Abstracts of Technical Articles from Bell System Sources

Heat Treatment of Magnetic Materials in a Magnetic Field—II. Experiments with Two Alloys.[1] RICHARD M. BOZORTH and JOY F. DILLINGER. The magnetization of two alloys, as affected by heat treatment in a magnetic field at various temperatures, is examined in some detail in order to elucidate the nature of the accompanying changes which result in some cases in a 30-fold increase in maximum permeability. The *experiments* show that these alloys (one containing approximately 35 per cent iron and 65 per cent nickel, the other 20 per cent iron, 60 per cent cobalt and 20 per cent nickel) can be effectively heat treated in a magnetic field of 10 oersteds if the temperature is above 400° C. and below the Curie point of the alloy. The time during which the magnetic properties change has been measured at different temperatures and is found to vary according to the equation $r = Ae^{W/kT}$. The experiments are *interpreted* in terms of the domain theory of ferromagnetism. The changes which occur are due to the relief of magnetostrictive stresses which arise when the material becomes ferromagnetic upon cooling through the Curie point or when an external magnetic field is applied, and the relief comes about by plastic flow or diffusion in the separate domains. The values of A (about 10^{-12} second) and W (2.1 electron volts) are the same as those determined by Bragg and Williams for the above equation which also gives the time necessary for the establishment of a superstructure in alloys. The relation between the two processes, establishment of superstructure and the relief of magnetostrictive strains, is pointed out.

Heat Treatment of Magnetic Materials in a Magnetic Field—I. Survey of Iron-Cobalt-Nickel Alloys.[2] JOY F. DILLINGER and RICHARD M. BOZORTH. The changes that occur in the magnetic properties of iron-cobalt-nickel alloys when they are annealed in a magnetic field, have been investigated for a series of these alloys. The maximum change for the iron-nickel alloys occurs between 65 and 70 per cent nickel and is evidenced by a large increase in maximum permeability and a hysteresis loop of rectangular shape. All of the alloys with Curie points above 500° C. and with no phase transformation have their properties similarly changed. Thorough preliminary annealing

[1] *Physics*, September, 1935.
[2] *Physics*, September, 1935.

enhances the effect. With an extreme preliminary anneal of 1400° C. for 18 hours specimens of 65 permalloy have been obtained with the record value of maximum permeability of 600,000. The magnetic characteristics of materials treated in this way are relatively insensitive to stress. These magnetic characteristics are, however, highly anisotropic; the maximum permeability in one direction is as much as 150 times as large as that at right angles.

Newer Concepts of the Pitch, the Loudness and the Timbre of Musical Tones.[3] HARVEY FLETCHER. It has generally been thought that corresponding to the three psychological aspects of a sound, namely, the pitch, the loudness and the timbre, there are the three physical aspects of a sound wave, namely, the wave-length, the amplitude and the wave form. Although it is true that there is such a correspondence in a very approximate way, when the matter is examined more closely it is found that each of the psychological aspects depends upon all three of the physical properties of the sound wave.

In the paper it was shown how loudness can be defined in a quantitative way and measured by experimental methods which are described. From such measurements a relation has been found between loudness as it is ordinarily understood by the lay man and the physical intensity. In the higher intensity regions it is found that if the intensity of a sound is increased 1000-fold then the loudness will be increased 10-fold. In other words in these regions the loudness as determined by the average observer is proportional to the cube root of the intensity. For the lower intensities the loudness increases more rapidly than for the high intensities, being almost proportional to the intensity in the regions near the threshold. It is shown that the loudness depends upon the frequency, the overtone structure and the intensity of the complex sound.

In a similar way a precise definition of pitch is given which makes it possible to make quantitative measurements of this psychological aspect of a sound. Contrary to the usual notion it is found that the pitch varies not only with the fundamental frequency but also with intensity of the sound and with the overtone structure. For example, it was found that the pitch of a tone having a frequency between 100 and 200 cycles may be lowered more than a full tone by increasing the intensity without changing the frequency. Also it was shown that the pitch of a complex tone may shift as much as 1 or 2 octaves by changing the overtone structure. Numerous examples are given to show that pitch also depends upon the three physical quantities, frequency, overtone structure, and intensity. Although quantitative measurements

[3] *Jour. Franklin Institute*, October, 1935.

on timbre are still lacking there is no doubt that similar results will be found for timbre, namely, that although it depends principally upon the overtone structure, nevertheless, changes in fundamental frequency and changes in the intensity also produce large changes in the timbre.

