Abstracts of Technical Papers[1]

Carrier Telephony on Power Lines.[2] N. H. SLAUGHTER and W. V. WOLFE. The fundamental requirements of a telephone circuit are outlined briefly and translated into the terms of the power line carrier telephone problem. Considerable data on transmission line characteristics at carrier frequencies are presented, which clearly show the magnitude of the transmission problem and the best frequency values to employ. The advantages of using the "metallic circuit" arrangement rather than the commonly employed "ground return" arrangement are emphasized.

One of the chief problems in carrier telephony on power lines is to provide an efficient means of connecting the carrier equipment to the power line, and the various possibilities and preferred methods are discussed at some length.

The nature of the circuits and equipment employed are then described, together with an indication of their range of usefulness in power line telephone communication.

The Nature of Language.[3] R. L. JONES. In introduction, the history of human language is outlined and the manner of speech production is briefly described with special reference to English. Following this is a summary treatment of available data on the subject of speech and hearing. Much of this is the result of investigations carried out during the past few years in the Research Laboratories of the American Telephone and Telegraph Company and the Western Electric Company, at New York.

Human speech employs frequencies from a little below 100 cycles per second to above 6,000 cycles, a range of about six octaves. The ear can perceive sound waves ranging in pressure amplitude from less than 0.001 of a dyne to over 1,000 dynes and in frequency of vibration from about 20 cycles per second to about 20,000, a range of about ten octaves.

The intensities and frequencies used most in conversation are those located in the central part of the area of audition. The energy of speech is carried largely by frequencies below 1,000, but the characteristics which make it intelligible, are carried largely by frequencies above 1,000. Under quiet conditions good understanding is possi-

[1] The purpose of these abstracts is to supplement the contents of the *Journal* by reviewing papers from Bell System sources which relate directly to electrical communication but which will not be reprinted in the *Journal*.

[2] Journal A. I. E. E., Vol. XLIII, p. 377, Apr., 1924.

[3] Journal A. I. E. E., Vol. XLIII, p. 321, Apr., 1924.

ble with undistorted speech having an intensity anywhere from one hundred times greater, to a million times less than that at exit from the mouth. On the whole the sounds, *th*, *f*, *s*, and *v* are hardest to hear correctly and they account for over half the mistakes made in interpretation. Failure to perceive them correctly is principally due to their very weak energy although it is also to be noted that they have important components of very high frequency.

The Physical Criterion for Determining the Pitch of a Musical Tone.[4] HARVEY FLETCHER. This paper describes experiments in which a high quality telephone system was used to reproduce musical sounds from the voice, the piano, the violin, the clarinet and the organ without any appreciable distortion. Into this telephone system electrical filters were introduced which made it possible to eliminate any desired frequency range. Results with this system show that only the quality and not the pitch of such musical sounds changes when a group of either the low or high frequency components is eliminated. Even when the fundamental and first seven overtones were eliminated from the vowel *ah* sung at an ordinary pitch for a baritone, the pitch remained the same. These results were checked by a study of synthesized musical tones produced by ten vacuum tube oscillators, with frequencies from 100 to 1,000 at intervals of 100. It was found that three consecutive component frequencies were sufficient to give a clear musical tone of definite pitch corresponding to 100, and that in general when the adjacent components had a constant difference which was a common factor to all components a single musical tone of pitch equal to this common difference was obtained, but not otherwise. Recent work on hearing has shown that the transmission mechanism between the air and the inner ear has a non-linear response which accounts for the so-called subjective tones. When the components of low frequency are eliminated from the externally impressed musical tone, they are again introduced as subjective tones before the sound reaches the nerve terminals. Calculation of the magnitude of these subjective tones from the non-linear constants of the ear shows that the results on pitch are what might be expected.

Sound spectra of ten typical musical sounds, obtained with an electrical automatic harmonic analyzer to be described by Wegel and Moore, are given for *ah* sung at pitch d, a sung at a, piano c_1, piano c', violin g', clarinet c, organ, pipe, c_1 for three pressures, and organ pipe c'.

Ferromagnetism and Its Dependence Upon Chemical, Thermal and Mechanical Conditions.[5] L. W. MCKEEHAN. This review considers

[4] Physical Review, Vol. XXIII, No. 3, March, 1924.

[5] Journal of Franklin Institute, V. 196, pp. 583–601; 757–786, 1924.

first the general properties of ferromagnetic bodies and the particular forms of magnetization curves and hysteresis loops exhibited by iron, cobalt, nickel, and their alloys with each other and with other elements. The Heusler alloys are also described. The effects of temperature upon magnetization are then discussed in detail for the case of iron and the behavior of alloys is compared with this as a standard, both reversible and irreversible changes being discussed in some cases. The transient effects of mechanical strains within the elastic limit and the permanent effects of over-strain of the kinds usually met with in practice are considered. The review concludes with speculations in regard to the electronic groups in the atomic structure which are responsible for the occurrence of ferromagnetic properties. One hundred and forty references to recent periodical literature are intended to give starting points for more detailed study of any of the subjects discussed.

Permeater for Alternating Current Measurements at Small Magnetizing Forces.[6] G. A. KELLSALL. This is a description of a permeameter for making alternating current measurements of permeability on toroidal specimens at small magnetizing forces and at telephonic frequencies. It is a special type of transformer with a single turn secondary. The primary consists of a suitable number of turns of insulated copper wire wound directly on a finely divided toroidal magnetic core made of one of the high permeability permalloys. The single turn secondary is an annular copper shell enclosing the primary with an additional space provided for the core to be tested. The copper shell is provided with convenient means for opening and closing. The sample whose permeability is to be determined is interlinked with the open secondary which is then closed. The inductance of the instrument connected as one arm of an inductance bridge is then measured at the primary terminals. From the value thus obtained, the constants of the transformer and the dimensions of the sample, the permeability is computed.

Furnace Permeater for Alternating Current Measurements at Small Magnetizing Forces.[7] G. A. KELLSALL. This is an adaptation of the permeameter previously described for the measurement of permeability at elevated temperatures. It consists essentially of a permeameter with an addition of an annular electric furnace immediately surrounding the sample under test and suitably heat insulated from the other parts of the instrument. Like the simpler permeameter, it measures the permeability of ring samples for small magnetizing forces at

[6] J. O S. A. and R. S. I., 8, pp. 329–338, 1924.
[7] J. O. S. A. and R. S. I., 8, pp. 669–674, 1924.

telephonic frequencies without the necessity of winding magnetizing coils upon them. The maximum temperature at which measurements can be made with this apparatus is about 1,000° C. By filling the unheated furnace with liquid air, a minimum temperature of —190° C is attainable making the whole range of the instrument about 1,200° C.

The changes introduced in order to adapt to permeameter for measurements at different temperatures do not impair its accuracy, the determination of permeability at both high and low temperature having the same precision as at room temperature.