TESTING THE STRENGTH LIMITS OF THE WORKING GROOVES OF ROLLING MILLS

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In rolling mills, the worker is compressed during the transition between the grooves (the height of the cross-section of the rolled product decreases) and stretched (the length of the rolled product increases), while taking on the required shape and dimensions. As a result of this deformation, the metal structure improves. The working hives receive the rolling force and transfer it to the bearing supports and clamping mechanisms of the bed of the working hive. The base hives hold the working hives and give them the necessary rigidity.

There are solid and structural (dressing) worker bees: structural bees are a structure consisting of a steel boom and a bandage made of inedible material applied to it. Beehives can be smooth (for sheet rolling) and profiled (for long-range rolling): Each hive will have a trunk, two necks, and one or two running ends (Fig 1).

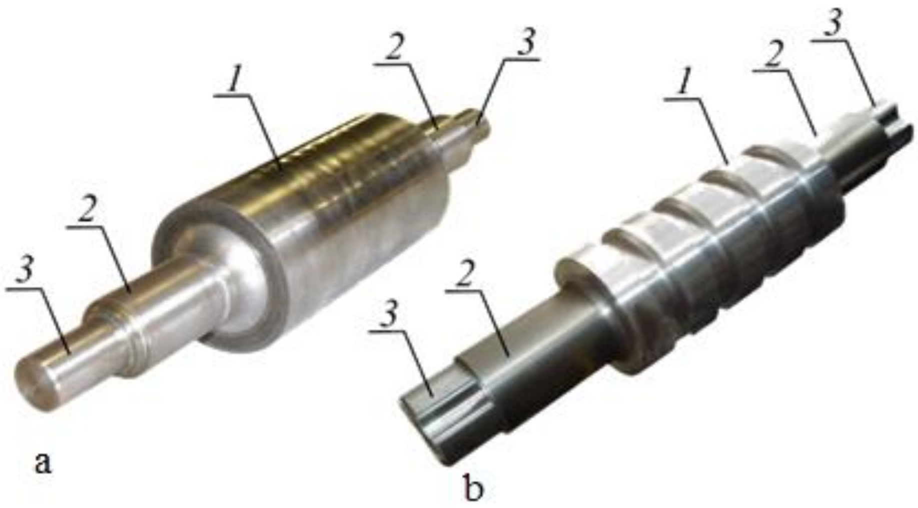

Figure 1. Integrated worker bees: a - smooth; b - profiled; 1 - barrel; 2 - neck; 3-running tips

The barrel is the working part of the barrel that deforms the rolled metal. There will be arches in the trunk of the profiled beehive. The nominal diameter of the barrel is considered the main parameter of the beehives of long-range rolling mills. The diameters of the trunks are selected taking into account the permissible angle of coverage. For example, when the grade of metal is more than α = 22...Acceptable viewing angles of 24° are used.

$D_{b.i}$ of the Barrel.I the working diameter (diameter along the working bottom of the chute) must meet the following condition:

$$D_{b.i} \geq \frac{\Delta h}{1-\cos\alpha}, \qquad (1)$$

Δh - where H is the compression of the rolling strip.

$D_b/D_{b.i}$ of the nominal diameter of the barrel to its working diameter.The coefficient i is chosen to be less than 1.4 to avoid reducing the accuracy too much. The ratio of L_b/D_b of the barrel length to its nominal diameter will be 2.2 / 3.0 for the draft rolling cell and 1.2 / 2.0 for the pure rolling cell. In order to increase the rigidity of the cells, the lowest possible values of the L_b/D_b ratio are acceptable. The final length of the trunk is specified based on the most advantageous location of the gutters. Barrels of working chicks are periodically regurgitated. At the same time, many surface defects that degrade the rolling quality are eliminated, and the original dimensions of the grooves are restored in profiled beehives.

If the separation line is located outside the gauge, then the gauge is called a closed gauge (Fig 2).

