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WORKING ROLL FOR A ROLLERMILL

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ABSTRACT OF THE DISCLOSURE

A working roll for a rolling mill which has an annular cavity in the region of its expandable rolling surface which cavity can be filled with a liquid under adjustable pressure so as to cause the rolling surface to expand and to assume a desired cambered shape.

BACKGROUND OF THE INVENTION

This invention relates to a working roll for rolling mills which roll is suitable, in particular, for use in plate rolling-mill trains with large plate widths.

In plate rolling mills, the rolls are ground with a specific camber in order to compensate for the bending of the rolls as a result of the rolling pressure. The camber is determined by the particular width of plate, the strength of the material, the rolling pressure necessary and the resilient bending line of the rolls in question. Therefore, where plates of different widths are to be processed, differently cambered rolls would be required. This disadvantage is countered by preventing the working rolls from bending too severely by means of separate backing-up rolls. Roll stands of four-high construction, that is to say with two working rolls and two backing-up rolls are extremely extensive and expensive, however. The camber cannot be altered as desired; the reduction in the roll gap of the material being rolled is limited, and with the different plate widths, the plates are not uniformly thick.

It has further been proposed to subject the working rolls by means of forces acting on the roll necks to a preliminary bending in such a manner that the bending caused by the rolling force is substantially compensated for. The forces acting on the roll neck may be variable in order to obtain an appropriate preliminary bending for different widths of plate and qualities of material. Even with this proposal, however, complete compensation is impossible because a different bending line is produced by the bending due to the rolling force than by the preliminary bending by the forces acting on the roll necks. Furthermore, these additional forces additionally load the roll stand and that the roll adjustment devices are not as the whole roll stand must be correspondingly more robust in design. Subsequent installation of the devices necessary for this in existing rolling mills is practically impossible.

In order to vary the camber of the working rolls during the rolling of plate, it has also been proposed to heat the rolls unequally in such a manner that they have different temperatures outside and inside their cavity. However, the different temperatures of the roll can only be checked and kept within specific limits with great difficulty. The heating of a roll takes a great deal of time and the external influences, such as the heat developing through the rolling operation, the dissipation of heat etc., cannot be varied sufficiently quickly.

SUMMARY OF THE INVENTION

It is the object of the present invention to overcome the described difficulties in providing a satisfactorily cambered working roll.

The invention consists in a working roll for roller mills wherein the roll has an annular cavity in the axial region of its rolling surface which cavity is filled in operation with a liquid, and wherein the roll is associated with means for imparting pressure to the liquid in the said cavity so that the rolling surface assumes a cambered shape. The said means for imparting pressures to the liquid within the cavity are designed to permit an adjustment of the liquid pressure in accordance with the degree of camber required.

In order that the invention may be clearly understood, examples of embodiments of a working roll according to the invention will now be described with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIGURE 1 shows partially in section a working roll which consists of a core and a shell, and wherein the pressure liquid is supplied from the outside;

FIGURE 2 shows partially in section a portion of a working roll with a core and shell, wherein the pressure inside the roll is produced by a piston in the roll neck;

FIGURE 3 shows partially in section a portion of the working roll with core and shell, wherein the pressure inside the roll is produced by means of a differential piston in the roll neck; and

FIGURE 4 shows partially in section an enlarged view of the roll neck at the differential piston end of the roll.

DESCRIPTION OF PREFERRED EMBODIMENTS

FIGURE 1 shows a working roll which consists of a core 8 and an expandable outer portion or shell 9. The neck portions 10 and 11 respectively are rigidly connected to the core 8. The expandable shell 9 is sealed off from the core at its ends by seals 12. The thickness of the shell may vary in order to obtain an adaptation of the camber to the deflection or bending of the roll. The annular cavity 13 between shell and core is connected through passages 14 to a rotary inlet 15. When the annular cavity 13 in the roll is subjected to pressure, the roll expands in accordance with the broken line 16. The broken line 16 indicates the expansion of the shell 9 through hydraulic pressure. The expansion is illustrated in an exaggerated form; in reality it is a question of expansions in the region of a few tenths of millimeters.

