where a is the lattice parameter [3]. However, the formulas obtained thereby differ strongly from (10) - (12) only for instants of time differing from r/s and $|y|/s$ by $\Delta t \sim a/V$. Without dwelling on this question in detail, we indicate only the order of magnitude of the stresses and velocities in the indicated time interval, for a sound pulse consisting, say, of cylindrical waves:

$$v^u \sim V\sqrt{\frac{aV}{rs}}\sin a;\ \ \sigma_1^u \sim \rho s^2\sqrt{\frac{aV^3}{rs^3}}\sin a\cos a;\ \ \sigma_2^u \sim \rho s^2\sqrt{\frac{aV^3}{rs^3}}\sin^2 a.$$

Consequently, the intensity of the pulse depends quite strongly on the velocity with which the dislocation emerges to the crystal surface.

In conclusion we note that the most convenient to observe is apparently the transition radiation of a dislocation emerging to the surface of an elastic twin, which consists, as is well known, of a large number of dislocations. Experiment shows that the velocity of the twinning dislocations can become appreciable in this case [4].

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SUPERCONDUCTING ALLOYS IN A RAPIDLY ALTERNATING MAGNETIC FIELD OF LARGE AMPLITUDE

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As already noted earlier [1], the condition for the smallness of the Joule heating of a superconductor placed in an alternating field whose amplitude is comparable with the critical field can be satisfied at a temperature that is sufficiently close to the transition temperature T_c. This raises the possibility of considering nonlinear problems. The first is that of determining the frequencies characterizing the behavior of the parameter Δ. It is clear beforehand that $\Delta(t)$ will follow the field adiabatically at external-field frequencies below a certain characteristic frequency Ω_0. Therefore to determine $\Delta(t)$ when $\omega \ll \Omega_0$ it is possible, in first approximation, to use the equations of the Ginzburg-Landau theory, in which the field depends on t as a parameter. To the contrary, when $\omega \gg \Omega_0$, we can expect Δ to respond, in the main, to the time-averaged value of the square of the field, whereas the high-frequency oscillations of Δ will have a small amplitude. In this case the time-averaged value of Δ will be determined by the Ginzburg-Landau equations, which contain the mean square of the field. Another important problem is that of the behavior of the field $\vec{A}(\vec{r}, t)$ itself. Here, too, there should exist a characteristic frequency Ω_1 that separates the region of low frequencies, at which the penetration of the field into the superconductor is determined by the Meissner effect, from the high-frequency region, where the main role is played by the skin effect. In the model of a superconductor with a large content of paramagnetic impurities, the frequencies Ω_0 and Ω_1 are of the same order of magnitude [1].

As we shall presently see, in the case of alloys with nonmagnetic impurities the situation is quite different. Unfortunately, it is impossible to write down in this case sufficiently simple equations describing the behavior of Δ in the entire frequency range of interest. However, to obtain the frequency Ω_0 it is sufficient to calculate, using the general equations [1], the correction to Δ of second order in the field. We discuss first the case of a superconductor whose dimensions are so small that Δ is constant throughout the sample. In this case the correction $\Delta^{(1)}$ to Δ is determined from an equation of the form (apart from terms of no significance in this case)

$$\left[\frac{i\pi}{8}\frac{\omega_0}{T}-\frac{7\zeta(3)}{4\pi^2}\left(\frac{\Delta_0}{T}\right)^2-\frac{\pi}{4}\frac{\Delta_0}{T}\frac{\omega_0}{\omega_0+i/\tau}\right]\Delta^{(1)}_{\omega_0}$$
$$=\left(\frac{2e}{c}\right)^2\frac{\pi D}{8}\frac{\Delta}{T}\left(1-\frac{\omega_0}{2(\omega_0+i/\tau)}\right)(A^2)_{\omega_0}. \tag{1}$$

Here Δ_0 is the unperturbed value of Δ and D is the diffusion coefficient of the normal electrons. The time τ characterizes the homogeneous relaxation of the electron energy, connected with electron-electron and electron-phonon interactions. At temperatures close to T_c this time is quite large. If the field is sufficiently monochromatic, then we can speak of a mean value Δ_0^1 $(\omega_0 = 0)$ and of a component with frequency $\omega_0 = 2\omega$, where ω is the field frequency. When $\omega\tau \gg 1$ the last term in the left side of (1) then equals $\pi\Delta_0/4T$ for the harmonic $\omega_0 = 2\omega$ and vanishes in the case of the mean value. Therefore the oscillating part of the correction to Δ is smaller than the correction to the mean value by a factor $(\Delta_0/T) \ll 1$.

We see therefore that for samples having small dimensions the high-frequency situation, in the sense indicated above, is realized at all frequencies $\omega\tau \gg 1$. The situation changes in the case of a superconducting half-space. As shown by calculation, the equation for $\Delta^{(1)}$ differs in this case from (1), roughly speaking, by the fact that it is necessary to make the substitution

$$\frac{\omega_0}{\omega_0+i/\tau}\to\frac{\omega_0}{\omega_0+iDk^2}, \tag{2}$$

where the wave vector k characterizes the spatial variation of Δ.

