Among many metallides in titanium systems, the aluminide Ti₃Al is one of the most promising.

It was found in [1, 2] that titanium aluminide Ti₃Al in alloys of the titanium system has a high creep resistance at 700–800°C. The long-term strength of Ti₃Al can be increased considerably by alloying with metals, as the result of which solid solutions based on this compound are formed.

The effect of the titanium–zirconium analog on the structure and properties of Ti₃Al was investigated in [3]. It forms continuous solid solutions with the α and β modifications of titanium. This work is a continuation of the investigation, and concerns the effect of molybdenum, which forms continuous solid solutions only with β titanium.

The investigation was conducted along a radial section passing from the composition of the alloy corresponding to Ti₃Al (16 wt.% Al) to pure molybdenum.

The alloys were prepared from an alloy whose composition corresponded to the composition of the Ti₃Al compound. This alloy was prepared by consumable-electrode arc melting and remelting. Molybdenum foil (99.9% Mo) 0.2 mm thick was added to the electrode.

Alloys with up to 30 wt. % Mo were prepared by induction melting in suspension in an atmosphere of pure helium [4]. In this case the charge materials were prepared by nonconsumable-electrode arc melting. Alloys with more than 30 wt. % Mo were remelted six times by nonconsumable-electrode arc melting.

The chemical composition of all the alloys was checked by weighing the ingots after melting in the arc furnace (losses amounted to ≤0.5–1%).

The cast alloys were homogenized in vacuum at 1000°C for 25 h and annealed at 800°C for 300 h with subsequent slow cooling in the furnace.

The phase equilibrium of the alloys was studied by conventional physicochemical analysis.

Differential thermal analyses were made in a Kurnakov pyrometer. The annealed samples were heated in an electric resistance furnace at the rate of about 500°C/h. For examination of the microstructure the samples were etched in a reagent consisting of hydrofluoric acid (1 part) + nitric acid (2 parts) + glycerin (3 parts). The hardness was determined in the Vickers apparatus under a load of 10 kg. The specific

Fig. 1. Microstructure of alloys of the Ti₃Al–Mo section after annealing (×200). a) 0.5% Mo, α₂; b) 15% Mo, α₂+β.
The data from the thermal analysis indicate that alloys with up to 30 wt.% Mo undergo a transformation in the solid state during heating, changing from the hexagonal α₂-structure (phase based on Ti₃Al) to the β-solid solution with a bcc lattice. An increase of the molybdenum concentration lowers the temperature of this transformation from 1150°C for pure Ti₃Al to 930°C for the alloy with 15% Mo.

The annealed alloys without molybdenum and with 0.5 wt.% Mo have the same polyhedral structure of α₂-phase (Fig. 1a). An increase of the molybdenum concentration to 1% or higher results in the appearance of β solid solution, the amount of which increases with the molybdenum content (Fig. 1b). Alloys containing over 30 wt.% Mo in the annealed condition have a single-phase polyhedral structure of β-solid solution. Alloys with 30, 17.5, and 10% Mo, quenched respectively from 800, 900, and 1000°C, have a single-phase β-structure.

The polythermal section of the Ti₃Al-Mo system plotted from the data of the thermal and microstructural analyses is shown in Fig. 2. The section is quasibinary, the solubility of molybdenum in Ti₃Al amounting to less than 1 wt.%. In chemical interaction of the components this section is similar to the binary phase diagram of the Ti-Mo system.

For alloys containing up to 20 wt.% Mo we also plotted composition vs properties diagrams, shown in Fig. 3 in juxtaposition with part of the polythermal section. The hardness and specific electrical resistance increase sharply within the α₂-region; in the α₂+β-region these characteristics increase with the molybdenum concentration at a lower rate. The density of the alloys increases monotonically with the molybdenum content.

Some of the alloys were subjected to creep tests by the centrifugal bending method at 700°C with a stress of 20 kg/mm².

As can be seen in Fig. 4, alloys with 0.5, 4.0, 5.0, and 20% Mo (samples with other molybdenum concentrations fractured in various stages of preparation due to increasing brittleness resulting from the conditions of melting in laboratory furnaces) have a high creep resistance at 700°C. The heat resistance of these alloys was lowest for the alloy with 4% Mo, containing a considerable number of large particles of β-phase, which evidently also promotes more rapid weakening of the material. The heat resistance was highest