

## Abstracts of Bell System Technical Papers\* Not Published in This Journal

*An Approximate Quantum Theory of the Antiferromagnetic Ground State.* P. W. ANDERSON<sup>1</sup>. *Phys. Rev.*, **86**, pp. 694-701, June 1, 1952. (Monograph 1995).

A careful treatment of the zero-point energy of the spin-waves in the Kramers-Heller semiclassical theory of ferromagnetics leads to surprisingly exact results for the properties of the ground state, as shown by Klein and Smith. An analogous treatment of the antiferromagnetic ground state, whose properties were unknown, is here carried out and justified. The results are expected to be valid to order  $1/S$  or better, where  $S$  is the spin quantum number of the separate atoms.

The energy of the ground state is computed and found to lie within limits found elsewhere on rigorous grounds. For the linear chain, there is no long-range order in the ground state; for the simple cubic and plane square lattices, a finite long-range order in the ground state is found. The fact that this order can be observed experimentally, somewhat puzzling since one knows the ground state to be a singlet, is explained.

*Method of Synthesis of the Statistical and Impact Theories of Pressure Broadening.* P. W. ANDERSON<sup>1</sup>. Letter to the Editor. *Phys. Rev.*, **86**, p. 809, June 1, 1952.

*Arcing at Electrical Contacts on Closure. Part III. Development of an Arc.* L. H. GERMER<sup>1</sup> and J. L. SMITH<sup>1</sup>. *Jl. Applied Phys.*, **23**, pp. 553-562, May, 1952. (Monograph 2002).

A description is given of a system made up of experimental electrodes and an oscilloscope by means of which the potential across the electrodes can be recorded with a time resolution of about  $10^{-9}$  sec. and a potential sensitivity of 1-trace width per volt. The closure of the electrodes to produce a short arc is synchronized with the oscilloscope sweep so that the beginning of the arc is photographed.

As an arc starts the potential across the electrodes decreases more or less gradually from the applied voltage to a steady value characteristic of the metal of the electrodes. The course of this change is extremely variable as is also the time over which the change is spread. The average value of the time appears to

\* Certain of these papers are available as Bell System Monographs and may be obtained on request to the Publication Department, Bell Telephone Laboratories, Inc., 463 West Street, New York 14, N. Y. For papers available in this form, the monograph number is given in parentheses following the date of publication, and this number should be given in all requests.

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vary with circuit inductance and with the nature of the electrode surfaces. For inactive silver surfaces and an inductance of  $0.10 \mu h$  the average value of the time is about  $0.007 \mu \text{ sec.}$ , and for active surfaces and the same inductance  $0.011 \mu \text{ sec.}$  For active surfaces and an inductance of  $5 \mu h$  the average value of the time is  $0.02 \mu \text{ sec.}$

The electrode separation at which an arc strikes is determined from the oscilloscope traces and from a correction for the height of the mound of metal thrown up by the arc. For active silver electrodes the average separation (at 40 or 45 volts) corresponds to a gross electric field of  $0.8 \times 10^6 \text{ volts/cm.}$  and for inactive silver electrodes to a field of  $2.3 \times 10^6 \text{ volts/cm.}$  These are probably better values than earlier measurements of these fields. There has not yet been any success in interpreting these phenomena in terms of fundamental processes.

*A Carrier Telegraph System for Short-Haul Applications.* J. L. HYSKO<sup>1</sup>, W. T. REA<sup>1</sup> and L. C. ROBERTS<sup>1</sup>. *Elec. Eng.*, **71**, pp. 625-630, July, 1952. (Monograph 2006).

This compact frequency-shift carrier telegraph system provides channels in and above the voice range. The channel terminal unit incorporates arrangements for handling Teletypewriter Exchange Service supervisory signals and employs no electromagnetic relays.

*Some Problems in Sampling Accounting Procedure.* H. L. JONES<sup>1</sup>. pp. 209-250. *Am. Soc. for Quality Control.* Quality control conference papers. 6th Annual Convention. N. Y., Am. Soc. Quality Control, 1952.

