[9]), these characteristics must be known in order to test the applicability of the theories based on exchange-inversion models to magnetic phase transitions.

Accordingly, we set out to investigate the effect of high pressure and strong magnetic fields on the low-temperature transition in Mn_3Ge_2, to determine its elastic properties, and to take dilatometric measurements in a wide temperature interval.

1. SAMPLES AND MEASURING TECHNIQUES

The measurements were conducted with polycrystalline Mn–Ge alloy samples containing 60-70 at.% of Ge. According to phase diagrams [10], alloys of such a chemical composition contain Ge and an eutectic consisting of Mn_3Ge_2 and Ge. The use of alloys with a high content of Ge has been dictated by the following reasons. Since Mn_3Ge_2 is formed by means of a peritectic transition from Mn_5Ge_3 and an alloy containing 50.5 at.% of Ge, it is very difficult to obtain in a pure form. At the same time, since Mn_5Ge_3 is strongly ferromagnetic, even a very small addition of the Mn_5Ge_3 phase affects the magnetic properties of the alloy as a whole. The hazard of Mn_5Ge_3 contamination is greatly reduced by preparing alloys with a large content of Ge. Microstructure analysis of the investigated alloys indicated the presence of two phases only: the chemical compound Mn_3Ge_2 and Ge. The preparation technique and the purity of the starting materials are the same as those described in [2].

The high-pressure magnetization has been measured with a pendulum magnetic balance and a miniature high-pressure chamber made of VT3-1 titanium alloy [11]. The pressure transfer medium was a 50% mixture of transformer oil and isopentane. The weight of the samples was 228 mg and their linear dimensions did not exceed 6.3 mm.

Magnetic measurements in pulsed magnetic fields were made by the Faraday method using a piezoelectric torsion balance described in [12]. The balance was calibrated by comparing the relative magnetization intensity σ measured under pulse conditions with σ obtained in static measurements.

Thermal expansion of Mn_3Ge_2 was measured with a quartz dilatometer having a clock-type indicator with minimum scale division of 0.001 mm. The heating and cooling rate did not exceed 1 deg $\cdot$ min^{-1}. In dilatometric measurements and for investigation of the elastic properties we used samples 42 mm long and 3 mm in diameter. The elastic moduli – Young's modulus E and the shear modulus G – were measured by the "composite vibrator" method with quartz-crystal excitation at frequencies of about 38 and 26 kHz respectively. The obtained values of E and G made it possible to calculate the Poisson ratio $\mu = (E/2G) - 1$ and the compressibility $\varkappa = 3(1 - 2\mu)/E$.

2. EXPERIMENTAL RESULTS AND DISCUSSION

Figure 1 shows the temperature dependence of the relative elongation $\Delta L/L$ and of the thermal expansion coefficient α of Mn_3Ge_2 plotted in the course of heating. In the region of magnetic transition temperatures $\Theta_1 = 158$ and $\Theta_2 = 264$°K the $(\Delta L/L)$ curve shows sharp discontinuities and the $\alpha(T)$ curve, deep minima. Such changes are characteristic of first-order magnetic phase transitions and their origin is due to changes in the magnetic state taking place at the temperatures Θ_1 and Θ_2. Figure 1 indicates that magnetic transitions taking place with rising temperature at the point Θ_1 are associated with constriction of the crystal lattice, the volume change being equal to $\Delta V/V = 3\Delta L/L = (1 \pm 0.1) \cdot 10^{-4}$. In the temperature regions $T < \Theta_1$, $\Theta_1 < T < \Theta_2$, and $T > \Theta_2$ the thermal expansion coefficients are nearly constant and are equal respectively to $\alpha_1 = (9 \pm 1) \cdot 10^{-6}$, $\alpha_2 = (12 \pm 1) \cdot 10^{-6}$, and $\alpha_p = (13 \pm 1) \cdot 10^{-6}$ deg^{-1}.

Figure 2 shows the temperature dependence of Young's modulus E, the shear modulus G, and the compressibility $\varkappa$. The temperature dependence of Young's modulus E plotted during heating (and cooling) approximately repeats the temperature dependence G(T); their shape is quite involved but they do not exhibit characteristic minima at the points Θ_1 and Θ_2 that usually correspond to magnetic transitions. Of special interest is the ab-

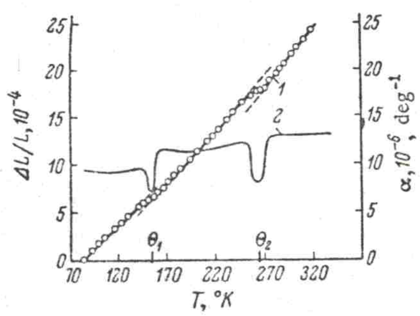

Fig. 1. Temperature dependence of relative elongation $\Delta L/L$ (1) and thermal expansion coefficient α (2) of Mn_3Ge_2.