April 2, 1935. J. L. ADAMS, JR 1,996,500

ROLLING MILL ROLL

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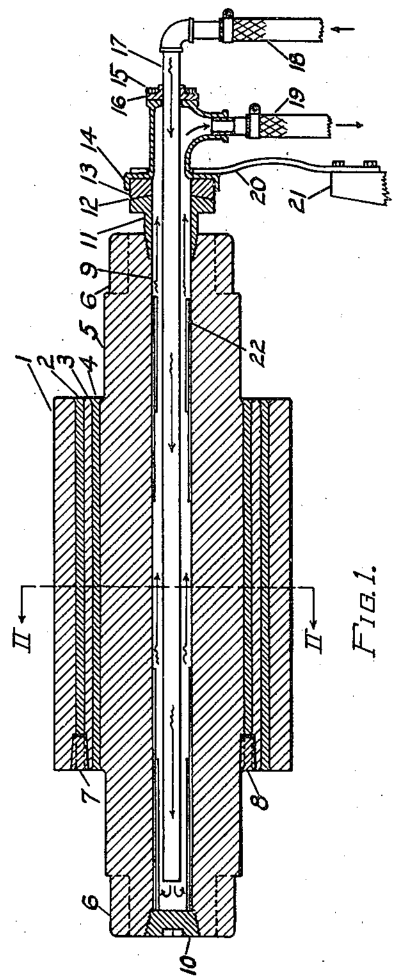

FIG. 1.

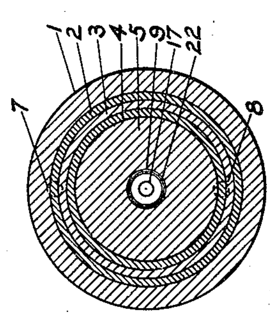

FIG. 2.

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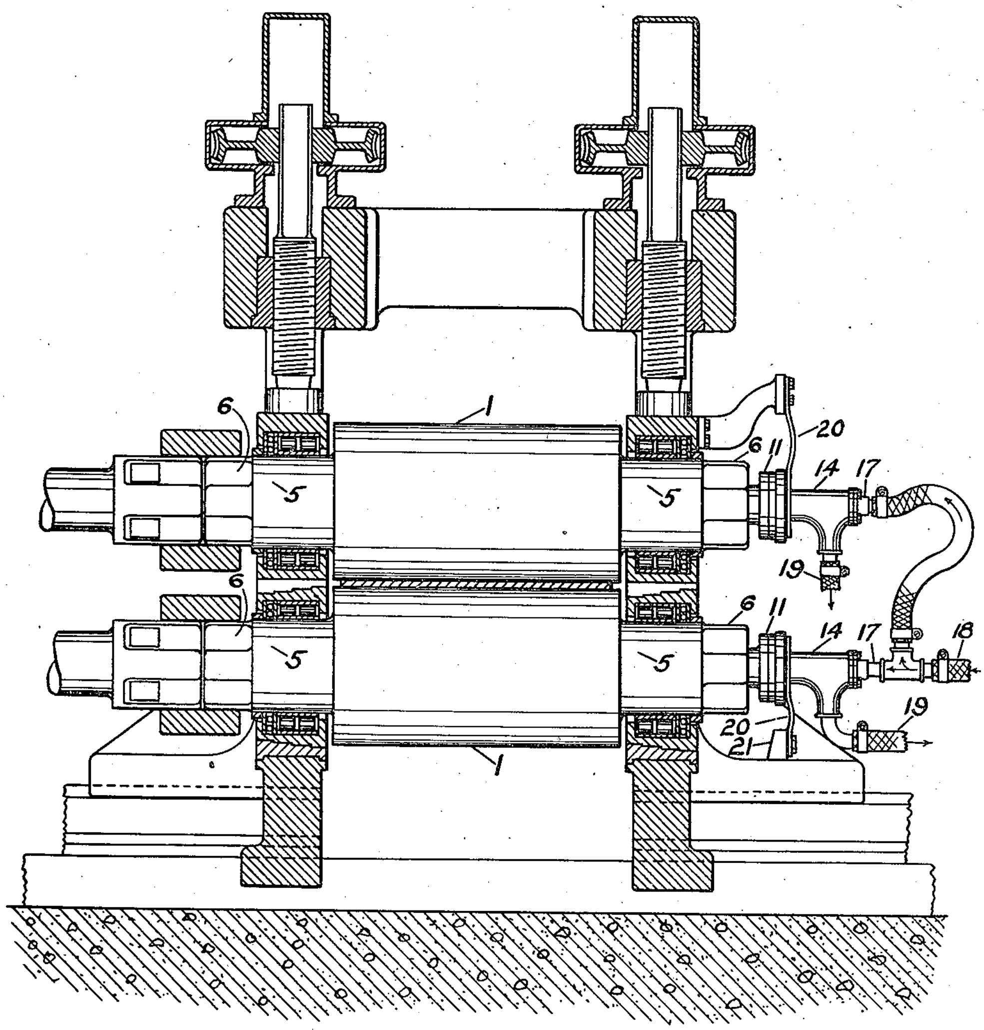

