

Abstracts of Bell System Technical Papers Not Published in This Journal

*Deformation Potentials and Mobilities in Non-Polar Crystals.** J. BARDEEN¹ and W. SHOCKLEY.¹ Bibliography. *Phys. Rev.*, v. 80, pp. 72-80, Oct. 1, 1950.

ABSTRACT—The method of effective mass, extended to apply to gradual shifts in energy bands resulting from deformations of the crystal lattice, is used to estimate the interaction between electrons of thermal energy and the acoustical modes of vibration. The mobilities of electrons and holes are thus related to the shifts of the conduction and valence-bond (filled) bands, respectively, associated with dilations of longitudinal waves. The theory is checked by comparison of the sum of the shifts of the conduction and valence-bond bands, as derived from the mobilities, with the shift of the energy gap with dilation. The latter is obtained independently for silicon, germanium and tellurium from one or more of the following: (1) the change in intrinsic conductivity with pressure, (2) the change in resistance of an n - p junction with pressure, and (3) the variation of intrinsic concentration with temperature and the thermal expansion coefficient. Higher mobilities of electrons and holes in germanium as compared with silicon are correlated with a smaller shift of energy gap with dilation.

Lepeth Sheath for Telephone Cables. E. J. LARSEN² and R. B. FARRELL.² *Elec. Engg.*, v. 69, pp. 1014-1017, Nov., 1950.

ABSTRACT—A new telephone cable sheath design has been developed by the Bell Telephone Laboratories in cooperation with Western Electric engineers. This sheath structure consists of a polyethylene jacket extruded on the cable core, over which a relatively thin lead sheath is applied. This design provides a high degree of protection against cable damage by lightning, and its adoption has resulted in a reduction in costs.

Effects of Calendar Shifts in Series of Monthly Data. C. E. ARMSTRONG.³ *Am. Statistician*, v. 4, pp. 20-21, Oct., 1950.

Scattering of Electrons in Crystals in the Presence of Large Electric Fields. J. BARDEEN¹ and W. SHOCKLEY.¹ *Phys. Rev.*, v. 80, pp. 69-71, Oct. 1, 1950.

ABSTRACT—By the calculation of transitions between states appropriate to electrons moving in a large uniform electric field superimposed on a periodic crystal field, it is shown the probabilities of scattering by lattice vibrations

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²W. E. Co.

³A. T. & T. Co.

or imperfections are independent of the uniform field and are given by the usual expressions derived for zero field. This justifies the procedure of treating acceleration by the field and scattering as independent processes.

*Conductivity Measurements at Microwave Frequencies.** A. C. BECK¹ and R. W. DAWSON.¹ *I.R.E., Proc.*, v. 38, pp. 1181-1189, Oct., 1950.

ABSTRACT—Because of the skin effect, the surface condition of conductors becomes very important in determining attenuation at microwave frequencies. This has been investigated by measuring small wire samples at a frequency of about 9,000 megacycles. A sample of the wire to be measured is inserted in a metal tube to form the center conductor of an open-ended coaxial line. The ratio of the peak frequency to the half-power bandwidth of this coaxial-line resonator, measured with the aid of an oscillographic display of its amplitude-versus-frequency characteristic, gives its loaded Q . The amplitude characteristic of the frequency-modulated signal generator, on which a wavemeter marker appears, is viewed simultaneously and used as a reference. By correcting the result to obtain the unloaded Q of the center conductor alone, the effective conductivity of the sample is obtained.

Results of measurements on a number of samples of different conductors having various surface conditions, treatments, and platings are given. These results are of value in the design of microwave components of all types where loss is a factor of importance.

Propagation of UHF and SHF Waves Beyond the Horizon. K. BULLINGTON.¹ Letter to the editor. *I.R.E., Proc.*, v. 38, pp. 1221-1222, Oct., 1950.

Simple Torsion Pendulum for Measuring Internal Friction. M. E. FINE.¹ *Jl. Metals*, v. 188, sec. 1, p. 1322, Nov., 1950.

*Experiments on the Initiation of Electric Arcs.** F. E. HAWORTH.¹ *Phys. Rev.*, v. 80, pp. 223-226, Oct. 15, 1950.

