Abstracts of Bell System Technical Papers*
Not Published in this Journal

AIKENS, A. J.,[1] and C. S. THAELER.[2]

Control of Noise and Crosstalk on N1 Carrier Systems, A.I.E.E. Trans., Commun. & Electronics, **9,** pp. 605–611, Nov., 1953.

BENEDICT, T. S.[1]

Microwave Observation of the Collision Frequency of Holes in Germanium, Letter to the Editor, Phys. Rev., **91,** pp. 1565–1566, Sept. 15, 1953.

BENNETT, W.[1]

Telephone System Applications of Recorded Machine Announcements, Elec. Eng., **72,** pp. 975–980, Nov., 1953.

Applications of voice-recording equipment discussed in some detail can be divided into four general groups: Announcements made directly to and providing a service to subscribers, such as weather forecasts and the time of day; announcements to assist subscribers in connection with telephone service, that is, intercept announcements when an individual calls a vacant or disconnected terminal, or emergency announcements if an unusual condition prevents normal service; announcements to expedite service and assist operators in completing calls, including completion of calls from a dial to a non-dial phone, and advising operators of the time delay for completing long distance calls; and specialized announcement or recording services, such as price quotation and ticket reservation.

BRIGGS, H. B.,[1] and R. C. FLETCHER.[1]

Absorption of Infrared Light by Free Carriers in Germanium, Phys. Rev., **91**, pp. 1342–1346, Sept. 15, 1953.

The absorption of infrared light associated with the presence of free carriers in germanium has been measured by injecting these carriers across a p-n junction at room temperature. The absorption is found to be proportional to the concentration of carriers. The absorption as a function of wavelength shows the same rather sharp maxima previously observed in normal p-type germanium. These bands are found to change with temperature. An explanation of this absorption is offered in terms of a degenerate energy band scheme.

BRIGGS, H. B., see M. TANENBAUM.

CARLITZ, L.,[1] and J. RIORDAN.[1]

Congruences for Eulerian Numbers, Duke Math. J., **20**, pp. 339–343, Sept., 1953.

CLARK, M. A., see H. C. MONTGOMERY.

CRABTREE, J.,[1] and B. S. BIGGS.[1]

Cracking of Stressed Rubber by Free Radicals, Letter to the Editor, J. Polymer Sci., **11**, pp. 280–281, Sept., 1953.

DICKINSON, F. R., see L. H. MORRIS.

FELCH, E. P.,[1] and J. L. POTTER.[1]

Preliminary Development of a Magnettor Current Standard, A.I.E.E. Trans., Commun. & Elec., **9**, pp. 524–531, Nov., 1953.

In the wartime development of the air-borne magnetometer, a method of detecting extremely small changes in magnitudes of magnetic fields was developed. The principle involved was the use of a second-harmonic type of magnetic modulator now known as a magnettor. This instrument can detect changes in magnetic fields in the order of 10^{-5} oersted. A study was made at Rutgers University under the sponsorship of Bell Telephone Laboratories to determine the feasibility of obtaining a standard of current using the magnettor principle.

FLETCHER, R. C., see H. B. BRIGGS.

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[1] Bell Telephone Laboratories, Inc.

GOERTZ, M., see H. J. WILLIAMS.

GRAY, M. C.[1]

Legendre Functions of Fractional Order, Quart. Appl. Math., **11,** pp. 311–318, Oct., 1953.

GRISDALE, R. O.[1]

Formation of Black Carbon, J. Appl. Phys., **24,** pp. 1082–1091, Sept., 1953.

Electron microscopic evidence is presented in support of the hypothesis that black carbon resulting from pyrolysis of gaseous hydrocarbons is produced through the intermediate formation of droplets of complex hydrocarbons. Electron diffraction studies further confirm the hypothesis if, as has been found for particles of carbon blacks, the droplets consist in part of graphitic nuclei arranged with their basal planes tangential to the droplet surface. The carbonization of small solid spherules of highly cross-linked organic polymers is described, and it is shown that the morphology of the carbonization products is wholly analogous to those for pyrolytic carbon and carbon blacks. It is suggested, therefore, that the formation of carbon by the carbonization of solids and by deposition from the gas phase occurs through similar mechanisms and that the two processes are simply two extremes in an infinite series of processes which are all fundamentally alike.

