March through June, 1957

IBM Technical Papers Published in Other Journals

The AN/GSQ-7: A Reliability Progress Report, H. E. Cooley and R. E. Nienburg, *Proceedings of the Second RETMA Symposium on Applied Reliability,* Syracuse, New York, (June 10-11, 1957).

This paper presented (1) the philosophies and the means of implementing these philosophies employed to realize the reliability imposed by the AN/FSQ-7 specifications and (2) some of the results recorded to date.

Beams of Uniform Strength Subjected to Uniformly Distributed Loading, W. A. Gross and J. P. Li,* *Journal of Applied Mechanics, Trans. ASME,* **24,** No. 1, 105 (March, 1957).

Beams with uniform strength subjected only to bending have the same maximum flexural stress at any cross section. The shapes, deflections, and weights are given for certain cantilever, simple, and fixed beams of uniform strength and appreciable weight subjected to uniformly distributed loading. (Work done at Iowa State College.)

*Ford Motor Co.

Capacitor Checker, J. Cozzo, *Radio Electronics,* **28,** 51 (May, 1957).

A checker is described which tests paper, mica, and electrolytic condensers, and gives a visual indication of leakage, shorts and opens.

Character Recognition Procedures Simulated and Tested by Computer, E. C. Greanias, C. J. Hoppel, M. Kloomok, and J. S. Osborne, *Automation Progress* (British), 158-163 (April, 1957).

A logic for the recognition of printed characters employing a "proportional parts" method has been tested extensively by simulation. The proportional parts method relates the identity of a character to the relative size and position of character elements detected by optical scanning along closely spaced vertical lines. The video information from each scan is coded to designate the number, size, and position of inked areas detected by the scanner. The time sequence or order of occurrence of this coded information is tested by logical circuitry against prescribed sequences for character recognition. A set of coding definitions, a prescribed sequence for the recognition of a given character, and the methods of simulative testing of the recognition logic on the IBM Type 650 Magnetic Drum Data Processing Machine are discussed.

Chemistry of the Group VB Pentoxides. VI. The Polymorphism of Nb_2O_5, Frederick Holtzberg, Arnold Reisman, Margaret Berry and Melvin Berkenblit, *Journal of the American Chemical Society,* **79,** 2039-2043 (May 5, 1957).

The polymorphism of Nb_2O_5 has been reinvestigated. Experimental results indicate the definite existence of two modifications and the possible existence of a third. The δ-modification recently reported has been shown to be a poorly crystallized state of the γ-phase. It is proposed that the α- and β-phases are identical, with the β-modification existing as a two-dimensional array. Transformation temperatures were found to be: amorphous to γ 435°, γ to α 830°. The densities are: amorphous 4.36 g/cm^3 at 25°, γ 5.17 g/cm^3 at 25° and α, 4.55 g/cm^3 at 25°. None of the transformations was reversible. The α-phase was reindexed on the basis of a monoclinic unit cell with $a = 21.34$A, $b = 2.816$A, $c = 19.47$A and $\measuredangle\beta = 120°20'$ having 14 molecules/unit cell and an X-ray density of 4.52 g/cm^3. The freezing point of Nb_2O_5 obtained in the study was 1491°.

Chirality of K Particle, Satosi Watanabe, *Physical Review,* **106,** 1306-1315 (June 15, 1957).

In the two-component theory, the neutrino that can exist in nature is characterized by one of the eigenvalues of the "chirality" operator, $\gamma 5$, which anticommutes with the parity operator. The chirality operator is generalized so that it can be applied also to bosons. The K particle that can exist in nature is characterized by a certain condition on the eigenvalues of the chirality operator. There is strong reason to believe that the chirality quantum number thus introduced is closely related to the strangeness quantum number.

Computers—Present and Future, Part I, J. Svigals, *Pacific Electronics Monthly,* 12-17 (March, 1957).

Two kinds of electronic digital computers have proven to be commercially successful. These are the large-scale computer systems designed for application to commercial problems and medium-scale, general-purpose computers. This article discusses descriptive terms common to all of these machines.

Computers—Present and Future, Part II, J. Svigals, *Pacific Electronics Monthly,* 4-10 (April, 1957).

This article describes the general characteristics and unusual features of presently available large-scale, commercial, digital computer systems and medium-scale general-purpose ma-

chines. Predictions of the future trends in the characteristics of these machines are included.

Computers Simplify Design of Polynomial Cam Curves, M. Kloomok and R. V. Muffley, *Product Engineering,* **28,** 196-202 (March, 1957).

