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Volume II

DAMPING CAPACITY OF MATERIALS

by
Robert E. Maringer

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1157. Admiralty Materials Laboratory, Holton Heath, Great Britain,
HIGH DAMPING CAPACITY ALLOYS FOR THE REDUCTION OF NOISE AND VIBRATION. PART II - FIRST REPORT ON MANGANESE-COPPER ALLOYS by D. Birchon, N. J. Orlando, and L. J. Steele, May 1961, 34 pp.

Not abstracted.

1158. Air Force Institute of Technology,
STUDY OF THE DISSIPATION OF INTERNAL ENERGY IN A VIBRATING BEAM by G. R. Blitch and J. Green, 1961, Report No. GAE/Mech 61-10, 63 pp.

In a cantilever beam undergoing forced transverse vibration, the phenomenon of internal damping appears as a small nonlinear term in the equation for the energy contained in the beam due to the deflection of the beam. Energy loss per cycle in the beam is equal to the area of the hysteresis loop. Equations of the hysteresis loop contain parameters characteristic of the material in the beam.

1159. Alers, G. A. and Thompson, D. O.,
DISLOCATION CONTRIBUTIONS TO THE MODULUS AND DAMPING IN COPPER AT MEGACYCLE FREQUENCIES, Journal of Applied Physics, Vol. 32, No. 2, February 1961, pp. 283-293.

The three elastic moduli of 99.999+ percent pure copper and their associated internal frictions were measured between 4.2° and 250° K both before and after fast neutron bombardment. Changes produced by the irradiation were used to determine the dislocation contributions to damping and moduli as a function of frequency and temperature.

1160. Ansell, G. S. and Arnold, P. E.,
INTERNAL FRICTION BEHAVIOR OF AN ALUMINUM-ALUMINUM OXIDE SAP-TYPE, Transactions, Metallurgical Society of American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), Vol. 221, February 1961, pp. 206-207.

Activation energy for the relaxation process and temperature of the relaxation peak are determined with the

internal friction constant and damping characteristics of fine-grained as-extruded and recrystallized coarse grain dispersion alloy specimens at 343° to 923° K and frequencies of 0.9 to 1.8 cps.

1161. Arizona University, Tucson,
DIFFUSION IN Ag-Zn SYSTEM by C. T. Tomizuka and R. A. Roberts, 1961, Contract AF 49/638/-790, 16 pp.

Not abstracted.

1162. Atomic Energy Commission,
EFFECT OF CHANGING TEMPERATURE ON THE INTERNAL FRICTION OF URANIUM by R. E. Maringer, 1954, 14 pp., Declassified 1961.

The variation of the internal friction of alpha swaged uranium wire was studied as a function of temperature, heating rate, strain amplitude, and strain rate. A peak associated with the stress-induced motion of twin boundaries and a peak associated with grain boundary relaxation and transformation were observed. The internal friction increased linearly with both heating and strain rates. This damping loss was interpreted as resulting from the change in dimensions of twinned areas during straining.

1163. Atomic Energy Commission Publication,
THE YOUNG'S MODULUS AND INTERNAL FRICTION OF POLYCRYSTALLINE MgO AT ROOM TEMPERATURE by R. Hanna and W. B. Crandall, 1961.

As the density of the specimen increased the Young's modulus increased linearly, whereas the internal friction decreased. It was found that the internal friction was inversely proportional to the square of the grain diameter.

1164. Atomic Energy Commission Publication,
AN INTERNAL FRICTION STUDY OF VERY LOW CARBON MARTENSITE by J. K. Jackson, 1961, Report No. TID-15643.

The structure of martensite in iron-nickel-carbon alloys containing less than 0.015 percent by weight carbon was investigated by measuring the 40° C carbon diffusion internal friction peak. Measurements of the internal friction in alloys containing 0.0, 2.5, 5.1, 6.5, 10.5, and 16.5 percent

by weight nickel were made at low frequencies with a torsion pendulum. By evaluation of the effects of varying nickel content and heat treatment on the nature of this peak, the existence of a structure in which the carbon atoms are ordered was revealed in specimens which had been quenched from temperatures at which austenite is stable.

1165. Atomic Energy Commission Publication,
LOW TEMPERATURE INTERNAL FRICTION IN PLASTICALLY DEFORMED MAGNESIUM by R. T. C. Tsui, 1961, Report No. TID-14140.

The internal friction of hexagonal metal crystals of magnesium and zinc was studied between 4.2° and 300° K at frequencies of about 4 and 40 kilocycles. Two kinds of internal friction peaks were found in cold-worked polycrystalline and monocrystalline magnesium. The peak at 20° K behaved very much like the Bordoni-type peak observed in face-centered cubic metals. The broad peak or peaks occurring from 70° to 160° K showed a strong dependence on plastic deformation. Some measurements on deformed single crystals of zinc showed the existence of a broad internal friction peak in the vicinity of 210° K.

1166. Avco Corporation, Research and Advanced Development Division, Wilmington, Massachusetts,
DEVELOPMENT TEST OF SILICON RUBBER LINER FOR MINUTE-ADLE by P. J. Aminsky, March 1961, Report No. AD-406-546, 11 pp.

Not abstracted.

1167. Barinov, I. P., Dashkovskii, A. I., and Evstyukhin, A. I.,
THE INTERNAL FRICTION AND MODULUS OF SHEAR ELASTICITY OF IODIDE HAFNIUM AND ALLOYS OF THE SYSTEM HAFNIUM-ZIRCONIUM, Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 3, 1961, pp. 74-81.

The following hafnium-zirconium alloys were studied: hafnium 95 percent, zirconium 5 percent; hafnium 80 percent, zirconium 20 percent; hafnium 50 percent, zirconium 50 percent; hafnium 30 percent, zirconium 70 percent; and iodide zirconium. Internal friction increases very slowly at first. At higher temperatures (≦ 1250°), internal friction increases

rapidly. Iodide zirconium, as well as alloys containing ≧ 50 percent zirconium, show a drop in internal friction and an increase in shear modulus in the temperature interval corresponding to polymorphic transformation.

1168. Bayazitov, M. I., Gladkovskii, V. A., and Kochnov, V. E., THE EFFECT OF STRAIN ON THE INTERNAL FRICTION OF ELECTROLYTIC COPPER, Sb. Nauchn.-Tekhn. Tr., Nauchn.-Issled. Inst. Met. Chelyab. Sovnarkhoza, No. 3, 1961, pp. 189-194.

The effect of plastic deformation on the temperature dependence of internal friction in 99.9 percent pure copper was studied. Three internal-friction maxima were observed in specimens deformed 2 to 10 percent: 400° (deformation effect), 460° (relaxation of grain boundaries), and 240° (impurities).

1169. Belov, K. P., Levitin, R. Z., Nikitin, S. A., and Pedko, A. V., MAGNETIC AND MAGNETOELASTIC PROPERTIES OF DYSPROSIUM AND GADOLINIUM, Zhuranl Eksperemental'noĭ i Teoreticheskoĭ Fiziki, Vol. 40, 1961, pp. 1562-1569.

The magnetic properties of dysprosium and gadolinium were determined. The temperature dependence of the modulus of elasticity, E, and of the internal friction, Q^{-1} (proportional to the decrease in vibration damping), of dysprosium confirmed the existence of ferro ⟶ antiferro ⟶ paramagnetism transitions at 88° and 175° K, respectively.

1170. Belov, K. P., Levitin, R. Z., and Nikitin, S. A., MAGNETOELASTIC PROPERTIES OF TERBIUM AND HOLMIUM, Izv. Akad. Nauk SSSR, Ser. Fiz., Vol. 25, 1961, pp. 1382-1384.

A large anomaly of the Young's modulus was found in terbium at 234° K (Curie point) and the maximum of internal friction is at 223° (ferromagnetic-antiferromagnetic transition point). The magnetostriction is large at liquid-nitrogen temperature and decreases with rising temperature. Anomalies of the Young's modulus and of internal friction were observed in holmium at 196° K.

1171. Bernshtein, M. L. and Trubetskova, R. I.,
EFFECT OF SMALL ADDITIONS OF SOME ELEMENTS ON THE PROPERTIES OF A NICKEL-CHROMIUM AUSTENITE ALLOY, Stal', Sb. Statei, 1961, pp. 462-468.

The following elements were added to a nickel-chromium alloy of the type N36KhTyu with an increased amount of carbon: boron 0.005 percent, niobium 1.5 percent, calcium 0.1 percent, zirconium 0.2 percent, and cerium 0.01 percent. The additives increased resistance to creep during its first stage. Internal friction (determined by torsional vibrations) shows a distinct peak at 550° to 750°.

1172. Berry, B. S.,
MAGNITUDE OF THE ZENER RELAXATION EFFECT. PART 4. ANISOTROPY OF THE RELAXATION STRENGTH IN Al-4% Cu., Acta Metallurgica, Vol. 9, February 1961, pp. 98-105.

The important parameters controlling the anisotropy of the Zener relaxation in quenched and reverted aluminum-four percent copper (1.8 atomic percent copper) are determined from internal friction measurements in torsional and transverse vibration on (100) oriented single crystal specimens. The anisotropy is much larger than predicted by the theories of Le Claire and Lomer and Zener, and the maximum tensile relaxation strength occurs in the (100) orientation, for which this theory predicts a minimum value.

1173. Bhatia, A. B. and Moore, R. A.,
ULTRASONIC ATTENUATION IN NORMAL METALS AT LOW TEMPERATURES, Physical Review, Vol. 121, 1961, pp. 1075-1086.

The possible influence of electron-electron collisions on attenuation is briefly discussed.

1174. Bloch, A.,
DAMPING WITHOUT INFLUENCE ON FREQUENCY, Nature, Vol. 191, 9 September 1961, pp. 1086-1087.

Reformulation of conditions of damped oscillation without influence on frequency of gyroscopic systems, which can be extended to systems (not necessarily gyroscopic) with

more than one degree of freedom. This is exemplified by a dynamic system consisting of a mass and a spring which both are subject to damping.

1175. Bordoni, P. G., Nuovo, M., and Verdini, L., LOW-TEMPERATURE DISSIPATION PEAK IN NIOBIUM, Physical Review, Vol. 123, No. 4, 15 August 1961, pp. 1204-1206.

The energy dissipation coefficient, Q^{-1}, and the resonant frequency of a circular plate of niobium were measured as a function of temperature in the range 60° to 300° K. The measurements were carried out at four different frequencies from 18 to 174 kc/sec with strain amplitudes smaller than 10^{-7}. For each vibration mode, a pronounced peak is found for the dissipation coefficient while the frequency-temperature curves show a corresponding inflection. The temperature, T_m, of the dissipation peak depends on the vibration frequency according to an Arrhenius equation which characterizes the thermally activated relaxation effects. The activation energy, $\overline{W}$, and the limiting relaxation time, $\overline{\tau}_0$, of the process were computed and these values $\left[\overline{W} = 0.265 \text{ eV and } (\overline{\tau}_0)^{-1} = 61 \times 10^{11} \text{ sec}^{-1}\right]$ are in agreement with the values previously found in some face-centered cubic metals for the relaxation effect due to the motion of dislocations. The value of $\overline{W}$ found in niobium show that the effect cannot be directly produced by the motion of interstitial atoms of hydrogen.

1176. Bordoni, P. G., Nuovo, M., and Verdini, L., RELAXATION OF DISLOCATIONS IN CUBIC FACE-CENTERED METALS, Proceedings of the Third International Congress on Acoustics, Elsevier, Holland, Vol. 1, 1961, pp. 583-586.

Ultrasonic attenuation determination of the activation energy of dislocations induced by straining chemically pure specimens of silver, gold, palladium, and platinum.

1177. Bordoni, P. G., Nuovo, M., and Verdini, L., DYNAMIC BEHAVIOR OF POLYMETHYL METHACRYLATE BETWEEN 60 AND 300 K, Vol. 20, No. 4, 1961, pp. 667-694.

The resonant frequency and the coefficient of energy dissipation were measured as a function of temperature in

the range of 60° to 300° K for several specimens of polymethyl methacrylate of the plasticized and unplasticized type. A relaxation effect is superposed to another cause of energy dissipation which increases not only with temperature but also frequency. The frequency-temperature curve exhibits a knee near 230° K.

1178. Brooklyn Polytechnic Institute, Department of Mechanical Engineering,
DAMPING OF FLEXURAL VIBRATIONS OF SANDWICH PLATES by Y. Y. Yu, May 1961, TN 10, AFOSR 838, 36 pp.

Not abstracted.

1179. Brown University, Office of Naval Research Contract,
VIBRATIONS AND WAVE PROPAGATION IN ALUMINUM ALLOYS AT ELEVATED TEMPERATURES, S. R. Bodner and A. F. Fraser, August 1961, Technical Report No. 24, Nonr-562(20).

Measurements of the dynamic modulus and damping of commercially pure aluminum (1100) and an aluminum alloy (2024-T4) were obtained over a frequency range of 20 to 3500 cps, at temperatures from 80° to 1100° F. For the small test oscillations, the results were found to be amplitude independent. The frequency and temperature dependence of the results are discussed in relation to linear viscoelastic representations, metallurgical properties, and possible temperature-time correspondence.

1180. Buffalo University,
ELASTIC PROPERTIES OF CARBONS AND GRAPHITES by J. Andrew, J. Distante, N. Juul, and T. Tsuzuku, October 1961, 20 pp.

A description of the preparations for carrying out experiments on internal friction in carbons in the range of low temperatures is presented, including a block diagram of the electronics in construction. Measurements of the elastic modulus as a function of temperature for four types of graphite (3000 C HT) were repeated and found to be the same as previously reported.

1181. Bungardt, K., Preisendanz, H., and Brandis, H., A NOVEL TORSION OSCILLATOR FOR MEASURING THE INTERNAL FRICTION OF METALS, Archiv für das Eisenhuttenwesen, Vol. 32, No. 2, 1961, pp. 113-122.

A torsion oscillator is described suitable for damping measurements of metals and alloys at -180° to 1500° with frequency, Qf, 0.5 to 2.5 cycles, and isothermal and continuous control of temperature. Comparative measurements are given of damping and shear modulus of pure iron and cobalt as a function of temperature.

1182. Bureau of Mines, FATIGUE PROPERTIES OF MANGANESE-COPPER DAMPING ALLOYS by J. W. Jensen, A. E. Schwaneke, and D. F. Walsh, Report of Investigations 5853, 1961, 14 pp.

This report investigates properties of induction melted alloys containing approximately 65 percent, 75 percent, and 80 percent manganese and of an induction arc-melted alloy with 78 percent manganese. Heat treatment is carried out to obtain optimum mechanical and damping properties. Rockwell hardness, tensile strength, damping capacity and endurance limit data are presented.

1183. Carswell, W. S., INVESTIGATION OF STRAIN AGING OF QUENCH-AGED α - IRON CONTAINING NITROGEN, USING INTERNAL-FRICTION TECHNIQUE, Acta Metallurgica, Vol. 9, No. 7, July 1961, pp. 670-677.

The strain aging of alpha-iron containing nitrogen, and quench aged at various temperatures, was examined after slight strain by means of torsional-pendulum damping. The changes in damping after strain can be described in three stages: an initial rise in damping, a decrease which varies as $(\text{time})^{2/3}$, followed by a much slower decrease with time. It is suggested that these changes in damping are due to the Cottrell-Bilby mechanism of strain aging and to the dissolution of precipitates by the dislocations. The variation in density of dislocations with strain and quench-aging temperature may be explained by Koehler's model for the generation of dislocations.

1184. Carter, W. J. and Liu, F. C.,
STEADY-STATE BEHAVIOR OF NONLINEAR DYNAMIC VIBRATION ABSORBER, Transactions, American Society of Mechanical Engineers, Journal of Applied Mechanics, Vol. 28, Series E, No. 1, March 1961, pp. 67-70.

The Frahm-type dynamic vibration absorber is analyzed for the case where both main and absorber springs have nonlinearities of the Duffing type. A one-term-approximation solution is assumed for the motions of the two masses, and the resulting amplitude equation is solved using a graphical procedure. It is shown that the optimum dynamic-vibration-absorber system for variable frequency excitation is that which has a hardening main spring together with a softening absorber spring.

1185. Caughey, T. K. and O'Kelly, M. E. J.,
EFFECT OF DAMPING ON THE NATURAL FREQUENCIES OF LINEAR DYNAMIC SYSTEMS, Journal of Acoustical Society of America, Vol. 33, No. 11, November 1961, pp. 1458-1461.

An analysis is presented of the effect of weak damping on the natural frequencies of linear dynamic systems. It is shown that the highest natural frequency is always decreased by damping, but the lower natural frequencies may either increase or decrease, depending on the form of the damping matrix.

1186. Cavanaugh, R. D.,
AIR SUSPENSION AND SERVO-CONTROLLED ISOLATION SYSTEMS, Shock and Vibration Handbook, New York, New York, McGraw-Hill Book Company, Incorporated, 1961 (Chapter 33, C. M. Harris and C. E. Crede, Editors).

This chapter discusses vibration isolation using pneumatic springs as vibration isolators and the application of servo-control systems to vibration isolation.

1187. Chambers, R. H. and Schultz, J.,
DISLOCATION RELAXATION SPECTRA OF COLD-WORKED BODY-CENTERED CUBIC TRANSITION METALS, Physical Review Letters, No. 6, 1961, pp. 273-275.

In the internal friction versus temperature curves of niobium, tantalum, molybdenum, and tungsten with structural

defects by cold working, peaks are found at 100° to 200° K at about 15 kc/sec. The specimens had been given a three-percent tensile prestrain at 300° K (except at 600° K for tungsten). All four metals show a strong amplitude dependence of internal friction.

1188. Chang, R.,
THE ELASTIC AND ANELASTIC PROPERTIES OF REFRACTORY MATERIALS FOR HIGH-TEMPERATURE APPLICATIONS, Mechanical Properties of Engineering Ceramics, New York, New York, Interscience Publishers, Incorporated, 1961, pp. 209-220 (W. W. Kriegel and H. Palmour, Editors).

Examples of anelastic phenomena associated with grain boundary relaxation, twin interface motion, or dislocation motion in some refractory oxides and other high temperature materials are presented.

1189. Chang, R.,
DISLOCATION RELAXATION PHENOMENA IN OXIDE CRYSTALS, Journal of Applied Physics, Vol. 32, No. 6, June 1961, pp. 1127-1132.

The dislocation relaxation of MgO and Al_2O_3 crystals was studied by means of anelastic measurements. The experimental data are analyzed according to the theory of Seeger, Donth, and Pfaff. It is shown that the ratio of Peierls forces to shear modulus is about 2×10^{-5} for MgO and possibly also for Al_2O_3. Comparison of the dislocation relaxation phenomena of oxides and metals indicates, rather surprisingly, that the ratio of Peierls force to shear modulus in oxides is about an order of magnitude smaller than that in face-centered cubic metals.

1190. Chih-Tsiang, T.,
ON THE MECHANISM OF INTERNAL-FRICTION PEAK INDUCED BY DIFFUSION OF INTERSTITIAL ATOMS IN FCC CRYSTAL, Scientia Sinica, Vol. 10, No. 8, 1961, pp 930-937.

The relation between carbon content and internal-friction height of carbon diffusion in nickel and steel containing 18.5 percent manganese was studied. The results are related to the rotation of atom pairs in the crystal lattice under stress.

1191. Ch'i-wei, L.,
INVESTIGATION OF THE GRAIN-GROWTH OF FERRITE DURING TEMPERING BY INTERNAL FRICTION METHOD, Scientia Sinica, Vol. 10, 1961, pp. 324-331.

The results are given of research on the grain growth of ferrite during the tempering of quenched iron-carbon alloy by the internal friction method. The relation between the grain growth during tempering and the increase of height of the Snoek peak was experimentally established. The activation energy for the grain growth was computed and the concept of grain and subgrain discussed.

1192. Collette, G., Roederer, C., and Crussard, C.,
STUDY BY INTERNAL FRICTION AND BY TENSILE TESTING OF THE PRECIPITATION OF NITROGEN IN PURE IRON-NITROGEN ALLOYS. APPLICATION TO THE AGING OF EXTRA MILD STEELS, Mémoires Scientifiques de la Revue de Métallurgie, Vol. 58, No. 1, 1961, pp. 61-72.

Not abstracted.

1193. Collette, G. and Saada, G.,
THE MEASUREMENT OF THE VARIATION OF THE INTERNAL FRICTION OF A HIGH PURITY COPPER BY MEANS OF THE AMPLITUDE OF VIBRATION, Comptes Rendus, Vol. 252, 1961, pp. 1954-1956.

The variations in the internal friction in relation to the elongation of a high purity copper strip were studied by means of a flywheel pendulum with an attached edge and an optical enlargement arrangement. This apparatus is called a hysteresismeter. It is thought that the variations of the elongation with the amplitude of the deformation are due to the movement of the crystal dislocations.

1194. Conger, R. L.,
NONLINEAR DAMPING LOSSES IN YIG, Journal of Applied Physics, Vol. 32, No. 8, 1961, pp. 1525-1527.

High-power ferromagnetic resonance in a flat plate has a component of the precession parallel to the applied direct-current field. This component causes frequency doubling and also coherent amplification of some scattered spin waves. These spin waves then cause a linear damping of the parallel

component of the precession, which in turn causes a nonlinear damping of the principal component of the precession. The nonlinear damping causes the microwave susceptibility to decrease with increasing power and to become approximately inversely proportional to the radio-frequency field at high power levels.

1195. Crafton, P. A.,
SHOCK AND VIBRATION IN LINEAR SYSTEMS, New York, New York, Harper and Brothers, 1961, 415 pp.

This book fills the need for a complete treatment of linear systems from the mechanical point of view. It contains a solid mathematical background from complex variables through Laplace transformations to transfer functions and frequency spectrums. The greater part of the book deals with lumped-parameter systems with multiple degrees of freedom. Included are such topics as branched systems and shock and vibration isolation by feedback control. Continuous systems are also discussed.

1196. Crede, C. E.,
APPLICATION AND DESIGN OF ISOLATORS, Shock and Vibration Handbook, New York, New York, McGraw-Hill Book Company, Incorporated, 1961 (Chapter 32, C. M. Harris and C. E. Crede, Editors).

This chapter discusses the practical aspects of isolation and isolators. Data are included on the characteristics of typical commercially available isolators including both dimensional and performance characteristics. Dampers of various types are discussed in detail to provide design and application data where the damping attainable from internal hysteresis of the spring is not great enough.

1197. Crede, C. E. and Ruzicka, J. E.,
THEORY OF VIBRATION ISOLATION, Shock and Vibration Handbook, McGraw-Hill Book Company, Incorporated, New York, New York, 1961 (Chapter 30, C. M. Harris and C. E. Crede, Editors).

The topics considered are: (1) influence of damping in vibration isolation, (2) multiple degree-of-freedom systems, (3) properties of a biaxial stiffness isolator, (4) nonlinear vibration isolators, (5) isolation of random vibration,

(6) vibration isolation of non-rigid body systems, and (7) wave effects in isolators. The bibliography has 28 entries.

1198. Dabosi, M. F.,
EFFECT OF PURITY OF IRON ON ITS INTERNAL FRICTION, Métaux, Corrosion-Industries, Vol. 36, June 1961, pp. 244-247.

Torsional cycling of electrolytic iron and zone-melted iron. Effects of carbon and nitrogen impurities, testing temperature, various heat treatments, and magnetization on damping properties.

1199. Dashkovskii, A. I. and Savitskii, E. M.,
INTERNAL FRICTION IN STRONTIUM, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 11, No. 5, May 1961, pp. 811-812.

Low frequency damping and modulus data are given for temperatures up to 670° C. The data show damping peaks and changes associated with recrystallization and phase changes.

1200. Dashkovskii, A. I.,
COMPARATIVE STUDY OF INTERNAL FRICTION IN URANIUM AND IRON IN RELATION TO POLYMORPHISM, Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 3, 1961, pp. 183-189.

The internal friction of iron wire 0.8 millimeter in diameter containing carbon 0.02 percent and phosphorus 0.007 percent was determined by the torsion pendulum during heating from room temperature to 1100° and on cooling. During $\alpha - \gamma$ transformation a sharp reversible change in internal friction occurs. The internal friction of uranium during heating drops at 750° to 770° ($\alpha \rightarrow \beta$ transformation) and rises at about the same temperature during cooling. The observed changes are attributed to modification of the crystal lattice during polymorphic transformation.

1201. Dashkovskii, A. I., Eustjuchin, A. I., Savickij, E. M., and Skorov, D. M.,
INTERNAL FRICTION OF URANIUM, Kernenergie, Vol. 4, May 1961, pp. 404-408.

Investigation of the influence of temperature and structure in a torsion pendulum under vacuum at 20° to 850° C, using cold-drawn heat-treated wires of 0.98 millimeter diameter.

1202. Dashkovskii, A. I. and Savitskii, E. M.,
TEMPERATURE DEPENDENCE OF INTERNAL FRICTION, SHEAR, MODULUS, AND LINEAR EXPANSION OF LANTHANUM AND CERIUM, Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 3, 1961, pp. 196-202.

Temperature dependence for lanthanum and cerium of internal friction and shear modulus as determined at 20° to 670° and linear expansion at 20° to 730°. In addition, shear modulus was determined at room temperature. After heat treatment, the specimens contained 0.01 percent oxygen. Allotropic transformations take place for lanthanum at 326° to 375°, while for cerium at 700° to 720°. Internal friction for lanthanum drops during $\alpha \rightarrow \beta$ transformation from 0.92 to 0.01 Q^{-1}, but with further temperature rise it increases sharply.

1203. Day, D. E. and Rindone, G. E.,
INTERNAL FRICTION OF PROGRESSIVELY CRYSTALLIZED GLASSES, Journal of American Ceramics Society, Vol. 44, 1961, pp. 161-167.

Internal friction of partly crystallized $LiO_2 . 2.75SiO_2$ glass fibers was measured by the torsion pendulum technique. With increasing crystallization, internal friction measurements showed that the low-temperature peak, attributed to stress-induced diffusion of alkali ions, decreased continuously and shifted to higher temperatures; the intermediate temperature peak decreased continuously; and a high temperature relaxation appeared which suggested an early stage of nucleation long before $Li_2Si_2O_6$ crystals could be detected by X-ray diffraction.

1204. Dekartova, N. V. and Rozhanskii, V. N.,
STUDY OF THE RELATIVE SURFACE ACTIVITY OF SOME METALS ON ZINC BY AN INTERNAL FRICTION METHOD,
Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 11, No. 1, 1961, pp. 138-143.

The effect of active adsorption media on the atomic relaxation processes was investigated during the study of extinction of free torsional vibrations with frequencies of 1 to 10 cps in single and polycrystalline zinc. A large increase of relaxation stress along the grain boundaries was observed on fine-grained samples of amalgamated zinc, owing to the crystallization of mercury on intercrystalline boundaries. The relative surface activity of several easily fusible metals (mercury > tin > bismuth > Wood's metal > lead) on zinc was measured by the method of internal friction.

1205. De Morton, M. E.,
MAGNETOMECHANICAL DAMPING IN CHROMIUM,
Philosophical Magazine, Vol. 6, July 1961, pp. 825-831.

Torsion pendulum testing of ordered specimens at -80° to 80° C was accomplished after tensile deformation. Damping hysteresis was observed with changing temperature and strain amplitude below 40° C, and a marked reduction of strain-amplitude-dependent damping in this region when a biasing tensile stress is present is correlated with the suggestion that an antiferromagnetic domain structure exists in chromium below 40° C.

1206. De Morton, M. E.,
RECOVERY AND RECRYSTALLIZATION IN 99.98% Cr,
Transactions, American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), Vol. 221, 1961, pp. 395-400.

Recovery and early recrystallization of heavily deformed 99.98 percent chromium was investigated by studying metallographic structure, X-ray line sharpening, electrical resistivity, plastic properties, internal friction, and shear modulus together with some hardening and relief of internal strains incurred before the visible growth of a textural substructure above 350° (recrystallization in situ). The complex behavior of shear modulus, internal friction, and its strain amplitude dependence during annealing are discussed qualitatively in terms of the relative mobility of dislocations.

1207. De Veubeke, B. M. F.,
INFLUENCE OF INTERNAL DAMPING ON AIRCRAFT RESONANCE, Agard Manual on Aeroelasticity, Part I-Structural Aspects, Vol. 1, January 1961, 49 pp.

Not abstracted.

1208. Dhar, P. R., Bhattacharjee, K. K., and Ghosh, S. S.,
INTERNAL FRICTION OF COLD-WORKED Cu, Journal of Scientific and Industrial Research, Vol. 20D, 1961, pp. 237-238.

Effect of annealing for seven days at room temperature (29°) on the internal friction of cold-worked copper was studied by the torsional pendulum method modified by Fine. The internal friction increased gradually with the degree of cold working and reached a maximum for 70 percent redistribution. The annealing process enabled some of the dislocations created by cold working to be pinned down by impurity atoms inside the metal, thus lowering the internal friction. Etching to remove the oxide layer from the surface of the annealed wire freed some of the bound dislocations, thus increasing the internal friction.

1209. Dilewijns, J.,
COBALT-CARBON ALLOYS, Cobalt, No. 11, June 1961, pp. 28-35.

This article explores the metallographic structure of cobalt-carbon alloys containing up to three-percent carbon, and the effect of noncarbide-forming and manganese additions on the existing phases. Evaluation is made of hardness, tensile strength, Young's modulus and damping capacity, and of the effectiveness of cerium-mischmetal and nickel-magnesium additions made to obtain spheroidal graphite.

1210. Dobbs, E. R.,
ATTENUATION OF SOUND IN GERMANIUM AT ULTRA-HIGH FREQUENCIES, Proceedings, Seventh International Conference on Low-Temperature Physics, Canada, University of Toronto Press, 1961, pp. 291-293.

The acoustic wave in pure germanium is measured from 1.5° to 300° K using compressional waves at 508 mc/sec

and shear waves at 333 mc/sec. The temperature dependence of the attenuation is accounted for in terms of the known behavior of the phonon mean free path.

1211. Dorn, J. E.,
MECHANICAL BEHAVIOR OF MATERIALS AT ELEVATED TEMPERATURES, New York, New York, McGraw-Hill Book Company, Incorporated, 1961, 529 pp.

The final three chapters on thermal stresses, creep under non-steady temperatures, and damping all provide much empirical data.

1212. Douglas Aircraft Company, Incorporated, El Segundo, California,
SONIC FATIGUE DAMPING SYSTEM DEVELOPMENT by J. R. Rhoads, February 1961, ES 40223, AD-272-911.

Not abstracted.

1213. Dulis, E. J., Chandhok, V. K., and Hirth, J. P.,
RELATIONSHIP BETWEEN FATIGUE AND DAMPING CHARACTERISTICS AND MICROSTRUCTURE OF 12% Cr STEELS, American Society for Metals Transactions Quarterly, Vol. 54, September 1961, pp. 456-465.

Chromium martensitic steels, at 12 percent, that contain substantial amounts of delta ferrite (15 percent to 20 percent) have unusually high fatigue strengths and damping capacities at 500° and 700° F. This behavior is related to the precipitation of alpha prime (high chromium body-centered cubic phase associated with 885° F embrittlement) in the highly stressed delta ferrite regions during fatigue testing.

1214. Eby, R. K.,
THE CRYSTALLINE RELAXATION AND FIRST-ORDER TRANSITIONS IN POLYTETRAFLUOROETHYLENE, American Chemistry Society, Div. Org. Coatings Plastics Chem., Preprints, Vol. 21, No. 2, 1961, pp. 184-192.

The modulus and internal friction of polytetrafluoroethylene were measured with longitudinal waves at a frequency of 12 megacycles between 220° and 548° K. The

samples covered a wide crystallinity range and included an unsintered specimen (as-polymerized material that had not been heated above the melting point).

1215. Eby, R. K. and Sinnott, K. M.,
TRANSITIONS AND RELAXATIONS IN POLYTETRAFLUOROETHYLENE, Journal of Applied Physics, Vol. 32, No. 9, September 1961, pp. 1765-1771.

The modulus and internal friction of polytetrafluoroethylene were measured with longitudinal waves at a frequency of 12 mc/sec between 248° and 548° K and the fluorine magnetic resonance was studied between 77° and 375° K. The results resolve discrepancies which exist in the literature and introduce new information about the relaxations and first-order transitions in polytetrafluoroethylene.

1216. Eder, F. X. and Haefner, H.,
THE INTERNAL FRICTION OF IRON-CARBON NITROGEN ALLOYS AND OF Al-1% Mg ALLOY, Experimentelle Tecknik der Physik, Vol. 9, No. 1, 1961, pp. 37-43 (In German).

The internal friction was measured on wire specimens between zero and 100° C and frequencies from 1 to 10^{-4} per second, using an electromagnetic torsional system. Three different steels gave single damping peaks, with activation energies from 19.5 to 27 kilocalorie $mole^{-1}$; these are attributed to carbon and nitrogen atom diffusion. The aluminum-magnesium alloy gave two peaks, which may be due to dislocation movement and to grain boundaries.

1217. Edmonds, P. D.,
ON CORRELATING THE LOSS FACTORS OF CYLINDRICAL AND SPHERICAL RESONATORS, Journal of Acoustical Society of America, Vol. 33, No. 5, May 1961, pp. 615-622.

Theoretical results are presented which relate the Q factors (internal friction) of solid resonators to two loss parameters. These are assumed to be characteristic of the energy loss in the homogeneous isotropic material constituting the resonators. The following cases are treated: torsional, fundamental longitudinal and fundamental bending modes of solid cylinders, and radial modes of solid and hollow spheres.

1218. Egorov, N. N.,
CALCULATING THE DECAY OF ULTRASOUND IN HYPOEUTECTOID STEELS AND ULTRASTRONG CAST IRONS MODIFIED WITH MAGNESIUM, Primenenie Ul'traakustiki k Issled. Veshchestva, No. 15, 1961, pp. 255-261.

Theoretical curves are given for the decay of ultrasound in hypoeutectoid steels. Experiments were made at 0.8 to 18 mc/sec in a steel of grain size 0.04 to 0.5 millimeter. The coefficient of diffusion of ultrasound was calculated for cast irons with a pearlite base and containing spheroidal graphite modified by magnesium.

1219. Emschermann, H. H.,
DIRECT ELECTRICAL INTEGRATION OF CLOSED CALIBRATION CURVES AND THEIR APPLICATION TO THE MEASUREMENT OF THE DAMPING OF METALS AND THE INDICATING OF PISTON ENGINES, VDIZ, Vol. 103, 11 February 1961, pp. 169-176.

By means of the method described, the required values can be recorded directly over a practically unlimited frequency range. For example, the damping of a material in the work content of an indicator diagram where there are variables, such as temperature, stress, load, speed, etc., can be plotted directly.

1220. Engelhardt, R. E., Mills, K. D., and Schneider, K.,
SHOCK AND VIBRATION IN ROAD AND RAIL VEHICLES, Shock and Vibration Handbook, New York, New York, McGraw-Hill Book Company, Incorporated, 1961 (Chapter 45, C. M. Harris and C. E. Crede, Editors).

The sources of shock and vibration in vehicles and the environment to which passengers and cargo are subjected depend primarily on the type vehicle and the surface over which it travels. This chapter considers these sources, discusses method of control, and presents data for typical environmental conditions.

1221. Entwistle, K. M.,
INELASTICITY OF THE VACANCY-SOLUTE ATOM INTERACTION IN TERNARY ALUMINUM-ALLOYS BASE 4% COPPER, Métaux, Corrosion-Industries, Vol. 36, June 1961, pp. 235-241.

This article investigates damping properties of aluminum-copper and aluminum-copper-indium wires as dependent on annealing temperature and time (53° to 99.6° C), carried out after quenching from 530° to 535° C. Explanation of the changes in terms of formation and disappearance of vacancies and dissolved atom diffusion.

1222. Eshelby, J. D.,
DISLOCATIONS IN VISCOELASTIC MATERIALS, Philosophic Magazine, Vol. 6, August 1961, pp. 953-963.

An expression for the force required to move a dislocation steadily through a viscoelastic medium, in particular Zener's standard linear solid, is derived and is applied to the case of a screw dislocation in iron exhibiting the Snoek effect.

1223. Estrin, E. I., Zueva, O. M., Maksimova, O. P., and Piguzov, Yu. V.,
EFFECT OF INTERNAL FRICTION CAUSED BY DIRECT AND INVERSE MARTENSITE TRANSFORMATION, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 11, No. 2, 1961, pp. 252-260.

A temperature effect on the internal friction of iron-23.7 percent, nickel-2.80 percent manganese was studied during transformation. The presence of a distorted crystal lattice is a factor necessary for the completion of relaxation processes leading to the peak of the internal friction in the face-centered phase at 250°.

1224. Evtushenko, L. A. and Levitin, R. Z.,
ANOMALIES OF SHEARING MODULUS IN THE MnO, CoO, AND Cr_2O_3 ANTIFERROMAGNETICS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 12, No. 1, 1961, pp. 155-157.

The Young modulus and internal frictions are anomalous near the point of antiferromagnetic transformation of MnO, CoO, NiO, and Cr_2O_3.

1225. Ezzat, A.,
DAMPING CHARACTERISTICS OF PIPES VIBRATING IN FLEXURE AND FILLED WITH VARIOUS MATERIALS, Experimental Mechanics, Vol. 1, July 1961, pp. 10-15.

Measurement of vibration parameters of oscillating aluminum alloy pipes with magnetic pickup coil to determine effect of kinematic viscosity of filler fluid and solid filler particle size on damping coefficient, resonant frequency, and equivalent spring constant.

1226. Fastov, N. S.,
CREATION OF HIGH TEMPERATURES BY INTERNAL FRICTION, Doklady Akademii Nauk SSSR, Vol. 138, No. 5, 11 June 1961, pp. 1069-1072.

This article examines torsional vibrations of an isotropic metallic rod loaded at one end with a force-couple applied to its outside surface; the other end is fixed. The results of analysis show that the maximum of internal friction (and temperature) corresponds to those values of relaxation time for which the degree of relaxation is small compared to unity.

1227. Feltner, C. E. and Morrow, J. D.,
MICROPLASTIC STRAIN HYSTERESIS ENERGY AS A CRITERION FOR FATIGUE FRACTURE, Transactions, American Society of Mechanical Engineers, Journal of Basic Engineering, Series D, March 1961, pp. 15-22.

An energy criterion for fatigue failure is postulated in this paper. Microplastic strain hysteresis energy is considered to be an index for fatigue damage. On this basis, a relation is developed between stress amplitude and the number of cycles to failure. This relation utilizes only material properties obtained from the static true stress-strain tension test. The analysis is found to compare well with an experimentally determined S-N curve for SAE 4340 steel.

1228. Ferry, J. D.,
VISCOELASTIC PROPERTIES OF POLYMERS, New York, New York, John Wiley and Sons, Incorporated, 1961, 482 pp.

This book is a compilation of practical information needed by field investigators for making measurements and

interpreting data. The nature of viscoelastic behavior is discussed, as well as the experimental techniques available to study behavior, and the dependence of macroscopic properties on environmental variables. This book is the first general summary of the state-of-the-art in this field.

1229. Filson, D. H. and Lax, E.,
LOW TEMPERATURE ACOUSTIC ATTENUATION IN ALUMINUM, Proceedings, Third International Congress on Acoustics, Elsevier, Holland, Vol. 1, 1961, pp. 580-582.

Acoustic attenuation in 99.995 percent pure polycrystalline aluminum is measured at 25 to 130 kc/sec. Ratios of experimental to theoretical attenuation are included.

1230. Florida University, Gainesville, Florida,
STUDY OF ELASTIC WAVE PROPAGATION AND DAMPING IN GRANULAR MATERIALS by B. O. Hardin, August 1961, 230 pp., Ph. D. Thesis.

Not abstracted.

1231. Frye, W. A.,
RUBBER SPRINGS, Shock and Vibration Handbook, New York, New York, McGraw-Hill Book Company, Incorporated, 1961 (Chapter 35, C. M. Harris and C. E. Crede, Editors).

This chapter describes the properties of rubber which are of importance in vibration- and shock-isolation applications, explains how these properties are influenced by environmental conditions, and presents basic information for the design of rubber vibration and shock isolators, such as, rubber springs.

1232. Galkin, A. A. and Korolyuk, A. P.,
AN APPARATUS FOR STUDYING ULTRASONIC ABSORPTION IN METALS AT LOW TEMPERATURES, Cryogenics, Vol. 2, September 1961, pp. 48-52.

The sound intensity of a signal transmitted through a small crystal specimen of tin is automatically recorded as a function of magnetic field. Resultant data enable determination of the Fermi surface.

1233. Gall, W. G. and McCrum, N. G.,
INTERNAL FRICTION IN STEREOREGULAR POLYMETHYL METHACRYLATE, Journal of Polymer Science, Vol. 50, 1961, pp. 489-495.

The internal friction, δ, and torsion modulus, G, of conventional (I), isotactic (II), syndiotactic (III) and polymethyl methacrylates (IV) were studied as a function of temperature.

1234. Garber, R. I. and Soloshenko, I. I.,
INFLUENCE OF ANNEALING ON THE DECREMENT OF DECAY OF VARYING ELASTIC-PLASTIC FLEXURE, Physics of Metals and Metallography, Vol. 12, No. 1, March 1961, pp. 136-137.

To study the processes of the strengthening and annealing of crystals during variable flexure, the measurement of the dependence of the decay decrement on the number of cycles, N, and temperature was undertaken, and also on intermediate heating. The experiments were carried out on crystals of bismuth, rock salt, and polycrystalline lead.

1235. General Atomic, Division of General Dynamics, San Diego, California,
A PROGRAM OF RESEARCH ON MECHANICAL METALLURGY AS RELATED TO FUEL-ELEMENT FABRICATION by T. A. Trozera, J. L. White, and R. H. Chambers, 20 October 1961, Summary Report GA-2691.

As part of a large program, the damping of tantalum was studied after various amounts of deformation.

1236. Giannini Controls Corporation, Malvern, Pennsylvania,
DAMPING RELATIONSHIPS FOR HIGHLY COUPLED SYSTEMS WITH MANY DEGREES OF FREEDOM by A. Fonda, 1961, 37 pp.

Not abstracted.

1237. Goodman, L. E. and Bowie, G. E.,
EXPERIMENTS ON DAMPING AT CONTACTS OF A SPHERE WITH FLAT PLATES, Experimental Mechanics, Vol. 1, February 1961, pp. 48-54.

An apparatus for studying slip damping at rounded contacts for three different systems of forces is described. Experimental results are presented for the constant normal force versus varying tangential force problem when a Type 316 stainless steel sphere is driven between two flat Type 316 stainless steel plates. They are in fair agreement with theoretical predictions of R. D. Mindlin and others.

1238. Goryaga, A. N., Levitin, R. Z., and Lin, C. T.,
ANOMALIES OF THE YOUNG'S MODULUS AND INTERNAL FRICTION IN FERRITES HAVING A COMPENSATION POINT, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 12, 1961, pp. 458-460.

The effect of temperature on the Young's modulus, E, and internal friction, 1/Q, of two samples of lithium ferrite-chromite was studied by the composite vibrator method at 130 kc/sec. $Li_2O.2.3Cr_2O_3$ had a compensation point (θ_k) at 371.5° K and $Li_2O.2.5Fe_2O.2.5\text{-}Cr_2O_3$ had θ_k = 326° K. The $\Delta E/E$ and 1/Q sharply decreased at θ_k in both compounds. The anomalies in E and 1/Q in studied compounds evidently are not related to the technical magnetization because they do not disappear in the field of saturation, that is, when the sample becomes a single domain. The observed anomalies of E and 1/Q were similar to those observed in antiferromagnetics near the Neel point.

1239. Greenwood, J. A., Minshall, H., and Tabor, H.,
HYSTERESIS LOSSES IN ROLLING AND SLIDING FRICTION, Proceedings, Royal Society, Vol. 259A, No. 1299, 1961, pp. 480-507.

The elastic input energy was calculated for a hard cylinder or sphere rolling on rubber, and values were obtained for the rolling friction. These values disagreed with the experimental ones, suggesting that the use of the hysteresis loss factor was invalid. Hysteresis energy losses for complex stress cycles were measured with a thin-walled rubber tube. The deformation of rubber by a long, hard roller was considered.

1240. Gridnev, V. N. and Efimov, A. I.,
INVESTIGATION OF RELAXATION PHENOMENA IN MANGANIC FERRITE, Invest. Vysshikh Ucheb Zavedenii, Chernaya Met., No. 10, 1961, pp. 75-81.

The following high-purity alloys were investigated: carbon 0.020, 0.020; manganese 0.82, 0.63; silicon 0.007, 0.007; nitrogen 0.002, 0.002; copper 0.01, 0.01 percent. Peaks of internal friction, shear modulus, and activation energy of carbon diffusion in the lattice of the solid solution depend on heat-treatment conditions. In recrystallized alloys, due to the high purity of grain boundaries, the peaks of internal friction are close in value to those determined for pure polycrystalline iron. When grain boundaries are blocked by impurities, the value of high temperature internal friction is lowered considerably; at the same time, the relaxation of the shear modulus is also lowered.

1241. Gurtin, M. E.,
ON THE USE OF CLEARANCE IN VISCOUS DAMPERS TO LIMIT HIGH FREQUENCY FORCE TRANSMISSION, Transactions, American Society of Mechanical Engineers, Journal of Engineering for Industry, Vol. 83, Series B, No. 1, 1961, pp. 50-52.

The steady-state vibration of a single degree of freedom system with clearance in the viscous damper was investigated.

1242. Hamme, R. N.,
VIBRATION CONTROL BY APPLIED DAMPING TREATMENTS, Shock and Vibration Handbook, New York, New York, McGraw-Hill Book Company, Incorporated, 1961 (Chapter 37, C. M. Harris and C. E. Crede, Editors).

Surface treatments are often added to structural members to increase the net damping capacity of the structural system by as much as an order of magnitude. This paper considers the effectiveness of various damping treatments. The treatments included are mastic deadeners, asphalted felt, constrained damping layers, fibrous blankets, and a frequency-selective deadener. The chapter is concluded with a section on the design of vibration-damping treatments.

1243. Hand, W.,
ELECTRICAL ANALOG FOR VIBRATION-DAMPING MEASUREMENTS, Electro-Technology, Vol. 68, No. 5, November 1961, pp. 117-120.

Article describes the substitution of an electric analog circuit with known parameters for the test specimen to provide a method for checking the accuracy of electrical measuring circuits used to evaluate the damping characteristics of vibration-deadening materials.

1244. Harris, C. M. and Crede, C. E., Editors,
SHOCK AND VIBRATION HANDBOOK, 3 Volumes, New York, New York, McGraw-Hill Book Company, Incorporated, 1961.

The chapters of this handbook each deal with a discrete phase of the subject of shock and vibration. Chapters dealing with similar subject matter are grouped together. The first group of chapters deals with fundamental concepts of shock and vibration. The second group of chapters deals with instrumentation for measurement of shock and vibration. The laboratory test equipment in use is described in the next group of chapters. Other topics include computational methods, vibration isolation, and damping. Volume Three considers engineering design and environmental conditions. Separate chapters consider the effects of shock and vibration on man, ships, missiles, and structures. The final chapter takes up earthquakes and man-made ground motions.

1245. Hatch, D. K. and Admas, C. H.,
VISCOELASTIC DAMPING, American Society of Mechanical Engineers Preprint, 1961, 3 pp.

The use of viscoelastic materials, both as homogeneous-layer and constrained-layer treatments, for energy-dissipation is discussed. Frequency and temperature effects on the damping properties are considered. Applications to the control of noise and vibration are mentioned.

1246. Heckl, M.,
WAVE PROPAGATION ON BEAM-PLATE SYSTEMS,
Journal of Acoustical Society of America, Vol. 33, No. 5, May 1961, pp. 640-654.

Formulas for the attenuation of bending waves that travel over a beam-plate system, containing one or several beams, are derived and compared with measurements. It is found that one beam gives an attenuation which is very small near the resonances of the beam and rather high elsewhere, but on the average over wide frequency bands the attenuation appears to go nearly like the square root of frequency.

1247. Heinrick, G. and Desoyer, K.,
THEORY OF A TEST METHOD FOR MEASURING MATERIAL DAMPING, Ost. Ing. Arch., Vol. 15, 1961, pp. 88-102.

The test method consists of the measurement of the displacement of the end of a rotating cylindrical test specimen which is clamped at one end and loaded with a weight at the free end. The interpretation of the measurements is given in terms of the coefficients of the stress-strain relations of a Kelvin body with static hysteresis.

1248. Heller, W. R.,
QUANTUM EFFECTS IN DIFFUSION: INTERNAL FRICTION DUE TO HYDROGEN AND DEUTERIUM DISSOLVED IN ALPHA IRON, Acta Metallurgica, Vol. 9, June 1961, pp. 600-613.

Torsion pendulum measurements were made from 4.2° to 300° K on annealed and quenched wire specimens with theoretical analysis of internal friction phenomena in terms of quantum mechanics. The effect of dissolved hydrogen-deuterium on relaxation and magnetomechanical damping was investigated as a function of temperature. Relation of isotope shifted peaks to tunneling effects and localized lattice distortion around the dissolved atom was also discussed.

1249. Hertelendy, P.,
DISPLACEMENT AND STRAIN-ENERGY DISTRIBUTION IN A LONGITUDINALLY VIBRATING CYLINDRICAL ROD WITH A VISCOELASTIC COATING, American Society of Mechanical Engineers Paper, No. 61-Wa-30, 1961, 6 pp.

A numerical solution by R. M. Davies of the Pochammer frequency equation is used to determine the displacement and strain-energy distribution across the cross section of an infinite elastic circular cylindrical rod for a number of wave lengths of the first, second, and third modes of symmetrical longitudinal wave propagation. With these results, the effect of a thin uniform layer of viscoelastic material is investigated.

1250. Hiki, Y.,
INTERNAL FRICTION OF SYNTHETIC QUARTZ, Physical Society of Japan, Journal, Vol. 16, No. 4, April 1961, pp. 664-670.

Internal friction of 26 specimens of synthetic quartz was measured at room temperature using the composite oscillator method. Synthetic quartz usually had smaller values of the internal friction than natural quartz. The internal friction of specimens parallel or nearly parallel to the Y-axis was almost independent of the strain amplitude, while that of specimens inclined to the axis at high angles showed noticeable amplitude-dependence. The orientation-dependence of the values of the internal friction could be well explained by the theory of dislocation damping. The dislocation density in synthetic quartz was estimated to be 10^2-10^3 cm^{-2}, being about one-hundredth of the density in natural crystals. The effect of X-irradiation on the internal friction of quartz was also studied for both synthetic and natural ones.

1251. Himelblau, H., Jr. and Rubin, S.,
VIBRATION OF A RESILIENTLY SUPPORTED RIGID BODY, Shock and Vibration Handbook, New York, New York., McGraw-Hill Book Company, Incorporated, 1961 (Chapter 3, C. M. Harris and C. E. Crede, Editors).

This chapter discusses the vibration of a rigid body on resilient supporting elements, including (1) methods of determining the inertial properties of a rigid body, (2)

discussion of the dynamic properties of resilient elements, and (3) motion of a single rigid body on resilient supporting elements for various dynamic excitations and degrees of symmetry.

1252. Holmes, J. F.,
LEAD AND ITS ALLOYS, Metal Industry, Vol. 99, 22 December 1961, pp. 502-503.

This article reviews effects of lithium, copper, silver, cadmium, calcium, nickel, cobalt, silica, arsenic, magnesium, bismuth, tin, thorium, and antimony, and temperature on vibration resistance, creep rate, compression, fatigue, tensile and creep strengths, hardness, grain structure, density, neutron absorbability, elongation, stress and stress rupture life.

1253. Hopkins, H. G.,
DYNAMIC ANELASTIC DEFORMATION OF METALS, Applied Mechanics Reviews, Vol. 14, June 1961, pp. 417-431.

This article encompasses: (1) research into nonlinear stress-wave propagation in metals and alloys as polycrystalline aggregates, (2) calculation of rate of strain and pressure effects on dependent and independent mechanical behavior as related to low amplitude stress levels, and (3) high amplitude stress effects on deformation and compressibility of quasi-fluid and solid mechanical behavior.

1254. Hotta, H.,
DAMPING CAPACITY AND MECHANISMS IN CAST IRON, Imono, Vol. 33, July 1961, pp. 511-518.

Measurement of damping capacity in gray, nodular, malleable and Meehanite cast irons and cast steel as a function of composition up to 4.05 percent carbon, bending strain, and structural characteristics. Damping capacity is unchanged for up to three-percent carbon, but increases sharply thereafter due to the carbon mass effect and is affected by the shape of the graphite in the matrix and by strain amplitude. The high damping capacity of gray iron is attributed to dislocation movement due to stress concentration.

1255. Hubbard, H. H. and Houbolt, J. C.,
VIBRATION INDUCED BY ACOUSTIC WAVES, Shock and Vibration Handbook, New York, New York, McGraw-Hill Book Company, Incorporated, 1961 (Chapter 48, C. M. Harris and C. E. Crede, Editors).

The material of this paper deals mainly with the effects on structures and components of noise sources associated with airplanes, missiles, and space vehicles. The manner in which structures and equipment respond to these intense acoustic loadings is described from both the theoretical and experimental points of view.

1256. Huber, R. J., Baker, G. S., and Gibbs, P.,
DAMPING EFFECTS OF THIN SURFACE FILMS, Journal of Applied Physics, Vol. 32, No. 11, November 1961, p. 2488.

During a study of internal friction of aluminum oxide single crystals, it was observed that a small amount of sodium nitrate on the surface of the crystal caused a damping peak, having a maximum logarithmic decrement of 5×10^{-5}, centered on the melting temperature of the salt. The damping was attributed to a second-phase layer, a viscous fluid, on the aluminum oxide crystal surface.

1257. Huber, R. J., Baker, G. S., and Gibbs, P.,
HIGH-TEMPERATURE KILOCYCLE INTERNAL FRICTION IN Al_2O_3 SINGLE CRYSTALS, Journal of Applied Physics, Vol. 32, No. 12, December 1961, pp. 2573-2579.

Dislocation damping in Al_2O_3 single crystlas was measured to 1850° C. Undeformed specimens show no damping greater than $\delta = 10^{-5}$. Deformed specimens have an exponentially rising damping above 1450° C with an activation energy of 100 to 120 kilocalories per mole. The damping is amplitude independent at least to 10^{-5} strain amplitude.

1258. Hull, E. H.,
SHAFT WHIRLING AS INFLUENCED BY STIFFNESS ASYMMETRY, Journal of Engineering for Industry, May 1961, pp. 219-226.

Using elementary apparatus and instrumentation, shaft whirling was investigated for three cases involving round and flattened shafts in combination with uniform or asymmetric stiffness bearing supports.

1259. Ichiyama, T. and Takashina, K.,
HIGH-TEMPERATURE INTERNAL FRICTION BEFORE Ac_1 TRANSFORMATION IN STEELS, Transactions, Japan Institute of Metals, Vol. 2, 1961, pp. 10-15.

Internal friction was measured as a function of temperature for 0.09 percent, 0.38 percent, and 0.85 percent carbon steels by using a torsion pendulum with a vibrational frequency of about 1.9 cps. The internal friction increased with increasing carbon content and with increasing temperature.

1260. Ikushima, A. and Suzuki, T.,
INTERNAL FRICTION OF LiF AT LOW TEMPERATURES, Physical Society of Japan, Journal, Vol. 16, No. 12, December 1961, pp. 2587-2588.

Internal-friction measurements at 15, 25, and 35 mc/sec were made on annealed and cold-worked (3.1 percent compression) LiF single crystals at 50° to 300° K. Deformed crystals gave a well-defined main peak and a subsidiary one at lower temperatures; peak height increased with deformation, but no change in peak location took place. The peaks correspond to the Bordoni peak and its subsidiary found in metals; the activation energies, Q, and the attempt frequencies, ν_0, are given as 0.090 and 0.02 electron volts for the main peak and its subsidiary, respectively, and 6×10^9 sec^{-1} and $1 \times 10^8 sec^{-1}$.

1261. Institute Elettrotecnico Nazl. Galileo Ferraris, Turin, Italy,
INFLUENCE OF SMALL AMOUNTS OF IMPURITIES ON RECRYSTALLIZATION AND GRAIN GROWTH OF HIGH-PURITY IRON by G. Venturello, F. Bonaccorso, and G. D. Gatta, 1961, Report No. AD-266541, United States Department of Commerce, Office of Technical Service (II. INTERNAL FRICTION PEAK DUE TO GRAIN-BOUNDARY RELAXATION IN IRON WITH DIFFERENT IMPURITY CONTENTS, 9 pp.).

The introduction of $\leqq 22$ parts per million carbon to pure iron increased the position of the internal friction peak a little, but with 68 parts per million carbon the peak disappeared, confirming the experiments of Kê. In addition to the effects of small amounts of impurities, the related effects of recovery and grain growth were investigated.

1262. Ivanov, V. E., Shapoval, B. I., and Amonenko, V. M., INVESTIGATION OF PHASE TRANSFORMATIONS IN ZIRCONIUM AND BERYLLIUM BY THE INTERNAL FRICTION METHOD, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 11, No. 1, January 1961, pp. 52-58.

A new method of determining internal friction has been developed. A maximum of the internal friction has been found in zirconium due to the formation of zirconium hydride. The height of the maximum is to a considerable degree dependent on the rate of heating. A maximum, Q^{-1}, has been found in the region of what is assumed to be the polymorphous transformation in beryllium.

1263. Jacobs, H. and Jenckel, E., DYNAMIC-MECHANICAL PROPERTIES OF POLYURETHANE, I. THE DEPENDENCE OF MECHANICAL BEHAVIOR OF POLYURETHANE ON THE CHEMICAL CONSTITUTION AND THE THERMAL HISTORY, Makromolekulare Chemie, Vol. 43, 1961, pp. 132-143.

Several types of polyurethane were studied for their dynamic-mechanical properties in the range of 180° to near the melting point. These properties were determined by the measurement of the mechanical loss factor tangent δ and the moduli G' and G'' by use of a torsional pendulum at a constant frequency.

1264. Jacobs, H. and Jenckel, E., DYNAMIC-MECHANICAL PROPERTIES OF POLYURETHANE, II. THE INFLUENCE OF SWELLING AGENTS ON THE MECHANICAL PROPERTIES OF POLYURETHANE, Makromolekulare Chemie, Vol. 47, 1961, pp. 72-85.

The influence of the various low-molecular weight solvents on the dynamic-mechanical properties of polyurethane was studied from -180° to 50° above the glass transition by using a torsional pendulum at a constant frequency of one cycle per second.

1265. Julien, M. A.,
THE SHOCK-ABSORBING PROPERTIES OF RUBBERS AND ELASTOMERS, Rev. Gen. Caoutchouc, Vol. 38, 1961, pp. 1465-1482.

A classification of elastomers into low, medium, high, and very-high hysteresis compositions, listing the approximate limits of shock absorption, the number of oscillations to 99 percent, and the elastomer and reinforcing elements characteristic of each, is proposed.

1266. Kaganov, M. I. and Chikvashvili, Ya. M.,
A THEORY OF ABSORPTION OF SOUND IN UNIAXIAL FERROMAGNETIC DIELECTRICS, Soviet Physics-Solid State, Vol. 3, July 1961, pp. 200-204.

The theory of spin waves is used to calculate the temperature and frequency dependences of the absorption coefficient of sound in a ferro-magnetic dielectric (a ferrite) at temperatures far below the Curie point.

1267. Kamger, K., Keefer, D., and Wert, C.,
INTERACTIONS OF INTERSTITIALS WITH DISLOCATIONS IN IRON, Acta Metallurgica, Vol. 9, 1961, pp. 403-414.

The interaction between interstitial nitrogen and carbon with dislocations in body-centered-cubic iron was examined by use of anelastic measurements. Use was made of both the Snoek damping peak and the cold-work damping peak. It is suggested that methods which depend on use of either effect alone are insufficient for calculation of the strength of the interaction because such methods involve assumptions about the Cottrell atmosphere which apparently are unwarranted.

1268. Kamel, R. and Attia, E. A.,
ANNEALING SPECTRUM OF COLD-WORKED SILVER, Acta Metallurgica, Vol. 9, 1961, pp. 1047-1053.

Pure silver wires were cold worked by twisting to different degrees and the changes in room-temperature internal friction, elastic modulus, and resistivity were measured after various heat pulses were imposed at different temperatures.

1269. Kamel, R.,
MICROCREEP RELAXATION OF PINNED DISLOCATIONS IN GOLD, Acta Metallurgica, Vol. 9, January 1961, pp. 65-68.

Internal-friction and elastic-modulus measurements on quenched and annealed gold wire specimens at zero to 1000° C to determine dislocation line-vacancy interaction and the resulting effect on dislocation climb, phase lag between stress and dislocation motion, and related microcreep phenomena. Relaxation curves are obtained as a function of time and temperature, with vacancy or divacancy diffusion being attributed as the rate-controlling process.

1270. Kamigaki, K. and Hirone, T.,
ULTRASONIC ATTENUATION IN ALUMINUM AND ALUMINUM-COPPER ALLOYS AT LOW TEMPERATURE, Physical Society of Japan, Journal, Vol. 16, 1961, pp. 2077-2078.

Ultrasonic attenuation coefficients at five megacycles per second are given from 100° to 300° K for 99.99 percent aluminum polycrystal and aluminum-3.7 percent by weight copper polycrystal quenched from 500°.

1271. Kamigaki, K.,
ULTRASONIC ATTENUATION IN MAGNETITE AT LOW TEMPERATURES, Physical Society of Japan, Journal, Vol. 16, June 1961, pp. 1170-1174.

The ultrasonic attenuation coefficients in magnetite crystals measured over the temperature range 4.2° to 300° K are discussed. Two kinds of attenuation peaks were observed below the transformation temperature of ionic ordering.

1272. Kamigaki, K.,
ULTRASONIC ATTENUATION IN TIN SINGLE CRYSTALS AT LOW TEMPERATURES, Physical Society of Japan, Journal, Vol. 16, 1961, pp. 1141-1144.

The ultrasonic attenuation coefficient and velocity in the superconducting and the normal states of tin single crystals were measured at temperatures between 1.5° and 4.2° K.

1273. Kawamoto, M. and Tanaka, T.,
ELASTIC HYSTERESIS ENERGY AND FATIGUE STRENGTH, Jour. Japan Soc. Test, Mat., Vol. 10, January 1961, pp. 28-34.

Fatigue tests were performed on steel and heat-resistant chrome-molybdenum-vanadium steel at room temperature under completely reversed direct stresses, and plastic strains in the specimens were measured by a newly developed strain gauge with 2000 times magnification. The results show a linear relation between plastic strain versus number of stress cycles until failure (both plotted on a logarithmic scale).

1274. Kekalo, I. B. and Livshits, B. G.,
THE EFFECT OF MAGNETIC DIFFUSION IN INVAR INVESTIGATED BY INTERNAL-FRICTION METHODS, II, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 12, 1961, pp. 644-651.

The work is an investigation of the effect of thermal influence on internal friction at temperatures below the Curie point to affirm the magnetic diffusion hypothesis concerning the effect. Samples for investigation were made from Invar with 0.26 percent carbon.

1275. Kekalo, I. B. and Livshits, B. G.,
A NEW MAGNETO-DIFFUSION EFFECT IN INVAR STUDIED BY THE INTERNAL FRICTION METHOD, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 12, 1961, pp. 314-321.

The new effect was a decrease in internal friction during isothermal exposures of Invar below the Curie point. No decrease in the value of internal friction was observed in samples magnetized to saturation. The value of internal friction observed after thermal exposure was restored almost to the initial value by magnetic action. The observed effects were explained by the segregation of carbon atoms near the boundaries of domains.

1276. Kekalo, I. B. and Livshits, B. G.,
INTERNAL FRICTION OF INVAR AS A FUNCTION OF CARBON CONTENT, MAGNETIZATION, AND TIME FACTOR, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 12, 1961, pp. 838-845.

The effect of temperature and composition on internal friction of Invar containing 0.01 percent and 0.26 percent carbon was studied in direct and alternating magnetic fields. The background of internal friction in Invar is characterized by a sharp decrease to 260° to 300°. In a magnetic field, the background of internal friction decreased considerably and up to the Curie point depended little on temperature.

1277. Kemmnitz, G., Meumann, H., and Espanion, G.,
EVALUATION OF DAMPING LOOPS, II, Rheologica Acta, Vol. 1, 1961, pp. 560-565.

Loss tangent and loss modulus are evaluated for various types of hysteresis loops. Phase angles are constant only for linear viscoelastic response.

1278. Kerwin, E. M., Jr. and McQuillin, R. J.,
VIBRATION DAMPING STUDIES, Cambridge, Massachusetts, Bolt, Beranek, and Newman, Incorporated, September 1961.

The progressive-wave experiments done so far show that the method appears to be a valid one for evaluating vibration damping treatments. The advantages of the method will make it more attractive in certain cases (higher damping, shorter wavelength, etc.). Further work would be required before such a test could be specified for routine testing.

1279. Kharitonov, A. V.,
AN APPARATUS FOR MEASURING INTERNAL FRICTION IN SOLIDS OVER THE RANGE 20 TO 400 kc/s, Akusticheski Zhurnal, Vol. 7, No. 1, 1961, pp. 104-106.

The apparatus described is designed to investigate matetials with low internal friction ($Q^{-1} = 10^{-2}$ to 10^{-6}). Longitudinal oscillations of the sample are produced by means of a plate condenser formed by the face of the sample and an electrode. Measurements are made by either an eddy-current method (for nonferromagnetic substances) or by

using a barium titanate pickup ring holding the mounting wires. Sample deformation amplitudes can be measured ranging from about 10^{-8} to 5×10^{-5}. Measurements in aluminum, magnesium, and copper show only a slight frequency dependence of the internal friction.

1280. King, J. C.,
FUNDAMENTAL STUDIES OF THE PROPERTIES OF NATURAL AND SYNTHETIC QUARTZ CRYSTALS, Vol. 36, 5 September 1961, Report No. 25334-B, AD-258444, p. 26.

It has been established that contact metal electrodes used in electrolyzing quartz yield incompletely treated material and that in this respect vapor-plated gold electrodes are superior. From preliminary results on these high-angle crystals, it appears feasible to fabricate a high-temperature resonator operating at its turnover point. One specimen of electrolyzed synthetic quartz operating at five megacycles has yielded a value of Q in excess of 600,000 at 500° C.

1281. Kline, D. E.,
RADIATION EFFECTS IN POLYSTYRENE, Journal of Applied Polymer Science, Vol. 4, 1961, pp. 191-194.

Comparison of the dynamic mechanical properties of amorphous polystyrene before and after irradiation and partially crystalline polymer suggests that the three-dimensional cross-linking through irradiation simulates, at least partly, the physical effect of crystallites in holding together the amorphous structure.

1282. Kono, R.,
THE DYNAMIC BULK AND SHEAR VISCOSITY OF HIGH POLYMERS, Physical Society of Japan, Journal, Vol. 16, No. 8, August 1961, pp. 1580-1586.

The results of the transverse and longitudinal wave measurement on two groups of high polymers as a function of temperature at a frequency of 2.5 mc/sec are presented. One group contains those polymers with no or only slight steric hindrances, i.e., polyvinylchloride, vulcanized rubber and polytrifluoromonochloroethylene. The other group includes the materials with strong steric hindrances, i.e., polyethyl methacrylate, poly-n-butyl methacrylate and poly-i-butyl methacrylate.

1283. Koppelmann, J. and Gielessen, J.,
THE DEPENDENCE OF THE APPEARANCE OF RELAXATION IN HIGH-MOLECULAR-WEIGHT POLYMERS ON THE PRESSURE, Kolloid-Zeitschrift, Vol. 175, 1961, pp. 97-99.

Curves of dielectric loss factor and dielectric constant versus frequency at one atmosphere and 500 atmospheres at 105° for polymethyl methacrylate over frequencies of 10 to 10^5 cycles indicate a relation between these variables and the activation energies from free vols.

1284. Koster, W. and Kampschulte, G.,
CHARACTERISTIC PROPERTIES OF LOW-CARBON STEEL BY USING DAMPING MEASUREMENTS, Archiv für das Eisenhuttenwesen, Vol. 32, 1961, pp. 809-922.

Maximum damping capacity of pure iron wire was measured at 220° as a function of solute atoms. Maximum damping capacity of deformation increased with increase in solute atoms, reaching a saturation value which indicated the quantity of solute atoms held by dislocations. The saturation value of nitrogen-containing iron was nine times as great as that of carbon-containing iron.

1285. Kotkin, G. L.,
THEORY OF ABSORPTION OF SUPERSONIC WAVES BY METALS IN A MAGNETIC FIELD, Zhurnal Eksperemental'noĭ i Teoreticheskoĭ Fiziki, Vol. 41, 1961, pp. 281-287.

Equations are derived describing the complex modulus of the elasticity of a model under conditions where the electron mean free path is much greater than the wave length of sound.

1286. Kramer, I. R. and Demer, L. J.,
EFFECTS OF ENVIRONMENT ON MECHANICAL PROPERTIES OF METALS, Progr. Materials Sci., Vol. 9. No. 3, 1961, pp. 131-199.

This article presents a review of the effect of thin films of oxide and of other metals and of electrolytes and surface active agents on the tensile, bending, creep, and fatigue strength of metals and on their internal friction and damping behavior.

1287. Kraus, G. and Carr, D. E.,
HYDROXYTITANIUM ACYLATES IN CIS-CONJUGATED DIENE POLYMER COMPOSITIONS, United States Patent 3002944, Applied 5 January 1958, Accepted 10 March 1961.

From 0.5 to 10 parts by weight phr of a hydroxytitanium acylate of given general formula improves the physical properties, especially tensile and hysteresis properties, of carbon-black-compounded cis-conjugated diene polymers, such as natural rubber, cis-polybutadiene, and cis-polyisoprene.

1288. Krishtal, M. A. and Baranova, V. I.,
INTERNAL FRICTION AND ELECTRIC RESISTANCE OF THE IRON-CHROMIUM ALLOYS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 12, 1961, pp. 768-771.

Internal friction and electrical resistance were measured in iron-chromium alloys containing 1 and 1.8 atomic percent chromium and a small amount of carbon after quenching from 800°, 900°, 1000°, 1050°, and 1100° and various degrees of heating. The content of carbon in solid solution increases with increased temperature of quenching because of increased solubility of chromium carbides. Concentration of carbon in interstitial position of solid solution increased with increased heating to <1050°.

1289. Krivoglaz, M. A.,
THEORY OF ELASTIC VIBRATORY DAMPING IN SYSTEMS CONTAINING DISSOLVED PARTICLES OR MICROVOIDS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 12, 1961, pp. 338-349.

The dispersion of the velocity of sound and the damping of elastic vibrations are examined in systems in which the particle solubility is altered by elastic vibration. Relations giving the frequency dependence of sound velocity, sonic absorption coefficient and internal friction are developed for isothermal and adiabatic conditions.

1290. K'ung, C. P.,
INTERNAL FRICTION PEAKS OBSERVED IN HIGH-CHROMIUM STEELS AND HIGH-CHROMIUM-NICKEL STEELS AT HIGH TEMPERATURES, Wu Li Hsueh Pao, Vol. 17, No. 5, 1961, pp. 237-245.

Several internal friction peaks were observed at high temperatures during torsion pendulum measurements in four types of high-chromium steels and eight types of high chromium-nickel steels. An internal friction peak at approximately 570° was observed in each three types of ferritic high-chromium steels (27 percent chromium, 25 percent chromium-titanium, 20 percent chromium) after quenching. Another internal friction peak was observed at approximately 640° in the testing of furnace-cooled specimens of the above-mentioned three types of high-chromium steels. In furnace-cooled specimens of 13 percent chromium, an internal friction peak was observed at approximately 610°. An internal friction peak at approximately 730° was observed in each of the eight types of austenitic high-chromium-nickel steels.

1291. Kuznetsov, V. N.,
ΔE-EFFECT AND DAMPING OF ULTRASOUND IN FERRITES, Izv. VUZ Fiz., No. 6, 1961, pp. 43-47.

The influence of the magnetization of nickel and nickel-zinc ferrites of different composition on the rate of propagation and attenuation of ultrasonic waves in the 1 to 10 megacycle band is discussed.

1292. Lancaster, P.,
EXPRESSIONS FOR DAMPING MATRICES IN LINEAR VIBRATION PROBLEMS, Journal of Aerospace Science, Vol. 28, No. 3, March 1961, p. 256.

In Milne's paper, damping forces in the problems investigated are represented by hysteretic damping. In this article, viscous damping is included in this theory. The results are of academic interest only because the response of the physical systems considered can not, at present, be measured accurately enough to justify using the derived equations to solve for the damping matrix.