*Photometric Determination of Beryllium in Beryllium-Copper Alloys.* C. L. LUKE<sup>1</sup> and M. E. CAMPBELL<sup>1</sup>. *Anal. Chem.*, **24**, pp. 1056-1057, June, 1952. (Monograph 2013).

*Steady Rotational Flow of Ideal Gases.* R. C. PRIM<sup>1</sup>. *Jl. Rational Mech. and Analysis*, **1**, pp. 425-497, July, 1952.

This paper concerns the steady rotational flow of non-viscous and thermally non-conducting gases subject to no extraneous force field. For the most part attention is restricted to gases having constant specific heats. However, some of the results are valid for more general classes of fluids. Uniformity of total flow energy (stagnation enthalpy) or of entropy throughout the flow is not assumed. The present work is intended to be a comprehensive treatment of the status (in 1949) or rotational flow theory from the point of view of the establishment of general properties of such flows and the discovery and study of families of exact solutions to the equations governing them.

*Finishing Metal Parts for Telephones.* F. B. RINCK<sup>3</sup>. *Metal Progress*, **61**, pp. 65-70, June, 1952.

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<sup>3</sup> Western Electric Company

*Binary Counter Uses Two Transistors.* R. L. TRENT<sup>1</sup>. *Electronics*, **25**, pp. 100-101, July, 1952.

Various timing and registry functions are provided by transistorized counter with repetition rate from 0 to 50 kc. It has stability without the usual sacrifice in sensitivity and it permits either positive or negative triggering pulses to be used.

*Structural Imperfections in Quartz Crystals.* W. L. BOND<sup>1</sup> and J. ANDRUS<sup>1</sup>. *Am. Mineral.*, **37**, pp. 622-632, July-August, 1952. (Monograph 2001).

A method for examining the topography of atomic planes is developed and applied to quartz crystals. It is thought to have higher resolution than the method of Wooster and Wooster (*Nature*, **155**, p. 786 (1945)), or that of Ramachandran (*Proc. Ind. Acad. Sci.*, **19A**, p. 280 (1944)). Because of the higher resolution it gives more detailed information. A fair percentage of ostensibly perfect quartz is shown to have slight irregularities.

*Packaging Principles Employing Plastics and Printed Wiring to Improve Reliability.* W. J. CLARKE<sup>1</sup> and N. J. EICH<sup>1</sup>. pp. 133-137. A. I. E. E., I. R. E. and R. T. M. A. Symposium, Progress in Quality Electronic Components. Proceedings, Wash., D. C., May 5-7, 1952. Wash., D. C., R. T. M. A., 1952.

*Miniaturized Components for Transistor Action.* P. S. DARNELL<sup>1</sup>. pp. 51-57. A. I. E. E., I. R. E. and R. T. M. A. Symposium, Progress in Quality Electronic Components. Proceedings, Wash. D. C., May 5-7, 1952. Wash., D. C., R. T. M. A., 1952.

*Some Basic Concepts of Quality Control.* G. D. EDWARDS<sup>1</sup>. Shewhart Medalist Address. *Ind. Quality Control*, **9**, pp. 9-10, July, 1952.

*Effective Sum of Multiple Echoes in Television.* A. D. FOWLER<sup>1</sup> and H. N. CHRISTOPHER<sup>1</sup>. *S. M. P. T. E., JI.*, **58**, pp. 491-500, June, 1952.

Observers compared the interfering effect of multiple echoes with that of single echoes in black-and-white television pictures. The multiple echoes were 2, 4 or 8 echoes of equal strength but different delays. The single echoes were 40, 35 or 30 db weaker than the main signal. A method for estimating addition effects of several echoes is presented and demonstrated to be consistent with the test results.

