properties of parts made of monolithic iron to be attained. Similar results have been obtained with parts produced from titanium powder by forging with counterpressure [1].

CONCLUSIONS

A mathematical model of the forging process has been developed. Analysis of this model shows that the principal factors influencing the strength of parts are the pressure head, temperature of heating for forging, degree of extrusion, and the relationship between the degree of extrusion and preform density. The highest mechanical characteristics in parts from iron powder are ensured at the following parameters (within the ranges investigated): specific counterpressure 80 MN/m², temperature of heating of preforms for forging 1250°C, preform density 5.1×10⁻³ kg/m³, and coefficient of extrusion 1.78. The experimental results obtained can be utilized in the development of a process for the production of parts from P/M preforms by forging with counterpressure.

LITERATURE CITED


DISSOLUTION OF Cr₂C₂ IN A NICKEL MATRIX DURING SINTERING.

I. REACTION OF CHROMIUM CARBIDE WITH NICKEL DURING SOLID-PHASE SINTERING

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High density in hard metals is usually attained by liquid-phase sintering. After the appearance of a liquid phase, consolidation of a compact being sintered and structure formation are determined mainly by three processes: flow of liquid; dissolution and resolidification; and solid-phase sintering of the resultant carbide skeleton [1]. The formation of hard-metal structure is influenced primarily by dissolution and resolidification. Essentially, this consists in the most active surfaces of the solid phase - small particles or surface fragments of small radii of curvature - being dissolved in the liquid phase and then being deposited on the surfaces of large particles.

The appearance of the liquid phase is preceded by solid-phase sintering, during which, when the carbide is soluble in the binder, a preparatory process takes place promoting the attainment of local eutectic concentrations in the binder. According to [2], reaction in the Cr₂C₂-Ni system during solid-phase sintering takes place at temperatures of 700-800°C, and involves surface diffusion of chromium atoms into nickel. As a result, a diffusion zone of low chromium concentration forms along the edges of a nickel particle. Raising the tempera-
X-ray structural investigations have established that as a result of the reaction of the carbide with the binder the nickel lattice parameter changes from 0.3516 nm at a sintering temperature of 600 to 0.3530 nm at 1000°C, whereas the parameters of the elementary Cr$_3$C$_2$ lattice remain unchanged. The structure of chromium carbide alloys sintered at temperatures above 1200°C contains graphite, which is indicative of diffusion of carbon as well as chromium into the nickel binder. Evidence in support of these data has been obtained in an x-ray diffraction investigation of alloys sintered at temperatures above the eutectic point [3]. Its results show that the carbide Cr$_3$C$_2$ decomposes into Cr$_7$C$_3$ and also into chromium and carbon, which form with nickel an alloy similar in properties to an 80% Ni–20% Cr alloy. An analysis of the chemical compositions of Cr$_7$C$_3$ and Cr$_2$C particles in alloys with nickel has demonstrated that these carbides can dissolve up to 6% Ni [4]. Consequently, the reaction of the carbide with the binder would not be expected to be unipolar. Subsequent electron probe microanalyses of the compositions of carbide particles in an alloy with nickel after sinter-

Fig. 1. Variation of structure of chromium carbide particle as function of sintering temperature: a) 900, b) 980; c) 1030; d) 1080; e) 1140; f) 1180°C. Magnification: a, b, d) 1500; c) 2000; e, f) ×1000.