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(54) COOLING OF A ROLL IN A ROLL STAND

(71) We, CENTRE DE RECHERCHES METALLURGIQUES/CENTRUM VOOR RESEARCH IN DE METALLURGIE, of 47 Rue Montoyer, Brussels, Belgium, a Belgian Body Corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a roll stand and to a method of cooling a roll, which can be applied in particular (but nor solely) in the case where one has to deal with grooved rolls, for example in rolling wire rod, such as steel wire rod.

The rolling of metal products, such as strip, bar and wire rod, results in the generation of large amounts of heat tending to raise the temperature of the rolls between which the products are rolled. The resulting increase in temperature adversely affects the performance of the rolls from several view points, among which the following should be mentioned; deterioration of the mechanical properties at the surface of the roll (substantially due to the temperature level reached), and rapid wear of the rolls (due to large temperature gradients).

Thus, in order to be able to continue rolling, it is important to cool the rolls so that, in operation, heating is kept within limits compatible with standard operation without unacceptable deterioration.

To this end, it has already been suggested to use devices which can be applied to rod rolling mills and in which the upper part of the upper roll of the roll stand is sprayed with a coolant liquid which flows along and around the rolled product and is allowed to run down the surface of the lower roll or rolls. In this way all the rolls of a stand are cooled by means of a single cooling liquid supply, but this device has the disadvantage of permitting only uneven and wrongly localised cooling of the rolls, which cannot be considered as an effective solution of the above-mentioned problem, in particular from the point of view of a sufficient and uniform decrease in the temperature gradient.

In order to decrease the temperature gradient, it has already been suggested to direct water against the rolls in a zone as close as possible to the contact areas between the rolls and the product. To this end, use was made of simple nozzles or conduits, which resulted in a very poor efficiency, a large amount of water being necessary. Moreover, positioning the nozzles was a different task in the case of grooved rolls, owing to the presence of guide rollers for the product between one groove and the other.

The present invention provides a method of cooling a roll in a roll stand having two rotating rolls defining between them a nip in which a product is to be rolled, comprising the steps of atomizing a coolant liquid by means of a compressed gas, forming the resulting mixture of gas and atomized liquid into a jet, and directing the jet immediately against a portion of the surface of one of the said rolls, the said surface portion being on the exit side of the stand and facing the rolled product emerging from the nip during rolling.

The higher the speed of the jet, the better is the cooling effect. Preferably, a Laval tube is used to atomise the liquid and to form the mixture into a jet. The jet should strike the roll as close as possible to the contact zone between the roll and the product.

It is preferable for the jet to have a velocity component directed in a direction opposite to the direction of rotation of the roll, which enhances the intimacy of contact between the mixture and the roll and, thus, the intensity of the cooling effect.

In the case where the method is applied to a stand having grooved rolls, the dimensions of the jet are preferably chosen such that the surface portion against which the jet is directed occupies at least the major part of the width, preferably the entire width, of the groove in the said roll. The dimensions of the jet can be adjusted by controlling the pressure of the compressed gas (e.g. air) used for atomizing the coolant liquid (e.g. water).

The invention also provides a roll stand comprising two rotatable rolls defining between them a nip in which a product is to be rolled, and a jet-forming nozzle having an axis directed towards a portion of the surface of one of the said rolls, the said surface

portion being on the exit side of the stand and facing the product emerging from the nip during rolling, the nozzle being in close proximity to the said one roll and having a bore diverging substantially conically towards an outlet and a conduit opening into the outlet end of the bore, means for supplying compressed gas to the bore, and means for supplying coolant liquid to the conduit, whereby the coolant liquid is atomized by the compressed gas.

The apparatus preferably comprises a series of nozzles disposed substantially in the same plane transverse to the rotation axis of the roll.

According to a first embodiment the axes of the nozzles are arranged in a fan configuration, i.e. they diverge towards the roll. According to a second embodiment they are arranged substantially parallel to one another, the outlets of the nozzles being mutually staggered stepwise one behind another, i.e. in the direction of the said axes.

