METHOD OF ROLLING E.G. LIGHT SECTIONS ON A MILL AND A MILL FOR USE WITH THE METHOD

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ABSTRACT
It is known to roll light sections by rolling the material on continuous roughing and finishing mills in succession, subsequently cutting the material into lengths and conveying them transversely in a cooling bed. The invention increases the capacity of the rolling mill by providing two parallel-axis finishing mills with a shear and a switch between the roughing mill and the finishing mill, the shear being actuated when the leading end of the respective length is at least within the respective finishing mill, and the length being initially rolled in the finishing mill at a speed equivalent to that of the roughing mill, but after a substantial proportion of the length has passed through the finishing mill, the finishing mill speed being substantially reduced, the next succeeding length meanwhile being fed through the other finishing mill.
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The present invention relates to a method for rolling material, in particular light sections, on a mill having a high throughput and to a mill for use with the method. The material is rolled on continuous roughing (pre-finishing) and finishing mills in succession and after being cut into suitable lengths, the lengths are conveyed to cooling beds, over which they are conveyed in a transverse direction and divided into commercial lengths.

It is desirable to increase the production capacity of the mill. The production capacity of a mill is primarily determined by the speed of rolling and the rate at which following stock-handling units are able to cope with the rolled stock; these stock-handling units have to operate at the same rate as the mill.

The mill proper is able to operate at a high production rate if the drive systems are suitably designed. This is already the case, for example, of rod mills. In light section mills, the maximum possible rolling speed is a function of the cooling bed charging rate. The best cooling bed charging rate which has so far been attained is approximately 20 metres per second.

The present invention provides a method of rolling material (preferably to form light sections), including rolling the material in a continuous pre-finishing mill with a light speed (e.g. of at least 40 metres/second), passing the material through a shear, and using the shear to cut the material into successive lengths suitable for further handling after rolling on a (e.g. for cooling in a cooling bed in which the lengths are conveyed generally transverse to the mill axis), passing the successive lengths through a switch, passing a first length of the material through first looping means, rolling the first length of material in a first finishing mill, actuating the switch to pass a second length of the material through second looping means, rolling the second length of material in a second finishing mill, actuating the switch to pass a third length of the material through the first looping means, and repeating the cycle, the shear being actuated when the leading end of the respective length is at least within (and preferably has passed through) the respective finishing mill, the length being initially rolled in the finishing mill at a speed equivalent to that of the pre-finishing mill, but after a substantial proportion (preferably about two-thirds) of the length has passed through the finishing mill, the finishing mill speed being substantially reduced (preferably down to a speed of about 10 metres/second).

The present invention also provides a rolling mill for rolling material, the mill having a continuous pre-finishing mill with a high exit speed (e.g. of at least 40 metres/second), a shear following the pre-finishing mill, a switch following the shear for switching the material into a first path or a second path, looping means and a finishing mill in each path (the finishing mills usually having parallel axes), and

Automatic control means for actuating the shear to cut the material into suitable lengths for further handling after rolling, and for actuating the shear whenever the leading end of the respective length of the material being cut off is at least within the respective finishing mill, for switching the switch to pass successive lengths alternately down the first path and down the second path, and for substantially reducing the speed of the finishing mill from a speed equivalent to the speed of the pre-finishing mill after a substantial proportion of the respective length has passed through the finishing mill.

The invention can increase the speed of the mill to between 40 and 50 metres/second, giving the mill a high hourly throughput rate. It is possible to operate the mill practically continuously at a high rolling speed by alternating the finishing mills.

The braking of the cut length in the respective finishing mill can be effected by braking the finishing mill motors from the high rolling speed of say 40 metres/second to a substantially lower, braked speed of say 10 metres/second in 1½ seconds. By the time braking has been effected, the length has practically left the finishing mill, and after the length has been run out on the run-out table, the finishing mill is brought back to the high rolling speed of 40 metres/second in 2 seconds. The whole rolling operation in the finishing mill is completed in (Finished section length = length of cooling bed)/rolling speed = 200 metres/40 m/s=5 sec.

The braking of the finishing mill from high to low rolling speed is effected in 1.5 seconds. The finishing mill runs at the low speed for a period of 0.5 seconds. The time to return from the low to the high rolling speed is 2 seconds, plus an additional 1 second safety period until the next length is braked in the other finishing mill. Every 10 seconds the next cooling bed length passes into the same finishing mill.

The invention has the advantage that the rolled stock can be put through the rolling mill at a substantially higher speed without the cooling bed costing any more. In addition there is the advantage of a high hourly throughput through the mill without this being deleteriously affected by the input capacity of the following stock-handling units. Because the lengths of section can be run out on the run-out table at a lower speed, it is possible to keep both the braking time and braking distance, and thus also the rate of cooling bed operation, to a reduced value whereas run-out speeds of 40 to 50 metres/second would require very long run-out tables because of the long braking distance and also very long cooling beds because only slower rates of operation can be controlled mechanically. These long run-out tables and the long cooling beds would, however, result in an exceedingly long plant. Using the invention, on the other hand, the length of the cooling bed can be kept to approximately 150 – 200 metres.