1293. Laxar, F. H., Frame, J. W., and Blickwede, D. J., THE EFFECT OF ALUMINUM ON STRAIN AGING AND INTERNAL FRICTION IN LOW-CARBON STEEL, Transactions, American Society for Metals, Preprint No. 224, Vol. 53, 1961, pp. 683-696.

Internal-friction results indicate that carbon and aluminum atoms interact. This is evidenced in the internal-friction curves of these steels by three abnormal peaks which increase in size at the expense of the normal peak as aluminum content increases. The equilibrium solid solubility of carbon in ferrite at 700° C, as measured by the sum of the peak maxima, decreases with increasing aluminum content.

1294. Lazan, B. J., DAMPING AND RESONANCE FATIGUE PROPERTIES OF MATERIALS CONSIDERING ELEVATED TEMPERATURES, Mechanical Behavior of Materials at Elevated Temperatures, New York, New York, McGraw-Hill Book Company, Incorporated, 1961, pp. 477-515.

Material damping and its relation to resonance and acoustical fatigue are discussed. Among the topics covered in material damping are internal friction, viscoelastic damping, magnetoelastic damping, static hysteresis, and comparisons of damping mechanisms and representative data of engineering materials. The nomenclature and units of damping are also covered.

1295. Lazan, B. J. and Goodman, L. E., MATERIAL AND INTERFACE DAMPING, Shock and Vibration Handbook, New York, New York, McGraw-Hill Book Company, Incorporated, 1961 (Chapter 36, C. M. Harris and C. E. Crede, Editors).

The term damping is defined, and its significance as an engineering property is discussed. Various methods for measuring damping in metals are presented. The damping of viscoelastic materials and their use as interface adhesives are studied. The bibliography has 40 entries.

1296. Leak, G. M.,
GRAIN-BOUNDARY DAMPING, I. PURE IRON, Proceedings, Physical Society, Vol. 78, Part 6, December 1961, pp. 1520-1528.

Internal-friction measurements were performed on specimens of high-purity iron from which carbon and nitrogen had been removed. A relaxation peak, observed at about 500° C for a frequency of vibration about one cycle per second, is associated with the presence of grain boundaries in the specimens. The activation energy, Q, associated with this damping process, is 46 kcal mol^{-1}. The damping appears to be governed by a term: frequency x $(grain\ size)^2$ exp (Q/RT). The variation of peak damping and background damping is similar to that observed in other pure metals.

1297. Levitin, R. Z.,
APPARATUS FOR MEASURING THE MODULI OF ELASTICITY AND INTERNAL FRICTION BY THE "COMBINED OSCILLATOR" METHOD, Pribory i Tekh. Eksper., No. 2, March-April 1961, pp. 162-163.

The use of self-excitation in determining the moduli of elasticity and internal friction makes possible a very considerable improvement in the accuracy of measurement. This method is applied to the excitation of a "combined oscillator". The main advantage of this device is that it can be used in the investigation of small specimens (one-to-two centimeters in length).

1298. Levitin, R. Z. and Nikitin, S. A.,
MAGNETOELASTIC AND ELASTIC PROPERTIES OF DYSPROSIUM, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 11, 1961, p. 948.

Dysprosium is ferromagnetic at < 85° K; at > 85° K, it becomes antiferromagnetic and has a Neel point at 179° K. The magnetostriction properties of dysprosium (99.8 percent pure) were studied. The sample was not subjected to any thermal treatment. The curves of the longitudinal and transverse magnetostriction (isotherms), the Young's modulus, and internal friction as the function of temperature were plotted. Near the temperature of ferromagnetic transformation, a sharp increase in the value of Young's modulus and a decrease of internal friction is observed.

concepts. Then time effects and multiaxial-stress effects, for low temperatures, are considered individually. In the final two chapters, time effects and multiaxial-stress effects are both taken into account, and the creep of a rotating disk is studied as an illustrative problem.

1305. Lung, C.,
AN INVESTIGATION ON THE GRAIN-GROWTH OF FERRITE DURING TEMPERING BY INTERNAL FRICTION METHOD, Scientia Sinica, Vol. 10, 1961, pp. 324-331 (In English).

The results are given of research on the grain growth of ferrite during the tempering of quenched iron-carbon alloy by the internal friction method. The relation between the grain growth during tempering and the increase of height of the Snoek peak was experimentally established.

1306. Lushnikov, G. A. and Murav'ev, Yu. I.,
PROPAGATION OF ULTRASOUND IN STEELS IN WIDE RANGES OF TEMPERATURE CHANGES, Trudy Inst. Met. im. A. A. Baikova, No. 8, 1961, pp. 173-177.

The rates of propagation of ultrasound and its extinction in metals as a function of temperature and the penetration of ultrasound of megacycle frequency through steels 30Kh9S, Kh18N9, 3, and 45 were measured.

1307. Lysaght's Central Research Laboratory,
TESTING OF INTERNAL FRICTION APPARATUS, 13 July 1961, Research Report No. 218.

The construction of the internal friction apparatus has been completed and the results of a number of tests show that it is functioning satisfactorily. Accurate results can be obtained with both wire and strip specimens up to 0.35 inch widths.

1308. Lysaght's Central Research Laboratory,
THE RATE OF SOLUTION OF CARBON IN SHORT TIME ANNEALED SEMI-KILLED STEEL, 4 August 1961, Research Report No. 226.

The rate at which carbon is taken into solution during the short time annealing treatment of cold-worked semi-killed steel has been measured using internal friction methods.

The solution of the equilibrium amount of carbon is not completed until some time after the completion of recrystallization.

1309. Macdonald, J. R.,
THEORY AND APPLICATION OF A SUPERPOSITION MODEL OF INTERNAL FRICTION AND CREEP, Journal of Applied Physics, Vol. 32, No. 11, November 1961, pp. 2385-2398.

General relations are derived for the attenuation factor, phase factor, and specific dissipation function, 1/Q, pertaining to transmission of small amplitude stress waves in a material describable by a distribution of relaxation times. Curves of 1/Q versus frequency show a region approximately proportional to frequency at sufficiently low relative frequencies, a region of virtual frequency independence, and a final region proportional to inverse frequency at high relative frequency. The relation of the present work to other treatments of creep and internal friction is discussed, and the applicability is examined to the analytic and numeric results to creep measurements on metals and rocks, to low-frequency wave transmission in the earth, to other damping results for the earth as a whole, and to higher frequency wave transmission and vibration results for geophysical and other solids. Good agreement between theory and experiment is found for frequency regions where adequate data are available, indicating that all the damping phenomena considered may be well described by a linear theory in the range of very small strain.

1310. Mackintosh, A. R.,
SHEAR WAVE ATTENUATION IN NORMAL AND SUPERCONDUCTING TIN, Proceedings, Seventh International Conference on Low Temperature Physics, Canada, University of Toronto Press, 1961, pp. 240-243.

Measurements were made on tin single crystals at 1.2° K with an attenuation of 80 mc/sec, the temperature dependence of the electromagnetic part of the absorption of waves in a superconductor being determined theoretically. Values are obtained for magnetoacoustic effects as a function of temperature and magnetic field direction.

1311. Madejski, J.,
FATIGUE AND DAMPING IN PRISMATIC RODS, Proc. Vibration Problems, Polska Akad. Nauk. Inst. Podstawowych, Problemow Tech., Vol. 9, No. 2, 1961, pp. 211-242 (In Polish).

The aim of the work is to explain certain strength processes on the grounds of physics of solids. The notion of defect is introduced and defined by a differential equation. The number of domains is computed by means of equations of the "dynamic theory of plasticity." Damping power and the admissible load are computed.

1312. Magrath, H. A., Rogers, O. R., and Grimes, C. K.,
SHOCK AND VIBRATION IN AIRCRAFT AND MISSILES, Shock and Vibration Handbook, New York, New York, McGraw-Hill Book Company, Incorporated, 1961 (Chapter 47, C. M. Harris and C. E. Crede, Editors).

This chapter outlines methods for estimating and controlling vibration in the structure of flight vehicles during their operation.

1313. Maringer, R. E.,
SOME EFFECTS OF DIRECTIONAL ORDERING IN ZONE-MELTED IRON, Journal of Applied Physics, Vol. 32, 1961, pp. 366S-367S.

The effects of carbon and nitrogen in iron were studied with the use of both mechanical and magnetic methods. Internal-friction techniques were used to follow the magnetoelastic after-effect, and showed the existence of a peak in the magnetoelastic damping near the Snoek peaks.

1314. Massachusetts Institute of Technology, Cambridge, Massachusetts,
THE INTERNAL FRICTION OF LINEAR AND CROSS-LINKED PHOSPHATE GLASSES AND METHACRYLATE POLYMERS by R. L. Myerson, 1961, Thesis.

This paper deals with the effects of cross-linking on the internal friction spectrum of methacrylate polymers and sodium phosphate glasses. Sodium phosphate glasses are a long-chain structure when the sodium-phosphorus ratio is one. As more phosphorus is introduced into the system, the

structure changes into a three-dimensional network. The changes in the energies were measured for various peaks of tangent δ versus temperature from close to liquid nitrogen temperature to the glass temperature of the material. Similar runs were made with hexyl methacrylate and hexyl methacrylate cross-linked with ethylene dimethacrylate.

1315. McCrum, N. G.,
INTERNAL FRICTION IN POLYOXYMETHYLENE, Journal of Polymer Science, Vol. 54, 1961, pp. 561-568.

Mechanical relaxation in butyl polyoxymethylene was studied by means of a torsion pendulum at a frequency of approximately 1.1 cps. The logarithmic decrement and torsion modulus were measured from 100° to 430° K.

1316. Mertsching, J.,
THEORY OF ULTRASONIC ATTENUATION OF METALS IN MAGNETIC FIELDS OF HIGH FREQUENCIES, Physica Status Solidi, Vol. 1, No. 4, 1961, pp. 345-351.

This article presents a computation of ultrasonic attenuation in metals in the case of no local drag of the Fermi surface (no "collision drag"), using the model of free electrons according to the theory of Cohen, Harrison, and Harrison.

1317. Midecke, P.,
ATTENUATION OF ULTRASONIC WAVES IN AUSTENITIC Cr-Ni STEELS, Materialprufung, Vol. 3, January 1961, pp. 1-4.

Measurements were made of ultrasonic reflection by reflectograms and hardness tests on austenitic forged, rolled, and cast chromium-nickel steel (18 to 25 percent chromium, 8.5 to 21.3 percent nickel, 0.1 to 0.49 percent carbon). Ultrasonic penetration depth as influenced by microstructure precipitations, carbon content, and mode of shaping is investigated.

1318. Mikoshiba, N.,
INTERACTION OF ELECTRONS AND HOLES WITH ACOUSTIC WAVES IN INTRINSIC SEMICONDUCTORS, Physical Society of Japan, Journal, Vol. 16, 1961, pp. 895-905.

A self-consistent semiclassical theory is given for explaining the characteristics of the interaction of electrons and holes with acoustic waves in intrinsic semiconductors.

1319. Miles, G. W. and Leak, G. M.,
GRAIN-BOUNDARY DAMPING, II. IRON INTERSTITIAL ALLOYS, Proceedings, Physical Society, Vol. 78, Part 6, December 1961, pp. 1529-1542.

Internal-friction measurements of the grain-boundary relaxation peak were performed on alloys of high-purity iron containing carbon or nitrogen. The influence of these impurities on peak height, peak temperature and on the activation energy for the mechanism giving rise to the damping was determined. The results differ from those reported on the influence of substitutional impurities. The explanation of these effects is discussed qualitatively in terms of the boundary sliding and boundary migration mechanisms.

1320. Minnesota University, Minneapolis, Minnesota,
RESPONSE OF CIRCULAR PLATES EXHIBITING GENERALIZED BOUNDARY DAMPING AND EMPIRICALLY BASED MATERIAL DAMPING by C. C. Fu, November 1961, ASD TR61 647, AD-271-992.

An approximate solution, for the steady state vibration in the neighborhood of a linear resonance, is presented for circular plates whose edges may be embedded in viscoelastic material. Material damping within the plates is accounted for by a recently proposed stress-strain formulation based on experimental data.

1321. Minnesota University, Minneapolis, Minnesota,
DAMPING AND FATIGUE PROPERTIES OF SANDWICH CONFIGURATIONS IN FLEXURE by L. Keer and B. J. Lazan, November 1961, ASD TR61 646, AD-272-016.

A combined theoretical and experimental study was undertaken to develop an analytical approach for predicting the damping of sandwich configurations in flexure. The

theory developed analyzes the various contributions to total damping, considering stress distribution and unit damping properties of skin and core, and employs a simple summation process to determine the damping of the composite.

1322. Minnesota University, Minneapolis, Minnesota, ANALYTICAL FORMULATION OF DAMPED STRESS-STRAIN RELATIONS BASED ON EXPERIMENTAL DATA WITH APPLICATIONS TO VIBRATING STRUCTURES by T. J. Mentel and C. C. Fu, November 1961, ASD TR61 623, AD-271-963.

The analytical technique of describing material damping by elliptical hysteresis loops was applied to experimental damping data to produce damped, stress-strain relations. The objective of this approach is to produce an easily tractable mathematical description of the stress-strain relation which at the same time adheres closely to experimentally observed behavior.

1323. Minnesota University, Minneapolis, Minnesota, VISCOELASTIC SUPPORT JUNCTION DAMPING OF BEAMS by T. J. Mentel, R. L. Schultz, and C. C. Fu, March 1961, ASD TR60 779, AD-271-957.

An experimental study with evaluation of relevant theory was conducted of the damping action at the support interfaces of beams which incorporate viscoelastic bonding material. The objective was the identification of support junction damping techniques which might be of practical use in vibration attenuation.

1324. Minnesota University, Minneapolis, Minnesota, PHENOMENOLOGICAL THEORIES OF HYSTERETIC MATERIAL DAMPING WITH APPLICATION TO THE VIBRATIONS OF CIRCULAR PLATES by J. S. Whittier, November 1961, ASD TR61 264, AD-271-572.

This report presents a discussion of prediction of hysteretic specific damping energy of structural materials under combined dynamic stress knowing the damping under uniaxial stress. Consideration is limited to biaxial states of stress. Bounds for biaxial stress damping are proposed to be the values predicted by assuming purely dilatational

damping and purely distortional damping. Available published data show qualitative agreement with the predicted bounds.

1325. Mirkin, I. L., Tseitlin, V. Z., and Morozova, G. G., INTERNAL FRICTION AND SHEAR MODULUS OF BINARY NICKEL ALLOYS, Tsentral. Nauch.-Issledovatel. Inst. Tekhnol. i Mashinstroen., No. 101, 1961, pp. 49-60.

Five nickel-chromium alloys containing 4.52 to 26.9 percent by weight chromium and five nickel-aluminum alloys smelted in an argon atmosphere containing 0.98 to 7.36 percent by weight aluminum, as well as four nickel-aluminum alloys smelted in vacuo in a high-frequency furnace containing 0.68 to 7.0 percent by weight aluminum were studied for internal friction and shear modulus during heating to 800°. The introduction of aluminum and chromium into nickel causes a decrease in the height of the first peak on the curve of temperature versus internal friction (at 100° to 200° for pure nickel), so that at five percent by weight aluminum or 9.5 percent by weight chromium the first peak disappears completely. The anomalous effects in the temperature dependence of the shear modulus (minimum at 100° to 200° and maximum at the Curie point for pure nickel) also disappear with increased amounts of aluminum and chromium.

1326. Mirkin, I. L., Tseitlin, V. Z., and Morozova, G. G., INTERNAL FRICTION AND SHEAR MODULUS OF SOME PURE METALS WHICH ARE COMPONENTS OF HEAT-RESISTANT ALLOYS, Tsentral. Nauch. Issledovatel. Inst. Tekhnol. i Mashinostroen, No. 101, 1961, pp. 34-48.

Pure nickel, aluminum, and molybdenum were studied for internal friction and shear modulus at high degrees of deformation (≧ 90%) by low-frequency torsional vibrations. The temperature dependence of internal friction for nickel shows three peaks: at 100° to 200°, caused by ferromagnetic strictional effects, at 300° to 400° or at 400° to 500° depending on annealing conditions, caused by relaxation stresses along grain boundaries during their viscous gliding, and at 700° to 800°. The temperature dependence of internal friction for aluminum shows only one peak at 100° to 200° (caused by relaxation stresses along grain boundaries), while the similar curve for molybdenum does not show any peaks at all.

1327. Monsanto Chemical Company, Plastics Division, St. Louis, Missouri,
LAMINATED ARCHITECTURAL GLASS FOR ACOUSTICAL CONTROL, May 1961, Technical Service Bulletin.

This bulletin describes SAFLEX polyvinyl butyral plastic. Specially prepared glass laminates with the SAFLEX interlayer are uniquely effective in reducing sound transmission in acoustically engineered structures. The transmission loss is as high as 40 decibels over parts of the frequency spectrum.

1328. Monsanto Chemical Company,
VISCOELASTIC DAMPING: AN ENGINEERING APPRAISAL OF INDUSTRY NEEDS, June 1961, P. E. G. Report No. 47, 46 pp.

The objective of the study was to delineate technology trends and review the needs of industry in the field of viscoelastic damping. The authors discuss the advantages of thermoplastics, rubbers, and foams and list what appear to be the best viscoelastic damping materials, considering environment, application, and economics.

1329. Morduchow, M.,
ON CLASSICAL MODES OF A DAMPED LINEAR SYSTEM, Journal of Applied Mechanics, Vol. 28, No. 3, Series E, September 1961, p. 458.

The purpose of this note is to demonstrate Rayleigh's condition (damping matrix of a linear vibrating system is a linear combination of the stiffness and inertia matrices) in a straightforward manner without the use of normal coordinates. This procedure leads to explicit results for the damping factor and natural frequency in any principal mode. The method is applied to a vibrating beam with simultaneous internal and external damping.

1330. Morinaga, T. and Zaima, S.,
THE DAMPING CAPACITY AND FATIGUE OF CAST Al-Cu ALLOYS, Imono, Vol. 33, March 1961, pp. 182-189.

Torsion fatigue, tensile, and hardness tests on specimens containing 3.2 percent to 18.6 percent copper. An

increase in fatigue strength is noted as the damping capacity in torsional oscillation increases, both occurring as a function of copper content.

1331. Morinaga, T., Muromachi, S., and Zaima, S., THE DIRECTIONALITY OF ALUMINUM SHEET AS AFFECTED BY ADDED ELEMENTS, PART 3. DETECTION OF DIRECTIONALITY BY MEANS OF DAMPING CAPACITY AND X-RAY ANALYSIS, Light Metals, Vol. 11, July 1961, pp. 9-16.

The effect of manganese, tin, iron, magnesium and titanium additions on earing and directionality phenomena in 1S aluminum alloy specimens are determined by Harbert pendulum measurements of damping capacity and X-ray structural analysis.

1332. Morse, R. W., ULTRASONIC ATTENUATION IN METALS, Proceedings, Seventh International Conference on Low Temperature Physics, Canada, University of Toronto Press, 1961, pp. 233-239.

This paper reviews experiments on the interaction of ultrasonic waves and electrons in metals at low temperature by observation of an attenuation of ultrasonic waves by electrons occurring when the electron free path is comparable to or greater in size than the ultrasonic wave length. Also discussed were applications of attenuation measurements to determination of Fermi surface, superconducting energy gaps, anisotropy and the possibility of an acoustic factor in gold, silver, tin, and copper single crystals at 1.2° K.

1333. Motorola, Incorporated, Scottsdale, Arizona, COMPARATIVE VIBRATION TESTS by B. Facey and F. Turner, March 1961, Report No. TM5881, AD-271-206.

Vibration characteristics of three encapsulating compounds were studied in a module mockup. Filling compound, clear silicone polymer, and opaque silicone rubber were investigated.

1334. Motorola, Incorporated, Scottsdale, Arizona, COMPARISON OF DAMPING PROPERTIES (BOUNCE) AT 25° C, -55° C, AND 125° C, August 1961, Report No. TM626, AD-271-207.

The sidewinder modules were designed to utilize an encapsulating material with good vibrational damping properties. To study this property, a brief economic bounce test was constructed to compare various materials. The test specimens were dropped to the floor from a height of 36 inches. The distance that each ball rebounded was measured and recorded.

1335. Motorola, Incorporated, Scottsdale, Arizona, COMPARISON OF DAMPING PROPERTIES (BOUNCE) AT 25° C, -55° C, OF EIGHT FLEXIBLE ENCAPSULATING MATERIALS by R. Facey and D. T. Foster, September 1961, 3 pp.

Not abstracted.

1336. Muller-Vogt., G., AMPLITUDE-DEPENDENT DAMPING OF STEEL--ITS CAUSES AND CORRELATIONS TO BRITTLE FRACTURE SUSCEPTIBILITY, Archiv für das Eisenhuttenwesen, Vol. 32, May 1961, pp. 323-330.

Investigation by free torsion oscillation of damping in specimens of unalloyed and low-alloyed steels (0.04 percent to 0.69 percent carbon), at frequencies from 25 to 400 oscillations per second and at temperatures from -8° to 40° C.

1337. Mura, T., Tamura, I., and Brittain, J. O., ON THE INTERNAL FRICTION OF COLD WORKED AND QUENCHED MARTENSITIC IRON AND STEEL, Journal of Applied Physics, Vol. 32, No. 1, 1961, pp. 92-96.

A theoretical explanation is given for the internal friction peaks which are observed for cold-worked iron and steels and for steels in the martensitic condition. The theory for the peaks is based on the addition of a term to the free energy in order to account for the strain energy due to the interaction of an atmosphere and the line imperfections. The standard linear solid was obtained from the model in which dislocations are vibrating with an atmosphere of carbide precipitates.

1338. Nakayasu, H., Markovitz, H., and Plazek, D. J., THE FREQUENCY AND TEMPERATURE DEPENDENCE OF THE DYNAMIC MECHANICAL PROPERTIES OF A HIGH DENSITY POLYETHYLENE, Transactions, Society of Rheology, Vol. 5, 1961, pp. 261-283.

Dynamic mechanical measurements were performed on an unannealed sample of a high-density polyethylene with a torsion pendulum instrument in both forced and free oscillations. Data were obtained at frequencies between 2×10^{-4} and 9 cps and at 10 temperatures between -30° and 80° C, above which significant irreversible changes in the sample occur.

1339. Naval Construction Research Establishment, Great Britain, SOME STRUCTURAL DAMPING TECHNIQUES, MATERIALS, AND APPLICATIONS by J. M. Donaldson, 1961, 52 pp.

Not abstracted.

1340. Naval Ordnance Laboratory, PROPERTIES OF TiNi AND ASSOCIATED PHASES by W. J. Buehler and R. C. Wiley, 1961, Report No. AD-266 607, 91 pp.

Alloys based on the ductile intermetallic compound, TiNi, and associated phases, Ti_2Ni and $TiNi_3$, referred to as Nitinols, are nonmagnetic, corrosion resistant, and hardenable up to 62 Rockwell C. TiNi has vibration damping properties, which decrease markedly on heating slightly above room temperature.

1341. Niblett, D. H., LOW-FREQUENCY MEASUREMENTS ON THE BORDONI INTERNAL FRICTION PEAK IN COPPER, Journal of Applied Physics, Vol. 32, May 1961, pp. 895-899.

Torsion pendulum measurements were made of the internal friction of cold-worked specimens at 4° to 300° K at a frequency of 10 to 20 cps. The Bordoni internal friction peak is observed in pure polycrystalline copper at 62° K at 13.4 cps. A value of 0.14 electron volts is deduced for the activation energy by comparison.

1342. Nilson, W. G.,
THE EFFECT OF QUENCHING AND NEUTRON IRRADIATION ON INTERNAL FRICTION OF ALUMINUM-5% MAGNESIUM ALLOY, Canadian Journal of Physics, Vol. 39, No. 1, January 1961, pp. 119-132.

Low-frequency internal-friction data were obtained to determine the effects of quenching and neutron irradiation on solute movement. A damping peak near 150° C, attributed to stress-induced reorientation of solute atoms, was found to be shifted to lower temperatures by these treatments. This behavior corresponds to a reduction in relaxation time for the damping process, and is compatible with the idea that the solute atoms act as traps for vacancies.

1343. Nine, H. D. and Truell, R.,
PHOTOSENSITIVE-ULTRASONIC PROPERTIES OF CADMIUM SULFIDE, Physical Review, Vol. 123, 1961, pp. 799-803.

Ultrasonic attenuation in single crystals of cadmium sulfide is a function of light irradiation. Two distinct types of behavior have been observed. Some crystals show a decrease of attenuation with white light application, and others show an increase of attenuation with white light. The ultrasonic attenuation and the conductance of the crystals were measured as a function of temperature.

1344. Nowick, A. S. and Berry, B. S.,
LOGNORMAL DISTRIBUTION FUNCTION FOR DESCRIBING ANELASTIC AND OTHER RELAXATION PROCESSES, IBM Journal, October 1961, p. 297.

Such phenomena as dielectric, magnetic and anelastic relaxation are often described in terms of a distribution of relaxation times. It is shown that a relaxation process which exhibits a Gaussian distribution in the logarithm of the relaxation times can be specified completely by three parameters: the mean relaxation time, the width of the distribution, and the magnitude of the relaxation. The relationships of these parameters to experimentally measurable functions are usually complicated. These relationships were obtained in numerical form by machine computation.

1345. Nowick, A. S. and Seraphim, D. P.,
MAGNITUDE OF THE ZENER RELAXATION EFFECT,
Acta Metallurgica, Vol. 9, January 1961, pp. 40-48.

A brief review of the two proposed mechanisms for this phenomenon, the pair reorientation theory of Zener and the directional short-range order theory of Le Claire and Lomer, is presented with data for the relaxation strength of polycrystalline samples from 19 alloy systems, with information from lattice-parameter data.

1346. Nuovo, M.,
DYNAMIC MEASUREMENTS OF ELASTIC AND ANELASTIC CONSTANTS, Ricerca Scientifica, Vol. 31, November 1961, pp. 212-243.

Not abstracted.

1347. Oak Ridge National Laboratory, Tennessee,
RECORDING EQUIPMENT FOR INTERNAL FRICTION MEASUREMENTS by R. L. Stephenson and H. E. McCoy, Jr., 31 October 1961, Contract W-7405-eng-26, ORNL-3197, 13 pp.

An apparatus was developed for recording internal friction data. An optical lever is used and the passage of the beam across the scale is detected by photoconductive cells. The apparatus is inexpensive and requires a minimum of maintenance. It has been used for accurate determinations of values of δ from below 0.0001 up to 0.3.

1348. Oberst, H., Bohn, L., and Linhardt, F.,
VIBRATION-DAMPING PLASTICS IN NOISE SUPPRESSION,
Kunststoffe, Vol. 51, No. 9, 1961, pp. 495-502 (German Plast., Vol. 51, No. 9, 1961, pp. 17-22).

Viscoelastic, amorphous plastics are highly efficient for damping vibration in metal structures. They are generally used in the form of one-sided coverings or as a core sandwiched between two sheets. The effects of temperature are considered; maximum damping decreases with rising temperature.

1349. Osinski, Z.,
FREE VIBRATION OF A NONLINEAR SYSTEM, RELAXATION AND INTERNAL FRICTION BEING TAKEN INTO CONSIDERATION, Arch. Budowy Maszyn, Vol. 8, No. 4, 1961, pp. 411-426.

Natural vibration of elastic elements is considered, taking into consideration the relaxation properties and the internal damping of the material by using third-order polynomials.

1350. Ostemann, M. J., Hanscome, T. D., Kircher, J. F., and Clark, J. W.,
RADIATION CAN RUIN YOUR DESIGN, SAE Journal, Vol. 69, June 1961, pp. 82-84.

Effect of radiation on many properties, including stability and internal friction of metals, is discussed.

1351. Papadakis, E. P.,
GRAIN-SIZE DISTRIBUTION IN METALS AND ITS INFLUENCE ON ULTRASONIC ATTENUATION MEASUREMENTS, Journal of Acoustical Society of America, Vol. 33, 1961, pp. 1616-1621.

The average grain diameter for polycrystalline materials is determined from the diameter standard deviations of aluminum, copper, Armco iron and chromium steel and then used for the computation of the ultrasonic attenuation caused by Rayleigh scattering, with comparisons of area distribution derived from hypothetical volume distributions with rate.

1352. Pare, V. K.,
STUDY OF THE BORDONI INTERNAL-FRICTION PEAKS IN COPPER, Journal of Applied Physics, Vol. 32, No. 2, March 1961, pp. 332-340.

The internal friction of several cold-worked copper single crystals was measured between 4° and 300° K at 4 kc/sec. Vibrational strain amplitudes ranging from 10^{-7} to 2×10^{-5} were used. In pure samples, the height of the Bordoni relaxation peak increased slightly with strain amplitude, but in all samples the activation energy of the relaxation process was not affected. This conclusion may be

reconciled with the theory of Donth - and some other aspects of the measurements (such as, peak width) can be clarified - by assuming that the dislocations participating in the relaxation process are under internal stresses resulting from the prior cold work. An activation energy of 0.12 electron volt is consistent with the present data, but the range of frequency represented in the comparison is not sufficient to determine the value accurately. It is shown that the subsidiary peak consists of two separate peaks at about 30° and 40° K.

1353. Payne, A. R.,
DYNAMIC MECHANICAL PROPERTIES OF FILLER LOADED VULCANIZATES, Rubber and Plastics Age, August 1961, pp. 963-967.

The present work establishes the reality of an amplitude of vibration below which no change in dynamic modulus occurs. The experimental results show that large changes in dynamic modulus and phase angle occur at strains comparable with those frequently met in service. A description is given of the important changes that occur on straining rubber vulcanizates containing carbon black, especially at low amplitudes of strain.

1354. Pennsylvania State University,
THE INTERNAL FRICTION OF SODA ALUMINOSILICATE GLASSES AND ITS STRUCTURAL INTERPRETATION by D. E. Day, 1961, Ph.D. Thesis.

These glasses were investigated because they offer a new approach for studying the mechanisms responsible for the two internal friction peaks observed in alkali silicate glasses. A structural model was developed for the soda alumino-silicate glasses and with this model it has been possible to definitely establish the mechanisms responsible for the low and intermediate temperature internal friction peaks.

1355. Philips Research Report,
INTERNAL FRICTION IN LIGHTLY DEFORMED PURE IRON WIRES by J. D. Fast and M. B. Verrijp, Vol. 16, February 1961, pp. 51-65.

Internal friction of pure (99.99 percent) iron wires is measured before and after subjection to small plastic

deformation. Damping after deformation is found to be dependent on amplitude, temperature of deformation, and temperature of measurement.

1356. Polotskii, I. G. and Taborov, V. F.,
EFFECT OF ADMIXTURES AND HEAT TREATMENT ON ABSORPTION OF ULTRASOUND IN COPPER SINGLE CRYSTALS, Dopovidi Akad. Nauk Ukr. RSR, No. 12, 1961, pp. 1606-1609.

The effect of small admixtures of beryllium and magnesium on the absorption of ultrasound (30 to 200 megacycles) in copper single crystals was studied on samples made of 99.999 percent pure copper.

1357. Ponomarev, I. F. and Rozhdestvenskii, S. S.,
A STUDY OF THE STRUCTURAL CHANGES OF HYDRATED CEMENT BY THE RESONANCE METHOD, Tsement, Vol. 27, No. 5, 1961, pp. 18-21.

The physical chemistry processes taking place during the setting of cement depend on many factors, which to some degree can be illuminated by a study of the internal friction and the dynamic modulus of elasticity. Curves of internal friction versus time in days show significant peaks and depressions which correspond to changing conditions within the cement structure, which are reflected by varying degrees of absorption of the energy of elastic vibration.

1358. Potemkin, A. P.,
DAMPING OF FREE VIBRATIONS IN BENDING AND TORSION, Vestnik Mashinostroyeniya, No. 6, June 1961, pp. 15-17.

This article describes a method for computing relative damping in flexural and torsional vibrations. Formulas for relative damping are based on static tests, and the speed of deformation has no effect. The results of investigations can be applied to the comparative analysis of damping vibrations for different cross sections and any stress condition. This is an improvement on the existing experimental methods for the determination of the logarithmic decrement of damping.

1359. Pravdyuk, N. F., Pokrovskii, Yu. I., and Vikhrov, V. I., EFFECT OF NEUTRON IRRADIATION ON INTERNAL FRICTION IN ZINC SINGLE AND POLYCRYSTALS, Atomnaya Energiya, Vol. 10, 1961, pp. 347-352.

Results were presented concerning the effect of irradiation on internal friction, 1/Q, and critical stress amplitude, σ critical, of zinc poly- and single crystals. Also, the effect of orientation of the base plane (0001) in relation to the longitudinal axis of the specimens of 1/Q and σ critical was studied. The value 1/Q was determined by transverse vibration ($\sim$ 300 cps) before and after exposure to an integral neutron flux of 3×10^{18} and 1.5×10^{19} neutrons per square centimeter. The σ critical value was estimated from the dependence of 1/Q on the amplitude of the normal stress calculated from the amplitude of vibrations.

1360. Prikhod'ko, V. N. and Savitskaya, A. N., DETERMINATION OF TENDENCY TO INTERCRYSTALLINE CORROSION IN STEEL TYPE 18-8 BY THE METHOD OF INTERNAL FRICTION, Izvest. Vysshikh Ucheb. Zavedenii, Chernaya Met., No. 11, 1961, pp. 185-192.

Internal friction was measured at 20° to 800° by the method of free torsional oscillations on a wire made of steels OKh18N9 and 1Kh18N9T. At temperatures of annealing 380° to 440°, internal friction changes only slightly, while at 450° to 850° there is a considerable increase in internal friction; this is ascribed to the formation of chromium carbides with resulting increased tendency toward intercrystalline corrosion.

1361. Prosvirin, V. I., ON THE MECHANISM OF DIRECTED DEFORMATION OF METAL DURING HEAT CYCLING, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 11, No. 5, 1961, pp. 732-793.

Results are presented of an investigation on the kinetics of the change in shape of iron, nickel and aluminum and an attempt is made to explain the reasons for the damping character of irreversible deformation.

1362. Purdue University, Lafayette, Indiana,
AN INTERNAL FRICTION STUDY OF VERY LOW CARBON MARTENSITE by J. K. Jackson, 1961, Ph.D. Thesis.

The structure of martensite in iron-nickel-carbon alloys containing less than 0.015 percent by weight carbon was investigated by measuring the 40° C carbon diffusion internal friction peak. Measurements were made of the internal friction in alloys containing zero, 2.5, 5.1, 6.5, 10.5, and 16.5 percent by weight nickel. By evaluation of the effects of varying nickel content and heat treatment on the nature of this peak, the existence of a structure in which the carbon atoms are ordered was revealed in specimens which had been quenched from temperatures at which austenite is stable. It is proposed that this structure is tetragonal martensite and that the tetragonality of the structure persists at these very low carbon contents because of the ordering influence of the residual accommodation stresses exerted on the martensite by the austenite matrix. In iron-nickel-carbon alloys with a ferritic structure, the addition of nickel decreases the height and area of the 40° C peak, shifts its position to a lower temperature, but causes the peak to be only slightly broadened, if at all. The shift in the peak position with increasing nickel content indicates that there is a long range effect of nickel on the movement of the carbon atoms within the lattice. The reduction in the peak area with increasing nickel content implies that short range interactions with the nickel atoms prevents some of the carbon atoms from participating in the relaxation processes which give rise to the peak under investigation.

1363. Quader, M. A.,
ANELASTIC MEASUREMENT OF DIFFUSION IN ALPHA-AgCd ALLOYS, Indian Journal of Physics, Vol. 35, No. 9, September 1961, pp. 446-458.

Measurements of the internal friction peak are made for three alpha-AgCd alloys with 24.3, 29.3, and 33.8 atomic percent cadmium and 30.8 percent zinc alpha brass. The peaks are due to changes in local order with the external stress. The measured values of the relaxation time are used to calculate the diffusion coefficient of the silver-cadmium alloys. The calculated values are in good agreement with the directly measured diffusion coefficients of alloys of corresponding compositions.

1364. Rawlings, R. and Robinson, P. M.,
INTERNAL FRICTION EFFECTS IN IRON-SILICON-NITROGEN ALLOYS, Iron and Steel Institute, Journal, Vol. 197, 1961, pp. 211-214.

The internal friction of iron-silicon-nitrogen alloys was investigated. Three to five peaks occur in the curve of internal friction plotted against temperature (zero to 80°). Alloys containing 0.5 percent, 1.1 percent, and 1.9 percent silicon were prepared in a vacuum resistance furnace. Nitrogen was added by heating the wire in partly cracked NH_3. The peaks are related to characteristic atom movements.

1365. Rawlings, R. and Robinson, P. M.,
THE SOLUBILITY OF SILICON NITRIDE IN FERRITE, Iron and Steel Institute, Journal, Vol. 197, April 1961, pp. 306-308.

Nitrogen in solid solution in equilibrium with silicon nitride is determined by measuring internal friction of steel wires containing 0.5 to 1.9 percent silicon at 600° to 900° C. with calculation of heat of solution of silicon nitride and activity coefficient of silicon.

1366. Read, B. E. and Williams, G.,
THE DIELECTRIC AND DYNAMIC MECHANICAL PROPERTIES OF POLYOXYMETHYLENE (DELRIN), Polymer, Vol. 2, 1961, pp. 239-255.

The dielectric and dynamic mechanical properties of polyoxymethylene (Delrin 500) have been measured in order to investigate molecular motions. The dynamic shear modulus and loss factor have been determined in the frequency range from 0.05 to 1 cps from -190° up to the melting point (180°). Two loss maxima have been observed at about -77° and 87°, respectively.

1367. Read, H. J. and Graham, A. H.,
THE ELASTIC MODULUS AND INTERNAL FRICTION OF ELECTRODEPOSITED COPPER, J. Electrochem. Soc., Vol. 108, No. 1, January 1961, pp. 73-78.

This article describes experimental techniques and calculations for the determination of elastic modulus and

internal friction from sonic measurements on thin-walled tubes prepared by electrodeposition. A method of making the tubes with the necessary precision is presented. Data on the effects of some plating variables are given, but special attention is devoted to relationships between the structures of the deposits and the elastic properties under study.

1368. Reding, F. P., Faucher, J. A., and Whitman, R. D., MECHANICAL BEHAVIOR OF POLYCARBONATES, Journal of Polymer Science, Vol. 54, 1961, pp. S56-S58.

Dynamic mechanical measurements with a recording torsional pendulum from -170° to 240° were made on polybisphenol-A carbonate, polybis-o-cresol-A carbonate and polytetrachlorobisphenol-A carbonate. All show two damping peaks, one at low temperatures, identified with the carbonate group and one at high temperature, from the phenyl groups and the main chain.

1369. Reed, F. E., DYNAMIC VIBRATION ABSORBERS AND AUXILIARY MASS DAMPERS, Shock and Vibration Handbook, New York, New York, McGraw-Hill Book Company, Incorporated, 1961 (Chapter 6, C. M. Harris and C. E. Crede, Editors).

This chapter considers auxiliary masses attached to vibrating systems by springs and damping devices to assist in controlling the amplitude of vibration of the system. Some of the topics discussed are: (1) forms of dynamic absorbers and auxiliary mass dampers, (2) influence of a simple auxiliary mass system upon a vibrating system, (3) nonlinearity in the spring of an auxiliary mass damper, (4) distributed mass absorbers, and (5) practical applications on single degree-of-freedom systems.

1370. Rensselaer Polytechnic Institute, Troy, New York, PULSED ULTRASONIC STUDIES OF SOLIDS by H. B. Huntington, August 1961, Report No. AD-260-576.

Ultrasonic techniques and their application to the measurements of velocity and attenuation in solids are discussed.

1371. Robinson, P. M.,
INTERNAL FRICTION EFFECTS IN IRON AND IRON ALLOYS, Australian Institute of Metals, Journal, Vol. 6, August 1961, pp. 217-226.

This article investigates the influence of stress-induced movements of solute atoms to and from interstitial sites in the lattice in iron and iron alloys containing carbon and nitrogen. These phenomena can be utilized to study solubilities, precipitation rates, and diffusion rates of carbon and nitrogen in binary and ternary iron alloys.

1372. Rosin, G. S.,
DETERMINING THE DAMPING OF ELASTOPLASTIC MATERIALS, Izmerit. Tekhnika, No. 9, 1961, p. 21 (Measurement Tech., No. 9, pp. 710-711).

The use of forced oscillations allows the determination of damping at almost any frequency.

1373. Royal Aircraft Establishment, Farnborough, England,
A REPRESENTATION OF INTERNAL DAMPING AND RELAXATION IN SOLID MATERIALS by H. K. P. Neubert, August 1961, AD-264-945.

Based on earlier theories of mechanical, electrical, and magnetic relaxation phenomena, a simple model is discussed which is capable of representing qualitatively the experimentally established characteristics of internal damping in solid materials. These are constant damping over a wide frequency range and, at high values of damping, increasing stiffness in dynamic (as compared with static) tests.

1374. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF DAMPING TREATMENTS FOR DESTROYER HULLS, June 1961, AD-466-436, No. 5, 96 pp.

This phase of the investigation was concerned with the development of damping treatments from nitrile rubbers. The basic objective was to develop a treatment which would be effective over a wide frequency range. A total of 84 treatments were prepared. None was considered completely satisfactory.

1375. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF DAMPING TREATMENTS FOR NEW CONSTRUCTION SUBMARINES AND SURFACE SHIPS by J. J. Eynck, January 1961, Report No. 94-25, Vol. 30.

Not abstracted.

1376. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF DAMPING TREATMENTS FOR DESTROYER HULLS by R. R. James, November 1961, AD-266-649.

Research is presented in connection with the development of damping treatments (identified as F57) for surface ships. F57 is a graphite-filled copolymer of vinyl acetate with maleic anhydride.

1377. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF DAMPING TREATMENTS FOR NEW CONSTRUCTION SUBMARINES by R. R. James, November 1961, AD-262-943.

A nitrile rubber treatment, the best developed to date for use on submarine light plating such as found in tanks and in the superstructure, is described. The treatment is given a conformance rating of 85 percent from the standpoint of damping efficiency over the frequency range of 100° to 6000° C and temperature range of 30° to 85° F.

1378. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF DAMPING TREATMENTS FOR DESTROYER HULLS by R. R. James, November 1961, AD-266-627.

This investigation is being conducted to develop a damping treatment for destroyer hulls which will reduce the interference of the ship's noise with the ship's sonar. The properties of a nitrile rubber damping treatment and a plastic damping treatment were measured by these test

procedures. Specification limits based on the performance of the two damping treatments are proposed.

1379. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF DAMPING TREATMENTS FOR NEW CONSTRUCTION SUBMARINES by J. Oser, November 1961, AD-266-127.

Not abstracted.

1380. Ruzicka, J. E.,
DAMPING STRUCTURAL RESONANCES USING VISCO-ELASTIC SHEAR-DAMPING MECHANISMS, Journal of Engineering for Industry, Part 1, November 1961, pp. 403-413.

This paper considers the problem of resonant vibration control in designing structures to function in modern dynamic environments. Methods of specifying structural damping are given, and damping properties of engineering materials are reviewed. The disadvantages of some current design practices and special structural design practices are outlined, and special structural designs which incorporate viscoelastic shear-damping mechanisms are suggested as a method of controlling the resonant flexural vibrations of structures. The general dynamic characteristics and design philosophy of structures and strip dampers (additive damping techniques) that incorporate viscoelastic shear-damping mechanisms are discussed.

1381. Ruzicka, J. E.,
DAMPING STRUCTURAL RESONANCES USING VISCO-ELASTIC SHEAR-DAMPING MECHANISMS, Journal of Engineering for Industry, American Society of Mechanical Engineers, Transactions, Series B, Vol. 83, November 1961, pp. 414-424.

Effects of shock excitation, steady-state vibration excitation level, structure resonant frequency and environmental temperature (-100° to 500° F) on the damping properties of solid and viscoelastic-damped aluminum beams.

1382. Ryder, R. J. and Rindone, G. E.,
INTERNAL FRICTION OF SIMPLE ALKALI SILICATE GLASSES CONTAINING ALKALINE-EARTH OXIDES, II. INTERPRETATION AND DISCUSSION, Journal of American Ceramic Society, Vol. 44, 1961, pp. 532-540.

Changes in peaks caused by composition variables are explained on a structural basis. The most probable mechanism for the new high-temperature peak is believed to be an interaction between the network and clusters formed because of the addition of alkaline-earth oxides.

1383. Sakamoto, K. and Sugeno, T.,
INTERNAL FRICTION OF IRON-NICKEL ALLOYS CONTAINING NITROGEN OR CARBON, Oyo Butsuri, Vol. 30, 1961, pp. 120-126.

Internal friction was measured for iron-nickel alloys (5.0 percent to 31.6 percent nickel) containing small amounts of nitrogen or carbon, which were quenched from their γ-phase. There are two maxima, at 40° and 160° to 210°; the 40° maximum is of Snoek type, which is associated with the stress-induced diffusion of nitrogen or carbon in alpha-iron. The other peak is of the same nature as is observed in cold-worked iron.

1384. Sakui, S. and Takei, H.,
THE EFFECT OF AGE HARDENING ON THE RIGIDITY MODULUS AND THE INTERNAL FRICTION IN 17-7PH STAINLESS STEEL WIRE, Japan Institute of Metals, Journal, Vol. 25, January 1961, pp. 34-36 (In Japanese).

Changes in the rigidity modulus, electrical resistivity, and hardness and internal friction following aging at 20° to 600° C for various times are examined for stainless steel wire containing 1.24 percent aluminum of 0.65 millimeter diameter, using a torsion pendulum, potentiometric and micro-Vickers hardness measurements.

1385. Sakui, S. and Takei, H.,
THE EFFECT OF COLD DRAWING AND ANNEALING ON THE RIGIDITY MODULUS AND INTERNAL FRICTION IN STAINLESS STEEL WIRES, Japan Institute of Metals, Journal, Vol. 25, January 1961, pp. 30-33 (In Japanese).

Changes in the rigidity modulus, electrical resistivity, and hardness and internal friction due to cold drawing and annealing at 100° to 600° C are measured in 13 chromium and 18-8 stainless steel wires of 0.7 or 0.6 millimeter diameter, using torsion pendulum, potentiometer and micro-Vickers hardness testing methods.

1386. Sauzade, M.,
SATURATION AND MEASUREMENT OF THE RELAXATION TIME IN THE FERROMAGNETIC RESONANCE OF YTTRIUM IRON GARNET, Ann. Phys., Vol. 6, 1961, pp. 595-642.

The resonance magnetization induced by a microwave field of 9350 megacycles in a sphere of yttrium-iron garnet was measured.

1387. Savitskii, E. M. and Dashkovskii, A. I.,
INTERNAL FRICTION AS A METHOD OF PHYSICAL CHEMICAL ANALYSIS OF METALLIC ALLOYS, Akademiya Nauk, SSSR, Otdeleniye Tekhnicheskikh Nauk, Izvestiya, Metallurgiya i Toplivo, No. 5, 1961, pp. 96-100.

The study of internal friction in a single-component system reflects very sensitively the transformation of crystal structure caused by changes in temperature. In two component systems, the value of internal friction decreases proportionally to the concentration of the second component. Formation of chemical compounds is characterized by a jump in the curve of internal friction versus composition. Measurements of internal friction can be used for the study of a nonequilibrium state, such as, the phase transitions in metals and alloys.

1388. Schulz, H.,
THE MECHANICAL RELAXATION IN ICE-HF CRYSTALS WITH VARIOUS HF CONCENTRATIONS, Naturwissenschaften, Vol. 48, No. 22, 1961, p. 691 (In German).

The mechanical damping of cylindrical ice-HF resonators was measured in the frequency range 0.2 to 4 kc/sec and the temperature interval zero to -110°C. The logarithmic decrement was determined by torsion oscillations relative to the crystallographic C-axis.

1389. Schwemmer, L. J. and Loftus, T. S.,
CONSTRAINED LAYER DAMPING APPLIED TO PRINTED CIRCUIT BOARDS, American Society of Mechanical Engineers, Paper No. 61-WA-309, 1961, 7 pp.

This paper discusses the loss factor dependency of some damping materials on parameters such as temperature, frequency, and board dimensions. Certain materials are very sensitive to temperature and frequency and when exposed to random environments, exhibit shifts in natural frequency of the composite board to undesirable operating points. The use of BTR (Broad Temperature Range) elastomer in a constrained layer-damping medium for printed-circuit boards is recommended because of its virtually constant performance over wide temperature and frequency ranges. The material is also time and temperature stable.

1390. Sekiguchi, Hisami, and Atsumi, K.,
DYNAMIC CHARACTERISTICS OF BUTYL RUBBER, Nippon Gomu Kyokaishi, Vol. 34, 1961, pp. 516-521.

The dynamic characteristics of butyl rubber were determined, and the suitability of the rubber for absorbing vibration was investigated. Characteristics for the design of a rubber vibration insulator were investigated.

1391. Seraphim, D. P. and Nowick, A. S.,
MAGNITUDE OF THE ZENER RELAXATION EFFECT, PART 3. ANISTROPY OF THE RELAXATION STRENGTH IN Ag-Zn AND Li-Mg SOLID SOLUTIONS, Acta Metallurgica, Vol. 9, February 1961, pp. 85-97.

Variation of the Zener relaxation effect as determined in face-centered cubic silver-zinc and body-centered cubic lithium-magnesium solid solutions from measurements on

oscillating single-crystal rods in flexure and in torsion. The effect has a high anisotropy, such that the relaxation strength is greater for (111) than for (100) oriented crystals, applying to both the face-centered cubic and the body-centered cubic solid solutions and explained by relaxations involving next-nearest neighbor atom pairs.

1392. Sethna, P. R.,
TRANSIENTS IN CERTAIN AUTONOMOUS MULTIPLE DEGREE OF FREEDOM NONLINEAR VIBRATING SYSTEMS, October 1961, Report No. ASD TR 61-449, 37 pp.

Oscillations of weakly nonlinear autonomous multiple degree of freedom dynamical systems are studied. The analysis includes nonlinear effects arising from the potential as well as the kinetic energies of the systems and the systems include elements that produce nonlinear dissipative forces. The method of averaging is applied to a suitably transformed set of equations. In several important cases nonperiodic solutions for arbitrary initial conditions are obtained by quadratures.

1393. Sharma, M. G.,
RESONANT STRENGTH OF A VIBRATING MEMBER HAVING TWO DEGREES OF FREEDOM WITH HYSTERESIS DAMPING, International Journal of Mechanical Sciences, Vol. 3, August 1961, pp. 118-128.

Comparison of experimental and theoretical damping characteristics of various alloy shafts of aluminum, magnesium, titanium, and steel (SAE 1020, SAE 4130). Only hysteresis of material damping is considered in the energy dissipation of the fixed shafts. Fluctuating loads are induced to produce stresses.

1394. Shil'krut, D. I.,
DETERMINATION OF RHEOLOGICAL LAWS OF INCOMPLETELY ELASTIC BODIES SUBJECT TO PERIODIC PROCESSES IN THE CASE OF A HYSTERESIS LOOP OF ELLIPTICAL TYPE, Akademiya Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, Izvestia, Mekhanika e Mashinostroeniie, No. 4, July-August 1961, pp. 141-146.

Not abstracted.

1395. Shmatov, V. T. and Grin, A. V.,
HIGH-TEMPERATURE INTERNAL FRICTION IN METALS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 12, 1961, pp. 600-606.

The background to high temperature damping capacity, and the damping peak on grain boundaries in metals are both related to vacancies. It is considered that the first proceed from the non-equilibrium change in vacancy concentration in the volume of the grains, while the second occurs on their boundaries.

1396. Shurakov, S. S.,
RELAXATION PHENOMENA IN HARDENED STEEL, Metalloved i Termichesk. Obrabotka Metal., No. 4, 1961, pp. 36-39.

Samples of 12Kh2N4A steel were subjected to tensile and torsional tests. Their elasticity moduli were determined and relaxation stresses studied at 20° and -196°.

1397. Shushaniya, V. R. and Golovin, S. A.,
EFFECT OF TEMPERATURE ON THE INTERNAL FRICTION OF CARBON STEEL, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 11, 1961, pp. 809-811.

The effect of the temperature, t, on the relaxation of internal friction, Q^{-1}, and on the modulus of shear of carbon steel B-1 (carbon 0.92) was determined with specimens heated one hour at 1000° in vacuum and quenched in H_2O from different temperatures. Q^{-1} of specimens quenched from 660° to 710° passed through a maximum at t = 40°, decreased, and passed through a low, slight maximum at 200°.

1398. Shustin, O. A., Velichkina, T. S., Baranskii, K. N., Yakoviev, I. A.,
ABSORPTION OF SOUND IN ROCHELLE SALT NEAR THE LOWER CURIE POINT, Zhurnal Eksperimental'noĭ i Teoreticheskoĭ Fiziki, Vol. 40, 1961, pp. 979-980.

Absorption of polarized sound was measured at a frequency of five megacycles in Rochelle salt at the lower Curie point $\theta = -18°$.

1399. Shuvalov, L. A. and Pluzhnikov, K. A.,
PECULIARITIES OF ELASTIC PROPERTIES AND INTERNAL FRICTION OF TRIGLYCINE SULFATE CRYSTALS NEAR THE CURIE POINT, Kristallografiya, Vol. 6, 1961, pp. 692-699.

Internal friction was shown by the changes in the logarithmic decrement of damping, δ, of intrinsic mechanical vibrations of a piezoresonator. δ passed through a pointed maximum near θ. This and available data let to the conclusion that strong anisotropy of internal friction and anomalous increase in internal friction at θ for deformation associated with ferroelectric polarization (reorientation of domains) is a common property of all ferroelectric crystals regardless whether phase transition at θ is of the first or second order and is independent of the presence or absence of piezoelectric properties in the crystal above θ.

1400. Simon, G.,
THE INFLUENCE OF BLOCH WALL MOTIONS ON THE DAMPING OF ULTRASONIC WAVES IN FERROMAGNETIC METALS, Ann. Phys., Vol. 7, No. 3-4, 1961, pp. 140-148.

A theoretical discussion of the role of Bloch walls if presented.

1401. Smagin, A. G.,
INTERNAL FRICTION IN QUARTZ, Kristallografiya, Vol. 6, 1961, pp. 686-691.

The coefficient of internal friction, μ, in quartz crystals is due to crystalline defects and is, therefore, a statistical dimension. The value of δ for quartz resonators at the intrinsic $f = 100$ kilocycles obtained by extrapolation of experimental values compared well with the theoretical value.

1402. Smith, G. M. and Albee, D.,
A NONLINEAR DIFFERENTIAL EQUATION FOR THE EVALUATION OF SOLID DAMPING, Proceedings, American Society for Testing Materials, Vol. 61, 1961, pp. 1362-1368.

Paper is based on the idea that damping of a single-degree-of-freedom system can sometimes be represented

better by hysteretic rather than viscous damping. Results of a very incomplete investigation of this theory are presented.

1403. Snowdon, J. C.,
RESPONSE OF NONLINEAR SHOCK MOUNTINGS TO TRANSIENT FOUNDATION DISPLACEMENTS, Journal of Acoustical Society of America, Vol. 33, No. 10, October 1961, pp. 1295-1304.

The transient behavior of shock mountings disturbed by steplike displacements that invoke large departures of mount stiffness from linearity is described theoretically and compared with the behavior of an ideal linear mounting. The influence of mount damping upon the transient motion of the mounted item is discussed in detail.

1404. Snowdon, J. C.,
REDUCTION OF THE RESPONSE TO VIBRATION OF STRUCTURES POSSESSING FINITE MECHANICAL IMPEDANCE, Journal of Acoustical Society of America, Vol. 33, No. 11, November 1961, pp. 1466-1475.

Expressions are derived from which the isolation provided by a simple mounting system when supported by any nonrigid foundation may be determined if the mechanical impedance of the foundation is known. As an example, the mechanical impedance of a damped beam at its midpoint is employed to simulate the behavior of such a foundation. Damping of the foundation is found to have little influence upon the over-all edge of the dynamic mechanical properties of natural rubber, and a high-damping synthetic rubber has enabled the behavior of antivibration mountings to be described realistically.

1405. Southampton University, Department of Aeronautics and Astronautics,
THE OPTIMUM USE OF UNCONSTRAINED LAYER DAMPING TREATMENTS by D. J. Mead and T. G. Pearce, July 1961, A. A. S. U. Report No. 126.

Not abstracted.

1406. Southampton University, Department of Aeronautics and Astronautics,
AN EXPERIMENTAL INVESTIGATION OF THE DAMPING PROPERTIES OF AQUAPLAS UNDER RANDOM AND HARMONIC EXCITATION, June 1961, Report No. 173, 60 pp.

An investigation was made of the characteristics of the commercial damping treatment, Aquaplas F 102 B, by measurement of the vibration of a two-layer plate, which is covered with the treatment on one side. The linearity of the damping and stiffness of the treatment is established by comparison of the dynamic properties measured under harmonic and random conditions.

1407. Stanford University, California,
ELASTIC PROPERTIES RESEARCH by J. L. Lytton and J. A. Hren, September 1961, AD-266-670.

The dynamic modulus (at about 300° C) and plastic properties of an iron - three-percent silicon oriented transformer sheet were studied in the temperature range 25° to 1200° C. The role of disordering on the elastic properties of an Fe_3Al alloy was completed. Both dynamic modulus and damping capacity measurements were made in the temperature range 25° to 900° C. Five specific elastic and anelastic characteristics were identified. The role of ferromagnetism on the elastic properties of nickel and cobalt was evaluated.

1408. Stanford University, California,
DAMPING DUE TO CREEP IN A VIBRATING HELICAL SPRING by R. C. Meiner, August 1961, Report SUDAER 113, AFOSR TN 61-1421, 48 pp.

This report describes techniques to obtain practical values of damping due to creep and to assess the creep properties of a helical aluminum spring. Some preliminary test results are presented in graphical form.

1409. Starodubtsev, S. V., Domoryad, I. A., and Khiznichenko, L. P.,
THE CHANGE IN MECHANICAL CHARACTERISTICS OF AMORPHOUS SELENIUM UNDER THE ACTION OF γ RAYS, Doklady Akademii Nauk SSSR, Vol. 139, 1961, pp. 594-595.

The influence of γ-rays on the internal friction, Q^{-1}, and the shear modulus, G, of amorphous selenium was studied. Threadlike samples of selenium were used. γ-Irradiation increases G and decreases Q^{-1}; this corresponds to a transition to a crystalline state.

1410. Starodubtsev, S. V., Domoryad, I. A., and Khiznichenko, L. P.,
THE EFFECT OF TEMPERATURE AND PLASTIC DEFORMATION ON THE INTERNAL FRICTION AND RATE OF SHEAR OF GLASSLIKE SELENIUM, Dokl. Akad. Nauk Uz. SSR, No. 8, 1961, pp. 18-19.

The experiments were conducted by the method of vibrating oscillations between -40° and 30°. With the increase in temperature, the shear rate, G, decreases and the internal friction, Q^{-1}, increases.

1411. Stewart-Warner Corporation, South Wind Division, Indianapolis, Indiana,
INTERFACE DAMPING AT RIVETED JOINTS, PART 1. THEORETICAL ANALYSIS by D. Mead and D. C. G. Eaton, September 1961, AD-270-463.

A theoretical examination is made of potential structural damping increments obtainable by insertion of a linear viscoelastic interfacial layer between plates of riveted joints. Consideration is given to a lap joint having antisymmetry about its single rivet, and being subjected to harmonic longitudinal loading.

1412. Swartz, J. C.,
APPARATUS FOR MEASURING INTERNAL FRICTION AND MODULUS CHANGES OF METALS AT LOW FREQUENCIES, Review of Scientific Instruments, Vol. 32, No. 3, March 1961, pp. 335-338.

A description is given of a torsion pendulum and associated apparatus which were employed in measuring internal

friction and modulus changes due to dislocations. One specimen chamber is used for temperatures between 80° and 400° K and another for the range 290° to 1000° K. Decrements above 4×10^{-5} were observed at maximum strain amplitudes in the range 2×10^{-7} to 2×10^{-4}. Modulus changes may be measured within one-part in 10^4.

1413. Swartz, J. C.,
ON THE INTERPRETATION OF INTERNAL-FRICTION EXPERIMENTS ON STRAIN AGING OF IRON, Journal of Applied Physics, Vol. 32, No. 10, October 1961, p. 2048.

The logarithmic decrement of torsional vibrations in iron wires containing carbon was measured during strain aging as a function of temperature. Analysis of the peak and background components provides no evidence of the dissolution of carbon atmospheres during deformation.

1414. Tamura, I., Mura, T., and Brittain, J. O.,
THE INFLUENCE OF ALLOYING ELEMENTS ON THE INTERNAL FRICTION OF COLD-WORKED AND QUENCHED MARTENSITIC IRON AND STEEL, Transactions, American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), Vol. 221, 1961, pp. 1158-1162.

Plain carbon-steel in the cold-worked or martensitic conditions has an internal friction peak at about 250° at a frequency of one cycle per second. The effect of substitutional alloying elements on this peak was examined experimentally. The alloys were vacuum melted cobalt-, chromium-, molybdenum-, and silicon-iron. The internal friction of the alloys at 30° to 500° was determined with the torsion pendulum.

1415. Taylor, A.,
LOW-TEMPERATURE INTERNAL-FRICTION PEAKS IN SINGLE CRYSTALS OF NaCl AND LiF, Journal of Applied Physics, Vol. 32, No. 9, September 1961, pp. 1799-1800.

The internal friction was measured for LiF and NaCl single crystals in the temperature range of 20° to 220° K at 40 and 6 kc/sec; annealed and deformed structures are compared. For NaCl a peak occurs around 100° K, for LiF at 60° K in the case of deformed materials; the peak intensity increased with deformation and in heavily deformed LiF there was evidence of the appearance of a second peak.

1416. Thurn, H.,
CHANGES IN POLYETHYLENE "SINGLE CRYSTALS" WITH TIME, Kolloid-Zeitschrift, Vol. 174, 1961, p. 73.

Linear polyethylene obtained as a powder by cooling down a 0.1 percent solution in xylene to 78° was subjected to nuclear resonance and mechanical-dynamic measurements with the quartz fiber vibrator when first obtained, and again after storage for four months. The low-temperature maximum of -120° is lacking in mechanical damping measurements made immediately after preparation of the powder from solution but it appears after four months, and is fully developed in powder which has been melted.

1417. Tobias, S. A.,
MACHINE-TOOL VIBRATION, Shock and Vibration Handbook, New York, New York, McGraw-Hill Book Company, Incorporated, 1961 (Chapter 40, C. M. Harris and C. E. Crede, Editors).

The machining of metals and other materials is invariably accompanied by relative vibration between workpiece and tool. The effect of vibration on tool life and the elimination of vibration are also discussed.

1418. Trakna, R. E.,
INVESTIGATION OF LOW-TEMPERATURE ULTRASONIC ABSORPTION IN FAST-NEUTRON IRRADIATED SiO_2 GLASS, Physical Review, Vol. 123, September 1961, pp. 2020-2026.

Ultrasonic attenuation measurements made in normal and fast neutron-irradiated fused silica from 7 to 50 megacycles and from 1.5° to 200° K are discussed. A broad attenuation curve, attributed to a structural relaxation with a distribution of activation energies, occurs at low temperatures.

1419. Trapp, W. J. and Lazan, B. J.,
MATERIAL PROPERTIES THAT AFFECT ACOUSTICAL FATIGUE LIFE AND THE ROLE OF DAMPING, Symposium on Acoustical Fatigue, American Society for Testing Materials, 1961, pp. 3-18.

This article examines the influence of fatigue strength, maximum static stress, natural frequency, and structural

damping in acoustic fatigue of aircraft components. Classification of excitation types and spectral curves with emphasis on noise sources and environment are also included.

1420. Truell, R.,
INFLUENCE OF DEFORMATION AND TEMPERATURE ON THE COBALT γ - IRRADIATION OF SODIUM CHLORIDE. EVIDENCE FOR ELECTRICAL INTERACTION BETWEEN DISLOCATIONS AND POINT DEFECTS, Journal of Applied Physics, Vol. 32, 1961, pp. 1601-1604.

Ultrasonic attenuation measurements in NaCl, as a function of Co^{60} γ-ray irradiation, show no appreciable dependence on temperature in the range from room temperature to liquid-nitrogen temperature; hence, there is no appreciable thermal activation energy for the process of immobilizing the dislocations. The effect of plastic deformation on the attenuation-irradiation behavior is large.

1421. Tsien, C. T.,
MECHANISM OF INTERNAL FRICTION PEAK INDUCED BY DIFFUSION OF INTERSTITIAL ATOMS IN FACE-CENTERED CUBIC CRYSTAL, Scientia Sinica, Vol. 10, 1961, pp. 930-937.

Steel studied contains 18.5 percent manganese. Nickel samples were prepared from electrolytic nickel. The specimen was heated to about 380°. The nickel specimen was carburized in a $C_6H_6 + H_2$ atmosphere at 1000° to 1300° for three hours. After that treatment, specimens were heated for five minutes at 1300° and then quenched in H_2O. The relation between the carbon content and the height of the internal friction peak of carbon diffusion in pure nickel and in manganese steel was established.

1422. Tyapunina, N. A., Shaskol'skaya, M. P., Chzhao-Tszyan (Chao-Chien), and Vekilov, Yu. Kh.,
INFLUENCE OF PLASTIC DEFORMATION AND IRRADIATION OF THE INTERNAL FRICTION OF SINGLE-CRYSTAL LiF, Fiz. tverdogo Tela, Vol. 3, No. 12, December 1961, pp. 3637-3644 (In Russian, English translation in: Soviet Physics-Solid State).

Observations are reported on internal friction at 100 kc/sec, dislocation density and double refraction in single-crystals LiCl as affected by plastic deformation and by

irradiation with X-rays. The results agree with the dislocation theory of the origin of internal friction.

1423. Ungar, E. E. and Hatch, D. K.,
HIGH-DAMPING MATERIALS, Product Engineering, Vol. 32, No. 16, April 1961, pp. 44-56.

The dynamic properties of viscoelastic materials depend on frequency, amplitude of stress, temperature, and loading history. This article relates observed dynamic behavior to molecular structure and thereby arrives at the mechanisms which determine behavior. With this information, it is possible to tailor new materials with special properties. Basic data on over 50 materials are given, and sample problems show how to put theory and data to work.

1424. United States Department of Commerce, Office of Technical Services,
PHYSICAL METALLURGY OF TUNGSTEN AND TUNGSTEN-BASE ALLOYS by H. G. Sell, G. H. Keith, R. C. Koo, and R. H. Schnitzel, 1961, Report No. AD-266330, 143 pp.

Additional base-line data on the metallurgical properties of pure tungsten above 2500° F were obtained. Internal friction measurements were carried out at 20° to 800° C on high-purity and dosed polycrystalline tungsten wires and single crystals of tungsten. Internal friction damping peaks are due to carbon and oxygen. Methods of dosing interstitials into tungsten were further explored.

1425. United States Government Research Report,
ULTRASONIC ATTENUATION AND VELOCITY MEASUREMENTS IN QUARTZ by T. Fitzgerald and R. Truell, 5 August 1961, Vol. 36, AD 257 068, p. 78.

The frequency dependence of the attenuation of compressional waves in X-cut quartz is discussed. The dependence obeys an approximate square law consistent with the dislocation damping theory. The behavior of the attenuation as a function of temperature below 100° K is in agreement with that predicted by a phonon-phonon process. The temperature dependence of the velocity measured in this experiment indicates that it remains constant at a value of 5.75×10^6 cm/sec to within ± 0.02 percent.

1426. University College, Cardiff, South Wales,
IRON-CHROMIUM-NITROGEN ALLOYS by R. Rawlings and T. B. Koshal, 1961, 32 pp. (United States Department of Commerce, Office Technical Service, PB Report 155, 284).

The internal friction and critical strain (the minimum strain at which the internal friction is dependent on the maximum strain of vibration) was determined. Other samples containing < 0.02 percent nitrogen were quenched in water and the internal friction versus temperature curve was measured. The curves contained three or four maxima which all increased with time of heating at 800° or 850°. Several sets of curves for various nitriding times were obtained for the 0.94 percent and the 4.2 percent chromium alloy. When the same experiments were carried out with the specimen magnetized during saturation, the internal friction versus temperature curves were greatly simplified. Only two maxima were observed and all future testing will be carried out with the specimen magnetized. The other maxima obtained appeared to have magnetoelastic origins.

1427. Vane, F. F.,
SHOCK AND VIBRATION IN SHIPS, Shock and Vibration Handbook, New York, New York, McGraw-Hill Book Company, Incorporated, 1961 (Chapter 46, C. M. Harris and C. E. Crede, Editors).

The primary objectives of the control of shock and vibration in ships are to achieve acceptable environmental conditions for ship personnel and passengers, and to obtain conditions to meet operational requirements. This chapter describes the techniques for the measurement and control of shock and vibration in ships to achieve the above objectives.

1428. Vekilov, Yu. Kh.,
THE PHENOMENON OF "PHOTOINELASTICITY" IN AgCl, Fiz. tverdogo Tela, Vol. 3, No. 2, February 1961, pp. 545-546 (In Russian, English translation in: Soviet Physics-Solid State, Vol. 3 No. 2, August 1961, p. 400).

Measurement of the damping of torsional vibrations in annealed silver chloride specimens at one cycle per second shows that irradiation by ultraviolet light decreases the damping by about 30 percent, but that the original value is

recovered when irradiation ceases. The effect is due to migration of color centers and dislocations.

1429. Vekilov, Yu. Kh., Tyapunina, N. A., and Shaskol'skaya, M. P.,
INTERNAL FRICTION AND DISLOCATION DENSITY AFTER PRELIMINARY PLASTIC DEFORMATION OF LiF, Kristallografiya, Vol. 5, No. 6, November-December 1960, pp. 953-955 (In Russian, English translation in: Soviet Physics-Crystallography, Vol. 5, No. 6, May-June 1961, pp. 908-910).

The quartz-oscillator resonance method was used to show a dependence of internal friction on the dislocation density.

1430. Verma, G. S. and Joshi, S. K.,
ORIGIN OF HYPERSONIC ATTENUATION IN GERMANIUM AT LOW TEMPERATURES, Physical Review, Vol. 121, 15 January 1961, p. 396.

Hypersonic attenuation in germanium at different temperatures is calculated and compared with the recent low-temperature measurements by Truell and his associates. The excellent agreement between the theory and experiment for the temperature dependence shows that Umklapp processes are responsible for the attenuation at low temperatures.

1431. Verner, V. D., Finkel'shtein, B. N., and Shalimova, A. V.,
A STUDY BY THE METHOD OF INTERNAL FRICTION OF THE BEHAVIOR OF NITROGEN IN F. C. C. IRON ALLOYS, Fiz. tverdogo Tela, Vol. 3, No. 11, November 1961, pp. 3363-3366 (In Russian, English translation in: Soviet Physics-Solid State).

The temperature dependence of internal friction was studied for the alloys, iron + 30 percent nickel, iron + 20 percent nickel + 9 percent manganese, and iron + 28 percent manganese, saturated with nitrogen. An internal-friction peak was found at 265° to 280° C, caused by the diffusion of nitrogen. (English translation in: Soviet Physics-Solid State).

1432. Warburton, F. L., James J. F. P., and Hother-Lushington, S.,
SOME VISCOELASTIC PROPERTIES OF NYLON, British Journal of Applied Physics, Vol. 12, No. 5, May 1961, pp. 230-237.

The dynamic modulus of nylon fibers was measured over a wide frequency range at different temperatures and humidities, and also the life under load. The results of both sets of experiments can be explained on the assumption that increase in temperature only affects the internal friction of nylon, whereas absorption of water has also a significant although smaller effect on the elastic properties.

1433. Weeks, R. F.,
TECHNIQUES FOR THE DETERMINATION OF ULTRASONIC ATTENUATION IN FUSED SILICA, International Radio Engineers Intl. Conv. Rec., Part 6, 1961, pp. 296-303.

The frequency dependence of the intrinsic ultrasonic attenuation in fused silica is discussed. Studies using conventional delay lines are complicated by the difficulty of measuring transducer losses. A second technique makes use of two optical measurements of the integrated acoustic flux within a small polished test sample. This technique is in principle independent of frequency, transducer radiation pattern, and the dimensions of the sample. Both techniques are discussed in detail and measurements are presented.

1434. Whitworth, R. W.,
CHANGES OF ELASTIC MODULUS ASSOCIATED WITH INTERNAL FRICTION IN SODIUM CHLORIDE, Philosophical Magazine, Vol. 6, 1961, pp. 1115-1181.

Previous measurements of the amplitude-dependent internal friction of sodium chloride at 90 kilocycles and room temperature were extended to study the corresponding changes in Young's modulus. It is concluded that the motion of dislocations giving rise to the amplitude-dependent damping lags in phase behind the stress by about 30° to 60°.

