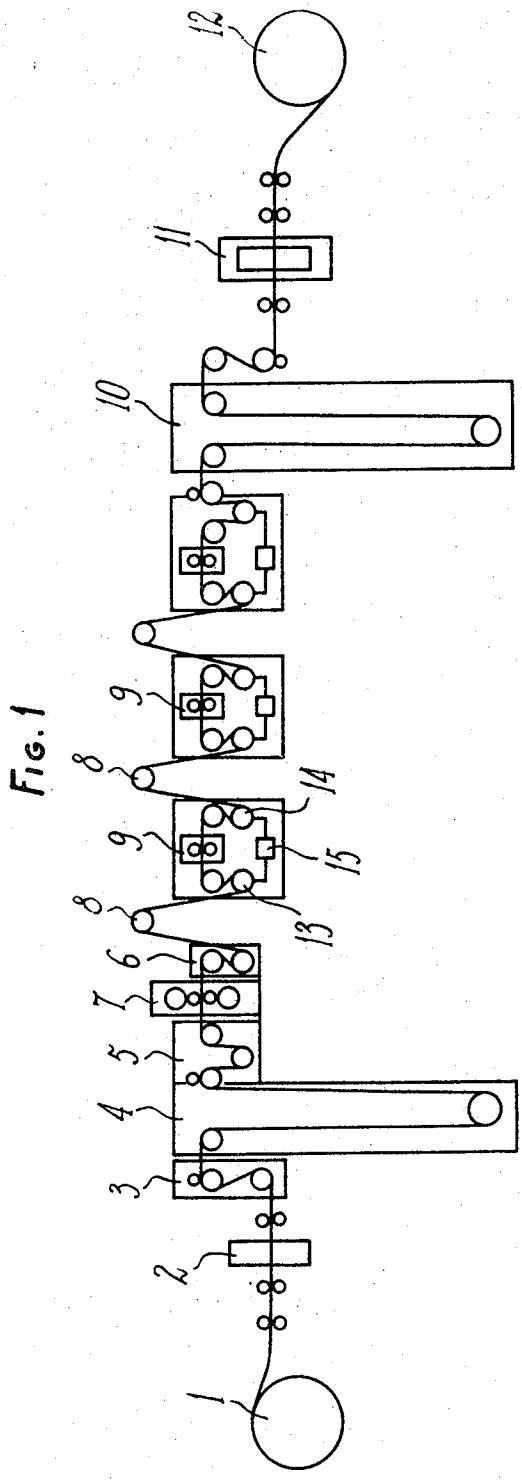


FIG. 1

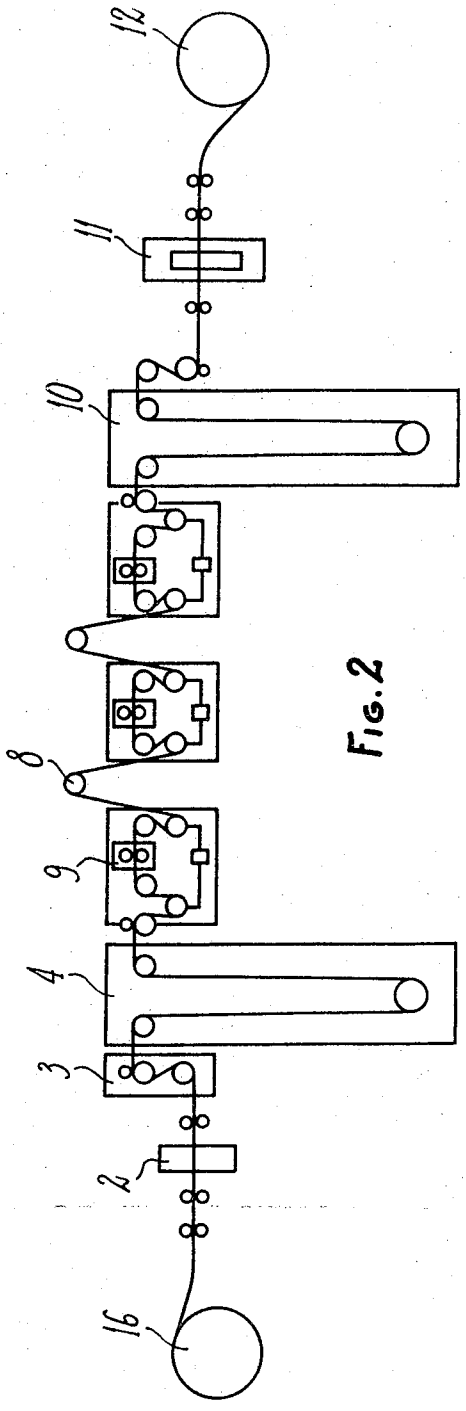


FIG. 2

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FIG. 3

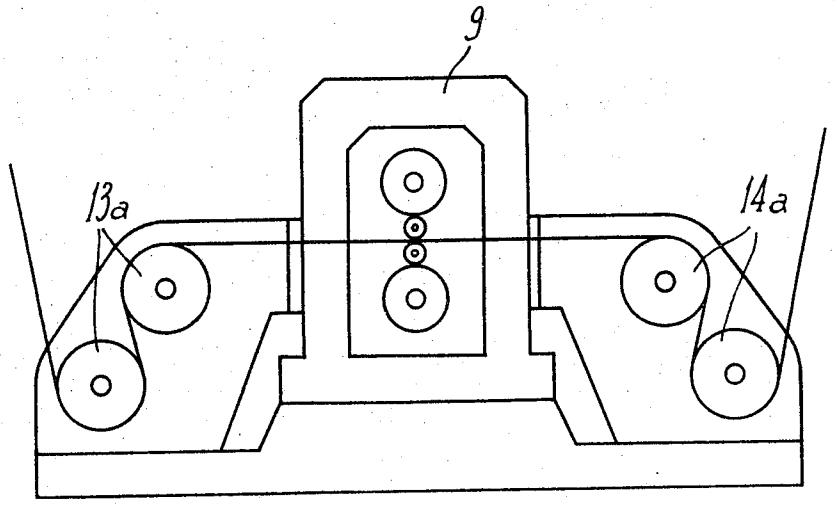
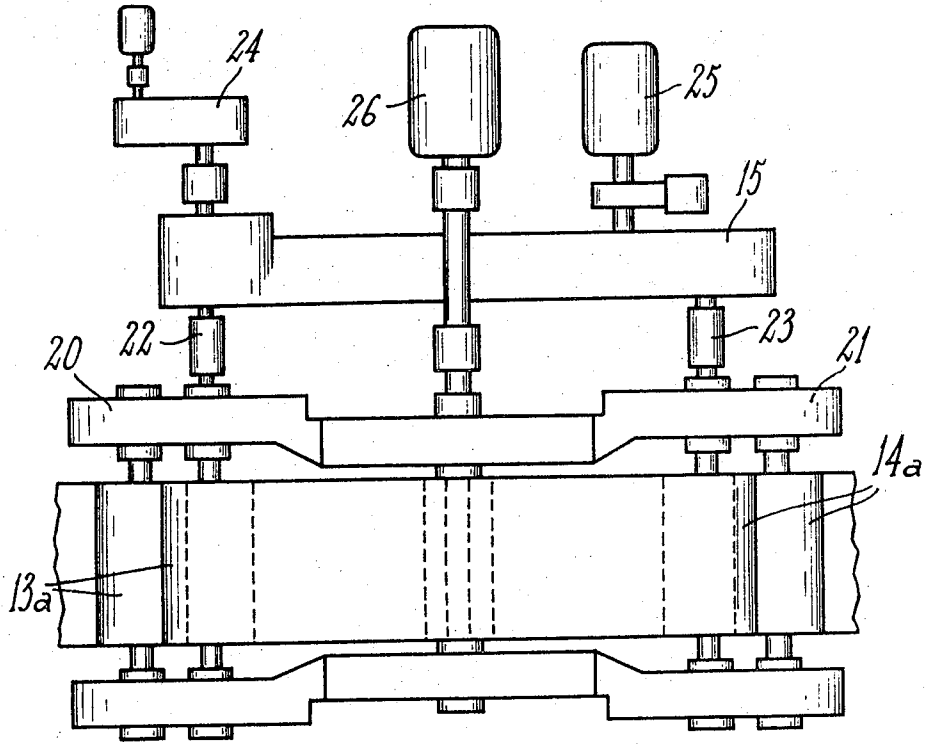


FIG. 4



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METHOD AND DEVICE FOR THE CONTINUOUS ROLLING OF THIN STRIPS

The present invention relates to a method of and a device for the continuous rolling of thin metal strips.