Preferably the nozzles of the series are connected to one another and fixed to a guide through which the rolled product passes while emerging from between the rolls. This makes it possible, on the one hand, to orientate the nozzles accurately relative to one another so that, for example, they effectively spray a given groove and, on the other hand, to displace them together with the guide, for example for passing from one groove to another in the case where each roll has more than one groove.

The invention will be described further, by way of example only, with reference to the accompanying drawings, in which:—

Figure 1 is a diagrammatic cross-section of part of the exit side of a roll stand; and

Figure 2 is a similar view of another roll stand.

In the roll stand illustrated in Figure 1 there are two grooved rolls 1 and 2, the cross-section being taken at the position of a groove in each roll. The two rolls are rotated in the directions indicated by arrows 3 and 4 by a mill drive (not shown). A guide 5 has its axis 6 directed along the grooves in question and is formed with a bore 7 through which rolled product can pass as it emerges from the nip defined between the rolls 1, 2.

The roll stand has a cooling device comprising two series each of three nozzles 8 to 10 and 11 to 13 (in the form of Laval tubes) having their axes diverging in a fan configuration in the same plane perpendicular to the axes of the rolls and intersecting the middle of each groove in question. Compressed air flows through the substantially conically divergent outlet sections of the bores 14 of the nozzles, the air being supplied to their convergent inlet ends, whereas coolant water is supplied through a common conduit 15 opening laterally into the outlet ends of the bores 14 obliquely to their longitudinal axes, where it is atomized by the compressed air and emerges from the Laval tubes as jets. An assembly of each series is mounted rigid with the guide 5 by the intermediary of a sleeve 16. Each jet is directed immediately against a surface portion of the respective roll on the exit side of the stand and facing the rolled product emerging from the nip. The jets nearest the axis 6 have a velocity component directed oppositely to the direction of rotation of the respective rolls.

Figure 2 shows a variant of the cooling device shown in Figure 1, each series of nozzles in this case comprising two nozzles whose axes are parallel and whose outlets are staggered one behind the other. The remaining features are the same as in Figure 1.

WHAT WE CLAIM IS:—

1. A method of cooling a roll in a roll stand having two rotating rolls defining between them a nip in which a product is to be rolled, comprising the steps of atomizing a coolant liquid by means of a compressed gas, forming the resulting mixture of gas and atomized liquid into a jet, and directing the jet immediately against a portion of the surface of one of the said rolls, the said surface portion being on the exit side of the stand and facing the rolled product emerging from the nip during rolling.

2. A method as claimed in claim 1, in which a Laval tube is used to atomize the liquid and to form the mixture into a jet.

3. A method as claimed in claim 2, in which the compressed gas is introduced through the inlet end of the Laval tube and the liquid is introduced into the outlet end of the Laval tube.

4. A method as claimed in any of claims 1 to 3, in which the jet has a velocity component directed oppositely to the direction of rotation of the said one roll.

5. A method as claimed in any of claims 1 to 4, each roll having a circumferential groove in which the said surface portion occupies at least the major part of the width of the groove of the said one roll.

6. A method as claimed in any of claims 1 to 5, comprising directing more than one said jet against more than one said portion of at least one of the said rolls.

7. A roll stand comprising two rotatable rolls defining between them a nip in which a product is to be rolled, and a jet-forming nozzle having an axis directed towards a portion of the surface of one of the said rolls, the said surface portion being on the exit side of the stand and facing the product emerging from the nip during rolling, the nozzle being in close proximity to the said one roll and having a bore diverging substantially conically towards an outlet and a conduit opening into the outlet end of the bore, means for supplying compressed gas to the bore, and means

for supplying coolant liquid to the conduit, whereby the coolant liquid is atomized by the compressed gas.