GRISDALE, R. O.[1]

Properties of Carbon Contacts, J. Appl. Phys., **24,** pp. 1288–1296, Oct., 1953.

Microphone carbon has been produced by deposition of pyrolytic carbon films over the surfaces of small spherules of silica. The properties of contacts between these spherules are shown to be dependent on the structure and geometry of the carbon surface as determined by electron diffraction and microscopic studies. The graphite-like crystallites in pyrolytic carbon surfaces are more or less preferentially oriented with their basal planes parallel to the surface, and the contact properties depend systematically on the degree of orientation. This is explained in terms of the anisotropy in properties of these crystallites which are closely approximated by those of single crystal graphite which were determined. The contact resistance and its temperature coefficient and the "burning voltage" for carbon contacts are explicable on this basis. However, the microphonic sensitivity of carbon contacts is independent of the surface structure and depends only on the surface geometry.

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HARRIS, C. M.[1]

Speech Synthesizer, Acoust. Soc. Am., J., **25,** pp. 970–975, Sept., 1953.

"Standardized speech" constructed from building blocks called speech modules has been described; it was synthesized by piecing together bits of magnetic tape containing recorded speech sounds. An electromagnetic device, a "speech module synthesizer," is described here which performs the synthesis automatically. When buttons on a keyboard are pressed, a sequence of corresponding speech modules are automatically recorded on tape exactly in tandem. The modules are selected from a group "stored" on a rotating magnetic drum. The pressing of a button causes an electrical signal corresponding to a module to be reproduced — the electrical switching is so arranged that only one complete module is reproduced for a single button-pressing. This electrical signal is amplified, biased, and then fed into a constantly rotating head which makes contact with stationary magnetic tape and records the signal on it. A 10-kc signal superposed on each stored speech module controls an electromagnetic clutch which (a) measures the length of the recording accurately, and (b) advances the tape at the completion of the recording by the correct amount so that the next recording forms a connected sequence with it. The same module may be used any number of times and in combination with different stored modules, thereby introducing wider experimental control in standardized speech studies. The principle of this type of device could be applied to other classes of problems involving communication of information, as the conversion into speech of typing or of electronically-red printed matter.

HARRIS, C. M.[1]

Study of the Building Blocks in Speech, Acoust. Soc. Am., J., **25,** pp. 962–969, Sept., 1953.

Identification of the information-bearing elements of speech is important in applying recent thinking on information theory to speech communication. One way to study this problem is to select groups of building blocks and use them to form standardized speech which then may be evaluated; a method having the advantage of simplicity is described. Individual recordings of the building blocks were made on magnetic tape and then various pieces of tape were joined together to form words. Experiments indicated that speech based upon one building block for each vowel and consonant not only sounds unnatural but is mostly unintelligible because the influences on vowel and consonants are missing which ordinarily occur between adjacent speech sounds. To synthesize speech with reasonable naturalness, the influence factor should be included. Here these influences can be approximated by employing more than one building block to represent each linguistic element and by selecting these blocks properly, taking into account the spectral characteristics of adjacent sounds so as to approximate the

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time pattern of the formant structure occurring in ordinary speech. There is no *a priori* method of determining how many building blocks are required to produce intelligible standardized speech. This can only be determined from experiments involving listening tests. Such tests are described.

HOLDAWAY, V. L.[1]

Bulb Puncture in Gas Tubes, Electronics, **26,** pp. 208, 210, 212, Nov., 1953.

HOPKINS, I. L.[1]

Ferry Reduction and the Activation Energy for Viscous Flow, J. Appl. Phys., **24,** pp. 1300–1304, Oct., 1953.

The relationship proposed by Ferry and his co-workers for the effects of frequency and temperature on the dynamic properties of certain polymers is shown to lead to a method for calculating the activation energy of viscous flow from relaxation, creep, and dynamic test data, the results agreeing with those obtained in steady-state flow. The Ferry reduction explains, and is supported by, observed increases in dynamic modulus and viscosity with increasing temperature.

