Phase Slippage and Josephson Phenomena in Wide Superconducting Films

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Resistive state properties of wide superconducting films of tin have been studied experimentally. This state is connected in our case with the phase-slip lines (PSLs) arising against a dynamic vortex state due to an evolution of the vortex instability. Formation of the first PSL structure occurs at the point of maximum viscosity much earlier, than the thermal instability destroys a superconducting phase - due to an optimal specific resistance of the samples and effective heat removal.
We investigated the magnetic field dependencies of the critical currents when the PSL structures appear. Application of an external field results in randomly oscillating I(H) curves. Heights of the peaks and troughs are very variable, and there are no quite definite oscillation periods and central peaks. Nevertheless, these curves are reproducible.
To analyze this phenomenon we consider the PSL as a specific Josephson junction consisted of a large number of small individual contacts, and suppose that there is enough trapped flux present to make the phases of the contacts random in zero applied fields. This explains why there were no central peaks. In an external field the phases of the individual contacts change, but they remain random. We check this model quantitatively with Fourier analysis to find an autocorrelation function and estimate the widths of individual contacts and PSL as a whole, for different samples and temperatures.