As is well known, in the static case $\Delta^{(1)}$ contains two damped exponentials with exponents of order of magnitude

$$Dk^2\sim\frac{\Delta^2}{T}\ \left(k\sim\frac{\kappa}{\delta}\right);\qquad Dk^2\sim\frac{1}{\kappa^2}\frac{\Delta^2}{T}\left(k\sim\frac{1}{\delta}\right), \tag{3}$$

where δ is the London depth of penetration and κ is the parameter of the Ginzburg-Landau theory. In the case of an alternating field we should consider separately, as above, the correction to the average value $(\omega_0 = 0)$ and the high-frequency component $(\omega_0 = 2\omega)$. From

(1) with allowance for (2) it follows that the deviation from adiabaticity becomes appreciable at least for one of the exponents in (3) at frequencies

$$\Omega_0 \sim \frac{\Delta^3}{T^2} \text{ for } \kappa \lesssim 1, \qquad \Omega_0 \sim \frac{1}{\kappa^4}\frac{\Delta^3}{T^2} \text{ for } \kappa \gg 1.$$

The field penetration is determined by Maxwell's equation curl $\vec{H} = (4\pi/c)\vec{j}$, where

$$j = -\frac{\sigma}{c}\left(\frac{\partial A}{\partial t} + \frac{\pi|\Delta|^2}{2T} A\right). \tag{4}$$

The transition from the Meissner effect to the skin effect is thus realized at frequencies $\Omega_1 \sim \Delta^2/T$. We see that $\Omega_0 \ll \Omega_1$, especially in the case of London superconductors or superconductors of small dimensions.

It was already noted above that when $\omega \gg \Omega_0$ the oscillating part of Δ is small and can be neglected in first approximation. Therefore we can write for the average value of Δ and for the field a system of nonlinear equations similar to the Ginzburg-Landau equations. In dimensionless form these equations are of the form (for the plane problem)

$$\begin{gathered} -\frac{1}{\kappa^2}\frac{\partial^2\Delta}{\partial z^2} + \overline{A^2}(z)\Delta + (\Delta^2 - 1)\Delta = 0, \\ -\frac{\partial^2 A}{\partial z^2} + \frac{\partial A}{\partial t} + \Delta^2 A = 0, \end{gathered} \tag{5}$$

where the frequency scale is $\pi\Delta_0^2/2T$. It is very important that, within the limits of applicability of (5), we can separate a frequency region $\Omega_0 \ll \omega \lesssim \Omega_1$ in which the field penetration is still determined by the Meissner effect. It is possible here to raise the question of destruction of the superconductivity by a high-frequency field for superconductors of the first kind, in analogy with the procedure used by Ginzburg in calculating the superheating field [2]. Without dwelling on the derivation, we present the equation connecting the value of Δ on the boundary of the superconductor with the amplitude h_1 of the magnetic field in the case when $\kappa \ll 1$:

$$h_1^2 = \frac{2}{\kappa\Delta}(1 - \Delta^2)\sqrt{\omega^2 + \Delta^4}\,\sqrt{\Delta^2 + \sqrt{\omega^2 + \Delta^4}}. \tag{6}$$

At not too high frequencies the $\Delta(h_1)$ plot exhibits hysteresis, just as in the static case [2]. However, unlike the static case, the $\Delta(h_1)$ curve has another branch corresponding to a small but nonzero value of Δ on the boundary. In the field-amplitude interval where $\Delta(h_1)$ is not single-valued, a jump from one regime to the other is possible. A similar situation obtains also in the case of films, although the expression for $\Delta(h_1)$ is then more complicated. It turns out that the conditions for the realization of the hysteresis picture are more favorable here from the point of view of experimental observation than for bulky samples.

In conclusion we note that the relations between Ω_0 and Ω_1 in pure superconductors are different than in alloys. This question was already considered in part by Kemoklidze and Pitaevskii [3].

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POSSIBILITY OF DETERMINING THE UPPER LIMIT OF THE NEUTRINO MASS FROM THE TIME OF FLIGHT

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According to contemporary data [1, 2], the upper limit of the mass of the electronic neutrino is $mc^2 \leq 200$ eV. It is possible in principle to obtain the upper limit of the neutrino mass by using remote pulsed neutrino sources and observing the lag of the lower-energy neutrinos behind those of higher energies.

It is shown in [3 - 6] that it is possible to expect in supernova explosions the emission of $\sim 10^{57}$ neutrinos and antineutrinos in a wide spectral region, with about 10 MeV average energy, within a time on the order of several hundredths of a second. The characteristic distance in our galaxy is $L \simeq 10$ kpsec, or $T = L/c \simeq 10^{12}$ sec. The particle covers the distance L within a time $t = L/\beta c = T/\beta$. For ultrarelativistic particles $\beta \simeq 1 = 1/2\gamma^2$, where $\gamma = E/mc^2$. The interval between the arrivals of two simultaneously emitted particles having different energies E_1 and E_2 is

$$\Delta t = t_1 - t_2 \simeq \frac{T}{2}\left(\frac{1}{\gamma_1^2} - \frac{1}{\gamma_2^2}\right)$$

or, if $\gamma_2^2 \gg \gamma_1^2$

$$\Delta t \simeq \frac{T}{2\gamma_1^2};$$

hence

$$mc^2 \simeq E_1\sqrt{\frac{2\Delta t}{T}};$$

Assuming that in observations of neutrinos emitted from a supernova it is difficult to obtain a value of Δt much smaller than the duration of the neutrino flash ($\Delta t_\gamma \simeq 3 \times 10^{-2}$ sec) [6], we get $mc^2 \lesssim 2$ eV at $E_1 \simeq 8$ MeV. Thus, it is possible to improve the estimate of the upper limit of the neutrino mass by two orders of magnitude compared with the contemporary value.

To observe antineutrino fluxes from a supernova in our galaxy we can use a large amount ($\gtrsim 1000$ tons) of organic scintillator placed in a special underground chamber (to screen it against cosmic rays). When 10^{57} antineutrinos are produced at a distance of 10 kpsec, a particle flux of density 10^{11} particles/cm^2 will strike the earth. With the effective cross sec-