Each finishing mill will have one or more finishing stands. The finishing stands are powered by individual or combined drive systems.

The automatic control means may be arranged such that actuation of the shear causes a command signal to be given to substantially reduce the speed of the respective finishing mill.

The speed of the finishing mill can be substantially reduced either by means of a time-dependent braking system or by means of an optical switch in the run-out
table, since the length is at first rolled in the finishing mill at the high speed of the pre-finishing mill, until a substantial proportion thereof has run out on the run-out table.

In order to ensure that the rolled stock is conveyed reliably on the looping means, even when the speed is slowed down, as to avoid the lengths of material being pushed together and causing overlapping in the finishing mill, each looping means may be a looping table having a lateral guide plate, the position of the guide plate corresponding to the size of the largest loop. The growing loop can move against these guide plates in such a manner that the pressure in the rolled stock or material as the rolling speed is reduced cannot detrimentally affect the guidance of the material. For this reason each looping table can be made to rise slightly on one side and have a clearly defined, double-sided guide corresponding to the largest loop radius. Thus each looping means may be a looping table having a narrow looping channel with guide walls on either side thereof.

A respective single-strand run-out table may follow each respective finishing mill; each run-out table can have a brake pusher member. A transverse cooling bed may follow each run-out table, the transverse cooling bed being for conveying the lengths of rolled stock generally transverse to the finishing mill axis; the run-out tables can have ejectors, pushers or rakes for ejecting, pushing or lifting the lengths of rolled stock into the cooling beds. The cut lengths of the rolled stock can be equal to the cooling bed length, and each cooling bed is able to cope with half the production of the rolling mill. When the rolled stock has been conveyed transversely on the cooling bed, it leaves the cooling bed, having been cooled to the appropriate temperature for discharge, and is then conveyed on a run-out table to the following stock-handling unit.

Alternatively, however, a common, two-strand run-out table may follow both finishing mills, for receiving rolled stock from each finishing mill. From the two-strand run-out table, the lengths from each finishing mill can be conveyed together to a cooling bed with a double-sized cooling surface. This is, however, only possible where the rate of cooling operation is fast enough not to hold up the run out of the lengths from the rolling mill.

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

FIG. 1 is a plan view showing the basic layout of a plant in accordance with the invention;
FIG. 2 is a section through the looping table, along the line II—II in FIG. 1; and
FIG. 3 is a working diagram for the roll stands of the finishing mills.

Referring to FIG. 1, 2 and 3 are respectively a vertical and a horizontal rolling stand in a roughing (pre-finishing) mill A. The mill A is followed by a shear 3, from which the rolled stock passes through a switch 4 and deflecting rolls 5c to a double looping table 5 with guides 5a and 5b on either side. The external radius of the loop is limited by outer guide plates 6, 6a and inner guide plates 7, 7a (see FIG. 2) which are inclined so as to rise slightly and then drop vertically; this prevents the rolled stock cobbling. At the outlet ends of the loop guides 5a, 5b are arranged tubular guides 8, 8a which convey the rolled stock alternately to one of two finishing mills composed of a horizontal and a vertical stand 1a, 2a or 1b, 2b, the two mills being designated B and C respectively. Following the roll stands of the finishing mills B and C are two run-out tables 10, 10a, one for each finishing mill, which are aligned with the axes of the respective finishing mills; each run-out table 10 or 10a is provided with a brake pusher member D and, in the vicinity of a respective laterally adjoining cooling bed 11 or 12, with a pusher member S for conveying the rolled stock to the appropriate cooling bed 11 or 12.

The plant operates as follows. The steel is rolled in the roughing mill A at a speed of about 40 to 50 metres/second. After a length I equivalent to a cooling bed length has passed through the mill, it is cut from the strand of rolled stock by the shear 3, passes through the switch 4 and the guide 5a of the looping table 5 and then through the tubular guide 8 onto the finishing mill B, where the rolled stock is further rolled, initially still at a speed of 40 or 50 metres/second. As soon as approximately ½ of the length of rolled stock has been discharged from the finishing mill B to the run-out conveyor 10, the shear 3 cuts off a further length II corresponding to a cooling bed length. The shear 3 gives a command signal when it is actuated, and this command signal causes the drive of the finishing mill B to brake to 10 metres/second and at the same time the end of the cooling bed length is deflected on to the looping table 5 by means of the deflecting rolls 5c so that the loop of rolled stock passes close to the guide plates 6 and 7 and the thrust in the rolled stock produced when the finishing mill B is braked is absorbed in the narrow guides of the looping table. At the same time, the leading end on the run-out conveyor 10 is subjected to tensile stress which theoretically has no harmful effect on the rolled stock.