It is known that if the ratio of the linear speeds of a metal strip on the entering side and on the exit side of a rolling stand is kept at a constant value, a given elongation and therefore a given thickness reduction is imparted to said strip.

The variations in thickness of the strip formed during the rolling cycle will have the same relative values as the variations in thickness of the strip before the rolling operation. As a result, the rolling operation will produce a strip of which the absolute variations in thickness will be smaller than those of the strip before the rolling operation.

Under these conditions it is clear that a rolling operation with a preset elongation will permit of producing thin strips with a high degree of precision in the thickness thereof. Thus, for example, considering an initial strip having a nominal thickness of, say, 2 millimeters, with a maximum thickness variations of the order of 0.05 mm, if this strip is rolled with constant elongations to reduce its thickness to 0.2 mm, the thickness variations of the end strip product will not be in excess of five microns.

Of course, this result is not subordinate to the nature of the rolling stand of which the structure is immaterial.

Devices are already known which are designed for imparting a predetermined elongation to a strip as it travels through a rolling stand. These known devices consist of rolls divided into two groups : a first group disposed upstream of the rolling stand and of which the rolls are mechanically interconnected so as to have the same peripheral speed; this group will be referred to as the retaining unit; and a second group disposed downstream of the rolling stand and of which the rolls are also mechanically interconnected so as to have the same peripheral speed; this second group will be referred to as the driving unit.

In order to keep the ratio of the peripheral speeds of the rolls constituting each group to a constant, predetermined value, mechanical connecting means are provided between the two groups of rolls. This ratio may be rendered adjustable by interposing mechanical or hydraulic variable-speed glaring, for example, in this mechanical connection between the two groups.

Low-yield rolling mills are also known, on the other hand, i.e. mills wherein the distance between the axes of the rolls varies but little when the rolling effort varies. Rolling mills of this type are adapted to deliver from an input product of irregular thickness, for example a hot-rolled strip, an output product of which the maximum thickness variation will not exceed a few hundredths of millimeter. Now these favorable results cannot be obtained unless the rolling mills are constructed with a high degree of rigidity, or by imparting thereto an apparent rigidity by resorting to known contrivances such as prestress, yield corrections, etc.

It is the essential object of the present invention to provide a rolling method and means which combine the advantageous features of the devices briefly described hereinabove.

The method of this invention is characterized in that the previously hot-rolled strip is subjected to a first thickness-regularizing pass in the cold state through a mill permitting of not maintaining to a constant value the thickness variations of the strip before and after the rolling operation, that is, imparting to the strip an elongation which is not necessarily of constant value, this first pass being followed by several rolling passes performed in rolling stands in which a predetermined elongation is imparted to the strip.

The device for carrying out the method of this invention comprises a rolling stand for performing said regularizing pass, which is disposed between two tension units imparting to the strip an elongation of which the value is not necessarily constant, said regularizing rolling stand being followed by a plurality of rolling stands each adapted to impart a predetermined elongation to the strip which is worked simultaneously in a plurality of rolling stands, the elongation being imposed in each stand by using tension units disposed on either side of each stand, the rotational speeds of these units being maintained at a constant, adjustable ratio by means of a mechanical connection between these units, the adjustment of this ratio kept at a constant value being obtained by using a variable speed gearing.