ABSTRACT—Arcs have been struck in vacuum between widely spaced electrodes by positive ion charging of an insulating film on the cathode, at separations from 0.5 to 5 mm and at potentials from 34 to 2000 volts. The arc current must be allowed to grow initially at the rate of at least 10^6 amp./sec. for the arc to occur. These experiments constitute a test of one of the fundamental steps postulated to account for the initiation of an arc between electrodes coming together at low voltages.

Mobilities of Molecular and Atomic Rare Gas Ions in the Parent Gases: Helium, Neon, and Argon. J. A. HORNBECK.¹ Letter to the editor. *Phys. Rev.*, v. 80, pp. 297-298, Oct. 15, 1950.

Bell Telephone Laboratories—An Example of an Institute of Creative Tech-

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nology.* M. J. KELLY.¹ *Roy. Soc. Lond., Proc., A*, v. 203, pp. 287-301, Oct. 10, 1950.

ABSTRACT—To keep pace with the evolution of its research laboratory and take advantage of the opportunities accruing from the adoption of the scientist and his methods, the engineering organization of industry has undergone major change. Its relatively simple operation, in the last century, of transforming the inventor's model into a design for manufacture, performed largely by empirical methods, has now expanded into many successive interlaced operations. Each, as it has matured, employs more of the scientific method and of fundamental analysis in the solution of its problems.

There has been so much emphasis on industrial research and mass-production methods in my country, that even our well-informed public is not sufficiently aware of the necessary and most important chain of events that lies between the initial step of basic research and the terminal operation of manufacture. In order to stress the continuity of procedures from research to engineering of product into manufacture and to emphasize their real unity, I speak of them as the single entity 'organized creative technology'. I am using the Bell Telephone Laboratories and its operations as an exemplification of this unity.

Pseudo Closed Trajectories in the Family of Trajectories Defined by a System of Differential Equations. L. A. MACCOLL.¹ *Quart. Applied Math.*, v. 8, pp. 255-263, Oct., 1950.

ABSTRACT—This paper is concerned with certain simple closed curves, here called pseudo closed trajectories, which play an important part in determining the topological properties of the family of trajectories (or characteristics) defined by a system of differential equations of the form

$$\frac{dx}{dt} = X(x, y), \quad \frac{dy}{dt} = Y(x, y).$$

Some of these curves are considered in a rather incidental way in the writings of Poincaré. However, the full concept of pseudo closed trajectories does not seem to have been discussed explicitly heretofore.

Teletype's Share in Bell System Operations. P. H. MIELE.² *Bell Tel. Mag.*, v. 29, pp. 180-190, Autumn, 1950.

ABSTRACT—Western Electric makes equipment for transmission of the spoken word; Teletype, its subsidiary, makes equipment for transmission of the written word.

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Mechanism of Magnetization and Alnico V. E. A. NESBITT¹ and H. J. WILLIAMS.¹ Letter to the editor. *Phys. Rev.*, v. 80, pp. 112-113, Oct. 1, 1950.

The P-Germanium Transistor.^{*} W. G. PFANN¹ and J. H. SCAFF.¹ *I.R.E. Proc.*, v. 38, pp. 1151-1154, Oct., 1950.

ABSTRACT—The transistor effect in p-type germanium is discussed and some properties are given for p-germanium transistors made in the laboratory. These exhibit higher cutoff frequency and somewhat lower current multiplication than their n-germanium counterparts. Under certain conditions a negative resistance "snap" effect is observed which is apparently peculiar to p-type germanium. Both types of transistor are governed by the same physical principles but they differ in the signs of the emitted carriers and of the bias voltages.

Transistor as a Reversible Amplifier. W. G. PFANN.¹ Letter to the editor. *I.R.E., Proc.*, v. 38, p. 1222, Oct., 1950.

Electronics. J. R. PIERCE.¹ *Sci. Am.*, v. 183, pp. 30-39, Oct., 1950.

ABSTRACT—A general account of the means by which the smallest fundamental particles are manipulated to accomplish many subtle tasks of our technological civilization.

Millimeter Waves.^{*} J. R. PIERCE.¹ *Physics Today*, v. 3, pp. 24-29, Nov., 1950.

