March 14, 1939. W. ROHN 2,150,340

COOLING ROLLING MILL

Filed Sept. 27, 1937

Fig. 1

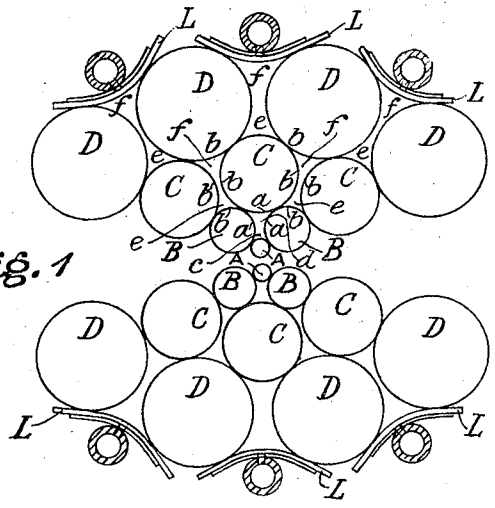


Fig. 2

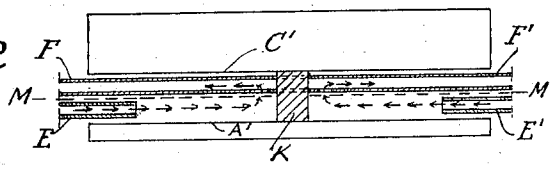


Fig. 3

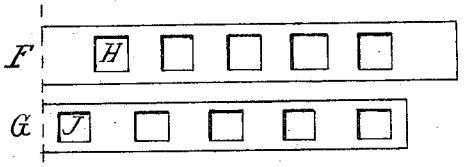
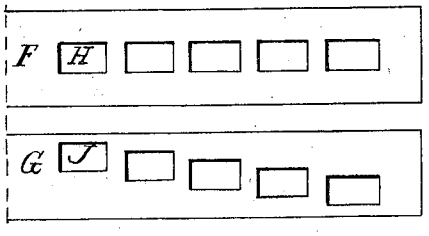


Fig. 4



Inventor:
Wilhelm Rohn
by
Paul Fischbeck
Attorney

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COOLING ROLLING MILL

Wilhelm Rohn, Hanau-on-the-Main, Germany

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11 Claims. (Cl. 80—41)

The present invention relates to means for cooling so-called multi-high rolling mills, for example 12 high and 20 high rolling mills.

Fig. 1 is a front view, partly in cross-section, of the rolls of a twenty-high rolling mill;

Fig. 2 is a fractional view, partly in cross-section, of an intermediate space of a twenty-high rolling mill;

Fig. 3 is a diagrammatic view showing the arrangement of two cooling-pipes;

Fig. 4 is a diagrammatic view showing another rangement of two cooling-pipes;

The arrangement of the rolls in a 20 high rolling mill is illustrated in Figure 1, in which A are the working rolls, B the rolls which support the working rolls, C further supporting rolls for the intermediate rolls B and D are the outer supporting rolls. The reference letters L represent strips of packing material, for example of felt or leather. These multi-high rolling mills enable working rolls of very small diameter to be employed and consequently a very great reduction can be effected at each pass. Owing to this, however, excessive heating of the rolls, and in particular of the working rolls, occurs and it is important to conduct this heat sufficiently rapidly away from the rolls, the more so because their capacity for taking up heat is only small. The known cooling devices by which the cooling liquid simply trickles from the outside over the surface of the rolls or is sprayed on to them are not sufficient because, if the rolls are merely sprinkled with liquid, the heat is not conducted away sufficiently quickly from the very small accessible surface of the working rolls and is not conducted away at all from the places indicated by the letters *a* and *b* in Figure 1. This is only possible if provision be made for a cooling medium, for example cooling oil or an emulsion of oil and water, to flow with sufficient speed through the intervening spaces *c*, *d* and *e*, *f* located between the places *a* and *b*, and the velocity of flow has a component of considerable magnitude parallel to the axis of the rolls. If for this purpose the cooling medium is allowed to flow from one end face of the rolls in the longitudinal direction of the rolls through the intermediate spaces *c*, *d* and *e*, *f* and a device for carrying away the oil is provided at the other end face of the rolls, the desired result may indeed be obtained, provided the rolls are not on too heavy duty and, more particularly, if the length of the rolls is not excessively great. In the case of rolls which are on particularly heavy rolling and of rolls of very great length it has been found that the cooling medium is heated up considerably while it flows along the surface of the rolls through the intermediate spaces *c*, *d* and *e*, *f*, the consequence of which is that the rolls become heated up at one end and increase slightly in diameter at this end, that is to say the pass between the rolls does not remain uniform along the entire length of the working rolls. This could be partially compensated by allowing the cooling medium to flow from right to left along the upper rolls and from left to right along the lower rolls. If this were done, however, both sets of rolls become very slightly conical which would lead to forced slipping and torsional oscillations and thereby to disturb the rolling operation. In order to avoid these disadvantages, according to the present invention the cooling medium is not introduced only at one end face of the rolls into the intermediate spaces *c*, *d* and *e*, *f* but is introduced from both end faces of the rolls, for example it enters through *c* and *e* and escapes from *d* and *f*. This can be done, for example, by providing a supply of cooling medium of the kind shown in Figure 2.