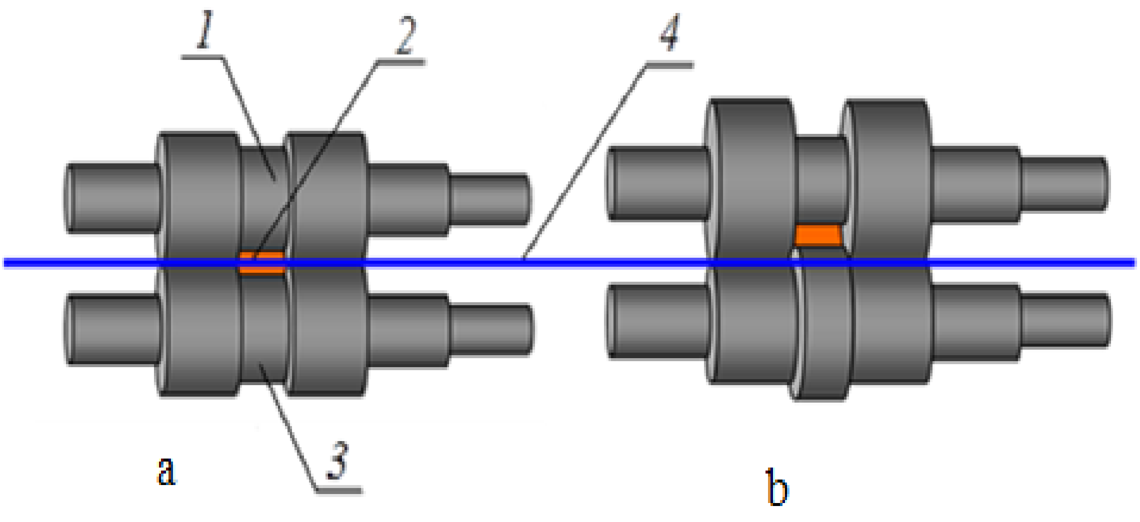

Figure 2. Types of calibers: a - open; b - closed; 1, 3 - Wasp; 2 - caliber; 4-Tangent wasp

Special shaft profiling is used to protect the strip or sheet from displacement relative to the axis. For example, when boiling thin sheets on a quartz machine, the working grooves are bent to 0.5 mm, and the support grooves are cylindrical. When cold-rolling thin sheets, the opposite is done - the furrows are made convex. However, this and any other profiling should ensure not only the correct placement of the screed (rollout) in the grooves during deformation, but also the minimum transverse thickness.

Both steel and cast iron can be used to make working hives. Cast and forged steel grooves are produced for hot rolling, while only forged steel grooves are produced for cold rolling. In the total number of hot-rolled furnaces, the share of forged steel furnaces is about 20%, and the share of cast furnaces (steel and cast iron) is 75-80%. Cast honeycombs are cheaper than hammer honeycombs, they are easy to make, but they have a lower viscosity and strength.

The use of bandages made of materials with high tensile strength, the possibility of replacing bandages made with repeated bullet use, reduces metal consumption and gives a great economic effect. Beehives with steel bullets and cast-iron bandages have proven themselves to be the best at work. To date, the accumulated experimental material on the longevity of bees is mainly estimated by how many tons of metal have been rolled. In case of abrasive corrosion, the U-shaped corrosion of the calipers is defined as:

$$U = kps, \qquad (2)$$

where k is the coefficient of friction, the material of the friction pair, the deformability of the surface, characterizing the lubrication conditions; P is the pressure on the contact of the metal with the grooves; s is the friction path, i.e. the length of the rolled metal. The rods are designed for the maximum vertical strength exerted by the rolled metal, a force that will have two components:

$$P = P_{st} + P_{din}, \qquad (3)$$

where P_{st} is the static component of the rolling force, defined as the product of the average contact pressure and the horizontal projection of the contact area, taking into account the shape of the caliper; P_{din} is the dynamic component, determined experimentally or taking into account the belt viscosity of the elements of the working cells and the intermediate grooves in their joints, taking into account the movement of masses in the grooves with vertical cushions. the solution of differential equations is determined using.

Under the action of force P, the rods bend, and the thickness of the rolled metal becomes uneven in width. The effects of bending the beehives will need to be considered, especially when rolling thin sheets and strips. f is the total bending of the Hive in cross-section at a distance x from the base (Fig 3):

$$f = f_1 + f_2, \qquad (4)$$

where f_1 is bending as a result of bending moments; f_2 is bending as a result of transverse forces.

Assume that a smooth work surface is loaded with an evenly distributed load with intensity q when rolling a sheet with a width of V.