This is the last in a series of six articles on cam design. Equations are given for specifying cam contours, together with curve-fitting methods using polynomial equations with ten constants. Polynomial curves are compared with common cam curves, and the use of computers in solving cam problems is discussed.

Convenient X-Ray Tube Mount for Two-Crystal Spectrometer, F. W. Chambers and H. Cole, *The Review of Scientific Instruments,* 465, 466 (June, 1957). (Letter to the editor).

This note describes an x-ray tube mount for a two-crystal spectrometer in which the x-ray tube may be locked to the first crystal, enabling tube and crystal to rotate together about the axis of the first crystal. The mount offers extreme flexibility in placing the tube in space while at the same time remaining rugged and free from creep.

Depolarization of Positive Muons in Matter,* D. Berley,† T. Coffin,† R. L. Garwin, L. Lederman,† and M. Weinrich,† *Bulletin of the American Physical Society,* Series II, **2,** 204 (April 25, 1957). (Abstract).

We have investigated the state of polarization of muons after stopping in various materials. Preliminary evidence shows that the muon beams are nearly 100% polarized. This is deduced by comparing the asymmetries obtained in the muon beam[1] with those observed by π-μ-ε decay in nuclear emulsion,[2] in propane bubble chambers[3] and in liquid hydrogen bubble chambers.[4] The depolarization in various materials is studied by measuring the peak-to-valley ratios with a standard requirement of 9.3 g/cm^2 on the decay electron energy. The results are for μ^+ mesons: C, 1.80 $\pm$ 0.08; CH_2, 1.60 $\pm$ 0.15; emulsion, 1.38 $\pm$ 0.09; calcium, 1.66 $\pm$ 0.10; aluminum, 2.00 $\pm$ 0.20; H_2O, 1.41 $\pm$ 0.10; sulfur, 1.0 $\pm$ 0.08; NaCl, 1.0 $\pm$ 0.15. In the case of nuclear emulsions, the depolarization was unchanged when the precession time was decreased, thus decreasing the average time which the muon spends in equilibrium before decay. These results will be discussed.

*Supported by the Office of Naval Research and the U. S. Atomic Energy Commission joint program.
†Columbia University.
1 Garwin, Lederman, and Weinrich (to be published).
2 J. Friedman and V. Telegdi (to be published).
3 I. Pless and R. Williams (private communication).
4 R. Adair et al (to be published).

Design Objectives for the IBM Stretch Computer, S. W. Dunwell, *Proceedings of the Eastern Joint Computer Conference (Dec. 10-12, 1956)* 20-22 (May, 1957).

The IBM Stretch Computer will provide significant improvement over existing computers in operational speed, facility of programming, and ease of maintenance. For its realization, it will depend on new components, some of which have not yet been fully developed. The new computer will consist of three major sections, all communicating with one multi-section memory which may be expanded, as required, to meet additional needs or incorporate new devices. The functional relationships among the different sections will be discussed in the light of their effect on both the design and operation of the machine.

Easy-to-align F. M. Tuner, R. Abbatecola, *Radio-Electronics,* **28,** 54 (July, 1957).

The tuner described in this article is designed to simplify the alignment procedure by using a 6BN6 gated-beam limiter-detector tube. Only standard, easily obtained components are required.

Economic Receiving and Distributing Points as Found by the Median Method, W. J. Merrill* and W. H. Hoffman,† *Advanced Management,* **22,** No. 5, 19-21 (May, 1957).

A statistical method is described for determining the optimum location of a shipping or receiving point, tool room, or other location within an installation. Various major considerations, such as cost factors, ton-miles, and transportation considerations are discussed, along with an analysis of specific problems. A practicable *modus operandi* is outlined in a step-by-step procedure which can be employed to solve a wide variety of location problems.

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Energy Dependence of the Asymmetry in Beta Decay of Polarized Muons,* D. Berley,† T. Coffin,† R. L. Garwin, M. Weinrich,† *Physical Review,* **106,** 835 (May 15, 1957).

In a continuation of recent experiments, we are studying the energy dependence of the asymmetry of the positron angular distribution arising from decay of polarized muons. This is done by determining the ratio of the maximum to the minimum positron rate in the angular distribution as a function of thickness of carbon traversed by the positrons. The following results are at hand: For carbon thicknesses of 9.3, 15.6, 19.2, 22.2, 24.5, and 25.8 g/cm^2 we find peak-to-valley ratios of 1.80 $\pm$ 0.08, 1.84 $\pm$ 0.1, 2.14 $\pm$ 0.10, 2.24 $\pm$ 0.35, 3.17 $\pm$ 0.64 and 4.55 $\pm$ 1.6, respectively. When resolution effects are included, the distribution corresponding to the 9.3 g/cm^2 point is found to be $f(\theta) = 1 - 0.305 \pm 0.033 \cos\theta$ for positive muons in carbon. If this point is used to normalize the theoretical expressions given by Lee and Yang, then the data may be compared with the predictions of the two-component theory. To do this, the positron range calibration curves provided us by the Chicago betatron group are used. The tentative results indicate good agreement with the choice

$$\mu^+ \rightarrow \varepsilon^+ + \nu + \nu.$$

*Supported by the Office of Naval Research and the U. S. Atomic Energy Commission joint program.
†Columbia University.