Figure 2 is a side view of the upper working roll A and the uppermost supporting roll C, the intermediate block K and the pipes E, E', F, F' being shown in vertical cross-section. In this figure A' indicates the surface of the roll A which faces the space *c*, and C' represents the surface of the roll C which faces the spaces *d*. The narrowest part of the hollow space between *c* and *d* is indicated by the dotted line M—M. The cooling medium is now pumped in, for example through pipes E and E' at both ends of the roll A into the hollow space *c* and is conducted away through the pipes F and F' in the hollow space *d* towards both end faces of the rolls. The direction of flow of the cooling medium is indicated by arrows. The cooling medium can, however, also be allowed to flow in the reverse direction through the pipe system. Which of the pipes F and E must be made shorter and which must be led to the centre of the hollow space will depend on the work which is being performed by the rolls at the time. In the arrangement illustrated, the ends of the working rolls are cooled most strongly and the middle is cooled least because the cooling medium has already become slightly warmer there. The result of this is that the working rolls become slightly thicker in the middle, that is to say they become slightly convex and therefore the crown is increased.

By a suitable choice of the direction of flow and of the lengths of the pipes the middle of the rolls can be kept cooler than the ends of the rolls

and the convexity or the crown is reduced so that the rolls can, to a large extent, be adapted to suit the kind of work which is being done at any time, i. e., they can be adapted to suit materials of greater or less hardness, or of different widths, as well as to the reduction desired to be effected per each pass or to meet differences in the thickness of the original strips between its edges and its center. The cooling medium can be introduced into the spaces *e*, *f* in a similar manner to that indicated in Figure 2 for the spaces *c*, *d* and the convexity, i. e., the crown of the intermediate and outer supporting rolls can thereby be influenced in a corresponding manner.

For example, when the working rolls have a diameter of 50 mm. and a length of 850 mm. and a power of 1000 kilowatts is employed, the supply of cooling medium can be regulated in such a way that the difference of temperature at the middle and ends of the working rolls amounts to 50° C. In this case the increase in the diameter of the rolls at the hottest places as compared with its diameter at the coolest place is 0.03 mm., which gives the rolls a crown which is desirable for rolling dead soft annealed mild steel strip of 600 mm. width. In the case of the supporting rolls of 500 mm. diameter, a temperature difference of 10° C. between the middle and ends of these rolls produces an increase in diameter of 0.06 mm.

In order now to be able to effect a particularly fine regulation of the difference in temperature between the middle and the ends of the rolls the device which is hereinafter described may be employed. For this purpose, for example, the pipe F which extends up to the central plane of the rolling mill is provided in the manner indicated in Figure 3 with openings which are uniformly distributed over its length in such a manner that the cooling medium flowing through the pipe F can escape through these openings. By means of a second pipe which is disposed inside or outside the pipe F and is longitudinally displaceable or rotatable relatively to the pipe F, some of the openings can be closed and the flow of cooling medium can thereby be controlled to flow mostly at the end or mostly at the middle. This arrangement is illustrated in detail in Figures 3 and 4. In Figure 3 the pipes F and G which are actually arranged concentrically to one another are shown one above the other. The pipe F has openings H, the distance between each one of them being equal to the diameter or width of the openings. The pipe G which is arranged concentrically to the pipe F has openings J which are of the same size as the openings H in the pipe F. In the example illustrated in Figure 3 the openings H and J coincide exactly at one end of the pipes F and G, while at the other end they are relatively displaced by a distance equal to the width of one of the openings. When the pipes are in the position illustrated in Figure 3, the opening at the extreme right of the pipe F is opened and the opening at the extreme left of the pipe is closed so that the oil escapes for the most part at the right-hand end of the pipe F. If now the pipe G is axially displaced so that its extreme left-hand opening coincides with the extreme left hand opening of the pipe F, then the extreme right-hand opening of the pipe F is closed completely and the cooling medium flows away at the side of the rolls to a considerably greater extent than previously. The pipes can also be adjusted to any intermediate position between these extreme positions. By this means any irregularities in the thickness of the hot-rolled starting material can be partly or fully compensated.

Another form of construction is illustrated in Figure 4. In this the pipe G is not displaceable axially along the pipe F but is rotatable. Both pipes are again arranged concentrically one to the other. In this case, however, the openings in the pipe G do not lie in a horizontal plane but are disposed in such a manner that when the openings H and J on the extreme right hand end of the pipes coincide, that is to say the extreme right-hand opening is free for the oil to flow out, the openings at the other end do not coincide and no oil can escape from the pipe F at this end.