ABSTRACT—Lying between the longest infrared rays and the shortest microwaves of the electromagnetic radiation is the region of millimeter waves, which are difficult to produce and to measure and which have as yet found few applications. The millimeter wave range, a relatively undeveloped field for research, presents a challenge to theoreticians, experimentalists, and inventors alike. This article was prepared at the request and through the cooperative effort of the ONRD advisory committee on millimeter wave generation as a means for stimulating effort in this new field.

Note on Stability of Electron Flow in the Presence of Positive Ions. J. R. PIERCE.¹ Letter to the editor. *Jl. Applied Phys.*, v. 21, p. 1063, Oct., 1950.

Communications Metallurgy.^{*} E. E. SCHUMACHER.¹ Delivered at annual autumn meeting of the Institute of Metals at Bournemouth, Sept. 18, 1950. *Inst. Metals, Jl.*, v. 18, pp. 1-23, Sept., 1950.

ABSTRACT—The lecture describes the function of the metallurgical department in a communications system. The need for metallurgical research and development, the origin of metals problems, the requirements imposed on metal components, and the integration of metallurgical developments into an operating communications system are given emphasis. It is shown how

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the solutions to problems may derive from previous experience, from empirical investigation, or from fundamental research.

Illustrative examples are given to demonstrate the complementary roles of engineering and research in correlating the properties of metals with their structure, and their structure with their history of fabrication.

Carrier Telephone on Rural Power Lines. J. L. SIMON.⁴ *Elec. Light & Power*, v. 28, pp. 92, 137, Oct., 1950.

ABSTRACT—A pictorial and diagrammatic treatment of the problems involved in transmitting carrier telephone currents over existing rural power lines.

*Weathering Studies on Polyethylene.** V. T. WALLDER,¹ W. J. CLARK,¹ J. B. DE COSTE,¹ and J. B. HOWARD.¹ References. *Ind. & Engg. Chem.*, v. 42, pp. 2320-2325, Nov., 1950.

ABSTRACT—Polyethylene has been used for a number of years as a dielectric material but only recently has it been considered as a mechanical protection for wires and cables intended for direct exposure to the weather. Data are presented on the results of a 10-year program on the effects of weather on polyethylene. An accelerated test, which for the materials tested shows good correlation with natural aging, is described and used to evaluate the aging characteristics of compounds of polyethylene containing carbon black. Data are given showing effects on aging of different types of carbon blacks such as furnace and channel blacks, effects of carbon black concentration on aging, the necessity for efficient dispersion of the carbon black in the polyethylene, and the relation between aging and carbon-black particle size. Age resistance of polyethylene is shown to increase as the average molecular weight of the polymer is increased. These data indicate that channel grades of carbon black which have a particle diameter of about 25 $m\mu$ or less when well dispersed in an appropriate polyethylene at concentrations of 1 to 2% can produce compositions having a natural outdoor life expectancy sufficiently long to be considered for most outdoor applications in the wire and cable field.

Why Standardize Thicknesses of Thin Flat Metals. I. V. WILLIAMS.¹ *Standardization*, v. 21, pp. 260-261, 272, Oct., 1950.

ABSTRACT—Before considering the methods of standardizing thicknesses of metals, let us first consider why there should be any demand or need for such standards. Some very strong arguments can be advanced in favor of such practice, and the benefits which are derived therefrom should favor producers, warehousemen, and consumers.

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*Test of 450-Megacycle Urban Area Transmission to a Mobile Receiver.**
A. J. AIKENS¹ and L. Y. LACY.¹ *I.R.E., Proc.*, v. 38, pp. 1317-1319, Nov., 1950.

ABSTRACT—Measurements were made of mobile radio-telephone transmission at 450 Mc in New York City using frequency modulation. Comparison was made with transmission at 150 Mc using identical speech modulation. Effective radiated powers were about equal. Direct comparison tests were made with the receivers installed in a moving automobile. The transmitter and the receiver used at 450 Mc were developed especially for the job. The receivers used at the two frequencies had substantially the same noise figures. The tests permitted estimates of the relative magnitudes of the shadow losses at the two frequencies and included measurements of r^4 noise. Subjective tests of circuit merit comparing the two frequencies were made by a number of observers.

