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NASA TECH BRIEF

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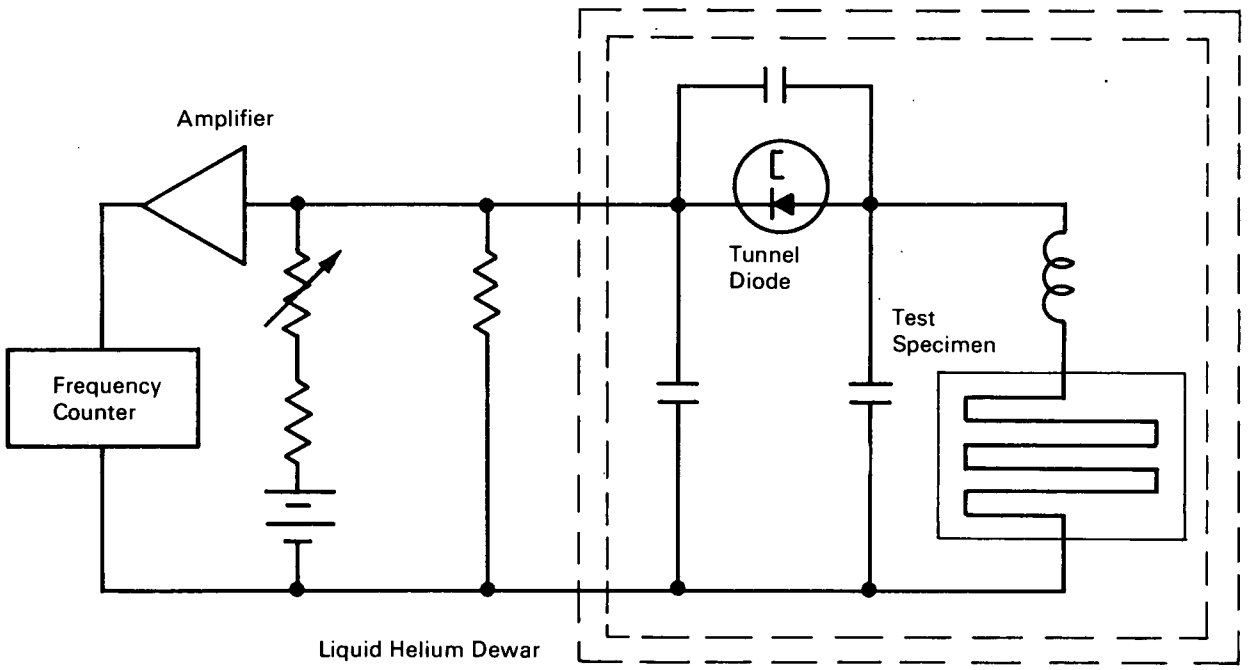
Kinetic Inductance Measured in a Superconducting Wire



Oscillator Circuit Senses Inductance Change

The capability of metal in a superconducting state (i.e. cooled to a few degrees Kelvin) to transport an enormous current density has stimulated a widespread interest in developing practical applications for this phenomenon; e.g., a commercial power generating station could transmit electrical power in a superconducting transmission line that would carry thousands of amperes at a low voltage.

A research program has been initiated for the purpose of developing the experimental techniques and theoretical foundation to further the understanding of the physical process. An important physical parameter investigated in the program is the kinetic inductance, L_K, associated with the inertial mass of the electron in a superconducting metal. Even in a metal, L_K has a very small value; for example, in a 1-meter length of 0.25-mm diameter superconducting wire well below its transition temperature, L_K, is approximately 10^{-10} henry. To measure the small values, the test specimen is included as part of the inductance of the tank circuit of the tunnel diode oscillator shown in the figure. A shift in the frequency of the oscillator, caused by changes in the inductance, is sensed by a frequency counter. Experimental data has verified that a fre-

(continued overleaf)

quency shift in the oscillator tank circuit is proportional to a change in kinetic inductance. The simplicity of the technique makes the measurement of L_K particularly useful in determining the critical field and current of high-field superconductors. Also, the measurement technique is ultrasensitive; in fact, frequency shifts observed with a thin-film aluminum wire have been used to detect changes in temperature of 5×10^{-7}°K, a change in magnetic field of 10^{-5} gauss, and a change in current associated with one quantum in a flux magnetometer.

Potential applications would be its use as a transducer that measures a magnetic field and as the sensing element in a flux quantization magnetometer.

Note:

The following documentation may be obtained from:

Technical Information Service
American Institute of Aeronautics
and Astronautics, Inc.
750 Third Avenue
New York, New York 10017
Single document price $3.00
(or microfiche $0.50)

Reference:

N69-33783, Measurements of the Kinetic Inductance of Superconducting Linear Structures

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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