1435. Woodward, A. E., Sauer, J. A., and Wall, R. A., DYNAMIC MECHANICAL BEHAVIOR OF SOME PARTIALLY CRYSTALLINE POLY-ALPHA-OLEFINS, Journal of Polymer Science, Vol. 50, 1961, pp. 117-125.

Measurements of the internal friction, Q^{-1}, and the dynamic elastic storage modulus, E^1, of partially crystalline poly-1-penetene (I), poly-3-methyl-1-butene (II), and poly-4-methyl-1-pentene (III) were measured as functions of temperatures $> 80°$ K. A resonance technique at audio frequencies was used.

1436. Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, PROGRESS IN THE DEVELOPMENT OF VIBRATION DAMPING MATERIALS, Proceedings, Wright Air Development Center -- University of Minnesota Conference on Acoustical Fatigue, March 1961, Report No. TR 59-676, pp. 185-206.

This paper discusses the theoretical and experimental investigation of various types of viscoelastic coatings used on sheet metal structures to dampen their bending vibrations. The dynamic-elastic porperties of a material under fluctuating tensile loading with an unrestricted transverse strain are analyzed.

1437. Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, QUICK ESTIMATION OF THE DAMPING FROM FREE DAMPED OSCILLOGRAMS by J. C. Burgess, Wright Air Development Center -- University of Minnesota Conference on Acoustical Fatigue, March 1961, Report No. TR 59-676, pp. 457-460, W. J. Trapp and D. M. Forney, Jr. (Editors).

A quick and fairly accurate estimate of the damping ratio, D, of a linear single degree of freedom system can be obtained from an oscillogram of free damped motion by using the relation $D = 0.75/n$, where n is the number of cycles of motion in the length of record required for the amplitude of the envelope of the motion to decrease to one percent of its initial value.

1438. Wright Air Development Center, Wright-Patterson Air Force Base, Ohio,
SOME EXPERIMENTAL RESULTS FROM EVALUATION OF CONSTRAINED DAMPING LAYER STRUCTURES by C. A. Dahlquist, Wright Air Development Center -- University of Minnesota Conference on Acoustical Fatigue, March 1961, Report No. TR 59-676, pp. 447-456, W. J. Trapp and D. M. Forney, Jr. (Editors).

This paper presents the results of adding damping tapes to a vibrating structure. Several different viscoelastic adhesives were used. Various filler materials which can be placed between the structure and the tape to increase the strain in the damping layer are mentioned. The importance of matching the damping material to job requirements is emphasized.

1439. Wright Air Development Center, Wright-Patterson Air Force Base, Ohio,
Acoustical Fatigue Test Procedures used in Aircraft Industry and Their Limitations by D. M. Forney, Jr., Wright Air Development Center -- University of Minnesota Conference on Acoustical Fatigue, March 1961, Report No. TR 59-676, pp. 339-378, W. J. Trapp and D. M. Forney, Jr. (Editors).

A broad review of acoustical fatigue testing practices used in the aircraft industry and associated groups is made in which descriptions of the rather substantial variations existing in the experimental and analytical approach to the problem are included. Some of the more important controversial questions, such as type of acoustic environment simulation required, the type and use of test facilities, test objectives, and the analytical philosophy from group to group, are discussed. Some description of new facilities being designed and built is also given.

1440. Wright Air Development Division, Wright-Patterson Air Force Base, Ohio,
EXPERIMENTS ON SLIP DAMPING AT ROUNDED CONTACTS by L. E. Goodman and C. B. Brown, June 1961, Report No. TR 60-161, Part II.

The apparatus described in Part I of this report was modified and used to obtain measurements of energy dissipation per cycle at the contact between a flat and spheres

of various diameters. The results agree well with the theoretical predictions of Mindlin and Deresiewicz. Neither the sphere diameter nor the normal load magnitude appear as essential parameters. The results indicate the necessity of using surface rather than bulk elastic constants in the determination of contact damping. The material employed was AISI 316 stainless steel.

1441. Wright Air Development Center, Wright-Patterson Air Force Base, Ohio,
DESIGN CONSIDERATIONS FOR MINIMIZING ACOUSTIC FATIGUE by H. H. Hubbard, Wright Air Development Center -- University of Minnesota Conference on Acoustical Fatigue, 1961, Report No. TR 59-676, pp. 321-338, W. J. Trapp and D. M. Forney, Jr. (Editors).

This paper contains a brief summary of the available published information relating to the more detailed design procedures for minimizing noise-induced structural fatigue. In particular, past damage experience is reviewed, descriptions are given of some ways in which specified designs may be made less vulnerable to noise damage, and some discussion is directed toward the possible problems of the future.

1442. Wright Air Development Division, Wright-Patterson Air Force Base, Ohio,
ACOUSTIC DAMPING MECHANISMS by E. M. Kerwin, Jr., Wright Air Development Center -- University of Minnesota Conference on Acoustical Fatigue, March 1961, Report No. TR 59-676, pp. 286-319, W. J. Trapp and D. M. Forney, Jr. (Editors).

This paper describes the various acoustic damping mechanisms, and presents a discussion of the radiation of sound from panels and the related damping factor. Acoustic damping is compared to damping from applied treatments, and the conclusion is reached that properly designed and applied damping treatments can give more damping, and, perhaps, more predictable and reliable damping, than is provided by acoustic dissipation of energy.

1443. Wright Air Development Center, Wright-Patterson Air Force Base, Ohio,
REVIEW OF STRUCTURAL DAMPING MECHANISMS by B. J. Lazan, Wright Air Development Center -- University of Minnesota Conference on Acoustical Fatigue, March 1961, Report No. TR 59-676, pp. 168-184, W. J. Trapp and D. M. Forney, Jr. (Editors).

This paper reviews damping properties of materials at engineering stress levels. In addition to inherent structural damping, surface addition approaches are considered to counteract the serious problem of resonance amplification. The conclusion is reached that greater utilization of interface adhesive shear as a damping mechanism should be encouraged.

1444. Wright Air Development Center, Wright-Patterson Air Force Base, Ohio,
THE DAMPING, STIFFNESS AND FATIGUE PROPERTIES OF JOINTS AND CONFIGURATIONS REPRESENTATIVE OF AIRCRAFT STRUCTURES by D. J. Mead, Wright Air Development Center -- University of Minnesota Conference on Acoustical Fatigue, March 1961, Report No. TR 59-676, pp. 235-261, W. J. Trapp and D. M. Forney, Jr. (Editors).

This paper is a survey of research conducted in Great Britain, and particularly at the University of Southampton, on the damping of riveted joints. The following topics are covered: (1) the damping mechanisms, (2) the measured damping of typical joints at both low and high frequencies, (3) the damping of multijointed structures, (4) the stiffness of riveted joints, (5) the damping of a bonded honey-comb, and (6) the fatigue failure of joints under acoustic loading.

1445. Wright Air Development Division, Wright-Patterson Air Force Base, Ohio,
CRITERIA FOR COMPARING THE EFFECTIVENESS OF DAMPING TREATMENTS by D. J. Mead, January 1961 (University of Southampton, June 1960, Report No. 125).

In this report, expressions are derived for the response of simple vibrating systems, from which criteria have been deducted to indicate the effectiveness of a damping treatment in attenuating the response. The criteria include factors by which the treatment increases the mass and stiffness of the

system, together with the loss factor increment. It is shown that whereas the mass and loss factor increase is always advantageous, a stiffness increase in some instances is detrimental.

1446. Wright Air Development Center, Wright-Patterson Air Force Base, Ohio,
DAMPING OF SIMPLIFIED CONFIGURATIONS WITH ADDITIVES OR INTERFACES by T. J. Mentel, Wright Air Development Center -- University of Minnesota Conference on Acoustical Fatigue, March 1961, Report No. TR 59-676, pp. 207-234, W. J. Trapp and D. M. Forney, Jr. (Editors).

Work on simplified damping configurations is reviewed with particular emphasis on support damping mechanisms. Optimization techniques for maximizing the damping by these configurations are discussed. Some preliminary experimental results, dealing with the support damping of beams, are presented.

1447. Wright Air Development Center, Wright-Patterson Air Force Base, Ohio,
INTRODUCTION TO ACOUSTICAL FATIGUE by E. J. Richards, Wright Air Development Center -- University of Minnesota Conference on Acoustical Fatigue, March 1961, Report No. TR 59-676, pp. 9-55, W. J. Trapp and D. M. Forney, Jr. (Editors).

A description is given of how acoustic or aerodynamic excitation of structures occurs as a result of turbulent movements. The need to know not only the pressure field, but sufficient of its correlation characteristics to calculate the loadings on the structure is stressed. The parameters involved in the response of the structure are emphasized, the lesson again being the need to know the modes of oscillation, the damping, both structural and acoustic, in these modes, and the need to relate more closely than at present the relationship between the root mean square stress levels so calculated to the fatigue life of the structure. It is concluded that fatigue testing of an actual aircraft may yet be needed as a routine measure.

1448. Wright Air Development Center, Wright-Patterson Air Force Base, Ohio,
Proceedings, Wright Air Development Center -- University of Minnesota Conference on Acoustical Fatigue, September 1959, Project No. 7360, 1961, Report No. TR 59-676, W. J. Trapp and D. M. Forney, Jr. (Editors).

This report is composed largely of invited papers and some selected seminar material presented at the Conference on Acoustical Fatigue. The conference was designed to establish communication between individuals from the several disciplines involved in acoustical fatigue problems, namely, acoustics, applied mechanics, and service failure analysis.

1449. Wright Air Development Division, Wright-Patterson Air Force Base, Ohio,
ULTRASONIC METHODS FOR THE STUDY OF STRESS CYCLING EFFECTS IN METALS by R. Truell, B. Chick, G. Anderson, C. Elbaum, and W. Findley, April 1961, Report No. TR 60-920.

Discussion centers on the use of ultrasonic methods to study defects of formation and their consequences in connection with stress cycling and fatigue of aluminum. Measurements, especially in the very early stages of stress cycling, support the idea that the cycling is accompanied by a dying out of dislocation damping effects, including recovery, as the result of the immobilization of dislocation oscillation by slip processes.

1450. Yamakawa, I. and Takeda, S.,
FORCED VIBRATION OF A ONE-DEGREE-OF-FREEDOM SYSTEM WITH UNSYMMETRICAL VISCOUS DAMPING, Transactions, Society of Mechanical Engineers, Japan, Vol. 27, No. 173, January 1961, pp. 73-77 (In Japanese).

The forced vibration of a one-degree-of-freedom system with an unsymmetrical viscous damper was analyzed theoretically. The numerical results showed that the neutral line of vibration of such a system has a tendency of shifting to the direction in which the damping is weak. These results were checked by experiment.

1451. Yegorov, N. N.,
DAMPING OF RAYLEIGH WAVES IN AN ELASTIC LAYER ON A HALF-SPACE, Primeneniye Ul'taakust, K Issled, Veshchestva, No. 15, Report No. AD-412-232, 1961, pp. 225-234.

Damping of rayleigh waves in an elastic layer on a half-space is discussed.

1452. Yi, C. and Kung, C.,
THE CHANGE OF INTERNAL FRICTION AND ELECTRICAL RESISTANCE OF METALS AND ALLOYS DURING CREEP TESTS, Acta Metallurgica Sinica, Vol. 5, March 1961, pp. 93-98.

The materials investigated included high-purity iron (99.96 percent), Armco iron, alloy steels, and nickel-chrome alloys.

1453. Zetzsche, A. and Buch, K.,
APPARATUS FOR MEASURING INTERNAL FRICTION OF SOLIDS, Exper. Tech. der Phys., Vol. 9, No. 3, 1961, pp. 128-135 (In German).

The apparatus is designed to set a suspended solid test rod in oscillation by means of a feedback network, and to observe the decaying oscillations of the after removal of the driving force. An electronic circuit is described which counts the number of decaying oscillations. An example illustrates the application of the apparatus.

1454. Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio,
BIBLIOGRAPHY AND TABULATION OF DAMPING PROPERTIES OF NON-METALLIC MATERIALS by S. H. Chi, September 1962, ASD Report No. TR 60-540, AD-289-856.

This bibliography contains a nearly complete list of references on the damping properties of nonmetallic materials for the period from 1929 to 1959, together with an index of nomenclature, units, and test methods. Tabulations of the in-phase and out-of-phase components of Young's modulus and the shear modulus for the various materials are also shown, and graphical representations of experimental data indicate the loss factor values for different materials.

1455. Aeronautical Research Council, Great Britain,
CONCEPT OF COMPLEX STIFFNESS APPLIED TO PROBLEMS OF OSCILLATIONS WITH VISCOUS AND HYSTERETIC DAMPING by S. Neumark, 1962, 35 pp.

Not abstracted.

1456. Aerospace Corporation, El Segundo, California,
MATERIALS AND STRUCTURES EVALUATION PROGRAM, INVESTIGATION OF THE FREE VIBRATIONS OF MULTI-LAYERED CYLINDRICAL SHELLS, SEMIANNUAL TECHNICAL REPORT, 1 JANUARY THROUGH 30 JUNE 1962 by V. I. Weingarten, 11 September 1962, DCAS-TDR-62-182, AD-291166, 29 pp.

Not abstracted.

1457. Aeronautical Research Council of Great Britain,
THE ANALYSIS OF BLADE VIBRATION DUE TO RANDOM EXCITATION by D. S. Whitehead, 1962, ARC-R & M-3253, 16 pp.

Not abstracted.

1458. Alefeld, G.,
DISLOCATION-CONTROLLED AMPLITUDE-DEPENDENT RELAXATION-DAMPING, Zeitschrift für Physik, Vol. 170, No. 3, 1962, pp. 249-266.

The activation processes for gliding dislocations during plastic deformation of solids should lead to amplitude-dependent internal-friction even for the case of small oscillatory dislocation movements about the equilibrium positions. Alefeld suggests that rise in internal friction with amplitude should be the beginning of an internal-friction maximum which lies at the higher amplitude. The theory accounts qualitatively for the main features of amplitude-dependent internal-friction experiments.

1459. Aleksandrov, L. N.,
INTERNAL FRICTION IN TUNGSTEN, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 13, April 1962, pp. 636-638.

Tungsten wire annealed and sintered with small amounts of Al_2O_3, Fe_2O_3, SiO_2, and molybdenum is forged and drawn to 0.2 millimeter size. The internal friction, microstructure and modulus of rigidity are determined in the 700° to 2400° C range and at different heating and annealing rates.

1460. Alers, G. A., Condit, R. E., and Karbon, J. A.,
LOW-TEMPERATURE INTERNAL FRICTION PEAKS IN GOLD, Applied Physics Letters, Vol. 1, 1 September 1962, pp. 8-9.

Internal friction peaks have been measured in plastically deformed gold bars at 18 kilocycles. Peaks were observed at 121° and 70° K. The former peak is in agreement with the results of Bordini and others. The activation energy for the process giving rise to the peaks is estimated at 0.2 and 0.1 electron volts for the high and low temperature peaks, respectively.

1461. Anonymous,
COLLECTED WORKS--PROBLEMS IN DYNAMICS AND STRENGTH ("Voprosy dinamiki i prochnosti"), Riga, Akad. Nauk Latv SSSR, Vol. 8, 1962, 186 pp. (In Russian).

This book is a collection of fourteen papers concerning dynamics of elastic and plastic bodies. Of special interest

are the first four papers which deal with various aspects of damping in engineering systems. In particular, the first paper is a general treatment of systems with one or two degrees of freedom with a consideration of hysteresis effects on amplitudes and frequencies. The second investigates the problem of a laminated beam with a tip mass subject to a harmonic driving force. Hysteresis effects are considered and vibration characteristics determined. A third paper treats hysteresis effects in a laminated cantilever beam driven by a harmonic force at the tip. The fourth paper investigates amplitudes for forced vibration of a single-degree-of-freedom system with a nonlinear spring force.

1462. Applied Psychological Services, Villanova, Pennsylvania, CONTINUUM MECHANICAL BEHAVIOR OF ENGINEERING MATERIALS by J. Marin, April 1962, ERB B 84, AD-289-306.

Not abstracted.

1463. Arizona University, Tucson, Arizona, IMPERFECTIONS IN METALS by C. T. Tomizuka, January 1960, December 1962, AF 49 638 790, AD-408-483, 13 pp.

This report investigates diffusion in pure noble metals under hydrostatic pressure, diffusion as a function of temperature, internal friction in alpha brass, tracer diffusion studies, and activation volume of a vacancy.

1464. Army Research Office, Durham, North Carolina, Washington, District of Columbia, Office of Technical Services, United States Department of Commerce, DISSIPATION OF ENERGY BY THE GRAIN BOUNDARIES by B. Hanna and W. B. Crandall, 1962.

The internal friction, Q^{-1}, and the extinction coefficient, K, of the infrared transmission were measured at room temperature for several polycrystalline magnesium oxide compacts, heat-treated at various temperatures. Both Q^{-1} and K (extrapolated) decreased by the increase in the mean grain surface area, and a linear relationship was found between the internal friction and the infrared scattering.

1465. Atomic Energy Commission Publication,
INTERNAL FRICTION MEASUREMENTS OF CERAMIC MATERIALS by P. D. Southgate, 1962, ASD-61-628.

A highly refined experimental equipment has been constructed which allows for accurate determinations of the internal friction in carefully supported specimens vibrating as free-free beams. Experimental work has been confined to magnesium oxide single crystals.

1466. Autonetics, Downey, California,
VIBRATION DAMPING ANALYSIS by G. R. Talbott, B. L. Weigand, and D. O. Dittman, April 1962, TR-62-245, AD-459-936, 10 pp.

This report is an analysis of vibration damping.

1467. Ayabe, H. and Kusiyama, T.,
DAMPING FACTOR OF HELICAL SPRING, Transactions, Society of Mechanical Engineers, Japan, Vol. 28, No. 194, October 1962, pp. 1251-1260.

The damping factor of a helical compression spring with constant pitch was determined. The damping effects come from internal and external friction of the coil itself, and contact friction of both ends of spring. The minimum damping factor is derived.

1468. Baccaredda, M.,
CRYSTALLINITY AND MECHANICAL DYNAMIC PROPERTIES OF HIGH POLYMERS, Chimica e l'Industria, Vol. 44, 1962, pp. 1383-1389.

Young's modulus, E, (determined through sound velocity measurements at medium frequencies) and internal dissipation, Q^{-1}, were measured at different temperatures for various types of polymers of C_2H_4, styrene, C_3H_6, 1-butane, HCHO, C_2F_4, and butadiene. The resulting diagrams show clearly first and second order transitions. E increases with the degree of crystallinity, but the contrary was observed for polyethylene at low temperatures. The influence of thermal treatments on crystallinity was studied for polyethylene terephthalate.

1469. Baker, G. S.,
DISLOCATION MOBILITY AND DAMPING IN LiF, Journal of Applied Physics, Vol. 33, May 1962, pp. 1730-1732.

Measurement of amplitude dependent dislocation damping in lithium fluoride bars to determine the relationship between the dislocation velocities below the yield stress and those present during plastic deformation.

1470. Baker, G. S.,
INTERNAL FRICTION OF LiF AND NaCl, Acta Metallurgica, Vol. 10, No. 4, April 1962, p. 448.

The amplitude dependence of dislocation damping and Young's modulus of lithium fluoride and sodium chloride were investigated. The damping behavior of the two crystals is essentially the same. The logarithmic decrement is small ($<10^{-4}$) at low-strain amplitudes and raises steeply at higher strain amplitudes. Periodic dislocation motion of 1000 b is seen at stress levels an order of magnitude below the macroscopic yield stress. At the higher strain amplitudes, the vibrations themselves cause changes in damping, both at the high-strain amplitudes and at subsequent low-strain amplitudes. The time dependence of these changes in damping was measured and is discussed in terms of Granato-Lücke theory and various types of pinnings. The decrease in damping upon high-strain amplitude damping in sodium chloride reported by Witworth was observed. This decrease in damping was accompanied by a decrease in modulus and an increase in low-strain amplitude damping.

1471. Baranova, V. I. and Golovin, S. A.,
EFFECT OF QUENCHING TEMPERATURE ON INTERNAL FRICTION AND ELECTRIC RESISTIVITY OF IRON-MOLYBDENUM ALLOYS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 14, 1962, pp. 296-298.

Internal friction, Q, and electric resistivity, ρ, of alloys containing a variable amount of molybdenum (0.78 percent to 8.37 percent) and 0.019 percent to 0.037 percent carbon were measured at various temperatures (room to

400°) after quenching samples from various temperatures (900° to 1300°). Alloys containing 1.02 percent to 3.67 percent molybdenum had a sharp peak caused by interstitial inclusion of carbon atoms in the alpha-iron lattice. This peak decreases with increase of molybdenum. Heating of iron-molybdenum alloy to 1050° caused transfer of carbon atoms into the solid solution, dissolving of carbides, and increase of the value of the low-temperature peak. Heating to temperatures greater than 1050° resulted in a noticeable transfer of carbon atoms into vacancies which formed.

1472. Barry Controls, Watertown, Massachusetts, PROTECTION OF MISSILE ELECTRONICS BY VIBRATION ISOLATION AND STRUCTURAL DAMPING TECHNIQUES by J. E. Ruzicka, 1962.

Design philosophies and experimental data are presented to illustrate the effectiveness of vibration isolators and viscoelastic-damped structural configurations in reducing the vibration experienced by missile electronic equipment.

1473. Battelle Memorial Institute, Columbus, Ohio, THE DYNAMIC BEHAVIOR OF HYPERCRITICAL-SPEED SHAFTS by J. E. Voorhees, C. C. Mellor, Jr., and R. G. Dubensky, Proceedings, Army Conference on Dynamic Behavior of Materials and Structures, Springfield Armory, Massachusetts, Army Research Office, 1962, pp. 150-169.

Not abstracted.

1474. Bauer, C. L. and Gordon, R. B., MECHANISM FOR DISLOCATION PINNING ON THE ALKALI HALIDES, Journal of Applied Physics, Vol. 33, 1962, pp. 672-682.

Changes in the elastic modulus and internal friction of plastically deformed rock-salt, caused by changes in the mean free length of oscillating dislocation segments, were observed during x-irradiation at temperatures ranging from 10° to 300° K. The rates at which the modulus and damping changes occur during irradiation are independent of temperature; but, during irradiation at helium temperature, the magnitude of the effects is smaller. This decrease in magnitude is due to the absence of thermal unpinning.

1475. Baxter, W. J. and Wilks, J.,
AN INTERNAL-FRICTION PEAK IN COPPER, Acta Metallurgica, Vol. 10, No. 2, February 1962, pp. 175-178.

This article interprets low-temperature internal-friction peaks in copper in terms of point defects. Whether these are vacancies or interstitials, or a combination, remains to be seen.

1476. Baxter, W. J. and Wilks, J.,
INSTABILITIES IN THE INTERNAL FRICTION OF SOME SPECIMENS IN COPPER, Philosophical Magazine, Vol. 7, March 1962, pp. 427-438.

Occasionally, a curious phenomenon has been observed when exciting copper beams in flexural modes of oscillation. At a certain value of the exciting force, the amplitude of the resonant oscillations varies rapidly by a factor of two with a period of the order of a second. This behavior appears similar to that previously reported by Takahashi. The instability is shown to be associated with a large discontinuous change in the amplitude of the internal friction when measured as a function of strain amplitude. A consideration of the present results indicates the existence of time-dependent effects in the pinning of dislocations by point defects, not hitherto reported.

1477. Beaulieu, C. E. and Dube, A.,
THE INFLUENCE OF AGING TEMPERATURE ON THE "KOSTER EFFECT" IN MARTENSITE, Canadian Metallurgical Quarterly, Vol. 1, No. 1, 1962, pp. 33-39.

The rates of recovery of internal friction and of modulus of rigidity in freshly quenched steel increase rapidly with the aging temperature. The experimental results can be at least partly explained by the theory of Granato and Lücke. A basis for a possible modification of the theory is suggested.

1478. Becker, V. H.,
ON THE ANALYTICAL DETERMINATION OF MATERIAL DAMPING DURING MECHANICAL OSCILLATIONS, PART I, Verein Deutscher Ingenieure Zeitschrift, Vol. 104, No. 2, 11 January 1962, pp. 49-59 (In German).

The conventional formulations for damping based on the proportionate rate of vibrations, produce results which often are not confirmed in practice. Modified formulae are derived to illustrate the factors and their relative influences on the damping of different types of systems of oscillation.

1479. Becker, V. H.,
ON THE ANALYTICAL DETERMINATION OF MATERIAL DAMPING DURING MECHANICAL OSCILLATIONS, PART II, Varein Deutscher Ingenieure Zeitschrift, Vol. 104, No. 4, February 1962, pp. 163-165.

The Bernoulli-Euler beam equation is modified by the addition of two terms, one proportional to external (viscous) damping and the other proportional to internal (viscous) damping. The resulting differential equation is solved, obtaining both amplitude and natural frequency as functions of the damping constants. An example illustrates the theory.

1480. Beguin, P.,
INFLUENCE OF DIFFERENT TYPES OF PLASTIC DEFORMATION ON DAMPING CAPACITY OF BRASS 70-30, Mémoires Scientifiques de la Revue de Métallurgie, Vol. 59, No. 5, May 1962, pp. 371-378.

Damping capacity of heat-treated, rolled, machined, and electrolytically polished 70-30 brass sheets as a function of the vibration amplitude during simple torsion and alternate torsion deformation; influence of the crystal structure and defects such as fissures, point defects, vacancies and dislocations in the deformation.

1481. Berbegal, J. M. B., de Andres Sanz, M. P., and Martorell, J. T.,
THE FIRST STAGE IN THE TEMPERING OF MARTENSITE IN CARBON STEELS, Inst. Hierro Acero, Vol. 15, 1962, pp. 85-102.

Steels containing 0.12 percent, 0.27 percent, and 0.85 percent carbon were quenched in water and cooled to liquid-nitrogen temperature. The changes in damping capacity and elastic modulus with temperature were measured with frequencies of 600 to 25,000 cps.

1482. Bernstein, B. T.,
ELASTIC PROPERTIES OF POLYCRYSTALLINE TUNGSTEN AT ELEVATED TEMPERATURES, Journal of Applied Physics, Vol. 33, No. 6, June 1962, p. 2140.

The velocity of compressional and shear waves in tungsten was measured at 10 mc/sec by a pulse echo technique. Compressional velocities could be measured up to 1800° C, but shear wave measurements were possible only up to 1280° C, due to excessive damping at higher temperatures. The results show a smooth decrease in velocity with temperature, except for an anomaly near 800° C. The adiabatic elastic constants are computed from the measured velocities.

1483. Berry, B. S.,
REVIEW OF INTERNAL FRICTION DUE TO POINT DEFECTS, Acta Metallurgica, Vol. 10, April 1962, pp. 271-280.

Considerations of principal point defects that cause internal friction (by a stress-induced ordering mechanism) in all cases where the introduction of the defects sets up local asymmetric distortions of the surrounding lattice. Categories in which the relaxation centers are believed to contain a single isolated or two interacting elementary point defects are analyzed, with the defects being an interstitial solute atom, a substitutional solute, a vacancy and a split self-interstitial. Published and experimental data are reviewed for face-centered-cubic, body-centered-cubic, and diamond-structure metals and alloys.

1484. Bieniek, M. P. and Freudenthal, A. M.,
FORCED VIBRATIONS OF CYLINDRICAL SANDWICH SHELLS, Journal of Aerospace Science, Vol. 29, No. 2, February 1962, pp. 180-184.

Formulas are developed for the solution of the title problem. The materials of the core and of the facings are assumed to be orthotropic and dissipative with linear stress-strain relations whose complex moduli are independent of the frequency. It is pointed out that this assumption not only leads to simpler equations but also to a better representation of the dissipative behavior of real materials.

1485. Birkenbiel, H. J. and Cahn, R. W.,
INDUCED MAGNETIC ANISOTROPY CREATED BY MAGNETIC AND STRESS ANNEALING OF IRON-ALUMINUM ALLOYS, Proceedings, Physical Society, Vol. 79, 1 April 1962, pp. 831-847.

Polycrystalline samples of five iron-aluminum solid solutions have been subjected to various heat treatments either in a strong magnetic field or under tensile stress. The maximum value of anisotropy occurs at 21 to 22 atomic percent aluminum. A variety of heat treatments have been employed to explore the inhibiting effect of spontaneous long- or short-range order on the development of induced anisotropy. This inhibiting effect is pronounced, and in stoichiometric Fe_3Al it is possible to prevent the creation of induced anisotropy almost completely. Such inhibition is to be expected if the induced anisotropy is caused by directional order. A close correspondence is observed between the composition dependence of induced anisotropy and that of the Zener internal friction.

1486. Bodner, S. R. and Fraser, A. F.,
VIBRATIONS AND WAVE PROPAGATION IN ALUMINUM ALLOYS AT ELEVATED TEMPERATURES, Transactions, Society of Rheology, Vol. 6, 1962, pp. 157-177.

Measurements of the dynamic modulus and damping of commercially pure aluminum (1100) and an aluminum alloy (2024-Tr) were obtained over a frequency range of 20 to 3500 cps at temperatures from 80° to 1100° F. For the small test oscillations, the results were found to be amplitude independent.

1487. Bordoni, P. G.,
DISLOCATION RELAXATION AT HIGH FREQUENCIES, Proceedings, Resonance and Relaxation in Metals, Chapter VI, American Society for Metals, 1962.

Not abstracted.

1488. Bratina, W. J.,
CONTRIBUTION OF THE RELAXATION MAXIMUM DUE TO OXYGEN IN ALPHA-TITANIUM, Acta Metallurgica, Vol. 10, No. 4, April 1962, p. 332.

This article investigates the internal friction maximum in alpha-titanium attributed to oxygen. He concludes that localized distortion by the substitutional solute atoms is responsible for the oxygen maximum. He shows that the width of the peak depends on the amount by which the specimen was oxidized.

1489. Bratina, W. J. and Mills, D.,
STUDY OF FATIGUE IN METALS USING ULTRASONIC TECHNIQUE, Canadian Metallurgical Quarterly, Vol. 1, No. 2, October-December 1962, pp. 83-97.

Study of the behavior of lattice imperfections, dislocations and interstitial atoms and their effects on fatigue properties of annealed (100° to 200° C for 24 hours) 1095 carbon steel and stress relieved 1050° F 4340 alloy steel. Basic mechanisms associated with cyclic and fatigue stressing are investigated using a megacycle frequency internal friction method (ultrasonic wave attenuation).

1490. Bratina, W. J. and Mills, D.,
EFFECT OF DISLOCATIONS ON THE ULTRASONIC WAVE ATTENUATION IN DEFORMED CARBON STEELS, Acta Metallurgica, Vol. 10, April 1962, pp. 419-422.

Study of the attenuation component in Armco iron and carbon steels before and after plastic deformation. An increase in damping associated with dislocation loop solute atom (interstitial) interaction is observed at low strain amplitudes at room temperature but only in previously cold worked material. The dislocation component of the attenuation increase approximately linearly with strain and falls off with time.

1491. Brown, N. and Ekvall, R. A.,
TEMPERATURE DEPENDENCE OF THE YIELD POINTS IN IRON, Acta Metallurgica, Vol. 10, November 1962, pp. 1101-1107.

Between 300° and 90° K the elastic limit and the anelastic limit were measured in polycrystalline irons using a high sensitivity extensometer. The elastic limit was independent of temperature but depended on purity. The anelastic limit depended on temperature and impurity content, but the decrease in temperature dependence with decreasing amount of impurity indicated that an ultra-pure iron should show no temperature dependence of the anelastic limit.

1492. Bruner, L. J. and Mecs, B. M.,
DISLOCATION DAMPING IN COPPER AFTER LOW TEMPERATURE PLASTIC DEFORMATION, Acta Metallurgica, Vol. 10, No. 4, April 1962, pp. 494-495.

A double torsion pendulum was used at liquid helium temperature to investigate the internal friction of plastically deformed copper. Annealing at room temperature after plastic deformation at low temperature increases the relaxation strength and shifts it to a higher temperature.

1493. Buehler, W. J. and Wiley, R. C.,
TiNi: DUCTILE INTERMETALLIC COMPOUND, American Society for Metals, Transactions Quarterly, Vol. 55, 1962, pp. 269-276.

X-ray diffraction, metallographic, mechanical, and internal friction data are given to show that the intermetallic compound TiNi exists at room temperature as a ductile and impact-resistant material with unique vibration-damping characteristics.

1494. Bungardt, K., Preisendanz, H., and Brandis, H.,
CONTRIBUTION TO THE ELASTOMECHANICAL BEHAVIOR OF IRREVERSIBLE IRON-NICKEL ALLOYS, DEW Technische Berichte, Vol. 2, No. 2, April 1962, pp. 59-71.

Experimental analysis of the elastomechanical behavior of iron-nickel alloys containing 82.74 percent to 90.68 percent iron and 9.21 percent to 17.14 percent nickel by internal friction measurements at -180° to 900° C under vacuum or

hydrogen atmospheres of 1 Torr pressure, and by microscopic analysis. Damping characteristics and modulus of shear as affected by temperature, cold work, and heat treatment.

1495. Bungardt, K., Preisendanz, H., and Horn, E., CORRELATIONS BETWEEN PHASE BOUNDARY REACTIONS, DIFFUSION PHENOMENA AND THE ELASTOMECHANICAL PROPERTIES OF ZIRCONIUM-NITROGEN-ALLOYS, Zeitschrift für Metallkunde, Vol. 53, No. 8, August 1962, pp. 495-503.

Zirconium wires are exposed to nitrogen partial pressures of 50×10^{-4} Torr at 850° to 1400° C and the damping characteristics, modulus of shear at -150° to 900° C and microstructure are determined. Correlation between internal friction and diffusion of nitrogen is explored.

1496. Bunn, P. M., Cummings, D. G., and Leavenworth, H. W., Jr., THE EFFECT OF ZIRCONIUM ON INTERNAL FRICTION IN COLUMBIUM, Journal of Applied Physics, Vol. 33, October 1962, pp. 3009-3013.

The effect of zirconium on internal friction in niobium has been investigated over the frequency range of 0.5 to 10 cps. An entirely new peak was observed which was attributed to the diffusion of oxygen in the vicinity of zirconium atoms. The normal niobium oxygen peak was not observed until approximately 0.14 percent by weight oxygen was added to the specimens. The normal niobium-nitrogen peak was readily observed, but a zirconium-nitrogen peak was not observed until oxygen concentration was reduced below 0.1 percent by weight. These observations are explained on the basis of a strong attraction between zirconium and oxygen atoms.

1497. Burbach, J. and Haasen, P., AGING KINETICS OF ALPHA-IRON FROM DAMPING MEASUREMENTS IN THE KILOCYCLE REGION, Physica Status Solidi, Vol. 2, No. 6, 1962, pp. 134-141.

The change in damping of iron containing 0.006 percent carbon was measured at about 1 kc/sec during aging at temperatures between 20° and 90° C. The specimens had been previously annealed and quenched and some deformed

plastically. The damping was amplitude independent and decreased with time. The damping is attributed to dislocation motion and the decrease in damping to the pinning of dislocations by carbon atoms which diffuse through the lattice.

1498. Bureau of Mines, Metallurgy Research Center, Rolla, Missouri,
VIBRATION DAMPING CAPACITY OF VARIOUS MAGNESIUM ALLOYS by D. F. Walsh, J. W. Jensen, and J. A. Rowland, 1962, BM-RI-6116, 20 pp.

A study of damping capacity was made on a number of magnesium-base alloys, commercial types, and experimental compositions. Hardness and tensile properties were determined, and the microstructure of each alloy was examined. Alloys of low yield strength, in general, possessed high damping ability. A correlation was established between damping capacity and composition.

1499. Butta, E. and Giusti, P.,
TRANSITIONS DEPENDENT ON MOLECULAR WEIGHT IN POLYSOBUTYLENE, Ricerca Sci. Rend., Sec. A., Vol. 2, 1962, pp. 362-371.

Samples of polyisobutylene of different molecular weights (6000 to 300,000) were tested for dynamic mechanical properties by an electrostatic dynamic method at frequencies of the order of 10^4 mc/sec and at temperatures ranging from -170° to zero. Samples of high-molecular-weight (80,000 to 300,000) behaved as completely amorphous polymers; the sound velocity (V) decreased almost linearly with increasing temperature, changing slope at about -68°. At this temperature a sudden increase in the damping factor was observed. Samples of low molecular weight (6000 to 15,000) showed two successive changes of slope, whose position depended on molecular weight. The damping factor was low and independent of temperature at a low temperature.

1500. California Institute of Technology, Grad. Aero. Lab.,
FORMULAS FOR THE DETERMINATION OF THE MATERIAL DAMPING OF A CYLINDRICAL SHELL BY THE DECAYING FREE VIBRATION; APPENDIX, APPROXIMATION FORMULAS FOR BESSEL AND HANKEL FUNCTIONS by H. Krumhaar, June 1962, AFOSR 2995, SM 62-31, 47 pp.

Not abstracted.

1501. Central Laboratory, TNO Delft, Netherlands,
MECHANICAL PROPERTIES OF HIGHLY FILLED ELASTOMERS by F. R. Schwarzl, July 1962, N62558-2822, AD-283-289.

Three experimental techniques are described, by means of which dynamic shear moduli and damping of filled rubbers may be determined within a frequency range from 0.1 to 100 cps, within a temperature range from -150° to 100° C and within a strain range from 0.001 percent to 0.5 percent shear. The preparation is described of polyurethane rubbers filled with different inert filler substances up to a volume content of 40 percent.

1502. Central Laboratory, TNO Delft, Netherlands,
MECHANICAL PROPERTIES OF HIGHLY FILLED ELASTOMERS, APPENDICES, July 1962, N62558-2822, AD-283-290.

This article reviews the experimental details of the preparation of polyurethane treatment of filler materials, and presents numerical data of dynamic mechanical measurements.

1503. Chadwick, P.,
THERMAL DAMPING OF A VIBRATING ELASTIC BODY, Mathematika, Vol. 9, Part 1, No. 17, June 1962, pp. 38-48.

A formal solution of the coupled thermoelastic equations representing small amplitude oscillations of an elastic body is obtained and applied to the modes of free vibrations of the body and to forced vibrations. Several results of Zener's theory are derived for thermal damping which are shown to agree with the normal mode analysis of subject paper. The solutions given by Pasler are discussed.

1504. Chambers, R. H. and Schultz, J.,
DISLOCATION RELAXATION SPECTRA IN PLASTICALLY DEFORMED REFRACTORY B.C.C. METALS, Acta Metallurgica, Vol. 10, No. 4, April 1962, pp. 466-483.

A study was made of thermally activated internal-friction relaxation peaks produced by plastic deformation of the body-centered cubic metals niobium, tantalum, molybdenum, and tungsten. Two broad peaks are produced by room-temperature deformation of niobium, tantalum, and molybdenum.

At least one peak of a similar nature is produced in tungsten deformed at 400° C. A study of the influence of prestrain, thermal history, and impurity concentration on the peak structure suggests that the dislocation mechanisms responsible for these peaks are in many ways similar to those producing the Bordoni peaks in copper and that strain aging is responsible for the relatively low-temperature annealing behavior exhibited by these metals.

1505. Chesapeake Instrument, Corporation, Shadyside, Maryland, DYNAMIC MECHANICAL PROPERTIES OF MATERIALS FOR NOISE AND VIBRATION CONTROL by E. Cook, J. A. Lee, and E. R. Fitzgerald, July 1962, NONR 267800, AD-285-029.

Shear characteristics presented in various tables include frequency, storage compliance, loss compliance, loss tangent, storage modulus, loss modulus, shear velocity and attenuation. Materials studied include polyisobutylenes, butadiene-acrylonitrile copolymers, miscellaneous materials such as damping materials, polyurethane, and adhesives.

1506. Chollet, P. and Crussard, C., KINETICS OF PRECIPITATION OF CARBON IN IRON-CARBON ALLOYS FOLLOWING ALPHA HARDENING, MEASURED BY INTERNAL FRICTION, Comptes Rendus, Vol. 255, 1962, pp. 917-919.

Measurements of internal friction made at Snoek's peak on iron-carbon alloys following alpha hardening show that the kinetics of the precipitation of carbon (characterized by the exponent, n, in the Wert and Zener law) and the apparent activation energy related to it may vary according to temperature and carbon content.

1507. Cincinnati University, INTERNAL FRICTION IN SUBSTITUTIONAL SOLID SOLUTIONS: THE COPPER-NICKEL SYSTEM by C. H. Baloun, 1962, Ph. D. Thesis.

Internal friction measurements using the torsion pendulum method were made on eleven alloys of copper and nickel. The alloys of low nickel content show only a monotonic increase of internal friction with increasing temperature which is due to plastic deformation along and through grain boundaries. The alloys of high nickel content show minima

in internal friction in the vicinity of the Curie point in agreement with theory. The alloys of intermediate-composition show several relaxation maxima.

1508. Clark, A. E. and Strakna, R. E.,
LOW-TEMPERATURE EXCESS SPECIFIC HEAT OF SiO_2 GLASS, Physics and Chemistry of Glasses, Vol. 3, No. 4, 1962, pp. 121-126.

A low-temperature ultrasonic attenuation associated with a structural relaxation occurs in fused silica. A specific defect, an elongated Si - O - Si bond with two equilibrium positions for the bridging oxygen atom, was suggested as a possible loss mechanism.

1509. Coenen, M.,
VIBRATION DAMPING AND STRUCTURE OF GLASSES IN SYSTEM LiF-BeF_2, Glastech. Ber., Vol. 35, 1962, pp. 425-431.

Droplets of BeF_2-containing glass are suspended in a matrix glass with 40 molecular percent LiF. Experiments from -50° to 400° show free mechanical vibrations (torsion frequency, three cycles per second) in the results of damping measurements. Both unmixing phases have freeze temperatures, 70° for droplet glass, 200° for the matrix.

1510. Coltman, R. R.,
REACTOR IRRADIATION STUDIES AT 4° K, Proceedings, Radiation Damage in Solids, Vol. 2, New York, New York, International Publications, Incorporated, 1962, pp. 205-229.

Copper, gold, tin, silver, aluminum, nickel, iron, zinc, magnesium, and bismuth are irradiated from 4° to 20° K by neutrons and gamma-ray using a helium cryostat in the reactor and isochronally annealed at 20° to 300° K to determine change in electrical resistivity, stored energy release, size, yield stress, damage rate, resonant frequency, Young's modulus, and internal friction.

1511. Columbia University, New York,
ANELASTIC-PLASTIC BEHAVIOR OF A FILLED ELASTOMER by R. A. Heller, R. D. Stoll, and A. M. Freudenthal, June 1962, Technical Report No. 13, NONR 266/78, 62 pp.

Not abstracted.

1512. Conte, R., Dreyfus, B., and Weil, L.,
PLASTIC TORSION OF IRON WHISKERS, Acta Metallurgica, Vol. 10, No. 12, December 1962, pp. 1125-1141.

Iron monocrystals in the form of hydrogen-reduced whiskers are tested in cyclic torsion at 20° to 300° K and subjected to irradiation by fast neutrons to relate dislocation phenomena and interaction with various point defects and imperfections to mechanical properties. Internal friction phenomena are analyzed in terms of the Granato-Lücke theory, and relaxation is considered in terms of the Mott-Nabarro theory.

1513. Crissman, J. M. and McCammon, R. D.,
APPARATUS FOR MEASURING THE DYNAMIC MECHANICAL PROPERTIES OF POLYMERIC MATERIALS BETWEEN 4° AND 300° K, Journal of Acoustical Society of America, Vol. 34, No. 11, 1962, pp. 1703-1706.

Measurements were carried out at frequencies in the mid-audio range. The apparatus uses either the free decay or bandwidth method of determining the internal friction, and values as low as 6×10^{-5} were obtained. Measurements from 20° to 130° K for polystyrene are reported.

1514. Crussard, C.,
STACKING FAULTS IN ALPHA IRON, Acta Metallurgica, Vol. 10, No. 8, August 1962, pp. 749-750.

Stacking fault formation accompanying the dissolution of dislocations in alpha-iron heat-treated at 200° to 300° C is related to the Suzuki, Cottrell, and Shroeck mechanisms; carbon and nitrogen absorption and precipitation; and internal friction contributions as a function of temperature.

1515. Dabosi, F.,
INFLUENCE OF THE PURITY ON SOME MAGNETIC PROPERTIES AND ON THE INTERNAL FRICTION OF Fe, Mémoires Scientifiques de la Revue de Métallurgie, Vol. 59, 1962, pp. 685-711 (II. pp. 784-799).

Influences of iron purity on magnetic structure were investigated. Armco and electrolytic iron were used. The influence of the mobility of imperfections and of the magnetic characteristics on the damping was determined by measurements of the internal friction of the metals.

1516. Dahlberg, P., Carnahan, R. D., and Brittain, J. O., DISLOCATION DAMPING IN MAGNESIUM OXIDE CRYSTALS AT LOW FREQUENCIES, Journal of Applied Physics, Vol. 33, No. 12, December 1962, pp. 3493-3498.

Amplitude dependent internal friction measurements were made on magnesium oxide crystals over the temperature range zero to 300° C at frequencies of about five cycles per second. Analysis of the temperature dependency of the critical breakaway strain, delineating the transition from amplitude dependent internal friction, permits an evaluation of the relative pinning strength of the iron ions.

1517. Damask, A. C., EFFECTS OF NEUTRON IRRADIATION ON NONFISSIONABLE ALLOYS, Proceedings, Radiation Damage in Solids, Vol. 2, New York, New York, International Publications Incorporated, 1962, pp. 3-19.

This paper investigates the effects of time, temperatures from -80° to 500° C flux, trapping-size concentration, activation energy, strain region and point defects on diffusion rate, electrical resistivity, ordering rate, and internal friction of alpha phase copper-zinc and copper-aluminum, iron-carbon, and iron-silicon irradiated by neutrons, electrons, and gamma particles.

1518. Dashkovskiy, A. I. and Savitskiy, Ye. M., TEMPERATURE FUNCTION OF INTERNAL FRICTION, YOUNG'S MODULUS AND SHEAR MODULUS OF ZIRCONIUM, NIOBIUM AND ZIRCONIUM-NIOBIUM ALLOYS, Proceedings, Metallurgy and Metallography of Pure Metals, New York, New York, Gordon and Breach, Science Publishers, Incorporated, 1962, pp. 218-227.

Torsion pendulum and flexural oscillations methods are used to study the internal friction, shear modulus, and Young's modulus of zirconium, niobium, and zirconium alloys containing up to 10 percent niobium from room temperature to 1100° C. Data are obtained indicating that the internal friction method may be used to observe and study phase transformation in metals and alloys and to check and plot phase diagrams.

1519. Dashkovskiy, A. I., Yevstyukhin, A. I., Savitskiy, Ye. M., and Skorov, D. M.,
TEMPERATURE FUNCTION OF INTERNAL FRICTION AND SHEAR MODULUS OF URANIUM, Proceedings, Metallurgy and Metallography of Pure Metals, New York, New York, Gordon and Breach, Science Publishers, Incorporated, 1962, pp. 228-232.

Wire uranium specimens are annealed at 630° to 960° C and tested by the low amplitude torsional oscillation method to determine internal friction and shear modulus at 20° to 900° C and changes in internal friction and shear modulus during allotropic transformations.

1520. David, R., Van der Loan, H. R., and Poulis, N. J.,
ATTENUATION OF LONGITUDINAL ULTRASONIC WAVES IN ALUMINUM AT LOW TEMPERATURES, Physica, Vol. 28, April 1962, pp. 330-342.

The attenuation of longitudinal ultrasonic waves at low temperatures has been measured in two very pure aluminum single crystals down to 0.4° K at frequencies between 5 and 35 MHz. As would be expected, no dependence on crystal orientation has been found. The ratio between the attenuations in the superconductive and the normal state proved to be slightly frequency-dependent.

1521. Day, D. E. and Rindone, G. E.,
PROPERTIES OF SODA ALUMINOSILICATE GLASSES, Journal, American Ceramics Society, Vol. 45, 1962, pp. 496-504.

The low- and intermediate-temperature internal friction peaks are caused by the stress-controlled movement of the sodium and nonbridging oxygen ions, respectively. There is close correlation between the temperature shift of the low-temperature peak and the activation energy for electric conduction.

1522. DeBatist, R.,
LOW-FREQUENCY MECHANICAL RELAXATION PEAKS IN COLD-WORKED BODY-CENTERED CUBIC METALS, Physica Status Solidi, Vol. 2, No. 6, 1962, pp. 661-667.

This article presents measurements of internal losses in niobium, tantalum, molybdenum, and tungsten using a

torsion pendulum method at 80° to 300° K. The loss peaks are attributed to point defect and dislocation line mechanisms.

1523. De Jong, M.,
THE ANISOTROPY OF THE ZENER RELAXATION, Acta Metallurgica, Vol. 10, No. 4, April 1962, pp. 334-335.

Two different mechanisms have been proposed to explain the Zener relaxation. In this discussion, the interpretation of the Zener relaxation in terms of the reorientation of pairs of solute is favored.

1524. Demina, E. L., Tai, T. F., and Bernshtein, M. L.,
THE EFFECT OF COLD WORKING AND ALLOYING ON THE MICROSTRUCTURE AND PROPERTIES OF NICKEL HEAT-STABLE ALLOYS, Issled. po Zharoproch. Splavam, Akad. Nauk SSSR, Inst. Met., Vol. 9, 1962, pp. 139-145.

Several alloy compositions containing nickel and chromium, cobalt, molybdenum, tungsten, titanium, and aluminum were studied. Internal friction increases with an increase in cold working and at high temperatures a shift in the internal friction curve toward a lower temperature indicates a decrease in relaxation time and a redistribution in viscosity coefficient.

1525. De Morton, M. E.,
MEASUREMENT OF NITROGEN DIFFUSION IN CHROMIUM BY ANELASTIC METHODS, Journal of Applied Physics, Vol 33, 1962, pp. 2768-2770.

The internal friction peak for nitrogen in dilute solution in very pure chromium occurs at 160° for approximately one cycle per second, but is unstable owing to partial precipitation of nitrogen. Interpretation of internal friction data at low frequencies and elastic aftereffect measurements in terms of the theory of Snoek gives the lattice diffusion rate of nitrogen in chromium as $D = 3 \times 10^{-4} \exp(-24,300/RT)$.

1526. Dillon, O W. Jr.,
AN EXPERIMENTAL STUDY OF THE HEAT GENERATED DURING TORSIONAL OSCILLATIONS, Jour. Mech. Phys. Solids, Vol. 10, 1962, pp. 244-253.

The heat generated during torsional oscillations of round aluminum tubes is reported. By twisting for many

cycles, easily measurable temperatures are produced. The structural insensitive nature of the particular test material was helpful in obtaining reproducible results. Static mechanical data for the material are also presented, and a correlation of mechanical and thermal energies is obtained.

1527. Douglas Aircraft Company, Incorporated, Long Beach, California,
SONIC FATIGUE DAMPING MATERIAL DEVELOPMENT by J. M. Sniker and P. R. McGowan, October 1962, NOW62-1071, AD-293-601.

Approximately 120 damping specimens were fabricated and strain gages attached. The damping ratios for these specimens are being determined. Four sets of adhesion panels were fabricated and are available for test. Four basic polymers were selected for evaluation and are on hand or are being acquired. A literature search was extended to assure inclusion of any data which have recently become available.

1528. Dunayev, F. N. and Yakovlev, G. P.,
INTERNAL FRICTION IN WELL-ORDERED IRON-NICKEL ALLOY, Izv. Akad. Nauk SSSR, Ser. Fiz., Vol. 26, 1962, pp. 284-287.

To investigate the dependence of internal friction on the orientation in the lattice for alloys with components having similar atomic dimensions, Permalloy 66 (Fe-Ni66) was chosen. To obtain an unordered condition, wires were heated in vacuo for two hours at 1000°, cooled to 600° at 200° per hour and from 600° to room temperature at 2° to 3° per second. To obtain an ordered state in the lattice, the wires were tempered for 16 hours at 450°. The nonferromagnetic part of the internal friction depends little on the orientation; the ferromagnetic part is very sensitive to the changes in orientation and to the frequencies of acceleration.

1529. Eby, R. K.,
EMPIRICAL RELATIONS OF THERMODYNAMIC "CONSTANTS", TO THE ACTIVATION PARAMETERS OF POLYMER RELAXATIONS, Journal of Chemical Physics, Vol. 37, 1962, pp. 2785-2790.

Experimental data are analyzed to show that for some polymer relaxations observed in dynamic mechanical

experiments, the activation enthalpy and entropy appear to follow a series of empirical relations. Also, the modulus and internal friction of polypropylene and polyoxymethylene are reported. Measurements made between -65° and 165° with longitudinal waves at a frequency of 12 mc/sec show relaxations to occur at 60° in polypropylene and at zero and 145° in polyoxymethylene.

1530. Eby, R. K. and Wilson, F. C.,
RELAXATIONS IN COPOLYMERS OF TETRAFLUOROETHYLENE AND HEXAFLUOROPROPYLENE, Journal of Applied Physics, Vol. 33, No. 10, 1962, pp. 2951-2955.

By means of ultrasonic and dielectric measurements, the modulus and internal friction of a series of copolymers of tetrafluoroethylene and hexafluoropropylene were measured with longitudinal waves at a frequency of 12 mc/sec between -80° and 260° C and the dielectric dissipation factor was measured at 0.1, 1.0, 10, and 100 kilocycles between -180° and 200° C. Samples included copolymers with compositions ranging from pure PTFE to pure polyhexafluoropropylene.

1531. Ehlers, F. E.,
RESPONSE OF INTERNALLY DAMPED BEAMS ON VIBRATING SUPPORTS, Journal of Acoustical Society of America, Vol. 34, No. 1, 1962, pp. 40-53.

The classical Euler beam equation is modified by introducing a hysteretic damping term which is proportional to the strain but which is in phase with the strain velocity. General solutions are obtained for the cantilever, clamped, and pin-supported beams whose supports are moved by a prescribed function of time.

1532. Einspruch, N. G.,
ULTRASONIC LOSS IN YTTRIUM IRON GARNET, Physics and Chemistry of Solids, Vol. 23, 1962, pp. 1341-1342.

The temperature dependence of the ultrasonic attenuation in polycrystalline yttrium iron garnet at 10 mc/sec was examined by the pulse-echo technique.

1533. Enrietto, J. F.,
COMPLEX DAMPING EFFECTS IN Fe-Mn-N ALLOYS, Transactions, American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), Vol. 224, 1962, pp. 1119-1123.

It is impossible to resolve the broad internal friction peaks observed in the iron-manganese-nitrogen system into a number of smaller peaks; this may be caused by the distribution of nitrogen between two types of lattice sites. The approximations of single relaxation times and two types of sites are too crude to yield results which are consistent with other measurements.

1534. Entwistle, K. M.,
ON THE DECAY OF VACANCIES IN ALUMINUM-COPPER ALLOYS MEASURED BY AN INTERNAL FRICTION METHOD, Acta Metallurgica, Vol. 10, April 1962, pp. 286-291.

The decay of vacancies in aluminum-copper alloys has been measured by an internal friction method. During isothermal aging of aluminum - four percent by weight copper - wires at 73° C, changes of internal friction at low frequencies are interpreted in terms of a migrating internal friction peak caused by stress-induced ordering of copper atoms.

1535. Entwistle, K. M.,
THE INTERNAL FRICTION OF METALS, Metallurgical Reviews, Vol. 7, No. 26, 1962, pp. 175-238.

The aim of this review is to give a general picture of the metallurgically interesting work on internal friction which has appeared during 1952-1962. Emphasis is laid on problems presented in the interpretation of internal-friction measurements in terms of structural processes giving rise to the energy loss.

1536. Escaig, B.,
INTERNAL FRICTION AT HIGH TEMPERATURES AND DIFFUSION OF VACANCIES BETWEEN DISLOCATIONS, Acta Metallurgica, Vol. 10, No. 9, September 1962, pp. 829-834.

A theory of amplitude independent internal friction arises from a vacancy diffusion mechanism between lattice

dislocations which absorb or emit the vacancies. This theory is developed and applied to polygonized structures and Frank arrays, using the Nabarro creep formalism.

1537. Ezzat, A.,
EXPERIMENTAL INVESTIGATION OF THE VIBRATION-ISOLATION CHARACTERISTIC OF SAWDUST, Experimental Mechanics, Vol. 2, No. 9, September 1962, pp. 274-277.

The principal objective of the investigation was to determine the suitability of ordinary, dry sawdust as a medium for isolating vibrations resulting from movement of machine parts and engine elements. It is concluded that the transmissibility of sawdust depends mainly upon the equivalent damping factor of the system.

1538. Falk, M., and Co., Limited, Great Britain,
THE MEASUREMENT OF THE PHYSICAL PROPERTIES OF MATERIALS IN A CONTROLLED ENVIRONMENT, 1962, Technical Communication-387, 8 pp.

Not abstracted.

1539. Fastov, N. S.,
THERMODYNAMICS OF IRREVERSIBLE DEFORMATION PROCESSES AND ITS APPLICATION TO VISCOUS FLOW OF SOLID BODIES, Probl. Metalloved. i Fiz. Metal., Inst. Metalloved i. Fiz. Metal, No. 7, 1962, pp. 117-133.

Unequilibrated states of solid bodies caused by uniform deformation and heating at constant rate (without temperature gradients) are discussed theoretically, and equations are derived. The application of these equations to damping of torsional vibrations of wire specimens shows that the value of logarithmic decrements of maximum damping (as a function of frequency and temperature) is by unity smaller than the value of relaxation time.

1540. Finkelshtein, B. N.,
THE INTERNAL FRICTION METHOD IN METALLURGY, Industrial Laboratory, Vol. 28, No. 5, December 1962, pp. 595-603.

Applications of the internal friction method for studying such metallurgical properties as modulus of elasticity, shear

modulus, creep, activation energies and diffusion coefficients. Design of several types of apparatus for testing wire, plate, and tensile specimens.

1541. Fischbach, D. B.,
THE ZENER RELAXATION AND A NEW MAGNETIC RELAXATION EFFECT IN IRON-RICH ALUMINUM ALLOYS, Acta Metallurgica, Vol. 10, April 1962, pp. 319-326.

The damping behavior of solid solutions containing 8 to 36 percent aluminum is investigated at 350° to 750° C using a torsion pendulum. A new magnetoelastic damping peak is observed near 600° C in alloys containing less than 22 percent aluminum. A mechanism involving the diffusion-limited stress-induced oscillation of magnetic domain walls anchored by magnetic directional ordering is proposed.

1542. Fitzgerald, T., and Truell, R.,
RADIATION EFFECTS IN NATURAL QUARTZ PHONON-PHONON INTERACTION CHANGES AND ANNEALING OUT OF DEFECTS, Acta Metallurgica, Vol. 10, No. 4, April 1962, p. 500.

In-reactor irradiation measurements of single crystal natural quartz were interpreted in terms of ultrasonic attenuation and velocity. Differences in attenuation before and after such irradiation were measured as a function of ultrasonic frequency (up to 1500 mc/sec) and temperature (down to 2° K). Phonon-phonon interaction at 500 mc/sec is described with particular regard to changes brought about by irradiation.

1543. Forest Products Laboratory, Madison, Wisconsin,
CALCULATION OF VIBRATION DAMPING IN SANDWICH CONSTRUCTION FROM DAMPING PROPERTIES OF THE CORES AND FACINGS by W. L. James, December 1962, 49 pp.

This paper predicts natural frequency and logarithmic decrement of free vibration in strips of structural sandwich from previously measured properties of the cores and facings.

1544. Forney, D. M., Jr. and Trapp, W. J.,
DAMPING MATERIALS PROBLEMS IN AEROSPACE ENVIRONMENTS, Proceedings, Institute of Environmental Sciences, 1962 Annual Technical Meeting, Mt. Prospect, Illinois, 1962, pp. 535-543.

Discussion of effects of vacuum, elevated temperatures, and radiation on metals and viscoelastic, damping polymers. Since an optimized damping system involves the effective coupling of both metallic materials of vehicle construction and viscoelastic damping polymers, any detrimental effect of space environments on the properties of either will seriously reduce the strength of the damping system as a whole.

1545. Forney, D. M. and Trapp, W. J.,
THE EFFECT OF AEROSPACE ENVIRONMENTS ON VIBRATION DAMPING TECHNIQUES AND MATERIALS, Soc. of Aerospace Mater. and Process Engr. National Symp. on Effects of Space Environment on Materials, St. Louis, May 1962, 24 pp.

Since an optimized damping system involves the effective coupling of both metallic materials of vehicle construction and viscoelastic damping polymers, any detrimental effect of space environments on the properties of either will seriously reduce the strength of the damping system as a whole. This is shown to be the case with each of the environmental parameters of concern.

1546. Forte, B.,
ON THE STRESS-STRAIN RELATION IN THE FORMAL THEORY OF ANELASTICITY, Nuovo Cimento, Vol. 24, No. 3, 1 May 1962, pp. 442-451.

This article examines the different consequences of physical interest in a theory of relaxation phenomena based on a linear differential relation between stress and strain of order higher than one.

1547. Franz, H.,
MECHANICAL DAMPING CAUSED BY MAGNETIC PROCESSES, Zeitschrift für Metalkunde, Vol. 53, January 1962, pp. 27-37.

Theory of magnetic damping as affected by frequency, stress amplitude, and magnetization is discussed for

ferromagnetic, antiferromagnetic, and piezoelectrical materials in terms of damping by magnetic-mechanical hysteresis and damping by micro and macro eddy currents.

1548. Fuji Iron and Steel Company,
STUDY OF INTERSTITIAL SOLUTE ATOMS IN IRON BY MEASUREMENT OF INTERNAL FRICTION by T. Ichiyama, Technical Report, Vol. 11, October 1962, pp. 352-360.

The theory and method of determination of internal friction are outlined and their uses for the studies of interstitial atoms, such as carbon and nitrogen, and their diffusion are described.

1549. Garber, R. I. and Mogilnikova, T. T.,
INTERNAL FRICTION AND PLASTIC DEFORMATION OF OVERSTRESSED MICROREGIONS IN A SOLID BODY. II, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 13, No. 5, 1962, pp. 735-737 (In Russian).

Superimposition of a monotonically increasing stress on freely decaying elastic vibrations brought about a considerable increase in the internal frictions of tin and lead specimens at room and liquid helium temperature. The experiments showed that this effect cannot be attributed to recrystallization during the internal friction measurements.

1550. Garber, R. I. and Mogilnikova, T. T.,
DETERMINATION OF THE ELASTIC LIMIT OF REAL SOLIDS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 13, 1962, pp. 314-316.

The elastic limit was determined by changes of damping at different stresses at room temperature for 110 grams per square millimeter of lead and 70 grams per square millimeter of tin.

1551. Garlanda, T. and Manza, G.,
THE TORSION PENDULUM IN THE STUDY OF POLYMER PROPERTIES, Materie Plastiche, Vol. 28, 1962, pp. 388-397.

A discussion of the torsion pendulum method for determining the dynamic properties of polymers.

1552. Gelli, D.,
A QUALITATIVE MODEL FOR AMPLITUDE-DEPENDENT DISLOCATION-DAMPING, Journal of Applied Physics, Vol. 33, No. 4, 1962, pp. 1547-1550.

This article proposes a two-mechanism model for dislocation damping. The first mechanism is due to movement of the vibrating dislocation inside the most dense region of the atmosphere. The second mechanism is due to the movement of dislocations in the low-d region of the atmosphere. Both mechanisms contribute an amplitude-dependent and an amplitude-independent component to the decrement.

1553. Gelli, D., Federighi, T., and Pieragostini, F.,
NEUTRON IRRADIATION EFFECTS ON DISLOCATION DAMPING IN COLD-WORKED ALUMINUM, Philosophical Magazine, Vol. 7, No. 82, October 1962, pp. 1791-1794.

This article investigates the internal friction and dynamic modulus measurements of rod specimens cold-worked by drawing to 40 percent reduction and irradiated with fast neutrons near room temperature. Large irradiation effects are observed, with changes in resonant frequency and logarithmic decrement being attributed to dislocation pinning by point defects introduced by bombardment. Depinning, vacancy interaction, and recovery phenomena are observed after isochronal annealing at 20° to 250° C.

1554. General Atomic, Division of General Dynamics, San Diego, California,
A PROGRAM OF BASIC RESEARCH ON MECHANICAL PROPERTIES OF REACTOR MATERIALS by T. A. Trozera, J. L. White, and R. H. Chambers, 10 November 1962, Summary Report GA 3585.

As part of a larger program, data were gathered on the damping of niobium and tantalum. A theory to interpret these data in terms of kink motions is proposed.

1555. Gerson, R.,
PIEZOELECTRIC AND DIELECTRIC PROPERTIES OF LEAD TITANATE ZIRCONATE CERAMICS AT LOW TEMPERATURES, Journal of Applied Physics, Vol. 33, 1962, pp. 830-833.

These properties of polarized lead titanate zirconate ceramics were measured between 4° and 77° K. The

materials retain strong piezoelectric activity at the lower temperature. The free relative dielectric constant of one type of ceramic was measured at one kilocycle, rose almost linearly from 380 at 4° K to 1300 at room temperature. The mechanical losses decreased sharply at low temperatures; this suggests a reduction in domain-wall mobility.

1556. Giannini Controls Corporation, Berwyn, Pennsylvania, DETAILED INSTRUCTIONS FOR THE USE OF PREVIOUSLY PUBLISHED DECAY-DAMPING RELATIONSHIPS by A. G. Fonda, April 1962, Report No. TR-02-002, 39 pp.

Not abstracted.

1557. Giannini Controls Corporation, Berwyn, Pennsylvania, PARAMETRIC ACCURACY STUDY OF A PREVIOUSLY PUBLISHED DECAY-DAMPING RELATIONSHIP by A. G. Fonda, December 1962, Report No. TR-02-003, 109 pp.

A method was previously published with algebraic proof, for the approximation of the "motion decay" coefficients of aeroelastic systems from their conventionally computed "required damping" coefficients. The present report compares results found by this method, for many combinations of conditions, with exact results found by otherwise less satisfactory methods. Recent refinements of the original technique are also presented. The decay-damping transformation extends the conventional "flutter solution" technique into a full predictor of classical system response.

1558. Gibbons, D. F., INTERACTION OF ACOUSTIC WAVES WITH CONDUCTION ELECTRONS, Proceedings, Resonance and Relaxation in Metals, Chapter XI, ASM, 1962.

Not abstracted.

1559. Gibbons, D. F. and Chirba, V. G., THE EFFECT OF PLASTIC DEFORMATION ON THE ATTENUATION OF ACOUSTIC WAVES IN LITHIUM FLUORIDE CRYSTALS, Acta Metallurgica, Vol. 10, No. 4, April 1962, pp. 484-488.

After deformations of approximately one percent in compression, the attenuation of lithium fluoride shows a large peak in the neighborhood of 65° K for a frequency of 80 kc/sec.

The attenuation in an undeformed crystal shows no such attenuation maximum. The position and activation energy depends upon the purity of the crystal. The maximum peak attenuation decreases with annealing at room temperature, and a five-minute X-irradiation from a 50 kilovolt-10 milliangstrom tungsten target completely removes the attenuation maximum.

1560. Gilman, J. J.,
DEBRIS DIPOLES AND LOW-TEMPERATURE INTERNAL FRICTION IN CRYSTALS, Philosophical Magazine, Vol. 7, No. 82, October 1962, pp. 1779-1782.

Edge dislocation dipoles, left as "debris" in the wake of moving screw dislocations, are suggested as accounting for the low temperature internal friction peaks (Bordoni peaks) appearing in crystals following plastic deformation. Phenomena observed for lithium fluoride crystals are compared with data observed for copper, aluminum, niobium, tantalum, molybdenum and tungsten. The Bordoni peaks are attributed to the flip-flopping of such dipoles.

1561. Gladwell, G. M. L.,
A REFINED ESTIMATE FOR THE DAMPING COEFFICIENT, Royal Aeronautical Society, Journal, Vol. 66, 1962, pp. 123-124.

In the "peak amplitude" method of resonance testing, a method is described for analyzing a peak assuming: (1) only a single resonant mode is involved, and (2) the contribution to amplitude from off-resonant vibration is constant in the neighborhood of the peak. The peak will then be symmetrical about the natural frequency. Hysteretic damping is assumed.

1562. Golovin, S. A. and Sarkisyan, D. A.,
DEFORMATION OF AGED LOW-CARBON STEEL, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 13, 1962, pp. 924-926.

The change of internal friction during deformation of aged low-carbon steel containing 0.09 percent by weight carbon and 0.04 percent by weight aluminum is studied by torsion methods of low-carbon steel were recrystallized at 620° for one hour and deformed by drawing to 5 percent, 30 percent, and 67 percent. Two maxima were observed at 40° and 200°.

1563. Goodman, L. E. and Brown, C. B.,
ENERGY DISSIPATION IN CONTACT FRICTION: CONSTANT NORMAL AND CYCLIC TANGENTIAL LOADING, Journal of Applied Mechanics, Paper No. 61-WA-29, Vol. 29, No. 1, March 1962, pp. 17-22.

Measurements of the energy dissipated per cycle and the hysteresis loop shapes have been found to agree well with the theory of Mindlin and Deresiewicz in the range investigated. The sphere diameter and the normal load appear as parameters only in the way demanded by the theory. In the range investigated energy dissipation appears to be primarily a surface phenomenon and not one due to material damping.

1564. Gordon, R. B.,
THE STUDY OF THE INTERACTION BETWEEN POINT DEFECTS AND DISLOCATIONS THROUGH INTERNAL FRICTION EXPERIMENTS, Acta Metallurgica, Vol. 10, April 1962, pp. 339-347.

The interpretation of dislocation damping effects in terms of a pinning model is reviewed. Internal friction data are applied to the study of the effect of plastic deformation on dislocations and of the phenomena of recovery, quench hardening and dislocation pinning by solute atoms and radiation-induced defects.

1565. Granato, A. V. and Stern, R.,
DISLOCATION DAMPING IN COPPER AT KILOCYCLE AND MEGACYCLE PER SECOND FREQUENCIES, Journal of Applied Physics, Vol. 33, September 1962, pp. 2880-2883.

A recent conclusion that the vibrating string model of dislocation motion cannot account for the magnitude of the observed amplitude-independent damping of kilocycle per second frequencies is shown to be not generally valid. In fact, it is shown that there are specimens for which the extrapolated values of the decrement from megacycle frequencies to 15 kc/sec are higher than any previously measured values at 15 kc/sec. This result shows that the model can easily account for the magnitudes observed in the kilocycle region, and contributes a substantial fraction, if not all, of the component of the damping at 15 kc/sec which can be removed by irradiation.

1566. Greguss, Pal.,
ULTRASONIC VIBRATIONS AND THEIR USE IN THE CHEMICAL INDUSTRY, Magy. Kem. Lapja., Vol. 17, 1962, pp. 494-505.

Not abstracted.

1567. Gridnev, V. N., Lotsko, D. V., Trefilov, J. I. and Chernenko, N. V.,
VARIATION OF THE PHYSICAL PROPERTIES OF TITANIUM ALLOYS AT 100-400°, Sb. Nauchn. Rabot Inst. Metallofiz., Akad. Nauk Urk. SSR, No. 15, 1962, pp. 192-200.

Titanium alloys exhibit anomalous variations of many physical properties at 100° to 400°. Titanium alloys containing aluminum 2.3 and 5, chromium 1.87 and 5, iron 2.2 and 5, tin 3 and 5 percent by weight, as well as titanium iodide and technical titanium (VT-1). The specimens were subjected to various degrees of deformation and then tested. Internal friction and shear modulus were determined by the torsional vibration method. All alloys exhibited a contraction in the 100° to 400° range. The effect increased with the amount of alloying elements and with the degree of previous information. A correlation was found between this effect and the hydrogen content of the alloy. No anomaly was observed in the temperature dependence of electric resistivity and internal friction.

1568. Gupta, D. and Weinig, S.,
INTERACTIONS BETWEEN INTERSTITIAL AND SUBSTITUTIONAL SOLUTES IN AN H.C.P. LATTICE, Acta Metallurgica, Vol. 10, No. 4, April 1962, pp. 292-298.

In the present investigation, binary and several dilute ternary alloys were studied. The internal friction peaks are attributed to a localized distortion of the octahedral sites caused by substitutional solute atoms.

1569. Harlow, R. G., Hinton, R., and Rider, J. G.,
A FREQUENCY MODULATION TECHNIQUE FOR THE MEASUREMENT OF INTERNAL FRICTION, Journal of Scientific Instruments, Vol. 39, December 1962, pp. 598-599.

A frequency modulation technique for the detection of small amplitudes of vibration involved in measurements of

internal friction is described and may be realized by using standard electronic equipment. This technique is particularly suitable for a laboratory where only limited facilities are available. An absolute optical method is used to calibrate the system and confirm its linearity.

1570. Hasiguti, R. R., Igata, N., and Kamoshita, G., INTERNAL FRICTION PEAKS IN COLD WORKED METALS, Acta Metallurgica, Vol. 10, April 1962, pp. 442-447.