*Pressure Broadening of the Ammonia Inversion Line by Foreign Gases: Quadrupole-Induced Dipole Interactions.** P. W. ANDERSON.¹ *Phys. Rev.*, v. 80, pp. 511-513, Nov. 15, 1950.

ABSTRACT—The broadening of the 3,3 line of the inversion spectrum of ammonia by foreign gases which are not expected to have dipole or quadrupole moments has been measured accurately by Smith and Howard. This broadening is greater than that previously computed by the author using the interaction of the molecule's dipole moment with the induced dipole on the foreign gas atom. In this paper the broadening is explained quantitatively using the interaction of the induced dipole on the foreign gas atom with the quadrupole moment of ammonia. It is concluded that a model of the ammonia molecule using bond dipoles of the appropriate size to give the known dipole moment, or a model with point charges at the atoms, again adjusted to give the correct dipole moment, both give quadrupole moments which explain the broadening cross sections with good accuracy.

*Antenna Systems for Multichannel Mobile Telephony.** W. C. BABCOCK¹ and H. W. NYLUND.¹ *I.R.E., Proc.*, v. 38, pp. 1324-1329, Nov., 1950.

ABSTRACT—This paper describes an arrangement whereby several antennas may be mounted on a single mast at the transmitting site of a multichannel system operating in the 152-162-megacycle band. The antennas are so disposed as to minimize shadowing effect of the mounting structure, while keeping intertransmitter coupling to a tolerable minimum. Measurements of the electrical characteristics are presented for arrangements of 6 antennas mounted on a 62-foot steel mast. These measurements on a full-scale struc-

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ture are supplemented by tests at a higher frequency on reduced-scale, simplified models.

*Wave Functions for Superconducting Electrons.** J. BARDEEN.¹ References. *Phys. Rev.*, v. 80, pp. 567-574, Nov. 15, 1950.

ABSTRACT—The observed variation of the transition temperature of mercury with isotopic mass is evidence that the superconducting state arises from interaction of electrons with lattice vibrations. The interaction term which gives scattering of electrons at high temperatures contributes at low temperatures a term to the energy of the system of electrons plus normal modes. Fröhlich has calculated the interaction energy at $T = 0^\circ\text{K}$ by second-order perturbation theory. The energy is calculated here by taking wave functions of superconducting electrons, which have energies near the Fermi surface, as linear combinations of Bloch functions whose coefficients are functions of coordinates of the normal modes. In an equivalent approximation, Fröhlich's expression for the interaction energy is obtained. When the energy is calculated directly rather than by perturbation theory, modified expressions are obtained for the energy and distribution of electrons in the superconducting state. The criterion for superconductivity is $\hbar/\tau > \sim 2\pi kT$, where τ is the relaxation time for electrons at some high temperature T where τT is constant. It is shown that superconducting electrons have small effective mass.

*Clampers in Video Transmission.** S. DOBA, JR.¹ and J. W. RIEKE.¹ *A.I. E.E., Trans.*, v. 69, pt. 1, pp. 477-487, 1950.

ABSTRACT—One of the major problems connected with the transmission of television signals is the exceptionally wide video band of frequencies involved. For the present black-and-white standards this amounts to about 4 megacycles. In the transmission of the television signal at video frequencies, that is, noncarrier transmission, the problem is further complicated because the lower limit of the frequency range extends literally to zero frequency.

*Calculation of Vowel Resonances, and an Electrical Vocal Tract.** H. K. DUNN.¹ Bibliography. *Acoustical Soc. Am., Jl.*, v. 22, pp. 740-753, Nov., 1950.

ABSTRACT—By treating the vocal tract as a series of cylindrical sections, or acoustic lines, it is possible to use transmission line theory in finding the resonances. With constants uniformly distributed along each section, resonances appear as modes of vibration of the tract taken as a whole. Thus, the fundamental mode of the smaller cavity may be affected considerably by a higher mode of the larger; and in addition, higher resonances are found

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without postulating additional cavities. This is an advantage over the lumped constant treatment, where it is necessary to postulate a different cavity for each resonance, and where the interaction terms in the equation do not include the higher modes of vibration. Under the distributed treatment, dimensions for each vowel may be taken from x-ray photographs of the vocal tract. The calculations then yield at least three resonances which lie in the frequency regions known for the vowel, from analyses of normal speech. Dependence of the different resonances upon the different cavities is discussed in some detail in the paper.