Then, for a smooth working socket f_1 and f_2, determine the bends of A.I. Selikov's formulas will look like this:

$$f_1 = \frac{P}{384EJ_b}\left[8a^3 - 4aB^2 + B^3 + 64c^3\left(\frac{J_b}{J_{bo'}} - 1\right)\right]; \qquad (5)$$

$$f_2 = \frac{P}{\pi G D_b^2}\left[a - \frac{B}{2} + 2c\left(\frac{D_b^2}{d_{bo'}^2} - 1\right)\right], \qquad (6)$$

where $P = qB$ is the rolling force; $J_b = \pi D_b^4/64$ is the moment of inertia of the borehole cross-section; D_b is the diameter of the borehole; $J_{bo'} = \pi d_{bo'}^4/64$ is the moment of inertia of the borehole cross-section; $d_{bo'}$ is the diameter of the borehole; *a, s* is the moment inertia of the working well. geometric dimensions; belt and slip modules for the E - and G - tongue material, respectively, are:

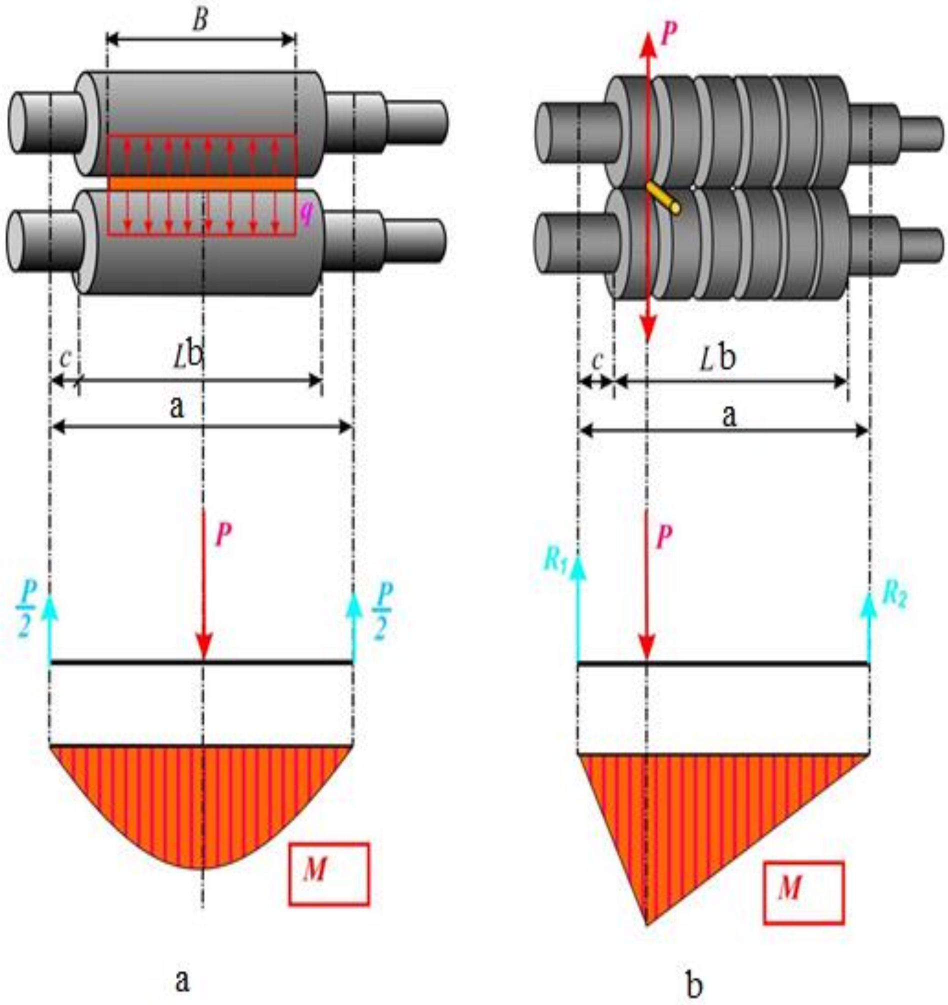

Figure 3. Bending moment plots: a - straight groove; b-calibrated groove

A.I. Selikov's formulas take into account that $d_{bo'}<D_b$, and also that the width of the rolling sheet is less than the length of the barrel. In calibrated beehives of pure rolling cells with a $L_b/D_b<2$, neck bending plays a major role in the overall deformation of the beehive. Thus, depending on the strength limits of the rolling mill working grooves, we will need to determine the rolling strength and accurately determine the rolling speed and deformation limits.

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