Internal friction peaks appearing after cold rolling at room temperature are investigated in copper, silver, aluminum, nickel, titanium, zirconium, magnesium, cobalt, iron, and uranium at 77° to 300° K. Activation energies and frequency factors are obtained from peak shifts with possible mechanisms for the processes responsible for the peaks.

1571. Hatch, D. K. and Adams, C. H., VISCOELASTIC DAMPING, J. Brit. Shipb. Res. Assn., Vol. 17, No. 7, 1962.

The rheological properties of viscoelastic materials are described, and their application in isolating noise and vibrational energy in resonating structures is discussed. The damping mechanisms are briefly described. The effects of plasticizers, fillers, and copolymers on damping characteristics are discussed.

1572. Hayashi, S. and Miyajima, N., STUDIES ON THE VIBRATION CHARACTERISTICS OF QUAY WALLS, Rep. Trasnport Tech. Res. Inst., Tokyo, No. 46, February 1962, 21 pp.

This paper describes vibration tests on trestle-type piers, a gravity-type quay wall, and a cellular quay wall, undertaken to establish methods of design to withstand earthquakes. Measurements were taken during free vibrations following sudden release of the structure from applied force, and during vibrations forced by vibrators, by explosive charges set on the sea bottom, and by earthquakes.

1573. Hewitt, J.,
THE STUDY OF HYDROGEN IN LOW-ALLOY STEELS BY INTERNAL FRICTION TECHNIQUES, Hydrogen in Steel, Iron and Steel institute Special Report, No. 73, London, 1962, pp. 83-89.

Low alloy steel is tested by the internal friction method to determine the low temperature diffusion data for hydrogen and the amount of hydrogen present at temperatures less than 200° C in interstitial solution. Observations are confirmed by electrolytic induction of hydrogen, delayed failure test, weld cracking, and hairline cracking.

1574. Hikata, A., Chick, B., Elbaum, C., and Truell, R.,
ULTRASONIC ATTENUATION AND VELOCITY DATA ON ALUMINUM SINGLE CRYSTALS AS A FUNCTION OF DEFORMATION AND ORIENTATION, Acta Metallurgica, Vol. 10, April 1962, pp. 423-429.

Measurements of ultrasonic attenuation and velocity changes have been made simultanesouly and continuously during the room temperature tensile deformation of aluminum single crystals oriented for single slip and for "polyslip". Both longitudinal and shear waves were used at frequencies of 10 and 13 mc/sec. The observed changes in attenuation in the polyslip orientations were consistent with an explanation based on the number of equally favored slip systems in each case.

1575. Hoff, N. J.,
DAMPING OF THE VIBRATIONS OF A COILED SPRING DUE TO CREEP IN STRUCTURES, New York, Academic Press, Incorporated, 1962, pp. 355-373.

This is a study of the vibrations of a concentrated mass suspended from a coiled spring when the material of the spring is capable of deforming both elastically and in consequence of creep. Also included are calculations of the attenuation from energy considerations both for linear and nonlinear creep and the derivation of the differentail equations of motion for the general nonlinear case and solution through the use of Fourier series.

1576. Holmes, D. K. and Thompson, D. O.,
THE INVESTIGATION OF RADIATION DAMAGE USING MECHANICAL VIBRATIONS, Proceedings, Resonance and Relaxation in Metals, American Society for Metals, Chapter IX, 1962.

Not abstracted.

1577. Huntington, H. B. and Johnson, R. A.,
IMAGE FORCE INFLUENCE ON THE RELAXATION STRENGTH OF POINT DEFECTS, Acta Metallurgica, Vol. 10, No. 4, 1962, p. 281.

It is shown that image force considerations enhance the relaxation strength of a defect by a factor of about four. The determination of the d-field of a point defect is subtle and quite model-sensitive. Calculation of the d-field distortion for the "split" interstitial in a face-centered cubic lattice indicates that its magnitude, even with the enhancement of the image force, is rather small.

1578. Hutchison, T. S. and Rogers, D. H.,
DISLOCATION PINNING IN ALUMINUM AT LOW TEMPERATURES, Acta Metallurgica, Vol. 10, No. 4, April 1962, pp. 397-400.

Measurements of internal friction in pure aluminum at low temperatures and kilocycle frequencies revealed an attenuation maximum with amplitude at a temperature of about 47° K and strain amplitude of 2×10^{-6}. The maximum is attributed to a dislocation breakaway mechanism and is discussed in terms of an extension of the Granato and Lücke theory.

1579. Hutchison, T. S. and Rogers, D. H.,
ULTRASONIC DAMPING AT KILOCYCLE FREQUENCIES IN ALUMINUM AT LOW TEMPERATURES, Journal of Applied Physics, Vol. 33, No. 3, March 1962, pp. 792-799.

Measurements of 40 kc/sec acoustic damping in well-annealed polycrystalline, 99.996 percent pure aluminum in temperatures between 4.2° and 273° K are compared with theories of dislocation damping by Granato and Lücke and by Rogers. Two dislocations systems are indicated, both pinned by impurity atoms, with the average loop length of

the one greater than that of the other. An amplitude-dependent dynamic loss and an amplitude-dependent breakaway loss for the long-loop system, and the usual amplitude-dependent breakaway loss for the short-loop system are observed. The temperature dependence of various parameters important to the several types of damping is discussed, and limits to the values of the types are deduced for different temperatures. Electron-lattice damping is observed at temperatures below 60° K and is found to be larger than theory predicts.

1580. Ichikawa, R. and Tanikawa, T.,
EFFECTS OF ALLOYING ELEMENTS ON THE DAMPING CAPACITY OF CAST MAGNESIUM ALLOYS, Light Metals, Vol. 12, March 1962, pp. 69-74.

Influence of alloying elements, heat treatment, and temperature on damping capacity is measured by torsion pendulum at 20° to 350° C for cast binary and ternary magnesium alloys containing, silver, aluminum, bismuth, cadmium, copper, lanthanum, lead rare earth, antimony, silicon, tin, zinc, and zirconium; and for binary aluminum alloys containing copper, magnesium and silicon.

1581. Ikushima, A.,
INTERNAL FRICTION DUE TO DISLOCATION, Met. Phys., Vol. 8, May 1962, pp. 111-119.

Not abstracted.

1582. Illinois University, Urbana Engineering Experimental Station,
AN INVESTIGATION OF THE USE OF INTERNAL FRICTION TECHNIQUES IN THE STUDY OF DIFFUSION AND PHASE CHANGES IN METALS by C. Wert, April 1962, AFOSR 2573, AD-275-712.

The following work is described: (1) measurements of diffusion in the ferromagnetic alloy, iron-18 percent vanadium, (2) the Zener relaxation in ternary alloys, (3) diffusion of gases in hafnium and ytterbium, (4) metal-gas equilibrium and the niobium-nitrogen terminal solid solution, (5) precipitation in gold-nickel alloys, and (6) diffusion studies at high pressure.

1583. Illinois University, Urbana, Illinois
METAL-GAS EQUILIBRIUM AND THE NIOBIUM-NITROGEN SOLID SOLUTION by J. R. Cost and C. A. Wert, January 1962, AFOSR 2067, AD-273-232.

Not abstracted.

1584. Illinois University,
RESPONSE OF A LINEAR TWO DEGREE OF FREEDOM SYSTEM EXCITED BY TWO DISTINCT AND INDEPENDENT FREQUENCIES by J. A. Kasuba and W. J. Worley, November 1962, T&AM-237, 34 pp.

Not abstracted.

1585. Illinois University, Urbana, Illinois
THE INTERSTITIAL-DISLOCATION DAMPING INTERACTIONS IN COLUMBIUM by D. H. Boone, 1962, Ph. D. Thesis.

Cold-work peaks were found in niobium-nitrogen (also tantalum-nitrogen) alloys. The characteristics of the peak were found to be divided into two parts; a low nitrogen part, below 0.018 percent, and a high nitrogen part, above 0.018 percent. For the low nitrogen peak, the height was a linear function of initial nitrogen content while only slightly dependent upon the amount of deformation up to five percent. The characteristics of the high nitrogen peak were relatively insensitive to both nitrogen content and deformation.

The relaxation is pictured as occurring in clusters of interstitials around the dislocations. These clusters can interact with an externally applied stress by changing shape or orientation. The high relaxation strength is the result of the interaction of these interstitials in these clusters, and the increase in relaxation time is the result of a cluster's increase in size.

1586. Jacobsen, E. H.,
MICROWAVE ULTRASONICS, Acta Metallurgica, Vol. 10, No. 4, April 1962, p. 499.

Recent experiments show that is is possible to generate the propagate elastic waves in crystalline solids at microwave frequencies by means of the piezoelectric effect. The attenuation of such waves proceeds via anharmonic forces between atoms which couple energy irreversibly into other modes of the system.

1587. Jones, C. K. and Brown, C. S.,
THE GROWTH RATE DEPENDENCE OF THE INTERNAL FRICTION OF SYNTHETIC QUARTZ, Proceedings, Physical Society, Vol. 79, 1 May 1962, pp. 930-937.

Measurements were made of the mechanical Q as a function of crystal growth rate for five megacycles per second AT-cut shear plates from 4° to 400° K. A peak was found which was related to phonon-dielectric imperfection interactions.

1588. Kaufman, J. G.,
DAMPING OF LIGHT METALS, Materials in Design Engineering, Vol. 56, No. 2, August 1962, pp. 104-105.

Vibration decay is measured for wrought and cast aluminum alloys, aluminum powder metallurgy alloys, electrical conductor alloys and cast magnesium alloys. Effects of soft aluminum cladding on damping behavior were observed.

1589. Kekalo, I. B. and Livshits, B. G.,
DEPENDENCE OF INTERNAL FRICTION AND MODULUS OF RIGIDITY OF NICKEL ON MAGNETIC POLE, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 13, April 1962, pp. 599-608.

Annealed nickel rod is vibrated with a torsion pendulum and the internal friction is measured at constant and alternating magnetic poles. The magnetic peak and rigidity modulus are studied as function of magnetic polarity, pole strength, and frequency and amplitude of vibration.

1590. Kekalo, I. B. and Livshits, B. G.,
INFLUENCE OF MAGNETIZATION ON THE TEMPERATURE DEPENDENCE OF INTERNAL FRICTION IN NICKEL, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 13, January 1962, pp. 54-61.

This article presents an investigation and a tabulation of the influence of magnetic field intensities (9 to 250 oersteds) on the temperature dependence of internal friction in nickel wire at 10° to 440° C.

1591. Kekalo, I. B. and Livshits, B. G.,
NEGATIVE ΔG EFFECT AND MAGNETIC DAMPING CAPACITY OF NICKEL DEPENDING ON HEAT TREATMENT, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 14, 1962, pp. 223-230.

Not abstracted.

1592. Kennedy, A. J.,
ANELASTICITY, Processes of Creep and Fatigue in Metals, New York, New York, John Wiley and Sons, Incorporated, 1962, pp. 7-55, Chapter 2.

This chapter presents a mathematical analysis of the anelastic effects occurring in metals and solids in terms of the various viscoelastic models, such as the Voigt and Maxwell element and the Boltzmann superposition principle model. An examination is made of the phase differences existing between stress and strain when some damping mechanism is operative in the solid, as well as internal-friction distribution of relaxation time, temperature dependence of relaxation time, and temperature dependence of rate processes. Damping and internal-friction data are given for pure iron, aluminum - four percent copper - alloy, and alpha-brass.

1593. King, J. C. and White, D. L.,
A NEW HIGH FREQUENCY ULTRASONIC TRANSDUCER, Acta Metallurgica, Vol. 10, No. 4, April 1962, p. 499.

A new depletion layer transducer which is uniquely valuable for internal friction studies is described. It can generate extremely high frequency acoustic waves, perhaps beyond 30,000 mc/sec, and its frequency can be varied over a considerable range by the superposition of a direct current biasing electric field.

1594. Kline, D. E. and Sauer, J. A.,
RADIATION AND MOISTURE EFFECTS IN POLYMERIZED EPOXY RESINS, Transactions, SPE (Society of Plastics Engineers), Vol. 2, No. 1, 1962, pp. 21-24.

Upon absorption of 0.88 percent water by a Bisphenol A-based epoxy resin cured with m-phenylenediamine, the temperature at which the main damping peak and the

associated modulus drop is lowered by about 25°. Curing at elevated temperatures produced no appreciable differences in modulus or damping behavior. Irradiation of both unfilled and aluminum-filled resins shifts the onset of the main loss peak to lower temperatures by about 50° with changes in the modulus.

1595. Koehler, J. S.,
INTERNAL FRICTION AND DISLOCATIONS, Proceedings, Resonance and Relaxation in Metals, American Society for Metals, 1962, Chapter VII.

Not abstracted.

1596. Kofstad, P., Butera, R. A., and Craig, R. S.,
APPARATUS FOR CONTINUOUS RECORDING OF INTERNAL FRICTION, Review of Scientific Instruments, Vol. 33, No. 8, August 1962, pp. 850-853.

An internal friction apparatus based upon the principle of the torsion pendulum is described.

1597. Konobeevskii, S. T., Pravdyuk, N. F., Pokrovskii, Yu. I., and Vikhrov, V.,
EFFECTS OF NEUTRON IRRADIATION ON THE INTERNAL FRICTION OF METALS, Deistvie Yadern. Izluchenii na Materialy, Akad. Nauk SSSR, Otd. Tekhn. Nauk, Otd. Fiz.-Mat. Nauk, 1962, pp. 219-234.

The effect of irradiation was studied on copper, aluminum, and magnesium, and its effect on the modulus of elasticity of copper only. The effects on internal friction of the plastic deformation were studied on copper and that of fatigue on magnesium. Integrated flux of 2.0×10^{16} to 5.0×10^{20} nvt (neutrons per square centimeter) was used for irradiation. The number of fast neutrons with an energy of more than one million electron volts was 35 percent with respect to that of thermal neutrons. The temperature of the samples was equal to or less than 80° in the tests. The internal friction of all samples was measured at 20 to 200 kc/sec and stresses of 2 to 500 grams per square millimeter before and of 2 to 20,000 grams per square millimeter after irradiation.

1598. Koshkin, N. I. and Sheloput, D. V.,
ABSORPTION OF ULTRASOUND NEAR THE MELTING POINT OF POLYCRYSTALLINE PARAFFIN, Primenenie Ul'traakustiki k Issled. Veshchestva, No. 16, 1962, pp. 97-99.

A previously described method was used to investigate the temperature and frequency dependences of ultrasound absorption near the melting point of polycrystalline paraffin. The results are given in the form of curves at frequencies of 2 to 22.2 mc/sec. In this frequency range, ultrasound absorption is higher in the polycrystalline phase than in the liquid phase.

1599. Koster, W.,
DAMPING MEASUREMENTS AS AN AUXILIARY IN METALLURGICAL RESEARCH, Zeitschrift für Metallkunde, Vol. 53, 1962, pp. 17-26.

A summary of possibilities in metallurgical research offered by damping measurements is given. A detailed discussion is made of the following items: diffusion, Snoek-damping in body-centered cubic solid solutions, Zener-damping in face-centered cubic substitutional solid solutions, matrix atoms and foreign atoms interstitially dissolved in face-centered cubic alloys, phase transformations, grain boundary viscosity, and interfaces.

1600. Koster, W.,
DAMPING MEASUREMENTS AS A RESEARCH TOOL IN PHYSICAL METALLURGY, Zeitschrift für Metallkunde, Vol. 53, 1962, pp. 17-27 (In German).

This article presents the theory and application of damping measurements in metallurgical research. A detailed discussion is made of the following items: diffusion, Snoek-damping in body-centered cubic solid solutions, Zener-damping in face-centered cubic substitutional solid solutions, matrix atoms and foreign atoms interstitially dissolved in face-centered cubic alloys, phase-transformations, grain-boundary viscosity, and interfaces.

1601. Koster, W. and Haber, J.,
DETERMINATION OF THE SOLUBILITY OF CARBON IN IRON-TITANIUM ALLOYS WITH THE AID OF DAMPING MEASUREMENTS, Archiv für das Eisenhuttenwesen, Vol. 33, No. 1, 1962, pp. 23-26.

Samples of pure iron wire containing 0.2 to 3.9 percent titanium were carburized in a CO atmosphere at 1150° to a final content of 0.9 percent carbon. Maximum values of Snoek damping, with respect to temperature, half-width, and maximum height, do not vary from those for iron-carbon alloys without titanium. The phase boundaries of alpha-iron, alpha-iron + TiC, and alpha-iron + TiC + Fe_3C in the iron corner of the iron-titanium-carbon system were determined at 700°.

1602. Kroenmueller, H., Seeger, A., Jager, H., and Rieger, H.,
ELECTRIC, MAGNETIC, AND MECHANICAL STUDIES OF RECOVERY IN NICKEL, Physica Status Solidi, Vol. 2, No. 5, 1962, pp. K105-K111.

Quenched samples show the migration of interstitials in stage III. Magnetic and mechanical aftereffects measured in nickel irradiated at 20° indicate relaxation effects are explained in terms of anisotropic interstitial configurations.

1603. Kudryavtseva, L. A. and Panin, V. E.,
TEMPERATURE EFFECT ON INTERNAL FRICTION OF Cu-Al SOLID SOLUTIONS, Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 1962, pp. 93-98.

Two maxima were found: a small one at 280°, and a sharp large one at 520°. The first maximum is considered to be caused by the ordering of the alloy. The second maximum is due to grain-boundary effects. In alloys with 0.025 percent phosphorus there is a further maximum at approximately 70°, probably connected with diffusion of impurities. Annealing at a temperature of, or less than, 900° causes a sharp decrease of the second maximum.

1604. Kustova, A. V.,
THE EFFECT OF THE STRUCTURE OF THE SPACE GRID ON THE HYSTERESIS LOSSES IN RUBBER, Primeneniye Ultraakust, K Issled, Veshchestva, No. 16, AD-412-124, 1962, pp. 3-11.

This article examines the effect of the structure of the space grid on the hysteresis losses in rubber.

1605. Lazan, B. J.,
DAMPING PROPERTIES OF MATERIALS AND MATERIAL COMPOSITES, Applied Mechanics Review, Vol. 15, February 1962, pp. 81-88.

This article covers the microscopic and macroscopic investigation of materials including mild and alloy steel, magnesium and aluminum alloys, German silver, tantalum, plastic and other composites. Anelastic, viscoelastic, and magnetoelastic behavior are considered in terms of elastic hysteresis, grain size and structure, plastic behavior, and amplitude dependences.

1606. Lazan, B. J.,
STRESS-STRAIN-TIME RELATIONS FOR IDEALIZED MATERIALS, American Society for Testing and Materials, Special Technical Publication No. 325, 1962.

This article contains a general review of methods and mathematics of idealized models.

1607. Livshits, L. S., Panich, S. I., and Assonova, Ye. A.,
EFFECT OF ALLOYING ON THE CONCENTRATION OF SOLUTE CARBON IN FERRITE, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 13, 1962, pp. 572-576.

The internal friction method has been used to study the effect of alloying with various different concentrations of manganese, chromium, molybdenum, tungsten, vanadium, and niobium on variations in the concentration of carbon in solution in ferrite. It has been found that the concentration of solute carbon in alpha iron diminishes as the affinity of the alloying element to carbon, and its concentration in the steel, increase.

1608. Lomer, J. N. and Niblett, D. H.,
EFFECTS OF ELECTRON IRRADIATION ON THE INTERNAL FRICTION OF COPPER, Philosophical Magazine, Vol. 7, 1962, pp. 1211-1222.

Studies were made of the variations of the internal friction of pure copper after electron irradiation at about 100° K and room temperature. The results are interpreted in terms of the pinning of dislocation lines by point defects.

1609. Lomer, J. N., Mitchell, E. W. J., and Niblett, D. N.,
SOME EFFECTS OF ELECTRON IRRADIATION ON THE INTERNAL FRICTION OF COPPER, Proceedings, Radiation Damage in Solids, Vol. 1, International Publications, Incorporated, 1962, pp. 205-222.

The internal friction of 99.999 percent copper is measured at 100°, 400°, 200°, and 265° K before and after electron irradiation at both room and liquid-nitrogen temperatures. Measurements are also made during warm-up. Results in terms of theoretical concepts on irradiation damage.

1610. Lowell Industries, Incorporated, Boston, Massachusetts,
VIBRA-CHECK, 1962.

Vibra-Check is a scientifically engineered, chemically-compounded, and field-tested vibration-damping material for mounting machinery. It does not absorb liquids like felt, does not cold-form like rubber, and does not deteriorate like cork. In laboratory tests, Vibra-Check has eliminated up to 90 percent vibration.

1611. Lücke, K.,
DAMPING PHENOMENA CAUSED BY CRYSTAL IMPERFECTIONS, PARTICULARLY BY DISLOCATIONS, Zeitschrift für Metallkunde, Vol. 53, February 1962, pp. 57-71.

This article covers the systematic investigation of internal-friction phenomena as affected by crystal imperfections in terms of relations between nondimensional defects and diffusion, two-dimensional defects and grain-boundary viscosity, and the various effects of dislocations. Damping measurements are used for investigating the mechanism of irradiation damage and plastic deformation and subsequent recovery.

1612. Lysaght Central Research Laboratory,
PRELIMINARY STUDY OF INTERNAL FRICTION CHANGES AFTER COLD WORK AND AFTER SUBSEQUENT ANNEALING, 14 June 1962, Research Report No. 229.

This report investigates the changes in the internal friction, due to dislocation damping, after heavy deformations in irons and steels containing a range of carbon contents.

1613. Lysaght Central Research Laboratory,
RATE OF SOLUTION OF CARBIDES DURING SHORT TIME ANNEALING OF LOW CARBON STEELS, 4 January 1962, Research Report No. 239.

Internal friction measurements have been used to determine the rate of carbon solution from pre-existing carbides in commercially cold-reduced, capped, and semi-killed steels during abbreviated annealing cycles at 600° and 700° C.

1614. Makkay, R. W. and Fine, M. E.,
VACUUM REDUCTION OF α-Nb_2O_5 AT LOW TEMPERATURES, Journal of Applied Physics, Vol. 33, February 1962, p. 745.

Conduction and internal friction measurements performed on samples of α-Nb_2O_5 are discussed. A broad internal friction peak was observed at 50° C in an as-sintered specimen. This peak was not observed in another sample which was vacuum annealed for 132 hours at 125° C in vacuum after sintering. A peak was, however, observed at 35° C, and a shelf observed near 10° C indicates the presence of a third peak.

1615. Makkay, R. W., Geiger, G. H., and Fine, M. E.,
ELASTICITY AND INTERNAL FRICTION OF α-Fe_2O_3, Journal of Applied Physics, Vol. 33, March 1962, pp. 914-916.

Young's modulus and internal friction of natural crystals of α-Fe_2O_3 have been measured as functions of temperature in the region of the Morin transition with and without a 1570-oersted magnetic field. Nonelastic components of strain occur. These are probably due to stress-induced changes in the directions of the magnetization vectors.

1616. Maltseva, G. K. and Postnikov, V. S.,
INFLUENCE OF HEAT TREATMENT ON TEMPERATURE DEPENDENCE OF INTERNAL FRICTION OF BERYLLIUM BRONZE, Izvestiya-VUZ--Chernaya Metallurgiya, No. 7, 1962, pp. 146-150.

Copper wires with 1 to 19 percent beryllium traces of iron and nickel are subjected to torque bending after hardening at 800° C and annealing at 240° to 500° C. Formation of alpha-beta and alpha-gamma phases and their effects on intergrain displacements during torque bending are determined. Effects of hardening, annealing, and beryllium content on internal friction are discussed.

1617. Marquis, H., Dube, A., and Letendre, G.,
VARIATION OF INTERNAL FRICTION AND SHEAR MODULUS DURING TEMPERING OF QUENCHED STEELS, Mémoires Scientifiques de la Revue de Métallurgie, Vol. 59, 1962, pp. 119-126.

The shear modulus of quenched steels containing 0.02 percent to 1.25 percent carbon increases during tempering, first at less than 100° and then at 250° to 350°. Internal friction is decreased as the low-temperature treatment immobilizes stacking faults in the crystals.

1618. Martinet, B. and Goel, J. J.,
DETERMINATION OF STAGE OF RECOVERY OF WORK-HARDENED TUNGSTEN BY MEASUREMENTS OF YOUNG'S MODULUS AND INTERNAL FRICTION USING AN INVERTED PENDULUM, Helvetica Physica Acta, Vol. 35, No. 7-8, 1962, pp. 538-541 (In French).

After annealing, Young's modulus and internal friction of a tungsten wire were measured as functions of temperature. A wire subjected to a similar treatment after mechanical deformation of 3×10^{-3} showed a new peak in internal friction at 300° C. Other similar experiments are described.

1619. Martinet, B. and Secretan, B.,
MEASUREMENTS OF INTERNAL FRICTION AND OF YOUNG'S MODULUS OF VERY PURE ALUMINUM AT VERY LOW FREQUENCY AND AS A FUNCTION OF THE TEMPERATURE, Helvetica Physica Acta, Vol. 35, No. 4-5, 1962, pp. 266-272.

An inverted pendulum permits measurements, as a function of temperature, T, in the range 80° to 1000° K.

Measurements were made on polycrystalline aluminum (99.999 percent) wires. The wires were annealed for five hours at 720° K, and the experiments were made at 293° to 850° K. An internal friction peak was observed. This peak has been attributed to relaxation of stresses across the joints of grains; this seems to be confirmed by the absence of such a peak in single-crystalline samples.

1620. Mason, W. P.,
LOW FREQUENCY COMPONENT OF THE INTERNAL FRICTION OF SINGLE CRYSTAL COPPER AND ITS RELATION TO THE BORDONI PEAK, Acta Metallurgica, Vol. 10, No. 4, April 1962, pp. 461-465.

When a polycrystal is permanently strained by a few percent, an internal friction peak known as the Bordoni peak appears. According to the present theory, this is due to the nucleating loop, but the magnitude is larger than that for the Seeger theory on account of the multiple well model. The model agrees quantitatively with the measured results.

1621. Mason, W. P.,
HIGH-AMPLITUDE INTERNAL FRICTION AND ITS RELATION TO FATIGUE, Proceedings, Resonance and Relaxation in Metals, American Society for Metals, 1962, Chapter VIII.

Not abstracted.

1622. Matsushita, H., Hashida, T., and Fujishima, H.,
HIGH-FREQUENCY VIBRATION CHARACTERISTICS OF RUBBER. I. HIGH-FREQUENCY VIBRATION CHARACTERISTICS OF VARIOUS KINDS OF PURE GUM RUBBER, Nippon Gomu Kyokaishi, Vol. 35, 1962, pp. 769-773.

The propagation rate of longitudinal waves, absorption coefficient, dynamic Young's modulus, and loss factor for 12 kinds of vulcanized rubber consisting of natural and synthetic rubber at 100 to 2000 centipoise were measured by means of longitudinal-wave resonance method.

1623. Matusik, F. J.,
THE STUDY OF THE ANELASTIC BEHAVIOR AND INTERNAL FRICTION OF GLASS IN THE AUDIO FREQUENCY REGION BY TRANSVERSE VIBRATION TECHNIQUE, University Microfilms, Ann Arbor, Michigan, 1962, 179 pp.

Not abstracted.

1624. Maxwell, B. and Guimon, C.,
DYNAMIC MECHANICAL SPECTRA AND LIMIT OF LINEAR VISCOELASTICITY OF HIGH POLYMERS, Journal of Applied Polymer Science, Vol. 6, 1962, pp. 83-93.

Polymers tested were polyethylenes with varying degrees of branching, polypropylene, poly-1-butene, polystyrene, styrene-butadiene copolymer, styrene-acrylo-nitrile-methylstyrene terpolymer, cellulose acetate, cellulose acetate, cellulose acetate butyrate, and polycarbonate. Dynamic stress-strain curves, in-phase modulus, loss factor, stress limit, strain limit, linear viscoelastic limits, and ultimate strain were measured.

1625. McCrary, L. E. and Rogers, B. A.,
DAMPING PROPERTIES OF SOME COPPER-MANGANESE ALLOYS, Metall, Vol. 16, 1962, pp. 1074-1077.

The temperature dependence of the damping properties of copper-manganese alloys containing 72 percent to 92 percent manganese was determined, as well as the transition from the tetragonal to the cubic phase by resistance measurements. The results do not indicate that stress relaxation at twin boundaries is the principal cause of the high damping value of these alloys.

1626. McCrum, N. G.,
THE VARIATION OF INTERNAL FRICTION IN POLYCHLOROTRIFLUOROETHYLENE WITH DENSITY AND TEMPERATURE, Journal of Polymer Science, Vol. 60, 1962, pp. S3-S5.

One internal-friction peak centered at -40° (one cycle per second). A second peak centered at -10° originates in the amorphous region. The internal-friction peak at 100° is reduced as the decrement increases, supporting the dielectric evidence by which the relaxation is assigned to the amorphous region. There is a small subsidiary peak centered at 140° in high-decrement samples.

1627. McLean, D.,
MECHANICAL PROPERTIES OF METALS, New York, New York, John Wiley and Sons, Incorporated, 1962, 403 pp.

This book summarizes the knowledge that has been accumulated about the way in which the metallographic and defect structures of metals combine with the atomic forces to produce the observed mechanical properties. Of special interest are the chapters on imperfections in pure metals and anelasticity. In these chapters, the mechanisms by which materials dissipate energy are described and numerous experimental results are presented to illustrate the effect on internal friction of temperature, strain amplitude, heat treatment, and cold working.

1628. Mead, D. J. and Pretlove, A. J.,
AN EXPERIMENTAL INVESTIGATION OF THE DAMPING PROPERTIES OF AQUAPLAS UNDER RANDOM AND HARMONIC EXCITATION, ASD-TDR-62-336, March 1962, 43 pp.

The characteristics of the commercial damping treatment "Aquaplas F 102 B" were found by measurements of the vibration of a two-layer plate, covered on one side with the treatment. Linearity of the damping properties of the treatment was investigated and confirmed by a comparison of the plate vibration characteristics under both random and harmonic excitation. Consideration is then given to the reduction of bending stress in the skin when Aquaplas is applied to one side of the skin.

1629. Meitzler, A. H.,
SELECTIVE ATTENUATION OF ELASTIC WAVE MOTIONS IN STRIPS OF POLYCRYSTALLINE METALS, Journal of Acoustical Society of America, Vol. 34, April 1962, pp. 444-453.

Measurements of the attenuation of elastic pulses having 5 to 35 megacycle carrier frequencies and traveling in thin strips of polycrystalline aluminum have been made.

1630. Meland, T.,
FRICTIONAL PROPERTIES AND WEAR PROPERTIES OF PLASTIC MATERIALS, Tek. Ukeblad, Vol. 109, 1962, pp. 351-360 (In Norwegian).

The relation between the frictional properties and the macromol structure of plastic materials is discussed. The work of rolling friction is due to hysteresis losses. There is a connection between the relation between rolling friction and velocity and the relation between dynamic loss factor and frequency.

1631. Mendelsohn, K.,
EXPERIMENTAL WORK ON SUPERCONDUCTIVITY, IBM Journal of Research and Development, Vol. 6, January 1962, pp. 27-30.

A statistically disordered single crystal of tantalum wit 30 percent niobium is investigated. Work on specific heats, ultrasonic attenuation, and on the behavior of thin superconductive films is presented.

1632. Midwest Research Institute, Kansas City, Missouri,
RESEARCH ON PANEL FLUTTER by E. F. E. Zeijdel and D. R. Kobett, Progress Report No. 1, 1962, 10 pp.

Not abstracted.

1633. Miller, D. R.,
INTERNAL FRICTION OF TITANIUM AND ITS ALLOYS, Transactions, Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), Vol. 224, April 1962, pp. 275-281.

Internal friction and elastic modulus variations in electrorefined and iodide refined titanium and alloys of the latter with oxygen, nitrogen, aluminum, and zirconium are investigated at 20° to 800° C. An anomaly in the variation of rigidity modulus with temperature is observed with analysis of dislocation, creep, stress relaxation, and diffusion phenomena.

1634. Miller, R. D. and Day, E. E.,
LOW TEMPERATURE DAMPING QUALITIES OF STEEL AND ALUMINUM DETERMINED WITH FOIL STRAIN GAGES, Current Engineering Practice, Vol. 4, March 1962, pp. 1-4.

The damping capacity of SAE 1020 steel and 6063-T5 aluminum is measured by resistance-foil strain gages from -250° F to room temperature. A study is made of effects of temperatures on the gage factor, logarithmic decrement, amplitude of vibration frequency.

1635. Minaeva, K. A.,
MEASUREMENT OF INTERNAL FRICTION IN SINGLE CRYSTAL FERROELECTRICS BY THE COMPOUND VIBRATOR METHOD, Kristallografiya, Vol. 7, 1962, pp. 425-428.

The logarithmic decrement of damping, δ, and the elastic compliance constant, s_{33}, of single crystal triglycinesulfate were obtained as a function of temperature from 40° to 54° by the compound vibrator method.

1636. Minnesota University,
ON THE ZENER EFFECT IN ALLOYS. I. THE SIZE FACTOR by J. M. Sivertsen, September 1962, Technical Report No. 6, Contract Nonr 710-29.

Not abstracted.

1637. Morawiec, H. and Joszt, K.,
EFFECT OF STRUCTURE ON THE ATTENUATION OF ULTRASONIC WAVES IN Cu AND ITS ALLOYS, Prace Inst. Hutniczych., Vol. 14, No. 1, 1962, pp. 55-62.

Attenuation coefficients of elastic waves in aluminum, copper, brass, and aluminum brass were measured by means of an ultrasonic defectoscope. The attenuation coefficient increases with grain size and with variety of grain size.

1638. Morse, R. W.,
ULTRASONIC ATTENUATION IN SUPERCONDUCTORS, IBM Journal of Research and Development, Vol. 6, January 1962, pp. 58-62.

The ultrasonic attenuation in metals arising from direct interaction of the elastic waves and conduction electrons and

the physical variables on which it depends are reviewed. The drop in attenuation of longitudinal waves on entering the superconducting state is in good agreement with BCS theory, the various factors combining to make the relative attenuation depend only on the energy gap.

1639. Muss, D. R.,
DEFECT PRODUCTION, INTERNAL FRICTION, AND YOUNG'S MODULUS IN IRRADIATED TUNGSTEN, Dissertation Abstracts, Vol. 22, 1962, p. 4059 (Thesis, 1961, University Microfilms, Order No. 62-901, 141 pp.).

The effect of 10 to 14 million electron volts deuteron irradiation on tungsten is studied experimentally. Two aspects of this problem are examined. The first is a study of the incident deuteron energy dependence of defect production; the second is a study of the effect of radiation-induced defects.

1640. Muss, D. R. and Townsend, J. R.,
INTERNAL FRICTION AND YOUNG'S MODULUS IN IRRADIATED TUNGSTEN, Journal of Applied Physics, Vol. 33, May 1962, pp. 1804-1807.

Measurements of internal friction and Young's modulus as a function of temperature and 13.7 million electron volts deuteron bombardment flux are reported for polycrystalline tungsten. A dislocation-relaxation peak is observed in the curve of internal friction as a function of temperature. The peak height is found to be reduced by irradiation.

1641. Naguszewski, B. and Ciringione, J. L.,
DEVELOPMENT OF A TORSIONAL VIBRATION DAMPER TESTING MACHINE, Proceedings, American Society of Mechanical Engineers Meeting 15-19 April 1962, Paper 62-PGP-7, p. 11.

This paper describes a method of evaluating the damping constant of an untuned torsional viscous damper with the use of a two-mass damper testing machine.

1642. National Aeronautics and Space Administration, ON SCALING LAWS FOR MATERIAL DAMPING by S. H. Crandall, December 1962, TN D 1467, 25 pp.

Similarity analyses were made to provide scaling laws which indicate the effects of amplitude, frequency, and material properties on the resonant damping experienced by structural elements when the damping is due to internal material properties. Two nonlinear damping "laws" are considered. Correlations provided by the scaling laws were performed on data from a large number of tests with steel, brass, and aluminum cantilever beams.

1643. National Aeronautics and Space Administration, AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE NATURAL FREQUENCIES AND MODE SHAPES OF A FOUR-STAGE SOLID-PROPELLANT ROCKET VEHICLE by S. A. Leadbetter, V. L. Alley, Jr., R. W. Herr, and A. H. Gerringer, August 1962, TN D-1354, 42 pp.

This report presents the results of a combined experimental and analytical investigation of the natural frequencies, mode shapes, and damping of a four-stage solid-propellant rocket vehicle. The fuel mass and fuel damping were simulated. The results of a study of the effects of joint stiffness are given.

1644. Naydenko, O. K. and Petrov, P. P., TYPES OF VIBRATION ISOLATION MOUNTS, Joint Publications Research Service, Washington, D. C., JPRS-21021, 1962, pp. 160-199 (From Book Amortizatsiya Sudovykh Dvigateley i Mekhanizmov, Leningrad Union Publishing House for the Shipbuilding Industry).

Not abstracted.

1645. Northwestern Technological Institute, Evanston, Illinois, AN INTERPRETATION OF THE ANOMALOUS INTERNAL FRICTION IN COLD-WORKED Ai-Cu ALLOYS OBSERVED BY Kê by R. D. Carnahan and J. O. Brittain, March 1962, Technical Report No. 4, NONR-1228/17/, 10 pp.

Not abstracted.

1646. Northwestern Technological Institute, Evanston, Illinois, DISLOCATION DAMPING IN MAGNESIUM OXIDE CRYSTALS AT LOW FREQUENCIES by P. Dahlberg, R. D. Carnahan, and J. O. Brittain, 26 April 1962, Technical Report No. 5, Contract NONR 1228(17), NR 032-464, 21 pp.

Amplitude dependent internal friction measurements have been made on magnesium oxide crystals over the temperature range of zero to 300° C at frequencies of approximately five cycles per second. Analysis of the temperature dependency of the critical breakaway strain, delineating the transition from amplitude-independent to amplitude-dependent internal friction, permits an evaluation of the relative pinning strength of the Fe^{2+} and Fe^{3+} ions.

1647. Nowick, A. S.,
RESONANCE AND RELAXATION PHENOMENA, Proceedings, Resonance and Relaxation in Metals, American Society for Metals, 1962, Chapter 1.

Not abstracted.

1648. Nowick, A. S. and Berry, B. S.,
THE ZENER RELAXATION AS A DISTRIBUTION OF RELAXATION TIMES, Acta Metallurgica, Vol. 10, April 1962, pp. 312-318.

The functional form and width of the distribution of relaxation times have been determined for the Zener relaxation in a silver-30 percent zinc alloy. The results indicate that a major part of the distribution of relaxation times is due to a distribution of the activation energies. Finally, an attempt is made to interpret the distribution of activation energies in terms of local concentration fluctuations in the solid solution.

1649. Ogawa, T.,
INTERNAL FRICTION OF CdS CRYSTAL CAUSED BY PHOTOCONDUCTIVITY, Physical Society of Japan, Journal, Vol. 17, No. 2, February 1962, pp. 400-401.

Equations are derived for mechanical loss and sound velocity in terms of elastic, piezoelectric, dielectric, and conductivity constants. The equations are used to interpret the change of mechanical loss and sound velocity in cadmium sulfide with light intensity.

1650. Ono, R. and Komatsu, N.,
DYNAMIC VISCOELASTIC PROPERTIES OF TIRE CORDS I. BEHAVIOR AT LOW AMPLITUDE, Sen-i Gakkai Shi, Vol. 18, 1962, pp. 15-21.

Dynamic viscoelastic properties in relatively low amplitude (0.30 percent elongation) and low frequency (12.1 cps) have been measured for several tire cord samples prepared under various spinning and twisting conditions.

1651. Panseri, C., Federighi, T., and Gelli, D.,
EFFECT OF QUENCHING ON ROOM-TEMPERATURE DISLOCATION DAMPING IN ALUMINUM, Nuovo Cimento, Supplement 26, 1962, pp. 23-39.

Specimens were single crystals and also polycrystalline rods of 99.995 percent pure aluminum. The rods were annealed for eight hours at 630° and cooled in the furnace. They were quenched in salt water at 20° from a small cylindrical sheath extended from the furnace. The principal effects of quenching are to make the vibration decrement less amplitude dependent and even independent for high quenching temperatures, to increase the independent component, to decrease the frequency of resonance of the specimen and its elastic modulus.

1652. Pare, V. K., Thompson, D. O.,
TEMPERATURE DEPENDENCE FROM 250-370 K OF DISLOCATION PINNING IN COPPER SINGLE CRYSTALS BY RADIATION DEFECTS, Acta Metallurgica, Vol. 10, April 1962, pp. 382-389.

Measurements of internal friction and modulus defects at 15 kc/sec are used to study the pinning of dislocations in copper crystals by fast-neutron-induced defects. A delay time distribution for the pinning defects is observed, with the process governed by a single activation energy.

1653. Parfitt, G. G. and Lambeth, D.,
THE DAMPING OF STRUCTURAL VIBRATIONS, Aero. Res. Counc., CP 596, 1962, 17 pp.

The report describes a study of backed damping layers and related treatments for application to metal beams and panels to damp out mechanical vibration. The basic theory

of a backed layer, or damping tape, is summarized, and the design of a tape is discussed.

1654. Pedinoff, M. E.,
ABSORPTION OF ULTRASONIC WAVES IN PURE METHYLCYCLOHEXANE, Journal of Chemical Physics, Vol. 36, 1962, pp. 777-783.

The ultrasonic-pulse technique was extended to lower frequencies by the use of solid dielectric transducers and was used to determine the anomalous absorption of sound in methylcyclohexane at 150 to 3500 kc/sec. Extensive sound absorption was attributed to the irreversible perturbation of an equilibrium between two of the rotational isomers by the sound wave.

1655. Pennsylvania University, Philadelphia, Pennsylvania,
TEMPERATURE DEPENDENCE OF THE YIELD POINTS IN IRON by R. A. Ekvall and N. Brown, February 1962, Technical Report, Contr. Nonr 551-20.

Not abstracted.

1656. Petarra, D. P.,
INTERNAL FRICTION IN IRON AT TEMPERATURES IN THE RANGE 0 DEGREES TO 500 DEGREES AT FREQUENCIES NEAR 1 c/s, University Microfilms, Order No. 62-3842, 150 pp. (Dissertation Abstracts, Vol. 23, 1962, p. 1399).

The primary observations consisted of the relationship between the height of the cold-work and Snoek internal friction peaks, and the annealing behavior of the background damping. Also, during the course of this investigation, three intermediate internal friction peaks were observed in the temperature range between the Snoek and cold-work peaks.

1657. Petarra, D. P. and Beshers, D. N.,
CORRELATION BETWEEN THE COLD-WORK PEAK AND THE SNOEK PEAK IN THE IRON-NITROGEN AND IRON-CARBON SYSTEMS, Acta Metallurgica, Vol. 10, No. 4, April 1962, p. 449.

The height of the cold-work internal-friction peak in iron was studied as a function of solute content for the iron-nitrogen and iron-carbon systems, with varying amounts of

cold work. The height of the cold-work peak increases linearly with increasing solute concentration; the rate of increase depends upon the degree of cold-work.

1658. Pirson, A. and Wert, C.,
THE ZENER RELAXATION IN TERNARY Au-Ag-Zn ALLOYS, Acta Metallurgica, Vol. 10, April 1962, pp. 299-304.

Well-formed Zener damping peaks have been observed in ternary alloys of gold, silver, and zinc. The relaxation strength across the ternary along a line of constant zinc concentration of 15 atomic percent goes through a maximum at about an equal ratio of gold to silver. The relaxation strength at low concentration of zinc for an alloy of equal ratio of gold to silver increases at the square of the zinc concentration, as is true for binary alloys.

1659. Pisarenko, G. S.,
DISSIPATION OF ENERGY IN MECHANICAL VIBRATIONS, Kiev, Izd-vo Akad. Nauk SSSR, 1962, 435 pp. (In Russian).

This monograph is divided into two main parts. The first part summarizes what is known about the physics of energy dissipation in structural materials. The second part of the book applies the asymptotic methods of Krylov-Bogoliubov to the analytical solution of various structural damping problems, including beams, turbine blades and plates.

1660. Pisarenko, G. S., Editor,
PROBLEMS ON THE DISPERSION OF ENERGY DURING VIBRATION OF ELASTIC SYSTEMS, Institute of Metalceramics, Akad. Sci., USSR, 1962, 223 pp. (In Russian).

This book contains articles by more than twenty authors on various aspects of damping in materials and structures.

1661. Plenard, E.,
CAST IRON DAMPING CAPACITY. STRUCTURE AND PROPERTY RELATIONS, Centre Techniques Ind. Fonderie, Paris, Intern. Foundry Congr., Congr. Papers, 29th Detroit, 1962, pp. 298-305.

The damping capacity of cast iron containing graphite in flake form is greatly improved by a higher cooling rate

on solidification, an increase in carbon equivalent, and the presence of martensite in the matrix. It seems to diminish as the phosphorus rises; iron-silicon, silicon-calcium, and silicon-manganese-zirconium inoculations make the damping capacity of cast iron less dependent on thickness, but the inverse applied to inoculations with zirconium. It was noted that the damping capacity of the grades of cast iron examined varied within wide limits; maximum values 150 times greater than the minimum were observed for cast iron containing graphite in flake form, six times greater for cast iron containing graphite in spheroidal form, and three times greater for malleable cast iron, in the case of damped lateral vibrations.

1662. Plenard, E.,
ROLE OF GRAPHITE IN GRAY CAST IRON SUBJECTED TO STRESS TESTS, Fonderie, No. 191, January 1962, pp. 1-14.

Young's modulus, internal stress, and stress transmission were measured as functions of graphite structures in gray cast iron and XC38 Armco iron containing also pearlite, martensite, austenite, troostite, and sorbite. Tables include Young's modulus, damping capacity, elongation, and internal stress, as well as energy-deformation diagrams for cast iron samples.

1663. Plenard, E.,
CAST IRON DAMPING CAPACITY STRUCTURE AND PROPERTY RELATIONS, Modern Castings, Vol. 41, May 1962, pp. 144-151.

This article investigates effects of structural factors, mechanical properties, and measurement variables such as frequency and intensity of the vibration and nature of stresses on damping capacity.

1664. Plenard, E.,
RELATION BETWEEN DAMPING CAPACITY, STRUCTURE, AND DIVERSE MECHANICAL PROPERTIES OF CAST IRON, Fonderie, No. 201, November 1962, pp. 389-403.

Damping capacity of various gray iron samples is discussed as a function of vibration amplitude, load, frequency, internal stress, cooling rate, heat treatment temperatures from 200° to 900° C and carbon, silicon, and phosphorus

content. Correlation is established between damping capacity and mechanical properties and alloy content.

1665. Plenard, E.,
DAMPING CAPACITY OF CAST IRON, Machine Moderne, Vol. 56, No. 645, December 1962, pp. 29-37.

Relationship of damping capacity to testing parameters and mechanical properties for gray, white, and malleable cast irons, steels, aluminum, nickel, copper, and Armco iron.

1666. Ponomarev, I. F. and Rozhdestvenskii, S. S.,
STUDY OF THE HEAT RESISTANCE OF HYDRATED CEMENTS AT LOW TEMPERATURES BY A RESONANCE METHOD, Tr. Novocherk. Politekhn. Inst., Vol. 129, 1962, pp. 35-44.

The resonance characteristics observed were the value of the dynamic elasticity modulus and the logarithmic quenching decrement (internal friction). Specimens of slag, portland cement, and three laboratory-prepared portland cements were studied. The optimum water content can be determined from the internal friction, where maximum strength will correspond to minimum internal friction.

1667. Postnikov, V. S.,
INTERNAL FRICTION AND STRENGTH, Tsiklicheskaya Prochnost Metal., Akad. Nauk SSSR, Inst. Met., Materialy Vtorogo Soveshch. po Ustalosti Metal., Moscow, 1962, pp. 207-217.

The dependences of the internal friction, Q^{-1}, and the strength, σ, on the temperature at high temperatures were studied and correlated. The Q^{-1} versus composition and σ versus composition isotherms of 17 binary systems were analogous at high temperatures, 0.5 to 0.8 melting point. This parallelism between Q^{-1} and σ was further confirmed with six alloys based on nickel.

1668. Postnikov, V. S., Zolotukhin, I. V., and Gorshkov, G. A., STUDY OF MECHANICAL AND THERMAL FATIGUE IN METALS BY THE METHOD OF INTERNAL FRICTION, Tsiklicheskaya Prochnost Metal., Akad. Nauk SSSR, Inst. Met., Materialy Vtorogo Soveshch. po Ustalosti Metal., Moscow, 1962, pp. 218-226.

The internal friction, Q^{-1}, was correlated with the mechanical and thermal fatigue of polycrystalline and coarse-crystalline cadmium, zinc, aluminum, and gold. Cyclic deformation of polycrystalline cadmium, zinc, and aluminum eliminated the maximum in the Q^{-1} versus temperature plots.

1669. Powles, J. G. and Mansfield, P., MOLECULAR MOTION IN POLYPROPYLENE BY PROTON SPIN-LATTICE RELAXATION, Polymer, Vol. 3, 1962, pp. 339-342.

Measurements of the proton spin-lattice relaxation time, T_i, at a resonant frequency of 21.5 mc/sec as a function of temperature over a range of about 100° to -200° for polypropylene (I) and for polypropylene-3,3,3-d_a (II). In correlating frequency with temperature for I, incorporating nuclear resonance and mechanical loss measurements, the peak in mechanical loss is approximately 100 cps. The rate of reorientation of the Me groups in I varies with temperature with a mechanical loss peak in I due to Me groups of approximately -200° for 100 cps.

1670. Pradhan, S. P., ACTIVATION ENERGIES FOR IMPURITIES IN VANADIUM FROM MEASUREMENTS OF INTERNAL FRICTION, University Microfilms, Order No. 62-3218, 103 pp.; Dissertation Abstracts, Vol. 23, 1962, pp. 1053-1054.

The breakaway of dislocations from the impurity pinning points resulting in the amplitude dependent component of internal friction in a specimen vibrating under oscillatory stress is characteristically determined by the activation energy for impurities in the specimen. The presence of 1.0, 1.5, and 2.0 atomic percent hafnium impurity shows a decrease in activation energy with increasing impurity concentration. In annealed states, the activation energies range from 0.05 to 0.04 electron volts. With cold work, the values

of activation energy seem to increase at first and then with further increase in cold-work the activation energies continue to decrease.

1671. Pravdyuk, N. F., Pokrovskii, Yu. I., and Vikhrov, V. I., THE INFLUENCE OF NEUTRON IRRADIATION ON THE FATIGUE PROPERTIES OF MAGNESIUM AS DETERMINED BY INTERNAL FRICTION MEASUREMENTS, Properties Reactor Mater. Effects Radiation Damage, Proceedings, International Conference, Berkeley Castle, England, 1962, pp. 293-301.

Samples of distd. magnesium were irradiated at less than 80° with 10^{19} newtons per square centimeters. Fatigue tests were carried out at resonance in reverse plane bend at 200 to 300 cps. Beyond an alternating stress amplitude, the internal friction increased with increasing stress amplitude. The results are taken to indicate the occurrence of work-hardening in the early stages of fatigue. In irradiated material, fatigue produced a gradual softening in the early stages due to the removal of irradiation-induced defects.

1672. Privorotskii, I. A., THEORY OF ABSORPTION OF ULTRASONIC RADIATION IN SUPERCONDUCTORS, Zh. Eksperim. i Teor. Fiz., Vol. 43, 1962, pp. 1331-1338.

Equations were derived to describe the peculiarities of absorption of ultrasonic radiation in superconductors, peculiarities that are associated with two mechanisms of phonon scattering: absorption of a phonon by an electron and the decay of a phonon into a pair of quasi-particles.

1673. Quader, M. A., DISLOCATION DAMPING IN α-AgCd ALLOY, Indian Journal of Physics, Vol. 36, No. 2, February 1962, pp. 77-84.

The effect of heat treatment on the dislocation damping is studied in silver-cadmium alloy (29.3 atomic percent cadmium). A handling effect is observed, analogous to that found by previous workers in pure gold. The furnace-cooled specimen shows more handling effect than the water-quenched one, but the amplitude-independent internal friction is higher in the water-quenched specimen. Thus, the results for this alloy are contradictory in regard to the quench-hardening

effects. The observed effects are interpreted in terms of the pinning of dislocations by vacancies and are discussed in the light of Granato and Lücke's theory.

1674. Quader, M. A.,
INTERNAL FRICTION IN Au-Ni ALLOY, Indian Journal of Physics, Vol. 36, No. 6, June 1962, pp. 330-333.

Measurements were made of internal friction of a gold-nickel alloy containing 74 percent nickel, using the torsional pendulum method, over a temperature range from 40° to 500° C. Variations in temperatures for internal friction peaks are attributed to aging of the alloy.

1675. Quader, M. A.,
INTERNAL FRICTION IN Al-Cu ALLOY, Journal of Applied Physics, Vol. 33, 1962, pp. 1922-1927.

Measurements of the internal friction in pure aluminum and two aluminum alloys with 2 and 2.95 percent by weight copper were made by using a torsional pendulum. With solution treated and quenched alloys a weak internal friction peak (peak I) was obtained at the same temperature range at which grain-boundary relaxation occurred in pure aluminum. From the rigidity modulus measurements, the solubility temperatures for the 2 and 2.95 percent by weight copper in aluminum are obtained and agree well with previous results. An internal friction peak due to Zener relaxation, however, was not observed in these alloys.

1676. Read, B. E.,
MECHANICAL RELAXATION IN SOME OXIDE POLYMERS, Polymer, Vol. 3, 1962, pp. 529-542.

The purpose of the work is to present and discuss some low-frequency mechanical data on the related oxide polymers, polyethylene oxide (I), polypropylene oxide (II), and polyacetaldehyde (III). The shear modulus and damping for these three oxide polymers have been measured at a frequency of about one cycle per second and at temperatures down to -190°. The relaxation behavior of I depends significantly on the molecular weight of the polymer, its state of annealing, and the presence of absorbed liquids, such as H_2O and dioxane. Partially crystalline and amorphous samples of II and an elastomeric sample of III have also been studied.

1677. Reding, F. P., Fuacher, J. A., and Whitman, R. D., GLASS TRANSITIONS IN ETHYLENE COPOLYMERS AND VINYL HOMOPOLYMERS AND COPOLYMERS, Journal of Polymer Science, Vol. 57, 1962, pp. 483-498.

Glass transition temperatures, T_g, indicated by mechanical loss maxima, were determined for a number of polymers. The mechanical loss maxima were determined by measurements with a torsion pendulum (rigid samples) or an Instron tester (flexible samples), the loss being taken as the percentage of area in the stress-strain hysteresis loop compared to the total area under the stress-strain curve.

1678. Rice University, Texas, RESEARCH ON THE PHYSICS OF SOLID MATERIALS by F. R. Brotzen, Semiannual Status Report No. 6, 1962, 10 pp.

Not abstracted.

1679. Reinitz, K. and Huntington, H. B., UNPINNING OF DISLOCATIONS IN ROCK SALT BY ILLUMINATION IN THE VISIBLE, Journal of Applied Physics, Vol. 33, 1962, pp. 760-761.

The effect of γ-ray irradiation and subsequent or simultaneous illumination in the visible on the attenuation of ultrasonic propagation in the megacycle range in alkali halides is reported. The point defects formed by the γ-rays apparently act as pinning centers for the dislocations, reducing the attenuations, and can be unpinned by illumination in the visible.

1680. Rindone, G. E., GLASS RESEARCH BY INTERNAL FRICTION MEASUREMENTS, Mineral Industries Journal, Vol. 31, 1962, pp. 1-6.

Glasses are tested by measuring internal friction against temperature by using a torsional pendulum at a frequency of 0.4 cps at -60° to 500°. With alkali silicate glasses, peaks on the curve are obtained in the range -39° to -28° and 145° to 186°. It is assumed that the low-temperature peak is caused by alkali ion diffusion and the second peak by non-bridging oxygen ion diffusion.

1681. Roberts, J. M. and Brown, N.,
LOW FREQUENCY INTERNAL FRICTION IN ZINC SINGLE CRYSTALS, Acta Metallurgica, Vol. 10, April 1962, pp. 430-441.

The stress amplitude dependent internal friction of specimens is measured at 10^{-1} to 10^{-2} cps frequency by capacitance strain gage measurement of the hysteresis loops. Effects of temperature, orientation, prior permanent deformation, annealing, impurities, and stress bias on the energy loss are interpreted in terms of the Granato-Lücke theory of dislocation damping.

1682. Rodden, W. P. and Whittier, J. W.,
DAMPING OF SHAKER-EXCITED BEAMS CALCULATED SOLELY FROM DISPLACEMENT-AMPLITUDE MEASUREMENTS, Acoustical Society of America, Vol. 34, April 1962, pp. 469-471.

This article presents the derivation of relations between the tip-to-root displacement-amplitude ratio and the damping of a cantilever beam in steady-state vibration. It is shown that, within certain limits, it is possible to determine the damping of a shaker-driven cantilever beam from simple displacement-amplitude measurements at the tip and root of the beam, provided the ratio of the moving mass of the beam is known.

1683. Rogers, D. H., Hutchison, T. S., and McBride, S. L.,
DISLOCATION PINNING IN ALUMINUM AT LOW TEMPERATURES, Acta Metallurgica, Vol. 10, April 1962, pp. 397-400.

Measurements of internal friction in 99.99 percent pure aluminum at 4.2° to 290° K, and kilocycle and megacycle frequencies reveal an attenuation maximum with amplitude at a temperature of about 47° K and strain amplitude of 2×10^{-6}. The maximum is attributed to a dislocation breakaway mechanism and is discussed in terms of an extension of the Granato and Lücke theory.

1684. Rosenfield, A. R.,
250 C INTERNAL FRICTION PEAK IN IRON, Nature, Vol. 196, No. 4859, 15 December 1962, p. 1083.

This article investigates the theory that the internal friction peak at 250° C in iron is caused by the diffusion of iron.

1685. Royal Aircraft Establishment, Great Britain,
THE STATIC AND DYNAMIC RESPONSE PROPERTIES OF INCIDENCE VANES WITH AERODYNAMIC AND INTERNAL VISCOUS DAMPING by W. J. G. Pinsker, August 1962, 24 pp.

Not abstracted.

1686. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DAMPING OF STEEL PLATES BY SOUNDAMP TYPE RAL by J. W. Hollister, July 1962, AD-278-297.

Soundamp type RAL (rubber-air-lead) was evaluated for damping vibration in steel plates.

1687. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
PRELIMINARY EVALUATION OF MONSANTO VIBRATION DAMPING TREATMENT MRC-OG4 by B. V. Howell, November 1962, AD-287-844.

Damping properties of a plastic coating (graphite-filled copolymer of vinyl-chloride and vinyl-acetate) are utilized in damping treatments for new construction submarines and ship hulls.

1688. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
VIBRATION DAMPING TREATMENTS FOR NEW CONSTRUCTION SUBMARINES by J. Oser, March 1962, AD-273-840.

It was found that the effect of temperature on the damping of the treatments utilizing chromated felt was due to the materials which were incorporated in the felt, rather than to the felt proper, two unconstrained treatments were tested on 3/4-inch and 1 3/4-inch-thick steel bars. One of these treatments, type H, was a nitrile rubber vulcanizate. The other was a plastic compound. The main ingredient was a modified polyvinyl acetate.

1689. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF DAMPING TREATMENTS FOR NEW CONSTRUCTION SUBMARINES by J. Oser, September 1962, AD-285-217.

The development of elastomeric materials to replace chromated felt in constrained-layer treatments for damping heavy plating in new construction submarines is discussed. A new treatment, treatment 230, was developed which consisted of an aluminum constraining layer 1 1/4 -inch thick, and perforated butyl rubber damping layer, 1/16 -inch thick. The treatment was tested on a 1 3/4 -inch-thick steel bar.

1690. Sack, H. S.,
REVIEW OF LOW TEMPERATURE RELAXATION PEAKS, Acta Metallurgica, Vol. 10, April 1962, pp. 455-460.

A brief survey is given of the Bordoni-type relaxation peaks that are observed in plastically deformed single and polycrystals of copper, aluminum, lead, molybdenum, tantalum, niobium, tungsten, magnesium, zinc, lithium fluoride, and sodium chloride at 4.2° to 300° K. The differences in behavior of these peaks in materials of different space lattices are emphasized, with relation to dislocation pinning and breakaway strain.

1691. Sauer, J. A., Merrill, L. J., and Woodward, A. E.,
DYNAMIC MECHANICAL STUDIES OF IRRADIATED POLYPROPYLENE, Journal of Polymer Science, Vol. 58, 1962, pp. 19-28.

The internal friction and the dynamic modulus of isotactic polypropylene samples irradiated in a pile from 5.4×10^{17} to 14×10^{18} nvt are studied at low audio frequencies and over the temperature range from 100° to more than 400° K. Up to a dose of approximately 3×10^{18} nvt (total neutron flux in neutrons per square centimeter, there is a decrease in the temperature at which the final upswing in damping and drop in modulus occurs. As the dose increases above 3×10^{18} nvt, all evidence of crystallinity is lost, and the internal-friction peak which occurs around 300° K.

1692. Schiller, P.,
FUNDAMENTALS OF THE DAMPING BEHAVIOR OF METALS, Zeitschrift für Metallkunde, Vol. 53, January 1962, pp. 9-17 (In German).

This article presents a theoretical analysis of damping properties of metals in terms of factors contributing to damping behavior, mechanism of relaxation processes, resonance, hysteresis, and measuring techniques.

1693. Schlapp, D. M.,
INTERNAL FRICTION OF GLASS UNDER HIGH STRAIN, Nature, Vol. 195, 4 August 1962, p. 483.

The logarithmic decrement of torsional oscillations of a specimen of glass was found to increase by a factor of three or four when the specimen was subjected to a high torsional bias strain. The value of logarithmic decrement was also found to depend on previous mechanical history.

1694. Schlüter, H. and Hofmann, W.,
DAMPING CAPACITY OF PRE-STRAINED ALPHA-IRON, Materialprüf, Vol. 4, August 1962, pp. 288-291.

The effect of a static torsional prestrain on the Snoek damping capacity of carbon-bearing alpha-iron was studied. Theoretical consideration of the distribution of the carbon atoms in the iron and their effect on a lowering of the damping capacity was in good agreement with the results of the experiments.

1695. Schmidtmann, E., Hannen, H., and Schenck, H.,
INTERNAL-FRICTION CHARACTERISTICS OF IRON-MOLYBDENUM ALLOYS AS AFFECTED BY TESTING TEMPERATURE, COLD WORK AND HEAT TREATMENT, Archiv für das Eisenhuttenwesen, Vol. 33, No. 10, October 1962, pp. 715-722 (In German).

Measurements of internal friction are made by damping measurements at 20° to 850° C on 1 to 1.2-millimeter-thick cold-drawn wires of iron-molybdenum alloys containing 0.99 to 13.77 percent molybdenum after various heat-treating operations at 450° to 1050° C. Activation energy and relaxation determination.

1696. Schwaneke, A. E. and Jensen, J. W.,
MAGNETIC SUSCEPTIBILITY AND INTERNATION FRICTION OF TETRAGONAL MANGANESE-COPPER ALLOYS CONTAINING 70 PERCENT MANGANESE, Journal of Applied Physics, Supplement to Vol. 33, No. 3, March 1962, pp. 1350-1351.

Relation of structure to magnetic susceptibility and internal friction is described for a 70 percent manganese-30 percent copper alloy. The aged alloy exhibits a reversible f. c. t. to face-centered cubic transition at temperatures from 20° to 140° C, depending on the amount of aging. Magnetic susceptibility apparently obeys the Curie-Weiss law, but a change is observed in the temperature-susceptibility curve at the structure transition temperature. The low-stress internal friction of this alloy shows a resonance peak at the temperature of the structure change. Aging experiments with the 70 and 80 manganese alloys give evidence that quenching of alloys containing more than 80 percent manganese from solid-solution temperatures does not prevent changes typical of alloys aged to initiate precipitation of alpha manganese. Thus, the f. c. t. to face-centered cubic transformation that others have associated with the disappearance of antiferromagnetic ordering also is associated with an early stage of the alpha-manganese precipitation.

1697. Secretan, B. and Fornerod, R. C.,
MEASUREMENTS OF INTERNAL FRICTION OF 99.999% PURE ALUMINUM AS A FUNCTION OF DEFORMATION RATE, Helvetica Physica Acta, Vol. 35, 1962, pp. 524-528.

Measurements of internal friction and of the relative variation of the elastic modulus as a function of the deformation rate were made at room temperature. To avoid phenomena of restoration due to cold hardening, each measurement was made rapidly (duration 20 seconds). The average deformation rate varied from 10^{-9} to 10^{-6}, and the precision was better than two percent. Results do not agree with the quantitative theory of Granato and Lücke.

1698. Seeger, A. and Schiller, P.,
THE FORMATION AND DIFFUSION OF KINKS AS THE FUNDAMENTAL PROCESS OF DISLOCATION MOVEMENT IN INTERNAL-FRICTION MEASUREMENTS, Acta Metallurgica, Vol. 10, April 1962, pp. 348-357 (In German).

A model is proposed for the dislocation movement in the low-stress range (as used in internal-friction measurements) in terms of kink movement. The form, width, and energy of a kink are computed, with the thermal equilibrium kink density. Expressions for the interaction between kinks are derived from the continuum theory of dislocations.

1699. Seely, J. L., Baker, G. S., and Gibbs, P.,
PRESSURE EFFECTS ON THE INTERNAL FRICTION OF ALUMINUM, Journal of Applied Physics, Vol. 33, No. 8, August 1962, pp. 2458-2461.

Internal friction measurements were made as a function of hydrostatic pressures up to 3 kb by use of a piezoelectric torsional oscillator inside the pressure vessel, and with a Marx composite oscillator both before and after pressure treatment. Specimens were prepared by cold-working 99.99 percent aluminum polycrystals to a 50 percent reduction in width, followed by an anneal at 300° C. It is suggested that irreversible dislocation effects might occur as the result of shear stress produced near voids by hydrostatic stress.

1700. Seemann, H. J. and Mandler, R.,
DETERMINING THE DEGREE OF PURITY OF METALS BY MEANS OF DAMPING MEASUREMENT, Vakuum-Tech., Vol. 11, No. 6, 1962, pp. 161-167.

Methods for measuring the internal friction in metals are reviewed and a torsion pendulum apparatus is described. Damping phenomena such as Snoek damping occurring in body-centered-cubic metals, grain-boundary damping, and dislocation damping are discussed.

1701. Sekiguchi, H. and Sugawara, K.,
VIBRATION OF RUBBER CORD, Transactions, Japan Society of Mechanical Engineers, Vol. 28, No. 194, October 1962, pp. 1240-1244 (In Japanese).

Experimentally, rubber cord seems to have characteristics of string, on the one hand, and of a beam on the other. The equation of motion with a term for damping was introduced, and the solution compared with results of experiments.

1702. Sethna, P. R.,
TRANSIENT VIBRATIONS OF A BEAM WITH NONLINEAR MATERIAL PROPERTIES, Proceedings, Fourth United States National Congress on Applied Mechanics, American Society of Mechanical Engineers, New York, 1962.

Free vibrations of a simply supported beam with nonlinear viscoelastic material properties and under symmetrical initial conditions were studied. The method of analysis was based on the "Method of Averaging" for discrete systems. The solution obtained is asymptotically valid for small nonlinear terms. If the material properties are nonlinear and of the type that produce static hysteresis (metallic materials), then the probable nature of the solution is indicated.

1703. Shermergor, T. D. and Meshkov, S. I.,
DEFINING DAMPING CAPACITY BACKGROUND IN TORSIONAL VIBRATIONS, Physics of Metals and Metallography, Vol. 13, No. 6, 1962, pp. 17-23.

This article discusses the use of the Maxwell equation to calculate the natural oscillation frequency and internal friction of an isotropic cylindrical rod as a function of temperature. Comparison is made of the internal friction and background in a monocrystal and polycrystal rod.

1704. Shuvalov, L. A. and Minaeva, K. A.,
ANOMALIES IN THE ELASTICITY AND INTERNAL FRICTION OF $Pb\text{-}Mg_{1/2}W_{1/2}O_3$ NEAR THE ANTIFERROELECTRIC CURIE POINT, Dokl. Akad. Nauk SSSR, Vol. 146, 1962, pp. 808-809.

The curves of elasticity and logarithmic decrement of extinction versus temperature show a maximum at 33° to 38°

(about 2° below the antiferroelectric Curie point). These anomalies are apparently related to the domain structure of the material.

1705. Siol, M.,
INVESTIGATION OF STRUCTURAL CHANGES IN METALS BY MEANS OF INTERNAL-FRICTION MEASUREMENTS, Metalialprufung, Vol. 4, No. 8, 20 August 1962, pp. 284-287 (In German).

This article presents a review of fundamental relaxation mechanisms including Snoek damping and damping by vacancy and dislocation migration; measurements are made of internal friction by damping tests of iron containing 0.05 percent carbon at 72° to 89° C, aluminum containing four percent copper at 100° to 220° C, and aluminum containing nine percent magnesium at 100° to 250° C.

1706. Sivertsen, J. M.,
ELASTIC CONSTANT STUDIES OF METALLURGICAL PHENOMENA, Proceedings, Resonance and Relaxation in Metals, American Society for Metals, 1962, Chapter 12.

Not abstracted.

1707. Sivertsen, J. M.,
INTERNAL FRICTION AND MODULUS BEHAVIOR OF GAMMA IRRADIATED NaCl CRYSTALS, Acta Metallurgica, Vol. 10, April 1962, pp. 401-405.

The time dependence of the decrement and defect modulus of single crystals are measured during irradiation by cobalt-60 gammas to test the theory of dislocation pinning for explaining the strain amplitude-independent internal friction.

1708. Snowdon, J. C.,
ISOLATION FROM VIBRATION WITH A MOUNTING UTILIZING LOW- AND HIGH-DAMPING RUBBER-LIKE MATERIALS, Acoustical Society of America, Journal, Vol. 34, No. 1, January 1962, pp. 54-61.

The dynamic mechanical properties of rubber-like materials are reviewed. The value of a mounting composed of a low- and high-damping rubber in parallel is in this way

made apparent. Expressions are derived from which the ability of the so-called parallel mounting to isolate vibrations from any nonrigid foundation may be known.

1709. Snowdon, J. C.,
UTILIZATION OF HIGH-DAMPING RUBBERS IN VIBRATION CONTROL, Fourth International Congress on Acoustics, Copenhagen, Denmark, August 1962.

The performance of antivibration mounts employing natural rubber and a high-damping rubber, in either a series or parallel configuration, was evaluated for a two-stage mounting system supported by a nonrigid foundation. Knowledge of the mechanical properties of natural rubber and two high-damping rubbers has enabled realistic calculations to be made.

1710. Sosin, A.,
IRRADIATION PINNING AND THERMAL DEPINNING OF DISLOCATIONS, Acta Metallurgica, Vol. 10, April 1962, pp. 390-396.

Elastic moduli and internal-friction measurements are made in pure annealed copper prior to and after high-energy electron irradiation and selected thermal treatment. A model is presented showing that two (or more) types of dislocations contribute to damping, with analysis made of the nature of the interaction of point defects and dislocations.

1711. Southampton University,
THE DOUBLE-SKIN DAMPING CONFIGURATION by D. J. Mead, A. A. S. U. Report No. 160, April 1962, 46 pp.

This paper presents the theory of the response to external pressure fluctuations of a flat, rectangular sandwich plate with a damped core and simply-supported edges.

1712. Southwest Research Institute, San Antonio, Texas,
HANDBOOK OF DESIGN DATA ON ELASTOMERIC MATERIALS USED IN AEROSPACE SYSTEMS by A. G. Pickett and M. M. Lemcoe, January 1962, AD-273-880.

This handbook provides aerospace weapons system design engineers with useful data on the materials properties of elastomers. The data sources are Department of

Defense research reports and the technical literature of engineering design and elastomer technology. The elastomeric materials considered are compounds of high polymers currently available in this country. The properties considered are original mechanical and physical properties and their changes that result from aging and exposure to environments of aerospace weapons systems.

1713. Space Technology Laboratories,
SOME INTERESTING ASPECTS OF GENERAL LINEAR VISCOELASTIC DEFORMATION, February 1962, EM 12-4, 6120-7502-RU-000, 12 pp.

Considerable interest is presently being shown toward the use of the general theory of linear viscoelasticity in the solution of three-dimensional problems in continuum mechanics with time dependent material behavior. Making use of the simple relations connecting these complex functions of frequency, their behavior in the limits is examined permitting some interesting conclusions to be drawn, particularly in the case of the complex Poisson's ratio. Hypothetical values of the real and imaginary parts of the complex shear and bulk moduli are assumed, and the corresponding derived functions are shown to illustrate some of the results.