It may be advisable in some cases to provide separate cooling systems for the individual intermediate spaces *c*, *d* and *e*, *f*. The conduct of heat away from intermediate spaces *c*, *d* is particularly important as the working rolls A heat up the most. Since the area of the triangular spaces *c*, *d* and the diameter of the working rolls are small, it may sometimes be advisable to press the cooling medium through the spaces *c*, *d* under higher pressure than through the other spaces *e*, *f*.

In order to prevent the cooling medium from flowing back through a pipe other than that provided for its outflow, for example for preventing the cooling medium from the pipe E from escaping through the pipe F', a fitting piece K can be provided at the center of the spaces. The fitting pieces may be for example of artificial resin, and can be fixed on the ends of pipes F and F'.

The pipes by which the cooling medium enters and leaves may also be arranged in such a way that they are axially displaceable, i. e., in the longitudinal direction of the rolls. By this means the outlet or outlets for the cooling medium can be displaced at will in the longitudinal direction of the rolls whereby the removal of the heat from the rolls can be regulated.

I claim:

1. The method of cooling multi-high rolling mills which consists in pumping a cooling medium through the intervening spaces between the rolls, the pressure of the cooling medium pumped through the intervening spaces adjacent the working rolls being higher than the pressure of the cooling medium pumped through the remaining intervening spaces between the supporting rolls.

2. The method of cooling multi-high rolling mills which consists in pumping a cooling medium through the intermediate spaces adjacent the working rolls under high pressure, and then conducting the medium escaping from the said spaces through the remaining intervening spaces between the supporting rolls.

3. In a multi-high rolling mill a system of pipes extending into the intervening spaces between the rolls nearly to the center of the rolls, another system of pipes extending from outside into the said intervening spaces, means for admitting a cooling medium to part of the pipes and withdrawing it through the other, and means for axially displacing the pipes.

4. In a multi-high rolling mill a system of pipes extending into the intervening spaces between the rolls nearly to the center of the rolls, another system of pipes extending from outside into the said intervening spaces, means for admitting a cooling medium to part of the pipes and withdrawing it through the other, and means for rotating the pipes.

5. The method of cooling multi-high rolling mills which consists in conducting from both ends of the rolls a cooling medium into the intervening spaces between the rolls, bounded at all sides by the cylindric roll surfaces, in a direction parallel to the axes of the rolls, and leading off the cooling medium from the center of the intervening spaces.

6. The method of cooling multi-high rolling mills which consists in conducting from both ends of the rolls a cooling medium into the intervening spaces between the rolls, bounded at all sides by the cylindric roll surfaces, in a direction parallel to the axes of the rolls, leading off the cooling medium from the center of the intervening spaces, and regulating the quantity and the rate of flow of the cooling medium in such a manner that a desired degree of convexity or crown is imparted to the rolls.

7. In a multi-high rolling mill, a number of pipes considerably shorter than one half the length of the rolls, a number of pipes having about half the length of the rolls, both kinds of pipes extending from both ends of the rolls into the intervening spaces bounded by the surfaces of the rolls, and means for introducing a cooling medium from outside into one kind of the pipes.

8. In a multi-high rolling mill, pipes extending from both ends of the rolls into the intervening spaces bounded by the surfaces of the rolls, part of the pipes reaching nearly to the center of the said spaces and part of them being provided with perforations distributed over their length, means for introducing a cooling medium from outside into a number of the pipes, and means for closing and opening the said perforations in a predetermined manner.

9. In a multi-high rolling mill, pipes extending from both ends of the rolls into the intervening spaces bounded by the surfaces of the rolls, part of the pipes reaching nearly to the center of the said spaces and part of them being provided with perforations distributed over their length, other perforated pipes arranged coaxially with the said perforated pipes, means for introducing a cooling medium from outside into a number of the pipes, and means for making coincide a desired part of the perforations in the coaxial pipes.

10. In a multi-high rolling mill, pipes extending from both ends of the rolls into the intervening spaces bounded by the surfaces of the rolls, part of the pipes reaching nearly to the center of the said spaces and part of them being provided with perforations distributed over their length, other perforated pipes arranged coaxially with the said perforated pipes, means for introducing a cooling medium from outside into a number of the pipes, and means for moving the pipes parallel to the axes of the rolls and thereby making coincide a desired part of the perforations in the coaxial pipes.

11. In a multi-high rolling mill, pipes extending from both ends of the rolls into the intervening spaces bounded by the surfaces of the rolls, part of the pipes reaching nearly to the center of the said spaces and part of them being provided with perforations distributed over their length, other perforated pipes arranged coaxially with the said perforated pipes, means for introducing a cooling medium from outside into a number of the pipes, and means for rotating the pipes around their axes and thereby making coincide a desired part of the perforations in the coaxial pipes.

WILHELM ROHN.