

Abstracts of Technical Articles by Bell System Authors

*Dimensional Stability of Plastics.*¹ ROBERT BURNS. Because of inherent insulating properties, rigid plastics play an important part in the design and manufacture of precision electrical apparatus. Almost invariably, practical design considerations require that the plastics have reasonable structural possibilities since it is rarely practicable to disassociate completely electrical and structural functions.

This paper discusses one of the important factors in the successful use of plastics in precision devices, namely, dimensional stability. Since plastics are organic compounds, one must be prepared to accept a degree of instability not usually encountered in metals. The measurement of this property is therefore of prime importance to the user of plastics since the data provide a basis for design adjustment which frequently is the difference between failure and success.

The various types of dimensional change are reviewed. Data illustrating the separate effects of humidity, drying, and cycling procedures are submitted. The influence of fabricating processes such as compression or injection molding, and sheeting, is included.

*Some Numerical Methods for Locating Roots of Polynomials.*² THORNTON C. FRY. It is the purpose of this paper to discuss the location of the roots of polynomials of high degree, with particular reference to the case of complex roots. This is a problem with which the Laboratories has been much concerned in recent years because of the fact that the problem arises rather frequently in the design of electrical networks. Attention is not given to strictly theoretical methods, such as the exact solution by elliptic or automorphic functions: nor to the development of roots in series or in continued fractions, though such methods exist and one at least—development of the coefficients of a quadratic factor—is of great value in improving the accuracy of roots once they are known with reasonable approximation.

Instead, the paper deals with just two categories of solutions: one, the solution of the equations by a succession of rational operations, having for their purpose the dispersion of the roots; the other, a method depending on Cauchy's theorem regarding the number of roots within a closed contour.

*Thermistor Technics.*³ J. C. JOHNSON. This paper is confined to a study of how the three basic types of thermistors, namely, externally-heated or ambient temperature type, the directly-heated type, and also the indirectly-

¹ *A.S.T.M. Bulletin*, May 1945.

² *Quarterly Applied Mathematics*, July 1945.

³ *Electronic Industries*, August 1945.

heated type, are used in simple feedback amplifiers as regulation and control devices to effect the economies inherent in an entirely electrical system by eliminating such mechanical devices as motor-driven condensers, sliding contacts and rotary switches.

*Dynamic Measurements on Electromagnetic Devices.*⁴ E. L. NORTON. A method is presented by which measurements of flux may be made at any desired time during the operate cycle of an electromagnet. Apparatus is described which operates the magnet cyclically at an accurately held rate, and provides a means for measuring flux either by the use of a search coil or by the operating winding of the magnet itself. When using a search coil, it is connected to a direct-current milliammeter at the time in the cycle at which the value of the flux is desired and disconnected at the end of the cycle or just before the magnet is energized for the next pulse. If proper precautions are taken, the steady reading of the instrument is an accurate measure of the difference in the flux in the coil between the time it is connected to the meter and the time it is removed, or, since the latter is zero except for residual flux, the reading is a direct measure of flux.

The same apparatus may be used for the measurement of instantaneous current by the addition of an air core mutual inductance, and its use is extended to the measurement of armature position and velocity by the addition of a photoelectric cell and the proper amplifiers.

A form of vacuum tube filter is described which effectively filters the pulses from the indicating instrument without affecting the accuracy of the measurements.

*Coaxial Cables and Television Transmission.*⁵ HAROLD S. OSBORNE. Communication techniques and facilities useful to the entertainment industry have evolved naturally from the Telephone Companies' main objective—the transmission of speech. The development of carrier systems for long-distance transmission and technical features involved in the latest carrier medium—the coaxial cable—are reviewed. The television transmission capabilities of this medium, both now and what may be expected shortly after the war, are mentioned. The extensive system of such cables planned for the next five years, supplemented by radio relay systems to the extent that these prove themselves as a part of a communications network, will provide an excellent beginning for a nation-wide television transmission network. Planned primarily to meet telephone requirements, this network of cables will be suitable to meet the transmission needs of the television industry.

*The Performance and Measurement of Mixers in Terms of Linear-Network Theory.*⁶ L. C. PETERSON AND F. B. LLEWELLYN. This paper discusses

⁴ *Elec. Engg., Transactions Section*, April 1945.

⁵ *Jour. S.M.P.E.*, June 1945.

⁶ *Proc. I.R.E.*, July 1945.

the properties of mixers in terms of linear-network theory. In Part I the network equations are derived from the fundamental properties of nonlinear resistive elements. Part II contains a résumé of the appropriate formulas of linear-network theory. In Part III the network theory is applied, first to the case of simple nonlinear resistances, and next to the more general case where the nonlinear resistance is embedded in a network of parasitic resistive and reactive passive-impedance elements. In Part IV application of the previous results is made to the measurement of performance properties. The "impedance" and the "incremental" methods of measuring loss are contrasted, and it is shown that the actual loss is given by the incremental method when certain special precautions are taken, while the impedance method is in itself incomplete.