Ferroelectric Properties of Single Crystals of K(Ta, Nb)O$_3$, S. Triebwasser, *Proceedings Special Technical*

Conference on Solid-State Dielectric and Magnetic Devices, Washington 17, D. C. (April, 1957).

$KTaO_3$ and $KNbO_3$ form a continuous series of solid solutions throughout the entire range of concentrations. It has been found possible to grow single crystals of various compositions. The ferroelectric properties of the solid solution indicate a linear decrease of the Curie point, an increase of the dielectric peak at the transition, and a rapid decrease of the spontaneous polarization with increasing proportion of $KTaO_3$ in the solution.

High-Speed Transistor Computer Circuit Design, R. A. Henle, *Proceedings of the Eastern Joint Computer Conference (Dec. 10-12, 1956)* 64-66 (May, 1957).

New types of logical transistor circuits have been designed, using drift transistors and current-switching techniques. These circuits are capable of passing a signal through five sequential logical circuits in 100 millimicroseconds. The characteristics of the drift transistors are described, and it is shown how these characteristics led to the adoption of controlled current-switching mode of operation. The resulting circuits are relatively simple and reliable, insensitive to noise, and may be used for a variety of logical operations.

High Strength Structural Parts by Powder Metallurgy Applications, J. M. Copeland, *Journal of Metals,* **9,** 336 (March, 1957).

Any successful commercial application presupposes certain basic concepts of tooling design, raw materials and process controls. The basic processes which must be controlled are mixing, pressing, and sintering. A number of parts fabricated from several high-strength sintered materials are illustrated and discussed from design and material standpoints. General remarks are made concerning the final use of such parts and a general comparison is drawn between the use of certain sintered parts and the use of parts fabricated from wrought materials for specific applications. The paper is concluded with a short discussion of future trends in the industry.

Magnetic Resonance Determination of the Magnetic Moment of the Mu Meson, T. Coffin,* R. L. Garwin, L. M. Lederman,* S. Penman,* and A. M. Sachs,* *Physical Review,* **106,** 1108 (June 1, 1957).

By using the asymmetric decay of the positive mu meson, the magnetic moment has been measured by a resonance method. The g-value is 2.0064 ± 0.0048 in comparison with the predicted value 2.0024. The experiment is being continued with accuracy expected to reach 0.01%.

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Magnetocrystalline Anisotropy in Cobalt-Substituted Magnetite Single Crystals, L. R. Bickford, Jr., J. M. Brownlow, and R. F. Penoyer, *The Proceedings of the Institution of Electrical Engineers,* **104,** Part **B,** Supplement No. 5, 238-244 (May, 1957).

The growth of single crystals corresponding to $x=0$ (high-purity magnetite, $x=0.01$ and $x=0.04$ in the composition series $Co_xFe_{3-x}O4$ is described. First- and second-order anisotropy constants of these crystals are determined by the torque method over the temperature range $120° - 450°K$. The substitution of small amounts of cobalt for iron is found to add a positive contribution to K_1 and a negative contribution to K_2. At low cobalt concentrations, the magnitude of this contribution is a linear function of the amount of cobalt added. It is suggested that the effect of cobalt on the anisotropy is enhanced by the presence of divalent iron in magnetite, and it is concluded that the change in sign of K in magnetite at about 130°K is not caused by the presence of cobalt or any other foreign impurity.

Measurement of Rise and Decay Times of Stimulated Emission from Phosphors, G. Cheroff and S. P. Keller, *Journal of the Optical Society of America,* **47,** No. 5, 440 (May, 1957). (Letter to the editor).

This note describes an apparatus that can easily effect measurements of rapid rise and decay times of stimulated emission from infrared stimulable phosphors. Data obtained from four phosphors are presented as an illustrative example of what the apparatus can do.

Paramagnetic Resonance Detection along the Polarizing Field Direction, G. Whitfield and A. G. Redfield, *Physical Review,* **106,** 918 (June 1, 1957).