An electrical circuit based on the transmission line analogy has been made to produce acceptable vowel sounds. This circuit is useful in confirming the general theory and in research on the phonetic effects of articulator movements. The possibility of using such a circuit as a phonetic standard for vowel sounds is discussed.

Basic Theory Underlying Bell System Facilities Capacity Tables. A. L. GRACEY.³ *A.I.E.E., Trans.*, v. 69, pt. 1, pp. 238-243, 1950.

ABSTRACT—Discussion of the many considerations involved in the layout of a switching network adequate for present needs and flexible for future change is beyond the scope of the present paper. Rather, it deals with the specific problems of determining sizes of trunk groups and quantities of various components of dial central office equipment by the methods currently used in the Bell System. Examples are given, with illustrative tables. Enough of the probability theory underlying the tables is given to bring out the assumptions made to fit or approximate the various service conditions.

*Binaural Localization and Masking.** W. E. KOCK.¹ *Acoustical Soc. Am., Jl.*, v. 22, pp. 801-804, Nov., 1950.

ABSTRACT—Binaural experiments are described which indicate that the ability of the brain to localize a desired sound and to suppress undesired sounds coming from other directions can be traced in part to the different times of arrival of a sound at the two ears. It is suggested that the brain inserts a time delay in one of the two nerve paths associated with the ears so as to be able to compare, and thus concentrate on, those sounds arriving at the ears with this particular time of arrival distance.

The ability to perceive weak sounds binaurally in the presence of noise is shown to be a simple function of the direction of the desired sound and noise. An explanation is given for the effect reported by Koenig that front and rear confusion is avoided by head movements.

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*Number 5 Crossbar Dial Telephone Switching System.** F. A. KORN¹ and JAMES G. FERGUSON.¹ *A.I.E.E., Trans.*, v. 69, pt. 1, pp. 244-254, 1950.

ABSTRACT—The field of application of this new switching system is more extensive than that of any developed previously. The Number 5 system is capable of operating with all present local, tandem, and toll switching systems of the Bell System and of the independent companies which connect with it. In addition, it can serve as a tandem or toll center switching office where this is advantageous. It can be readily equipped with features for operation as required at toll centers for nationwide operator toll dialing and also for automatic message accounting which permits subscriber dialing to be extended to considerable distances. Number 5 crossbar is designed for operation with as few as four digits in a subscriber number or it can complete calls which require as many as 11 digits, (dialed by operators) three for the national area code, three for the office code, four for the numerals and the last for the station letter of the called number on certain types of party line service.

*Carrier-Controlled Relay Servos.** J. C. LOZIER.¹ *Elec. Engg.*, v. 69, pp. 1052-1056, Dec., 1950.

ABSTRACT—A study of servo systems shows that, when properly designed, the carrier-controlled relay servo will perform as well as a servo system with proportional control. In this article the problem of designing a carrier-controlled relay servo system for remotely tuning the variable capacitors of a transmitter is analyzed.

*Quality Rating of Television Images.** P. MERTZ,¹ A. D. FOWLER,¹ and H. N. CHRISTOPHER.¹ *I.R.E., Proc.*, v. 38, pp. 1269-1283, Nov., 1950.

ABSTRACT—Two methods of evaluating impairments in television images are described. Both employ observers and, therefore, yield subjective evaluations. The first is an extension of Baldwin's in which observers vote a preference between pictures with different impairments; one of the pictures is optically projected somewhat out of focus and is used as a reference. In the second method, the impairment is rated by observers in terms of pre-worded comments which are numbered and form a rating scale. Both methods permit an evaluation in terms of liminal increments as computed from the distribution of votes of the observers. These methods have been used to evaluate the impairing effects of echoes and noise in television pictures, and also to relate picture sharpness to other quality parameters.

*Fundamentals of the Automatic Telephone Message Accounting System.** J. MESZAR.¹ *A.I.E.E., Trans.*, v. 69, pt. 1, pp. 255-268, 1950.

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ABSTRACT—This paper discusses the economic background of the AMA system, explains its fundamental coding technique, describes its unique apparatus elements, and presents the basic features of both the recording and processing machinery.

