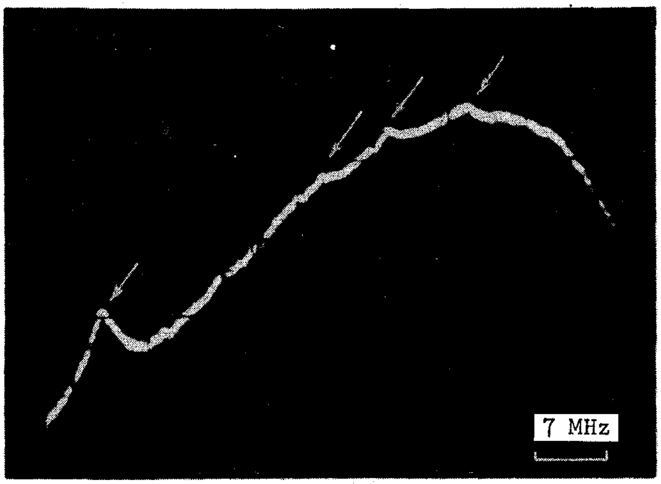

Fig. 1

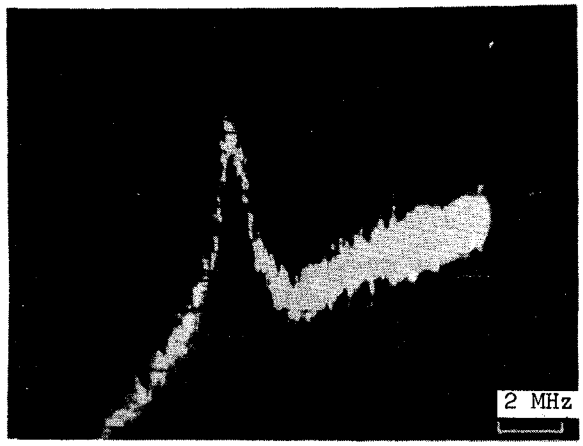

Fig. 2

Fig. 1. Oscillogram showing the power of the quasitraveling wave passing through the SF_6 cell as a function of the frequency, for one of the most intense rotational-vibrational lines of the CO_2 laser. Gas pressure in cell p = 2×10^{-2} Torr, cell length 80 cm. The arrows indicate the observed resonances.

Fig. 2. Oscillogram of one of the narrow resonances observed within a part of the Doppler line. Width at half-height 1.2 ± 0.2 MHz.

high pressures it increases as a result of the increase in the power needed to saturate the absorption.

Work aimed at clarifying the nature of the resonance broadening is being continued.

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PRESSURE DEPENDENCE OF THE TEMPERATURE OF THE TRANSITION OF THE COMPOUND Bi_2K INTO THE SUPERCONDUCTING STATE

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As is well known [1], the compound Bi_2K becomes superconducting at T = 3.57°K and has a positive derivative of the critical temperature with respect to pressure. This compound was one of the first superconductors revealing a positive sign of $\partial T_c/\partial p$ [2]. Experiments aimed at determining the influence of the pressure on T_c of Bi_2K were carried out earlier [2] only at a pressure close to 1500 atm. We deemed it of interest to study the variation of T_c with pressure in a wider pressure interval. We measured T_c of Bi_2K in the pressure range from zero to about 10 thousand atmospheres. T_c was determined from the plot of the resistance against temperature, and the critical temperature was taken to be the temperature corresponding to half the value of the resistance in the normal state. The samples were cut from a bead of the alloy (prepared in the same manner as in [1]) and usually measured 1.5 x 1.5 x 5 mm. The ratio of the resistance at room temperature to that at T = 4.2°K was approximately 298 and 250 for samples 1 and 2, respectively[1)].

The pressure was measured with a manganin resistor calibrated against the shift of T_c of tin, and $(\partial T_c/\partial p)$ of tin was assumed to be 4.5×10^{-5} deg/atm.

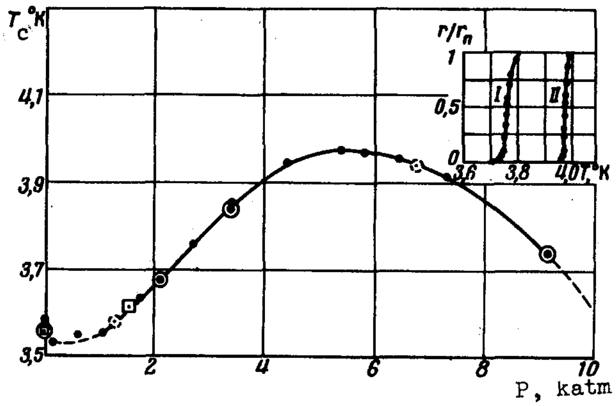

Fig. 1. T_c vs. pressure for Bi_2K: ⊙ - sample 1, ◉ -sample 2, ⊡ - sample used in [2]. The upper-right insert shows examples or r/r_n (T) obtained with sample 1 for two pressures: curve I corresponds to P = 2770 atm, and curve II to P = 5820 atm.