The leading end of the rolled stock which follows the cooling bed length I is caused, by reversal of the point 4, to pass into the guide 5b of the looping table 5 and passes through the tubular guide 8a into the finishing mill C in which this second length is initially also rolled at a speed of between 40 and 50 metres/second until, depending upon the operation of the shear 3, the next cooling bed length II is cut and the finishing mill C is braked to a speed of 10 metres/second. The deflection rolls 5c force the remaining cooling bed length II on to the looping table 5 to form a loop on the other half of the looping table where the rolled stock is guided closely between the guide plates 6a and 7a, so that when the rolling speed in the finishing mill C is reduced, the thrust may be absorbed in the loop of material. The leading end of this cooling bed length II is also subjected to tensile stress on the run-out conveyor 10a which again theoretically has no harmful effect on the rolled stock. On the run-out conveyors 10, 10a, the lengths of rolled stock are alternately brought to a standstill and conveyed to the cooling beds 11 or 12 and on these are conveyed transversely so that the lengths cool down. The subsequent cooling bed lengths III, IV and V are treated in the manner described above.

FIG. 3 is a working diagram of the drive for the roll stands of the finishing mills B and C.

The cooling bed length I enters the finishing mill B at a speed of 40 metres/second; for example, the cooling bed length is 200 metres. As soon as about 162.5 metres have entered the finishing mill B, the shear 3 is ac-
tuated and gives a command signal which causes the drive of the finishing mill B to be braked from 40 metres/second to 10 metres/second over a period of 1.5 seconds; for 0.5 seconds the drive remains at 10 metres/second and after a further 37.5 metres of material have passed through, it is again accelerated to 40 metres/second. After a further second, and drive of the finishing mill C is braked in 1.5 seconds from 40 metres/second to 20 metres/second so that the cooling bed length II runs out of the finishing mill C at a speed of 10 metres/second. After a further 0.5 seconds, the drive is again accelerated in 2 seconds to 40 metres/seconds. For each cooling bed 11, 12 a period of approximately 5 seconds is available for the braking and conveying of each cooling bed length so that with an operating time of 4.4 seconds for the cooling bed, smooth operation is guaranteed.

The figures given above are only given by way of example and the embodiments can be operated with other lengths I, II, other mill speeds and other time intervals during the operating cycle. However, a higher hourly throughput can be achieved in light section mills, maintaining high rolling speeds, without straining following stock-handling units beyond their technical capacity.

I claim:

1. A method of rolling material to form light sections, comprising:

- rolling the material in a continuous pre-finishing mill with a high exit speed,
- passing the material through a shear, and using the shear to cut the material into successive lengths suitable for further handling after rolling,
- passing the successive lengths through a switch,
- passing a first length of the material through first looping means,
- rolling the first length of material in a first finishing mill,
- actuating the switch to pass a second length of the material through second looping means,
- rolling the second length of material in a second finishing mill,
- actuating the switch to pass a third length of the material through the first looping means, and repeating the cycle,
- the shear being actuated when the leading end of the respective length is at least within the respective finishing mill, the length being initially rolled in the finishing mill at a speed equivalent to that of the pre-finishing mill, but after a substantial proportion of the length has passed through the finishing mill, the finishing mill speed being substantially reduced.

2. A method as claimed in claim 1, wherein the shear is actuated when the leading end of the respective length has passed through the respective finishing mill.

3. A method as claimed in claim 1, wherein the finishing mill speed is substantially reduced after about two-thirds of the respective length has passed through the finishing mill.

4. A method as claimed in claim 1, wherein the material is rolled in the pre-finishing mill at an exit speed of at least about 40 metres/second, and said substantial reduction of the finishing mill speed is a reduction down to about 10 metres/second.

5. A rolling mill for rolling material to form light sections, the mill comprising:

- a continuous pre-finishing mill with a high exit speed,
- a shear following the pre-finishing mill,
- a switch following the shear for switching the material into a first path or a second path,
- looping means and a finishing mill in each path, and automatic control means for actuating the shear to cut the material into suitable lengths for further handling after rolling, and for actuating the shear whenever the leading end of the respective length of the material being cut off is at least within the respective finishing mill, for switching the switch to pass successive lengths alternately down the first path and down the second path, and for substantially reducing the speed of the finishing mill from a speed equivalent to the speed of the pre-finishing mill after a substantial proportion of the respective length has passed through the finishing mill.

6. A rolling mill as claimed in claim 5, wherein said automatic control means comprises signalling means on the shear, for giving a signal when the shear is actuated, speed-reducing means on each finishing mill for substantially reducing the speed of the finishing mill on receipt of a signal from said signalling means, and means connecting said signalling means to said speed-reducing means.

7. A rolling mill as claimed in claim 5, wherein said automatic control means includes speed control means associated with each finishing mill for reducing the speed of each finishing mill to about 10 metres/second and increasing the speed of each finishing mill to a speed of at least about 40 metres/second and equal to that of the pre-finishing mill.

8. A rolling mill as claimed in claim 5, wherein each looping means is a looping table having a lateral guide plate.

9. A rolling mill as claimed in claim 5, wherein each looping means is a looping table having a narrow looping channel with guide walls on either side thereof.

10. A rolling mill as claimed in claim 5, wherein a respective single-strand run-out table follows each respective finishing mill.

11. A rolling mill as claimed in claim 10, wherein a transverse cooling bed follows each run-out table, the transverse cooling bed being for conveying the lengths of rolled stock generally transverse to the respective finishing mill axis.