*Conduction Phenomena in Gases.** J. P. MOLNAR.¹ *Elec. Engg.*, v. 69, pp. 1071–1076, Dec., 1950.

ABSTRACT—A review is made of the processes involved in the breakdown of a gas, in which a body of neutral gas particles that acts as an insulator is changed to one containing a great many charged particles that acts as a conductor. Factors which must be taken into account in discussing these mechanisms include the gas pressure and the nature of the applied field.

*Rooter for Video Signals.** B. M. OLIVER.¹ *I.R.E., Proc.*, v. 38, pp. 1301–1305, Nov., 1950.

ABSTRACT—This paper describes a device which takes the *n*th root of the instantaneous amplitude of a video signal. Its function is to linearize the over-all transfer characteristic, and thus to improve the picture quality in a television system using linear camera tubes and conventional cathode-ray viewing tubes.

*Tone Rendition in Television.** B. M. OLIVER.¹ *I.R.E., Proc.*, v. 38, pp. 1288–1300, Nov., 1950.

ABSTRACT—This paper is a review of some of the brightness transfer characteristics which may be obtained in television using present-day apparatus and techniques. Several families of curves are presented which show the effects of varying one or more of the relevant factors, the remainder being held constant at reasonable values.

*New Electronic Telegraph Regenerative Receiver.** B. OSTENDORF, JR.¹ *A.I.E.E., Trans.*, v. 69, pt. 1, pp. 32–36, 1950.

ABSTRACT—An all-electronic device for removing distortion from start-stop teletypewriter signals is described. The circuit utilizes a sine wave oscillator for timing and binary counters for synchronization. It provides low output distortion, high tolerance to input distortion, hit-reduction, transmission of steady-space break signals, and regeneration of one element-length of stop time. It features quick change of speed and code, use of office battery power, and reduction of routine maintenance to one adjustment. Over a year's experience has been obtained with about 100 of these units.

*Toward the Specification of Speech.** R. K. POTTER¹ and J. C. STEINBERG.¹ *References. Acoustical Soc. Am., Jl.*, v. 22, pp. 807–820, Nov., 1950.

ABSTRACT—This is an interim report on studies of the specification of speech

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sounds from acoustical measurements. Methods based upon analysis, synthesis, and vocal tract models are described. Included are the results of preliminary measurements on the vowel sounds of 25 speakers. Some of the problems in specifying the vowel sounds as indicated by these results are discussed.

Protective Grounding of Electrical Installations on Customer's Premises. A. H. SCHIRMER.¹ *A.I.E.E., Trans.*, v. 69, pt. 1, pp. 657-659, 1950.

ABSTRACT—The problem of electrical safety in rural areas is one of providing adequate insulation on circuits and equipment, and effective grounding and bonding. Providing adequate insulation presents no particular problems. However, there is some confusion as to what constitutes effective grounding and bonding. This paper briefly discusses the various factors which must be taken into account. The discussion is limited to a-c circuits.

*Six-System Urban Mobile Telephone Installation with 60-Kilocycle Spacing.** R. C. SHAW,¹ P. V. DIMOCK,¹ W. STRACK, JR.,¹ and W. C. HUNTER.¹ *I.R.E., Proc.*, v. 38, pp. 1320-1323, Nov., 1950.

ABSTRACT—This paper describes a 6-system mobile radiotelephone installation in Chicago, operating in the 152-162-megacycle band, and using 60-kc spacing of carrier frequencies, rather than the 120-kc spacing of previous practice. The measures required to achieve this frequency saving are described, including filters and special antenna arrangements at the land transmitter, "off-channel squelch" in the land receivers, connection of six land receivers to a common antenna, and other special co-ordinating means.

*Tone Rendition in Photography.** W. T. WINTRINGHAM.¹ References. *I.R.E., Proc.*, v. 38, pp. 1284-1287, Nov., 1950.

ABSTRACT—The photographic field is reviewed to find whether the tone rendition of a good picture can be predicted. The television engineer can find no solace in the fact that good photographs were made before measurements were made of the photographic media. He will be thwarted further when he learns that the best print is the result of experienced criticism of a work print. However, the experience of the photographer in obtaining pleasing results in spite of the limitations and distortions of the photographic process should be useful to the television engineer.