JONES, T. A.,[1] and W. A. PHELPS.[1]

A Level Compensator for Telephotograph Systems, A.I.E.E. Trans. Commun. and Electronics, **9,** pp. 537–541, Nov., 1953.

KARNAUGH, M.[1]

Map Method for Synthesis of Combinational Logic Circuits, A.I.E.E. Trans., Commun. and Electronics, **9,** pp. 593–598, disc. pp. 598–599, Nov., 1953.

KOMPFNER, R.,[1] and N. T. WILLIAMS.[1]

Backward-Wave Tubes, I.R.E., Proc., **41,** pp. 1602–1611, Nov., 1953.

It has been surmised for some time that a traveling-wave tube in which backward-traveling field components can be excited — such as for instance the "Millman" tube — may oscillate in a backward mode, the RF power emerging at the gun-end of the tube and its frequency depending only on the beam voltage. Experiments with the "Millman" tube show this to be so and oscillations have been observed in the first and second backward spatial-harmonic modes. The latter is excited between 600 and 900 volts, the tube oscillating between 5.9 and 6.4 mm. The former more power-

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ful mode is excited between 1,600 and 4,000 volts, the tube tuning continuously between 6.0 and 7.5 mm, thus covering a frequency band of 10,000 mc. Power output of about 10 mw has been measured at 6.4 mm. The tube has also been studied as an amplifier and more than 20-db stable backward gain has been obtained. A simple theory of backward gain and of oscillation starting conditions is given.

LANDER, J. J.[1]

Auger Peaks in the Energy Spectra of Secondary Electrons from Various Materials, Phys. Rev., **91,** pp. 1382–1387, Sept. 15, 1953.

The energy spectra of secondary electrons from carbon, beryllium, aluminum, nickel, copper, barium, platinum, and the oxides of beryllium, aluminum, nickel, copper, and barium have been measured with equipment of high stability and sensitivity. Characteristic peaks due to Auger electrons emitted as a result of absorption of a valence electron by an excited x-ray level were observed for all these materials. The peaks exhibit structure which is of some theoretical interest. The structure can be related to the distribution in energy of electrons in the valence band, and it complements that observed in soft x-ray emission work. Since the emission of the Auger electron is not subject to the selection rules governing the emission of x-radiation, additional information can be obtained from the Auger electron energy distribution. Excitation of Auger peaks by a beam of low velocity electrons provides an interesting technique for surface analysis. "Plasma" peaks of the type reported by Ruthemann, and interpreted by Pines and Bohm, were also observed.

LOVELL, G. H., see L. H. MORRIS.

MONTGOMERY, H. C.[1] and M. A. CLARK.[1]

Shot Noise in Junction Transistors, Letter to the Editor, J. Appl. Phys., **24,** pp. 1337–1338, Oct., 1953.

MORRIS, L. H.,[1] G. H. LOVELL[1] and F. R. DICKINSON.[1]

L3 Coaxial System — Amplifiers, A.I.E.E. Trans., Commun. & Electronics, **9,** pp. 505–517, Nov., 1953 (Monograph 2090).

The line amplifiers for the L3 coaxial system are designed to compensate for the loss of the 4 miles of cable which separate the repeaters; the flat amplifiers are used to compensate for equilizer loss and as transmitting amplifiers. The two types are basically similar, consisting of two feedback amplifiers in tandem, separated by an interamplifier network; in the line amplifier, this network is variable, and is automatically adjusted to com-

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pensate for variations in cable temperature, and for small deviations from the nominal 4-mile spacing.

PIERCE, J. R.[1]

Spatially Alternating Magnetic Fields for Focusing Low-Voltage Electron Beams, Letter to the Editor, J. Appl. Phys., **24,** p. 1247, Sept., 1953.

PIERCE, J. R.,[1] and L. R. WALKER.[1]

"Brillouin Flow" with Thermal Velocities, J. Appl. Phys., **24,** pp. 1328–1330, Oct., 1953.

A type of electron flow in a constant magnetic field is described. The beam of electrons is supposed to be everywhere in thermal equilibrium and the usual Brillouin flow is found when the equilibrium temperature tends to zero. Some considerations are put forward bearing on the choice of a suitable beam temperature in specific problems.