*A Figure of Merit for Electron-Concentrating Systems.*⁷ J. R. PIERCE. Electron-concentrating systems are subject to certain limitations because of the thermal velocities of electrons leaving the cathode. A figure of merit is proposed for measuring the goodness of a device in this respect. This figure of merit is the ratio of the area of the aperture which, in an ideal system with the same important parameters as the actual system, would pass a given fraction of the cathode current to the area of the aperture which in the actual system does pass this fraction of the cathode current. Expressions are given for evaluating this figure of merit.

*A 60-Kilowatt High-Frequency Transoceanic-Radiotelephone Amplifier.*⁸ C. F. P. ROSE. Here is described a high-frequency radio amplifier recently developed for the transoceanic-telephone facilities of the Bell System at Lawrenceville, New Jersey. In general, the amplifier is capable of delivering 60 kilowatts of peak envelope power when excited from a 2-kilowatt radio-frequency source. It is designed to operate as a "class B" amplifier for transmitting either single-channel double-sideband or twin-channel single-sideband types of transmission. Features are described which permit rapid frequency-changing technique from any preassigned frequency to another lying anywhere within the spectrum of 4.5 to 22 megacycles.

*Some Notes on the Design of Electron Guns.*⁹ A. L. SAMUEL. A method is outlined for the design of electron guns based on the simple theory first published by J. R. Pierce. This method assumes that the electrons are moving in a beam according to a known solution of the space-charge equation, and requires that electrodes exterior to the region of space charge be shaped so as to match the boundary conditions at the edge of the beam. An electrolytic tank method is used to obtain solutions for cases which are not amenable to direct calculation. Attention is given to some of the

⁷ *Proc. I.R.E.*, July 1945.

⁸ *Proc. I.R.E.*, October 1945.

⁹ *Proc. I.R.E.*, April 1945.

complications ignored by the simple theory and to some of the practical difficulties which are encountered in constructing guns according to these principles. An experimental check on the theory is described, together with some information as to the actual current distribution in a beam produced by a gun based on this design procedure.

*Microwave Radiation from the Sun.*¹⁰ G. C. SOUTHWORTH. During the summer months of 1942 and 1943, a small but measurable amount of microwave radiation was observed coming from the sun. This appeared as random noise in the outputs of sensitive receivers designed to work at wavelengths between one and ten centimeters. Over a considerable portion of the range, the energy was of the same order of magnitude as that predicted by black-body radiation theory.

Attempts were made to determine the effect of the earth's atmosphere on this radiation. Measurements made near sunrise or sunset, when the path through the earth's atmosphere was relatively long, differed only slightly from those made at noon. This suggested that any absorption that may have been present was small. In this connection it is of interest that small temperature differences could be noted between points below the horizon and the sky immediately above. This also suggested that the earth's atmosphere was relatively transparent.

In another kind of measurement the parabolic receiver was centered on the sun and its output was observed as the sun's disc moved out of the aperture of the receiver. The directional pattern so obtained indicated that at the shorter wave-lengths the sun's apparent diameter was considerably larger than that measured by ordinary optical means. This suggested that there may have been some refraction or perhaps scattering by the earth's atmosphere.

*Resistive Attenuators, Pads and Networks—An Analysis of their Applications in Mixer and Fader Systems (Part Eight of a Series).*¹¹ PAUL B. WRIGHT. In last month's discussion, the series-connected fader and the parallel-connected fader systems were considered, together with an analysis of their performance expressed both algebraically and in terms of the hyperbolic functions of a real variable. In this installment, the series-parallel-connected fader system discussion is continued and equations describing the complete behavior of this type network system are developed. This is followed by further analytical work dealing with the parallel-series-connected fader and mixer system and several lesser known systems which are quite useful to use. These are the *multiple bridge* and the *lattice network systems* which may be utilized to advantage for some applications. All of

¹⁰ *Jour. Franklin Institute*, April 1945.

¹¹ *Communications*, September 1945. (*Preceding parts of this Series appeared in earlier issues of Communications.*)

the equations which are derived are shown in the algebraical, hyperbolic and symbolical forms. The key chart which was presented earlier in this series may be used to great advantage when checking the definitions of the symbols used which are not specifically defined in the text. This procedure also may be directly applied to the hyperbolic equations shown. It is of course necessary to take into account that, in general, subscripts are used in most of the equations in the text while the key chart does not have any subscripts. This does not, however, alter the fundamental forms nor their definitions in terms of the propagation function, θ . To avoid the necessity for extensive interpolation of the hyperbolic function tables to find the correct numerical values for the various functions used throughout the text, a series of tables providing all of the functions required is presented.