tron-phonon interaction constant:

$$\lambda = \sum_{\nu=1}^{3} 2 \int_0^{\omega_c} \alpha_\nu^2(\omega) F_\nu(\omega) \frac{d\omega}{\omega},$$

and I_ν is a function which depends weakly on the phonon frequencies and pressure:[33]

$$d \ln I_l / dP = -0.1 \cdot 10^{-6}\ \text{bar}^{-1},$$
$$d \ln I_t / dP = 1.9 \cdot 10^{-6}\ \text{bar}^{-1}.$$

The results of the calculation of $d(\ln T_c)/dP$ made using Eqs. (4) and (5) as well as the data on the pressure-induced changes in the gap ($2\Delta_{av}$) and in the phonon frequencies (Table I), yield:

	$d \ln T_c/dP$, bar^{-1}
Eq. (4), $\omega_0 = \omega_t$:	$-4.95 \cdot 10^{-6}$
Eq. (4), $\omega_0 = \omega_l$:	$-6.9 \cdot 10^{-6}$
Eq. (5):	$-7.6 \cdot 10^{-6}$

Independent experiments give:

	[30]	[34]	[35]
$d \ln T_c/dP$, 10^{-6} bar^{-1}:	-4.9	-5.37	-6.75

Bearing in mind the approximate nature of the models used in[31,32], we find that the agreement between the calculated and experimental values is satisfactory. The experimentally determined values of $d(\ln 2\Delta_{1,av,2})/dP$ are equal, within the limits of the experimental error, which indicates that the phonon spectrum plays the dominant role in the change of $2\Delta/kT_c$ of lead under pressure.

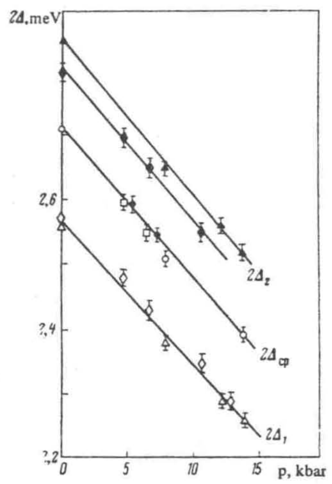

FIG. 4. Influence of high pressures on the energy gaps of superconducting lead. Different samples are represented by different symbols.

4. ENERGY GAP AND PHONON SPECTRUM OF THALLIUM

An investigation of the influence of pressure on the energy gap of thallium films was reported in[17]. The higher quality of our samples made it possible to extend somewhat the range of pressures and to carry out measurements of the shift of the characteristic frequencies in the phonon spectrum of this metal. The maximum value of R(300°K)/R(4.2°K) did not exceed 22 for any of the investigated films. The width of the superconducting transition, δT_c, ranged from 0.005 to 0.02°K. Prolonged annealing at room temperature improved considerably the superconducting characteristics of the films and the barrier properties of the tunnel diodes. A special feature of the films under pressure was the absence of a rise in T_c at low pressures, which should be typical of the bulk material.

The energy gap was determined from the $(dI/dU) = f(U)$ characteristics (Fig. 6). The maximum change in the gap at 13 kbar was $\Delta(P)/\Delta(0) = 3.60 \pm 1.7\%$ and the change in the critical temperature was $T_c(P)/T_c(0) = 3.5 \pm 0.5\%$. Thus, in the investigated range of pressures, the ratio $2\Delta/kT_c$ for thallium films remained constant within the limits of the experimental error.

Since the thallium junctions suitable for high-pressure measurements were prepared by a process which included the evaporation of thallium onto a cold substrate[17] and its subsequent annealing at room temperature, we determined the dependences $\sigma = f(U)$ and $(d^2U/dI^2) = F(U)$ for a large number of samples at zero (atmospheric) pressure. We found that the principal peaks in the phonon spectrum of thallium (Fig. 7) were located at $\omega_t = 3.99 \pm 0.03$ meV, $\omega_l = 9.5$

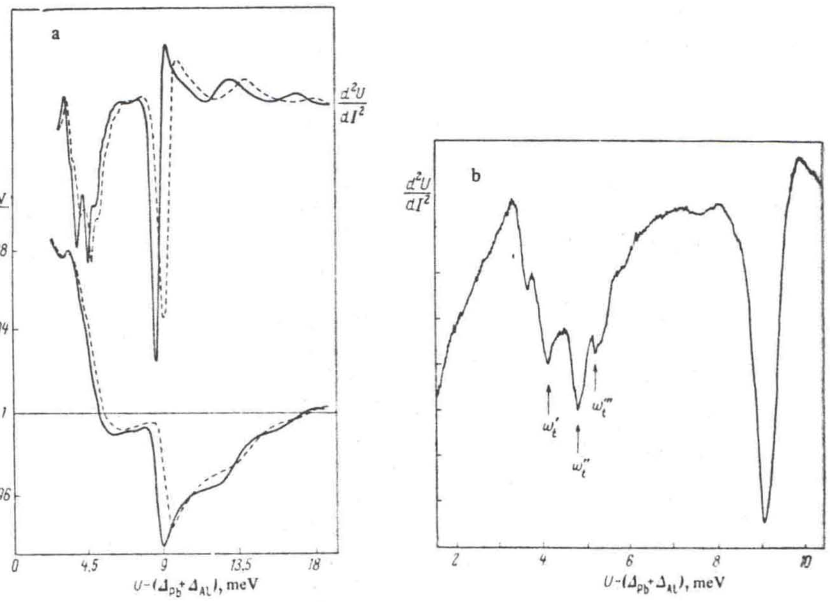

FIG. 5. a) Dependences of the characteristics $(dU/dI)_{25meV}/(dU/dI)_S$ and (d^2U/dI^2) on U for an Al-I-Pb sample at various pressures: the continuous curves correspond to P = 0 and the dashed curves to P = 8 kbar; the amplitude of (d^2U/dI^2) is normalized to the amplitude of ω_t. b) Actual trace of the second-harmonic voltage at P = 8 kbar for the same sample as in Fig. 5a; T = 1.17°K.