Ceramics in the Telephone.[4] A. G. JOHNSON and L. I. SHAW. In this descriptive paper by Western Electric engineers the problems of ceramic materials as they relate to telephone usage are discussed. New products with specific properties include every type of ceramic material—electrical porcelain, vitreous enameled parts, glass and heavy clay products. Manufacturing problems of the above materials are discussed.

La Transformation Triangle—Étoile pour des Éléments de Circuits Généraux.[5] JOHN RIORDAN. This paper gives the relations between the constants of linear passive transducers connected in star and delta. The delta-star transformation previously given by Lavanchy (*Revue Générale de l'Électricité*, XXXVI, pp. 11–31 and 51–59) is shown to admit a slight generalization, perhaps of little practical importance. In the reverse (star-delta) transformation (not previously given), three of the nine independent constants of the three transducers are shown to be defined uniquely, but of the remaining six, three may be defined at pleasure, subject only to dimensional and cyclic requirements. This lack of uniqueness is shown concordant with the connection conditions.

Flutter in Sound Records.[6] T. E. SHEA, W. A. MACNAIR, and V. SUBRIZI. Frequency modulation of a sound signal is caused by non-uniformity in the record speed during the recording or reproducing process. This source of flutter is discussed and was demonstrated at the May 1935 Convention of the Society of Motion Picture Engineers.

The paper includes a discussion of the physical nature of frequency modulation, the physiological effects of frequency modulation, the methods of producing known amounts of artificial flutter, and the methods of measuring flutter.

Acoustic Impedance of Small Orifices.[7] L. J. SIVIAN. Data are presented giving the measured acoustic reactance and resistance for a number of circular orifices varying in diameter from 1 cm. down to 0.034 cm., and for a rectangular orifice 1.9 cm. × 0.075 cm. The measurements were made for various particle velocities, the cor-

[4] *Indus. and Engg. Chemistry*, November, 1935.
[5] *Revue Générale de l'Électricité*, September 21, 1935.
[6] *Jour. S. M. P. E.*, November, 1935.
[7] *Jour. Acous. Soc. Amer.*, October, 1935.

responding Reynolds numbers varying from 0.7 to 3000, roughly. The reactance is found substantially independent of the particle velocity; a formula for computing it is given. The resistance approaches a constant value as the velocity is sufficiently decreased; formulae for computing this "low velocity" resistance are given. At larger velocities the resistance increases with the velocity. This is discussed from the standpoint of a loss of kinetic energy of flow, acting besides viscosity and turbulence.

Earth-Potential Measurements Made During the International Polar Year.[8] G. C. SOUTHWORTH. Data are presented covering the normal diurnal variation of earth-potentials as measured at about a dozen different points, mostly in eastern United States. These data are arranged in graphical form for the convenience of the casual reader and also in numerical form for the use of the correlator. The data for Wyanet (Illinois), Houlton (Maine), and New York (New York) are based on nearly continuous recordings extending over a period of one or two years. This period includes the International Polar Year. At other points, less extensive data were taken. These show the general characteristics peculiar to the location in question.

The data taken at Wyanet, Houlton, and New York have been analyzed for harmonic content. At New York the fundamental and to a large extent the harmonics also, are directed along a northwest-southeast line. At Wyanet and Houlton these components tend to rotate with time. The pronounced directive effect noted near New York appears to prevail rather generally along the eastern part of the United States from Massachusetts to Florida and possibly into Cuba. The rotary effect noted in the Houlton and Wyanet data is also found in data taken in the southern part of the Mississippi Valley. Most of the data point toward the generally accepted view that there is a close relation between earth-resistivity and the direction and magnitude of earth-potentials. However, there are some inconsistencies noted which tend to make this less definite.

The Characteristics of Sound Transmission in Rooms.[9] E. C. WENTE. The characteristics of electrical circuits used for communication purposes are advantageously determined from a measurement of the transmission loss as a function of frequency. Similarly, a measurement of the acoustic pressures at various points in a room while sound of fixed intensity is emitted from a source should permit an evaluation of the acoustic characteristics of the room. Measurements of this

[8] *Terrestrial Magnetism*, September, 1935.
[9] *Jour. Acous. Soc. Amer.*, October, 1935.

type have in the past not led to any useful results because of the large variations in acoustic pressures produced by standing waves. When a high-speed level recorder is used to record pressure levels automatically as the frequency of a constant source is continuously varied, curves are obtained which not only show the variations in the general level of acoustic pressures in the various frequency regions, but which also permit an evaluation of the reverberation characteristics of different parts of the room. The paper shows curves obtained with the recorder under various room conditions.