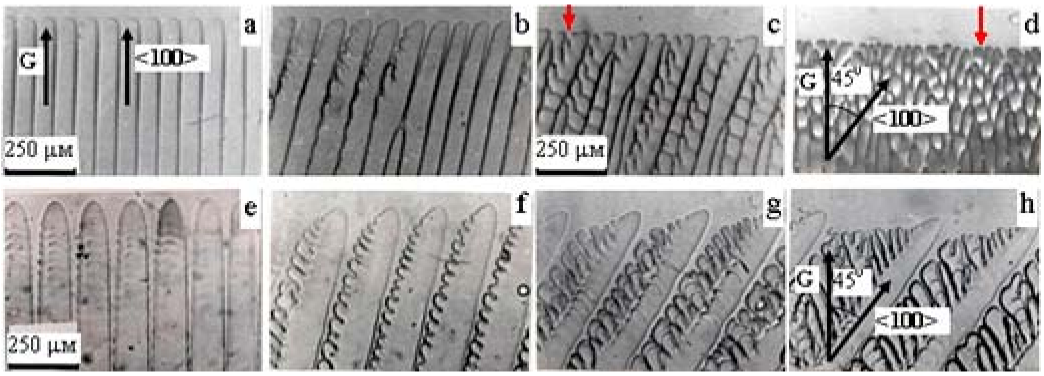

Fig. 2. Directional solidification. G – direction of thermal gradient. Angle between G and <100> direction is 0° for a), e) ; 15° for b), f); 30° for c), g) and 45° for d), h). Rate of growth is 3 µm/s for a) – d) and 6 µm/s for e) – h). Arrows on c) and d) indicates splitting element to compare with Fig. 1.

So analogy in morphologies put forward the question relatively analogy of “forced conditions” in both cases. Back to the rheocasting process (producing of degenerate dendrites) it must be noted that its essential feature is intensive shearing of the melt. Thereby it seems that flow incoming on solid-liquid interface generate some gradient. Due to this locally crystal is growing along this gradient (not in preferential direction) and some “directional solidification” take place.

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## LOCAL SURFACE HARDENING OF THE CRUSHING TOOL OF THE MOVING PLASMA ARC

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Studies of wear and hardening of the knife for crushing wood. This part is a truncated pyramid of steel 45. In the process of manufacturing the part was subjected to preliminary volumetric hardening. Visual examination showed a number of typical defects-surface corrosion of the metal, blunting, cracking and breaking of the cutting edge, the destruction of the fabric parts, breaking pieces in the peripheral zone.

The experimental results showed that the volume thermal hardening does not provide the required strength of the part. To increase the wear resistance in the process of friction and increase the resistance to plastic and brittle fracture, it is proposed to apply surface heat treatment of the part as the most complete providing the optimal combination of the viscosity of the part core with high surface hardness. This hardening is realized by local quenching with the help of a rapidly moving high-intensity highly concentrated heat source, namely a plasma arc generated by a DC plasma torch with a power of 0,6…1,4 kW.

Plasma quenching was carried out at arc currents I = 6…30 A and used as a plasma – forming argon gas, and the plasma torch used a crimping arc nozzle with a hole diameter equal to 1,2 mm. the speed of movement of the plasma torch varied from 10 to 30 mm/s. as a result of the experiments, the optimal hardening parameters were determined, namely, the speed of movement of the plasma torch v = 10…12 mm/s, and the arc current is I = 26 A for the flat surface of the crushing tool, and when quenching the cutting edge I = 16 A and v = 30 mm/s.

Metallographic analysis was performed to determine the effect of plasma arc on the microstructure and properties of steel. Samples in the form of a parallelepiped with a plasma path were taken for metallographic analysis. Microstructure of the material was determined by means of optical metallographic device type NEOPHOT-21. The phase composition of the treated surface layer was determined by X-ray diffraction. The measurements were carried out with a diffractometer D8 DISCOVER series 2.

We investigated the microhardness of the surface layer depending on the flow rate of argon, the arc current, travel speed of the plasma torch. The dependences of the microhardness of the steel on the velocity of the plasma arc along the depth of the surface layer are determined. The maximum depth of the hardened layer is achieved at v = 11 mm/s, i. e., a decrease in the velocity of the plasma arc leads to an increase in the depth of the hardened layer. An increase in the microhardness to 532…600 $HV_{0.1}$ is achieved, the thickness of the hardened layer can vary depending on the hardening rate from 0,4 to 0,7 mm. In addition, the effect of the arc current on the microhardness and depth of the hardened layer is studied.

The surface layer of the treated steel contains a dendritic structure that occurs during the recrystallization of the material. The dendritic structure of the material is well observed with an increase of ×675, it arose due to the rapid cooling of the heated material. Examination of hardened samples showed that an increase in the arc current leads to a significant expansion of the zone of thermal effect of the plasma jet.

The phase composition of the hardened steel layer was studied by X-ray diffraction. Comparison of the phase composition of the surface layer of samples treated with a plasma jet in protective media of nitrogen and argon showed a significant difference. Analyzing the results of X-ray diffraction studies, it was found that under the influence of a plasma jet in a protective nitrogen medium in the phase composition of steel formed iron carbides and nitrides – hexagonal phase type ε, due to the diffusion saturation of nitrogen and carbon of the starting material and the chemical processes. Experimentally confirmed the possibility of quenching the imposition of the next tracks on top of each other with the distance between their axes is equal to 0,4 mm.