1714. Spencer, E. G., Denton, E. G., and Chambers, R. P.,
TEMPERATURE DEPENDENCE OF MICROWAVE ACOUSTIC LOSSES IN YTTRIUM IRON GARNET, Physical Review, Vol. 125, 1962, pp. 1950-1951.

The temperature dependence of the acoustic losses in single-crystal yttrium iron garnet was obtained at 500 and 1000 mc/sec. At both frequencies, acoustic Q's of 2×10^5 were obtained, and these values were relatively insensitive to temperature for T above 100° K. The acoustic losses are dominated by an internal friction peak near 15° K.

1715. Springfield, J. F. and Raney, J. P.,
EXPERIMENTAL INVESTIGATION OF OPTIMUM END SUPPORTS FOR A VIBRATING BEAM, Experimental Mechanics, Vol. 2, December 1962, pp. 366-372.

Not abstracted.

1716. Stanford University, Stanford, California,
THE EFFECT OF LONG-RANGE ORDER ON THE ELASTIC PROPERTIES OF ALLOYS AT ELEVATED TEMPERATURES by J. A. Hren, United States Department of Commerce, Office of Technical Services, 1962, AD-276-547, 137 pp.

The dynamic elastic modulus of alloys near stoichiometric CuZn, FeCo, and Fe_3Al were measured by using transverse vibration of unrestrained cylindrical specimens. Test frequencies were 700 to 3000 cps. Internal friction measurements were made concomitantly by using both the free-decay and half-width methods. Experiments on FeCo and Fe_3Al were done in air with an applied magnetic field of 1500 oersteds to eliminate magnetic damping phenomena.

1717. Stanford University, Stanford, California,
THE ROLE OF PREFERRED ORIENTATION ON THE ELASTIC AND PLASTIC PROPERTIES OF METALS AT HIGH TEMPERATURES by J. L. Lytton, Department of Materials Science Report, 23 April 1962, No. 62-4.

Creep and dynamic Young's modulus tests were carried out on iron (with 3.1 percent silicon) and on OFHC copper.

1718. Stanley, J. and Wert, C.,
ANELASTIC MEASUREMENTS OF DIFFUSION COEFFICIENTS, Proceedings, Resonance and Relaxation in Metals, American Society for Metals, 1962.

Not abstracted.

1719. Starodubtsev, S. V., Domoriad, I. A., and Khiznichenko, L. P.,
VARIATION OF THE MECHANICAL CHARACTERISTICS OF AMORPHOUS SELENIUM IN RESPONSE TO GAMMA RAYS, Soviet Physics - Doklady, Vol. 16, No. 7, January 1962, pp. 625-626 (In Russian).

A study of the action of gamma rays on internal friction and shear modulus is reported.

1720. Starodubtsec, S. V., Usmanova, M. M., and Mikhaelyan, V. M.,
CHANGES IN SOME OF THE ELECTRICAL PROPERTIES OF BORON AND AMORPHOUS SELENIUM FROM THE ACTION OF γ-RAYS, Deistvie Yadern. Izluchenii na Materialy, Akad. Nauk SSSR, Otd. Fiz.-Mat. Nauk, 1962, pp. 355-361.

The preparation of polycrystalline boron samples is described. The sample was heated to 1350° for one hour, and cooled for six hours at a pressure of 1.5×10^{-7} millimeters. Exposure of such samples to γ-rays showed a significant decrease in resistance (up to 100 percent). Resistance versus dose curves show saturation at approximately 5×10^{8} roentgens. Exposure of vitreous selenium to γ-rays resulted in an approximate 46 percent decrease in the internal friction, and increase in tangent δ and electric conductivity.

1721. Stephenson, R. L. and McCoy, H. E., Jr.,
RECORDING EQUIPMENT FOR INTERNAL FRICTION MEASUREMENTS, Journal of Scientific Instruments, Vol. 39, No. 2, February 1962, pp. 34-55.

An apparatus was developed for recording internal friction data using an optical lever method. Instead of following the oscillations visually, however, the passage of the beam across the scale was detected by photoconductive cells. The apparatus was used for accurate determinations of logarithmic decrement from below 0.001 up to 0.3.

1722. Stern, R. M. and Granato, A. V.,
OVERDAMPED RESONANCE OF DISLOCATIONS IN COPPER, Acta Metallurgica, Vol. 10, April 1962, pp. 358-381.

The damping of ultrasonic waves in the 5 to 45 mc/sec range is measured in a high-purity copper single crystal during cobalt gamma irradiation. The dependence of the decrement on radiation time, frequency, temperature, and orientation is that expected for overdamped resonance of dislocations.

1723. Stollner, H.,
MEASUREMENT OF THE ELASTICITY MODULUS AND DAMPING OF SINTERED IRON, Planseeber. für Pulvermetall., Vol. 10, No. 1-2, April 1962, pp. 78-87.

Measurements of the sonic velocity and damping properties in dependence upon the particle size of the starting powders and the sintering temperature at various frequencies between 20 kc/sec (resonance method) and 2 to 14 mc/sec (echo method) were carried out on sintered iron samples prepared from eddy-mill powder.

1724. Stulen, F. B.,
A MODEL FOR THE MECHANICAL PROPERTIES OF METALS, Materials Research and Standards, Vol. 2, February 1962, pp. 102-108.

Description of a model or analog that simulates the various mechanical properties of a metal by duplicating qualitatively and quantitatively yielding, stress-strain relation, permanent set, strain hardening, damping, stress sensitivity point in damping, Bauschinger effect, dynamic stress-strain curve, delay time, creep, and stress relaxation. Various aspects of the model are verified by simulation on an electronic analog computer.

1725. Sugimoto, K. and Ibaraki, M.,
ROOM-TEMPERATURE INTERNAL FRICTION IN ANNEALED IRON ALLOYS, Transactions, Japan Institute of Metals, Vol. 3, No. 3, 1962, pp. 167-172.

Room-temperature internal friction in pure iron, steels, and silicon-iron (all vacuum-annealed at 950°) was measured at approximately 1.5 kc/sec by the transverse vibration method of Pattison in the strain-amplitude range of 1×10^{-4} to 1×10^{-8}. Internal friction increases linearly until the critical strain amplitude is exceeded. Then it increases nonlinearly until the maximum strain amplitude is reached. The source of this internal friction is considered to be principally due to magnetomechanical static hysteresis loss.

1726. Swartz, J. C.,
INTERNAL FRICTION AND MODULUS CHANGES IN COLD WORKED IRON CONTAINING CARBON, Acta Metallurgica, Vol. 10, April 1962, pp. 406-418.

This article explores the effect of carbon-dislocation reactions on the damping and modulus defect associated with dislocation motion in specimens of iron wire deformed in torsion at low temperature. Transient creep and temperature, and frequency and strain amplitude dependences of the damping and modulus defect are measured during pulse annealing.

1727. Swartz, J. C.,
INTERNAL FRICTION SPECTRA OF COPPER AFTER LOW TEMPERATURE DEFORMATION, Acta Metallurgica, Vol. 10, No. 4, April 1962, pp. 450-451.

This article describes torsion pendulum experiments on damping of high purity copper which show affects of deformation and annealing on Bordoni peaks.

1728. Swartz, J. C. and Weertman, J.,
A MODIFICATION OF THE KOEHLER-GRANATO-LÜCKE DISLOCATION DAMPING THEORY, Acta Metallurgica, Vol. 10, No. 4, April 1962, p. 448.

The dislocation damping theory of Koehler-Granato-Lücke is modified for metals with high-stacking fault energy. It is assumed that the most abundant impurity atom species interact only with the edge component of each dislocation. For this model the hysteretic, or frequency independent, damping initially increases linearly with stress amplitude and approaches the Granato-Lücke amplitude dependence at higher stresses.

1729. Takahashi, Y.,
MECHANISM OF THE DIELECTRIC AND MECHANICAL DISPERSION IN THE THERMOSETTING PHENOLIC RESINS, Journal of Applied Polymer Science, Vol. 6, 1962, pp. S34.

Experiments were run on an ammoniated resol type of phenol-o-cresol-HCHO resin (I) and on butylated I (II). The dielectric and mechanical dispersion values of II were considerably smaller than those of I, both cured at 170°.

1730. Takeuchi, T.,
ACTIVATION ENERGY OF BORDONI PEAK AND ITS RELATION TO PEIERLS STRESS, Physical Society of Japan, Journal, Vol. 17, No. 4, April 1962, pp. 659-665.

From the assumption that the fluctuations of the local shear stress displace a length of the dislocation for unit distance of the Peierls potential, the activation energy of Bordoni peak is derived for the crystals of relatively large Peierls stress and of low-dislocation density. For the crystals of the contrary case, it is pointed out that the activation energy of the Bordoni peak is affected by the dislocation density.

1731. Taylor, A.,
LOW TEMPERATURE INTERNAL FRICTION IN MONOCRYSTALLINE LITHIUM FLUORIDE, Acta Metallurgica, Vol. 10, No. 4, April 1962, pp. 489-493.

The effect of room temperature plastic deformation upon the internal friction of monocrystalline bars of lithium fluoride was measured over the temperature range 20° to 273° K at 6 and 40 kc/sec at about 1×10^{-7} strain amplitude. Slight deformation increased the overall internal friction and gave rise to a well-defined peak at about 72° K at 40 kc/sec. Further deformation up to five percent increased the height of this peak and caused the appearance of a second peak at about 160° K.

1732. Teutomico, L. J., Granato, A. V., and Lücke, K.,
THEORY OF THE THERMAL BREAKAWAY OF A PINNED DISLOCATION LINE WITH APPLICATION TO DAMPING PHENOMENA, Acta Metallurgica, Vol. 10, No. 4, April 1962, p. 448.

To extend the theory to finite temperatures, a detailed study of the possible static equilibrium positions of a pinned dislocation line as a function of external stress is required. This is done here for the two simple specific examples of a dislocation with a single pinning point and a dislocation with a continuous pinning agent. Also, it is shown in a general way how the damping and modulus change can be computed from these results.

1733. Texas University, Structural Mechanics Research Laboratory, Austin Texas,
ENERGY-DISSIPATING CHARACTERISTICS OF TRUSSGRID ALUMINUM HONEYCOMB by J. M. Lewallen and E. A. Ripperger, 1962, 46 pp.

The dynamic crushing strength and energy dissipation characteristics of the aluminum honeycomb Trussgrid have been determined at impact velocities ranging from zero to 100 ft/sec. Crushing strength of 500 to 800 psi and energy dissipations of 360 and 600 in. lb/cu in. have been observed. The stress-strain characteristics required of an ideal "one-shot" cushioning material.

1734. Thomas, W. T.,
SYSTEMS OF ONE DEGREE OF FREEDOM, Handbook of Engineering Mechanics, New York, New York, McGraw-Hill Book Company, Incorporated, 1962, 1632 pp., Chapter 56, Edited by W. Flugge.

This chapter contains the standard textbook material on vibrations of linear single degree of freedom systems, including such topics as the theory of seismic instruments, phase distortion in instruments, and equivalent viscous damping.

1735. Thompson, D. O.,
A THERMALLY ACTIVATED INTERNAL FRICTION SPECTRUM IN COPPER FOLLOWING NEUTRON IRRADIATION, Acta Metallurgica, Vol. 10, April 1962, pp. 327-331.

Measurements of the internal friction and Young's modulus of a neutron irradiated copper single crystal indicate that some conversion of the primary dislocation pinning defect at 270° K to about 400° K takes place in the dislocation neighborhood. With the cessation of bombardment, and after an unspecified incubation period, a thermally activated internal friction spectrum is developed.

1736. Thompson, N.,
METAL FATIGUE, Zeitschrift für Metallkunde, Vol. 53, February 1962, pp. 71-78.

This article examines hardening of metals by alternating stress, hardness measurement, and observations of damping

capacity. Direct observation of dislocations and other lattice defects is made by transmission electron microscopy.

1737. Tieng, Ke-Seng,
INTERNAL FRICTION IN THE WC-Fe, WC-Ni, AND WC-Fe-Ni POWDER METALLURGY SYSTEMS, Chosum Kwahakwon Tongbo, No. 1, 1962, pp. 8-9.

Internal friction in the WC-iron (iron 7 percent, 11 percent, and 15 percent), WC-nickel (nickel 7 percent, 11 percent, and 15 percent), WC-iron-nickel (5.25 percent iron, 1.75 percent nickel, and 11.25 percent iron, 3.75 percent nickel) powder metallurgy systems were studied at 0.8 to 2.3 cps at 10^{-3} millimeters.

1738. Toronto University,
AN EXPERIMENTAL INVESTIGATION OF THE SOUND GENERATED BY THIN STEEL PANELS EXCITED BY TURBULENT FLOW/BOUNDARY LAYER NOISE by G. R. Ludwig, November 1962, Contract AF 49-638-249, 123 pp.

Not abstracted.

1739. Truell, R. and Elbaum, C.,
HIGH FREQUENCY ULTRASONIC STRESS WAVES IN SOLIDS, Encyclopedia of Physics ("Handbuch der Physik") by S. Flugge, Acoustic II, Vol. 11, No. 2, Berlin, Springer-Verlag, 1962, pp. 153-258.

The propagation behavior of high frequency stress waves in solids is determined by the measurement of the attenuation and velocity of the stress waves as a function of whatever variables are of interest. Such measurements permit one to study the influence, on the propagation behavior, of any property of a solid that is sufficiently well coupled to the lattice.

1740. Tsuge, K., Enjoji, H., Terada, H., Ozawa, Y., and Wada, Y.,
MECHANICAL DISPERSION AND MOLECULAR MOTION IN CRYSTALS OR POLYETHYLENE AND OTHER POLYMERS, Japan Journal of Applied Physics, Vol. 1, 1962, pp. 270-276.

Dynamic mechanical loss of solution-grown polyethylene crystals is measured by a suspension method as a function of temperature, and the crystalline dispersion (alpha

dispersion) is observed above 40° in the same manner as in melt-grown polyethylene.

1741. Turner, T. J. and Williams, G. P., Jr., INTERNAL FRICTION IN SILVER SOLID SOLUTIONS, Acta Metallurgica, Vol. 10, April 1962, pp. 305-311.

Zener relaxation studies are made on 32 percent cadmium, 32 percent gold and 86 percent gold-silver solid solutions with a torsion pendulum and an elastic-after-effect apparatus at 250° to 900° C, with an Arrhenius equation describing the results.

1742. Underwood, E. E., Austin, A. E., and Manning, G. K., THE MECHANISM OF HARDENING IN 17-7 Ni-Cr PRECIPITATION-HARDENING STAINLESS STEELS, Iron and Steel Institute, Journal, Vol. 200, No. 8, August 1962, pp. 644-651.

High-purity ferrite single crystals of iron-17 percent chromium, 7 percent nickel, and 2 percent aluminum-are tested by X-ray diffraction, neutron diffraction and electron microscopy to determine the effect of aging, hardness, Magne gage, internal-friction and electrical resistivity.

1743. Ungar, E. E., LOSS FACTORS OF VISCOELASTICALLY DAMPED BEAM STRUCTURES, Journal of Acoustical Society of America, Vol. 34, No. 8, August 1962, pp. 1082-1084.

General expressions are obtained for loss factors of axially uniform linear composite structures in terms of the properties incorporating free and constrained viscoelastic components. Results are shown to be generalizations of earlier studies of coated and sandwich plates, and methods are given for utilizing information about such plates in dealing with more complicated structures by redefinition of structural and shear parameters.

1744. Ungar, E. E. and Kerwin, E. M., Jr.,
LOSS FACTOR OF VISCOELASTIC SYSTEMS IN TERMS OF ENERGY CONCEPTS, Journal of Acoustical Society of America, Vol. 34, No. 7, July 1962, pp. 954-957.

The definition of loss factor in terms of energy quantities is re-examined, particularly as it applies to composite viscoelastic systems. A restatement of this definition in terms of a corresponding viscoelastic spring is used to show that this definition is extremely useful for massless (ideal viscoelastic spring) systems, but may be applied unambiguously to spring systems with a single attached mass only at resonance. Simple relations are derived which express the loss factors of series-parallel arrays of massless viscoelastic springs in terms of properties of the individual components.

1745. United States Government Research Report,
INTERNAL FRICTION IN ALUMINUM OXIDE SINGLE CRYSTALS by R. J. Huber, G. S. Baker, and P. Gibbs, Vol. 37, 20 February 1962, p. S-58(A).

Measurements of internal friction of Al_2O_3 single crystals in longitudinal oscillation at a frequency of 50 kc and at strain amplitudes up to 10^{-5} are reported. The measurements were made by the composite oscillator technique as a function of temperature between 25 and 1850 C and as a function of plastic deformation of the samples.

1746. Van Houten, S.,
MECHANICAL LOSSES IN Li-DOPED NiO SEMICONDUCTORS, Physics and Chemistry Solids, Journal, Vol. 23, August 1962, pp. 1045-1048.

Measurements of the internal friction in lithium-doped NiO are described and discussed. The measurements were made with piezoelectric lead zirconate-titanate disks to which the NiO samples were cemented. The losses are measured as a function of the temperature at four frequencies on samples with 10 atomic percent lithium. The measurements are interpreted in terms of the hopping model, which proved to be useful in the description of the electrical conduction mechanism in mixed-valency semiconductors. From the loss measurements, an activation energy, q = 0.20 electron volts can be calculated which is in good agreement with the value found electrically.

1747. Van Neste, A. and Dube, A.,
INFLUENCE OF TEMPERATURE ON THE ELASTICITY MODULUS OF FERROMAGNETIC METALS, Comptes Rendus, Vol. 255, No. 15, 8 October 1962, pp. 1732-1734 (In French).

Determination of the influence of amplitude and temperature from -191° to 360° C during magnetostricture deformation on the internal friction and elasticity modulus of 1000° C heat-treated nickel samples.

1748. Van Neste, A. and Dube, A.,
VARIATION OF THE SHEAR MODULUS OF FERROMAGNETIC METALS WITH THE DEFORMATION AMPLITUDE, Comptes Rendus, Vol. 254, 1962, pp. 4024-4026.

The variation of internal friction was the same for compound nickel INCO "A" and Ferrovac iron (0.009 percent carbon) wires (0.75-millimeter diameter, 20-centimeter length) annealed at 1000° for one hour and cooled in the oven. The internal friction was weak for low amplitudes, passed through a maximum value, and was very weak for high amplitudes. This behavior was not ascribed to the dislocation but to the ferromagnetic properties, the most probable cause being the motion of the Bloch walls.

1749. Vekilov, Yu. Kh. and Piguzov., Yu. V.,
INTERNAL FRICTION IN SILVER CHLORIDE AT LOW TEMPERATURES, Fiz. tverdogo Tela, Vol. 4, No. 5, May 1962, pp. 1099-1102 (In Russian. English Translation in: Soviet Physics-Solid State).

Internal friction of silver chloride was measured between -190° C and 20° C. The effect of ultraviolet radiation applied at -190° C appeared only after heating to room temperature. Irradiation also produced peaks with unstable positions on the temperature scale. The results are explained by relaxation of point defects, produced by the irradiation, and by interaction of these defects with dislocations.

1750. Verner, V. D.,
INTERNAL FRICTION PRODUCED BY THE DIFFUSION OF NITROGEN ATOMS IN THE FIELD OF ELASTIC STRAINS IN γ SOLID SOLUTIONS OF FERROUS ALLOYS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 14, 1962, pp. 880-889.

At contents of nitrogen above a certain critical concentration (0.2 percent to 0.3 percent), the curve expressing the relation between the temperature and internal friction of samples with the structure of homogeneous nitrogen austenite and samples of nitrided steel containing austenite shows an internal friction peak due to the migration of nitrogen atoms in the field of elastic strains in the face-centered-cubic lattice.

1751. Villain, J. P. and de Fouquet, J.,
DEVELOPMENT OF THE DAMPING CAPACITY OF LOW-CARBON IRON AFTER AN ALTERNATING-TORSION FATIGUE TEST, Mémoires Scientifiques de la Revue de Métallurgie, Vol. 59, April 1962, pp. 286-294 (In French).

Damping capacity of iron as a function of the temperature (20° to 950° carbon), heat treatment, time, temperature (20° to 80° C) and the stress-strain cycle of the alternating-torsion fatigue test and of the relationship between internal friction and the distribution of carbon atoms.

1752. Wachtman, J. B., Jr. and Peiser, H. S.,
SYMMETRY CONDITIONS FOR INTERNAL FRICTION CAUSED BY JUMPING OF POINT DEFECTS IN CRYSTALS, Applied Physics Letters, Vol. 1, No. 1, September 1962, pp. 20-22.

Derivation, using group theory, of a condition for internal strain in a crystal due to the jumping of point defects under the influence of oscillating strain, with application to body-centered cubic crystals such as alpha iron.

1753. Wagenblast, H. and Damask, A. C.,
KINETICS OF CARBON PRECIPITATION IN IRRADIATED IRON, Physics and Chemistry of Solids, Journal, Vol. 23, 1962, pp. 221-227.

Iron containing approximately 0.01 percent by weight carbon was irradiated in the BNL reactor at different times and temperatures, and the amount of carbon in solution was measured by torsion pendulum internal friction. Isothermal annealings after irradiation for 12 days at 200° K showed that the irradiation accelerated the disappearance of carbon from solution by about three orders of magnitude over the thermal rate.

1754. Warnaka, G. E.,
THE EFFECT OF DYNAMIC STRAIN AMPLITUDE ON THE DYNAMIC MECHANICAL PROPERTIES OF ELASTOMERS, Proceedings, American Society of Mechanical Engineers, Paper No. 62-WA-323, 1962, 7 pp.

In spite of strain dependent plastoelastic behavior, elastomers have linear stress-strain characteristics at any given dynamic shear-strain amplitude. Because of linearity of stress and strain, instruments based on the Voigt model are capable of making accurate measurements of the dynamic mechanical properties of elastomers in the plastoelastic range.

1755. Watervliet Arsenal, New York,
THE RECOVERY OF THE ULTRASONIC ATTENUATION IN COPPER SINGLE CRYSTALS FOLLOWING SMALL PLASTIC DEFORMATION by J. Frankel, 1962, AD-612-160, 17 pp.

The change in the attenuation of an ultrasonic wave in a stressed single crystal does not take place smoothly. This work indicates that more than one recovery process is involved, and that the most clearly measured process has an activation energy of 1.5 electron volts.

1756. Wayne State University, Detroit, Michigan, MAGNETOACOUSTIC MEASUREMENTS IN THE NOBLE METALS AT 350 mc/sec by H. V. Bohm and V. J. Easterling, May 1962, AF 49 638 832, AD-295-928.

Not abstracted.

1757. Wert, J. J. and Rosenthal, P. C., AN INTERNAL-FRICTION STUDY OF AN ALLOY STEEL SUBJECT TO TEMPER BRITTLENESS, American Society for Metals Transactions Quarterly, Vol. 55, No. 3, September 1962, pp. 439-450.

Internal friction and impact characteristics of AISI 3310. Reducing the carbon content to 0.006 percent carbon did not remove susceptibility to temper brittleness but caused the transition from ductile to cleavage fracture of tough specimens to appear at a higher temperature. The development of temper brittleness was shown to be independent of the amount of carbon held in solution.

1758. Westinghouse Electric Corporation, HIGH-DAMPING ALLOYS AND PARTS PRODUCED THEREFROM, January 1962, Brit. 886,922, March 1958, U. S. Appl.

At present there is no alloy available for turbines with inlet steam temperatures of 1000° to 200° F with adequate damping, creep strength, and ductility. A new alloy is proposed containing cobalt, nickel, titanium, aluminum, and hafnium. The compound is cobalt 70 to 96 percent, nickel greater than or equal to 25 percent with cobalt and nickel greater than or equal to 92 percent, titanium 1 to 3 percent, aluminum 0.1 to 1.5 percent, titanium and aluminum less than 3.5 percent and hafnium 0.2 to 4 percent by weight. The alloy shows excellent damping characteristics, has a creep strength at greater than or equal to 1200° F with a Curie point at 1600° F.

1759. Westinghouse Electric Corporation, Pittsburgh, Pennsylvania, RESIN SHRINKAGE RELATED TO THE PERFORMANCE OF FILAMENT WOUND STRUCTURES by R. N. Sampson and B. Rosen, April 1962, NONR353700, AD-275-095.

Not abstracted.

1760. Westinghouse Electric Corporation, Pittsburgh, Pennsylvania, VIBRATION TRANSMISSION AND IMPEDANCE OF BASIC FOUNDATION STRUCTURES by D. V. Wright and D. F. Miller, October 1962, NOBS72326, AD-295-666.

This article investigates vibration transmission and impedance of basic foundation structures on ship hulls.

1761. Whiteman, I. R., ON THE DERIVATION OF THE STRESS-STRAIN DIAGRAM FROM A STATISTICAL APPROACH, Aerospace Engineering, Vol. 21, No. 10, October 1962, p. 56.

A model is made up of elastoplastic elements, all of which have the same value of Young's modulus, but which have different values of yield stress. It is shown that the dimensionless tangent modulus curve represents the cumulative frequency distribution of those elements which are in the elastic region. By plotting the cumulative distribution of aluminum 75-S-T6, the frequency distribution is found to be logarithmic normal with a displaced origin.

1762. Whittier, J. S., HYSTERETIC DAMPING OF STRUCTURAL MATERIALS UNDER BIAXIAL DYNAMIC STRESSES, Experimental Mechanics, Vol. 2, No. 11, November 1962, pp. 321-328.

Damping measurements were made for steel, brass, copper, magnesium alloy, and Monel under biaxial dynamic stresses. The experiments indicate that dilatational as well as distortional stresses are important in the damping of polycrystalline materials.

1763. Wisconsin University, Madison, Wisconsin, DEVELOPMENT OF INTERNAL FRICTION APPARATUS FOR DETECTING THE PRESENCE OF HYDROGEN IN IRON by W. C. Dries, 1962, Ph. D. Thesis.

The development of an apparatus for detecting internal friction in iron is described. The frequency range of the equipment is 100 to 12,000 cps, the temperature range, 150° to 340° K and the strain range, zero to 5×10^{-5}. The apparatus was used to measure internal friction in alpha-iron. Internal friction peaks in hydrogen-charged iron were found at 293° K, 4861 cps, and 370° K, 7580 cps. The mechanism

causing the damping was determined to be similar to the Koster mechanism for carbon in alpha-iron. The hydrogen damping is thought to be an interaction between hydrogen and dislocations.

1764. Woodward, A. E.,
TRANSITIONS AND SEGMENTAL MOTION IN HIGH POLYMERS, Transactions, New York Academy of Science, Vol. 24, 1962, pp. 250-261.

Nuclear magnetic resonance, dynamic mechanical loss, and storage modulus are well-suited for studying the principal glass transformation in amorphous and partially crystalline polymers. The dynamic mechanical method is the most suitable for the study of certain secondary transitions that appear to involve principally limited main-chain oscillations.

1765. Wozney, G. P.,
RESONANT-VIBRATION FATIGUE TESTING, Experimental Mechanics, Vol. 2, No. 1, January 1962, pp. 1-8.

Techniques are described for the fatigue testing of components, such as turbine buckers, used in large steam turbines and generators. Fatigue of these large structures, which have relatively high unit damping, is obtained through the use of resonant-vibration systems. An electromagnetic drive serves as the source of excitation. The circuit diagram of a very efficient automatic amplitude controller is given. A typical tuning-fork system of turbine blades had a loss factor of 0.0025.

1766. Wright-Patterson Air Force Base, Ohio, Aeronautical Systems Division,
RESULTS OF LOSS FACTOR MEASUREMENTS ON CONCRETE BEAMS USING A VISCOELASTIC OR SAND DAMPING SYSTEM, September 1962, ASD-TDR-62-717.

Not abstracted.

1767. Yamane, T. and Ueda, J.,
TEMPERING THIRTEEN PERCENT CHROMIUM STAINLESS STEEL (CHANGE OF THE INTERNAL FRICTION AT ROOM TEMPERATURE AFTER TEMPERING), Transactions, Japan Institute of Metals, Vol. 3, No. 3, 1962, pp. 179-183.

The room-temperature internal friction of 13 percent chromium stainless steel can be resolved into two components, one a strain amplitude-dependent component which appears in specimens tempered at more than 200 degrees, and the other a strain amplitude-independent component which decreases with increasing tempering temperatures to 400°. Minimum internal friction is achieved in specimens tempered at 600°.

1768. Yelyutin, V. P., Mozzhukhin, E. I., Panov, A. V., and Khalil, R. B.,
INTERNAL FRICTION OF COPPER IN SAMPLES PRODUCED BY POWDER METALLURGY, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 14, 1962, pp. 443-451.

The curve of internal friction of compressed copper briquets has two maxima, the first caused by the grain-boundary effect on the contact surface and the second by the presence of oxygen. Increased compaction pressure decreased internal friction.

1769. Yonemitsu, K.,
APPLICATION OF INTERNAL FRICTION TO ANALYSIS, Vol. 32, October 1962, pp. 44-48.

Internal friction is caused by the impurities in the interstices and it depends on the temperature. The Snoek peak existing at the temperature is utilized in the analysis.

1770. Zakharov, A. I.,
EFFECT OF NEUTRON IRRADIATION ON ELASTICITY MODULUS AND INTERNAL FRICTION OF COPPER, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 13, 1962, pp. 241-247.

Preliminary irradiation (1.5×10^{13} n/sq cm. sec.) of the single crystal and polycrystal copper samples increased the elasticity modulus, E, of the copper. The preliminary

plastic deformation decreased E. The internal friction of copper decreases during irradiation, while preliminary plastic deformation increases it.

1771. Zeidelman, R. L.,
DETERMINATION OF DAMPING CAPACITY OF STEEL,
Zavodskaya Laboratoriya, No. 3, 1962, pp. 347-351.

Samples of 12KhMF steel in the shape of tuning forks, with and without welded joints, are heat-treated and vibrated at 20° to 600° C. Damping capacity is determined as a function of temperature and applied force.

1772. Abowitz, G.,
ULTRASONIC ATTENUATION IN SINGLE-CRYSTAL CADMIUM, Journal of Applied Physics, Vol. 31, No. 5, May 1963, pp. 1503-1507.

Measurements were made of the attenuation of compressional and shear waves at 300° K and frequencies from 5 mc/sec. Determination of phase velocities of all modes of propagation for use in computing the adiabatic elastic constants.

1773. Admiralty Materials Laboratory, Great Britain,
HIGH DAMPING CAPACITY ALLOYS FOR THE REDUCTION OF NOISE AND VIBRATION - PART III. SUBMARINE PROPELLER APPLICATION by D. Birchon, February 1963, 4 pp.

Not abstracted.

1774. Akramov, G.,
RESONANCE DAMPING IN A METAL IN A MAGNETIC FIELD, Fiz. Tverd. Tela, Vol. 5, 1963, pp. 1310-1315.

In a metal placed in a magnetic field, besides sound waves, waves of another type, so-called spiral waves, can propagate. Under some conditions, frequencies and phase velocities coincide and resonance takes place between the waves of these two different types. Conditions of that resonance are considered and extinction is found for the transverse ultrasonic, as well as for the spiral waves in the resonance region.

1775. Alabuzhev, P. M. and Trus', A. M.,
RELAXATION PHENOMENA IN COMPRESSION SPRINGS DURING FASTENING, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 313.

Not abstracted.

1776. Alefeld, G.,
ACTIVATION ENERGY AND ACTIVATION VOLUME OF THE ELASTIC AFTER EFFECT IN GOLD, Acta Metallurgica, Vol. 11, No. 4, April 1963, pp. 291-315.

Creep and shear tests, with internal friction measurements, at 16° to 600° C, shows the activation volume of the elastic after-effect to be stress-dependent, as a function of time and temperature, and related to the binding energy of dislocations and impurities, analogous to the activation energy, which is temperature-dependent as a function of time is related to vacancy migration and self-diffusion energy.

1777. Aleksandrov, N. L. and Mordyuk, V. S.,
A DIRECT HEATING RELAXATION DEVICE, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 65-71.

This article describes a simple relaxation device for measuring the internal friction and the relative rigidity modulus of refractory metals, such as molybdenum and tungsten, using direct heating. Curves show the relationship between the internal friction and the annealing temperature, as determined by this device.

1778. Aleksandrov, L. N. and Orlov, V. N.,
RELATIONSHIP BETWEEN THE KINETICS OF RECRYSTALLIZATION AND STRESS RELAXATION IN METALS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 294-299.

This article investigates the relationship between the recrystallization kinetics and stress relaxation by studying the variation of internal friction with temperature and time. This was done using tungsten and molybdenum samples.

1779. American Standards Association,
RECOMMENDATIONS FOR NOMENCLATURE FOR SPECIFYING DAMPING PROPERTIES OF MATERIALS, Final Report of ASA Committee, Damping of Materials, American Standards Association, New York, New York, November 1963.

Not abstracted.

1780. Ang, C. Y. and Kamber, K. T.,
INTERNAL FRICTION IN BERYLLIUM, Journal of Applied Physics, Vol. 34, No. 11, November 1963, pp. 3405-3407.

Damping regions and internal friction peaks in as-drawn and argon and vacuum-annealed wire specimens are measured by inverted torsion pendulum at -196° to 735° C and one-cycle-per-second frequency. Observed phenomena are related to lattice structure and interstitial-substitutional impurity relations as a function of temperature and process history.

1781. Anonymous,
A CERTAIN CASE OF FLEXURAL VIBRATIONS OF A ROTATING SHAFT HAVING NONLINEAR MATERIAL, Archiwum Budowy Maszyn, Vol. 10, No. 4, 1963, pp. 369-382.

Not abstracted.

1782. Anonymous,
MEASURING MATERIALS' ELASTIC PROPERTIES, Engineering, Vol. 196, No. 5095, 13 December 1963, p. 765.

An electronic instrument for measuring Young's modulus and the damping capacity is discussed. The system is a closed loop operation which is self-oscillatory once phase relationships are adjusted and frequency is measured on a built-in meter.

1783. Aoki, K., Sekino, S., and Fujishima, T.,
ON THE BEHAVIOR OF C AND N IN Al-KILLED STEEL DURING ISOTHERMAL TREATMENT, Transactions, Japan Institute of Metal, Vol. 4, No. 1, 1963, pp. 46-51.

Not abstracted.

1784. Aoki, K., Sekino, S., and Fujishima, T.,
ON THE QUANTITATIVE MEASUREMENT OF INTERSTITIALLY DISSOLVED N AND C IN COMMERCIAL STEEL BY THE INTERNAL FRICTION METHOD, Transactions, Japan Institute of Metals, Vol. 4, No. 2, April 1963, pp. 84-89.

Not abstracted.

1785. Aoki, K., Sekino, S., and Fujishima, T., APPLICATIONS OF INTERNAL FRICTION TO STUDIES OF IRON AND STEELS, Tetsu-to-Hagane Overseas, Vol. 3, No. 2, 1963, pp. 138-146.

Not abstracted.

1786. Armour Research Foundation, Chicago, Illinois, INTERNAL FRICTION MEASUREMENTS; IN ITS STUDIES OF THE BRITTLE BEHAVIOR OF CERAMIC MATERIALS, PART II by P. D. Southgate and L. M. Atlas, April 1963, pp. 203-270.

Not abstracted.

1787. Ashmarin, G. M. and Krivandina, Y. A., THE EFFECT OF METAL PURITY ON GRAIN-BOUNDARY INTERNAL FRICTION OF ALUMINUM, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 171.

Not abstracted.

1788. Atomic Energy Commission Publication, EFFECT OF POROSITY, PART I; EXPERIMENTAL WORK, PART II by L. M. Atlas, 1963, ASD-TR-61-628, pp. 633-683.

Groups of Al_2O_3 bars varying in porosity, grain size, and conditions of fabrication have been prepared at temperatures between 1650° and 1845° C by normal sintering, and by hot pressing at pressures ranging between 500 and 300 psi. These bars as well as specimens of Lucalox, Wesgo Al995, and two grades of Alundum were subjected to measurements of Young's modulus, internal friction, and flexural strength in four-point loading.

1789. Atomic Energy Commission Publication, INTERNAL FRICTION MEASUREMENTS, PART II; STUDIES ON POLYCRYSTALLINE CRYSTALS, PART II by L. M. Atlas, 1963, ASD-TR-61-628, pp. 254-268.

The temperature dependence of the internal friction and creep in annealed and unannealed Wesgo Al-995 were measured in oxygen and hydrogen atmospheres to 1500° C. At low and moderate temperatures, damping in Wesgo Al-995

is characterized by relaxation processes which resemble those occurring in an alkali-free glass. Above 800° C, however, damping may be controlled first by the oscillatory movement of impurity cations, possibly paired with O_2 vacancies, and later by the diffusion of O_2 vacancies.

1790. Atomic Energy Commission Publication, ELASTICITY AND INTERNAL FRICTION OF POLYCRYSTALLINE YTTRIUM OXIDE by M. O. Marlowe and D. O. Wilder, 1963, IS-792.

The elastic modulus and internal friction have been determined from room temperature to 1658° C by sonic techniques. An exponential relation was found between volume fraction porosity and internal friction at room temperature. The elastic modulus decreased linearly with increasing temperature to 1350° C. At higher temperatures, a rapid decrease in elastic modulus occurred with a rapid increase in internal friction.

1791. Atomic Energy Commission Publication, THE INTERNAL FRICTION DUE TO OXYGEN IN SILVER by J. M. Papazian, 1963, No. UCRL-11017.

The presence of oxygen in amounts of the order of 100 parts per million in high purity silver is found to give rise to three low-temperature internal friction peaks. Measurements carried out on single-crystal wire specimens in a torsion pendulum show that these peaks occur at 130°, 180°, and 270° K at a frequency of about two cycles per second. It is shown that for both the 130° and the 180° peaks the peak height is proportional to the square of the oxygen concentration over the range from 100 to 300 parts per million. The peak at 270° K is tentatively ascribed to an oxygen-dislocation interaction.

1792. Atomic Energy Commission Publication, INTERNAL FRICTION MEASUREMENTS, PART I; STUDIES ON SINGLE CRYSTALS, PART II by P. D. Southgate, 1963, ASD-TR-61-628, pp. 204-254.

The internal friction between 10 and 50 kc/sec from -195° to 1000° C in single crystal MgO which has been plastically deformed at room temperature to introduce dislocations was studied. Experimental results are compared with

existing theories; the agreement is often found unsatisfactory. Further theoretical developments are based on models of dislocation motion similar to those used in the past.

1793. Atomic Energy Commission Publication, INTERNAL FRICTION IN SINGLE CRYSTAL CERAMICS by P. D. Southgate, 1963, No. IITRI-B6012-2, pp. 21-32.

Dislocation damping in MgO single crystal was studied. The existing theories for dislocation damping do not adequately describe the observed behavior of the MgO single crystals. A "disordered strip" model is proposed in which a disorder analogous to melting occurs in a strip lying in the glide plane.

1794. Atomic Energy Commission Publication, MICROSTRUCTURE AND MECHANICAL PROPERTIES OF CERAMICS by R. J. Stokes, 1963, HR-63-264.

The influence of microstructure on the following aspects of mechanical behavior was considered: elastic deformation, anelastic behavior, plastic deformation, brittle fracture, high temperature deformation, and creep.

1795. Atomic Energy Commission Publication, INTERNAL FRICTION AND CREEP IN POLYCRYSTALLINE CERAMICS by J. W. Stuart, 1963, No. IITRI-B6012-2, pp. 33-38.

The internal friction of Lucalox was studied to 1600° C in hydrogen and oxygen atmospheres. The activation energy for the high temperature internal friction process is 60 kilocalories per mole as compared to 40 kilocalories per mole for Wesgo alumina. This difference is attributed to the formation of spinel at the grain boundaries in the Lucalox, whereas a less refractory vitreous phase is present at the grain boundaries in the Wesgo alumina.

1796. Atomic Energy Commission Publication, ANELASTIC PHENOMENA IN POLYCRYSTALLINE OXIDE CERAMICS, PART II by N. A. Weil, 1963, No. ASD-TR-61-628, pp. 477-495.

Using this equipment, the variation of internal friction, Q^{-1}, with T, vibration amplitude, static load, and time in a Morganite Al_2O_3 rod has been briefly examined.

1797. Avraamov, Y. S., Kekalo, I. B., and Morgner, V., THE EFFECT OF TEMPERATURE, AMPLITUDE AND FREQUENCY OF ELASTIC OSCILLATIONS ON THE "MAGNETIC" PEAK OF INTERNAL FRICTION IN IRON, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 184.

Not abstracted.

1798. Azhazha, V. M., Gindin, I. A., Starodubov, Ya. D., and Shapoval, B. I., THE EFFECT OF LOW-TEMPERATURE DEFORMATION UPON THE CREEP AND INTERNAL FRICTION OF COPPER, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 15, No. 5, 1963, pp. 729-735 (In Russian).

A considerable improvement in the creep properties of technical-grade copper was produced by a preliminary treatment comprising heavy plastic deformation (in tension) at 4.2° K followed by a 100-hour anneal at 300° K. The rate of steady creep decreased, time-to-rupture increased, and the tendency of copper to develop intercrystalline cracks during creep was suppressed, the degree of improvement increasing with increasing purity and initial grain size of the metal. The treatment brought about a decrease in the internal-friction background of copper and raised the temperature at which a rapid increase in this property took place.

1799. Azizov, I. A., Popov, K. V., and Vinogradov, V. F., EQUIPMENT FOR MEASUREMENT OF INTERNAL FRICTION ON SPECIMENS OF A LARGE CROSS-SECTION, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 72.

Not abstracted.

1800. Baccaredda, M., Butta, E., and Frosini, V., MOLECULAR MOTIONS IN AMORPHOUS RANDOM ETHYLENE-PROPYLENE COPOLYMERS, Makromolekulare Chemie, Vol. 61, 1963, pp. 14-21.

Sound velocity, v, and damping factor, Q^{-1}, were determined in some amorphous C_2H_4-C_3H_6 copolymers from -170° to -15° by an electrostatic method at a frequency of 10,000 cps.

1801. Baranova, V. I.,
RELAXATION PROCESSES IN SYSTEMS IRON-CHROMIUM AND IRON MOLYBDENUM, Relaxation Phenomena in Metals and Alloys, Metallurgizdat, Moscow, 1963, p. 14.

Not abstracted.

1802. Barrand, P. and Leak, G. M.,
DENSITY OF DISLOCATION ATMOSPHERES, Acta Metallurgica, Vol. 11, 1963, pp. 158-161.

This work on iron wire was carried out to establish the atmosphere concentration around dislocations during strain aging. The Cottrell and Bilby equation was followed experimentally up to about 60 percent completion of the aging process. Precipitation of Fe_3C proceeds at dislocation sites as the interstitial carbon atoms migrate from the surrounding matrix. At the completion of strain aging, there are still approximately two carbon atoms per plane locked in atmosphere at the dislocation sites. Possibly a proportion of the carbon atoms in the solution migrates to the actual cores of the dislocations and precipitates as iron carbide. The remaining carbon atoms gather as a cloud, having a Maxwellian distribution in the vicinity of the dislocations and remain unprecipitated.

1803. Barrand, P. and Leak, G. M.,
INTERNAL FRICTION PEAK IN IRON, Nature, Vol. 198, No. 4877, 30 April 1963, p. 279.

Samples of iron containing nitrogen, oxygen, and carbon are subjected to deformation at 40° and 250° C to determine the effect of oxygen on 250° C internal friction peak, of iron carbide on Koster peak, and of nitrogen and carbon on the appearance of the peaks.

1804. Battelle Memorial Institute, Columbus, Ohio,
PRODUCTION URANIUM RESIDUAL STRESSES, INTERNAL FRICTION, AND MODULUS by E. L. Foster, Jr., 27 December 1963, BMI-1658.

Levels and distribution were determined for residual stresses in specimens representative of six normal steps in manufacture of hollow uranium fuel elements, and four alternative steps were formulated. A definite correlation was

noted between residual-stress level and specific manufacturing process steps. In measurements after various mechanical and thermal treatments, internal friction and Young's modulus went through a maximum and minimum, respectively, with increasing severity of quenching from a beta temperature.

1805. Baushis, I. P.,
THE EFFECT OF THE SCALE FACTOR ON RELAXATION STRENGTH OF METALS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 332.

Not abstracted.

1806. Baxter, W. J. and Wilks, J.,
THE EFFECT OF ANNEALING ON THE BORDONI PEAK IN ALUMINUM, Acta Metallurgica, Vol. 11, No. 8, August 1963, pp. 979-982.

Measurement of the magnitude of the Bordoni peak in polycrystalline aluminum at one kilocycle per second using the resonant bar technique and at one cycle per second using an inverted torsion pendulum. Specimens are prepared by a preliminary anneal at 400° C in argon gas, followed by deformation of a few percent extension.

1807. Bayazitov, M. I. and Kochnov, V. E.,
INVESTIGATION OF COLD-ROLLED TRANSFORMER STEEL BY INTERNAL FRICTION METHOD, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 15, No. 1, 1963, pp. 113-118.

This article presents a study of magnetic losses in E330 and E310 transformer steels as affected by quenching at 1100° C, annealing in the range of 200° to 700° C, solubility of nitrogen and carbon in steel, and by deformation of carbide and nitride phases. Determination was made of the relationship between internal friction and temperature in the zero to 700° C range by means of rotary pendulum. Effect of high cooling note on formation of carbide and nitride phases and magnetic losses.

1808. Berbegal, J. M. B., de Andres Sanz, M. P., and Martorell, J. T.,
DETERMINATION OF DAMPING VALUE AND ELASTIC MODULUS IN QUENCHED TECHNICAL CARBON STEELS, Instituto del Hierro y del Acero, Vol. 16, No. 84, April-June 1963, pp. 145-172.

Various carbon steel specimens are quenched in H_2O and tested in flexion up to 2000 cps at 25° to 625° C to determine the effect of temperature and structure on the elastic modulus, and of the dislocation movement and phase precipitation on the damping value.

1809. Bernshtein, M. L. and Tikhomirova, E. S.,
EFFECT OF COLD WORKING ON THE INTERNAL FRICTION OF TECHNICALLY PURE IRON, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 211, Edited by B. N. Finkelshtein.

Not abstracted.

1810. Biot, N. A. and Pohle, F. V.,
VALIDITY OF THIN-PLATE THEORY IN DYNAMIC VISCO-ELASTICITY, ASD-TDR-63-411, July 1963, 26 pp.

Resonance damping for a vibrating plate is investigated both according to the exact equations of dynamic viscoelasticity and the classical thin-plate equations derived in mechanics of materials to determine if the latter, simplified theory can adequately predict resonant amplitudes. Damping is introduced in the analysis through the complex shear modulus. The two theories are in excellent agreement in a range of wave-length as low as about ten times the thickness of the plate.

1811. Bishop, R. E. D.,
AN INVESTIGATION INTO THE THEORY OF RESONANCE TESTING, Philosophical Transactions, Series A, Vol. 255, January 1963, pp. 241-280.

Not abstracted.

1812. Bisseliches, J. C., Peters, D. T., and Spretnak, J. W., GRAIN BOUNDARY INTERNAL FRICTION IN ALPHA SOLID SOLUTIONS OF MAGNESIUM IN ALUMINUM, ASD-TDR-62-1095, January 1963, 43 pp.

The grain boundary relaxation in high purity aluminum and dilute solutions of magnesium in aluminum was studied by means of the low frequency torsional pendulum. The influence of grain size in high purity aluminum on the position of the peak is exactly as predicted by the Zener theory, namely, that the sliding distance is proportional to the average grain diameter. Magnesium exerts no pinning effect on the grain boundaries at the concentrations studied.

1813. Bogy, D. B. and Paslay, P. R., AN EVALUATION OF THE FIXED POINT METHOD OF VIBRATION ANALYSIS FOR A PARTICULAR SYSTEM WITH INITIAL DAMPING, Transactions, American Society of Mechanical Engineers, Journal of Engineering for Industry, Vol. 85, Series B, August 1963, pp. 233-236.

Not abstracted.

1814. Bokshteyn, S. Z., Bronfin, M. B., and Marichev, V. A., EFFECT OF PRELIMINARY PLASTIC DEFORMATION ON THE INTERNAL FRICTION OF MOLYBDENUM AND MOLYBDENUM ALLOYS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 123-127.

This article investigates the relationship between the temperature of maximum internal friction connected with plastic deformation and the grain size, in an attempt to explain the shift of the deformation maximum toward high temperatures when the grain size increases. Molybdenum powder and cast binary alloys of molybdenum with zirconium (0.13 percent) and rhenium (50 percent by weight) were tested.

1815. Bokshteyn, S. Z., Bronfin, M. B., Kishkin, S. T., and Marichev, V. A., THE INTERNAL FRICTION OF DEFORMED MOLYBDENUM AND ITS ALLOYS WITH ZIRCONIUM AND RHENIUM, Fizika Tverdogo Tela, Vol. 5, No. 11, 1963, pp. 3075-3080 (In Russian).

The internal friction of molybdenum, molybdenum-zirconium, and molybdenum-rhenium annealed and deformed

at room temperature was measured at 20° to 700° C. The temperature/internal-friction curves for molybdenum and molybdenum-zirconium showed peaks which could be made to vanish by annealing below the recrystallization temperature. For a constant degree of deformation, the position of the peaks along the temperature axis depended on the grain size of the specimen. These results are discussed in terms of dislocation theory, being evidently associated with the d and mobility of free dislocations. Peaks do not occur in molybdenum-rhenium alloys, and this is believed to be due to the occurrence of twinning during deformation.

1816. Boone, D. H. and Wert, C. A.,
INTERSTITIAL-DISLOCATION INTERACTION IN NIOBIUM, Physical Society of Japan, Journal, Vol. 18, Supplement 1, 1963, pp. 141-148.

Interstitial-dislocation interactions in niobium were studied by using the cold-work and Snoek internal friction peaks. Both the temperature of the cold-work peak and its height depended on the amount of nitrogen removed from solution by dislocations in deformed specimens. Interstitial oxygen had only a minor effect, and deformations beyond five percent changed the peak very little. The characteristics of the peak can be related to the interstitial content of the dislocation atmosphere and understood if these interstitials are assumed to interact to form clusters. These interstitial clusters relax in some cooperative manner which results in an order-of-magnitude increase in the relaxation strength per atom.

1817. Boor, J., Jr. and Mitchell, J. C.,
KINETICS OF CRYSTALLIZATION AND A CRYSTAL-CRYSTAL TRANSITION IN POLY-1-BUTENE, Journal of Polymer Science, Part A, Vol. 1, 1963, pp. 59-84.

The formation and melting of the two crystal modifications of poly-1-butene were studied by differential thermal analysis, infrared spectroscopy, dilatometry, and polarizing microscopy. Torsional damping and modulus, and offset yield points, were measured for some of the samples.

1818. Bratina, W. J. and Mills, D.,
STUDY OF FATIGUE IN METALS USING ULTRASONIC TECHNIQUE, Metal Treatment and Drop Forging, Vol. 30, No. 213, June 1963, pp. 239-245.

This article explores the use of ultrasonic wave attenuation and a dislocation loop pinning model to investigate the behavior of lattice imperfections, especially dislocations and interstitial carbon atoms, in cyclic and fatigue stressing of 1095 and 4340 steels. Effects of cycling rate, strain aging, annealing, and cold work are also investigated. Results are interpreted in terms of the formation of active dislocation loops and their immobilization by interstitial atoms.

1819. Brewster, J. J., Levy, M., and Rudnick, I.,
ULTRASONIC DETERMINATION OF THE SUPERCONDUCTING ENERGY GAP IN VANADIUM, Physical Review, Vol. 132, No. 3, 1963, pp. 1062-1072.

Ultrasonic attenuation measurements on single-crystal cylinders were used to determine the temperature-dependent superconducting energy gap of three samples of vanadium of different purities. An echo-pulse technique using longitudinal waves was used. The zero-temperature energy gap for the three samples was $(3.4 \pm 0.2)kT_c$, and $(3.5 \pm 0.1)kT_c$.

1820. Brown University, Providence, Rhode Island,
ULTRASONIC METHODS IN THE STUDY OF FATIGUE AND DEFORMATION IN SINGLE CRYSTALS OF ALUMINUM AND SODIUM CHLORIDE by B. Chick, A. Hikata, G. Anderson, W. Findley, C. Elbaum, and R. Truell, February 1963, ASD-TDR-62-186, 37 pp.

Not abstracted.

1821. Brown University, Metals Research Laboratory, Providence, Rhode Island,
ULTRASONIC METHODS IN THE STUDY OF FATIGUE AND DEFORMATION IN SINGLE CRYSTALS by B. Chick, A. Hikata, G. Anderson, W. Findley, R. Truell, and C. Elbaum, April 1963, 82 pp.

The use of ultrasonic methods (and in some cases electrical-conductivity measurements) for studying defect formation and motion in connection with deformation and stress cycling experiments in aluminum and sodium chloride single crystals is outlined.

1822. Brown University, Providence Rhode Island,
AN EXPERIMENTAL INVESTIGATION OF THE INTERNAL FRICTION OF SMALL DIAMETER QUARTZ STRANDS AT LOW FREQUENCIES by J. H. Whitelaw, July 1963, Contract NONR 362300, 26 pp.

Not abstracted.

1823. Bruner, L. J. and Mecs, B. M.,
MODULUS AND DAMPING OF COPPER AFTER PLASTIC DEFORMATION AT 4.2° K, Physical Review, Vol. 129, 1963, pp. 1525-1532.

The Bordoni dislocation relaxation peaks in copper were studied under experimental conditions which permit plastic deformation of specimens at 4.2° K, with measurement of their Young's modulus and internal friction upon subsequent warmup. A qualitative discussion of these results indicates that the interaction between point defects and dislocations is an essential feature of the dislocation relaxation process.

1824. Buehler, W. J., Gilfrich, J. V., and Wiley, R. C.,
EFFECT OF LOW-TEMPERATURE PHASE CHANGES ON THE MECHANICAL PROPERTIES OF ALLOYS NEAR COMPOSITION TiNi, Journal of Applied Physics, Vol. 34, 1963, pp. 1475-1477.

X-ray diffraction and dilation studies showed that alloys near the stoichiometric TiNi composition undergo transformation into the related phases Ti_2Ni and $TiNi_3$ at low temperatures. Changes of large magnitude in vibration damping were also noted and appear related to variations in the phase equilibrium of the system.

1825. Burmeister, C. W., Doan, D. B., and Gavenda, J. D.,
OPEN-ORBIT RESONANT ABSORPTION OF ULTRASOUND IN COPPER, Bulletin, American Physical Society, Series II, Vol. 8, No. 7, 1963, p. 517.

An extremely sharp and very pronounced spatial resonance line and its second harmonic have been observed in the absorption of high-frequency shear waves in copper.

1826. Butera, R. A. and Kofstad, P.,
INTERNAL FRICTION IN THE VANADIUM-HYDROGEN SYSTEM, Journal of Applied Physics, Vol. 34, August 1963, pp. 2172-2174.

Internal friction in a series of vanadium-hydrogen alloys has been measured over the temperature range -190° to 210° C. The hydrogen compositions varied from 1.2 to 14.5 atomic percent and two frequencies, 75 and 270 cps, were used. For each frequency, a single peak was observed having an amplitude which increased essentially linearly with hydrogen concentration. Comparison of the activation energy and temperature of this peak with that reported for the tantalum-hydrogen system indicates that the hydrogen atoms are located in the tetrahedral interstices.

1827. Butta, E., Vannucchi, C.,
DYNAMIC MECHANICAL PROPERTIES AND RELAXATION PHENOMENA IN SOME POLYAMIDES, Chimie et Industrie, Vol. 45, 1963, pp. 323-328.

In samples of nylon 6, nylon 6-6, nylon 6-10, and nylon 11, the sound velocity, v, and the internal dissipation, Q^{-1}, at a frequency of 10^4 cps were determined at -170° to 260°.

1828. Buzitskiy, V. N. and Soyfer, A. M.,
NEW TYPES OF ALL-METAL ELASTIC-DAMPING ELEMENTS, THEIR PREPARATION AND APPLICATION, Rasseyaniye Energii Pri Kolebaniyakh Uprugikh Sistem, SSSR, AD-613452, 1963, pp. 269-275.

Not abstracted.

1829. California Institute of Technology, Pasadena Dynamics Laboratory,
GENERAL THEORY OF VIBRATION OF DAMPED LINEAR DYNAMIC SYSTEMS by T. K. Caughey and M. E. J. O'Kelley, June 1963, 113 pp.

Not abstracted.

1830. Carnahan, R. D. and Brittain, J. O.,
POINT-DEFECT RELAXATION IN RUTILE SINGLE CRYSTALS, Journal of Applied Physics, Vol. 34, October 1963, pp. 3095-3104.

The existence of a well-defined relaxation process was established in internal-friction studies of nonstoichiometric rutile, TiO_2, crystals. The peak was observed only in crystals which were vacuum reduced to a room-temperature-resistivity value of 21 omega-centimeter or less and oriented so that the principle vibrational strain coincided with an alpha crystallographic axis. For measurements in the frequency range 3 to 10 cps, the peak temperature varied from approximately 60° to 85° C and exhibited a dependence on the degree of reduction, that is, the peak temperature increased with increasing reduction.

1831. Chernikova, I. N.,
STUDY OF THE EFFECT OF ANNEALING CARBON STEELS BY MEASUREMENTS OF THE INTERNAL FRICTION, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 61, Edited by B. N. Finkelshtein.

Not abstracted.

1832. Chollet, P.,
DETERMINATION OF THE CARBON OR NITROGEN CONTENT IN SOLID SOLUTION IN ALPHA-IRON BY INTERNAL FRICTION MEASUREMENTS, Centre Doc. Siderurg., Circ. Inform. Tech., Vol. 20, No. 6, 1963, pp. 1559-1565.

A review is given of the mathematical derivation of the method from the theory of damped vibrations and the experimental procedures of Koester and Wepner. Some sources of error are listed.

1833. Cimpl, Z.,
THE DEPENDENCE OF THE RECTANGULAR HYSTERESIS LOOP ON THE EXTERNAL STRESS IN MANGANESE-MAGNESIUM AND MANGANESE FERRITES, Czechoslovak Journal of Physics, Vol. 13, No. 7, 1963, pp. 518-525 (Translation).

Study of the dependence of the shape of a hysteresis loop on external stress, using samples of manganese-magnesium

ferrites. A high value is assumed for the energy of the magnetocrystallic anisotropy of manganese-magnesium ferrites of different composition. The sign of the magnetorestriction is determined from the character of changes in the hysteresis loop of the samples.

1834. Claiborne, L. T. and Einspruch, N. G.,
OSCILLATORY BEHAVIOR OF ULTRASONIC ATTENUATION IN SUPERCONDUCTING Nb-Zr ALLOYS, Physical Review Letters, Vol. 10, No. 2, 15 January 1963, pp. 49-51.

Measurements of the attenuation of ultrasonic compressional waves in zero applied magnetic field in superconducting niobium and in two niobium-zirconium alloys at four frequencies between 5 and 30 mc/sec. Results obtained indicate that the variations of the attenuation is a function of temperature, and there exists some temperature dependent mechanism for the absorption of energy from an ultrasonic wave.

1835. College of Aeronautics, Cranfield, Great Britain,
THE EFFECT OF NITROGEN IN ALPHA-IRON ON FERROMAGNETIC DOMAIN BOUNDARY MOVEMENT EXAMINED BY A MECHANICAL DAMPING METHOD by M. J. Steward, May 1963, 21 pp.

Not abstracted.

1836. Columbia University, New York, New York,
KILOCYCLE DAMPING IN PURIFIED IRON BETWEEN 77 AND 300 K by H. D. Guberman, 1963, NONR 26661, 75 pp.

Studies of damping in electron-beam-zone purified iron indicate that there is no low-temperature dislocation relaxation peak and that a modulus defect could be induced by high amplitude oscillations. This is shown to be due to dislocations which have been displaced from equilibrium positions.

1837. Crandall, S. H.,
DYNAMIC RESPONSE OF SYSTEMS WITH STRUCTURAL DAMPING, Air, Space, and Instruments, Draper Anniversary Volume, New York, New York, McGraw-Hill Book Company, 1963.

Linear structural damping has been widely used in analytical studies of vibration and flutter as a simple model

for damping mechanisms in which the dissipation increases with the stress level of the vibration. The linear structural damping assumption is easily described in terms of complex frequency response, but difficulties arise in translating this back into the time domain.

1838. Crandall, S. H.,
PERTURBATION TECHNIQUES FOR RANDOM VIBRATION OF NONLINEAR SYSTEMS, Journal of Acoustical Society of America, Vol. 35, November 1963, pp. 1700-1705.

Not abstracted.

1839. Crandall, S. H.,
RANDOM EXICTATION OF NONLINEAR SYSTEMS, In-Random Vibration, Vol. 2, Cambridge, Massachusetts, Massachusetts Institute of Technology Press, 1963, pp. 85-102.

Not abstracted.

1840. Crussard, C.,
RHEOLOGIC STUDY OF CREEP AND MECHANICAL HYSTERESIS OF MATERIALS, Métaux-Corrosion-Industries, Vol. 39, No. 459, November 1963, pp. 395-422.

This article investigates the use of cyclic torsion tests at 25° to 1300° C to determine the relationship of frequency to viscous creep, as well as the period, temperature, and creep activation energy to cycle height and the amplitude and frequency of internal stress.

1841. Datsko, O. I.,
EFFECT OF THE MECHANICAL STATE OF THE MATERIAL ON THE DAMPING CAPACITY OF FERROMAGNETIC NICKEL, Physics of Metals and Metallography, Vol. 16, No. 3, 1963, pp. 81-84.

Internal friction measurements were made of high purity nickel rods at 20° to 300° C in magnetic field and without magnetic field after deformation of the rods by 80 percent by stretching and recrystallization annealing at 500° to 900° C. Determinations were made of the temperature ranges of minimum and maximum internal friction values with reference to annealing temperature and time.

1842. Datsko, O. I. and Pavlov, V. A.,
VARIATION OF INTERNAL FRICTION WITH TEMPERATURE IN PURE NICKEL, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 174, Edited by B. N. Finkelshtein.

Not abstracted.

1843. David Taylor Model Basin, Washington, D. C.,
NEW METHODS FOR DETERMINING THE LOSS FACTOR OF MATERIALS AND SYSTEMS by F. Schloss, April 1963, AD-403-934, 18 pp.

Two new methods, one of which uses mechanical impedance techniques, are described for measuring the loss factor of materials and systems at any arbitrary frequency in frequency range from 10 to 10,000 cps. The accuracy of these methods increases with increased damping and, therefore, the methods complement other methods which are most accurate for low values of damping. The apparatus and accuracies are discussed.

1844. De Batist, R.,
ON THE DEFORMATION INDUCED INTERNAL FRICTION PEAKS IN NIOBIUM, Physica Status Solidi, Vol. 3, No. 8, 1963, pp. 1475-1479.

The activation energies and attempt frequencies for deformation induced damping peaks in niobium are determined for wire specimens deformed at 80° K and warmed to room temperature.

1845. de Klerk, J., Bolef, D. I., and Klemens, P. G.,
BOTTLENECK IN THE ATTENUATION OF HYPERSONIC WAVES IN QUARTZ AT LOW TEMPERATURES, Physical Review Letters, Vol. 10, 1963, pp. 127-128.

Hypersonic waves of 1000 mc/sec in single-crystal quartz at temperatures less than 2° K show a decrease in the attenuation for both compressional and shear waves. This decrease is attributed to a phonon bottleneck.

1846. De Morton, M. E.,
NONELASTIC TRANSITIONS IN CHROMIUM, Physical Review Letters, Vol. 10, No. 6, 15 March 1963, pp. 208-209.

This report investigates dependence of magnetomechanical damping, internal friction dynamic Young's modulus and dynamic shear modulus of high purity chromium on temperature from -196° to 150° C. Nonelastic behavior is interpreted in terms of an antiferromagnetic domain structure.

1847. De Morton, M. E., Lott, S. A., and Stainsby, D. F.,
MEASUREMENT OF INTERNAL FRICTION BY VELOCITY OBSERVATIONS OF TORSIONAL OSCILLATIONS, Journal of Scientific Instruments, Vol. 40, No. 9, 1963, pp. 441-443.

The logarithmic decrement at low frequency of a torsional pendulum is determined by the measurement of velocity decay in successive transits of an optic lever through the zero position. Speed and appn. over a wide range of logarithmic-decrement values without loss of accuracy are claimed.

1848. Djodjo, B. A.,
CALCULATION OF DAMPED LINEAR SYSTEMS BY HOLZER'S METHOD, American Institute of Astronautics and Aeronautics, Journal, Vol. 1, April 1963, pp. 966-967.

Not abstracted.

1849. Doroshek, S. I. and Tseytlin, A. M.,
RELAXATION STABILITY OF SEVERAL IRON-NICKEL ALLOYS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 326-331.

Nispan or N41Kh7 (Nickel-42.1 percent, chromium-4.9 percent, titanium-0.6 percent, molybdenum-2.2 percent, aluminum-0.5 percent, carbon-0.02 percent) has a minimum temperature coefficient of the modulus of elasticity at -180° to 150° C and good mechanical properties. A slight change in chemical composition results in a nonmagnetic corrosion-proof alloy N36KhTYuM (nickel-35.5 percent, chromium-13.3 percent, titanium-1.7 percent, aluminum-1.0 percent, carbon-0.04 percent, molybdenum-5.4 percent) with the required combination of physical and elastic properties. The alloys were tested for stress relaxation at 300°, 350°, 400°, 450°, and 500° C by loading the band samples as a ring under

certain stresses not exceeding the yield point. After 5, 10, 30, and 60 minutes, the samples were relieved, and the removed stress, relaxation stress, and relative values of these stresses were calculated.

1850. Douglas Aircraft Company, Incorporated, Long Beach, California,
SONIC FATIGUE DAMPING MATERIAL DEVELOPMENT by P. R. McGowan and J. M. Snider, February 1963, 53 pp.

Damping compounds were modified by the addition of aluminum or glass flakes of various sizes, and the effect, as measured by the changed damping factor of a vibrating strip, was determined. The addition of either material improved the damping, but the ratio of one part flakes to two parts base appears most efficient. A temperature of -65° F had little effect while an increase of temperature to 180° F greatly reduced the damping properties.

1851. Douglas Aircraft Company, Incorporated, Long Beach, California,
SONIC FATIGUE DAMPING MATERIAL DEVELOPMENT by P. R. McGowan and J. M. Snider, April 1963, Supplement No. 2, Report No. LB31046, 53 pp.

Damping compounds were modified by the addition of aluminum or glass flakes of various sizes and the effect, as measured by the changed damping factor of a vibrating strip, was determined. The addition of either material improved the damping, but the ratio of one part flakes to two parts base appears most efficient.

1852. Douglas Aircraft Company, Incorporated, Long Beach, California,
SONIC FATIGUE DAMPING MATERIAL DEVELOPMENT by P. R. McGowan and J. M. Snider, August 1963, Supplement No. 3, Report No. LB31046, 20 pp.

Tests to determine the reduction in stress level due to adhesion between structural elements were conducted with adhesion panels. From these tests it was determined that the addition of flake fillers increases the effectiveness of the base compounds.

1853. Douglas Aircraft Company, Incorporated, Long Beach, California,
SONIC FATIGUE DAMPING MATERIAL by P. R. McGowan and J. M. Snider, September 1963, NOW62 1071C, AD-600-170, 79 pp.

The best protection against sonic fatigue was obtained by adhesive damping in areas of structural attachment. Measurements of stress reduction in adhesion panels instrumented with a strain gage showed good results; materials had been compounded with glass or aluminum flake pigments. A polysulfide dispersion and a nylon-epoxy composition were used as the base compounds in these tests. Vibration damping tests were conducted with coated vibration strips with strain gages attached. An attempt was made to correlate dynamic physical properties of the damping compounds, such as creep and recovery, with damping efficiency. Loss moduli values were low for all materials tested but a very significant increase was obtained by the addition of flake pigments.

1854. Douglas Aircraft Company, Incorporated, Long Beach, California,
SONIC FATIGUE DAMPING MATERIAL DEVELOPMENT by J. M. Snider and P. R. McGowan, January 1963, NOW62 1071, AD-294-545.

Evaluations are made of vibration damping properties of compositions of nylon, epoxy resins, polyamide resins, phenolics, and nitrile rubber.

1855. Dunayev, F. N., Malev, N. S., and Borisova, N. V.,
THE EFFECT OF THERMOMAGNETIC TREATMENT ON INTERNAL FRICTION OF PERMINVAR AND 66-PERMALLOY, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 214.

Not abstracted.

1856. Dunayev, F. N., Yakovlev, G. P., and Borisova, N. B.,
INTERNAL FRICTION HYSTERESIS IN NICKEL, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 208.

Not abstracted.

1857. Eckstein, Y.,
ULTRASONIC ATTENUATION IN ANTIMONY. I. GEOMETRIC RESONANCE, Physical Review, Vol. 129, 1963, pp. 12-17.

Geometric resonances in ultrasonic attenuation were observed in antimony. The experimental method used was the continuous method. The sound frequency used was primarily 60 mc/sec, with some observations at 132 and 252 mc/sec and magnetic fields 4 to 200 gauss.

1858. Fastov, N. S.,
EQUATIONS OF VISCOUS FLOW AT HIGH STRESSES, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 31.

Not abstracted.

1859. Fastov, N. S.,
THE THEORY OF ELASTIC AFTEREFFECT IN HOMOGENEOUS BODIES, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 122, Edited by B. N. Finkelshtein.

Not abstracted.

1860. Favstov, Yu. K.,
CONCERNING THE DETERMINATION OF THE INTERNAL FRICTION OF DAMPING COATINGS, Mekhanika i Masinostroenie, May-June 1963, pp. 127-128.

Not abstracted.

1861. Fiat Research Laboratories, Turin, Italy,
FATIGUE RESISTANCE OF LIGHT ALLOY COMPRESSOR BLADES AT 20 AND 150 C, USING A CONSTANT AMPLITUDE AND A STANDARD INCREMENTAL AMPLITUDE LAW by L. Locati and G. Artusio, 1963, 13 pp.

In a fatigue test program to determine sulfur-nitrogen curves for compressor blades, the influence of temperature on Young's modulus, the damping coefficient, and hardness were measured also. The logarithmic decrement had a value 0.001 at 20° C and was twice that amount at 155° C.

1862. Fijuta, F. E. and Damask, A. C.,
THE INFLUENCE OF RADIATION-PRODUCED DEFECTS ON THE PRECIPITATION OF CARBON IN IRON, Physical Society of Japan, Journal, Vol. 18, Supplement III, 1963.

Measurements were made by electrical resistivity, internal friction, and electron microscopy. When the alloy is irradiated at ambient temperature (approximately 60° C) the number of precipitation particles formed and, hence, the rate of precipitation of carbon, is ten times the number in the unirradiated alloy. When the alloy is irradiated at low temperature (approximately -100° C) the disappearance of carbon from solution is one thousand times faster than the thermal rate. It is deduced that the carbon is temporarily trapped by vacancies and later released to precipitate at a temperature higher than the precipitation temperature in the unirradiated alloy.

1863. Finkelshtein, B. N. and Berezovskiy, V. N.,
X-RAY INVESTIGATION OF STRUCTURE OF TRANSFORMER IRON UNDER ELASTIC LOADING AND DURING STRESS RELAXATION, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 303.

Not abstracted.

1864. Finkelshtein, B. N.,
RELAXATION PHENOMENA IN SOLIDS, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 1, Edited by B. N. Finkelshtein.

Not abstracted.

1865. Finkelshtein, B. N., Editor,
RELAXATION PHENOMENA IN METALS AND ALLOYS, Authorized Translation from the Russian by Consultants Bureau, New York, New York, 1963.

The book contains papers presented at a conference in Moscow in 1960 and originally published in Russian in 1960.

1866. Franklin Institute, Philadelphia, Pennsylvania,
A STUDY OF THE BEHAVIOR OF DISLOCATIONS AND THEIR INTERACTION WITH OTHER LATTICE DEFECTS UNDER CONDITIONS OF ALTERNATING STRESS by K. U. Snowden and H. F. Wilsdorf, July 1963, ARL-63-114, 50 pp.

Not abstracted.

1867. Fraser, D. B.,
EFFECTS OF ALKALI IONS ON THE INTERNAL FRICTION OF QUARTZ, American Physical Society, Bulletin, Series 2, Vol. 8, April 1963, p. 354.

Experiments on the effects of alkali ions in the internal friction of quartz were discussed. Blocks were doped with lithium, sodium, and potassium, respectively, by electrodiffusion at 500° C. Measurements of Q^{-1} and resonant frequency were made from liquid-helium temperatures to near the quartz inversion point at 573° C. For a resonant frequency of five megacycles, internal-friction peaks were evident in the low-temperature region with sodium-doping giving a peak at 50° K, lithium a peak near 100° K, and potassium a peak near 200° K. The activation energies ranged from 0.06 to 0.2 electron volts.

