June 16, 1936. C. B. FERREE 2,044,384

COOLING OF ROLLS

Filed Jan. 11, 1936

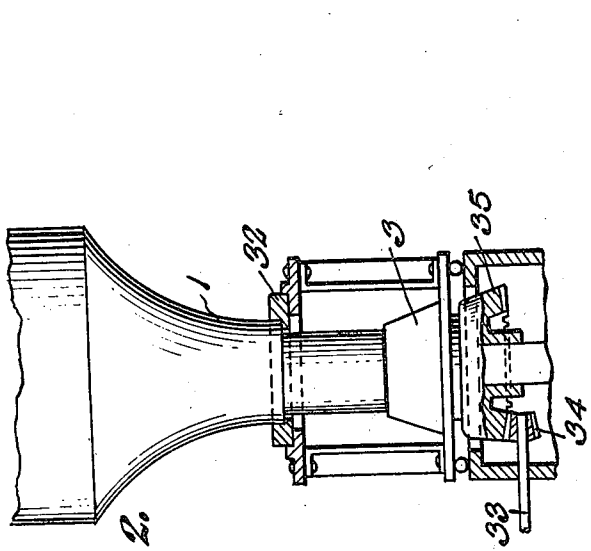


Fig. 2.

Fig. 1.

INVENTOR
Clifford B. Ferree.
BY
Christy and Wharton
his ATTORNEYS

Patented June 16, 1936 2,044,384

UNITED STATES PATENT OFFICE

2,044,384

COOLING OF ROLLS

Clifford B. Ferree, Pittsburgh, Pa.

Application January 11, 1936, Serial No. 58,670

3 Claims. (Cl. 266—6)

This invention relates to the production of rolling-mill rolls, and consists in an improvement in procedure, whereby a superior and more consistently uniform product is obtained. While it is primarily intended to be applied in the production of forged steel rolls, its applicability to cast rolls (using the term cast with the meaning familiar to the industry) is apparent. The invention will first be described in applicability to forged rolls. This application is a continuation in part of an application filed September 27, 1935, Serial No. 42,386.

In the accompanying drawing Fig. I is a view in vertical section, showing diagrammatically a roll in position in apparatus of the invention; and Fig. II is a fragmentary view, showing the lower portion of the roll in elevation, and showing in section, and more elaborately than in Fig. I, details of structure for the adequate support of the roll in position in such apparatus.

In the production of forged rolls the ingot is cast, forged to proper configuration, annealed, and then machined. It is commonly specified that a rolling-mill roll shall have an axial perforation or bore; the drilling of the bore then becomes part of the machining operation, and it is with rolls having axial bores that my invention has primarily to do. After machining, the roll is hardened; and, without entering into details, it will suffice to say summarily that hardening is effected by heating the roll to high temperature (typically 1480–1495° F.) and then cooling it rapidly. Not only must the cooling be effected rapidly, but it should be accomplished as uniformly as possible. Commonly it is effected by plunging the roll into a water bath.

In the practice of my invention I conveniently provide a furnace in which the roll standing vertically may be brought to the desired peak temperature.

Adjacent to such furnace I arrange the apparatus illustrated in the drawing; such adjacent arrangement being advantageous, in that with minimum lapse of time (ordinarily less than a minute) the roll may be lifted (by a crane) from the heating furnace, lowered to position within the cooling apparatus and there brought under subjection to the cooling agent. It will be perceived in Fig. I of the drawing that upon the upper neck of the machined roll 1 a collar 2 has been left; and this collar is serviceable, that attachment may be made, and that the roll may be raised, shifted, and lowered in the manner described.

The cooling apparatus includes a turn-table 3, a spray jacket 4, a cap 5, and a nozzle 6. The turn-table is adapted to receive the vertically disposed roll, axially aligned with its centre of turning, to sustain the roll, and, rotating, to carry the sustained roll with it in its rotation. And the turn-table is conveniently provided with an axial perforation 31. The roll rests upon the turn-table 3, and provision is made for maintaining it in vertical position, as by a rest conveniently in the form of an annulus 32, rigidly mounted upon the turn-table and engaged by the roll when in place upon the turn-table in a zone at higher level than the base upon which the end of the roll rests, and conveniently in the region of the tapered neck of the roll. Means for rotating the turn-table, and with it the roll resting by gravity upon it, are indicated in a shaft 33, equipped with a beveled pinion 34 that meshes with a beveled gear-wheel 35, made integral with the table 3 itself. The spray jacket is a double-walled cylinder, of length corresponding to or somewhat exceeding that of the barrel of the roll to be cooled, and of an internal diameter such as to receive the roll with small but sufficient clearance. The inner wall of the jacket is perforated with a multitude of small close-set evenly distributed orifices 41, and into the jacket supply pipes 42, 42, equipped with hand-controlled valves 43, 43, are led at points that are diametrically opposite one another and that are intermediate in the vertical extent of the jacket.

The jacket may conveniently be provided with a door 44. This door is but a separate and swinging portion of the wall; it is perforate, in like manner as is the immovable portion of the jacket wall. It extends from the upper rim of the jacket downwardly. To this door there is communication through flexible leads 45 from the supply pipes 42, and the valves 43 are so arranged as to control the water supply to wall and door together. The door is a provision that may be adapted to save head-room. It is of such width that when it is open a roll may be brought to alignment with the jacket at a lower elevation than if it had to clear the upper rim of the jacket. Manifestly the door may be increased in length and breadth, until it becomes a complete half of the cylindrical jacket.