The camber of the roll can be varied by varying the pressure. Naturally, both co-acting working rolls of a rolling mill stand must be constructed in the described form.

For many current roll dimensions, the pressure necessary for the production of the desired camber will be in the region of about 100 atm, so that the pressure liquid can be supplied to the cavity directly with normal known rotary inlets. In such cases, it is also possible to use the pressure liquid for the cooling of the roll in
that the cavities in the working roll are connected to a supply and discharge line and a pressure-supervising device is included in the system. This possibility is particularly important for hot rolling mills without any variation of the camber in the working roll when not subjected to internal hydraulic pressure. In contrast to the known art, the roll 19 as shown in FIGURE 3, the pressure liquid is not supplied from the outside. The annular cavity 19 is filled and a vent 20 renders complete filling possible. The pressure inside the annular cavity 19 is produced by means of a piston 21 which is mounted for longitudinal displacement in a concentric bore or conduit 23 in the neck portion of the roll. A stationary cylinder 23 which is mounted in a cup 24 of a supporting structure 25, has a differential piston 28 which transmits its motion through stationary thrust bearings 26 to the piston 21. The piston 21 rotates with the roll in stationary bearing 26. When pressure liquid is supplied to the cylinder 23 through a stationary pipeline 27, the actuating piston 28 is displaced and acts on the pressure piston 21 through the thrust bearing 26. The system acts as a pressure converter so that high pressures are produced inside the roll with comparatively low pressures supplied from outside. With a primary pressure of between 20 and 100 atm., a multiple of this pressure can be produced in the cavity of the roll. If the annular cavity 19 is completely filled, the stroke of the piston 21 solely depends on the compressibility of the pressure liquids and on the resiliency of the shell material.

FIGURE 3 likewise shows a portion of a working roll which has a core 39 and an expandable outer portion 30 which is expanded by hydraulic pressure. Mounted concentrically in the interior of the neck portion 31 of the roll is a differential piston 32, while passage 33 establishes communication with the annular roll cavity 34. The bore for the differential piston in the neck of the roll is closed with a cover 35. The cover itself is penetrated by a stationary pin 36 which is sealed by means of a rotary seal 37. All the components except the end cap and the pin 36 rotate. When pressure liquid is supplied through the pipeline 38, the differential piston 32 is displaced and produces by means of its piston pin 39 in the bore of the cylinder 33 a pressure which is determined by the ratio of the diameters of the part 32 of the piston and the part 39 thereof. Very high pressures can be produced in the cavities in the roll by means of a relatively low pressure in the pipeline 38. If the pressure in the pipeline 38 amounts to between 50 to 100 atm., a multiple of this pressure can be produced by the differential piston in the roll cavity.

As shown in FIGURES 3 and 4, a further pipeline 40 is connected to the pin 36. This pipeline is connected by means of a non-return valve 48 and serves to fill the cavity. A bore 47 permits the venting of the cavity 34 during the filling operation.

With all rolls with an outer shell, assurance must be provided that the shell does not turn in relation to the core. This can be brought about by an appropriate shrink fit of the shell on the core or by means of wedges, fitting into keyways. Such saving or keyways are shown and designated by 42 and 43 in FIGURES 2 and 3.

The desired camber curve produced by the liquid supplied under pressure into the cavity of the roller can be adjusted by varying the wall thickness of the roll in the region of the cavity or of the shell that forms a cavity together with the core of the roll. Such changes vary from a central plane at right angles to the roll axis towards the ends of the roll in such a manner that the expansion due to the internal pressure produces the desired camber curve in a longitudinal section of the roller.