Strong rf power, modulated at a low frequency, was applied to a paramagnetic solid (diphenyl pycril hydrazil) in a dc H_z of up to 20 gauss. The resulting changes in M_z at the modulation frequency produced a voltage in a coil oriented in the z direction, to provide a measure of M_z. A sensitive test of the equation of motion of the spin magnetization was achieved by using 19.5-mc/sec circularly polarized rf of up to 6 gauss in the x-y plane, square wave modulated at 280 cps. The observed 280-cps signal was consistent with the Bloch equations, assuming relaxation toward the instantaneous applied magnetic field. As predicted, M_z was not zero when $H_z=0$. A Bloch-Seigert effect was also observed.

The RAMAC Data-Processing Machine: System Organization of the IBM 305, M. L. Lesser and J. W. Haanstra, *Proceedings of the Eastern Joint Computer Conference, (Dec. 10-12, 1956). AIEE Special Publication* **T-92,** 139-146 (June, 1957).

A new automatic data-processing machine for business applications, utilizing a random-access memory system, is described. Unlike the usual batch method of machine-processing, the technique used permits transfer of information between any two points in the system and makes multi-choice decisions according to the current status of the information. This in-line operational concept is discussed in detail and the data transfer routes and processing control are shown. [A modified version of this paper appeared in IBM Journal, Vol. 1, No. 1, p. 62 (January 1957)].

Recent Developments in Very-High-Speed Magnetic Storage Techniques, W. W. Lawrence, Jr., *Proceedings of the Eastern Joint Computer Conference (Dec. 10-12, 1956)* 101-103 (May, 1957).

Development of new magnetic elements have shown that rapid-access memory systems with complete operating cycles of a fraction of a microsecond are feasible. This paper describes the theory of operation of these elements and presents experimental data on the performance of samples.

The Servo Controlled Memory Access in RAMAC, J. H. Davis and W. E. Dickinson, *Automatic Control,* 52-59 (June, 1957).

The details are given of the design and construction of the positional type servomechanism with velocity damping that controls the location of the reading and recording head of the RAMAC disk memory. Its unusual features include a duplex drive that provides motion in both horizontal and vertical planes from the same torque source, and tapped conductive-plastic type position-indicating potentiometers that greatly reduce linearity requirements. The use of detents to perform the final positioning of the read-record head reduces the accuracy requirement of the servomechanism, and large position voltages on the potentiometers essentially eliminate drift problems.

Study of the Second-Order Ferroelectric Transition in Glycine Sulfate. Sol Triebwasser, *Bulletin of the American Physical Society,* Series II, **2,** 126 (March 21, 1957). (Abstract.)

Dielectric constant, nonlinearity, and spontaneous polarization measurements have been taken on the recently reported ferroelectric glycine sulfate.[1] This material exhibits the classic second-order type of ferroelectric transition.[2] The properties discussed are described in terms of the usual expansion of the free energy in even powers of the polarization,

$$F = A(T - T_0)P^2 + BP^4 + CP^6, \qquad (1)$$

where

$A = 1.96 \times 10^{-3}$ (°C)$^{-1}$, $T_0° = 49.8$°C, $B = 2.3 \times 10^{-10}$ (esu/cm^2)$^{-2}$ and $C = 6.3 \times 10^{-19}$ (esu/cm^2)$^{-4}$. A and T_0 are found from measurements of the small-signal dielectric constant in the paraelectric region above T_0. B and C are derived from observations of the spontaneous polarization as a function of temperature below T_0. The value of B was measured independently by observations of the dielectric constant of electric-field-biased crystals[3] above the Curie point. The two results for B agree well within experimental accuracy (10%).

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[1] Matthias, Miller, and Remeika, *Phys. Rev.* **104,** 849 (1956). Single crystals used for this work were kindly furnished by Bell Telephone Laboratories.
[2] See, for example, A. F. Devonshire, *Advances in Phys.* **3,** 85 (1954).
[3] For details of the method see Drougard, Landauer, and Young, *Phys. Rev.* **98,** 1010 (1955).

Xerography and the IBM Electrostatic Printers, W. D. Bolton and W. E. Goetz, *Photographic Engineering,* **7,** Issues 3 and 4, 137-146 (May, 1957).

The IBM 938 Electrostatic Card Printer and the IBM 939 Electrostatic Address Label Printer are automatic business machines utilizing the xerographic process. These printers reproduce printed data from IBM master cards onto secondary cards or onto mailing labels. A detailed description of the machines is presented. In particular the newly engineered features not present in the standard process are discussed. These include fur brush development, infrared fixing, and conductive roll transfer. Also described are the special optical systems and illumination requirements, including several uses of light peculiar to the requirements of these machines.