The cap 5 is essentially of sheet metal, so shaped and proportioned that, resting upon and sustained by the spray jacket 4, it encases the upper end of a roll introduced within the jacket and resting upon the turn-table, in the position indicated in the drawing. The cap is provided with a central orifice 51, through which the noz-

zle 6 of a flexible hose may be introduced and inserted in the bore 11 of the seated roll, as shown in the drawing. Water supply to the nozzle is controlled by a hand-operated valve 61.

While the roll is in the machine shop, not only is it provided with an axial bore, indicated at 11 in the drawing, but within this bore at one end (the end that in the treatment under consideration becomes the lower end) a perforated plug 12 is set.

When a roll is to be cooled the cap 5 is removed from the jacket 4 and the door 44 (if a door be provided) is opened. A roll in vertical position, raised from an adjacent heating furnace and carried by a crane, is by the crane borne horizontally until it comes to vertical alignment with the jacket 4 and the turn-table 3 below. It then is lowered to position upon the turn-table, released from the carrying means, and left standing upon the turn-table. Its position upon the turn-table is accurately concentric. The carrying means being out of the way, the door 44 is closed, the cap 5 is applied, the nozzle 6 is thrust through the orifice 51 in the cap and into the upper end of the bore 11 within the roll, the valves 43, 43 and 61 are opened, and the turn-table is set in rotation.

Immediately a spray is projected in a multitude of radially and inwardly directed jets upon the outer cylindrical face of the barrel of the rotating roll while a stream of water begins to pour through the bore 11, escaping through perforated plug 12 and the perforation 31 in the turn-table. The perforation in the plug 12 at the lower end of the bore is insufficient in size to deliver water at the rate at which the nozzle supplies it. In consequence the bore immediately becomes flushed with water; but over every portion of the surface of the bore water is moving in a constant stream. At the same time the excess of water, overflowing the bore, is pouring over all the surface of the upper neck. And sheets of water passing downward from the face of the barrel of the roll are pouring over the surface of the lower neck. Thus all the surfaces of the barrel of the roll, of the necks, and of the bore are inundated, and over every portion the water is streaming. Water converted by contact with the hot metal to steam is immediately replaced by fresh supplies. Rotation of the roll conduces to uniformity in the cooling effect throughout the extent of the roll surfaces.

In such manner and by such means heat is extracted from the roll body with relatively great rapidity and in very uniform manner, resulting in a roll that is uniform in hardness and free of strains due to inequalities in degree of hardness.

The large flow of water required in the practice of the invention exceeds that obtainable from the usual municipal supply systems, and, accordingly, I provide a water storage tank, and a mechanically operated pump for feeding water in large volume from the tank to the roll-cooling apparatus. In the drawing such a tank 10 is illustrated, and a pump 20 is arranged to feed the required volume of water from the tank to the supply pipes 42. Beneath the jacket 4 a drainage-basin 30 is provided, to catch the spent water falling from the roll being treated, and from such basin the water is returned to tank 10, by way of a line 40. Thus, the water may be used over and over again, and from time to time water may be added to the supply, to make up for such losses as are occasioned by vaporization and leakage.

Water is obviously the economical cooling liquid to use; but, manifestly, other liquids—oil, for example,—will serve.

The apparatus and the method described are manifestly applicable to the treatment of a cast roll, technically so called. A cast roll is one that is cast in a mold that, but for machining operations, gives to the roll its ultimate dimensions. There is no forging operation performed upon it. However, after machining, a hardening step must be performed; and this hardening step consists in raising the roll to relatively high temperature, maintaining it under high-temperature conditions until approximate uniformity of temperature is attained throughout all the body, and then, with such rapidity and uniformity as is possible to attain, bringing it again to atmospheric temperature. With this explanation, the applicability of the described apparatus and method to the treatment of cast rolls is apparent.

I claim as my invention:

1. In apparatus for cooling rolls the combination of a centrally perforate turn-table adapted to sustain and carry a roll standing in vertical position and concentrically mounted upon it, and a spray jacket provided with an internal chamber, a cooling-liquid supply, and spray orifices in its inner wall, arranged above the turn-table and in position to surround at a spaced interval a roll standing upon the turn-table, and means for introducing cooling liquid under continuing supply to the bore of an axially perforate roll in place upon said turn-table.

2. In apparatus for cooling axially perforated rolls the combination of a turn-table adapted to sustain and carry a roll standing in vertical position and concentrically mounted upon it, a spray jacket provided with an internal chamber, a water supply, and spray orifices in its inner wall, arranged above the turn-table and in position to surround at a spaced interval a roll standing upon the turn-table, a cap removably borne by the spray jacket, and a water conductor extending through said cap and adapted when the cap is in place to deliver a stream of water to the axial perforation of a roll standing upon the turn-table.

3. The method herein described of cooling an axially perforate steel roll from the high temperature attained in hardening, which consists in maintaining the hot roll in vertical position and rotating it, causing a cooling liquid under continuing supply, filling the axial perforation, to escape in part at the lower end of the perforation and, overflowing the perforation, to flow in part over the upper neck of the roll, and causing additional quantities of cooling liquid, jetted upon the face of the barrel of the roll and enveloping the roll face, to descend thence and flow over the lower neck of the roll.

CLIFFORD B. FERREE.