Other feature and advantages of this invention will appear as the following description proceeds with reference to the attached drawing illustrating diagrammatically by way of example two specific forms of embodiment given by way of example but not of limitation. In the drawings :

FIG. 1 illustrates schematically in elevational view the device of this invention in the case of an arrangement wherein the strip is worked simultaneously by a thickness regularizing rolling stand and by further stands each adapted to impart a predetermined elongation thereto;

FIG. 2 illustrates schematically in elevation means for carrying out only the strip treatment in a plurality of stands to impart a predetermined elongation thereto, after the strip has been previously treated in a device such as shown in FIG. 1;

FIG. 3 illustrates on a larger scale one of the strip-elongating rolling stands, and

FIG. 4 is a plan view of the arrangement illustrated in FIG. 3, showing in greater details the means contemplated for driving the strip through this stand.

Referring to the drawings and more particularly to FIG. 1, it will be seen from left to right (i.e. direction of travel of the strip), the hot-rolled coil **1** mounted on the pay-out reel, followed by a welding unit **2** whereby, when the end of the coil is reached, a fresh coil is substituted therefor and the leading end is butt-welded to the trailing end of the strip remaining in the rolling line. Next, the arrangement comprises a tension unit **3**, a loop pit **4** permitting of accumulating a certain strip length to be rolled while the welding unit **2** is performing the aforesaid butt-welding operation, and tension units **5** and **6** disposed on either side of a rolling stand **7** in which a thickness regularizing pass is performed.

After this regularizing pass the strip is directed over a loop roll **8** and then through a series of rolling stands such as **9** each disposed between tension units such as **13** and **14**, the velocities of rotation of these units being kept at a constant adjustable ratio by mechanical connecting means shown in diagrammatic form at **15**, so that the desired elongation is imparted to the strip.

In the specific form of embodiment illustrated in more detail in FIGS. **3** and **4**, the tension unit **13** and **14** each comprise two rolls **13***a* and **14***a* respectively, disposed on either side of a rolling stand consisting of a four-high stand.

As already known in the art, the rolls **13***a* are synchronized with each other by means of gears housed in a case **20** and the rolls **14***a* are also synchronized with each other by other gears housed in a case **21**. The trains of gears are driven from shafts **22** and **23** respectively. The conventional driving mechanism designated generally by the reference numeral **15** is adapted to keep the ratio of the velocities of shafts **22** and **23** at a constant value. A variable-speed gearing **24** permits of modifying this constant ratio. A motor **25** provides the power necessary for driving the mechanism **15** and therefore the rolls of units **13** and **14**. Another motor **26** drives the rolls of the rolling stand **9**.

Loop means **8** are interposed between these rolling stands **9** and their function consists in providing a tension on the entering side and on the exit side of the tension units while permitting of accumulating strip. The arrangement is completed by a loop pit **10**, a cutting device **11** and a winding reel **12**.

In the device illustrated in FIG. **2** the coil **1** of FIG. **1** is replaced by a coil **16** delivered from a rolling line of the type illustrated in FIG. **1** in which it was subjected to an equalizing and reducing pass, and was then possibly annealed.

This device comprises all the means described hereinabove with reference to FIG. **1**, except of course the stand **7** where the thickness regularizing pass is performed; it is therefore not deemed necessary to describe it again.

Of course, this invention should not be construed as being limited by the specific forms of embodiment illustrated and described herein, since many modifications may be brought thereto without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A device for continuously cold-rolling a thin strip comprising a first rolling stand for performing a thickness regularizing pass, two tension units between which said rolling-stand is disposed to impart to said strip leaving said stand a more constant thickness than said strip had entering said stand, and a plurality of further rolling stands having tension units disposed on each side of each rolling stand each imparting a predetermined elongation to said strip, said elongation being imposed in each of said further stands by the use of said tension units disposed on each side of each stand, and mechanical connecting means disposed between said tension units for maintaining at a constant, adjustable ratio the rotation velocities of said units.

2. A device as set forth in claim 1, wherein variable-speed means are provided for adjusting the constant ratio maintained between the rotational speeds of the tension units disposed on either side of each of said further rolling stands.

3. A device as set forth in claim 1, wherein a variable-speed gearing is provided for adjusting the constant ratio maintained between the rotational speeds of the tension units disposed on either side of each of said further rolling stands and loop-forming means interposed between said rolling stands for tensioning said strip at the exit side of one stand and the tension unit at the entry side of the next stand while permitting accumulating strip in said loop-forming means.

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