1868. Funakubo, H. and Collette, G.,
TRANSITORY INCREASE IN OBSERVED INTERNAL FRICTION OF COPPERS OF DIFFERENT PURITIES AFTER HEATING AND TEMPERING, Trans. Natl. Res. Inst. Metals (Tokyo), Vol. 5, No. 1, 1963, pp. 7-15.

The two metals used were electrolytic, common cold-rolled copper, and pure oxygen-free high-conductivity electrolytic copper cast in a cylindrical ingot. Before measuring internal friction the temperature of recrystallization was determined. The common grade recrystallized at around 400°, and the pure copper recrystallized below 400°. Special apparatus allowed measurement of internal friction near ambient temperature. Samples of common and pure copper were roasted at temperatures up to 700° for 10 hours and tempered in water at 23°. Under the conditions used, there was a transitory increase in internal friction after roasting and tempering. Purity of the metal and the temperature of the roasting before tempering exert and influence on the phenomenon.

1869. Garber, R. I. and Mogil'nikova, T. T.,
INTERNAL FRICTION AND PLASTIC DEFORMATION OF OVERSTRESSED MICROAREAS OF SOLIDS, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, Edited by B. N. Finkelshtein.

Not abstracted.

1870. Garber, R. I. and Soloshenko, I. I.,
ACCUMULATION OF MICRODEFECTS IN ELASTOPLASTIC ALTERNATING BENDING, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 80.

Not abstracted.

1871. Giannini Controls Corporation, Astromechanics Research Division,
PARAMETRIC ACCURACY STUDY OF A PREVIOUSLY PUBLISHED DECAY-DAMPING RELATIONSHIP by A. G. Fonda, January 1963, ARD TR-02-003, Contract AF 49 (638)-1015, 35 pp.

Not abstracted.

1872. Gilman, J. J.,
ANELASTICITY CAUSED BY DEBRIS DIPOLES IN PLASTICALLY STRAINED CRYSTALS, Physical Society of Japan, Journal, Vol. 18, Supplement 1, March 1963, pp. 172-178.

It is argued that the Bordoni internal-friction peaks in plastically strained materials result from thermally-induced reorientation of edge dislocation dipoles and that this mechanism is consistent with observed relaxation, strength, peak multiplicities and breadths, annealing behavior and other features of experiments on copper, aluminum, lithium fluoride, niobium, tantalum, molybdenum, and tungsten.

1873. Glauz, R. D.,
TRANSIENT ANALYSIS OF A VIBRATING REED, Journal of Polymer Science, Part A, Vol. 1, 1963, pp. 1693-1700.

The physical properties of a viscoelastic material are obtained by measuring the damping effect on a free vibrating reed. The complex modulus is calculated from the frequency and damping factors.

1874. Golenishchev-Kutuzov, V. A.,
NONRESONANCE PARAMAGNETIC ABSORPTION OF SOUND IN CHROMIUM POTASSIUM ALUM, Zhurnal Eksperemental'noi i Teoreticheskoi Fiziki, Vol. 44, No. 1, 1963, pp. 63-64.

The frequency was 30 mc/sec. The absorption in the sample was measured as a function of the applied magnetic field by the change in the stability of the cavity contour.

1875. Golovin, S. A., Epshteyn, L. Y., and Shushaniya, V. R.,
INTERNAL FRICTION, ELECTRICAL RESISTANCE AND MECHANICAL PROPERTIES OF HARDENED STEEL AFTER TEMPERING IN A FURNACE AND BY ELECTRIC CURRENT HEATING, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 147-149.

The present paper considers the strengthening of hardened steel by electrical heating. Reinforcing steel grades St. 5 and 35 GS were tested. Internal friction and electrical resistance were measured in order to explain this steel strengthening.

1876. Gordiyenko, L. K.,
CHANGES IN INTERNAL FRICTION IN IRON AND LOW-CARBON STEEL IN THE REGION OF LOW PLASTIC DEFORMATION, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 263.

Not abstracted.

1877. Grachev, S. V. and Zubov, V.,
STRESS RELAXATION IN AUSTENITIC STEEL, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 309-312.

This article investigates the relaxation stability of several austenitic steels which had been subjected to plastic deformation and deformation aging at different temperatures. Steels were several iron-chromium-nickel alloys.

1878. Grunzweig and Hartmann AG Ludwigshafen, Germany, STRUCTURAL CONFIGURATIONS FOR INCREASED RESONANCE FATIGUE LIFE by G. Kurtze and L. Gruenz, January 1963, AF61 052 547, AD-297-875.

This report presents structural configurations for increased resonance fatigue life.

1879. Gruzin, P. L. and Semenikhin, A. N., LOW TEMPERATURE PEAK OF INTERNAL FRICTION IN ZIRCONIUM, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 15, No. 5, 1963, pp. 791-793.

The energy-dissipation coefficient, Q^{-1}, of polycrystalline zirconium was determined at 1.3 to 1.6 kc/sec and temperatures, t, from -196° to 200°. Specimens annealed in vacuum at 800° and cooled in the oven, exhibited a pronounced peak in the Q^{-1} versus t plot at 200° to 10° K. This corresponded to two-to-three percent relaxation in the normal modulus of elasticity. The value of the Q^{-1} maximum increased with the degree of deformation and for specimens with approximately one percent deformation it increased as the annealing temperature (four hours) decreased from 300° to 100°. The Q^{-1} maximum was slight after annealing four hours at 800°. The presence of 0.5 percent uranium lowered the Q^{-1} maximum and in the presence of one percent niobium or thorium the peak was absent.

1880. Gruzin, P. L. and Semenikhin, A. N., EFFECT OF NUCLEAR RADIATION AND PLASTIC DEFORMATION ON INTERNAL FRICTION IN ZIRCONIUM, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 236-242.

The investigation dealt with the effect of plastic deformation, annealing, and irradiation by neutrons and gamma rays on the internal friction and modulus of elasticity of polycrystalline zirconium. Neutron irradiation lowered the height of the low-temperature maximum of internal friction and led to the appearance of a sharp maximum of internal friction at 60° C. The irradiated samples were then annealed at 200° C for 20 hours, after which both maxima disappeared.

1881. Gruzin, P. L. and Semenikhin, A. N.,
RECOVERY OF INTERNAL FRICTION IN MOLYBDENUM SINGLE CRYSTALS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 258-262.

Recovery of internal friction and modulus of elasticity were observed in hardened molybdenum single crystals which were then deformed. The crystals were hardened by electrical heating at 1500° to 1600° C. The crystals were then bent, after the internal friction and modulus of elasticity had been measured. The crystals were then annealed at 600° C, and the samples were heated to 120° and 150° C. Neutron irradiation was found to lower the internal friction of a previously annealed molybdenum single crystal.

1882. Gurevich, V. L. and Kagan, V. D.,
ABSORPTION OF ULTRASONICS IN PIEZOELECTRIC SEMICONDUCTORS, Soviet Physics-Solid State, Vol. 4, March 1963, pp. 1788-1791.

Investigation of the effect of conduction electrons on the propagation and absorption of sound in piezoelectric semiconductors is reported. The electron free path is assumed to be much larger than the sound wavelength. The electron-electron interaction is considered and the expressions are applicable for arbitrary statistics of the current carriers.

1883. Hasiguti, R. R.,
INTERNAL FRICTION DUE TO DIFFUSION OF DISLOCATION-KINKS TRAPPED BY POINT DEFECTS, Physical Society of Japan, Journal, Vol. 18, Supplement 1, March 1963, pp. 114-118.

It is proved theoretically that the diffusion of dislocation-kinks trapped by point defects gives rise to an internal friction peak of the relaxation type. This peak is considered to be the one which appears in cold-worked metals above the Bordoni peak temperature.

1884. Hellan, K.,
A STUDY OF THE DAMPING PROPERTIES OF METALS, Acta Polytechnica Scandinavica, PH 27-669, 1963.

Not abstracted.

1885. Henney, R.,
THE DAMPING OF CONTINUOUS SYSTEMS, The Engineer, Vol. 215, March 1963, pp. 572-574.

Not abstracted.

1886. Henney, A. and Raney, J. P.,
THE OPTIMIZATION OF DAMPING OF FOUR CONFIGURATIONS OF A VIBRATING UNIFORM BEAM, Transactions, American Society of Mechanical Engineers, Journal of Engineering for Industry, Vol. 85, Series B, August 1963, pp. 259-264.

Not abstracted.

1887. Hikata, A., Chick, B. B., Elbaum, C., and Truell, R.,
DISLOCATION DAMPING IN SODIUM CHLORIDE, Applied Physics Letters, Vol. 2, No. 1, 1963, pp. 5-6.

The ultrasonic attenuation behavior was studied in sodium chloride single crystals, while being deformed in tension, at room temperature, and at a strain rate of 0.002 in/min. The tensile stress was applied parallel to the long axis of the specimen. Plastic glide, in equally stressed slip systems of sodium chloride single crystals, depends on the length of the slip path and the ultrasonic attenuation of a crystal (the part that depends on dislocation damping), along some crystal directions, can be decreased by small amounts of plastic strain, when the deformation geometry is properly selected.

1888. Hren, J. A.,
EFFECT OF ATOMIC ORDER AND FERROMAGNETISM ON THE ELASTIC AND ANELASTIC PROPERTIES OF Fe--25 at. % Al, Physica Status Solidi, Vol. 3, No. 9, 1963, pp. 1603-1618.

Measurements of the temperature dependence of the dynamic elastic modulus, E, and internal friction, Q^{-1}, are reported. A ΔE effect, of maximum magnitude 0.06, is reported for measurements of E (for H = 0 and H = 1500 oersteds) as a function of temperature. This modulus defect disappears at approximately 500°, in agreement with reported measurements of the longitudinal magnetostriction. Anelastic measurements show three damping maxima: a Snoek peak due to interstitial carbon at 250°, a Zener peak, and a grain-boundary peak near 700°.

1889. Huyck Metals Department, Milford, Connecticut, "FELTMETAL" FIBER METAL, Technical Bulletin No. A-1, 1963.

This bulletin describes the principal acoustical properties and those other properties which make the Feltmetal fiber metals unique in the acoustical field. The material is a controlled density sintered product made from metal fibers of virtually any common metal or alloy. The normal sound absorption coefficient of Feltmetal is plotted as a function of frequency to illustrate the effects of structure density, mounting technique, multiple layers, and temperature.

1890. Hyrat, J., CONTRIBUTION TO THE PROBLEM OF INTERNAL DAMPING OF VIBRATIONS OF THE AXIAL FLOW COMPRESSOR BLADES, Zpravodaj Vzlu, Vol. 37, No. 1, 1963, pp. 45-47.

Not abstracted.

1891. Iahouchevsky, W., HIGH Q CRYSTAL UNITS, Proceedings, Seventeenth Annual Symposium on Frequency Control, Paris Observatory, Meudon, France, 1963, pp. 233-247.

Not abstracted.

1892. Ikushima, A. and Suzuki, T., PROBLEMS RELATING TO THE BORDONI PEAK, Physical Society of Japan, Journal, Vol. 18, Supplement 1, 1963, pp. 163-171.

The results of experimental studies on several ionic crystals are presented. A model is proposed in which dislocation lines are pinned down by jogs and forced to deviate from alignment in the valleys of the Peierls potential, thereby giving rise to Bordoni-type relaxation peaks. The relation between these peaks and the peak corresponding to the Seeger mechanism is discussed.

1893. Ilers, K. H. and Breuer, H.,
MOLECULAR MOTION IN POLYETHYLENE TEREPHTHALATE, Journal of Colloid Science, Vol. 18, 1963, pp. 1-31.

The molecular motions in samples of different crystallinity were investigated by dynamic mechanical measurements of the loss modulus and shear modulus at one cps between -180° and 260°, and are discussed in connection with nuclear magnetic resonance, and dielectric and X-ray data of other authors.

1894. Illinois University,
RESEARCH OF NATURE OF INTERACTIONS OF DISSOLVED INTERSTITIALS WITH DISLOCATIONS by P. Bunn, R. Gibala, R. Hoffman, and C. Wert, May 1963, Progress Report No. 10, Contract AF 33-616-6176, 3 pp.

Not abstracted.

1895. Institute of Environmental Sciences,
REVIEW OF VIBRATION FUNDAMENTALS by R. O. Belsheim and P. F. Cunniff, 1963, pp. 171-176.

Not abstracted.

1896. Janak, J. F.,
DIFFUSION DAMPED DOMAIN WALL MOTION, Journal of Applied Physics, Vol. 34, November 1963, pp. 3356-3362.

Not abstracted.

1897. Johns Hopkins University, Applied Physics Laboratory,
THE TORSIONAL DAMPING CAPACITY OF A THIN WIRE AND ITS APPLICATION TO THE DAMPING OF A VIBRATING EARTH SATELLITE by P. R. Schrantz, J. F. Smola, and B. E. Tossman, CM-1039, AD-600182, August 1963, 61 pp.

Not abstracted.

1898. Jones, C. K. and Brown, C. S.,
THE EFFECT OF IONIZING RADIATION ON THE INTERNAL FRICTION OF SYNTHETIC QUARTZ, Proceedings, Physical Society, London, Vol. 82, No. 527, 1963, pp. 375-381.

The effect of ionizing radiation on the internal friction of five-megacycle shear waves in AT-cut synthetic quartz

resonators was measured, 10° to 400° K, as a function of the rate of growth of the parent quartz crystal. In all specimens, the 50° K peak is removed by irradiation, and for slowly grown quartz the 20° K peak is enhanced by approximately 50 percent. A radiation-induced peak was found at approximately 325° K in fast-grown synthetic quartz.

1899. Junge, H.,
THE APPLICATION OF THE SNOEK DAMPING METHOD TO THE DETERMINATION OF GAS DESORPTION FROM METALS, Vacuum, Vol. 13, 1963, pp. 513-524.

The desorption of nitrogen from high purity iron into vacuum or hydrogen at 500° to 800° C was studied.

1900. Keefer, D. and Wert, C.,
CLUSTERING OF N AND C IN Fe, Physical Society of Japan, Journal, Vol. 18, Supplement 3, 1963, pp. 110-114.

The clustering of nitrogen and carbon in solid solution in body-centered cubic iron has been deduced from anelastic measurements made in the vicinity of -25° C. For alloys of composition about 0.0005 atom fraction nitrogen or carbon, most interstitial atoms are singly dissolved in the lattice, but about five percent of the interstitial present is thought to be bound into pairs and triplets (combined).

1901. Kekalo, I. B. and Livshits, B. G.,
ON THE MAGNETO-DIFFUSION EFFECT IN INVAR, INVESTIGATED BY THE METHOD OF INTERNAL FRICTION, Academy of Sciences of the USSR, Bulletin - Physical Series, Vol. 26, No. 2, 1963, pp. 277-281.

This article investigates the magneto-diffusion effect as evinced by the behavior of the internal friction. Also considered is the effect of temperature (20° to 440° C), holding time, and magnetic and thermal cycling on the internal friction of annealed Invar. A determination is made of the relationship between magneto-diffusion effect, domain structure, and carbon diffusion.

1902. Kekalo, I. B., Livshits, B. G., and Morgner, V.,
THE EFFECT OF ELASTIC DEFORMATION AND CERTAIN MAGNETIC EFFECT ON INTERNAL FRICTION OF IRON, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 190.

Not abstracted.

1903. Kekalo, I. B., Livshits, B. G., Morgner, V., and Sololov, A. Yu.,
THE EFFECT OF DEFORMATION AND MAGNETIC EFFECTS ON INTERNAL FRICTION OF IRON, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 176.

Not abstracted.

1904. Kennedy, A. J.,
PROCESSES OF CREEP AND FATIGUE IN METALS, New York, New York, John Wiley and Sons, 1963.

The whole of the second chapter in this book is devoted to a discussion of anelasticity, with special emphasis on the use of viscoelastic models.

1905. Kern, R.,
METHODS FOR GAS DETERMINATION IN METALS, Physik Der Kondensierten Materie, AD-465-630, Vol. 1, 1963, pp. 105-124 (English Translation).

After a review of some essential aspects of gasmetal systems, a survey is made of the principal methods for the determination of hydrogen, nitrogen, and oxygen content in metals. The importance is emphasized of the methods of: vacuum extraction at high temperatures, mass spectroscopy, and analysis by nuclear activation. Some examples of gas determination are given, and the range of applicability of the different methods is discussed.

1906. Ketterson, J. B.,
ULTRASONIC ATTENUATION IN ANTIMONY. II. DE HAAS-VAN ALPHEN OSCILLATIONS, Physical Review, Vol. 129, 1963, pp. 18-22.

De Haas-van Alphen oscillations in the magnetoacoustic attenuation in single crystals of antimony were measured at

1.2° K in the range of fields from 4000 to 9100 gauss for the field in the x-z, y-z, and x-y planes. In addition to the carriers observed by sulfur, new carriers are seen. Evidence of nonellipsoidal behavior of the Fermi surface of the new carriers is observed.

1907. Kipka, S.,
DAMPING MEASUREMENTS ON CAST STEEL WITH A SOUND-IMPULSE-APPARATUS, Giessereitechnik, Vol. 9, No. 6, June 1963, pp. 176-178.

Comparative measurements of the sound attenuation in annealed and nonannealed specimens of GS 38.9 cast steel of given microstructure, using a commercial sound-impulse tester, in order to develop a simple nondestructive test for distinguishing between annealed and nonannealed steels.

1908. Kline, D. E. and Sauer, J. A.,
NUCLEAR RADIATION EFFECTS IN POLYTETRAFLUOROETHYLENE, Journal of Polymer Science, Part A., Vol. 1, 1963, pp. 1621-1626.

Dynamic mechanical studies of polytetrafluoroethylene, subjected to a total radiation dose of 10^8 rads, showed a decrease in the height of the three damping peaks which are observed in unirradiated samples near 200°, 300°, and 400° K., which is compatible with an increased degree of crystallization and consistent with the effects found in the internal-friction spectrum.

1909. Kochnov, V. Ye. and Bayazitov, M. I.,
SOLUBILITY OF NITROGEN AND CARBON IN COLD-ROLLED TRANSFORMER STEEL, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 134.

Not abstracted.

1910. Koda, S., Kamigaki, K., and Kayano, H.,
LOW TEMPERATURE ULTRASONIC ATTENUATION IN MAGNESIUM AND MAGNESIUM ALLOYS,. Physical Society of Japan, Journal, Vol. 18, Supplement 1, March 1963, pp. 195-199.

Study of ultrasonic attenuation in pure magnesium and magnesium-lithium and magnesium-nitrogen alloys from

4.2° to 300° K. Determination of the activation energies of the relaxation processes accompanied with several of the observed peaks and comparison of their determined ratio with that calculated from Seeger's theory.

1911. Kofstad, P. and Butera, R. A.,
INTERNAL FRICTION IN THE TANTALUM-HYDROGEN SYSTEM, Journal of Applied Physics, Vol. 31, No. 5, May 1963, pp. 1517-1520.

Measurements of internal friction in tantalum-(8.5 percent to 42.4 percent hydrogen) alloys at -179° to 210° C show six peaks at -170°, -83°, 1°, 36°, 54°, and 210° C. Comparisons of the 36° and 54° C peaks with heat capacity data result in their assignment to the long and short range order of hydrogen in the Ta_2H phase. Both the -83° C, and the 1° C, peaks show an amplitude dependence on the hydrogen concentration.

1912. Koiwa, M. and Hasiguti, R. R.,
INTERNAL FRICTION PEAKS AT LOW TEMPERATURES IN DEFORMED COPPER, Acta Metallurgica, Vol. 11, November 1963, pp. 1215-1222.

Internal friction of several polycrystalline copper wires of various purities deformed at liquid nitrogen temperature and at room temperature were measured as a function of temperature between -190° and 20° C at about one cps. There are three relaxation peaks in this temperature region, and detailed studies were made of the nature of one of the peaks which appeared around -125° C.

1913. Kovacs, A. J., Stratton, R. A., and Ferry, J. D.,
DYNAMIC MECHANICAL PROPERTIES OF POLYVINYL ACETATE IN SHEAR IN THE GLASS TRANSITION TEMPERATURE RANGE, Journal of Physical Chemistry, Vol. 67, 1963, pp. 152-161.

The storage shear modulus and loss tangent of polyvinyl acetate (average molecular weight 2×10^6) were measured at radian frequencies between 0.7 and 40 sec^{-1} and at 10 temperatures from 20° to 39.2° by using a modification of the torsion pendulum.

1914. Krasil'nikov, L. A.,
THE EFFECT OF CERTAIN TECHNOLOGICAL FACTORS ON RELAXATION OF STRESSES IN STEEL WIRE, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 320.

Not abstracted.

1915. Krishtal, M. A. and Baranova, V. I.,
TEMPERATURE DEPENDENCE OF THE VACANCY CONCENTRATION IN IRON CHROMIUM AND IRON-MOLYBDENUM ALLOYS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 16, 1963, pp. 626-628.

Not abstracted.

1916. Krishtal, M. A. and Golovin, S. A.,
RELATIVE DAMPING OF TORSIONAL OSCILLATIONS IN HEAT-TREATED U7A STEEL, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 73, Edited by B. N. Finkelshtein.

Not abstracted.

1917. Krishtal, M. A., Golovin, S. A., and Mokrov, A. P.,
MEASUREMENT OF ENERGY OF FORMATION OF VACANCIES IN ALLOYS OF THE SYSTEM IRON-MOLYBDENUM, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 155.

Not abstracted.

1918. Krishtal, M. A., Golovin, S. A., Maksimov, S. K., Vayner, Y. I., Baranova, V. I., and Pudoveyeva, V. P.,
INTERNAL FRICTION, STRUCTURE AND MECHANICAL PROPERTIES OF ALLOYS DEFORMED UNDER STATIC AND IMPULSE LOADS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 128-133.

An investigation was made of the mechanical properties of low-carbon steel (0.90 percent carbon), austenitic steel grade 1Kh18N9T, and OT-4 and Amg5VM alloys based on titanium and aluminum, respectively, under static and impulse loads.

1919. Krishtal, M. A., Golovin, S. A., and Pudoveyeva, V. P., MEASURING THE COLD BRITTLENESS THRESHOLD OF METAL BY THE INTERNAL FRICTION METHOD, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 120-122.

The amplitude dependence of the internal friction is a good method for investigating the processes taking place in metals and alloys. The present paper deals with the lowering of the dislocation mobility, leading to a decrease in the dampening decrement for samples of St. 5 and low-carbon steel annealed in a vacuum at 1000° C for one hour.

1920. Krishtal, M. A. and Goryachev, B. A., HIGH-FREQUENCY RESONANCE AND INTERNAL FRICTION IN TEMPERING BY HIGH-FREQUENCY CURRENTS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 150.

Not abstracted.

1921. Krishtal, M. A. and Goryachev, B. A., FEATURES OF THE VARIATION IN COMPOSITION WHEN A QUENCHED STEEL IS HEATED WITH RADIO-FREQUENCY CURRENTS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 15, 1963, pp. 819-823.

A study has been made of the influence of the frequency of the current in induction heating on the properties of mild steel after tempering. Resonance has been found between the "jump" frequency of the carbon atoms and that of the generators which accelerate the diffusion and anomalous change in the mechanical properties. The soaking period used during the induction tempering of quenched steel has been found to influence its strength characteristics and damping capacity.

1922. Kudryavtseva, L. A., Panova, L. M., Popov, L. E., and Sukhovarov, V. F., EFFECT OF VARIOUS ATOMIC DEFECTS ON KINETICS OF FORMATION OF K-STATE IN NICKEL-MOLYBDENUM ALLOYS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 15, 1963, pp. 451-455.

By employing multistage tempering at 150°, or less, it was possible to obtain a low-temperature increase of

electrical resistance as a result of K-state formation. Within this region of increase of electrical resistance two peaks of internal friction were determined, whereby one of these peaks lies in the region of rapid growth of electrical resistance and is ascribed to reorientation of pairs of vacancies.

1923. Kurtze, G.,
STRUCTURAL CONFIGURATIONS FOR INCREASED RESONANCE FATIGUE LIFE, ASD-TDR-62-1098, January 1963, 56 pp.

After a short summary of the existing methods used for the damping of bending waves, an analysis is given for the calculation of three types of sandwich panels with dissipative cores. These sandwich panels seem to represent the optimum solution with respect to high damping and are characterized by equally thick metal skin layers.

1924. Lawson, K. D., Sauer, J. A., and Woodward, A. E.,
LOW-TEMPERATURE INTERNAL FRICTION IN NYLON 4, Journal of Applied Physics, Vol. 34, No. 8, 1963, p. 2492.

Mechanical loss and shear modulus versus absolute temperature were determined in the region 100° to 300° K in specimens annealed in vacuum at 135° for four hours. There was an internal friction maximum at 127° K (0.31 cps) and a second-loss peak of much lower strength at approximately 213° K (0.295 cps).

1925. Lebedev, R. S. and Postnikov, V. S.,
EFFECT OF PLASTIC DEFORMATION ON INTERNAL FRICTION IN IRON ALLOYS, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 145, Edited by B. N. Finkelshtein.

Not abstracted.

1926. Lee, T. M.,
METHOD OF DETERMINING DYNAMIC PROPERTIES OF VISCOELASTIC SOLIDS EMPLOYING FORCED VIBRATION, Journal of Applied Physics, Vol. 34, No. 5, 1963, pp. 1524-1529.

The longitudinal vibration method and the torsional vibration method of evaluating dynamic properties of viscoelastic solids are discussed from a mathematical point of view.

1927. Lepin, G. F. and Toptunova, L. M.,
INVESTIGATION OF RULES GOVERNING STRESS RELAXATION, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 290.

Not abstracted.

1928. Levy, M., Kagiwada, R., and Rudnick, I.,
ULTRASONIC ATTENUATION OF TRANSVERSE WAVES IN V, Nb, AND Ta FOR ql<1, Physical Review, Vol. 132, 1 December 1963, pp. 2039-2046.

The temperature dependence of the ultrasonic attenuation coefficient of transverse waves with a wave vector parallel to <110> was measured in superconducting vanadium, niobium, and tantalum.

1929. Levy, M. and Rudnick, I.,
ULTRASONIC DETERMINATION OF THE SUPERCONDUCTING ENERGY GAP IN TANTALUM, Physical Review, Vol. 132, No. 3, 1963, pp. 1073-1080.

Ultrasonic measurements were performed on two single crystals of tantalum axially oriented on <110>. The temperature dependence of the attenuation coefficient of longitudinal waves propagating in this direction was used to compute the temperature dependence of the superconducting energy gap of tantalum.

1930. Livshits, B. G. and Rymashevskiy, G. A.,
CHANGING OF DEBYE TEMPERATURE DURING ORDERING OF A_3B TYPE ALLOYS, Ukrains'kii Fizichnii Zhurnal, Vol. 8, No. 2, 1963, pp. 243-248.

Debye temperature was calculated during disordering (quenching) and ordering (annealing) of Ni_3Fe, Ni_3Mn, and $CuNi_3$ alloy rods using electrical-resistance data and the damping value of elastic vibrations induced in the rods. The relationship between interatomic bonding force and Debye temperature was explored.

1931. Lomer, J. N.,
THE EFFECT OF ELECTRON IRRADIATION ON THE INTERNAL FRICTION OF COPPER BETWEEN 10 K AND 80 K, Philosophical Magazine, Vol. 8, 1963, pp. 951-955.

The change in the internal friction of copper was measured during warm-up of specimens after electron irradiation near 10° K. The damping decreased between 33° and 55° K. The decrease is attributed to a defect becoming mobile in this temperature range.

1932. Lord Manufacturing Company, Erie, Pennsylvania,
RESPONSE OF LAMINATES WITH DISSIPATIVE SKINS by G. E. Warnaka and R. R. Desai, 1963.

Laminates made with plastic or reinforced plastic skins were sometimes found to have different damping characteristics than expected on the basis of conventional laminate theory. Mathematical analyses of the effects of dissipative skins on the dynamic response of laminates are presented. Experimental verification is shown, and some practical design considerations are discussed.

1933. Lücke, K.,
ULTRASONIC MEASUREMENTS OF INTERACTION BETWEEN DISLOCATIONS AND POINT IMPERFECTIONS, Physical Society of Japan, Journal, Vol. 18, Supplement 1, March 1963, pp. 102-104.

This article is a study of the production and migration of point imperfections by measuring the time dependence of dislocation damping.

1934. Lysaght's Central Research Laboratory,
THE SOLUBILITY OF CARBON IN COMMERCIAL LOW CARBON STEEL, 24 October 1963, Research Report No. 298.

The equilibrium solubility of carbon (in commercial capped steels) has been determined after isothermal annealing at 700° and 600° C, following a normalizing treatment at 900° C.

1935. Mackintosh, A. R.,
ULTRASONIC ATTENUATION IN LEAD, Proceedings, Royal Society, Vol. 271, January 1963, pp. 88-104.

The absorption of longitudinal ultrasonic waves has been studied as a function of transverse magnetic field in pure single crystals of lead at 1.2° K.

1936. Maksimov, A. M.,
DETERMINING THE DEPTH OF INTERCRYSTALLINE CORROSION OF METALS AND ALLOYS BY CHANGES IN INTERNAL FRICTION AND RESONANCE FREQUENCY OF SPECIMEN, Zavodskaya Laboratoriya, No. 6, 1963, pp. 713-718.

Kh23N18, LA4, and 1Kh18N9T steels in cast and deformed states are corroded by boiling $CuSO_4$ and H_2SO_4 solutions and tested for intercrystalline corrosion depth by comparing the internal friction value and resonance vibration attenuation decrement value of corroded and noncorroded specimens.

1937. Maksimyuk, P. A.,
THE EFFECT OF CHANGES IN THE NUMBER OF FREE ELECTRONS ON THE MODULUS OF ELASTICITY, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 233.

Not abstracted.

1938. Mal'tseva, G. K., Postnikov, V. S., and Usanov, V. V.,
INTERNAL FRICTION OF CuAu AND Cu_3Au ALLOYS, Izv. Vysshikh Uchebn. Zavedenii, Chernaya Met., Vol. 6, No. 5, 1963, pp. 156-161.

The curve of temperature versus internal friction shows a decided peak at approximately 410°, which indicates that this peak is connected with the order-disorder transition.

1939. Mal'tseva, G. K., Postnikov, V. S., and Usanov, V. V.,
INTERNAL FRICTION OF BINARY ALLOYS WITH FACE-CENTERED-CUBIC LATTICE SUBJECT TO ORDERING, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 16, No. 2, 1963, pp. 302-309.

By using a low-frequency torsion pendulum, the internal friction of the following alloys subject to ordering was studied: CuAu, Cu_3Au, $CuPt_3$, and Cu_3Pd.

1940. Maltseva, G. K., Zolotukhin, I. V., and Postnikov, V. S., EFFECT OF TEMPERATURE ON THE DAMPING CAPACITY OF COPPER ALLOYS, Physics of Metals and Metallography, Vol. 16, No. 5, 1963, pp. 102-106.

The temperature and concentration dependence of the damping capacity of certain binary alloys have been studied. A number of peaks has been established on the temperature curve of damping capacity. Suggestions are made regarding the nature of these peaks.

1941. Mal'tseva, G. K. and Postnikov, V. S., DECOMPOSITION OF SUPERSATURATED SOLID SOLUTIONS OF COPPER-BERYLLIUM, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 79, Edited by B. N. Finkelshtein.

Not abstracted.

1942. Mangiarotty, R. A., ACOUSTIC RADIATION DAMPING OF VIBRATING STRUCTURES, Acoustical Society of America, Journal, Vol. 35, March 1963, pp. 369-377.

Not abstracted.

1943. Mar'evich, V. P. and Shklyar, R. Sh., INTERNAL FRICTION IN NICKEL AND MANGANESE AUSTENITE, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 15, No. 6, 1963, pp. 914-918.

The internal friction of steels G19 and G29 containing 18.69 percent and 29.4 percent manganese and N39 and N27 containing 39.45 percent and 27.0 percent nickel and all four containing 0.05 percent carbon was determined by the low-frequency torsional vibration method, as a function of the degree of deformation, d, the temperature, and the amplitude, a.

1944. Marine Engineering Laboratory, Annapolis, Maryland, PERFORMANCE OF AIR-RUBBER ISOLATOR, July 1963, AD-409-756.

An air-rubber isolator was evaluated to determine its compliance with design objectives of the contract and its general suitability for ship board use.

1945. Marine Engineering Laboratory, Ship Silencing Division, Annapolis, Maryland,
THE EFFECT OF ISOLATION MOUNT DAMPING ON VIBRATION TRANSMISSION IN A SIMPLE SYSTEM by R. Muksian, 1963, MEL-67-103C, AD-434250, 49 pp.

Not abstracted.

1946. Mason, W. P. and Batemen, T. B.,
ULTRASONIC ATTENUATION AND VELOCITY CHANGES IN DOPED n-TYPE GERMANIUM AND p-TYPE SILICON AND THEIR USE IN DETERMINING AN INTRINSIC ELECTRON AND HOLE SCATTERING TIMES, Physical Review Letters, Vol. 10, 1963, pp. 151-154.

Quantitative measurements were made of the attenuation of shear waves in n-type germanium which show that the intervalley relaxation time for highly-doped semiconductors is approximately 2×10^{-13} sec. Other measurements were made for p-type silicon doped with 2.5×10^{18} boron atoms per cubic centimeter. Therein, similar attenuations take place with the addition of smaller attenuations in directions for which, in n-type germanium, there was no electronic damping.

1947. Melpar, Incorporated, Falls Church, Virginia,
DETERMINATION OF THE DESIGN CRITERIA FOR OPTICALLY TRANSPARENT MODIFIED SELECTRON 400 PLASTIC MATERIAL by L. K. Eliason, May 1963, TDR63-342, AD-408-087, 35 pp.

This report concerns the measurement of certain design characteristics of modified selectron 400 transparent plastic material. The combination of optical properties and high-temperature capability indicated usefulness in aircraft applications; therefore, selective mechanical, physical, chemical, and electrical properties were determined. Individual results are given.

1948. Mentel, T. J. and Fu, C. C.,
STRESS-STRAIN RELATIONS WITH MEASURED CYCLIC DAMPING, American Institute of Astronautics and Aeronautics, Journal, Vol. 1, August 1963, pp. 1889-1891.

Not abstracted.

1949. Miller, B. I.,
TEMPERATURE DEPENDENCE OF THE ULTRASONIC ATTENUATION IN GERMANIUM, Physical Review, Vol. 132, 15 December 1963, pp. 2477-2483.

The ultrasonic attenuation in germanium has been measured as a function of temperature from 300° to 20° K and at frequencies of 4 to 132 megacycles using the pulse echo technique with longitudinal sound pulses along the <111> direction. The contribution to the attenuation from electron-phonon interactions was found to be negligible and independent of carrier concentration.

1950. Minnesota University, Minneapolis, Minnesota,
MATERIAL DAMPING UNDER BIAXIAL STATE OF STRESS GENERATED BY COMBINED AXIAL AND INTERNAL PRESSURE LOADINGS, July 1963, TDR63-647, AD-419-315, 30 pp.

A test machine was constructed which measures material damping in thin-walled, cylindrical specimens subject to combined internal pressure and axial cyclic loading. The purpose of this machine is to allow the complete range of biaxial stress states to be developed, so that the individual damping effects of distortional and dilatational straining action might be clearly discerned. Experimental results on a series of manganese alloy specimens are found to display significant damping effect associated with straining.

1951. Minnesota University, Minneapolis, Minnesota,
VISCOELASTIC SUPPORT DAMPING OF BUILT-IN CIRCULAR PLATES, JULY 1961-JULY 1962 by T. J. Mentel and R. L. Schultz, ASD-TDR-63-648, AD-425013, October 1963, 29 pp.

Not abstracted.

1952. Minnesota University, Minneapolis, Minnesota,
DAMPING OF MATERIALS UNDER BIAXIAL STRESS by P. J. Torvik, S. H. Chi, and B. J. Lazan, May 1963, TDR62-1030, AD-406-716, 45 pp.

A new theory in combined stress damping is developed and evaluated on the basis of experimental results for several materials. It is concluded that the new theory should be limited in application to materials whose dominant damping

mechanism is known to be plastic deformation. It appears that a separate theory of combined stress damping may be required for each mechanism of damping.

1953. Mirkin, I. L. and Endzelin, M. A.,
EFFECT OF BORON ON THE INTERNAL FRICTION OF 1Kh18N12T STEEL, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 229-232.

An investigation is made of the effect of boron on the temperature dependence of internal friction in heat-resistant austenitic steel, grade 1Kh18N12T, during long-term aging. This was done with boron concentrations of 0.01 and 0.03 percent by weight. The introduction of boron up to 0.03 percent does not affect damping below 500° C. However, at higher temperatures, the internal friction of steel is decreased by boron.

1954. Mišek, K.,
COMMENT ON THE ARTICLE BY KEKALO, I. B. AND LIVSHITS, B. G., Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 15, 1963, pp. 932-934.

Not abstracted.

1955. Mišek, K.,
THE MAGNETOMECHANICAL PHENOMENON IN AN ALTERNATING MAGNETIC FIELD AS A RELAXATION PROCESS, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 229, Edited by B. N. Finkelshtein.

Not abstracted.

1956. Mišek, K. and Toman, K.,
AGING OF ALUMINUM-SILVER ALLOYS, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 75, Edited by B. N. Finkelshtein.

Not abstracted.

1957. Mongy, M., Salama, K., and Beckman, O.,
DISLOCATION RELAXATION IN ALUMINUM SOLID STATE COMMUNICATIONS, Vol. 1, 1963, pp. 234-236.

Dislocation motions in the three principal planes of single crystal aluminum have been studied at ultrasonic frequencies of 10, 20, and 50 mc/sec. The activation energies and the relaxation frequencies, calculated from the position of the Bordoni peak, show a high degree of anisotropy. The' results are discussed in connection to Seeger's theory.

1958. Morgner, W. and Avraamov, Yu. S.,
LOW-TEMPERATURE DAMPING CAPACITY OF PURE IRON, Physics of Metals and Metallography, Vol. 16, No. 4, 1963, pp. 135-136.

Annealed electrolytic iron and Armco iron are torsion tested at 100° to -196° C in a magnetic field of 320 oersteds to determine the internal friction of specimens as a function of temperature, deformation, dislocation interaction and purity of the metal.

1959. Morley, A. W.,
NATURAL VIBRATION WITH DAMPING FORCE PROPORTIONAL TO A POWER OF THE VELOCITY, Royal Aeronautical Society, Journal, Vol. 67, June 1963, pp. 381-385.

Not abstracted.

1960. Morozov, O. G.,
INVESTIGATION OF THE STRENGTH OF SOLDERED JOINTS BY THE INTERNAL FRICTION METHOD, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 271-274.

Parts made of EI617 alloy were tested. The solder was a nickel-manganese-chromium alloy with a 0.05 millimeter boron film. The test results show a clear relationship between internal friction and strength at high temperatures. When the thermodiffusion time increases, the internal friction is lowered, while the heat resistance increases. When the internal friction remains constant, the heat resistance also stops changing. This relationship may be used for determining the type of thermodiffusion which will ensure high strength of the soldered joint.

1961. Nall, B. H.,
ACOUSTIC ATTENUATION IN A SOLID PROPELLANT,
American Institute of Astronautics and Aeronautics, Journal, Vol. 1, January 1963, pp. 76-79.

Measurements were made of longitudinal excitation from 500 to 14,000 cps in discrete steps by the successive use of quarterwave resonance, halfwave resonance, and pulse techniques.

1962. National Aeronautics and Space Administration,
INVESTIGATION OF THE YIELD PHENOMENON IN ZIRCALOY-2 AT ELEVATED TEMPERATURES by F. R. Shober, R. W. Getz, P. B. Shumaker, A. P. Young, M. F. Amateau, and R. F. Dickerson, 1963, Document N63-13574, 42 pp.

The yield phenomenon in Zircaloy-2 was studied by using elevated temperature short-time tensile tests, internal-friction measurements, and electron microscopy.

1963. National Aeronautics and Space Administration,
SELF-ERECTING FLEXIBLE FOAM STRUCTURES FOR SPACE ANTENNAS by V. L. Vaughan, Jr. and E. L. Hoffman, March 1963, TN-D-1610, 16 pp.

The concept of using flexible foam for the erecting mechanism and supporting structure of erectable Yagi disk antenna elements was investigated. These elements were investigated for packaging and erection ability, vibration damping in a vacuum, and temperature differential in a vacuum.

1964. Naval Air Engineering Center, Aeronautical Materials Laboratory, Philadelphia, Pennsylvania,
INVESTIGATION OF SAFE-T-FLO-PAK CUSHIONING MATERIALS by D. Minuti and D. R. Agnew, March 1963, AD-404-112L, 11 pp.

An investigation was made of cushioning materials (multitude of resilient, hollow, cylindrical coated, paper tubes), impact shock, dynamic set, vibration, creep, corrosion, density, moisture absorption, and flow.

1965. Navrotskii, I. V., Tomenko, Yu. S., Golik, V. R., and Dubrov, V. A.,
INVESTIGATION OF THE MECHANISM OF IMPACT FATIGUE BY MEASURING THE DAMPING OF OSCILLATIONS, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 237, Edited by B. N. Finkelshtein.

Not abstracted.

1966. Neighbours, J. R., Oliver, R. W., and Stillwell, C. H.,
ULTRASONIC ATTENUATION IN MnF_2 NEAR THE NEEL TEMPERATURE, Physical Review Letters, Vol. 11, No. 3, 1963, pp. 125-127.

Preliminary results are reported of ultrasonic attenuation experiments on single-crystal MnF_2 which showed a frequency-dependent attenuation peak only for longitudinal waves very close to the Neel temperature, a relatively slight dependence of attenuation on magnetic field strength, and no observable change in elastic constant of the Neel temperature.

1967. Neubert, H. K. P.,
A SIMPLE MODEL REPRESENTING INTERNAL DAMPING IN SOLID MATERIALS, Aeronautical Quarterly, Vol. 14, May 1963, pp. 187-210.

Not abstracted.

1968. Novokreshchenov, P. D., Zubekhin, V. P., and Savchenko, N. V.,
INVESTIGATION OF THE EFFECT OF LOW-MELTING COATINGS ON NICKEL STRENGTH AFTER CYCLIC HEAT TREATMENT BY THE INTERNAL FRICTION METHOD, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 112-114.

Pure tin, lead, and bismuth were coated on the nickel in an even layer of about 0.04 millimeter. Internal friction was then determined with a torque pendulum. The sample was heated for 10 seconds and cooled for 15 seconds, the maximum temperature being 800° C and the minimum temperature 100° C. The internal friction curve was determined for each sample after 0, 100, 500, and 1000 cycles. The

tests demonstrated that all low-melting coatings increase the internal friction of nickel between 100° and 350° C and significantly lower the internal friction at higher temperatures.

1969. Oberst, H., Becker, S. W., Meissner, J., and Thurn, H., ELASTIC AND VISCOUS PROPERTIES OF MATERIALS, Berlin, Beuth-Vertrieb GMBH, 1963, 71 pp.

This publication is divided into four parts. Chapter 1 deals with the ideal elastic behavior of solids drawing from the linear theory of elasticity and wave propagation. Chapter 2 takes up linear viscoelastic behavior and flow. Double Maxwell and Voigt models are introduced to describe these phenomena. Using complex modulus notation, relations are derived to relate the response of vibrating systems to the elastic and loss moduli of the specimen. In Chapter 4, experimental data are presented for a variety of high polymer materials showing the dependence of their moduli on frequency, temperature, and amplitude of stress.

1970. Ohio State University, Columbus, Ohio, CRITICAL SURVEY OF MECHANICAL PROPERTY TEST METHODS FOR BRITTLE MATERIALS by W. B. Shook, July 1963, AD-417-621, 136 pp.

A critical survey of the state-of-the-art of mechanical property tests of brittle materials is presented. The format utilized in presenting the information is based on property categories, since no significant breakdown for specific materials is justified.

1971. Okada, T. and Suita, T., ULTRASONIC ATTENUATION AND SOME RELATED BEHAVIORS IN IRRADIATED ALKALI HALIDE CRYSTALS, Physical Society of Japan, Journal, Vol. 18, Supplement 1, 1963, pp. 135-141.

Sodium chloride crystals subjected to gamma irradiation at room temperature were examined during deformation by the following experimental techniques: (1) observation of the yield point; (2) observation of the change in ultrasonic attenuation as a function of the load. The stress-strain relationships and the attenuation change versus stress were similar for the early stages of plastic flow in annealed crystals.

Here the damping increased rapidly; however, with further deformation the damping saturated at a certain value.

1972. Oklahoma State University, Stillwater Research Foundation, MEASUREMENT OF THE DYNAMIC FLEXURAL RESPONSE OF BEAMS AND PLATES by J. F. Guess and G. B. Thurston, October 1963, AD-422-665, 18 pp.

An experimental system is described which is capable of exciting and detecting flexural waves in viscoelastic beams and plates constructed of a wide range of materials and supported in various ways. The functions and limitations of the system are discussed.

1973. Okuda, S. and Hashiguti, Y., INTERNAL FRICTION PEAKS OF COLD-WORKED GOLD AND COPPER AT LOW TEMPERATURES, Acta Metallurgica, Vol. 11, 1963, pp. 257-265.

The internal friction and dynamic modulus of gold (99.999 percent) and copper (99.99 percent) deformed at room temperature and at liquid nitrogen temperature was measured as a function of temperature from -165° to 100° C by the inverted torsion pendulum method. Three internal friction peaks were found in this range. These peaks grew and decayed during the process of annealing. These results are believed to be due to the pinning of dislocations by single vacancies, divacancies, and (or) trivacancies and interstitials.

1974. Okuda, S., STUDY OF THE BORDONI PEAK IN F.C.C. METALS AFTER DEFORMATION AT 4.2 K AND SUBSEQUENT LOW TEMPERATURE ANNEALING, Physical Society of Japan, Journal, Vol. 18, Supplement 1, March 1963, pp. 187-195.

Measurement of the internal friction and dynamic modulus of gold, copper, silver and platinum from 4° to 300° K after torsional prestrain and subsequent annealing.

1975. Okuda, S.,
STUDY ON DISLOCATION RELAXATION PEAKS IN GOLD AND COPPER, Journal of Applied Physics, Vol. 34, October 1963, pp. 3107-3112.

An inverted torsion pendulum apparatus for the measurement of internal friction and dynamic modulus of metals over the temperature range 4° to 300° K after deformation in situ at 4° K is described. A detailed study of low-temperature internal friction peaks in pure gold and copper was carried out with this apparatus. The internal friction below 15° K was found to rise for gold specimens deformed at low temperature. This rise is discussed in detail and suggests a relaxation peak below 15° K in cold-worked gold.

1976. Osaka, Y.,
ULTRASONIC ATTENUATION IN NORMAL METALS, Physical Society of Japan, Journal, Vol. 18, No. 6, June 1963, pp. 877-901.

Equations are derived for ultrasonic attenuation of longitudinal and transverse waves in normal metals.

1977. Ostergaard, P. B., Cardinell, R. L., and Goodfriend, L. S.,
TRANSMISSION LOSS OF LEADED BUILDING MATERIALS, Journal of Acoustical Society of America, Vol. 35, No. 6, June 1963, pp. 837-843.

A number of architectural-partition materials were tested for sound-transmission loss with and without 2- x 4-inch wood studs. The results indicate that a new series of building products having high transmission loss is practicable, using conventional building materials with a lead sheet adhesively bonded, as well as the imaginative combinations of lead with many new substrate materials. Evaluating methods for new lead-bearing materials are outlined. The high damping of a constrained viscoelastic layer is an additional bonus.

1978. Papadakis, E. P.,
RAYLEIGH AND STOCHASTIC SCATTERING OF ULTRASONIC WAVES IN STEEL, Journal of Applied Physics, Vol. 34, No. 2, February 1963, pp. 265-269.

The ultrasonic attenuation in pearlitic SAE 4150 steel is measured from 5 to 100 megacycles at various stages in its heat treatment, including austenization, quenching, and tempering to martensite. The attenuation and related scattering are influenced by changes in grain diameter. Anisotropy and frequency of grains transformed to martensite is lower than pearlite, while martensite itself becomes less anisotropic upon tempering.

1979. Papazian, N.,
REINFORCED PLASTIC BLADES FOR GAS TURBINE ENGINE COMPRESSORS, Canadian Aero. and Space Journal, Vol. 9, October 1963, pp. 255-258.

Not abstracted.

1980. Pavlov, V. A.,
STUDY OF LATTICE DEFECTS BY INTERNAL FRICTION, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 169, Edited by B. N. Finkelshtein.

Not abstracted.

1981. Payne, A. R.,
ELASTIC AND DAMPING PROPERTIES OF VISCOELASTIC MATERIALS, Environmental Engineering Quarterly, No. 5, 1963, p. 57 (Society of Environmental Engineers, First Symposium and Exhibition, March 1963).

This paper stresses the main factors governing the elasticity and damping of viscoelastic materials used by designers of rubber mountings or built-in structural damping devices. In particular, the effects of fillers in modifying the elasticity and viscosity of these materials are discussed. Recent developments in damping aids using viscoelastic materials are reviewed.

1982. Pennsylvania State University, University Park, Pennsylvania, EFFECTS OF TRIAXIAL STRESSES ON MECHANICAL PROPERTIES OF METALS UNDER HIGH PRESSURE, September 1963, AFOSR 5273, AD-417-488.

This final report delineates the effects of triaxial stresses on mechanical properties of metal under high pressure.

1983. Pennsylvania State University, University Park, Pennsylvania, SEARCH FOR HIGH-Q LIQUID-FILLED SYSTEMS by M. M. Simon, 1963.

The bulk modulus and its associated loss factor for small viscoelastic specimens can be determined by placing the sample at a velocity node of a liquid-filled system. The Q of this system must be high in order to obtain accurate results. Thus, to develop systems of high Q with the aim in mind of eventually measuring the Q of test specimens, the frequency response and Q of several systems were determined, including tubes and spheres of metal or glass containing liquids of various viscosity and density.

1984. Petarra, D. P. and Beshers, D. N., DAMPING SPECTRUM OF IRON, Journal of Applied Physics, Vol. 34, September 1963, pp. 2739-2745.

The internal friction of iron was measured from zero to 400° C at one cycle per second. The results were analyzed in terms of the magnetomechanical contributions to the damping, discernible peaks, and the remaining backbround. Three new features of the damping spectrum are reported: a magnetomechanical rise above 200° C which corresponds to the ΔE effect; a sharp, but unstable, rise in the background damping above 150° C with an apparent activation energy of approximately 16 kcal/mole; and a dislocation dragging peak in the vicinity of 125° C.

1985. Piguzov, Y. V. and Bernshteyn, M. L., INVESTIGATION OF THE INTERNAL FRICTION OF IRON AFTER THERMOMECHANICAL AND THERMOMECHANICAL MAGNETIC WORKING, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 85-91.

Wire drawing was employed for the thermomechanical and thermomechanical magnetic working. The maxima of

internal friction for iron are at 40° and 200° C, and a relaxation peak at -50° C. Thermomechanical and thermomechanical magnetic working also cause a peak in the internal friction curve at -50° C. As a result of these tests, it was found that deformation and phase transformation affect the maximum in the same way at 40° C and at 200° C. This means that the relaxation effects at these temperatures are connected with dislocations. The new maximum of internal friction found in these investigations is probably connected with shearing slippage caused by migration of mobile dislocations.

1986. Pisarenko, G. S. and Khil'chevskii, V. V., DISSIPATION OF ENERGY IN MATERIALS, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 27, Edited by B. N. Finkelshtein.

Not abstracted.

1987. Pittsburgh University, Pittsburgh, Pennsylvania, AN INVESTIGATION OF A METHOD FOR MEASURING LOCALIZED DAMPING by G. F. Kirby, 1963, 64 pp.

Not abstracted.

1988. Plunkett, R., VIBRATION RESPONSE OF LINEAR DAMPED COMPLEX SYSTEMS, Journal of Applied Mechanics, Vol. 30, March 1963, pp. 70-74.

Not abstracted.

1989. Polyakov, S. N., BEHAVIOR OF CARBON IN ALPHA-IRON-MANGANESE AND ALPHA-IRON-MOLYBDENUM ALLOYS, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 86, Edited by B. N. Finkelshtein.

Not abstracted.

1990. Postnikov, V. S., Editor,
TRANSACTIONS OF THE THIRD ALL-UNION SCIENTIFIC CONFERENCES, Relaxation Phenomena in Metals and Alloys, ("Relaksatsionnyye yavleniya v metallakh i splavakh") Moscow, Metallurgizdat, 1963, 340 pp.

This book contains a collection of papers presented at a conference in Voronesh in 1962.

1991. Postnikov, V. S.,
RELAXATION PHENOMENA IN SOLIDS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 15.

Not abstracted.

1992. Postnikov, V. S.,
INTERNAL FRICTION IN PLASTICALLY DEFORMED METALS AND ALLOYS AT HIGH TEMPERATURES, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 199, Edited by B. N. Finkelshtein.

Not abstracted.

1993. Postnikov, V. S. and Belyayev, A. M.,
THE EFFECT OF VARIOUS FACTORS ON THE CHARACTER OF TEMPERATURE DEPENDENCE OF INTERNAL FRICTION OF ALUMINUM, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 159.

Not abstracted.

1994. Postnikov, V. S. and Gorshkov, G. A.,
RESTORATION OF INTERNAL FRICTION OF ALUMINUM AFTER CYCLIC DEFORMATION, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 115.

Not abstracted.

1995. Postnikov, V. S., Sharshakov, I. M., and Maslennikov, E. M., GRAIN-BOUNDARY STRESS RELAXATION IN PURE METALS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 165.

Not abstracted.

1996. Postnikov, V. S. and Zolotukhin, I. V., CYCLIC HEAT TREATMENT AS AFFECTING THE DAMPING CAPACITY AND ELONGATION OF ALUMINUM-ZINC ALLOYS, Physics of Metals and Metallography, Vol. 16, No. 6, 1963, pp. 131-133.

Cyclic heating at temperature up to 330° C of annealed aluminum-zinc alloy with zinc content ranging from 10 percent to 98 percent. Determination of the internal friction and grain size as functions of zinc content, temperature, and number of thermal cycles.

1997. Postnikov, V. S. and Zolotukhin, I. V., INVESTIGATION OF THERMAL FATIGUE OF ALUMINUM-COPPER ALLOYS BY THE INTERNAL FRICTION METHOD, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 105-111.

The alloys tested in the present paper contained 0.5 percent, 4 percent, 5.5 percent, 10 percent and 33.8 percent copper (by weight). The tests indicated that internal friction and elongation of high-copper alloys at high temperatures vary in the same way, while at room temperature and with low-copper content they vary in opposite directions. An increase in the maximum temperature of the heating-cooling cycle leads to a sharp drop in internal friction when the number of cycles increases.

1998. Powles, J. G., Strange, J. H., and Sandiford, D. J. H., PROTON SPIN LATTICE RELAXATION AND MECHANICAL LOSS IN STEREO-REGULAR POLYMETHYL METHACRYLATES, Polymer, Vol. 4, No. 3, 1963, pp. 401-404.

The proton spin lattice relaxation time, T_1, as a function of temperature was measured for three samples of polymethyl methacrylate of different tacticity. The dynamic mechanical losses in the frequency region of about 200 sec^{-1} were also measured by the vibrating-reed method.

1999. Prevention of Deterioration Center, NAS-NRC, Washington, D. C.,
ENVIRONMENTAL EFFECTS ON MATERIALS AND EQUIPMENT, June 1963, AD-417-353, Vol. 38, No. 6.

Not abstracted.

2000. Republic Aviation Corporation, Farmingdale, New York,
ENGINEERING PROGRESS REPORT ON INVESTIGATION OF THE BASIC MECHANISM OF METAL FATIGUE by B. Z. Hyatt and L. J. Teutonico, October 1963, NOW63 0704C, AD-425-449, No. 1, 18 pp.

The mechanism of metal fatigue is being investigated by studying dislocation dynamics in single crystals during stress cycling by means of ultrasonic attenuation measurements in the megacycle frequency range.

2001. Rice University,
LOW TEMPERATURE ANNEALING OF THE ULTRASONIC ATTENUATION IN PRESTRAINED LiF AFTER Co-60 GAMMA IRRADIATION AT LIQUID NITROGEN TEMPERATURE by M. Yabe, 1963, 29 pp.

Not abstracted.

2002. Richter, H. P. H.,
PHOTOGRAPHIC METHOD FOR MEASURING MATERIAL DAMPING AND DYNAMIC YOUNG'S MODULUS AT LOW FREQUENCIES APPLIED TO A FIBERGLASS REINFORCED RESIN STRUCTURE, Society of the Plastics Industry, 1963, 10 pp.

Not abstracted.

2003. Robert W. Benson and Associates, Incorporated, Nashville, Tennessee,
MECHANICAL HYSTERESIS by R. W. Benson, April 1963, Contract No. NONR 3995(00), 25 pp.

Mechanical hysteresis loops were obtained from a plot of the dynamic stress-strain characteristics of a material. Supplementary experiments demonstrating the complex motion of particles in a longitudinally excited vibrator, led to the conclusion that the paths traced by electrons in the lattice structure was different for the tensile and compressive portions of the cycle. Since the potential field in the

lattice structure was non-uniform, a hysteresis loss was observed. Illustrations of the effect of the shape of the hysteresis loop on fatigue are given.

2004. Roberts, J. M. and Hartman, D. E.,
THEORY OF DISLOCATION HYSTERESIS WITH APPLICATION TO DAMPING MEASUREMENTS IN MAGNESIUM SINGLE CRYSTALS, Physical Society of Japan, Journal, Vol. 18, Supplement 1, 1963, pp. 119-129.

The hysteretic damping theory due to Weertman and Salkovitz is modified by taking into account line tension-limited dislocation motion and by realization that some dislocation loops can bow further than the mean spacing between solute atoms in the crystal when the applied stress is less than the mean internal stress. The results of an experimental investigation concerning the effect of temperature (in the range 82° to 32° K), frequency (in the range 0.015 to 0.75 cps), prestrain (in the range 0 to 120 x 10^{-4}) and stress amplitude upon the energy loss associated with damping loops in about 99.96 atomic-percent pure-magnesium single crystals are reported.

2005. Rosenfield, A. R.,
THE 250 DEGREE INTERNAL FRICTION PEAK IN IRON, Nature, Vol. 198, 1963, pp. 279-280.

The contention that the 250° internal friction peak in iron is due to oxygen in solution is supported by the observation that the activation energy of the peak is close to that predicted for the activation energy for diffusion of oxygen in iron. Also, experiments on the effects of ternary additions show that the stronger the ternary as an oxide former, the more the 250° peak is suppressed.

2006. Rothenstein, B. F., Muntyanu, A. P., and Shif, A.,
COMPOUND FERROMAGNETICS WITH HIGH INTERNAL FRICTION, Metallovedeniye i Termicheskaya Obrabotka Metallov, No. 1, 1963, pp. 12-15.

This article investigates a method of increasing the internal friction of nonferromagnetic metals by electrodeposition of a ferromagnetic coating.

2007. Rovinskiy, B. M. and Lyuttsau, V. G.,
CERTAIN RESULTS OF THE STUDY OF STRESS RELAXATION IN METALS AND ALLOYS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 275.

Not abstracted.

2008. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
AN IMPROVED VIBRATION ISOLATOR FOR PIPE HANGERS, August 1963, AD-415-274, 25 pp.

The objective of this investigation was to develop a rubber vulcanizate which, when used as the vibration isolator in submarine pipe hangers, would transmit less vibration than the presently used vulcanizate. The vulcanizates tested comprised a styrenebutadiene vulcanizate, one based on chlorobutyl rubber, and one based on natural rubber. Natural rubber block-type isolators are recommended for use in pipe hangers in submarines.

2009. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
EFFECTS OF VARIOUS ENVIRONMENTS ON THE VIBRATION DAMPING EFFICIENCY OF MONSANTO TREATMENT MRC-OG4 by B. V. Howell, January 1963, AD-294-753.

This article presents damping characteristics of MRC-OG4 hull damping treatment before and after immersion in water and JP-5 fuel for two weeks, and after two weeks oven aging at 158° F.

2010. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF CONSTRAINED-LAYER DAMPING TREATMENTS FOR STEEL PLATES by J. Oser, March 1963, AD-299-073.

This article explores constrained-layer damping treatments for steel plates. The best damping treatment for one-inch-thick steel plate found to date consists of a ¼-inch constrained layer of polyvinyl plastic and a ¾-inch aluminum plate constraining layer.

2011. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF CONSTRAINED LAYER DAMPING TREATMENTS FOR STEEL PLATES by D. L. Phillips, D. F. Horwood, and J. Oser, Report No. 15, 16 April 1963, 22 pp.

Heavy steel plates in submarines, such as foundations and webs of deep frames, are presently damped against vibration by an appended layered assembly. The assembly comprises an intermediate (constrained) layer of treated wool felt and an outer (constraining) layer of steel plate. Treatments with constraining layers of aluminum yielded moderately higher dampings than treatments with constraining layers of steel of comparable weight, over the major portion of the frequency range between 100 and 1500 cps.

2012. Rucker Company, Oakland, California,
DEVELOPMENT OF METAL LAMINATES WITH HIGH DAMPING CAPACITY, October 1963, AD-421-924, No. 2, 137 pp.

Progress is reported on the development of metal laminates with high vibration damping for use in the fairwater and superstructure plating of submarines.

2013. Saba, R. G., Sauer, J. A., and Woodward, A. E.,
DYNAMIC SHEAR BEHAVIOR OF POLY (γ-BENZYL L-GLUTAMATE), POLY(DL-PROPYLENE OXIDE), AND POLYETHYL VINYL ETHER, Journal of Polymer Science, Part A, Vol. 1, 1963, pp. 1483-1490.

Damping and dynamic shear moduli were determined by a free decay-type torsion pendulum over a temperature range for one sample of each polymer.

2014. Sakamoto, M., Natsume, H., and Shimizu, G.,
INTERNAL FRICTION OF ADDITIVELY-COLORED KCl CRYSTALS, Physical Society of Japan, Journal, Vol. 18, Supplement 1, 1963, pp. 129-134.

The strain-amplitude dependence of internal friction at room temperature was measured in both clear and additively-colored KCl crystals. The concentration of the dominant pinning element was established from the strain-amplitude dependent part of the Granato-Lücke's equation.

2015. Samoilova, A. Ya. and Postnikov, V. S.,
RECOVERY OF INTERNAL FRICTION IN ALUMINUM, SILVER, AND PLATINUM AFTER REMOVAL OF LOAD, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 188, Edited by B. N. Finkelshtein.

Not abstracted.

2016. Savitskiy, V. G. and Popov, K. V.,
ROLE OF RELAXATION PHENOMENA IN THE MECHANISM OF METAL DEFORMATION AT LOW TEMPERATURES, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 300.

Not abstracted.

2017. Scanlan, R. H. and Mendelson, A.,
STRUCTURAL DAMPING, American Institute of Aeronautics and Astronautics, Journal, Vol. 1, April 1963, pp. 938-939.

Not abstracted.

2018. Schlumberger Well Surveying Corporation, Houston, Texas,
DETERMINATION OF ELASTIC CONSTANTS AND DECREMENTS FROM THE RESONANCES OF A FREE BAR by G. Crawford and A. Semmelink, 1963.

An electrodynamic method of initiating and detecting, independently, the flexural, longitudinal, and torsional vibrations of a free bar is described.

2019. Schoeck, G.,
INTERNAL FRICTION DUE TO THE INTERACTION BETWEEN DISLOCATIONS AND SOLUTE ATOMS, Acta Metallurgica, Vol. 11, No. 6, June 1963, pp. 617-622.

A theory is developed for an internal friction peak observed after cold-work in body-centered-cubic metals containing impurity atoms in interstitial solid solution. The elastic relaxation is attributed to the movement of dislocations normally locked by impurity atmospheres and immobile precipitate or solute atom clusters but which move at the peak temperature by dragging the solute atoms along.

2020. Schoeck, G. and Mondino, M.,
INTERNAL FRICTION DUE TO INTERSTITIAL-DISLOCATION INTERACTION IN Ta, Physical Society of Japan, Journal, Vol. 18, Supplement 1, March 1963, pp. 149-154.

Determination of the activation energy, activation energy of aging, height and saturation value of an internal-friction peak observed in cold-worked tantalum with oxygen in solid solution at about 340° C at a frequency of about 0.5 cps. Evaluation of an atomistic interpretation of the peak.

2021. Schurerova, E.,
INFLUENCE OF DISLOCATIONS ON INTERNAL FRICTION, Cesk. Casopis Fys., Vol. 13, 1963, pp.151-169.

Internal friction in crystals is at least partly due to dislocations. Three models are discussed in this review: (1) the relaxation model, due mainly to Seeger which explains the internal friction peak at low temperatures, and assumes that a dislocation moves irreversibly from one metastable position in the lattice to another under the influence of the external shearing stress and temperature fluctuations; (2) the resonance model due to Koehler which explains the amplitude-independent internal friction at low strain amplitudes, and assumes damped vibrations of dislocation sectors anchored firmly at both ends, and (3) the hysteresis model of Granato and Lücke which explains the amplitude-dependent internal friction at higher strain amplitudes.

2022. Seeger, A. and Schiller, P.,
CURRENT PROBLEM IN THE THEORY OF THE BORDONI RELAXATION, Physical Society of Japan, Journal, Vol. 18, Supplement 1, 1963, pp. 178-182.

The theory of the Bordoni relaxation based on the thermally activated formation of kink pairs is briefly reviewed. It is shown that a number of recent experiments, particularly after low temperature deformations, support the basic ideas of this theory. It appears likely that a general theory of kink formation and migration will be able to solve the existing difficulties and to provide a unified picture for a wide class of internal friction phenomena associated with dislocation movement.

2023. Seemann, H. J., Siol, M., and Heeg, K.,
HIGH-TEMPERATURE STRENGTH AND DAMPING CAPACITY OF SINTERED ALUMINUM (SAP) AS A MODEL, Metali, Vol. 17, 1963, pp. 997-1006.

The strength and damping capacity were measured between room temperature and 600° for sintered aluminum of various oxide contents and degrees of purity. Analysis of the damping curves shows the effect of the finely dispersed oxide particles on strength at high temperatures.

2024. Selisskii, Ya. P.,
MAGNETOSTRICTION, ELASTICITY MODULUS, AND INTERNAL FRICTION IN SOME FERROMAGNETIC SOLID SOLUTIONS OF IRON, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 231, Edited by B. N. Finkelshtein.

Not abstracted.

2025. Shermergor, T. D.,
PHENOMENOLOGICAL THEORY OF INTERNAL FRICTION, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 33.

Not abstracted.

2026. Shermergor, T. D. and Meshkov, S. I.,
CONCERNING THE TEMPERATURE DEPENDENCE OF THE DAMPING COEFFICIENT OF A MAXWELLIAN BODY, Inzhenerno-Fizicheskii Zhurnal, Vol. 6, May 1963, pp. 114-118.

Not abstracted.

2027. Shermergor, T. D. and Meshkov, S. I.,
PHENOMENOLOGICAL DESCRIPTION OF HIGH-TEMPERATURE INTERNAL FRICTION, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 46.

Not abstracted.

2028. Shermergor, T. D. and Postnikov, V. S.,
TEMPERATURE RELAXATION IN SOLIDS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 27.

Not abstracted.

2029. Shiren, N. S.,
NONLINEAR ACOUSTIC INTERACTION IN MgO AT 9 Gc/Sec, Physical Review Letters, Vol. 11, July 1963, pp. 3-6.

The nonlinear attenuation of acoustic wave pulses at 9 Gc in magnesium oxide has been studied. A second acoustic input was generated at the bona surface, obviating any second band. In order to investigate the role of a three-phonon coherent scattering process, the nonlinear interaction was suppressed by exploiting the paramagnetic resonance dispersion of Fe^{2+} impurities. Longitudinal polarization and independence of the impurity concentration were proven. The mechanism is attributed to three-phonon scattering through the cubic term in the anharmonic lattice energy.

2030. Shmatov, V. T.,
THERMODYNAMIC THEORY OF INTERNAL FRICTION IN SYSTEMS WITH ADDITIONAL PARAMETERS, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 12, Edited by B. N. Finkelshtein.

Not abstracted.

2031. Shviskovsky, E. G., Belozerova, E. P., and Tjapunina, N. A.,
EFFECT OF HIGH-FREQUENCY VIBRATIONS ON THE DISLOCATION STRUCTURE AND ON INTERNAL FRICTION OF ALKALI-HALIDE CRYSTALS, Physical Society of Japan, Journal, Vol. 18, Supplement 1, March 1963, pp. 161-162.

Crystals of sodium chloride and lithium fluoride are subjected to the action of a longitudinal stationary wave and simultaneous internal friction measurements at the same frequency but a different amplitude to establish that internal friction increases as new dislocations arise, reaches its maximum when single slipbands develop, and then decreases as broad slipbands appear.

2032. Sneed, R. J., Fink, E. L., and Abrams, M. C., ANELASTIC BEHAVIOR OF TANTALUM AND COLUMBIUM, ASD-TDR-62-323, February 1963, 121 pp.

A theoretical model is developed based on dislocation-interstitial interaction during stress application, which describes the anelastic behavior of body-centered-cubic metals particularly during yield delay. The model is supported by the results of yield delay experiments over a temperature range from -97° to 400° F.

2033. Snowdon, J. C., TRANSVERSE VIBRATION OF FREE-FREE BEAMS, Journal of Acoustical Society of America, Vol. 35, No. 1, January 1963, pp. 47-52.

Expressions are derived for the input impedance of damped free-free beams vibrating in their transverse modes, and for the transmissibility of one- and two-stage systems comprised of such beams and lumped elements of mass and compliance. The effect upon transmissibility and input impedance of varying the beam damping is considered in detail.

2034. Snowdon, J. C., MECHANICAL IMPEDANCE AND TRANSMISSIBILITY OF SIMPLY SUPPORTED BEAMS, Journal of Acoustical Society of America, Vol. 35, No. 2, February 1963, pp. 228-233.

The response to vibration of simply supported damped beams was determined theoretically. Expressions were derived for the transmissibility and input impedance and, in one case, the transfer impedance of such beams vibrating in their transverse modes, and for the transmissibility of one- and two-stage systems of beams loaded by lumped elements of mass. The effect of varying beam damping is considered in detail.

2035. Snowdon, J. C., TRANSIENT RESPONSE OF NONLINEAR ISOLATION MOUNTINGS TO PULSELIKE DISPLACEMENTS, Journal of Acoustical Society of America, Vol. 35, No. 3, March 1963, pp. 389-396.

The transient response of damped nonlinear isolation mountings to pulselike foundation displacements was

determined theoretically. The response of both "stiffening" and "softening" springs was examined. The effective duration of the displacement pulses was assumed in the analysis, and curves are presented to illustrate the results.

2036. Snowdon, J. C.,
STEADY-STATE AND TRANSIENT BEHAVIOR OF TWO- AND THREE-ELEMENT ISOLATION MOUNTINGS, Journal of Acoustical Society of America, Vol. 35, No. 3, March 1963, pp. 397-403.

The response of two- and three-element isolation mountings to sinusoidal, steplike, and pulselike input displacements was determined theoretically. In contrast to the two-element or simple mounting, the transmissibility of the three-element mounting at resonance can be made small without reducing the rate at which transmissibility decreases at high frequencies.

2037. Snowdon, J. C.,
TRANSVERSE VIBRATION OF SIMPLY CLAMPED BEAMS, Journal of Acoustical Society of America, Vol. 35, No. 8, August 1963, pp. 1152-1161.

Expressions are derived for the input impedance and transmissibility of simply clamped beams excited to transverse vibration by both central and off-center forces. The influence of beam damping is considered in detail.

2038. Snowdon, J. C.,
TRANSVERSE VIBRATION OF VEAMS WITH INTERNAL DAMPING, ROTARY INERTIA, AND SHEAR, Journal of Acoustical Society of America, Vol. 35, No. 12, December 1963, pp. 1997-2006.

The manner in which the Timoshenko equation may be extended to predict the response to vibration of beams with internal damping is discussed in detail. Representative computations of beam response contrasted with results obtained from the simpler Bernoulli-Euler theory, which assumes that the influence of rotary inertia and shear displacement may be disregarded.

2039. Snowdon, J. C.,
REPRESENTATION OF THE MECHANICAL DAMPING POSSESSED BY RUBBER-LIKE MATERIALS AND STRUCTURES, Mon. Summ. Automob. Engng. Lit., Vol. 32, No. 3, 1963.

The paper shows how the damping possessed by rubber-like materials and structures experiencing sinusoidal vibration can be realistically represented in theoretical analysis by the ratio of the imaginary to the real part of a complex elastic modulus.