The invention enables a variation of the camber of the working rolls in a simple manner. Instead of expensive four-high rolling mills, simpler two-high rolling mills can be used. The rolls according to the invention may be installed subsequently in all existing two-high rolling mills without any variation in the rolling mill. The production of the camber by hydraulic pressure in the interior of the roll does not lead to any additional stresses on the structure of the roll stands. The degree of camber can be easily controlled and can be adapted, in conjunction with thickness gauges, completely automatically to the particular material being rolled which may be at different temperatures and have different dimensions.

Conventional rolls may be used for the production of the rolls with outer shell according to the invention. A cavity between shell and core need not be present in the unpressurized condition. Some grooves in the shell or on the core are sufficient to enable the pressure liquid to expand the shell.

The ever higher demands as regards quality with respect to the rolling tolerances and the ever increasing widths of plate, can be met with rolls according to the invention without expensive additional devices being needed.

The invention may, of course, be used to advantage not only for plate rolling mills but also for other rolling mills.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A working roll for plate rolling mills, said working roll comprising, in combination:
   (a) a roller body having an expandable outer portion whose outer surface serves as a roller surface, said roller body further having, in the axial region of said roller surface, an annular cavity whose outer boundary is constituted by said outer portion; and
   (b) means communicating with said annular cavity for supplying thereto a liquid under pressure, said means including a conduit provided in said roller body communicating with said annular cavity for introducing liquid therein and a differential piston device, at least a portion of which is disposed in said conduit, said device portion being rotatable within said roller body and in contact with liquid in said conduit, as a consequence of which when said differential piston device is actuated, said device portion imparts pressure to said liquid and causes said outer portion, and hence said roller surface, to camber outwardly under the influence of the pressure of the liquid being supplied into said cavity.

2. A working roll for rolling mills as claimed in claim 1, wherein the thickness of the expandable outer portion in the region of the roller surface varies in an axial direction in such a manner that an expansion corresponding to the desired camber curve is obtained by the application of pressure to the liquid in the cavity of said roller body.

3. A working roll for rolling mills as claimed in claim 1, wherein the roller body has in the axial region of its rolling surface a core which is surrounded by said outer portion in the form of a shell which is sealed at its ends against the said core and forms with the core an enclosed cavity which receives the liquid under pressure.

4. A working roll for rolling mills as claimed in claim 1, wherein the camber curve of the roll is produced by means of a piston and wherein said differential piston device includes a thrust bearing, said piston being associated with said thrust bearing and a stationary pressure producing portion which acts upon the said thrust bearing so as to axially displace the latter and the associated piston for the application of the necessary force within the cavity.

5. A working roll for rolling mills, said working roll comprising, in combination:
   (a) a roller body having an expandable outer portion whose outer surface serves as a roller surface, said roller body further having, in the axial region of said roller surface, an annular cavity whose outer
boundary is constituted by said outer portion; and
(b) means communicating with said annular cavity for
supplying thereto a liquid under pressure, said means
including a conduit in communication with said annu-
lar cavity, and a differential piston device having
a cylinder, a piston portion of smaller cross section
which is mounted to rotate together with the roll,
said smaller cross section piston portion extending
into said conduit, a piston portion of larger cross
section disposed in said cylinder and exposed to the
pressure of a liquid supplied into said cylinder, said
piston portion of larger cross section being connected
to said piston portion of smaller cross section and a
sealed stationary supply device for supplying liquid
under pressure to said cylinder as a consequence of
which said large cross section piston portion actuates
said small cross section piston portion to force liquid
in said conduit into said cavity thereby to allow said
outer portion, and hence said roller surface, to cam-
ber outwardly under the influence of the pressure
of the liquid being supplied into said cavity.

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CERTIFICATE OF CORRECTION

Patent No. 3,457,617 Dated July 29th, 1969

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It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading of the patent, lines 4 and 5, change "Bergwetk" to "Bergwerk".

SIGNED AND SEALED
FEB 17 1970

(Seal)
Attest:

Edward M. Fletcher, Jr.
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