*Ferromagnetic Resonance in Nickel Ferrite.** W. A. YAGER.¹ J. K. GALT,¹ F. R. MERRIT,¹ and E. A. WOOD.¹ References. *Phys. Rev.*, v. 80, pp. 744-748, Nov. 15, 1950.

ABSTRACT—The ferromagnetic resonance phenomenon in single crystals of $\text{NiO} \cdot \text{Fe}_2\text{O}_3$ has been studied at room temperature at 24,000 Mc/sec. Small

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samples were used in order to avoid electromagnetic cavity-type resonances. The g -factor observed is 2.19. The first-order magnetocrystalline anisotropy constant K_1 was found so be -6.27×10^4 ergs/cc. The absorption line was very narrow (half-widths less than 100 oersteds) and fit a resonance curve quite satisfactorily.

Two Comments on the Limits of Validity of the P. R. Weiss Theory of Ferromagnetism. P. W. ANDERSON.¹ Letter to the editor. *Phys. Rev.*, v. 80, pp. 922-923, Dec. 1, 1950.

Television Picture Fidelity. M. W. BALDWIN, JR.¹ *Electronics*, v. 24, pp. 106-107, Jan., 1950.

ABSTRACT—Consideration of the various factors involved in the physics of image formation on a television picture tube, and discussion of inherent limitations and attributes of the overall system and its production techniques.

*Changes in Conductivity of Germanium Induced by Alpha-Particle Bombardment.** W. H. BRATTAIN¹ and G. L. PEARSON.¹ *Phys. Rev.*, v. 80, pp. 846-850, Dec. 1, 1950.

ABSTRACT—The bombardment of n -type germanium by alpha-particles from polonium first removes the conducting electrons at the rate of 78 per alpha-particle. After the electrons are gone conducting holes are introduced at the initial rate of 8.6 per alpha-particle. Some of these holes disappear with time at room temperature after bombardment is stopped, leaving only two conducting holes per alpha-particle. This change takes place only to the depth of penetration of the particles, namely 1.9×10^{-3} cm. The distribution of holes with depth is not uniform. The concentration rises from an initial value to a maximum at 1.4×10^{-3} cm depth and then falls to zero. The maximum is about 2.5 times the initial value and the integral under the curve is, of course, two holes per alpha-particle.

*Experimental Verification of Space Charge and Transit Time Reduction of Noise in Electron Beams.** C. C. CUTLER¹ and C. F. QUATE.¹ *Phys. Rev.*, v. 80, pp. 875-878, Dec. 1, 1950.

ABSTRACT—This paper describes a simple experiment which indicates some significant properties of the noise currents in a long electron stream, and verifies the applicability of the theory as worked out by Rack, Peterson, and Pierce to the noise properties of klystrons and traveling-wave tubes. An appendix shows that the observations are reasonably consistent with the theory.

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Note on the Inertia and Damping Constant of Ferromagnetic Domain Boundaries. C. KITTEL.¹ *Phys. Rev.*, v. 80, p. 918, Dec. 1, 1950.

*Reduction of SrO by Tungsten in Vacuum.** G. E. MOORE,¹ H. W. ALLISON,¹ and J. MORRISON.¹ *Bibliography. Jl. Chem. Phys.*, v. 18, pp. 1579-1586, Dec., 1950.

ABSTRACT—It is shown that in the temperature range 1150-1550°K, SrO is reduced by tungsten in vacuum. Both the rate of the reaction and its equilibrium constant can be calculated, giving values in substantial agreement with the experiments, which were performed under conditions such that both could be measured. The use of radioactive isotopes simplified the experimental work.

*Vaporization of Strontium Oxide.** G. E. MOORE,¹ H. W. ALLISON,¹ and J. D. STRUTHERS.¹ *Bibliography. Jl. Chem. Phys.*, v. 18, pp. 1572-1579, Dec., 1950.

ABSTRACT—The vapor pressure of SrO was measured by studying the product evaporated from platinum filaments coated with SrO. Most of the experiments employed radioactive isotopes. The possibility of systematic error caused by chemical reduction of the oxide or by its thermal dissociation is discussed. A value of λ_0 , the heat evaporation at 0°K computed from the results, is used to evaluate precision and to derive a vapor-pressure equation.