Figure 1 shows a plot of T_c against the pressure, obtained for the two samples of Bi_2K. The square denotes the value of T_c obtained in [2]. It is seen from the figure that T_c of Bi_2K varies nonlinearly with pressure. At low pressures, apparently, $\partial T_c/\partial p$ is less than zero. At P = 250 atm, $\partial T_c/\partial p$ reverses sign and reaches a maximum value 1.268×10^{-4} deg/atm in the region P = 2 - 3.5 katm. At the point P = 5.4 katm, $\partial T_c/\partial p$ vanishes, and then again becomes negative at higher pressures. For sample 1, measurements were made of the temperature dependence of the critical field at both zero pressure and P = 6.46 katm. The data obtained in these measurements are shown in Fig. 2. As seen from the figure, the plots of $H_c(T)$, for both P = 0 and P = 6.46 katm, are straight lines almost parallel to each other, with $\partial H_c/\partial T = 125$ Oe/deg.

A nonlinear variation of the critical temperature with pressure has been hitherto ob-

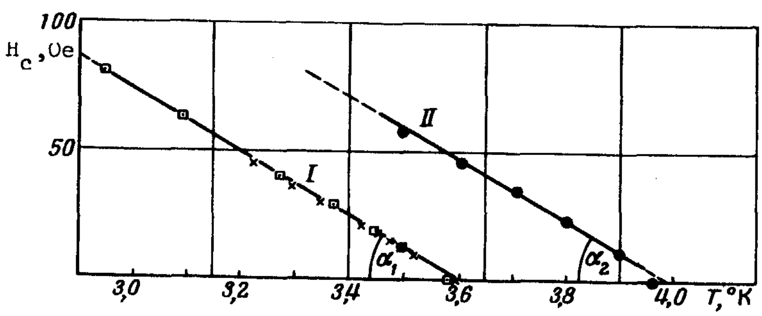

Fig. 2. H_c vs. T for both P = 0 and P = 5280 atm. Curve I - P = 0, × - data of present measurements, ⊡ - data of [2]. Curve II - P = 5280 atm. α_1 = 125±2 Oe/deg, α_2 = 123±2.

1) Samples 1 and 2 were made of beads prepared with slight excesses of potassium and bismuth, respectively.

served in thallium [3]. (Reduced strontium titanate also revealed a nonlinear variation of T_c with P, with T_c decreasing with increasing P [4].) In the case of thallium, however, the increase of T_c with pressure amounted to only 10^{-2} °K at the maximum of the $T_c(P)$ plot. The investigation of the $T_c(P)$ dependence of thallium has led the authors of [3] to the conclusion that there exist two mechanisms causing the change of T_c with pressure, namely the usual one, which leads to a decrease of T_c, and another, leading to an increase of T_c and connected with the change of the Fermi-surface topology with changing pressure; this mechanism was considered in [5]. It should be noted here that the large value of the electron-correlation parameter in the superconductor causes the superconducting characteristics to be usually weakly dependent on the topological features of the Fermi surface of the metal, and to be affected only by the change in the average density of states. Therefore, if the change of the Fermi-surface topology leads to a change in the state density, then a pressure dependence of $\partial H_c/\partial T$ in Bi_2K is to be expected if the foregoing point of view is correct. Indeed, the $H_c(T)$ plots obtained without pressure and at 6.46 katm are practically similar to each other[1)], and therefore the explanation proposed in [3] for the complicated character of the $T_c(P)$ dependence may not be applicable to Bi_2K. It can be assumed, however, that the form of the $T_c(P)$ curve shown in Fig. 1 is due to the pressure dependence of the phonon spectrum. Indeed, if the Bi_2K lattice-vibration spectrum is acoustic at low pressures, then T_c should satisfy the relation

$$T_c \sim \omega_0 \exp[-1/N(0)V] \tag{1}$$

and then T_c should decrease with pressure. An increase of pressure should lead to the appearance of new branches of the vibrations, and this may cause in turn an enhancement of the interelectron attraction, thus causing an increase of T_c. In addition, the vibration spectrum may cease to be acoustic as a result of the pressure, and it becomes necessary to use for the determinatino of T_c not Eq. (1) but an expression given in [6], from which it follows that T_c increases when low-frequency vibration branches are produced in the lattice.

Further research will probably permit a verification of these assumptions.

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