*Design Factors Influencing the Reliability of Relays.* J. R. FRY<sup>1</sup>. pp. 101-107. A. I. E. E., I. R. E. and R. T. M. A. Symposium, Progress in

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Quality Electronic Components. Proceedings, Wash., D. C., May 5-7, 1952. Wash., D. C., R. T. M. A., 1952.

*Energy of a Bloch Wall on the Band Picture. II. Perturbation Approach.* C. HERRING<sup>1</sup>. *Phys. Rev.*, **87**, pp. 60-70, July 1, 1952.

The "exchange stiffness" constant, which appears in the theory of the Bloch interdomain wall in ferromagnetics, can be calculated by computing the response of a saturated specimen to a small spatially varying perturbing field. This calculation is carried out here in the self-consistent field approximation, using running waves for the one-electron states, and the result is interpreted physically in terms of precession of the spins of moving electrons. Combination of the present theory with the Stoner-Wohlfarth model of the ferromagnetic electrons in nickel does not give satisfactory results, probably because the latter model does not approximate the actual self-consistent field solution very well. However, application of the theory to the free electron gas is of interest as a confirmation of the validity of the perturbation approach. It is shown that there exist, even in a ferromagnetic metal, quantum states orthogonal to all the low-lying states of the conventional band picture and having the properties of spin waves. The presumably universal relation between the exchange stiffness constant and the energies of spin waves of long wavelength is verified in the present approximation. It is shown that spin waves carry a current in a metal, though not in an insulator. For spin waves of long wavelength the present theory can be shown to include Slater's theory of spin waves in a ferromagnetic insulator, and a fortiori to include all previous theories based on the atomic model.

*Nonsynchronous Pulse Multiplex System.* A. L. HOPPER<sup>1</sup>. *Electronics*, **25**, pp. 116-120, August, 1952.

Voice transmitters use one frequency simultaneously but no synchronizing pulse is necessary, although time-division multiplexing is used. Random samples from each transmitter are tagged for identification at proper receiver. System is applicable to rural telephony and moving-vehicle communication.

*Design of Modulation Equipment for Modern Single-Sideband Transmitters.* A. E. KERWIEN<sup>1</sup>. *I. R. E., Proc.*, **40**, pp. 797-803, July, 1952. (Monograph 2012).

This paper deals with considerations that go into the design of modulation equipment for a single-sideband radiotelephone transmitter in which filters are used for sideband suppression. Balance requirements, frequency stability, the choice of intermediate frequencies, and methods of avoiding transmission of spurious frequencies are among the factors which are discussed.

*A Multichannel Single-Sideband Radio Transmitter.* L. M. KLENK<sup>1</sup>, A. J. MUNN<sup>1</sup>, and J. NEDELKA<sup>1</sup>. *I. R. E. Proc.*, **40**, pp. 797-803, July, 1952. (Monograph 2012).

This paper describes a new single-sideband radio transmitter for transoceanic

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service which represents a substantial improvement over past design. Its important features include: (a) a frequency band which permits deriving four telephone channels, if desired; (b) a push-button method for changing frequencies within a matter of seconds; (c) an increase in power over its predecessor; and (d) all-around improved transmission performance.

*Photometric Determination of Aluminum in Lead, Antimony, and Tin and Their Alloys.* C. L. LUKE<sup>1</sup>. *Anal. Chem.*, **24**, pp. 1122-1126, July, 1952. (Monograph 2013).

The work was undertaken because of a need for a reliable method for the determination of traces of aluminum in lead, antimony, and tin and their alloys. As a preparatory step toward the development of such a method, a thorough study of the specificity of the aluminon-thioglycolic acid and the oxine-cyanide-peroxide photometric aluminum methods was made. As a result, an accurate specific method for aluminum has been developed. This method is applicable to the analysis of lead, antimony, and tin and their alloys and can also be adapted for use in the analysis of a wide variety of other ferrous and nonferrous alloys.