2040. Soifer, A. M. and Buzitskii, V. N.,
NEW TYPES OF ALL-METAL ELASTIC-DAMPING ELEMENTS, THEIR PREPARATION AND APPLICATION, Mono, Rasseyanie Energii Pri Kolebaniyakh Uprugikh Sistem, Kiev, AD613452, 1963, pp. 269-275.

The damping elements are made of metallic rubber, the structural basis of which is a spatial lattice of thin metallic spiral, similar to rubber macromolecules. They are in the form of special elastic-damping elements (washer, bushing, membrane, plate, etc). The metallic rubber material can be used in joining and contact places of details and units of machines for dampening mechanical oscillations, and also in the suspension of aggregates, devices, and mechanisms for absorption of shock.

2041. Sokolovskiy, P. I., Golovin, S. A., Epshtein, L. E., Arone, R. G., and Yakovleva, V. S.,
STRENGTHENING OF QUENCHED STEEL DURING ELECTRICAL TEMPERING, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 15, No. 3, 1963, pp. 467-470.

Wire of 5 steel and 35GS steel is water quenched at 860° C, tempered by electrical heating at 170° to 400° C and tested for tensile strength, yield point, elongation, electrical resistance, and internal friction as affected by tempering temperature and carbide phase formations. Comparison is made of the mechanical properties of electrically tempered specimens with those of conventionally tempered specimens.

2042. Southampton University, Great Britain,
THE PRACTICAL PROBLEMS OF ASSESSING DAMPING TREATMENTS by D. J. Mead, ISAC Memoranda, No. 102, May 1963, 46 pp.

This paper discusses the practical situations in which damping treatments can be beneficial in attenuating noise and vibration. Consideration is given to systems under shock, and periodic and random excitation. Special reference is made to jet- and propeller-excited vibrations of airplane structures and also to vibrations excited by boundary layer pressure fluctuations.

2043. Southampton University, Great Britain,
THE DAMPING OF ALUMINUM HONEYCOMB SANDWICH BEAMS by D. J. Mead and G. R. Froud, January 1963, Summary Report, ASD-TDR-62-1096, 32 pp.

Not abstracted.

2044. Southgate, P. D.,
DISLOCATION MOBILITY AND PINNING IN HARD MATERIALS THROUGH INTERNAL FRICTION STUDIES, ASD-TDR-62-431, February 1963, 87 pp.

The internal friction of covalently bonded and partly covalently bonded materials was investigated at elevated temperatures. The apparatus employed an electrostatic drive system, and covered the range zero to 1500° C and 1 to 200 kc/sec. Single crystals of silicon, silicon carbide, and zinc oxide were measured. A steady rise of internal friction was seen in deformed silicon specimens above 500° C and was attributed to dislocation damping. Its magnitude was approximately proportional to the dislocation density and inversely proportional to the frequency.

2045. Southgate, P. D. and Attard, A. E.,
THERMALLY ACTIVATED DISLOCATION KINK MOTION IN SILICON, Journal of Applied Physics, Vol. 34, April 1963, pp. 855-863.

The internal friction of deformed silicon crystals has been measured between 3 and 60 kilocycles and at temperatures up to 1100° C. The component of internal friction due to dislocations becomes appreciable at 500° C, and rises steadily above this temperature. An interpretation of the

results is discussed in terms of the kinked-dislocation theories of Brailsford and of Seeger and Schiller.

2046. Space Technology Laboratories,
ON THE EXPERIMENTAL DETERMINATION OF THE COMPLEX SHEAR MODULUS OF A LINEAR ISOTROPIC VISCOELASTIC SOLID by W. G. Gottenberg and R. M. Christensen, 1963, EM 13-14.

Of the several theoretically equivalent means of representing the stress-strain behavior of a linear viscoelastic solid, it is shown that the complex modulus is the most desirable from the standpoint of experimentally determining the mechanical characteristics of such a solid.

2047. Spencer, E. G., Denton, R. T., Bateman, T. B., Snow, W. B., and Van Uitert, L. G.,
MICROWAVE ELASTIC PROPERTIES OF NONMAGNETIC GARNETS, Journal of Applied Physics, Vol. 34, October 1963, pp. 3059-3060.

Investigations on cylindrical rods of yttrium iron garnet have shown that the magnetostrictive effect at microwave frequencies makes them effective microwave acoustic transducers, and that a lower bound of the acoustic Q is of the order of 2×10^5 at 1 kMc.

2048. Stanford University, Stanford, California,
INFLUENCE OF LONG-RANGE ORDER ON SOME MECHANICAL PROPERTIES OF 2V PERMENDUR by J. A. Hren, December 1963, DMS-63-23, Vol. 1, 19 pp.

Not abstracted.

2049. Strakna, R. E., Clark, A. E., Bradley, D. L., and Slie, W. M.,
EFFECT OF FAST-NEUTRON IRRADIATION ON THE PRESSURE AND TEMPERATURE DEPENDENCE OF THE ELASTIC MODULI OF SiO_2 GLASS, Journal of Applied Physics, Vol. 34, 1963, pp. 1439-1443.

The low-temperature ultrasonic attenuation, the elastic moduli, and the temperature and pressure dependence of the moduli of SiO_2 glass are modified by heavy fast-neutron irradiation. A sample of Amersil optical-grade fused silica was irradiated to an integrated flux d. in excess of 5×10^{19}

neutrons per square centimeter. The effect of gamma-irradiation on the low-temperature ultrasonic loss and on the temperature dependence of sound velocity was also studied.

2050. Street, R.,
ELASTICITY AND ANELASTICITY OF CHROMIUM, Physical Review Letters, Vol. 10, No. 6, 15 March 1963, pp. 210-211.

Measurement of Young's modulus and the logarithmic decrement of longitudinal oscillation at 100° to 400° K of annealed and unannealed samples of chromium. Anomalies due to spin density wave transitions are observed and the transitions are found to be inhibited by residual strains in the samples.

2051. Sugeno, T., Sakamoto, K., and Ino, H.,
INTERSTITIAL-DISLOCATION INTERACTION IN COLD-WORKED IRON, Physical Society of Japan, Journal, Vol. 18, Supplement 1, 1963, pp. 154-162.

The strain-aging and the cold-work peak of very dilute iron-nitrogen alloys were studied. The number of locked nitrogen atoms to dislocations at the cold-work peak temperature was obtained by measuring the Snoek peak height of specimens after quenching from that temperature and then by subtracting this value from the initial Snoek peak height. The result is then used to interpret the mechanism of the cold-work peak.

2052. Suris, R. A.,
DISPERSIONAL RELATIONSHIPS IN THE THEORY OF ELASTIC RELAXATION, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 39, Edited by B. N. Finkelshtein.

Not abstracted.

2053. Suzuki, H.,
A NOTE ON THE PEIERLS FORCE, Physical Society of Japan, Journal, Vol. 18, Supplement 1, 1963, pp. 182-186.

A simple theory of the Peierls force in covalent crystals was developed. The Peierls force was calculated for several materials, and several internal friction peaks observed in germanium were discussed.

2054. Svergunenko, L. A.,
THE EFFECT OF ELECTRONS AND QUASIPARTICLES OF THE LATTICE ON INTERNAL FRICTION IN METALS AND ALLOYS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 53.

Not abstracted.

2055. Svergunenko, L. O.,
THE EFFECT OF ORDERING PROCESSES ON INTERNAL FRICTION IN Fe_3Al-TYPE ALLOYS, Fiz. Tverd. Tela, Vol. 5, No. 8, 1963, pp. 2052-2058.

A theory with multiple relaxation parameters is used to study internal friction in alloys of Fe_3Al type as a result of relaxation of long-range order. The formulas obtained give the value of internal friction, Q^{-1}, in terms of the physical characteristics of the alloy (elastic moduli, coefficients of the mal expansion, ordering parameters) and allow calculation of numerical values of Q^{-1} at different temperatures.

2056. Svergunenko, L. A.,
THEORY OF INTERNAL FRICTION IN METALS AND ALLOYS IN THE PRESENCE OF SEVERAL RELAXING PARAMETERS, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 40.

Not abstracted.

2057. Tasi, J.,
THERMOELASTIC DISSIPATION IN VIBRATING PLATES, Journal of Applied Mechanics, Vol. 30, No. 4, December 1963, pp. 462-567.

In this paper, the three-dimensional equations of linear thermoelasticity are used to obtain an integral formula for the dimensionless measure of energy dissipation in the free-vibration modes of a thermoelastic medium.

2058. Technion-Israel Institute of Technology, Haifa, Israel,
DEPENDENCE OF THE STRENGTH OF METALS ON THE RATE OF STRAIN by M. Reiner and D. Abir, March 1963, AD-412-287, 16 pp.

The thermodynamic theory of strength of a standard linear solid is specialized to the case tension. Tensile

experiments are carried out with four different kinds of mild steel at three different rates of loading. It is found that the coefficient of viscous damping decreases with increasing rate of loading.

2059. Thompson, D. O.,
EVIDENCE FOR VACANCY CLUSTERING IN DISLOCATIONS OF COPPER AS MEASURED BY INTERNAL-FRICTION TECHNIQUES, Physical Society of Japan, Journal, Vol. 18, Supplement 1, March 1963, pp. 104-114.

Measurement of the internal friction and Young's modulus of a copper single crystal after a series of light neutron bombardments at 375° K as functions of temperature from approximately 200° K to the bombardment temperature. Results indicate that bombardment-produced pinning points are lost as the temperature is lowered and recovered upon warming.

2060. Truell, R. and Granato, A.,
ANOMALOUS ULTRASONIC VELOCITY CHANGES IN DEFORMATION AND IRRADIATION INDUCED DISLOCATION PINNING, Physical Society of Japan, Journal, Vol. 18, Supplement 1, March 1963, pp. 95-101.

Consideration of the anomalous effect of dislocation pinning on damping and velocity (or modulus) for ultrasonic waves. Examples are shown for slightly deformed pure aluminum and sodium chloride single crystals.

2061. Tsobkallo, S. O.,
DETECTION OF DEFECTS IN METAL STRUCTURES AND SAMPLES BY MEASURING THE DAMPING OF OSCILLATIONS, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 165, Edited by B. N. Finkelshtein.

Not abstracted.

2062. Tsobkallo, S. O.,
ELASTIC AFTEREFFECT IN SPRING STEELS, Relaxation Phenomena in Metals and Alloys, New York, New York, Consultants Bureau, 1963, p. 112, Edited by B. N. Finkelshtein.

Not abstracted.

2063. Tuzuku, T. and Kobayashi, H.,
INTERNAL FRICTION OF CARBON MATERIALS, Proc. Conf. Carbon, 5th Univ. Park, Penna., 1961, Vol. 2, 1963, pp. 539-543.

The internal friction and the dynamic Young's modulus have been investigated as functions of the strain amplitude in the audiofrequency range, of the temperature (-120° to 100°), and of the degree of graphitization.

2064. Ungar, E. E.,
GUIDE TO DESIGNING HIGHLY DAMPED STRUCTURES USING LAYERS OF VISCOELASTIC MATERIAL, Machine Design, Vol. 35, No. 4, 14 February 1963, pp. 162-168.

This article discusses the damping that can be obtained from composite structures built up by adding surface treatments or constrained damping layers to existing structures. Comparisons are made of various treatments, and a practical approach involving combinations of two basic configurations is given.

2065. Ungar, E. E. and Kerwin, E. M., Jr.,
PLATE DAMPING DUE TO THICKNESS DEFORMATIONS IN ATTACHED VISCOELASTIC LAYERS, Proceedings, 65th Meeting of Acoustical Society of America, New York, New York, BBN Report No. 938, May 1963.

Energy dissipation due to thickness-wise motion of viscoelastic layers attached to plates is analyzed in order to supplement previous analyses of damping due to shear, flexural, and in-plane extensional motions.

2066. University College of South Wales,
IRON-CHROMIUM-NITROGEN ALLOYS by R. Rawlings and T. B. Koshal, Annual Technical Report No. 3, 28 February 1963, 9 pp.

Not abstracted.

2067. Urushadze, G. I.,
THEORY OF SOUND ABSORPTION IN FERROMAGNETIC SUBSTANCES AT LOW TEMPERATURES, Zhurnal Eksperemental'noĭ i Teoreticheskoĭ Fiziki, Vol. 44, 1963, pp. 258-260.

Equations are derived to describe the effect of paramagnetic impurities on the absorption of sound in a ferromagnetic dielectric.

2068. Van Neste, A. and Dube, A.,
THE EFFECT OF AN ALTERNATING MAGNETIC FIELD ON THE MODULUS OF ELASTICITY IN A FERROMAGNETIC METAL, Comptes Rendus, Vol. 256, 1963, pp. 2831-2841.

Internal friction and modulus of elasticity as a function of the extent of deformation on application of an alternating magnetic field (60 cps) parallel to the longitudinal axis of a sample of Inco A-Ni were measured.

2069. Vasil'yev, A. A. and Gruzin, P. L.,
THE TEMPERATURE DEPENDENCE OF INTERNAL FRICTION IN CHROMIUM, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 247-249.

An investigation was made of the change in internal friction of pure chromium between -196° and 200° C. Two minima can be seen clearly on the curve, the one at 300° being caused by the passage of chromium from the antiferromagnetic into the paramagnetic state. The curve showing the relationship between internal friction and amplitude at zero, 70°, and -196° C indicates that at 70° C the internal friction of chromium does not depend on the amplitude, while at zero and -196° C the amplitude relationship is observed even at low stresses.

2070. Vasil'yev, A. A., Gruzin, P. L., Zharov, Y. D., Polikarpov, Y. A., Trokin, Y. A., Breger, A. Kh., and Gol'din, V. A.,
EFFECT OF GAMMA AND NEUTRON IRRADIATION ON INTERNAL FRICTION OF COPPER, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 250-257.

The paper reports the results of studies on irradiation of copper by gamma rays from cobalt-60, as well as by polonium-beryllium neutrons and in atomic piles.

2071. Vekilov, Y. K. and Piguzov, Y. V.,
THE EFFECT OF LATTICE DEFECTS ON INTERNAL FRICTION OF SILVER CHLORIDE, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 92.

Not abstracted.

2072. Villain, J. P., de Fouquet, J., and Jacquesson, R.,
EVOLUTION OF INTERNAL FRICTION IN AN EXTRA-SOFT TEMPERED STEEL AFTER DIFFERENT HEAT TREATMENTS AT 720 DEGREES, Comptes Rendus, Vol. 256, 1963, pp. 942-945.

Samples containing nitrogen 0.002 percent and carbon 0.05 percent, 0.02 percent, or 0.01 percent initially, were annealed at 950°, polished mechanically before treatment, and quenched in ice water. The internal friction (δ 1) was determined at intervals by use of the Collette pendulum frequency of 0.8 cps at a temperature of 36°. Aging after temperature depends on the initial content of carbon in solution, which, when relatively high, appears to produce a three-phase aging process.

2073. Villain, J. P., de Fouquet, J., and Jacquesson, R.,
EFFECT OF THE ANNEALING TEMPERATURE ON THE AGE HARDENING OF EXTRA-MILD STEEL, Comptes Rendus, Vol. 256, 1963, pp. 2382-2385.

Steel specimens containing carbon 0.05 percent and nitrogen 0.002 percent were heated from 520° to 720° for 15 minutes in argon. After quenching, the samples were aged at 36°. The rate of aging of the samples was followed by measuring changes in internal friction and hardness. Immediately after quenching, the internal friction and the hardness were higher as the annealing temperature increased. After aging, the rate of decrease were lower as the annealing temperature decreased.

2074. Vodsedyalek, I.,
INTERNAL FRICTION IN STEEL WITH 12% Cr, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 198.

Not abstracted.

2075. Vorobeykov, A. M.,
INTERNAL FRICTION OF STEEL UNDER COMPLEX STRESS IN THE PRESENCE OF SURFACE ACTIVE SUBSTANCES, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 97-100.

The data obtained indicated that surface active substances are of some importance in the development of stress relaxation in metals. This is explained by the relative contribution of relaxation processes in the surface layer in relation to the processes inside the sample.

2076. Wachtman, J. B., Jr.,
MECHANICAL AND ELECTRICAL RELAXATION IN ThO_2 CONTAINING CaO, Physical Review, Vol. 131, No. 2, 1963, pp. 517-527.

The dynamic behavior of oxygen vacancies associated with the solid solution of calcium oxide in ThO_2 is treated by using an eight-position nearest-neighbor model. This treatment predicts an internal friction peak characterized by a single relaxation time and a dielectric-loss peak with a single relaxation time equal to twice the mechanical relaxation time. Both peaks were observed and are in accord with these predictions within experimental error.

2077. Ward, R. and Capus, J. M.,
INTERNAL FRICTION EFFECTS IN MARTENSITE, Journal of Iron and Steel Institute, December 1963, pp. 1038-1043.

Low-frequency internal friction studies of martensitic steels are reviewed. Three distinct internal friction phenomena are discussed in relation to the structures and processes occurring during tempering. It is concluded that internal friction peaks of the Snoek type are not obtainable in completely martensitic specimens using the customary low strain-amplitude test, and are only of interest in the study of tempering beyond the third stage. The possibility of finding a low-temperature peak due to stress-induced diffusion of carbon atoms in special alloy martensites is discussed. Two other effects in freshly quenched martensite, room-temperature decay of internal friction and a peak at approximately 220° C, appear to be analogous to effects found by Köster in cold-worked iron, and may have similar mechanisms.

2078. Weiss, G. P. and Smith, D. O.,
MEASUREMENT OF INTERNAL FRICTION IN THIN FILMS, Review of Scientific Instruments, Vol. 34, No. 5, May 1963, pp. 522-523.

A film (2000 A thick) is deposited onto a fused quartz ribbon which is clamped at one end. The film and ribbon assembly is set into clamped free flexural vibration. Decay of the vibration is measured by a light beam and photocell. Snoek relaxation of carbon in body-centered-cubic iron is measured to illustrate the technique.

2079. Winchell, P. G. and Cohen, M.,
SOLID-SOLUTION STRENGTHENING OF MARTENSITE BY CARBON, Electron Microscopy and Strength of Crystals, New York, New York, Interscience Publishers, 1963, pp. 995-1007.

An investigation was made of the mechanism of solid-solution hardening of carbon when dissolved in untempered and unaged iron-nickel-carbon martensite. Effect of heat treatment and nickel content on internal friction. Dependence of flow stress on testing temperature was discussed.

2080. Woodcock, D. L.,
ON THE INTERPRETATION OF THE VECTOR PLOTS OF FORCED VIBRATIONS OF A LINEAR SYSTEM WITH VISCOUS DAMPING, The Aeronautical Quarterly, Vol. 14, 1963, pp. 45-62.

Not abstracted.

2081. Yakovlev, A. P.,
INVESTIGATION OF THE DAMPING PROPERTIES OF SOME ALLOYS AT LOW TEMPERATURES, Rasseyanie Energii Pri Kolebaniyakh Uprug Sistem, Akad Nauk Ukr SSR, Kiev, 1963, pp. 199-204.

A description of an apparatus for investigating the damping properties of materials at low temperatures (from -196°C). Specimens prepared from aluminum alloys D16 and AMg-6 T, and also from titanium alloy VT-1D, in the received condition, were investigated in the apparatus. At the same maximum stress of 1000 kg/cm^2, the damping property of the alloy AMg-6T is the highest, that of D16 lower, and that of VT-1D the lowest.

2082. Yamane, T.,
ON THE HYDROGEN EMBRITTLEMENT OF A QUENCHED PLAIN CARBON STEEL, Tetsu-to-Hagane (Journal of the Iron and Steel Institute of Japan), Vol. 49, No. 7, July 1963, pp. 1003-1008 (In Japanese).

Specimens of 0.3 percent carbon steel are annealed at 700° C and quenched in martemper oil and in water. Tensile tests are carried out after subjecting the specimens to hydrogen absorption through electrolysis. The volume of hydrogen absorbed is measured and the internal friction of the specimens before and after absorption is determined by a transversal vibrating method.

2083. Yamane, T.,
ON THE RECOVERY OF THE INTERNAL FRICTION OF 39.6 PER CENT COLD-WORKED Ti BY ISOTHERMAL ANNEALING AT TEMPERATURE LOWER THAN THE RECRYSTALLIZATION TEMPERATURE, Transactions, American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) Metallurgical Society, Vol. 227, No. 4, August 1963, pp. 1024-1027.

The internal friction of cold-worked titanium isothermally annealed at 150° to 460° C is determined from the half-width of a resonance curve of specimens vibrated transversally by the electromagnetic method. The strain-amplitude dependent internal friction, increased by cold working, is decreased during the isothermal annealing by the annihilation of lattice defects.

2084. Yelyutin, V. P., Mozzukhin, Y. I., Antsiferov, V. N., and Zakharov, D. M.,
INTERNAL FRICTION IN NICKEL STRENGTHENED WITH DISPERSED OXIDE PARTICLES, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 243-246.

The internal friction of nickel containing 5 to 20 percent by volume Al_2O_3 or 10 percent $NiOAl_3O_3$ and of nickel alloy with 4 percent aluminum containing 10 percent Al_2O_3 or 10 percent $NiOAl_2O_3$ has been studied. It was found that the internal friction of pure nickel and nickel alloyed with aluminum oxide annealed at 1275° K has a peak at 425° K. Subsequent cold rolling with a 14 percent reduction does not change

the temperature of the peak, but makes the peak progressively less sharp as the content of aluminum oxide increases, until the peak completely disappears at an aluminum oxide content of 15 percent to 20 percent.

2085. Yelyutin, V. P., Natanson, A. K., Mozzhukin, Ye. I., and Vasil'yev, O. A.,
INTERNAL FRICTION OF GRADE VA-3 TUNGSTEN WIRE, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, pp. 55-64.

This article investigates the relationship between the physical and mechanical properties of grade VA-3 tungsten wire and the internal friction in order to improve the procedure for checking wire quality.

2086. Yelyutin, V. P., Natanson, A. K., Mozzhukhin, Ye. I., and Vasil'yev, O. A.,
A STUDY OF INTERNAL FRICTION OF GRADE VA-3 TUNGSTEN WIRE, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 15, No. 5, 1963, pp. 748-753.

The temperature-dependence of internal friction of tungsten wire at 288° to 2270° K was determined for samples taken from four different production batches. A grain-boundary peak was observed at approximately 1500° K. In some specimens a second peak, associated with recrystallization and grain-growth, was observed at 2100° to 2150° K.

2087. Zakharov, V. F. and Savitskiy, V. G.,
DETERMINATION OF THE MODULUS OF ELASTICITY AND INTERNAL FRICTION OF STEELS AT LOW TEMPERATURES, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 226.

Not abstracted.

2088. Zakoshchikova, Y. P. and Postnikov, V. S.,
THE EFFECT OF METALLIC COATINGS ON THE CHARACTER OF TEMPERATURE DEPENDENCE OF INTERNAL FRICTION OF LEAD AND TIN, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 101.

Not abstracted.

2089. Zharov, Y. D., Trokin, Y. A., Vasil'yev, A. A., Gruzin, P. L., and Polikarpov, Yu. A.,
DETERMINATION OF INTERNAL FRICTION AND THE MODULUS OF ELASTICITY OF METALS AT SMALL AMPLITUDES, Relaxation Phenomena in Metals and Alloys, Moscow, Metallurgizdat, 1963, p. 221.

Not abstracted.

2090. Zubekhin, V. P. and Novokreshchenov, P. D.,
A DECREASE IN THE INTERNAL FRICTION OF NICKEL AT ELEVATED TEMPERATURES UNDER THE INFLUENCE OF LOW-MELTING-POINT METAL COATINGS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 15, No. 5, 1963, pp. 798-800 (In Russian).

The application of a thin (0.04 millimeter) coating of tin, lead, and bismuth brought about a decrease in the internal friction of nickel at 400° to 800° C. The effect was attributed to a decrease in the total number of moving dislocations and in the length of the dislocation lines.

2091. Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio,
NOTE ON THE TRANSIENT OSCILLATIONS OF A SYSTEM INCORPORATING HYSTERETIC DAMPING by D. G. Jones, TDR 64 244, July 1964, AD-606-121.

The motion of a single degree of freedom viscoelastic system subsequent to an initial impulse is discussed. The logical difficulties inherent in the extension of the "complex modulus" concept to transient motions are highlighted but it is shown that for currently available materials, for which the loss factor, mu, rarely exceeds 0.5, these difficulties do not arise.

2092. Air Force Systems Command, Wright-Patterson Air Force Base, Ohio,
ANALYTICAL INVESTIGATION OF EFFICIENCY IN STRUCTURAL VIBRATION WITH AND WITHOUT DAMPING TREATMENT by C. L. Pao, Eleventh Annual Air Force Science and Engineering Symposium, 1964, 28 pp.

Not abstracted.

2093. Air Force Systems Command, Wright-Patterson Air Force Base, Ohio,
AN ASSESSMENT OF THE EFFECTIVENESS OF A VISCOELASTIC DAMPER ON THE FORCED VIBRATIONS OF A STRETCHED STRING by D. I. G. Jones, 1964, Technical Documentary Report, AD-608383, 14 pp.

Not abstracted.

2094. Astbury, N. F. and Moore, F.,
TORSIONAL HYSTERESIS IN PLASTIC CLAY AND ITS INTERPRETATION, Reprints of Papers, American Society for Testing Materials, Internal Conference on Materials, February 1964, pp. 405-419.

Not abstracted.

2095. Atomic Energy Commission,
ELASTICITY AND INTERNAL FRICTION THROUGH THE KILOCYCLE RANGE: REVIEW AND ANNOTATED BIBLIOGRAPHY by M. O. Marlowe and D. R. Wilder, June 1964, IS-925.

A review of techniques and fundamentals of Young's modulus and internal friction measurements is presented, along with an annotated bibliography of 377 entries.

2096. Avraamov, Yu. S. and Anoshin, A. I.,
INFLUENCE OF QUENCHING ON TEMPERATURE DEPENDENCE OF INTERNAL FRICTION IN TRANSFORMER STEEL, Akademii Nauk, SSSR, Metallov i Metallovedenie, Vol. 17, No. 4, 1964, pp. 614-616 (In Russian).

Induction heating and water quenching of transformer steel, electrolytic iron, and Invar and Permalloy specimens from 600° to 1000° C, followed by cooling to -196° C. Testing internal friction of specimens at -196° and 100° C to determine dependence on quenching temperatures.

2097. Azhazha, V. M., Bolgov, I. S., Shapoval, B. I., and Zeidlits, M. P.,
INVESTIGATION OF THE EFFECT OF BORON UPON THE PROPERTIES OF NICKEL BY THE INTERNAL FRICTION METHOD, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 18, November 1964, pp. 796-798.

Not abstracted.

2098. Battelle Memorial Institute, Columbus, Ohio,
LATERAL VIBRATIONS IN MISSILES; A BIBLIOGRAPHY by L. E. Hurlbert, W. L. Belton, T. J. Atterbury, July 1964, AD-451-321, 47 pp.

This bibliography consists of 377 entries and contains the results of a title survey conducted to obtain literature related to the problem of damping the transverse vibration of large missiles.

2099. Battelle Memorial Institute, Columbus, Ohio,
NITROGEN-INDUCED INTERNAL FRICTION IN CHROMIUM-35 a/o RHENIUM by M. J. Klein, 24 November 1964, BMI-1703.

An internal-friction profile induced by nitrogen in chromium-35 a/o rhenium was studied as a function of nitrogen concentration and heat treatment. From these studies, the solubility of nitrogen in this alloy was deduced. The equilibrium solubility of nitrogen in this alloy did not differ significantly from that in chromium determined by internal-friction techniques. However, the precipitation kinetics of nitrogen from solution appear to be slower in the alloy than in chromium.

2100. Battelle Memorial Institute, Columbus, Ohio,
THE EFFECTS OF INTERSTITIALS ON THE INTERNAL FRICTION OF CHROMIUM by M. J. Klein and A. H. Clauer, May 1964, ARL-64-88.

The diffusivity and solubility of nitrogen in chromium were investigated by internal-friction measurements. The anomaly in the Young's modulus and the damping peak associated with it at 40° C were also studied.

2101. Benoit, W.,
MEASUREMENT OF THE INTERNAL FRICTION OF THIN FILMS, Helvetica Physica Acta, Vol. 37, 1964, pp. 203-206.

Not abstracted.

2102. Berry, B. S. and Orehotsky, J. L.,
ANELASTIC PIEZORESISTANCE EFFECT IN ALLOYS, Philosophical Magazine, Vol. 9, No. 99, March 1964, pp. 467-484.

Experiments are described which establish the existence of a new anelastic piezoresistance effect. The effect consists of a change in the electrical resistivity of a sample as a result of stress-induced directional ordering.

2103. Birchon, D.,
HIGH-DAMPING ALLOYS, Engineering Materials and Design, Vol. 7, No. 9, Part 1, September 1964, pp. 606-608; Vol. 7, No. 10, Part 2, October 1964, pp. 692-696.

The damping capacities of some wrought manganese-copper alloys, cast irons, steels, and nonferrous metal at 5000 psi surface shear stress are compared, and typical mechanical properties of a high-damping 70/30 manganese-copper alloy are shown. Relationship of damping capacity to mechanical properties is reviewed with special reference to the suppression of noise and vibration.

2104. Bisogni, E., Mah, G., and Wert, C.,
DIFFUSION OF GASES IN SPECIAL INTERSTITIAL SITES IN HAFNIUM, Journal of Less-Common Metals, Vol. 7, No. 3, September 1964, pp. 197-204.

An investigation was made of internal-friction peaks caused in reactor-grade hafnium by diffused oxygen and nitrogen. The mechanism of the peak was discussed in terms of redistribution of strain dipoles formed by the interstitial impurity atoms with the substitutional impurity atoms. Equations were calculated for the diffusion coefficients.

2105. Bodger, W. K.,
THE MECHANICS OF BEARING SUPPORTS, American Society of Mechanical Engineers, Paper 64-GTP-3, 1964.

Not abstracted.

2106. Bratenko, V. N. and Fedotov, S. G.,
INVESTIGATION OF THE ELASTIC CHARACTERISTICS OF CHROMIUM-MANGANESE STEELS, Issled Stalei i Splavov, Nauka, Moscow, 1964, pp. 253-257.

The effect of alloying elements (0.07-0.57 and 2.3 percent titanium, 0.3-1.05 percent vanadium, 0.49-1.29, 2.51 and 2.98 percent molybdenum, 1.05-3.71 percent tungsten) on the normal elastic modulus, E, shear modulus G, Poisson ratio, and logarithmic damping decrement Q^{-1} of austenitic chromium-manganese steels (11.1-11.9 percent chromium, 18020.01 percent manganese, 0.06-0.08 percent carbon and 0.17-0.22 percent nitrogen) was investigated. The metal was tested in the initial state (water quenching from 1150° C,

stabilizing tempering at 750° C for 10 hours) and after stress-rupture tests at 650° C and 20 kg/mm^2.

2107. Brown University, Providence, Rhode Island, STRESS WAVES IN ANELASTIC SOLIDS, SYMPOSIUM, Berlin, Springer-Verlag, 1964, 342 pp., Edited by H. Kolsky and W. Prager.

Not abstracted.

2108. Burgess, W. B., AN APPROACH TO THE ISOLATION AND CONTROL OF VIBRATION IN LIGHT BUSINESS AIRCRAFT, Society of Automotive Engineers, Automotive Engineering Congress, Detroit, Michigan, 1964, 9 pp.

Not abstracted.

2109. California Institute of Technology, Jet Propulsion Laboratory, THERMALLY CONDUCTIVE METAL WOOL-SILICONE RUBBER MATERIAL CAN BE USED AS SHOCK AND VIBRATION DAMPER by W. W. Hough, April 1964, NAS7-100, NASW-6, JPL-321.

Not abstracted.

2110. California Institute of Technology, Pasadena, California, FRICTIONAL WEDGE SHOCK MOUNT IS INEXPENSIVE, HAS GOOD DAMPING CHARACTERISTICS by W. M. Tener, May 1964, JPL-IT-1001.

Not abstracted.

2111. Cameron, J. W., REDUCTION OF NOISE AND VIBRATION IN MILITARY VEHICLES, NRL Shock and Vibration Bulletin, December 1964, pp. 271-278.

Not abstracted.

2112. Campbell, J. D. and Taylor, D. B.,
ON THE NUMERICAL SOLUTION OF A WAVE PROPAGATION PROBLEM IN THE THEORY OF DISLOCATION MOTION, Stress Waves in Anelastic Solids, Symposium, Brown University, 1964, pp. 54-68.

Not abstracted.

2113. Chaleat, R.,
INFLUENCE OF A NONLINEAR RESTORING TORQUE ON THE DAMPING OF AN OSCILLATOR, Comptes Rendus, Academie Des Sciences, Paris, Vol. 258, No. 4, January 1964, pp. 1143-1145.

Not abstracted.

2114. Chang, F. S.,
STRESS RELAXATION AND HYSTERESIS AT VARIOUS STRAIN RATES, High Speed Testing, Vol. IV, 1964, pp. 37, Interscience Publishers.

Applying the Boltzmann superposition principle on a generalized Maxwell model, an analysis of the relations between extensions, relaxation, and hysteresis is presented, which shows that any one of these three can be calculated from the other two. The results obtained from the treatment of experimental data on polyisobutylene verify the theoretical deductions, which may also be considered as an additional explicit proof of the Boltzmann superposition principle.

2115. Chi, S. H. and Mentel, T. J.,
EXPERIMENTAL STUDY OF DILATATIONAL VERSUS DISTORTIONAL STRAINING ACTION IN MATERIAL DAMPING PRODUCTION, Journal of Acoustical Society of America, Vol. 36, 1964, pp. 357-365.

Not abstracted.

2116. Chollet, P.,
AGING OF IRON-CARBON ALLOYS AFTER ALPHA QUENCHING; MEASUREMENT OF THE INTERNAL FRICTION OF THESE ALLOYS, Métaux Corrosion-Industries, Vol. 39, No. 464, April 1964, pp. 117-142 (In French).

This article investigates aging of steels caused by the precipitation of carbon and nitrogen which are present in the

lattice of alpha-iron. Kinetics and the mechanism of aging are studied by measuring internal friction. Precipitation of carbon occurs after quenching in a single stage; the precipitation of nitrogen occurs in two distinct stages of aging. Nucleation and crystal growth are also explored.

2117. Chollet, P.,
STUDY OF THE AGING OF IRON-CARBON ALLOYS AFTER ALPHA-QUENCHING MEASUREMENT OF INTERNAL FRICTION OF THESE ALLOYS, Métaux Corrosion-Industries, Vol. 40, No. 467-468, July-August 1964, pp. 253-282 (In French).

The results of experiments on the kinetics of carbon precipitation after quenching showed the speed of precipitation to be a complex function of aging temperature and also that the activation energies of the alloys studied (0.005 percent, 0.012 percent, and 0.22 percent carbon) is less than that measured for carbon diffusion in alpha-iron. The variation in values of the exponent, n, in the Wert-Zener equation were accompanied by changes in the parameter $t_{50\%}$ with the inverse of the absolute aging temperature permitting the definition of three temperature ranges of differing precipitation. The characteristics of aging after quenching are tabulated and values of internal friction are given. Also given are values of the elastic limit, elongation, and fracture of carbon precipitated for alloys aged at 50° or 100° C for aging times up to 31,680 minutes.

2118. Chollet, P. and Crussard, C.,
KINETICS OF CARBON PRECIPITATION AFTER QUENCHING IN Fe-C ALLOYS, Mémoires Scientifiques de la Revue de Métallurgie, Vol. 61, No. 5, May 1964, pp. 389-397 (In French).

A study is made of precipitation of carbon, after quenching in water at 720° C, by measuring the internal friction at the peak temperature of carbon. The precipitation is carried out between 23° and 200° C. The results show three temperature ranges where different mechanisms participate, either for nucleation or for growth of the precipitates.

2119. Coffin, L. F., Jr.,
THE INFLUENCE OF MEAN STRESS ON THE MECHANICAL HYSTERESIS LOOP SHIFT OF 1100 ALUMINUM, Journal of Basic Engineering, Vol. 86, Series D, No. 4, December 1964, pp. 673-680.

Investigation of the progressive shifting of the mechanical hysteresis loop with repeated cycling in 1100 aluminum at 20° C for two constant uniaxial stress ranges and various tensile and compressive mean stresses.

2120. Collette, G.,
DEVICE FOR MEASURING INTERNAL FRICTION OF RIGID SPECIMENS, Métaux Corrosion-Industries, Vol. 39, No. 464, April 1964, pp. 143-155 (In French).

This article presents measurements of logarithmic decrement of free and forced oscillations of a mechanical system with its elastic part made from the metallic specimen. Internal friction of the order 10^{-3} with an absolute accuracy 10^{-6} and shearing modulus of metals can be determined and precipitation of carbon and nitrogen in iron was studied. The mathematical theory of the device is presented.

2121. Columbia University, New York,
MEGACYCLE DAMPING AND THE ELASTIC STIFFNESS COEFFICIENTS OF SINGLE CRYSTAL AND POLYCRYSTALLINE ARMCO IRON FROM ROOM TEMPERATURES TO 400 C by A. E. Lord, Jr., February 1964, ONR Technical Report No. 5.

The megacycle, pulse-echo internal friction method has been used to measure the carbon and nitrogen Snoek damping peaks in alpha-iron in the temperature range of 300° to 400° C.

2122. Cooney, K. P. and Thorn, R. P.,
CONSIDERATIONS IN THE SELECTION OF VISCOELASTIC MATERIALS FOR CONSTRAINED AND UNCONSTRAINED LAYER DAMPING TREATMENTS, American Society of Mechanical Engineers, Paper 64-WA/RP-8, 1964.

Not abstracted.

2123. Corcoran, R., Editor,
BRIEFING THE RECORD: HEAVENLY VIBRATIONS,
Mechanical Engineering, Vol. 86, No. 1, January 1964, p. 54.

The sounding boards of harps, formerly made of eastern spruce, were found to fail because of creep during and following the tuning process. A new hard wood was sought having the same acoustic properties in resonant frequency and damping. Sugar maple was the clear choice.

2124. Crandall, S. H., Khabbaz, C. R., and Manning, J. E.,
RANDOM VIBRATION OF AN OSCILLATOR WITH NONLINEAR DAMPING, Journal of Acoustical Society of America, Vol. 36, No. 7, July 1964.

Measurements of the vibration of a free mass which is isolated by a rubber support from a surface vibrating at a constant amplitude permit calculations of the dynamic characteristics of the support. This method permits high loadings and the application of considerable force.

2125. Dautreppe, D., Hivert, V., Moser, P., and Salvi, A.,
INTERNAL FRICTION PEAKS DUE TO POINT DEFECTS IN ZONE-MELTED IRON IRRADIATED WITH NEUTRONS AT 78 K, Comptes Rendus, Vol. 258, 4 May 1964, pp. 4539-4541.

Four peaks appear after irradiation. A model is proposed to account for the peaks.

2126. David, R.,
ULTRASONIC ATTENUATION IN SUPERCONDUCTING ALUMINUM, Philips Research Reports, Vol. 19, 1964, pp. 524-602.

The results of the measurements using longitudinal sound waves in specimens of different purity are in agreement with the theory of Bardeen, Cooper, and Schrieffer. Extrapolation leads to a zero-temperature energy gap of 3.5 kT_c. Measurements were performed on two single crystals of zone-refined aluminum with different sound-polarization directions. The value of the absorption depended on the polarization direction, but the calculated energy gap did not. Phase transitions in a very pure zone-refined aluminum single crystal were also investigated using ultrasound, in

order to find out something about the propagation velocity of the phase boundaries, and the structure of the intermediate state.

2127. David Taylor Model Basin, Acoustics and Vibration Laboratory, Washington, D. C.,
THEORETICAL AND EXPERIMENTAL DETERMINATION OF DAMPING CONSTANTS OF ONE- TO THREE-DIMENSIONAL VIBRATING SYSTEMS by E. H. Kennard and R. C. Leibowitz, June 1964, DTMB-1770, AD-602618, 37 pp.

Not abstracted.

2128. David Taylor Model Basin, Acoustics and Vibration Laboratory, Washington, D. C.,
MOBILITY AND SOUND RADIATION MEASUREMENTS ON A CYLINDRICAL GLASS-REINFORCED-PLASTIC MODEL by D. L. Ludwig and C. Noonan, November 1964, AD-609-182, 40 pp.

Vibration and sound radiation characteristics are determined for a 6-inch ID 28-inch long, internally ring-stiffened, glass-reinforced-plastic cylinder in the frequency range of 200 to 5300 cps. Drive-point mobility, an estimate of damping ratio, the mode shaped of resonant frequencies, and the sound pressure directivity patterns at resonances are presented.

2129. de Lamotte, E. and Wert, C.,
INTERNAL-FRICTION PEAKS CAUSED BY DEFORMATION IN Ta AND Nb, Physical Society of Japan, Journal, Vol. 19, September 1964, pp. 1560-1564.

Internal-friction peaks arising in tantalum and niobium after cold-working are observed from 200° to 300° C for a frequency of one cycle per second. An oxygen-dislocation interaction mechanism is studied as a possible cause of the results. Peaks in both metals are found to anneal away rapidly at their maxima.

2130. Delatte, J., Gouzou, J., and Habraken, L.,
INTERNAL DAMPING AND ITS APPLICATION TO METALLURGY, Revue Universelle des Mines, June 1964, pp. 161-180 (In French).

Not abstracted.

2131. Dey, B. N.,
INTERNAL FRICTION IN Cu-Ni ALLOYS, Journal of Applied Physics, No. 12, December 1964, pp. 3621-3623.

Internal friction peaks and peak activation energies in copper-(25 percent to 75 percent) nickel alloys are determined by torsion pendulum measurements after annealing from 150° to 750° C and quenching to 20° C.

2132. Don Bosco Institute for Research, Ramsey, New Jersey,
THE VIBRATION OF A SANDWICH PLATE WITH INTERNAL DAMPING, RADIATING INTO A FLUID MEDIUM ON ONE SIDE by I. W. Jones and V. L. Salerno, January 1964, NONR 4199-00, AD-431-932, 49 pp.

A theory is developed for the vibration analysis of an infinitely long sandwich plate whose facings and core both have linear damping properties. The plate is simply supported along its two edges. Solutions are obtained for the plate radiating waves into a fluid medium which exists on one side. Expressions are derived for the natural frequencies and the steady response for both cases.

2133. Don Bosco Institute for Research, Ramsey, New Jersey,
THE EFFECT OF STRUCTURAL DAMPING ON THE FORCED VIBRATIONS OF CYLINDRICAL SANDWICH SHELLS by I. W. Jones and V. L. Salerno, December 1964, AD-612-539, 41 pp.

An examination is made of the effects of structural-damping on the axisymmetric forced vibrations of a cylindrical sandwich shell. In numerical examples, two steel-faced sandwich cylinders are compared. One has a polymeric, and the other an elastomeric, core. The results indicate that under a time-harmonic radial pressure they are both effective for suppressing resonant vibration, the polymeric core being generally more effective than the elastomeric core.

2134. Ehrich, F. F.,
SHAFT WHIRL INDUCED BY ROTOR INTERNAL DAMPING, Journal of Applied Mechanics, Vol. 31, Series E, No. 2, June 1964, pp. 279-282.

An analysis is made of the instability in rotating systems induced by internal damping in the rotor. The stability boundary is defined in terms of the ratio of the external damping of the system to the internal damping in the shaft. It is shown that, in general, the whirl mode induced at the instability boundary occurs in the mode whose whirling speed is approximately one-half the rotational speed.

2135. Farthing, T. W.,
MANGANESE COPPER--THE SILENT METAL, Engineering Vol. 198, No. 5143, 13 November 1964, pp. 632-633.

Tensile properties, density, specific heat, fatigue strength, toughness and corrosion resistance of 70/30 manganese/copper alloy. Specific damping capacity is emphasized and shown graphically as a function of temperature and copper content for two heat-treat conditions. Comparative damping data for torsional vibration for various ferrous and nonferrous alloys and nonmetallic materials are shown for different surface shear stresses. Due to the unusually high damping characteristic, the manganese-copper alloy is considered for noise and vibration reduction applications.

2136. Fedorovskiy, A. Ye, and Bykov, V. N.,
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The instrument for measuring the internal friction of metals during heating included a coordinate recording device which detects the self-excited natural-frequency vibrations of a sample. The instrument contains an electromagnetic vibrator and a receiver, which transforms the mechanical vibration of the sample into electrical oscillations that are proportional in amplitude to the mechanical vibrations.

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SOLUTE ATOM-DISLOCATION BINDING ENERGY IN DILUTE Cu-Ge ALLOYS, Acta Metallurgica, Vol. 12, No. 12, December 1964, pp. 1329-1336.

Dislocation damping measurements on 100 single crystals of a series of copper-0.005 percent to 0.5 percent germanium alloys to determine the binding energy for germanium solute atoms to dislocations. Measurements were made from 190° to 580° C, using the Marx composite piezoelectric oscillator, with the specimens driven in their fundamental longitudinal mode of vibration at 80 kc/sec. Data follow the predictions of the hysteretic dislocation-damping analysis of Granato and Lücke; from this, the binding energy is calculated and compared with theoretical predictions.

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INTERNAL FRICTION OF PRESTRESSED IRON, M17-15814, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 18, No. 3, 1964, pp. 443-447 (In Russian).

Iron specimens, containing about 0.03 percent carbon, are vacuum annealed and prestressed at various rates at 300° C with loads up to 18 kilograms per square millimeter. These specimens undergo vacuum vibration testing of internal friction and relaxation during heating from 20° to 700° C and during cooling. Curves are plotted for dependence of

relaxation and internal friction on prestressing conditions and testing temperatures. The prestressing effect on thermal stability of iron is discussed in terms of interaction of carbon atoms with lattice distortions.

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DESIGN AND TECHNOLOGICAL CONDITIONS IMPROVING THE VIBRATIONAL CHARACTERISTICS OF TURBINE, Technika Lotnicza, Vol. 19, September 1964, pp. 225-234.

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DAMPING CAPACITY OF PLASTICALLY DEFORMED MILD STEEL, Physics of Metals and Metallography, Vol. 17, No. 3, 1964, pp. 111-114.

This article investigates testing internal friction and relaxation in aluminum-deoxidized low-carbon steel, deformed 5 percent to 67 percent by rolling and subjected to annealing, normalizing, recrystallization, and natural aging. Curves are presented for dependence of vibration damping on deformation, heat-treating processes and time of natural aging.

2143. Hasiguti, R. R., Igata, N., and Ueki, M.,
BREAK-AWAY OF PINNED DISLOCATIONS IN IRON SINGLE CRYSTALS, Tokyo University, Faculty of Engineering, Journal, No. 2, 1964, pp. 48-49.

One of the most important problems in the yielding of iron crystals is whether there actually exist dislocations which move at pre-yield low-stress levels. An approach to this problem was made by measuring the amplitude dependent internal friction, which discloses the stress level of unpinning of pinned dislocations.

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INVESTIGATIONS ON THE DIFFUSION AND PRECIPITATION OF CARBON IN FERRITIC IRON-NICKEL ALLOYS BY MEASURING THE DAMPING CAPACITY, Archiv für das Eisenhuttenwesen, Vol. 35, No. 11, November 1964, pp. 1105-1110 (In German).

Investigation of the effect of nickel on the diffusion and precipitation behavior of carbon in soft plain carbon steels

containing zero to 5 percent nickel and in two different grades of pure iron. Comparison of test results obtained during quench and strain aging.

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NEW TECHNIQUES AND MATERIALS FOR DAMPING, American Society of Mechanical Engineers, Paper 64-MD-22, 1964.

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APPARATUS FOR THE DETERMINATION OF DYNAMIC YOUNG'S MODULUS AND INTERNAL FRICTION IN VACUUM TEMPERATURES FROM 25 TO 1200 C, British Journal of Applied Physics, Vol. 15, December 1964, pp. 1573-1583.

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DEVICE FOR THE INVESTIGATION OF ENERGY DISSIPATION IN MATERIALS AT LOW TEMPERATURES, Zavodskaia Laboratoriia, Vol. 30, April 1964, pp. 489-491.

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EFFECTS OF MAGNETIC FIELD ON THE ULTRASONIC ATTENUATION IN SUPERCONDUCTING NIOBIUM, Physical Society of Japan, Journal, Vol. 19, No. 11, November 1964, p. 2235.

This article investigates pulse-echo techniques to measure ultrasonic attenuation in annealed niobium single crystal. Included is a graph of relative attenuation of superconducting state to normal state versus magnetic field. Permeability and magnetization are determined, as well as thermal

conductivity of superconducting indium-bismuth alloy. Ultrasonic attenuation is connected more directly with energy gap than is thermal conductivity.

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REFRACTORY INORGANIC NONMETALLIC MATERIALS, THEORY AND MECHANICAL PHENOMENA by K. S. Mendelson and P. D. Southgate, Technical Documentary Report, 1 April 1963 through 31 March 1964, Published March 1964, ASD-TDR-63-431, Part III, AD-601991, 81 pp.

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DISLOCATIONS IN SOLIDS by R. Thomson, December 1964, AD-610-014, 12 pp.

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RESEARCH ON THE NATURE OF INTERACTIONS OF DISSOLVED INTERSTITIALS WITH DISLOCATIONS by C. Wert, Wright-Patterson Air Force Base, Ohio, Aerospace Research Laboratory, March 1964, ARL-64-53, AD-441226, 32 pp.

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MAGNESIUM DAMPING CAPACITY--CAUSE AND EFFECTS, Light Metal Age, Vol. 22, No. 11, December 1964, pp. 4-8.

Vibration damping capacity is discussed from the standpoints of terminology, causes, methods of measurement, magnitude, and correlation with other properties. Classification of a number of materials on the basis of high, low, and medium damping capacity is made, and a damping index is shown for a series of cast and wrought magnesium and magnesium alloys and various commercial alloys.

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CHANGES IN DISSOLVED CARBON AND NITROGEN ON GALVANIZING by K. V. Barratt, 16 March 1964, Research Report 308.

The effects of short thermal cycles analogous to galvanizing heat treatment on the amount of carbon and nitrogen in a temper rolled C. A. capped steel have been investigated.

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THE LONG PERIOD DAMPING CAPACITY OF THIN WIRES IN TORSION by B. E. Tossman, NOW 62-0604C, AD-608-165, September 1964, 69 pp.

This research investigates the torsional damping capacity of thin wires subject to long-period forced oscillation. Because the periods of interest are in the order of 10 hours, the direct measurement of damping capacity is impossible. It is shown that since internal friction is a manifestation of material anelasticity, Boltzmann's superposition theory can be used to develop a functional relation correlating internal friction and creep.

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ULTRASONIC ATTENUATION IN TUNGSTEN AND MOLYBDENUM UP TO 1 gc/s, Physics Letters, Vol. 13, No. 4, 15 December 1964, pp. 282-283.

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INFLUENCE OF INTERSTITIAL SOLUTES ON ELASTICITY AND DAMPING OF CHROMIUM NEAR ITS NEEL TEMPERATURE, Journal of Applied Physics, Vol. 35, No. 12, December 1964, pp. 3566-3571.

This article investigates Young's modulus and damping behavior of extruded iodide-chromium rods as affected by carbide and nitride dispersions and heat treatment.

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RECOVERY PROCESSES FOLLOWING STATIC AND FATIGUE DEFORMATIONS IN IRON-CARBON-NITROGEN ALLOYS, Freiberger Forsch, B97, 1964, pp. 105-120 (In German).

This article investigates tensile and fatigue deformation of low-carbon steels containing 0.11 percent carbon, 0.32 percent to 0.45 percent manganese, 0.25 percent to 0.32 percent silicon, 0.0011 percent to 0.015 percent nitrogen, and 0.0056 percent to 0.0059 percent oxygen, and recovery phenomena by internal-friction measurements after tempering at 19° to 159° C. Recovery of yield strength and Lueders deformation are studied.

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MOTION OF A PENDULUM WITH STRONG DAMPING ON A VIBRATING BASE, Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk-Makhan. I Mashinostr., No. 4, NASA-TT-F-363, 1964, pp. 142-143.

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INFLUENCE OF ALPHA-IRRADIATION AT LOW TEMPERATURES ON THE INTERNAL FRICTION OF ULTRAPURE COPPER, Physica Status Solidi, Vol. 7, No. 2, 1964, pp. 577-590.

Copper foil of 99.999 percent purity, 5-μ thick, was irradiated at 30° K with alpha-particles from a 210 polonium source. The Bordoni peak is almost totally suppressed after irradiation and appears again after annealing above 125° K without reaching its original height. The subsidiary peaks disappear as well after the first irradiation. A series of other peaks is produced and may be explained by the interaction of dislocations with point defects.

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SOME EXPERIMENTS ON ANELASTIC REBOUND, Journal of Mechanics and Physics of Solids, Vol. 12, 1964, pp. 35-43.

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INTERNAL-FRICTION PEAKS IN ALLOYED FERRITE, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 18, No. 3, 1964, pp. 464-467 (In Russian).

Armco iron is separately alloyed with chromium, molybdenum, manganese, and nickel, quenched from 800° to 1050° C, deformed 10 percent and tested for internal friction from 20° to 280° C. Internal-friction peaks reflect the concentration of carbon in solid solutions, those affected by alloying elements and those caused by deformation.

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AN APPARATUS FOR THE MEASUREMENT OF YOUNG'S MODULUS AND INTERNAL FRICTION OF METALS, Journal of Scientific Instruments, Vol. 41, No. 10, October 1964, pp. 605-608.

This article describes an apparatus for the measurement of Young's modulus and the internal friction of metals in the kilocycle-per-second range. Measurements can be carried out from 100° to 430° K. The apparatus is based on a device recently described. Modifications consist mainly of an improved clamping device and the addition of a simple electronic circuit for evaluating internal friction. An electronic counter is used to determine resonance frequency.

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MAGNESIUM ALLOYS IN AIRCRAFT ACCESSORIES, Engineering Materials and Design, Vol. 7, No. 12, December 1964, pp. 842-844.

This article examines the weight, modulus of elasticity, fatigue properties, damping capacity, and resilience of magnesium alloys; and fabrication by casting, forging, machining, and forming. Applications for aircraft accessories are given as well as illustrated examples of magnesium alloy aircraft components (wheel, aircraft seat, brake, ignition unit, and alternator drive).

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A METHOD FOR THE AUTOMATIC MEASUREMENT OF INTERNAL FRICTION BY A TORSION PENDULUM, Journal of Scientific Instruments, Vol. 41, September 1964, pp. 564-565.

The authors state that they have measured the time for a light beam to pass between two fixed points at each side of the equilibrium center of a pendulum, and that, hence, they have data in numerical form and can automatically obtain the value of the damping with a computer.

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YOUNG'S MODULUS AND DAMPING CAPACITY OF THE ALLOYS El-973, OKh20N80 AND OKh20N60, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 17, No. 2, 1964, pp. 310-313.

Data are given for a 17 chromium-7 nickel steel, a 21 chromium-87 nickel alloy and a 20 chromium 60 nickel-18 iron alloy up to about 700° C.

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APPARATUS FOR THE DETERMINATION OF DYNAMIC YOUNG'S MODULUS AND INTERNAL FRICTION IN VACUUM AT TEMPERATURES FROM 25 TO 1200 C, British Journal of Applied Physics, Vol. 15, No. 12, December 1964, pp. 1573-1583.

This article presents a determination of Young's modulus and internal friction utilizing transverse free-free vibration for iron-silicon, iron-aluminum, and nickel in vacuum (between 25° and 1200° C). A description of a high-temperature elliptical radiation furnace and of electronic circuitry for decay time and resonant frequency determination is also given.

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DISLOCATION PEAKS OF INTERNAL FRICTION IN IRON-MANGANESE ALLOYS IN THE TEMPERATURE RANGE OF DIRECT AND REVERSE MARTENSITIC TRANSFORMATION, Uli Syuebao Acta Phys Sinica, Vol. 20, No. 9, 1964, pp. 909-918.

The internal friction in iron-manganese alloys containing 18.5 percent manganese was measured by a torsional pendulum. For the direct martensitic transformation, a stable peak of internal friction could be abserved at 100° C, and, for the reverse martensitic transformation, it could be observed at 200° C. With the increase in the number of heating and cooling cycles, the position of the peak shifts from the initial temperature of transformation and the height of the peak decreases.

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ACTIVATION ENERGIES FOR DIFFUSION AND DIFFUSION COEFFICIENTS OF OXYGEN AND NITROGEN IN MOLYBDENUM, Acta Metallurgica Sinica, Vol. 7, No. 1, 1964, pp. 68-76.

Stress-induced microdiffusion of oxygen and nitrogen in molybdenum is associated with the internal friction peaks shown with a torsion pendulum. Oxygen peaks at 115° and 200° C, nitrogen peaks at 160° and 300° C. Oxygen peaks are related to functions of oxygen content, theorized by free and coupled oxygen atoms.

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Ferromagnetic domain walls tend to move in phase with an alternating stress or magnetic field. This movement is opposed by directionally ordered interstitial atoms. When the time associated with the relaxation process is the order of the period of the moving walls, a phase lag between the applied field and the domain wall movement occurs. This phase lag, coupled with normal hysteresis losses, causes a variety of magnetic and magnetoelastic phenomena, among the them a strong temperature dependence of the alternating current magnetic permeability and a broad internal-friction peak in the temperature range of the Snoek peaks.

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STUDY OF THE RESTORATION OF AN INTERNAL-FRICTION PEAK IN WORK-HARDENED TUNGSTEN, Helvetica Physica Acta, Vol. 37, No. 7-8, 1964, pp. 673-688 (In French).

Specimens of high-purity tungsten wire are subjected to isochronel and isothermal annealing to various temperatures. Internal-friction values are determined by a modified version of the conventional inverted torsion pendulum. Physical interpretation of the results is presented in terms of the interaction between dislocations and vacancies. The relaxation energy of the process responsible for the peak and the migration energy of lattice defects were also measured.

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STUDIES OF CHANGES IN THE INTERNAL DAMPING AND THE DYNAMIC MODULUS IN HARDENED STEELS, Kovove Mater., Vol. 2, No. 5, 1964, pp. 492-504 (In Czechoslovakian).

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THE TEMPERATURE DEPENDENCE OF INTERNAL FRICTION OF A STANDARD STRAIGHT SPECIMEN DURING HIGH DAMPING, Izv Akad Nauk SSSR Mekhan Mashinostr, No. 3, 1964, pp. 90-95.

Small damped torsional oscillations of a rod are discussed. The upper end of the rod is fixed, and the lower is excited by angular impulse. An integral-differential equation is given for torsional oscillations with an exponential nucleus, with

one relaxation time, complying with the requirements of a standard straight specimen and corresponding to the plane section theory.

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INTERNAL FRICTION OF FERROMAGNETIC MATERIALS IN ALTERNATING MAGNETIC FIELD, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 18, No. 3, 1964, pp. 373-384.

This article presents research dealing with internal friction of ferromagnetic materials in general and nickel wires in particular, in alternating magnetic fields; and a discussion of their validity. Factors affecting internal friction, such as magnetic-field frequency and amplitude, order-disorder phenomena, domain structure, and grain-boundary migration are investigated.

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Iron alloys containing from zero to 7.58 percent molybdenum were measured for electrical resistivity at high temperatures. Vacancy concentrations were calculated from this data. Damping versus temperature data are also given.

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FATIGUE LIFE AND THE DAMPING CAPACITY OF ALUMINUM CAST ALLOY, Light Metals, No. 67, Part 1, September 1964, pp. 23-29.

Experiments determined damping capacity of eight cast JIS H 5202 aluminum alloys and the relationship between

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THE SIMPLIFIED VIBRATION DAMPER PROBLEM AND ITS SOLUTION, Royal Aeronautical Society, Journal, Vol. 68, August 1964, pp. 565-567.

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VISCOUS-PENDULUM DAMPER SUPPRESSES STRUCTURAL VIBRATIONS by W. H. Reed, III, November 1964.

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A STUDY OF THE EFFECTIVENESS OF VARIOUS METHODS OF VIBRATION REDUCTION ON SIMPLIFIED SCALE MODELS OF THE NIMBUS SPACECRAFT by H. D. Carden and R. W. Herr, August 1964, NASA-TN-D-2418, 26 pp.

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ANELASTIC BEHAVIOR OF COPPER SINGLE CRYSTALS AT LOW STRESSES by C. A. Stearns, E. R. Gotsky, and J. P. Cusick, Vol. 26, March 1964, NASA-TM-X-51670, 6 pp., References.

Compressive stress-strain measurements in the pre-macroyield region were made on 99.999 percent pure copper single crystals compressed at a constant strain rate of 4.5×10^{-5} sec^{-1}.

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DISLOCATION DAMPING IN SEMICONDUCTORS AND ABRUPT VERSUS SMOOTH KINKS, Journal of Applied Physics, Vol. 35, No. 12, 1964, pp. 3607-3613.

A previous dragging point model of dislocation mobility is modified and applied to the dislocation damping data in germanium and silicon.

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STABILITY OF NONCONSERVATIVE SYSTEMS by G. Herrmann, October 1964, Semiannual Progress Report No. 1, April-20 September 1964, NASA-CR-59223, 3 pp.

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As part of the overall United States Navy program to reduce the acoustic energy radiated into water by Naval ships, the use of laminated materials for use as foundation structures was investigated. This material is composed of alternate steel and viscoelastic layers, and is contemplated for its simultaneous use as a load-carrying member and a dissipator of time-varying energy passing through it or impinging upon it from the surrounding air.

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After irradiation, the nickel shows several regions of magnetic after-effect due to different defects. The energies of reorientation and recovery of the defects were determined.

2209. Polytechnic Institute of Brooklyn, New York, DAMPING PARAMETERS OF LAYERED PLATES AND SHELLS by N. Ron and Y. Y. Yu, April 1964, AFOSR-64-2088, AD-610140, Scientific Report No. 3, 52 pp.

Not abstracted.

2210. Postnikov, V. S. and El'kin, Yu. M., INVESTIGATION OF THE INTERNAL FRICTION OF ZINC, ALUMINUM AND COPPER IN THE PROCESS OF THEIR PLASTIC DEFORMATION, Proceedings, Issled Stalei i Splavov, Nauka, Moscow, 1964, pp. 374-379.

The internal friction, Q^{-1}, of zinc (99.9 percent), aluminum (99.7 percent) and copper (99.9 percent) in the process of plastic deformation at tension rates 0.00006 to 0.048 min^{-1} was investigated. Q^{-1} of zinc, aluminum, and copper varies in the process of straining. Moreover, it increases sharply in the second half of the elastic region. Near the proportionality limit, Q^{-1} reaches its maximum value and remains constant during further plastic deformation. Q^{-1} increases with the increase in the straining rates and sharply decreases when straining stops.

2211. Republic Aviation Corporation, Farmingdale, New York, INVESTIGATION OF THE BASIC MECHANISM OF METAL FATIGUE by B. Z. Hyatt and L. J. Teutonico, January 1964, AD-429-004, No. 2.

Improved methods were devised for electrochemical cutting and chemical polishing of single-crystal copper test specimens. The mechanical loading system designed for the cyclic deformation of single crystals was calibrated, and the reliability of strain measurements was determined. Measurements were made of the attenuation of longitudinal waves propagating through <110> oriented single crystals of copper during cyclic deformation. A general review is included.

2212. Rice University, Houston, Texas,
MICROSTRAIN AND LOW FREQUENCY HYSTERETIC DISLOCATION DAMPING IN COPPER SINGLE CRYSTALS by D. M. Barnett and J. M. Roberts, 1964, NSG-6-59, NASA-CR-58586, 37 pp.

Not abstracted.

2213. Richardson, P. D.,
NATURAL VIBRATION WITH DAMPING PROPORTIONAL TO A POWER OF THE VELOCITY, Royal Aeronautical Society, Journal, Vol. 68, 1964, pp. 846-849.

Not abstracted.

2214. Rosin, G. S.,
MEASUREMENT OF THE DYNAMIC CHARACTERISTICS OF SOUND AND VIBRATION INSULATING MATERIALS IN LONGITUDINAL VIBRATIONS, Akusticheskii Zhurnal, Vol. 10, 1964, pp. 1-10.

Not abstracted.

2215. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF SOUND DAMPING TREATMENT FOR SONAR DOMES, February 1964, AD-430-785.

The work was primarily directed towards the attenuation of flexural vibrations of the skin and/or reinforcing rods in the dome by applying a damping layer onto the surfaces of these structural members. One compound of polyvinyl chloride-acetate and 12 elastomeric vulcanizates were tested as damping materials. A hypalon 20 compound was selected as the most promising of these materials.

2216. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF 450-POUND-CAPACITY MOUNTING WITH HIGH VIBRATION DAMPING, June 1964, AD-441-238, No. 1.

A chlorobutyl rubber stock was selected for making the resilient element of this mounting because of its high damping and other desirable properties. Experiments are

under way to find a new shape for the resilient element made from this stock which will result in a mounting having the desired load/resonant frequency relationship.

2217. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF METAL LAMINATES WITH HIGH DAMPING CAPACITY by R. M. Antonucci, Progress Report No. 3, July 1964, AD-602-238.

This report describes techniques developed for the manufacture of flat panels for use on submarines. The panels consisted of six layers of mild steel interleaved with 10-mil thick layers of a neoprene ILA compound.

2218. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
CONFORMANCE OF DAMPING MATERIALS SUBMITTED BY LORD MANUFACTURING COMPANY TO SPECIFICATION MIL-P-23653 by R. R. James, May 1964, AD-438-398.

Two samples of damping material were evaluated to determine their suitability for use on light plates. One sample consisted of two steel bars 3/8 x 1½ x 15 inches in size to which a graphite-filled, plastic damping layer 0.55-inch thick was bonded. The second sample consisted of 10, foot-square tiles of a graphite-filled plastic damping material.

2219. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
SUITABILITY OF MIL-P-23653 MATERIAL FOR DAMPING MECHANICAL VIBRATIONS IN LIGHT STEEL PLATING by R. R. James, May 1964, AD-439-491.

The suitability of the damping material for application to light steel plates in ballast tanks and superstructure areas of submarines was investigated.

2220. Salvi, A., Dautreppe, D., and Freiss, E.,
A TORSIONAL PENDULUM FOR THE CONTINUOUS MEASUREMENT OF INTERNAL FRICTION, Comptes Rendus, Vol. 258, 1964, pp. 4039-4041.

Not abstracted.

2221. Savin, G. N.,
DYNAMICS OF AN ANELASTIC STRING OF VARIABLE LENGTH, Stress Waves in Anelastic Solids, Symposium, Brown University, Berlin, Springer-Verlag, 1964, pp. 78-86, Edited by H. Kolsky and W. Prager.

Not abstracted.

2222. Schneiders, A. M.,
INTERNAL FRICTION AND YOUNG'S MODULUS MEASUREMENTS ON SAP, Allumino, Vol. 33, No. 11, 1964, pp. 571-573.

The elastic behavior of SAP shows considerable differences from that of aluminum with the same impurity content. Young's modulus measurements show that the modulus for SAP alloys is higher than that of aluminum, that the dynamic modulus of SAP alloys is higher than their static modulus, and that their dynamic modulus decreases upon plastic deformation and recovers after heat treatment.

2223. Schoeck, G., Bisogni, E., and Shyne, J.,
THE ACTIVATION ENERGY OF HIGH-TEMPERATURE INTERNAL FRICTION, Acta Metallurgica, Vol. 12, December 1964, pp. 1466-1468.

Activation energy of internal friction is calculated theoretically and measured for aluminum and aluminum-magnesium alloys from 20° to 350° C. It is suggested that a diffusion-controlled dislocation relaxation is responsible for the rapid rise in internal friction at high temperatures.

2224. Secretan, B.,
INTERNAL FRICTION OF POLYCRYSTALLINE OR MONOCRYSTALLINE TUNGSTEN SUBJECTED TO A BENDING VIBRATION MODE, Helvetica Physica Acta, Vol. 37, No. 7/8, 1964, pp. 699-721.

Not abstracted.

2225. Shapoval, B. I.,
HIGH TEMPERATURE DAMPING CAPACITY OF METALS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 18, No. 2, 1964, pp. 306-308.

Damping was measured for copper, aluminum, and magnesium up to within a few tenths of a degree below the melting points. Data are interpreted in terms of vacancy diffusion.

2226. Shapoval, B. I., Azahazha, V. M., Bolgov, I. S., and Zeidlits, M. P.,
APPLICATION OF INTERNAL FRICTION TO DETERMINE THE EFFECT OF BORON ON PROPERTIES OF NICKEL, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 18, No. 5, 1964, pp. 796-798 (In Russian).

This article contains a study of the peaks of internal friction in high-purity nickel and vacuum-annealed nickel-boron alloy (0.005 percent to 0.1 percent boron) from 100° to 700° C. Also presented are curves of temperature and concentration dependence of internal friction, ductility, and stress-rupture strength of nickel-boron alloys. An explanation is given of the internal-friction peaks in terms of ferromagnetism, grain-boundary relaxation, and formation of mosaic structure.

2227. Shtrakhman, K. M.,
ZENER RELAXATION EFFECT IN Ag-Mg HOMOGENEOUS SOLID SOLUTIONS, Izv Vuz Tsvetnaya Met., No. 6, 1964, pp. 94-97 (In Russian).

The temperature and concentration relation of relaxation time was determined as well as the concentration relation of activation energy of the relaxation process. Changes in activation energy with concentration are investigated in relation to energy of elastic deformation of solid-solution lattice. Coefficients of magnesium diffusion in silver-magnesium solid solutions are determined and their concentration and temperature relations are plotted.

2228. Snowdon, J. C.,
APPROXIMATE EXPRESSIONS FOR THE MECHANICAL IMPEDANCE AND TRANSMISSIBILITY OF BEAMS VIBRATING IN THEIR TRANSVERSE MODES, Journal of Acoustical Society of America, Vol. 36, February 1964, pp. 366-375.

Not abstracted.

2229. Snowdon, J. C.,
LONGITUDINAL VIBRATION OF INTERNALLY DAMPED RODS, Journal of Acoustical Society of America, Vol. 36, March 1964, pp. 502-510.

The response of sinusoidal vibration of single and coupled systems of internally-damped rods was determined theoretically. Analysis of the vibration of uniform and exponentially-tapered rods was simplified by the assumption that the lateral dimensions of the rods were small compared with the wavelength.

2230. Snowdon, J. C.,
STEADY-STATE BEHAVIOR OF THE DYNAMIC ABSORBER--ADDENDUM, Submitted for publication in Journal of Acoustical Society of America, 1964.

This article presents a theoretical discussion of the manner in which the transmissibility of a vibrating item may be reduced by the attachment of a dynamic absorber or by the attachment of three absorbers of staggered natural frequencies. It is demonstrated at frequencies of concern.

2231. Southampton University, Great Britain,
THE OPTIMUM USE OF UNCONSTRAINED LAYER DAMPING TREATMENTS, Technical Documentary Report, January 1961-January 1962 by D. J. Mead and T. G. Pearce, August 1964, ML-TDR 64-51, AD-607244, 61 pp.

Not abstracted.

2232. Sperry, W. C.,
RHEOLOGICAL-MODEL CONCEPT, Journal of Acoustical Society of America, Vol. 36, No. 2, February 1964, pp. 376-385.

The subject of this paper is concerned with model representation of the physical properties of substances that are

treated as continua. Many different rheological models, both linear and nonlinear, are described. Applications are given showing how the models can be utilized for lumped vibration systems and for solid and fluid media.

2233. Springfield Armory, Massachusetts,
ULTRASONIC ATTENUATION STUDIES OF DIE BLOCK STEELS by R. D. Korytoski and R. H. Brockelman, December 1964, TR-19-1513, Vol. 3, 38 pp.

This investigation was undertaken to determine the feasibility of using ultrasonic attenuation measurements to nondestructively evaluate die block steels for other than gross defects. Both pulse echo and comparator type measurements were made on samples of die block steels in various conditions of heat-treatment.

2234. Stanford University, California,
APPARATUS FOR THE DETERMINATION OF DYNAMIC YOUNG'S MODULUS AND INTERNAL FRICTION AT TEMPERATURES FROM 25 C TO 1200 C by J. A. Hren, K. T. Kamber, J. L. Lytton, and O. D. Sherby, 1964.

Not abstracted.

2235. Stearns, C. A., Gotsky, E. R., and Cusick, J. P.,
ANEALSTIC BEHAVIOR OF COPPER SINGLE CRYSTALS AT LOW STRESSES, Journal of Applied Physics, Vol. 35, No. 12, December 1964, pp. 3620-3621.

Results of compressive stress-strain measurements in the premacroyield region are given for copper crystals tested at a constant strain rate while being subjected to low-amplitude mechanical oscillations.

2236. Strongin, B. G. and Kushta, G. P.,
DAMPING CAPACITY IN HEAT-TREATED Al-Zn ALLOYS, Physics of Metals and Metallography, Vol. 17, No. 2, 1964, pp. 90-95.