8. A roll stand as claimed in claim 7, in which the bore of the nozzle comprises a Laval tube.

9. A roll stand as claimed in claim 7 or 8, in which each said roll has a circumferential groove and the axis of the nozzle intersects the groove of the said one roll.

10. A roll stand as claimed in any of claims 7 to 9, comprising more than one said nozzle having their axes directed towards more than one said surface portion of the said one roll.

11. A roll stand as claimed in claim 10, in which the axes of the nozzles lie in a single plane transverse to the axis of rotation of the said one roll.

12. A roll stand as claimed in claim 11, in which the nozzle axes diverge from one another towards the said one roll.

13. A roll stand as claimed in claim 11, in which the nozzle axes are substantially parallel to one another and the outlets are staggered stepwise one behind another.

14. A roll stand as claimed in any of claims 10 to 13, further comprising a guide through which the product passes while emerging from the nip defined between the rolls, the nozzles being connected together and fixed to the guide.

15. A roll stand as claimed in any of claims 7 to 14, comprising a plurality of said nozzles having their axes directed towards a plurality of said surface portions on both the said rolls.

16. A method of cooling a roll in a roll stand, substantially as described herein with reference to the accompanying drawings.

17. A roll stand substantially as described herein with reference to, and as shown in, Figure 1 or Figure 2 of the accompanying drawings.

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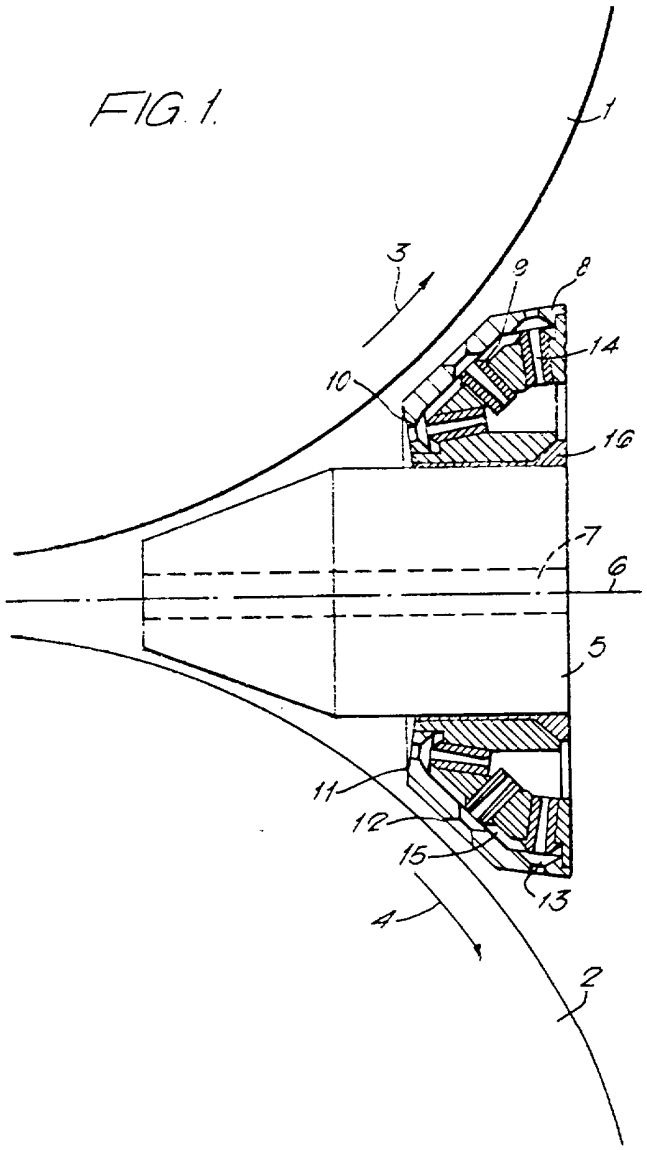
Sheet 1

FIG. 1.



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Sheet 2

FIG. 2.