FIG. 3.

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UNITED STATES PATENT OFFICE

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ROLLING-MILL ROLL

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Application July 28, 1933, Serial No. 682,581

8 Claims. (Cl. 80—41)

The present invention relates broadly to the art of rolling metals, and more particularly to the development of heavy rolls for hot rolling mills, such for example as that disclosed in my co-pending mill application, Serial No. 674,661, filed June 7th, 1933, although equally applicable to mills of other types than the one there shown, in which the rolls heretofore used may have shown a tendency to "puff out" at mid-point of the working length, due to the heat absorbed from the moving hot material, and to thereby deliver sheets of non-uniform thickness across their breadth, as well as to throw tremendous breaking strains upon the material of the roll itself, such as to often lead to the rupture thereof, with consequent material losses due both to the actual replacement charges involved, and to the output loss by the mill suffered during the replacement period.

One of the objects of my present invention is therefore to provide a roll substantially free from "puffing" at its mid-point, or in which such enlargement has at least been reduced to a value which will just about compensate for the slight elastic flexure of the roll between its roll-neck supports.

Another object is to substantially eliminate the breakage of rolls from unequal heat distribution causes, such as produce said "puffing".

Another important object is to provide for water-cooling of the interior of a mill-roll without thereby introducing aggravated heat strains therein.

A further object of value is to provide a roll in which the shaft element may be of a high-tensile steel, instead of the brittle cast material often used therefor, but in which the working roll surface is of great hardness, to readily withstand the normal working wear.

An added object is to grade the withdrawal of heat by the water, according to distance axially from the center point of the roll, so as to promote uniformity of surface temperature in the latter.

Still another object is to provide a roll in which the longitudinal equalization of temperatures is accelerated and improved by proper use of highly heat-conducting interposed metal layers, built into the roll.

Other objects of value will be self-evident to anyone skilled in the art to which my invention appertains.

With all these and other objects in view, I have shown a preferred embodiment of my invention, in which the illustrations delineate one practical form thereof, to exemplify the principles involved, but not to determine the limits of possible constructions thereinunder.

In the drawings, Figure 1 shows a longitudinal axial section of my improved mill roll, with attached water-cooling appurtenances;

Figure 2 is a transverse cross-section thereof, taken on the line II—II of Figure 1, and looking in the direction of the arrows.

Figure 3 illustrates the application of my roll to a mill of substantially standard construction, and the attachment of the water-cooling elements thereto.

In all these figures, identical parts are designated by the same identifying numerals.