*Millimeter Waves.** J. R. PIERCE.¹ *Electronics*, v. 24, pp. 66-69, Jan., 1951.

*Effect of Stress-Free Edges in Plane Shear of a Flat Body.** W. T. READ.¹ *Jl. Applied Mech.*, v. 17, pp. 349-352, Dec., 1950.

ABSTRACT—This paper determines the tangential stiffness of a flat rectangular body, or shear pad, with a uniform relative tangential displacement on the upper and lower surfaces. The state of stress differs from pure shear in that the edges are stress-free. The correction to the stiffness in pure shear is obtained as a function of Poisson's ratio and the length-to-thickness ratio. The paper also illustrates the power of energy methods in furnishing accurate approximations with a small amount of numerical work when only over-all quantities, such as stiffness, are investigated. By manipulating energy relations and using the Prager-Synge approximate method a few hours of slide-rule computation was sufficient to determine both upper and lower bounds for the stiffness.

*Growing Piezoelectric Crystals.** A. C. WALKER.¹ *Franklin Inst., Jl.*, v. 250, pp. 481-524, Dec., 1950.

ABSTRACT—This paper is a summary of work carried out at the Bell Tele-

* A reprint of this article may be obtained on request to the editor of the B. S. T. J.

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phone Laboratories on the growing of large single crystals of three different piezoelectric materials: ammonium dihydrogen phosphate (ADP); ethylenediamine tartrate (EDT); and quartz. Included are illustrations of some basic principles observed in the growing of these crystals, descriptions of improved apparatus for their growth, and pilot plant problems encountered in conjunction with the commercial production of ADP and EDT.

*Studies of the Propagation Velocity of a Ferromagnetic Domain Boundary.**
H. J. WILLIAMS,¹ W. SHOCKLEY,¹ and C. KITTEL.¹ References. *Phys. Rev.*, v. 80, pp. 1090-1094, Dec. 15, 1950.

ABSTRACT—This paper discusses the results and interpretation of measurements of the propagation velocity of a ferromagnetic domain boundary in the single crystal of silicon iron with a simple domain structure employed previously by Williams and Shockley. The experiment is similar in principle to the Sixtus-Tonks experiment, with the important difference that in the present experiment the eddy current configuration is amenable to exact mathematical calculation, thereby enabling a quantitative comparison with observation. Experiments and analysis similar to those described in paragraphs III and V have been carried out by K. H. Stewart and were reported at the Grenoble Conference on Ferromagnetism and Antiferromagnetism as were the principal results of this article. However, it appears from Stewart's hysteresis loops unlikely that his specimen had as simple a domain structure as that encountered in our experiments.

*Progress in Development of Test Oscillators for Crystal Units.** L. F. KOERNER.¹ *I.R.E., Proc.*, v. 39, pp. 16-26, Jan., 1951.

ABSTRACT—Early crystal unit test oscillators as conceived some 20 years ago were principally duplicates of the actual equipment in which the crystal units were to be utilized, a practice which resulted in a large variety of test circuits and procedures for testing. It is now recognized that a knowledge of the equivalent electrical elements making up the crystal unit is essential to the circuit engineer, and that the older conception of frequency and activity, the latter being an attempt to express the quality of a crystal unit in terms of a particular oscillator circuit, do not define adequately its characteristics. The equivalent electrical circuit of the crystal unit contains essentially a resistance, an inductance, and 2 capacitances, which together with frequency define the performance of the unit. Crystal units are available in the frequency range from about 1,000 cycles to over 100 Mc. Their resistance range may vary from less than 10 ohms to over 150,000 ohms, the inductance from a few millihenries to nearly 100,000 henries and the capaci-

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tances from about 0.001 μf to 50 μf . Modern test oscillators, with frequency and capacitance measuring apparatus as auxiliary equipment, will measure these quantities with accuracies sufficient to meet present needs. The transmission measuring circuit also is described and is proposed as the standard reference circuit for comparison with the test oscillators.

Electro Spot Testing and Electrography.^{*} H. W. HERMANCE¹ and H. V. WADLOW.¹ Reprinted from A.S.T.M., *Special Technical Publication No. 98*, pp. 12-34, 1950.

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