POTTER, J. L., see E. P. FELCH

READ, W. T., JR.[1]

Dislocations and Plastic Deformation, Physics Today, **6,** pp. 10–14, Nov., 1953.

Small and exceedingly rare defects in the structure of solids are the "weak links" that determine the strength of materials. The article reviews some fundamental concepts concerning plastic deformation in certain ductile metals.

RIORDAN, J., see L. CARLITZ.

ROMIG, H. G., see R. I. WILKINSON.

SCHNETTLER, F. J., see H. J. WILLIAMS.

SHERWOOD, R. C., see H. J. WILLIAMS.

SHOCKLEY, W.[1]

Some Predicted Effects of Temperature Gradients on Diffusion in Crystals, Letter to the Editor, Phys. Rev., **91,** pp. 1563–1564, Sept. 15, 1953.

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STEENECK, W. R.[1]

N1 Carrier Equipment Design, Commun. Eng., **13,** pp. 26–28, Sept.–Oct., 1953.

Progress in telephone apparatus and in radio equipment design seem to follow converging paths, each contributing something to the other. Bell Laboratories started in the telephone field and adopted radio as an accessory means of transmission. More recently, radio manufacturers have borrowed telephone-circuit techniques for remote controls and multiplexing. The N1 equipment, while it looks more like radio than telephone apparatus, is a most interesting example of economy in manufacture, testing, service, and also in cubic contents. And those gains have been achieved, it should be noted, as part of a program to increase reliability and to reduce the duration of outages.

TANENBAUM, M.[1] and H. B. BRIGGS.[1]

Optical Properties of Indium Antimonide, Letter to the Editor, Phys. Rev., **91,** pp. 1561–1562, Sept. 15, 1953.

THAELER, C. S., see A. J. AIKENS.

TIEN, P. K.[1]

Traveling-Wave Tube Helix Impedance, I.R.E., Proc., **41,** pp. 1617–1623, Nov., 1953.

The impedance parameter of a circular helix, from which the gain of a helix-type traveling wave amplifier is computed, is investigated for a "Tape-Helix" model. Results obtained in this paper indicate that the impedance has a smaller value than for the "Sheath-Helix" model, and is considerably reduced at larger values of ka, the ratio of the helix circumference to the free space wavelength. A tape helix surrounded by a dielectric medium is analyzed. It is shown that the results obtained from the theory can be used to evaluate the helix impedance for usual types of traveling wave tubes. They have been found to be in agreement with measurements on many tube designs.

WALKER, L. R., see J. R. PIERCE.

WILKINSON, R. I.[1] and H. G. ROMIG.[1]

Random Picture Spacing with Multiple Camera Installations, S.M.P.T.E. J., **61,** pp. 605–618, Nov., 1953.

When several high-speed cameras are operated simultaneously, but independently, it is possible that the aggregate of pictures obtained will

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satisfactorily cover the space between the pictures provided by any one camera. This paper gives a method for estimating the probability that the longest interval without a picture will not exceed a selected value.

WILLIAMS, H. J.,[1] R. C. SHERWOOD,[1] M. GOERTZ[1] and F. J. SCHNETTLER.[1]

Stressed Ferrites Having Rectangular Hysteresis Loops, A.I.E.E. Trans., Commun. & Electronics, **9,** pp. 531–537, Nov., 1953.

A study has been made of the effect of stress on the magnetic properties of ferrites. Rectangular hysteresis loops were obtained by encasing toroidal specimens in plastics which shrink during polymerization. Ferrites having this type of hystersis loop are useful in magnetic switching and magnetic memory devices.

WILLIAMS, N. T., see R. KOMPFNER.

WRIGHT, S. B.[1]

Higher Frequencies, Aero Digest, 67, pp. 66, 70, 72, Nov., 1953. Spectrum crowding plus new techniques has moved USAF ground-air communications into the ultra-high-frequency bands.

Correction

On page 878 of the July, 1953, issue of the JOURNAL, an error was made in quoting the number of P. H. Richardson's patent in Reference 5. It should have been 2,348,572.