Referring now more particularly to Figure 1, I have shown a very hard surfaced outer drum of alloy-steel or other suitable material 1, press-fitted upon the high heat-conductivity copper shell 2, in turn pressed upon the intermediate low heat conducting steel or iron bushing 3, itself pressed over the smaller copper shell 4, which is finally pressed tightly upon the heavy steel shaft 5 of suitable high-tensile forged material, properly equipped with driving flukes 6, equidistantly out on either end, so as to permit reversing the roll when desired, in order to better distribute the wear therealong, and maintain a better working face.

Shells 2 and 4, and bushing 3 are prevented from possible rotation within drum 1, and over shaft 5, respectively, by the drilled keys 7 and 8, preferably threaded, so as to permit ready removal if later required, but with outer end riveted-over slightly, to prevent working out during normal operation, or some equivalent means applied here for this purpose. It will be noted that shells 2 and 4 are riveted over somewhat into corresponding peripheral bevels on drum 1, bushing 3, and shaft 5, to ensure their remaining centred under all conditions of operation.

Shaft 5 is drilled through as indicated at 9, and suitably tapped at left-end to take the large plug 10, provided with suitable internal depressed hexagon or square socket as indicated, for use with appropriate wrench. Right end of shaft 5 is tapped identically to take a similarly threaded end on the special flanged slip-coupling 11, provided with arcuate face 12, pressed into firm contact with the graphite or other suitable and correspondingly curved cap 13, carried by the light T-formed housing 14, bolted at 15 to the heavy flange 16, properly threaded upon or welded to the long inlet tube 17, which is at the right suitably connected with the long flexible rubber hose, or flexible metal tube 18, with a similar tube 19 forming the return connection direct to housing 14 as indicated. Housing 14 is pressed tightly against cap 13, and it in turn against the rotating slip-coupling 11, by means of the flat spring 20, suitably mounted on supporting base 21, integral with base of mill.

Within the bore 9, of shaft 5, I may, or may not, place the thin metallic cylinders 22, of a plurality of graduated lengths, and made of some convenient anti-rust material, the plural layers of which serve to lower the heat flow inward to the water, at such points along the roll as normally tend to maintain lower relative temperatures than the centre elements thereof, due to heat conduction to and through the bearings and associated parts.

One possible group of water flow directions is indicated by the arrows, but other possibly better paths of flow may be readily devised.

On Figure 2, no new parts requiring identification appear, and so far as my present invention is directly concerned, no such new parts appear on Figure 3, the other structures indicated being those common to commercial mill practice, and only illustrated here in order to show the relation of my invention to a complete mill assembly. It is believed that such added parts will be self-evident to anyone skilled in the art of rolling metals, and of mounting the rolls.

It is understood that the application of my new roll is not limited to the particular type of mill here shown, however, its use in connection with a belt-mill of my invention having already been mentioned herein, and other possible uses being self-evident.

In the operation of my improved rolls, it will be observed that I have provided a plurality of highly heat conducting paths extending axially of the roll, and a plurality of rather low heat-conductivity films or surfaces interposed in the path of any radial flows of heat, thus tending toward an evening up of temperatures in the axial direction along surface of roll, as desired to prevent the localization of high temperatures, by which "puffing" is produced.

It will, however, be self-evident, that in some cases a single copper shell might be found sufficient to produce the desired effect to a practical extent, so that I do not wish to preclude my use of such a single shell, instead of the plurality shown as the preferred form on my drawings.

The centre of curvature of the arcuate slip-joint surfaces is made at about the roll-neck bearing position, in order that the normal slight flexure of the roll, under load, will not materially disturb the water-tightness of this joint.

While I have shown and described a preferred construction, it will be understood that changes in the structure, or in the arrangement of its parts, may be made without departing from the spirit of my invention, or the scope of its broader claims.

What I claim is:

1. In a hot-rolling mill roll, parts comprising an outer working-drum of outwardly hard-faced metal, an inner roll-shaft of tough and breakage resisting steel, and an interposed heavy shell of copper of very high heat conductivity in longitudinal direction of said roll, said latter shell being of greater diameter than any portion of said roll-shaft, and of less diameter than any part of said working-drum, and upset to these parts at both ends.