*Photometric Determination in Manganese Bronze, Zinc Die Casting Alloys, and Magnesium Alloys.* C. L. LUKE<sup>1</sup>. and K. C. BRAUN<sup>4</sup>. *Anal. Chem.* **24**, pp. 1120-1122, July, 1952. (Monograph 2013).

The work was undertaken in an effort to produce a rapid reliable method for the determination of aluminum appearing as a major constituent in copper, zinc, and magnesium alloys. The work shows that the photometric aluminum method described by Craft and Makepeace is very satisfactory and that by employing thioglycolic acid as a complexing agent it is possible to simplify the usual photometric methods for the determination of aluminum in nonferrous alloys. The paper contains experimental material that will aid future workers in the application of this method to other materials.

*Amplifiers for Multichannel Single-Sideband Radio Transmitters.* N. LUND<sup>1</sup>, C. F. P. ROSE<sup>1</sup> and L. G. YOUNG<sup>1</sup>. *I. R. E., Proc.*, **40**, pp. 790-796, July, 1952. (Monograph 2012).

Considerations are given for designing high-frequency amplifiers whose performance will meet the high standards required for amplifying multichannel signals. A relationship between tone and speech data is presented to show how the tone rating of the amplifier can be determined from the speech rating and interchannel modulation noise requirements.

*Measurement of Dynamic Shear Viscosity and Stiffness of Viscous Liquids by Means of Traveling Torsional Waves.* H. J. McSKIMIN<sup>1</sup>. *Acoustical Soc. Am. Jl.*, **24**, pp. 355-365, July, 1952.

A short periodically repeated train of torsional waves is transmitted along a glass or metal cylindrical rod. After reflection from the free end, these waves are

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sent back to the quartz crystal which serves as both transmitter and receiver. The phase shift and added attenuation caused by immersing the rod in the test liquid are measured by means of a special balancing arrangement, and yield a calculation of the impedance presented to the rod surface. From an analysis of wave propagation both in the rod and in the liquid, one can calculate the characteristic shear impedance of the liquid, and the dynamic viscosity and stiffness. Data for polyisobutylene liquids with static viscosities up to 2000 poises are given for the frequency range 25–150 kc. High frequency data (5–25 mc) for the same liquids obtained by a method previously reported on (see reference 10 (b)) are correlated to the present work. Some results for polypropylene, polyisoprene, polybutadiene, and polypropylene sebacate are also given.

*New Transistors Give Improved Performance.* J. A. MORTON<sup>1</sup>. *Electronics*, **25**, pp. 100–103, August, 1952.

Better manufacturing processes and germanium materials have provided greater reliability and reproducibility and improved frequency response. Higher power output and better noise figure for high-sensitivity applications are properties of new types.

*Microwaves.* J. R. PIERCE<sup>1</sup>. *Sci. Am.*, **187**, pp. 43–51, August, 1952.

They are radio waves that range in length from about a quarter of an inch to two feet. Investigated during the war for their utility in radar, they are now widely applied in communication.

*Glass Unit for Liquid and Vapor Phase Extraction Employing a Single Processing Chamber.* H. A. SAUER<sup>1</sup>. *Anal. Chem.*, **24**, p. 1232, July, 1952.

*The Transistors Development Status at Bell Telephone Laboratories, with Demonstration.* W. R. SITNER<sup>1</sup>. pp. 138–142. A. I. E. E., I. R. E. and R. T. M. A. Symposium, Progress in Quality Electron Components. *Proceedings*, Wash., D. C., May 5–7, 1952. Wash., D. C., R. T. M. A., 1952.

*Polyethylene Terephthalate as a Capacitor Dielectric.* M. C. WOOLEY<sup>1</sup>, G. T. KOHMAN<sup>1</sup> and W. MCMAHON<sup>1</sup>. *Elec. Eng.*, **71**, pp. 715–717, Aug., 1952.

Polyethylene terephthalate, or "Mylar", is a new rival of paper for use as the dielectric in electric capacitors. It appears superior in regard to insulation resistance, temperature coefficient of capacitance, and operating temperature range.

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