Temperature dependence of internal friction, shear modulus, and relaxation phenomenon is tested at 20° to 400° C for aluminum-zinc alloy containing 2 percent, 10 percent, and 25 percent zinc in annealed and in quenched states.

2237. Subrahmanya, Y. K.,
COMPARATIVE INVESTIGATIONS ON THE DAMPING CHARACTERISTICS OF CAST IRON USING CLASSICAL TECHNIQUES AND ULTRASONICS, Proceedings, Foundry Technology at the Freiberg Mining Academy, VEB Deutscher Verlag für Grundstoffindustrie, Leipzig, 1964, pp. 267-288 (In German).

Measurement of the damping characteristics of charcoal pig iron, white malleable iron, and malleable iron and steel by torsion testing and ultrasonic measurements. Evaluation of the effects of degree of saturation, graphite content, density, and mechanical properties on damping characteristics and velocity of sound.

2238. Suvorova, S. O., Sarrak, V. I., and Entin, R. I.,
INVESTIGATION OF STRAIN AGING OF IRON BY THE INTERNAL-FRICTION METHOD, Russ Met Mining, No. 4, 1964, pp. 88-89 (Translation).

A specimen of iron containing 0.03 percent carbon, 0.0006 percent nitrogen, and 0.33 percent titanium is tensile deformed in quenched state and aged at 60° C. A vibration attenuation method is used for determination of internal friction and strain-hardening susceptibility of iron as affected by interaction of carbon and nitrogen atoms with dislocations and as affected by titanium addition which binds carbon and nitrogen atoms into titanium nitride and titanium carbide phases and prevents strain-hardening effects.

2239. Suzuki, T., Ikushima, A., and Aoki, M.,
ACOUSTIC ATTENUATION STUDIES OF THE FRICTIONAL FORCE ON A FAST-MOVING DISLOCATION, Acta Metallurgica, Vol. 12, No. 11, November 1964, pp. 1231-1240.

This article investigates resonance damping due to internal friction of lithium fluoride, potassium chloride, copper, and copper alloy crystals studied at room temperature. Pulse-echo technique was used for this measurement, and damping constants were calculated. These constants were found to be dependent on temperature and X-ray irradiation.

2240. Szkopiak, Z. C. and Derry, L. W.,
SOME STRAIN-AGING EFFECTS IN COMMERCIAL NIOBIUM, Journal of Nuclear Materials, Vol. 13, No. 2, 1964, pp. 130-136.

The effects of strain aging on the room-temperature yield stress, tensile strength, elongation, and internal-friction relaxation peaks due to interstitial impurities have been discussed. The results show that the strain-aging behavior of niobium is in general similar to the behavior of mild steels. The mechanism of aging is, however, different insofar as oxygen plays an important part in the aging of niobium by diffusing to free dislocations first, and then being replaced by carbon. Besides replacing oxygen at dislocations, it is suggested that carbon contributes to strain aging by cluster formation.

2241. Van Houten, S. and Bosman, A. J.,
MECHANICAL AND DIELECTRIC RELAXATION IN TRANSITION METAL OXIDES, Transition Metal Compounds--Transport and Magnetic Properties, New York, New York, Gordon and Breach Science Publishers, 1964, pp. 123-136.

This is a survey of the relaxation losses in dense ceramic semi-conducting oxides that are due to moving electrons. Several models for relaxation losses are discussed and new measurements are made on lithium-doped nickel oxide over a large concentration region. Internal friction and dielectric dipole losses are measured.

2242. Vetiska, A.,
MEASURING OF DAMPING IN CAST IRON, Slevarenstvi, Vol. 12, No. 6, 1964, pp. 213-216 (In Czechoslovakian).

This article discusses theory, present methods, and their limitations and describes a proposed ultrasonic method for measuring damping characteristics. Results are compared with the widely used resonance method. Typical oscillograms and graphical results are presented for eight gray cast-iron compositions. Also presented are graphs of damping coefficient and logarithmic decrement as a function of tensile strength, and formulas and a nomogram relating these quantities.

2243. Walz, E.,
LATTICE DEFECTS IN Cu CAUSED BY MECHANICAL DAMPING, Physica Status Solidi, Vol. 7, No. 3, 1964, pp. 953-971 (In German).

This article describes apparatus constructed for the measurement of internal friction in the range 0.05 to 4 Hz from 110° to 450° K, allowing the deformation of single crystals (above 110° K) before measurement. The apparatus is used in measurement of the temperature dependence of the logarithmic decrement of crystals having different orientation and deformation and in measurement of quenched wires.

2244. Wepner, W., Kochendorfer, A., and Trimborn, F.,
INVESTIGATIONS ON THE PRECIPITATION OF CARBON FROM ALPHA-IRON, Archiv für das Eisenhuttenwesen, Vol. 35, No. 2, February 1964, pp. 141-151.

Measurement was made of the time dependence of precipitation in low carburized pure iron with the aid of damping and thermoelectric force. Theories and experimental results on deformed and non-deformed samples are compared.

2245. Westbrook, J. H.,
SEGREGATION AT GRAIN BOUNDARIES, Metals Review, Vol. 9, No. 36, 1964, pp. 415-471.

Composition, temperature, heat treatment, and structure all affect grain boundary segregation. In turn, the latter affects mechanical properties of tensile strength, yield point, fracture resistance, toughness, impact energy and internal friction, physical properties such as electrical resistivity, chemical properties of oxidation and corrosion resistance and rate processes such as annealing phenomena, diffusion, precipitation, and sintering.

2246. Wilkes College, Wilkes-Barre, Pennsylvania,
PRECISION MEASUREMENT OF INTERNAL FRICTION IN NON-METALLIC MATERIALS by D. P. Detwiler and S. J. Holden, Final Report, ARL-64-160, AD-608449, 1964, 32 pp.

Not abstracted.

2247. Yamane, T., Mimo, G., and Ueda, J., INTERNAL FRICTION OF TITANIUM COLD WORKED AND ANNEALED, Japan Institute of Metals, Transactions, Vol. 5, No. 3, July 1964, pp. 185-193.

This article is a study of the behavior of lattice defects in rolled or tensile deformed, annealed titanium from measurements of the internal friction using a transverse resonance vibration method.

2248. Abir, D., Manor, H., Reiner, M.,
THE SOLID VISCOSITY OF MILD STEEL, Topics in Applied Mechanics, Amsterdam, Elsevier Publishing Company, 1965, pp. 117-134.

Not abstracted.

2249. Air Force Materials Laboratory, Research and Technology Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio,
DISLOCATION MOBILITY AND PINNING IN HARD MATERIALS THROUGH INTERNAL FRICTION STUDIES by P. D. Southgate and K. S. Mendelson, June 1965, Technical Report AFML-TR-65-50.

Internal friction due to dislocations in silicon may be explained by the motion of geometrical kinks. A theory, which fits the observations very well, has been developed involving mobile pinning points for the dislocations. The peak, believed to be analogous to the Bordoni peak in metals, will only appear in measurements made below about 1000 cps. In indium antimonide, further measurements on temperature dependence of the rate of anneal of dislocation damping indicate an activation energy of the order of the energy of motion, 0.4 electron volts. An internal friction peak near 80° C has been seen in electron-irradiated oxygen-doped silicon.

2250. Air Force Materials Laboratory Research and Technology Division Air Force Systems Command, Wright-Patterson Air Force Base, Ohio,
BIBLIOGRAPHY AND ABSTRACTS OF PUBLICATIONS FOR PERIOD 1956-1964 DEALING WITH DAMPING PROPERTIES OF MATERIALS by J. L. Wood and L. T. Lee, August 1965, Technical Report AFML-TR-65 22.

This bibliography was compiled as an aid in furthering current and future research in the field of the damping of materials and structures. It is a continuation of the bibliography compiled by L. J. Demer in 1956. Each entry is coded on the basis of content using the classification system developed and used by Demer. This coding system makes it possible to construct a personal punched card filing system of the damping field based on the ASM-SLA punch card system.

2251. Alers, G. A. and Zimmerman, J. E.,
DISLOCATION MOBILITY IN FCC METALS BELOW 1 K,
Vol. 139, No. 2A, 19 July 1965, pp. 414-418.

The elastic moduli of pure face-centered-cubic metals are lowered by the presence of mobile dislocation loops, often called the modulus defect. Results of accurate modulus measurements from 20° to 0.1° K using liquid-helium and adiabatic-demagnetization techniques show that this modulus defect is temperature-dependent and decreases as the temperature approaches absolute zero.

2252. Ananev, I. V. and Timofeev, P. G.,
OSCILLATIONS OF ELASTIC SYSTEMS IN AIRCRAFT STRUCTURES AND METHODS OF DAMPING THEM, Izdatel Stvo Mashinostroenie, 1965, 529 pp.

Not abstracted.

2253. Anonymous,
ADMIRALTY MATERIALS LABORATORY ON SHOW,
Metallurgia, Vol. 72, No. 431, September 1965, pp. 114-118.

Work at the laboratory is discussed. Among the various projects is one dealing with the development of high damping alloys, the most promising of which are those in the Mn-Cn system. These appear to owe their high damping to a stress-induced crystal lattice reorientation. Research is also being conducted on the effect of coatings on the damping of plates or structures.

2254. Anonymous,
INTERNAL FRICTION, DAMPING, AND CYCLIC PLASTICITY,
American Society for Testing Materials, Special Technical Publication No. 378, 1965.

This article presents evidence of the practical significance of this technique in developing high-shear modulus materials and composites needed to perform crucial roles in spacecraft and other advanced structural systems. Included are accounts of research on rheological and damping tests, damping measurements for studying stress, strain and slip, and methods of control of vibration transmission and near-resonance effects.

2255. Ariaratnam, S. T.,
THE VIBRATION OF UNSYMMETRICAL ROTATING SHAFTS, American Society for Testing Materials, Transactions, Journal of Applied Mechanics, Vol. 32, Series E, March 1965, pp. 159-162.

Not abstracted.

2256. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire,
INTERNAL FRICTION OF H_2O, D_2O AND NATURAL GLACIERICE, 1965, AD-615732, 51 pp.

Not abstracted.

2257. Artusio, G. and Locati, L.,
FATIGUE RESISTANCE OF LIGHT ALLOY COMPRESSOR BLADES AT 20 AND 150 C, USING A CONSTANT AMPLITUDE AND A STANDARD INCREMENTAL AMPLITUDE TEST, Proceedings, Symposium on Current Aeronautical Fatigue Problems, Rome, Italy, 1965, pp. 131-141, Edited by J. Schijve, J. R. Heath-Smith, and E. R. Welbourne.

Not abstracted.

2258. Atomic Energy Research Establishment,
SOME MEASUREMENTS OF THE DAMPING CHARACTERISTICS OF URANIUM AND URANIUM CARBIDE FUEL PINS by H. J. Crawley and M. J. Parsons, 1965, R-4873.

A limited series of damping measurements was made on uranium metal and uranium carbide, with and without stainless steel cladding, for temperatures up to 750° C. Young's modulus was also calculated.

2259. Atomic Energy Research Establishment,
THE MEASUREMENT OF INTERNAL FRICTION BY A DECREMENTAL TECHNIQUE by D. B. Marwick, 1965, R-4432.

Apparatus for determining internal friction coefficients with values ranging from 10^{-2} to 10^{-6} is described. A self-resonant dynamic method with electrostatic transducers is used to initiate mechanical oscillation together with a precise method of measuring decrement. An application at a resonance frequency of 200 kc/sec is given.

2260. Baker, G. S. and Carpenter, S. H.,
SIMULTANEOUS DEFORMATION AND INTERNAL FRICTION MEASUREMENTS, Review of Scientific Instruments, Vol. 36, January 1965, pp. 29-31.

Not abstracted.

2261. Bergey, R. L.,
DEVELOPMENT OF A LAMINATED VIBRATION FIXTURE MATERIAL, NRL, The Shock and Vibration Bulletin, February 1965, pp. 227-229.

Not abstracted.

2262. Beshers, D. N.,
DIFFUSION OF INTERSTITIAL IMPURITIES IN BODY-CENTERED CUBIC METALS, Proceedings, Diffusion in Body-Centered Cubic Metals, American Society for Metals, 1965, pp. 149-152.

Not abstracted.

2263. Beshers, D. N.,
AN INVESTIGATION OF INTERSTITIAL SITES IN THE B.C.C. LATTICE, Journal of Applied Physics, Vol. 36, No. 1, January 1965, pp. 290-300.

This article presents a review of evidence for the Snoek model of interstitial position and diffusion in body-centered cubic metals. Models involving octahedral and tetrahedral sites are compared with estimations of saddle point and stable site grain energies. The Snoek model was not supported by relaxation-strength predictions.

2264. Blatherwick, A. A. and Matters, R. G.,
HIGH TEMPERATURE RUPTURE FATIGUE AND DAMPING PROPERTIES OF AISI DESIGNATION 616/TYPE 422 STAINLESS/STEEL, Journal of Basic Engineering, Vol. 87, June 1965, pp. 325-332.

Not abstracted.

2265. Bokshtein, S. Z., Bronfin, M. B., Kishkin, S. T., and Marishchev, V. A.,
INVESTIGATION OF THE STRUCTURE OF GRAIN BOUNDARIES IN MOLYBDENUM AND ITS ALLOYS WITH ZIRCONIUM AND RHENIUM BY THE INTERNAL FRICTION METHOD, Diffusion Processes, Structure, and Properties of Metals, New York, New York, Consultants Bureau Enterprises, Incorporated, 1965, pp. 27-34, Edited by S. Z. Bokshtein.

Not abstracted.

2266. Bronfin, M. B. and Marischev, V. A.,
INTERNAL FRICTION IN DEFORMED MOLYBDENUM ALLOYS, Diffusion Processes, Structure, and Properties of Metals, New York, New York, Consultants Bureau Enterprises, Incorporated, 1965, pp. 35-39, Edited by S. Z. Bokshtein.

Not abstracted.

2267. Carpenter, S. H. and Baker, G. S.,
DISLOCATION-INTERSTITIAL INTERACTIONS IN SINGLE-CRYSTAL TANTALUM, Journal of Applied Physics, Vol. 36, No. 5, May 1965, pp. 1733-1738.

Dislocation-interstitial interactions have been investigated in zone-melted single-crystal tantalum by internal-friction measurements. Damping measurements indicate that two separate pinning processes occur in the zero to 100° C range.

2268. Charkey, E.,
HOW TO CHECK PERFORMANCE UNDER LOW-FREQUENCY VIBRATION, Product Engineering, 30 August 1965, pp. 58-60.

Four methods to test the effects of vibration (in the zero to 10 cps range) on materials are described.

2269. Chiao, W. F. and Gordon, R. B.,
THE YIELDING OF MAGNESIUM STUDIES WITH ULTRASONICS, American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), Metallurgical Society, Transactions, Vol. 233, No. 6, June 1965, pp. 1164-1172.

The sharp-yield point found in magnesium crystals in the solution-treated and aged condition is studied by dislocation internal-friction experiments. Results show that the sharp yield is not due to the sudden release of pinned dislocations but is more likely due to the rapid multiplication of an initially small number of dislocations. Recovery of the dislocation internal friction after deformation is also studied.

2270. Columbia University, New York, New York,
DETERMINATION OF THE COMPLEX SHEAR MODULUS OF A FILLED ELASTOMER FROM A VIBRATING SANDWICH BEAM by T. Nicholas and R. A. Heller, AD-466-040, June 1965, 81 pp.

A technique for determining the complex shear modulus of a linear viscoelastic material from damped free vibrations of sandwich beams is presented. Experimental results for a wide range of temperatures and frequencies are presented for a potassium-chloride-filled polyurethane solid propellant. With the aid of an arhenius-type temperature-time shift function the shear modulus and damping constant are evaluated over eight decades of frequency.

2271. Cost, J. R.,
ZENER RELAXATION STUDIES OF VACANCY ANNEALING IN QUENCHED ALLOYS, Lattice Defects in Quenched Metals, Academic Press, 1965, pp. 443-466.

Measurement of Zener relaxation rate by static or dynamic (internal friction) method is described. Its use to monitor atomic mobility in alloys and to follow the annealing of a nonequilibrium vacancy population is discussed. Results of a vacancy annealing study in alpha silver-zinc alloys and in annealed silver-34 atomic percent zinc are reported.

2272. Cramer, J. A.,
DEVELOPMENT OF VIBRATION ISOLATORS FOR AIRCRAFT EQUIPMENT, Aircraft Engineering, Vol. 37, May 1965, pp. 159-160.

Not abstracted.

2273. Damask, A. C.,
EFFECT OF NEUTRON IRRADIATION ON PRECIPITATION OF CARBON IN ALPHA IRON, Diffusion in Body-Centered Cubic Metals, American Society for Metals, 1965, pp. 317-328.

Not abstracted.

2274. Datsko, O. I. and Pavlov, V. A.,
INTERNAL FRICTION IN NICKEL, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 19, No. 3, 1965, pp. 465-466 (In Russian).

Influence of heating conditions (rate and holding) on temperature dependence of internal friction of nickel, which has already undergone plastic deformation by drawing (to 80 percent reduction), was investigated. Deformed specimens were heated according to three variants, then analyzed metallographically to determine degree of recrystallization.

2275. David Taylor Model Basin, Washington, D. C.,
RECENT ADVANCES IN MECHANICAL IMPEDANCE INSTRUMENTATION AND APPLICATIONS by F. Schloss, Summary Report, February 1965, AD-461-789, 33 pp.

This report discusses an automatic impedance measurement system of high precision. These techniques have been applied to the evaluation of dynamic properties of resilient mountings, couplings, damped structures, and damping and viscoelastic materials and to the determination of the internal damping of materials as a function of vibratory stress, added water mass of propellers, and elastic moduli of heterogeneous materials such as fiber glass.

2276. DeVault, G. P. and McLennan, J. A.,
THEORY OF PHONON CONTRIBUTION TO INTERNAL FRICTION OF SOLIDS, Physical Review, Vol. 138, No. 3A, 3 May 1965, pp. A856-A864.

The theory of the internal friction, or viscosity, in insulating solids is discussed with the aid of the correlation-function expressions for viscosity. It is assumed that the displacements are sufficiently small that a phonon description can be used; consequently, the theory does not apply to such phenomena as plastic flow. There are a number of similarities with the theory of thermal conductivity, but also several interesting differences. In particular, the microscopic momentum is not transported with the phonon group velocity; it follows that the Boltzmann equation cannot be used to treat the momentum transport, or viscosity. In addition, it is found that, in contrast to the theory of thermal conductivity, one can expect to find a finite viscosity when certain processes are neglected.

2277. Dey, B. N. and Quader, M. A.,
INTERNAL FRICTION STUDY OF ALUMINUM ALLOY CONTAINING 7.5 WEIGHT PERCENT MAGNESIUM, Canadian Journal of Physics, Vol. 43, No. 7, July 1965, pp. 1347-1357.

Low-frequency internal-friction data were obtained using the torsion pendulum for the aluminum-7.5 percent by weight magnesium alloy to study the effects of quenching and aging on solute atom movements. A damping peak near 120° C, attributed to the stress-induced reorientation of solute atoms (Zener relaxation), was found to shift to 80° C, on quenching.

2278. Dolmatova, R. L., Korotayev, A. D., Koneva, N. A., Malov, U. V., and Tukhfatullina, R. M.,
INVESTIGATION OF ACTIVATION ENERGY OF ATOM ORDERING IN ALLOYED PERMALLOY, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 19, No. 2, 1965, pp. 257-262.

Measurement of activation energy of atom ordering processes in hardened and cold-deformed specimens of nickel-iron-chromium and nickel-iron-molybdenum composition. Temperature dependence of internal friction of deformed and ordered (after hardening) nickel-iron-chromium alloy was determined.

2279. Fanti, F. and Nuovo, M.,
DISLOCATION RELAXATION IN ALUMINUM, Acta Metallurgica, Vol. 13, No. 2, February 1965, pp. 89-98.

Energy dissipation coefficients were measured for high-purity aluminum as a function of temperature from 60° to 270° K by means of a resonance technique. Permanent strain was introduced by various means, but no appreciable change was observed with this type of cold working. Relaxation spectra and temperature dependence of resonant frequency were explored, as well as effects of annealing on the relaxation peaks.

2280. Farrell, K.,
HYDROGEN AND THE YIELD POINT IN IRON, Iron and Steel Institute, Journal, Vol. 203, No. 1, January 1965, pp. 71-74.

Influence of hydrogen on the yield point in iron. The major effect of hydrogen in supersaturation in iron and ferritic steels is to precipitate into voids and cause localized plastic flow and cracking. This leads to suppression of yield point and to embrittlement. Effects on internal friction and tensile stress are considered.

2281. Feigin, M. I.,
FORCED VIBRATIONS OF A SYSTEM WITH THE COMBINED-FRICTION DAMPER OPERATING ELASTICALLY, Akademiia Nauk SSSR, Izvestiia, Mekhanika, 1965, pp. 42-49.

Not abstracted.

2282. Gajendar, N.,
FREE VIBRATIONS OF A CIRCULAR PLATE, Royal Aeronautical Society, Journal, Vol. 69, May 1965, pp. 345-347.

Not abstracted.

2283. Gibala, R. and Wert, C. A.,
THE MEASUREMENT OF DIFFUSION COEFFICIENTS BY INTERNAL FRICTION, Proceedings, Diffusion in Body-Centered Cubic Metals, American Society for Metals, 1965, pp. 131-148.

Not abstracted.

2288. Gratch, S. and Wolosewick, R. M.,
TRANSIENT RESPONSE IN A VISCOELASTIC MATERIAL WITH TEMPERATURE-DEPENDENT PROPERTIES AND THERMOMECHANICAL COUPLING, American Society of Mechanical Engineers, Paper 65-APM-11, 1965.

Not abstracted.

2289. Hasiguti, R. R.,
THEORY OF MECHANICAL RELAXATION PEAKS IN COLD-WORKED METALS, Physica Status Solidi, Vol. 9, No. 1, 1965, pp. 157-166.

Internal friction peaks, which appear in cold-worked metals above the Bordoni peak temperature, are considered to be due to relaxation on the basis of a point defect-associated dislocation model. Calculated data for activation energies, pre-exponential factors and relaxation strengths are compared with experimental data for copper, silver, gold, aluminum, nickel, iron, magnesium, titanium, zirconium, and cobalt metals, gold-copper alloy, and lithium fluoride.

2290. Hegland, D. E. and Smith, R. J.,
VIBRATION DAMPER FOR VACUUM LINES, Review of Scientific Instruments, Vol. 36, May 1965, pp. 709-710.

Not abstracted.

2291. Hinton, T.,
MEASUREMENT OF INTERNAL FRICTION IN THE KILOCYCLE FREQUENCY RANGE, Review of Scientific Instruments, Vol. 37, No. 8, August 1965, pp. 1114-1119.

Specimens are excited into longitudinal resonance electrostatically; maximum drive voltage of about 500 volts root mean square is required to obtain strain amplitudes of 10^{-5} with specimen-electrode gap of 0.2 millimeter. Frequency modulation technique detects resultant vibrations.

2284. Goddard Space Flight Center,
MATERIAL DAMPING OF ALUMINUM BY A RESONANT-DWELL TECHNIQUE by N. Granick and J. E. Stern, 1965, NASA Technical Note D-2893.

The relations between material damping, stress amplitude, and frequency were experimentally examined for aluminum 2024-T4.

2285. Gorshkov, G. A. and Postnikov, V. S.,
CHANGES IN INTERNAL FRICTION OF ALUMINUM, CADMIUM, AND COPPER DUE TO CYCLICAL STRAIN, Izv Akad Nauk SSSR Metally, No. 1, 1965, pp. 108-112 (In Russian).

A torsion oscillation method was used to measure internal friction of aluminum, cadmium, and copper appearing as a result of cyclical strain. Strain frequency was 1150 cycles per minute. Specimens, in wire form, were previously annealed, and others were tested immediately after deformation without annealing.

2286. Graham, L. J. and Chang, R.,
SOME MECHANICAL PROPERTIES OF VITREOUS SELENIUM NEAR ITS GLASS TRANSITION, Journal of Applied Physics, Vol. 36, No. 10, October 1965.

The elastic and anelastic properties (in the megacycle frequency range), viscosity, and electrical resistivity of vitreous selenium near its glass transition temperature were measured as a function of the quench (or melt) temperature between 540° and 720° K. The measurements reveal a correlation between the various properties and the internal molecular structure of the material at the quench temperature.

2287. Granato, A. V.,
INTERNAL FRICTION STUDIES OF DISLOCATIONS, Internal Friction Damping and Cyclic Plasticity, American Society for Testing Materials Special Technical Publication No. 378, 1965.

A review is given of the type of information concerning mechanical properties of crystals obtainable from internal friction measurements. The methods of measurement, together with their advantages, disadvantages, and limitations are outlined.

2292. Hren, J. A. and Sherby, O. D.,
THE INFLUENCE OF LONG-RANGE ORDER ON SOME MECHANICAL PROPERTIES OF AN IRON-COBALT ALLOY, Appl. Mater. Res., Vol. 4, No. 1, January 1965, pp. 41-46.

This article presents mechanical-property data on 2V Permendure alloy, and explains steady-state creep behavior above the order-disorder transformation temperature of 740° C by a dislocation-climb mechanism similar to that proposed for pure metals. Dynamic elastic modulus and internal friction are calculated. Activation energy is corrected for temperature variation. Creep-resistance comparison of partially ordered and disordered states indicates that iron-cobalt alloy creeps more slowly than iron, by several orders of magnitude.

2293. Hutchison, T. S.,
STAGE III DEFECT ANNEALING IN SINGLE CRYSTALS OF ALUMINUM AND GOLD, Applied Physics Letters, Vol. 6, No. 1, 1 January 1965, pp. 22-24.

Measurement of ultrasonic attenuation at megacycle frequencies and low strain amplitudes during heating of aluminum and gold crystals following gamma irradiation at 77° K. Results used to confirm the long-range migration of interstitial-like defects in stage III annealing in both aluminum and gold.

2294. Hutchison, T. S., Rogers, D. H., and Turkington, R. R.,
THERMALLY ACTIVATED DISLOCATION MOTION IN ALUMINUM, Journal of Applied Physics, Vol. 36, No. 3, March 1965, pp. 871-873.

Study of the amplitude dependence of internal friction in cold-worked aluminum single crystals in the range 4° to 130° K at an applied stress frequency of 25 kc/sec showed the Lax and Filson peak lies between 10° and 30° K and the Bordoni peak lies between 90° and 120° K. The structure of the peaks varied with the amount of deformation. The results are discussed in terms of the breakaway of dislocations from pinning points.

2295. Kaelble, D. H.,
MICROMECHANISMS AND PHENOMENOLOGY OF DAMPING IN POLYMERS, Internal Friction Damping and Cyclic Plasticity, American Society for Testing Materials Special Technical Publication No. 378, 1965.

The damping properties of high polymers, represented in terms of dynamic storage and loss moduli, are discussed in terms of the characteristic regions of dynamic mechanical dispersion. The temperature-frequency interdependence of damping properties is defined from physical-chemical considerations and versatile techniques of measurement. The damping properties of elastomers, thermoset resins, and semicrystalline polymers are examined and discussed in terms of polymer structure and performance.

2296. Kamei, H., Knudsen, L. J., Pechter, L. S., and Tanner, L. N.,
TECHNIQUE FOR DETERMINING THE FREQUENCY RESPONSE OF LINEAR MECHANICAL SYSTEMS, Journal of Acoustical Society of America, Vol. 37, January 1965, pp. 66-76.

Not abstracted.

2297. Kemper, J. D.,
TORSIONAL INSTABILITY FROM FRICTIONAL OSCILLATIONS, Franklin Institute, Journal, Vol. 279, 1965, pp. 254-267.

Not abstracted.

2298. Kerwin, E. M., Jr.,
MACROMECHANISMS OF DAMPING IN COMPOSITE STRUCTURES, Internal Friction Damping and Cyclic Plasticity, American Society for Testing Materials Special Technical Publication, No. 378, 1965.

Structural damping limits the free responses of a system, including both resonances and propagating waves. In this paper, a review is given of a number of important mechanisms by which structural damping may be achieved. These mechanisms have been called "macromechanisms" because there are identifiable elements or portions of the structure in which-by design-the dissipation of vibratory energy takes place.

2299. Kimura, H. and Maddin, R.,
EFFECT OF QUENCHED-IN VACANCIES ON THE MECHANICAL PROPERTIES OF METALS AND ALLOYS, Lattice Defects in Quenched Metals, Academic Press, 1965, pp. 319-386.

This article presents experimental results of effects of quenching on mechanical properties of gold, copper, aluminum, zinc, and magnesium. Defects considered to be responsible for the effects are identified, and a brief description of the electron microscopic observations is given. Black dots, dislocation loops, stacking fault tetrahedra, and jogs are described. Work hardening, slip bands, overshooting effect, and dislocation pinning by quenched-in vacancies, as revealed by internal friction measurements, are discussed.

2300. Krechmer, V. G., Paisov, I. V., and Piguzov, Yu. V.,
SOME PECULIARITIES OF INTERNAL FRICTION IN COMPLEXLY ALLOYED HIGH-STRENGTH STEELS, Izv VUZ Chernaya Met, No. 1, 1965, pp. 91-94 (In Russian).

This article presents a study of internal friction and its relation to the mechanical properties of heat-treated 45KhGSNT and 45KhSNT high-strength steels. Also discussed are temperature relation of internal friction, the effect of heating temperature on relaxation stresses, and the changes in impact strength, yield strength, and hardness.

2301. Krishtal, Yu. A.,
INFLUENCE OF THE QUENCHING TEMPERATURE ON INTERNAL FRICTION OF Fe-Si ALLOYS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 19, No. 1, 1965, pp. 111-116 (In Russian).

Water quenching of vacuum-annealed transformer steel (2.9 percent to 3.1 percent silicon) from 500° to 1200° C, and study of the relaxation and internal-friction peaks at 20° to 260° C, as functions of quenching temperatures, are the subjects of this article. The role of the interstitial carbon and nitrogen atoms, atomic migration, and vacancy concentrations on internal friction and relaxation values is discussed.

2302. Kuznetsov, V. N.,
THE ΔE-EFFECT AND INTERNAL FRICTION IN FERRITES AT ULTRASONIC FREQUENCIES, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 19, No. 1, 1965, p. 123.

Measurements are presented for ferrites containing up to 50 percent nickel oxide or nickel oxide and zinc oxide. Both damping and modulus are strongly affected by magnetic fields.

2303. Kuznetsov, V. N.,
MEASUREMENT OF THE INTERNAL FRICTION IN A FERRITE FROM THE DAMPING OF ELASTIC OSCILLATIONS, Fizika, Vol. 8, No. 1, 1965, pp. 122-124.

Not abstracted.

2304. Lazan, B. J.,
DAMPING OF MATERIALS AND MEMBERS IN STRUCTURAL MECHANICS, New York, New York, Pergamon Press, Incorporated, Manuscript Submitted 10 August 1964 for Publication in 1965.

Damping studies have become increasingly significant in two general areas of engineering science: materials science and structural mechanics. The solution of several types of problems in structural mechanics requires information on the damping in the system before an analysis can be undertaken. This monograph is concerned primarily with damping as an important material property in the performance of machines and structures.

2305. Lazan, B. J.,
DAMPING STUDIES IN MATERIALS SCIENCE AND MATERIALS ENGINEERING, Internal Friction Damping and Cyclic Plasticity, American Society for Testing Materials Special Technical Publication No. 378, 1965.

Materials systems can be presented mathematically by constitutive equations which define the relations between forcing functions and the responses. An important feature of materials systems subjected to cyclic load is the damping. For purposes of damping studies, materials systems may be identified as uniform materials, members, material composites, and structural interfaces. A variety of motivations

and levels of approach can be associated with each of these categories, and each has an appropriate set of units and nomenclature. In spite of the variety of mechanisms and types of materials systems, damping phenomena can, in general, be classified under two major categories (rate-dependent and rate-independent), and each of these under two subcategories (quadratic and nonquadratic). Certain general features can be identified under this classification system. A variety of tests has been used to study both these general features and the specific properties of specific materials.

2306. Libman, N. B. and Khodakova, T. A.,
AGING OF N41KhTA ALLOY, Metalloved. Term Obrabotka Metallov, No. 2, 1965, pp. 16-19.

Wire of N41KhTA nickel-iron-base alloy (used for hair springs of watches) is water-quenched from 900° to 1050° C and aged at 100° to 800° C for various times in a hydrogen atmosphere. Values are given for hardness, tensile strength, elongation, internal friction, and thermoelasticity.

2307. Locati, L. and Artusio, G.,
FATIGUE RESISTANCE OF LIGHT ALLOY COMPRESSOR BLADES AT 20 AND 150 C, USING A CONSTANT AMPLITUDE AND A STANDARD INCREMENTAL AMPLITUDE TEST, Current Aeronautical Fatigue Problems, New York, New York, Pergamon Press, Incorporated, 1965, pp. 131-142.

Resonance fatigue tests on compressor blades were performed at 20° and 150° C using a standard incremental law and at constant amplitude using two or three load levels. Influence of temperature on Young's modulus, damping coefficient, and hardness were measured.

2308. Love, R. E., Shaw, R. W., and Fate, W. A.,
ATTENUATION OF LONGITUDINAL ULTRASOUND IN SUPERCONDUCTING LEAD, Physical Review, Vol. 138, 31 May 1965, pp. 1453-1460.

The ultrasonic pulse-echo technique was used to measure the absorption of ultrasound in superconducting and normal single-crystal lead. The purpose of this investigation was to measure the temperature dependence of the superconducting energy gap as well as to attempt to observe its anisotropy.

2309. Magner, R.,
DESIGNING AGAINST VIBRATION AND SHOCK, Design News, Vol. 20, 20 January 1965, pp. 12-17.

Not abstracted.

2310. Maringer, R. E.,
MAGNETIC AFTEREFFECTS IN Fe-Al ALLOYS, Journal of Applied Physics, Vol. 36, No. 3, March 1965, pp. 1239-1240.

Measurements of the decay of magnetic permeability with time after demagnetization have been performed on iron-17 atomic percent aluminum. Measurements were obtained over the range of 360° to 475° C. The decay curves could be separated analytically into two components, with relaxation times differing by about a factor of six. Relaxation times for the shorter of the two components agree well with relaxation times calculated from observations of the Zener peak (by internal-friction methods) in these alloys.

2311. Mason, W. P.,
MECHANISM FOR ELECTRON DAMPING OF DISLOCATIONS IN Pb, Applied Physics Letters, Vol. 6, No. 6, 15 March 1965, pp. 111-112.

The proposed mechanism utilizes the fact that a dislocation is surrounded by a strain field moving with the dislocation. Values are calculated for phonon damping using the lattice thermal conductivity curve in the range 1° to 1000° K.

2312. Mason, W. P.,
USE OF ULTRASONIC AND HYPERSONIC VELOCITY AND ATTENUATION MEASUREMENTS IN DETERMINING IMPERFECTION MOTIONS IN SOLIDS, Applied Mechanics Review, Vol. 18, No. 4, April 1965, pp. 257-263.

Thermal and electronic attenuations in perfect crystals and effects of point and line defects on velocity and attenuation values are derived for metal and insulating crystals.

2313. Mathieu, J. P.,
ON DAMPED VIBRATION THEORY, International Journal of Mechanical Sciences, Vol. 7, March 1965, pp. 173-182.

Not abstracted.

2314. Mecs, B. M. and Nowick, A. S.,
RELATION OF THE KOSTER EFFECT TO LOW-TEMPERATURE INTERNAL FRICTION PEAKS IN DEFORMED COPPER, Acta Metallurgica, Vol. 13, No. 7, July 1965, pp. 771-777.

A study is made to determine the relationship between the Koster effect (the modulus defect due to dislocations which is present in a freshly-deformed sample and which subsequently anneals out) and the various low-temperature relaxation peaks which have been observed. It is shown that the Koster modulus defect at room temperature is made up of several parts.

2315. Mellon Institute, Pittsburgh, Pennsylvania,
THE DEPENDENCE OF THE VISCOELASTIC MECHANICAL PROPERTIES OF POLYMERIC MATERIALS ON MOLECULAR AND MORPHOLOGICAL STRUCTURE, February 1965, NONR 269300, AD-615-595, No. 13, 148 pp.

Studies of crystallization in polymers (an infrared study of the interaction of polyamides with iodine in iodine-potassium iodide solution), of mechanical properties of polymers (temperature dependence of the viscoelastic behavior of polystyrene) (polyethylene-mechanical properties versus morphology), and of star- and comb-type branched polystyrenes (the preparation and characterization of some star- and comb-type branched polystyrenes).

2316. Miles, M. H., DeVries, K. L., and Gibbs, P.,
INTERNAL FRICTION UNDER HYDROSTATIC PRESSURE, Journal of Applied Physics, Vol. 36, No. 3, March 1965, pp. 852-854.

Internal friction measurements of zone-refined aluminum were obtained up to pressures of five kbar. The log of the background damping was found to increase linearly with pressure, with slopes of about 1.5×10^{-4} $kbar^{-1}$ and 47.7×10^{-4} $kbar^{-1}$ for CS_2 and kerosene pressure media, respectively. A reversible, intrinsic, pressure dependence of the amplitude-dependent part of the decrement was found.

2317. Minnesota University,
MATRIX METHODS IN NON-LINEAR DAMPING ANALYSIS by A. F. Metherell, August 1965, AFML-TR-65-128.

A method is established for predicting the damping matrix and hence the energy dissipation of a composite system.

2318. Morrow, J.,
CYCLIC PLASTIC STRAIN ENERGY AND FATIGUE OF METALS, Internal Friction Damping and Cyclic Plasticity, American Society for Testing Materials Special Technical Publication No. 378, 1965.

Experimental techniques and methods of interpreting results are reviewed and typical phenomenological cycle-dependent deformation and fracture behavior of metals are illustrated. It is shown that a stable hysteresis loop quickly develops under cyclic conditions. The cyclic stress-strain curve is defined as the locus of tips of several stable loops obtained at different cyclic strain ranges. Expressions are presented for mathematically representing the individual loops and the locus of their tips, and a number of experimental methods are disucssed for determining the stable cyclic stress-strain properties or the material constants in the mathematical expressions.

2319. National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Alabama,
FREE AND FORCED VIBRATIONS OF CANTILEVER BEAMS WITH VISCOUS DAMPING by F. J. Stanek, June 1965, NASA-TN-D-2831, 51 pp.

Not abstracted.

2320. Naval Ordnance Test Station, China Lake, California,
EFFECTS OF ULTRASOUND ON DEFORMATION CHARACTERISTICS OF STRUCTURAL METALS. PART 2. ACOUSTIC HEATING AND ZONE MELTING by B. Langenecker, W. Frandsen, and A. Kennedy, February 1965, TPR-371-PT2, NOTS-TP-3788, AD-612-915, 14 pp.

High-intensity ultrasound at 20 kc/sec is used in studies of mechanisms of metal deformation and treatment. Quantitative details about the experimental conditions are provided.

Measurements of internal friction during high-intensity ultrasonic radiation of metals are discussed.

2321. Naval Ordnance Test Station, China Lake, California, EFFECTS OF ULTRASOUND ON DEFORMATION CHARACTERISTICS OF STRUCTURAL METALS. PART 4. INTERNAL FRICTION AND CRYSTAL PLASTICITY IN INTENSE ULTRASONIC FIELDS by B. Lagenecker, May 1965, AD-462-609, 8 pp.

This article discusses the effects of ultrasound on deformation characteristics of structural metals.

2322. Nowick, A. S., ANELASTIC PHENOMENA IN METALS AND NONMETALLICS, American Society for Testing Materials Special Technical Publication No. 378, 1965.

A review is given of the use of anelasticity, particularly as manifested by an internal friction peak as a function of frequency or of temperature, in the study of defects in crystalline materials. The formal theory for the case of a single relaxation time is reviewed, and then generalized to considerations of a distribution of relaxation times. The physical origins of anelasticity are next discussed, consideration being given to mechanisms related both to point defects and to dislocations. Finally, the best known and understood examples of anelastic behavior in metals and in ionic and semiconducting materials are reviewed.

2323. Ohio State University Research Foundation, Columbus, Ohio, GRAIN BOUNDARY RELAXATION IN FOUR HIGH PURITY, FACE-CENTERED CUBIC METALS, FINAL REPORT, 1 MARCH 1963-1 MARCH 1965 by J. N. Cordea and J. W. Spretnak, April 1965, Technical Report No. TR-2, Contract AF33 657-7656, Project 7351, Task 735106, ML TR-65-116, 148 pp.

The grain boundary relaxation in high purity aluminum, nickel, copper, and silver was studied by means of a low frequency torsion pendulum. Both internal friction and creep at constant stress tests were conducted on all the metals. A lognormal distribution in relaxation times was used to explain the relatively wide experimental internal friction peaks and the gradual relaxation behavior during the creep tests. A

double-peak internal friction phenomenon observed in copper is explained by the segregation of minute quantities of oxygen to the grain boundary. The preferred orientation of grains in the wire specimens also appears to be an important factor. A similar double peak was also observed in high purity silver.

2324. Okapuu University,
SOME EXPERIMENTS ON VISCOUS DAMPING OF WHIRLING, SIMPLY SUPPORTED SHAFTS, Canadian Aeronautics and Space Journal, Vol. 11, June 1965, pp. 171-176.

Not abstracted.

2325. Papadakis, E. P.,
ULTRASONIC ATTENUATION CAUSED BY SCATTERING IN POLYCRYSTALLINE METALS, Journal of Acoustical Society of America, Vol. 37, No. 4, April 1965.

Ultrasonic-attenuation measurements have been made on fine-grained specimens of several metals. The grain-size distributions and ultrasonic velocities in these metals were also determined. Nickel and three iron alloys, one 30 percent nickel reported previously, the second 12 percent chromium (type 416 stainless steel), and the third 17 percent chromium and 1 percent carbon (type 440C stainless steel), all gave good results. Brass also gave good results, but copper showed much twinning, which as yet is unaccounted for.

2326. Pedersen, B., Krogdahl, T., and Stokkeland, O. E.,
ON THE MOTION OF HYDROGEN IN THE TANTALUM-HYDROGEN SYSTEM, Journal of Chemical Physics, Vol. 42, No. 1, 1 January 1965, pp. 72-79.

The proton spin-lattice relaxation time, T1, has been measured by a pulse technique as a function of temperature, in a series of tantalum-hydrogen samples with hydrogen content from hydrogen and tantalum equal to 0.1 to 0.66. The spin-lattice relaxation is determined by the rapid translation diffusion of the hydrogen atoms on the tantalum lattice. Discontinuities in the T1 curve indicate two-phase transitions in the temperature range from 200° to 400° K. The activation energy in the low-temperature phase is found to decrease linearly with increasing hydrogen content.

2327. Pfeffer, K. H., Schiller, P., and Seeger, P.,
DEFECT FORMATION IN FCC METALS CAUSED BY SPLITTING OF DISLOCATIONS, Physica Status Solidi, Vol. 8, No. 2, 1965, pp. 517-532.

The kinematics of extended jogs in dislocation lines in face-centered-cubic metals is treated from an atomic point of view. The theory predicts the generation of vacancies by the movement of jogs in edge dislocations and the coherent generation of interstitial atoms by jogs in 60- and 120-degree dislocations. The significance of these results in the theory of internal friction is discussed.

2328. Postnikov, Y. S., Ammer, S. A., and Belyayev, A. M.,
INTERNAL FRICTION, MODULUS OF RIGIDITY AND STRENGTH OF COPPER WHISKERS, Akademii Nauk, SSSR, Fizika Metallov i Metallovedenie, Vol. 19, No. 2, 1965, pp. 268-273.

A low-frequency torsional microbalance was constructed to investigate the temperature dependence of internal friction and modulus of rigidity of 20 copper whiskers, 3 to 10 mk diameter, in the temperature range from 20° to 800° C.

2329. Quader, M. A.,
INTERNAL FRICTION DUE TO DEFECTS IN SOLIDS, Journal of Scientific and Industrial Research, Vol. 24, No. 4, April 1965, pp. 162-169.

Various damping phenomena due to interstitials, substitutionals vacancies, grain boundaries, dislocations, and precipitates are reviewed.

2330. Robinson, P. M. and Richards, P. N.,
THE CHANGES IN INTERNAL FRICTION DURING THE RECRYSTALLIZATION OF IRON, Philosophical Magazine, Vol. 11, February 1965, No. 110, pp. 407-418.

Changes in internal friction which occur during the isothermal annealing of heavily deformed pure iron are studied for annealing temperatures from 500° to 700° C. Internal friction due to dislocation damping increases as recrystallization takes place, then falls to a constant level. The decrease in internal friction from the maximum value is associated with a repinning of the dislocations in the final

stages of recrystallization. The repinning of the dislocations is a dislocation rearrangement mechanism rather than the segregation of the solute atoms to the dislocation lines.

2331. Robinson, P. M. and Richards, P. N.,
SOLUBILITY OF CARBON IN COMMERCIAL LOW-CARBON STEEL, Journal of Iron and Steel Institute, June 1965, pp. 621-624.

The solubility of carbon in commercial capped steels has been determined after isothermal annealing at 700° and 600° C, following a normalizing treatment at 900° C.

2332. Rothenstein, B. F. and Policec, A.,
CONTRIBUTION TO THE MECHANISM OF INTERNAL FRICTION IN FERROMAGNETIC METALS IN AN ALTERNATING MAGNETIC FIELD, Zeitschrift für Physik, Vol. 187, 1965, pp. 6-20.

The theory of the effect is reviewed and extended.

2333. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
INVESTIGATION OF MOUNT WITH LOW- AND HIGH-DAMPING RUBBER ELEMENTS IN PARALLEL by R. Chow and R. E. Morris, AD-463-293, May 1965.

The concept of a parallel mount comprising a high-damping rubber element and low-damping element acting in parallel was investigated. A mount with the size and shape of a 7E450 mount, but with parallel elements made from a high-damping polyvinyl butyral and a low-damping natural rubber, respectively, was prepared and tested.

2334. Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, California,
DEVELOPMENT OF 450 POUND-CAPACITY MOUNT WITH HIGH VIBRATION DAMPING by R. Chow, March 1965, AD-460-191.

A high-damping mount was developed with a chlorobutyl resilient element as a possible replacement for the low-damping 7E450 mount with a neoprene resilient element. The high-damping mount had acceptable resonant frequencies over the load range.

2335. Ruzicka, J. E.,
VIBRATION RESPONSE CHARACTERISTICS OF VISCOELASTIC-DAMPED STRUCTURES, Shock and Vibration Bulletin, 1965, pp. 155-175.

Not abstracted.

2336. Salvi, A., Dautreppe, D., and Freiss, E.,
AUTOMATIC TORSION PENDULUM FOR THE CONTINUOUS RECORDING OF INTERNAL FRICTION AT CONSTANT AMPLITUDE AND VERY LOW FREQUENCIES, Review of Scientific Instruments, Vol. 36, No. 2, February 1965.

A torsion pendulum of the inverted type is maintained in oscillation at constant amplitude by means of an electric device. The mechanical oscillation gives rise to a frequency modulation which is detected in an original demodulator. The signal is amplified and used to supply two driving coils acting on small permanent magnets mounted on the inertia member. An example of a record showing internal-friction peaks in neutron irradiated iron is shown.

2337. Scavullo, M. A. and Stephens, D. G.,
EFFECT OF PRESSURE ENVIRONMENT ON DAMPING OF VIBRATING STRUCTURES, Shock and Vibration Bulletin, February 1965, pp. 197-203.

Not abstracted.

2338. Schnitzel, R. H.,
INTERNAL FRICTION OF TUNGSTEN SINGLE CRYSTALS, American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), Metallurgical Society, Transactions, Vol. 233, January 1965, pp. 186-192.

This article investigates internal-friction peaks at 300° and 400° C. The activation energies associated with them are determined for tungsten single crystals. The peak characteristics are similar to interstitial peaks observed in other body-centered-cubic metals. The origin of these peaks appears to be the Snoek mechanism.

2339. Siol, M.,
THE DAMPING OF ALUMINUM, PARTICULARLY OF RAFFINAL AND SAP, Metall, Vol. 19, No. 3, March 1965, pp. 230-236 (In German).

Theoretical analysis of internal friction at room temperature and at low temperatures of such aluminum materials as Raffinal (pure aluminum) and SAP. Various damping mechanisms based on dislocation concepts are analyzed, and the proposed theories are compared with experimental results.

2340. Soroka, W. W.,
HYSTERETICALLY DAMPED VIBRATION ABSORBER AND AN EQUIVALENT ELECTRICAL CIRCUIT, Experimental Mechanics, Vol. 5, February 1965, pp. 53-58.

Not abstracted.

2341. Southwest Research Institute, Department of Mechanical Sciences, San Antonio, Texas,
A REVIEW OF THE STATE-OF-THE-ART OF VIBRATION DAMPING ASSOCIATED WITH SHIP HULL STRUCTURES by W. E. Woolam, February 1965, AD-464-311, 76 pp.

A review of existing knowledge of damping of shiphull vibrations is presented with emphasis on values of damping coefficients of full-size ships. The contributions of various damping mechanisms to the over-all damping coefficient have been investigated in detail. The literature indicates that the predominant sources, in order of importance, are cargo, structural, and hydrodynamic damping.

2342. Snowdon, J. C.,
MECHANICAL IMPEDANCE OF FREE-FREE BEAMS, Journal of Acoustical Society of America, Vol. 37, February 1965, pp. 240-249.

Not abstracted.

2343. Stanley, J. T.,
THE EFFECT OF IRRADIATION ON PRECIPITATION OF NITRIDES IN IRON, Diffusion in Body-Centered-Cubic Metals, American Society for Metals, 1965, pp. 349-356.

Not abstracted.

2344. Stanley, M. W. and Hughes, I. F.,
AN INTERPRETATION OF THE SNOEK MECHANISM OF INTERNAL FRICTION IN METALS, Iron and Steel, Vol. 38, No. 5, May 1965, pp. 154-158.

The effect of the two factors governing the internal friction mechanisms associated with interstitial atoms changing sites in body-centered-cubic lattices. The factors are the number of interstitial atoms which change sites and the phase lag of the total strain caused by noninstantaneous jumping of interstitials. The theoretical derivation of the internal friction curve and results of internal friction experiments are noted.

2345. Thomas, E. V.,
DEVELOPMENT OF HIGHLY DAMPED SUBMARINE MACHINERY FOUNDATION, Shock and Vibration Bulletin, February 1965, pp. 205-209.

Not abstracted.

2346. Thompson, D. O. and Pare, V. K.,
DOSE DEPENDENCE OF THE DISLOCATION BREAKAWAY STRESS IN NEUTRON-IRRADIATED COPPER AS MEASURED IN NEUTRON-IRRADIATED COPPER AS MEASURED BY AMPLITUDE-DEPENDENT INTERNAL FRICTION, Journal of Applied Physics, Vol. 36, No. 1, January 1965, pp. 243-252.

This article presents measurements of strain-amplitude dependence of the internal friction in copper at 100° C as a function of fast neutron dose. It is in disagreement with the Granato-Lücke theory. The breakaway stress is proportional to the cube root of the integrated flux in the dose range from 10^{11} to 10^{14} neutrons per square centimeter. Results are discussed in terms of a source-hardening mechanism.

2347. Tokunaga, Y.,
ON THE VARIOUS PROPERTIES OF ACICULAR CAST IRONS, Imono, Vol. 37, No. 2, February 1965, pp. 28-37.

Investigations on the properties of flake-pearlitic, nodular-pearlitic, flake-acicular, eutectic graphite-acicular, and nodular-acicular cast irons showed that nodular-graphite irons had a higher Young's modulus and lower internal

friction than flake graphite irons, that graphite spheroidization increased fatigue strength remarkably, and that acicular irons showed low machinability.

2348. Turkov, S. K. and Shermergor, T. D., INTERNAL FRICTION FROM THE INTERACTION OF IMPURITY ATOMS WITH EDGE DISLOCATIONS, Soviet Physics - Solid State, Vol. 6, No. 12, June 1965, pp. 2807-2811.

An examination of the internal friction associated with diffusion of impurity atoms in the stress field of an edge dislocation executing vibrations in a glide plane under the action of an external harmonic driving force. The damping force exerted by the cloud on the dislocation is not regarded as being small.

2349. United States Bureau of Mines, Washington, D. C., MANGANESE-COPPER DAMPING ALLOYS (WITH BIBLIOGRAPHY) by J. W. Jensen and D. F. Walsh, Bulletin, 1965.

Extensive research and development was performed on the manganese-copper vibration-damping alloys to determine the relationship between the properties of the alloys and variations in composition, fabrication, and heat treatment. Both standard and special methods of testing were employed to obtain data on strength, elastic modulus, hardness, resistivity, dilatation, microstructure, crystal lattice, and damping capacity. The extensive tabular and graphical data of these properties are presented for alloys containing 50 percent to 85 percent manganese, as quenched (solid solution) and after various aging treatments.

2350. United States Bureau of Mines, Washington, D. C., INTERNAL FRICTION AS A FUNCTION OF ORIENTATION IN MAGNESIUM SINGLE CRYSTALS by R. R. Nothdurft and A. E. Schwaneke, Rep Invest No 6642, 1965, 18 pp.

The internal friction of eight single crystals of magnesium with orientation ranging from 10 to 84 degrees was measured at 33.5 kilocycles and 272° C and the results were interpreted in terms of the pinned-dislocation model proposed by Granato and Lücke.

2351. Vidal, G. and Bibring, H.,
INTERNAL FRICTION PEAKS IN Cb-4.8% Ti ALLOY, Compt Rend Acad Sci., Vol. 260, No. 3, Group 6, 18 January 1965, pp. 857-860.

A niobium 4.8 percent titanium alloy gave internal friction peaks at 100° C due to oxygen and at 340° C due to nitrogen, whereas unalloyed niobium gave peaks at 150° C and 285° C, the measurements being at a frequency of 0.6 hertz.

2352. Wagenblast, H. and Swartz, J. C.,
DAMPING PEAKS IN NEUTRON-IRRADIATED Fe-0.01% C, Acta Metallurgica, Vol. 13, No. 1, January 1965, pp. 42-44.

Internal-friction peaks observed in neutron-irradiated iron-carbon alloys during annealing at 125° to 400° C are attributed to the reorientation of carbon-vacancy complexes with a slight strain asymmetry.

2353. Walz, E.,
AN APPARATUS FOR MEASURING THE MECHANICAL RELAXATION PHENOMENA IN METALS DUE TO POINT DEFECTS, Zeitschrift für Metallkunde, Vol. 56, No. 5, May 1965, pp. 319-323.

An apparatus which permits determination of internal friction in quenched wires and plastically deformed single crystals is described. The specimen size ranged from 60 to 120 millimeters in length and up to 4 millimeters in diameter. The measurements could be carried out between 110° and 450° K in a 0.05 to 4 cps frequency range.

2354. Wang, F. E., Buehler, W. J., and Pickart, S. J.,
CRYSTAL STRUCTURE AND A UNIQUE "MARTENSITIC" TRANSITION OF TiNi, Journal of Applied Physics, Vol. 36, No. 10, October 1965.

Through single-crystal X-ray diffraction methods, the crystal structure of titanium nitride has been determined in the temperature range -70° to 900° C. Contrary to what has been assumed from previous work based on the powder pattern methods, the titanium nitride crystal structure is not a simple cesium chloride type.

2355. Wilson, R. A., Shaw, H. J., and Winslow, D. K., MEASUREMENT OF MICROWAVE ACOUSTIC ATTENUATION IN SAPPHIRE AND RUTILE USING NICKEL-FILM TRANSDUCERS, Journal of Applied Physics, Vol. 36, No. 10, October 1965.

Initial investigations on the room-temperature acoustic attenuation in sapphire and rutile at S band, which were reported earlier, showed the attenuation in both of these materials to be relatively low. These measurements have now been extended to other frequencies, and curves of attenuation are shown for rutile shear waves and sapphire longitudinal waves covering the frequency range from L band to X band, and for sapphire shear waves from L band to S band.

2356. Woodward, A. E. and Sauer, J. A., MECHANICAL RELAXATION PHENOMENA, Physics and Chemistry of the Organic Solid State, Vol. II, New York, New York, Interscience Publishers, 1965, pp. 637-723, Edited by D. Fox, M. M. Labes, and A. Weissbergen.

This is a comprehensive review of the present state of knowledge of mechanical relaxation behavior of organic solids. A wide variety of data is presented.

2357. Yale University, New Haven, Connecticut, THE YIELDING OF STEEL STUDIED BY ULTRASONICS by D. A. Koss and R. B. Gordon, Technical Report No. 9, October 1965.

Changes in the attenuation of AISI 1020, 1045, and 1095 steels, quenched and tempered, have been observed during tensile tests. Both attenuation and microstrain measurements fail to reveal pre-yield phenomena in as-tempered specimens, but there is a large pre-yield attenuation in strain-aged samples.

2358. Yamada, R. and Stein, R. S., DYNAMIC BIREFRINGENCE AND MECHANICAL LOSS SPECTRA OF CRYSTALLINE POLYMERS, Journal of Applied Physics, Vol. 36, No. 10, October 1965.

The variation of the real parts of the dynamic modulus, E^1, the dynamic strain-optical coefficient, K^1, the mechanical loss tangent, δ, and the optical loss tangent, α, have been

measured as a function of temperature between -40° and 120° C at constant frequency of one cycle per second for low-density polyethylene, high-density polyethylene, polypropylene, and nylon-6.

2359. Yamafuji, K. and Bauer, C. L.,
DIFFUSION-CONTROLLED DISLOCATION DAMPING, Journal of Applied Physics, Vol. 36, No. 10, October 1965.

A theory of diffusion-controlled dislocation damping is developed by considering the motion of pinning points within the dislocation core when an oscillating driving stress is applied to a crystal.

Appendix B. SUBJECT INDEX

Subject	Reference			
A				
Aluminum	15	21	23	42
	48	76	108	110
	113	162	166	188
	216	219	220	222
	223	240	262	293
	294	310	326	375
	361	386	413	433
	457	465	494	502
	544	556	561	576
	577	598	603	604
	611	621	628	629
	634	646	677	709
	710	720	750	751
	752	760	790	791
	809	810	811	819
	837	859	963	935
	941	968	969	978
	980	991	992	995
	1004	1011	1116	1138
	1229	1270	1279	1326
	1351	1361	1393	1408
	1486	1522	1526	1560
	1570	1574	1582	1601
	1629	1634	1637	1638
	1642	1665	1668	1679
	1683	1697	1699	1787
	1806	1820	1821	1840
	1933	1957	1993	1994
	2015	2023	2060	2126
	2210	2225	2234	2235
	2279	2285	2289	2293
	2294	2299	2316	2323
Aluminum Effect of Cladding	1101	1588		
Aluminum Alloys With Copper	123	166	167	277
	353	383	610	722
	819	802	858	859
	935	971	1172	1270
	1330	1534	1592	1675
	1705	1645	1667	1997

Subject	Reference			
Aluminum Alloys				
With Magnesium	204	277	395	396
	397	457	621	628
	745	760	996	1012
	1216	1342	1667	1705
	1812	2223	2277	
Type 2024	131	203	285	448
	609	622	1011	1179
	1486	2284		
Type SAP	310	863	1160	2023
	2103	2222	2339	
Miscellaneous	27	33	46	122
	128	151	248	262
	308	361	381	402
	469	440	488	502
	609	622	671	707
	858	859	863	892
	971	1040	1043	1057
	1179	1221	1330	1588
	1634	1667	1918	1956
	1996	2081	2103	2119
	2236			
Aluminum Oxide	517	724	1188	1189
	1256	1257	1745	1788
	1789	1795	1796	2355
Antiferroelectrics	1704			
Antimony	21	1857	1906	
Antimony-Bismuth Alloys	265	523		
Apparatus	6	9	13	104
	113	171	227	328
	386	436	480	518
	546	553	680	564
	581	583	587	594
	598	658	663	671
	675	699	722	739
	745	749	755	775
	868	944	957	982
	985	1034	1042	1082
	1097	1102	1124	1133
	1154	1181	1219	1232
	1279	1297	1301	1302
	1307	1347	1372	1412
	1453	1513	1569	1593
	1596	1641	1721	1754
	1778	1782	1799	1843

Subject	Reference			
Apparatus	2120	2136	2147	2148
	2170	2175	2177	2220
	2234	2243	2259	2275
	2291	2309	2336	2353
Applications				
Practical	30	32	38	39
	45	53	79	80
	114	119	133	144
	145	146	147	150
	192	195	209	210
	221	238	246	252
	261	276	312	400
	432	447	454	507
	558	590	618	635
	659	660	670	690
	701	850	900	905
	990	1048	1084	1085
	1086	1129	1152	1196
	1212	1231	1245	1312
	1333	1339	1372	1375
	1376	1377	1378	1379
	1406	1472	1610	1653
	1687	1688	1689	1760
	1773	1977	2008	2009
	2010	2011	2064	2207
	2215	2216	2217	2218
	2219	2252	2290	2333
	2334	2341	2345	
B				
Barium Titanate	578	986		
Beryllium	453	738	967	1262
	1780			
Beryllium Oxide	724	1188		
Bibliographies	278	347	851	877
	1454	1527	2095	2098
	2250			
Bismuth	21	265	645	653
Brass	654	845	1204	1234
	2090			
Boron	1720			
	14	234	255	369
	403	935	1020	1069
	1463	1480	1592	1637
	1642	1762	2325	

Subject	Reference			
C				
Cadmium	21	320	493	549
	653	654	773	1135
	1668	1772	2285	
Cadmium Alloys				
With Magnesium	259	589		
Cadmium Sulfide	759	1061	1343	1649
Carbon (See Graphite)				
Cast Iron	239	303	401	442
	619	722	765	890
	908	1026	1034	1037
	1055	1079	1080	1116
	1142	1218	1254	1661
	1662	1663	1664	1665
	2103	2237	2242	
Cerium	1202			
Chromium	538	834	965	1135
	1205	1206	1525	1846
	2051	2069	2100	2161
	2102	2103		
Chromium Alloys				
Miscellaneous	174	175	834	2099
Chromium Oxide	922	1224		
Coatings	226	852	1242	1249
	1256	1300	1348	1436
	1860	1968	2075	2078
	2088	2090	2253	
Cobalt	269	293	562	631
	1181	1407	1570	2289
Cobalt Alloys				
Miscellaneous	174	331	947	1209
	1716	1758		
Cobalt Oxide	922	1224		
Coelinvar	706	920		
Composites				
Miscellaneous	7	12	142	268
	285	348	438	463
	605	680	690	789
	797	900	901	937
	1059	1084	1085	1111
	1112	1148	1178	1295
	1303	1321	1323	1327
	1375	1376	1381	1389
	1438	1543	1686	1733
	1850	1851	1852	1853

Subject	Reference			
Composites				
Miscellaneous	1854	1932	1977	2002
	2009	2010	2011	2012
	2043	2064	2065	2109
	2128	2132	2133	2170
	2207	2209	2215	2217
	2218	2219	2221	2261
	2270	2298		
Concrete, Cement	172	355	513	514
	1357	1666	1766	
Copolymers, Terpolymers,				
Miscellaneous	182	228	271	658
	779	805	895	981
	1530	1624	1677	1687
	1800			
Copper	21	47	49	51
	128	166	167	181
	225	264	266	280
	281	293	294	305
	321	324	325	342
	343	361	370	371
	372	405	406	413
	421	451	465	486
	487	494	502	525
	526	536	540	570
	579	580	598	607
	634	643	644	653
	708	715	716	721
	761	762	769	783
	815	822	827	830
	873	929	935	951
	968	992	1020	1058
	1069	1075	1076	1077
	1089	1116	1123	1159
	1168	1193	1208	1279
	1341	1351	1353	1356
	1367	1475	1476	1492
	1507	1510	1560	1565
	1570	1597	1608	1609
	1620	1637	1652	1665
	1710	1717	1722	1727
	1735	1736	1755	1756
	1770	1798	1823	1825
	1868	1912	1931	1973

Subject	Reference			
Copper	1974	2000	2059	2070
	2167	2198	2210	2211
	2212	2225	2235	2239
	2243	2251	2285	2289
	2299	2323	2325	2328
	2346			
Copper Alloys				
With Aluminum	256	321	342	343
	482	498	1603	1667
	1940			
With Gold	51	54	540	569
	708	1938	1939	
With Zinc	259	305	321	481
	1099	1667	1716	1940
Miscellaneous	305	321	342	343
	498	502	540	830
	831	988	1356	1507
	1616	1667	1938	1940
	1941	2100	2131	2137
	2239			
Corrosion	478	491	1136	1360
	1936			
D				
Dysprosium	1169	1298		
E				
Electrodeposited Material	1083	1135	1367	2006
Elgiloy	628			
Elinvar	706	763	920	921
F				
Fatigue	44	45	46	55
	89	131	142	151
	250	251	262	268
	285	332	336	339
	348	423	424	439
	441	450	488	494
	557	584	598	602
	605	611	625	626
	697	720	778	803
	846	864	914	1000
	1012	1091	1106	1125
	1152	1212	1213	1227
	1254	1294	1311	1330

Subject	Reference			
Fatigue	1419	1439	1441	1447
	1489	1527	1545	1621
	1668	1671	1751	1765
	1818	1820	1821	1850
	1851	1852	1853	1854
	1878	1904	1923	1997
	2000	2003	2139	2171
	2307	2318		
Ferrites	706	920	1238	1266
	1291	1833	2302	2303
Ferroelectrics	794	986	1100	1635
G				
Gadolinium	1169			
Gallium	722			
Germanium	203	322	364	415
	416	499	598	664
	741	843	998	1108
	1109	1110	1210	1430
	1946	1949	2053	2201
Glass	61	217	241	242
	355	374	389	404
	529	678	722	746
	915	1046	1056	1088
	1203	1314	1354	1382
	1418	1508	1509	1521
	1623	1680	1692	1840
	2049			
Gold	245	470	761	762
	774	929	1058	1176
	1269	1460	1668	1756
	1776	1973	1974	1976
	2289	2293	2299	
Gold Alloys				
Miscellaneous	5	54	156	1128
	1582	1658	1674	1741
	1938	1939	2289	
Graphite	373	962	1180	1188
	2063			
H				
Hafnium	1167	1582	2104	
Hafnium-Zirconium Alloys	1167			
Holmium	1170			

Subject	Reference			
I				
Ice	65	66	527	528
	648	788	886	894
	1388	2256		
Indium	272	536		
Indium Antimonide	839	2249		
Invar	24	159	921	1274
	1275	1276	1849	
Irradiation				
Unspecified	153	334	895	1350
	1544	1576	2060	2138
Alpha	2167			
Deutron	1639	1640		
Electron	181	1608	1609	1710
Gamma	487	526	643	719
	874	1119	1409	1420
	1565	1679	1707	1719
	1720	1722	1971	2001
	2070			
Infrared	759			
Neutron	128	256	324	325
	451	459	486	525
	526	552	634	678
	873	875	961	962
	1047	1122	1123	1159
	1281	1342	1359	1508
	1510	1512	1517	1553
	1594	1597	1602	1652
	1653	1691	1735	1753
	1770	1880	1908	2049
	2059	2125	2273	2343
	2346	2352		
Ultraviolet	1098	1428	1749	
Visible	759	1061	1343	1474
	1649	1679		
X-Ray	200	781	1098	1100
	1422	1559	2239	
Iron	68	97	109	167
	185	211	220	266
	269	387	409	413
	433	437	465	532
	674	698	718	721
	734	754	825	830

Subject	Reference			
Iron	925	935	955	956
	961	1062	1063	1075
	1089	1097	1147	1181
	1200	1222	1240	1296
	1337	1351	1355	1361
	1490	1491	1512	1515
	1570	1592	1655	1662
	1665	1723	1725	1748
	1797	1809	1836	1840
	1863	1876	1902	1958
	1984	1985	2006	2096
	2125	2143	2289	2330
Iron				
Effect of Boron	127	254	298	948
	1147			
Effect of Carbon	41	59	68	69
	70	73	78	97
	101	126	185	190
	207	230	243	291
	309	316	323	345
	346	358	387	476
	500	501	506	542
	554	555	592	593
	608	637	640	650
	665	698	700	705
	717	745	765	766
	767	777	784	842
	909	948	949	950
	955	956	964	974
	975	1002	1005	1039
	1040	1044	1062	1073
	1102	1132	1164	1191
	1198	1216	1261	1267
	1284	1293	1305	1308
	1313	1319	1371	1413
	1414	1497	1506	1514
	1517	1601	1607	1612
	1613	1656	1657	1694
	1705	1726	1751	1753
	1783	1784	1785	1802
	1803	1832	1900	1909
	1921	1934	1984	1989
	2072	2073	2078	2116
	2117	2118	2120	2122

Subject	Reference			
Iron				
Effect of Carbon	2140	2144	2155	2181
	2238	2244	2273	2334
	2352			
Effect of Hydrogen	304	437	497	612
	925	1030	1248	1573
	1763	2082	2280	
Effect of Nitrogen	11	40	41	59
	68	69	73	103
	125	126	154	155
	170	185	207	243
	300	301	304	309
	323	346	358	385
	398	407	476	516
	546	592	637	696
	700	745	765	766
	767	800	842	909
	948	964	974	975
	976	1002	1030	1031
	1044	1049	1072	1183
	1192	1198	1216	1248
	1284	1313	1319	1364
	1365	1371	1426	1514
	1656	1657	1783	1784
	1785	1802	1803	1832
	1835	1899	1900	1909
	2051	2066	2072	2073
	2116	2117	2118	2120
	2121	2155	2238	2343
Effect of Oxygen	847	925	1132	1684
	1803	2005		
Effect of Phosphorus	554	859	966	
Iron Alloys				
With Aluminum	141	1101	1130	1407
	1452	1485	1541	1716
	1888	2055	2177	2310
With Chromium	169	174	537	538
	730	731	798	1021
	1049	1281	1414	1426
	1607	1667	1750	1801
	2066	2169		
With Cobalt	174	730	731	964
	1414	1716	2292	

Subject	Reference			
Iron Alloys				
With Manganese	58	236	237	410
	412	627	814	727
	876	903	976	1049
	1143	1190	1421	1431
	1533	1607	1750	1943
	1989	2169	2179	
With Molybdenum	627	798	799	849
	949	1049	1414	1471
	1607	1695	1801	1917
	1989	2096	2169	2191
With Nickel	95	96	97	159
	174	175	306	414
	628	693	793	854
	921	930	1083	1164
	1383	1414	1429	1494
	1528	1849	1943	2079
	2096	2144	2169	2278
	2325			
With Silicon	41	74	532	593
	792	800	847	1030
	1124	1364	1365	1407
	1414	1667	1717	1840
	1909	2096	2177	2301
With Titanium	792	1601	1667	2238
With Tungsten	793	798	836	838
	997	1607		
With Vanadium	798	813	849	910
	1049	1118	1607	
Miscellaneous	97	174	236	237
	410	920	921	1010
	1431	1925	2024	
Iron Oxide	1271	1615		
Iron Whiskers	952			
L				
Lanthanum	1202			
Lead	21	84	85	262
	264	344	361	405
	421	531	563	574
	598	653	687	764
	1029	1041	1135	1204
	1234	1549	1550	1935
	1977	2088	2090	2308
	2311			

Subject	Reference			
Lead Alloys	139	523	1252	1667
Miscellaneous				
Lead Titanate-Zirconate	1555			
Lithium Fluoride	697	1045	1050	1260
	1415	1422	1469	1470
	1559	1560	1731	2001
	2031	2239	2289	
Lithium-Magnesium Alloys	1095	1391		
M				
Magnesium	21	266	540	634
	691	742	941	1116
	1165	1260	1393	1570
	1597	1671	1910	2003
	2154	2225	2269	2299
	2350			
Magnesium Alloys				
Miscellaneous	285	350	352	378
	433	439	440	609
	622	687	742	885
	979	1498	1580	1588
	1762	1910	2103	2154
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	1792	1793	2029	
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	409	508	532	612
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	883	931	932	947
	955	956	961	965
	1010	1044	1101	1155
	1169	1170	1198	1205
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	550	606	628	639
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	392	465	630	1093
	1393	1488	1567	1570
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	352	393	438	609
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	474	630	855	856
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This report contains a brief introduction to the field of damping capacity in metals and an extensive, annotated bibliography. The introductory material presents the fundamentals of damping, general methods of measuring internal friction or damping capacity, and some representative damping properties. The bibliography contains over 2300 references to pertinent literature published from 1955 through 1965, and is cross-indexed by both author and subject.

In addition, computer searches were run by Defense Documentation Center and by the National Aeronautics and Space Administration for location of pertinent literature published during the last four years. Articles, books, and papers are listed alphabetically by the author's last name. (Where there is more than one author, the alphabetical listing is by last name of first author.) Reports are listed alphabetically by the corporate author, that is, by the corporation, company, or agency from which the report originated.

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