2. In a hot-rolling mill roll, parts comprising an outer working-drum of externally very hard-faced metal, an inner large diameter roll-shaft of very tough and breakage resisting steel, and a plurality of radially interposed heavy copper shells of ultra high heat conductivity and extending clear from roll-neck to roll neck along said roll, both of said shells being of greater diameter than any portion of said roll-shaft, and a less diameter than any part of said working-drum, and both shells being upset at both ends for rotational and longitudinal-positioning purposes.

3. In a hot-rolling mill roll, parts comprising an outer working-drum of externally wear resistant metal, an inner large diameter roll-shaft of very tough and break resistant steel which is drilled from end to end for insertion of a water-cooling means, at least one interposed heavy copper shell of longitudinally highly heat conducting construction, of larger diameter throughout than any part of said roll-shaft, and lesser diameter than any part of said working-drum, so as to segregate the latter two parts thermally and yet provide relatively free longitudinal expansion of each when required, without seriously straining the other axially, and a longitudinally-graded internal cooling means.

4. In a hot-rolling mill roll, parts comprising an outer working-drum of externally very wear resistant metal, an inner hollow large diameter roll-shaft of very tough and break resisting steel, a plurality of interposed heavy copper concentric shells of axially very high heat conducting construction, and of telescoping diameters, said shells being all of larger diameter than said roll-shaft thruout, and of smaller diameter thruout than said working drum, so as to provide for comparatively free longitudinal expansion relatively of each, without end obstructions being encountered to any injurious extent, and providing a plurality of radially interposed heat-flow obstructing surface films between said working-drum and said roll-shaft, the bore of said roll-shaft being provided with a longitudinally graded means of heat removal, alterable in position as determined by trial.

5. In a hot-rolling mill roll, parts comprising an outer working-drum of externally very wear-resistant metal, an inner large diameter hollow shaft of highly break-resistant metal, a plurality of radially interposed heavy concentric and highly heat conducting copper shells, at least one supplementary metal shell of lower heat conductivity and radially positioned between said copper shells, and included means for longitudinally centring said shells on said roll-shaft, and preventing relative rotation therebetween, all of said shells telescoping within one another consecutively, and being of larger diameter than any portion of said hollow shaft, and less diameter than any part of said working-drum.

6. In a hot-rolling mill roll, parts comprising an outer working-drum of externally very wear-resistant metal, an inner shaft of large diameter of highly break-resistant metal, a bore in said shaft for insertion of water-cooling elements, a plurality of heavy and radially telescoping copper shells successively interposed between said working-drum and said shaft, means for rotationally and longitudinally positioning said working-drum and said shells on said shaft, and cooling means providing graded cooling as required along said bore, the complete assembled structure being symmetrical about the longitudinal centre of its length, to permit the reversal of roll in mill if surface wear is found uneven, and by a simple reversal of the cooling elements alone.

7. In a hot-rolling mill roll, parts comprising an outer working-drum, a large diameter hollow inner shaft, a plurality of interposed elements of longitudinally highly heat-conducting copper, all of larger diameter than said shaft throughout, and of less diameter than said working-drum throughout, and all inter-keyed together, driving flukes on each end of said shaft, identical tapping at each end of the bore of said shaft, and the entire roll body characterized by symmetry about its longitudinal centre, for reversal purposes when required.

8. In a hot-rolling mill roll, parts comprising an outer working-drum, a large diameter hollow inner shaft, an interposed heavy shell of highly heat-conducting copper of greater diameter than said shaft and less diameter than said working-drum throughout, driving flukes at each end of said shaft, and along with the roll-necks symmetrically placed with respect to the longitudinal centre of working-drum, and an internal water-cooling means provided with an arcuate graphite sliding-seal operative under elastic compression by contacting parts.

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