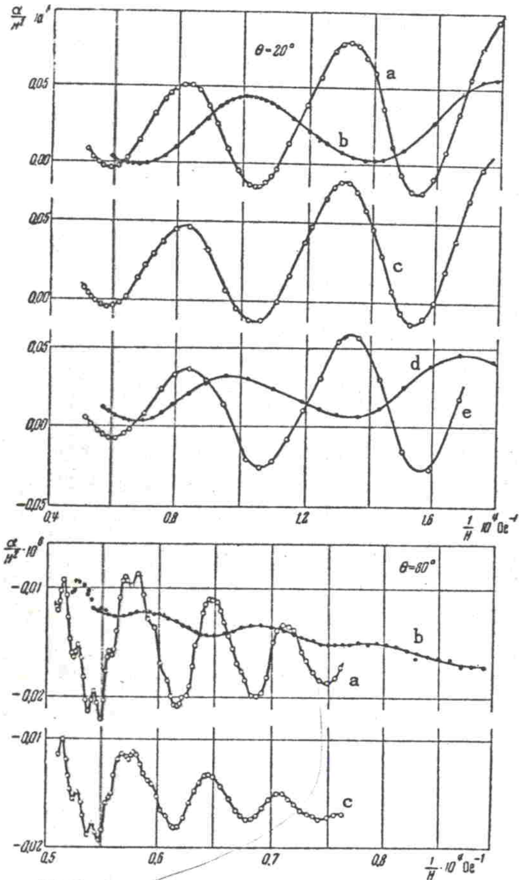

FIG. 2. The differences of the principal specific susceptibilities of a zinc crystal as a function of the applied magnetic field strength at $T = 4.2°$ K. At $\theta = 20°$; (a) $P = 0$ kg/cm^2; (b) $P \sim 1500$ kg/cm^2; (c) pressure removed; (d) pressure $P \sim 1500$ kg/cm^2 reapplied; (e) reapplied pressure removed. At $\theta = 80°$: (a) $P = 0$ kg/cm^2; (b) $P \sim 1500$ kg/cm^2; (c) pressure removed.

Using the data obtained, one can estimate the number of electrons in the group responsible for the investigated longest-period component of the de Haas-van Alphen effect in Zn. If n is the number of electrons in the given group, and Ω is the volume bounded by the corresponding Fermi surface in momentum space, then $n = \Omega V/h^3$, where V is the volume of the metal and h is Planck's constant. The equation $\Omega = \alpha S^{3/2}$ gives the relation between the volume Ω and the extremal cross sectional area of the Fermi surface, and $S = A/\Delta$ [where Δ is the period of the $\chi(1/H)$ curve]. Here α is a form factor that depends in general on the orientation of the field vector relative to the crystal axis. From these formulas we obtain

$$\delta n/n = \delta V/V - {}^3/_2 (\delta \Delta/\Delta) + \delta \alpha/\alpha.$$

In our case, in spite of the significant anisotropy of the compressibility of Zn, the fractional changes of the periods for $\theta = 20°$ and $\theta = 80°$ are close (0.52 and 0.43 respectively). We can thus assume that the shape of the Fermi surface changes but little, and set $\delta\alpha = 0$. Taking next $(\delta\Delta/\Delta)_{av} = 0.47$ and $(\delta V/V) \approx 3.10^{-3}$, we obtain $\delta n/n \approx -0.7$. In other words, the number of electrons responsible for the long-period component in the $\chi(1/H)$ curve for Zn is about 70%. For comparison, we note that a similar evaluation undertaken for Bi [taking $\delta\Delta/\Delta = 0.13$, obtained from the $\chi(1/H)$ curves for $\theta = -70°$] gives only a 10% decrease of the number of electrons responsible for the de Haas-van Alphen effect at a pressure of about 1500 kg/cm^2. This estimate is much rougher than the one performed here for zinc, owing to the way the anisotropy of the Fermi surface of Bi changes under pressure.[2]

Finally, it is interesting to note that the work per atom done by the external forces in compressing the crystal is 2×10^{-6} ev. To some extent this value characterizes the magnitude of the change of the binding forces in the Zn lattice under a pressure of about 1500 kg/cm^2. It is interesting that such a small change in the binding forces leads to so large a change in the parameters of the de Haas-van Alphen effect, owing to the anomalously small group of electrons in zinc with the Fermi energy $E_0 \sim 10^{-2}$ ev.

In conclusion the authors consider it their pleasant duty to thank I. M. Lifshitz for discussing the results of the work.

[1] B. I. Verkin, Doctoral Dissertation, Kharkov State University, 1956.

[2] Verkin, Dmitrenko, and Lazarev, J. Exptl. Theoret. Phys. **31**, 538 (1956); Soviet Phys. JETP **4**, 432 (1957).

[3] B. I. Verkin, Dokl. Akad. Nauk SSSR **81**, 529 (1951); B. I. Verkin and I. F. Mikhailov, J. Exptl. Theoret. Phys. (U.S.S.R.) **24**, 342 (1953).

[4] S. Sidoriak and D. Robinson, Phys. Rev. **75**, 118 (1949); J. Marcus, Phys. Rev. **84**, 787 (1951); F. Donahoe and F. Nix, Phys. Rev. **95**, 1395 (1954); T. Berlincourt and M. Steele, Phys. Rev. **95**, 1421 (1954).

[5] B. I. Verkin and I. M. Dmitrenko, Izv. Akad. Nauk SSSR, ser. fiz. **19**, 409 (1955).

[6] B. I. Verkin, I. F. Mikhailov, J. Exptl. Theoret. Phys. (U.S.S.R.) **25**, 471 (1953).

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