

## Abstracts of Bell System Technical Papers Not Appearing in this Journal

*Influence of Carbon and Silicon Variations in Grey Cast Iron.*<sup>1</sup> D. G. ANDERSON and G. R. BESSMER. In this short article the author gives the results of a series of tests of grey cast irons with different carbon and silicon contents. Three series were run in each of which the silicon content was kept constant and the amount of carbon varied. The results indicated that with two percent silicon the carbon content may be reduced without materially increasing the amount of combined carbon. This results in some improvement in the physical properties of the iron.

*Strength-Tests of Telephone Materials.*<sup>2</sup> J. R. TOWNSEND. Static tests, such as the ordinary tension or torsion tests, have fallen somewhat into disrepute during the last ten years, the author claims, as the ultimate strengths obtained from them are not always indicative of the forces materials will withstand in actual service. Their place is being taken by repeated-stress tests in which the sample is subjected to conditions more nearly representing those met in ordinary service. In illustration the author mentions several tests of this class being applied in Bell Telephone Laboratories on cable sheath material and springs.

*The Reduction of Atmospheric Disturbances.*<sup>3</sup> JOHN R. CARSON. In the decade or so during which the problem of eliminating or at least reducing atmospheric disturbances has been given serious and systematic study we have learned, more or less definitely, what we can and cannot do in this direction. For example, we know that there are definite limits to what can be accomplished by frequency selection. We know that directional selectivity is of substantial value, particularly when the predominant interference comes from a direction other than that of the desired signal, and we can calculate pretty well the gain to be expected from a given design.

The object of this note is to analyze another arrangement which provides for high-frequency selection plus low-frequency balancing after detection. The broad idea of balancing out the interference is old, but no general analysis of the arrangement seems to have been made. Furthermore the principle of balance has recently acquired

<sup>1</sup> "Fuels and Furnaces," Vol. VI, No. 7, pp. 957 and 972, July, 1928.

<sup>2</sup> "Instruments," Vol. 1, No. 7, pp. 313-315, July, 1928.

<sup>3</sup> *Proceedings of the Institute of Radio Engineers*, July, 1928, Vol. 16, No. 7, pp. 966-975.

fresh interest due to the system disclosed by Armstrong<sup>4</sup> in which high-frequency selectivity and low-frequency balancing are essential features. Armstrong's scheme is treated in more detail in the latter part of this paper.

The conclusions of this study are entirely negative, that is, no appreciable gain is to be expected from balancing arrangements. This is quite in agreement with the conclusion drawn over ten years ago as a result of a rather extended experimental study made in the Bell System. In fact, as more and more schemes are analyzed and tested, and as the essential nature of the problem is more clearly perceived, we are unavoidably forced to the conclusion that static, like the poor, will always be with us.

*Thermostat Design for Frequency Standards.*<sup>5</sup> W. A. MARRISON. A means for maintaining constant temperature is described in which those temperature variations which are essential for operation of the controlling element are prevented from reaching the controlled chamber by a wall of material especially chosen for the purpose. Such a wall 1 cm. thick, consisting of alternate thin layers of felt and copper, will reduce temperature variations having a period of one minute or less by a factor of 10,000 to 1.

*Technical Considerations Involved in the Allocation of Short Waves; Frequencies between 1.5 and 30 Megacycles.*<sup>6</sup> LLOYD ESPENSCHIED. This short paper discusses the relation between frequency and distance of transmission for short waves in so far as it affects allocation. A table is given in which the entire short-wave field from 10 to 200 meters is divided into three major bands each containing numerous sub-bands. For each sub-band the number of channels theoretically possible is given and also the number of channels being used at the present time. Factors affecting the separation of channels are also listed.

*Effect of Street Railway Mercury Arc Rectifiers on Communication Circuits.*<sup>7</sup> CHARLES J. DALY. This paper describes the effects experienced on the telephone circuits from two mercury arc rectifier substations recently installed in Bridgeport, Conn., and shows in table form the relative magnitude of the interfering effects between rotating equipment and mercury arc rectifiers as a means of energizing the street railway system. The method and the type of apparatus used to reduce the effects experienced from the rectifiers are also described.

<sup>4</sup> *Proceedings of the Institute of Radio Engineers*, Jan., 1928, Vol. 16, No. 1, p. 15.

<sup>5</sup> *Proceedings of the I. R. E.*, Vol. 16, No. 7, pp. 976-980, July, 1928.

<sup>6</sup> *Proceedings of the I. R. E.*, Vol. 16, No. 6, pp. 773-777, June, 1928.

<sup>7</sup> *Journal of the A. I. E. E.*, Vol. XLVII, No. 7, pp. 503-506, July, 1928.

*Compressed Powdered Permalloy—Manufacture and Magnetic Properties.*<sup>8</sup> W. J. SHACKELTON and I. G. BARBER. The paper gives a brief description of the manufacture of magnetic cores of compressed permalloy powder followed by information covering their magnetic properties with particular reference to their use in loading coils. Production of the powder, and its insulation, pressing and annealing, are discussed. Under magnetic properties, permeability, core loss, and modulation are treated. Curves are given illustrating the characteristics of interest in connection with the design and application of loading coils; and comparisons to corresponding characteristics of compressed powdered iron are made throughout.

*Thermal Agitation of Electric Charge in Conductors.*<sup>9</sup> H. NYQUIST. The electromotive force due to thermal agitation in conductors is calculated by means of principles in thermodynamics and statistical mechanics. The results obtained agree with results obtained experimentally.

*Time-Lag in Magnetization.*<sup>10</sup> RICHARD M. BOZORTH. An investigation has been made of the time-lag in magnetization in a permalloy wire to determine whether lag can be satisfactorily accounted for as due to eddy-currents alone or whether permalloy shows a marked magnetic viscosity such as has been observed by Ewing in iron wires. Eddy-current lag has been calculated approximately in a manner which takes into account the changing slope of the magnetization curve. A comparison of the calculated and observed magnetization-*vs.*-time curves indicates that the effect is well accounted for as eddy-current lag alone. The eddy-current lag has also been calculated for an iron ring, for which the time-lag has been reported recently in a number of papers by Lapp. The time-lag which he observed is satisfactorily accounted for as eddy-current lag instead of as magnetic viscosity as he had supposed.

*Thermal Agitation of Electricity in Conductors.*<sup>11</sup> J. B. JOHNSON. Statistical fluctuation of electric charge exists in all conductors, producing random variation of potential between the ends of the conductor. The effect of these fluctuations has been measured by a vacuum tube amplifier and thermocouple, and can be expressed by the formula  $\bar{I}^2 = (2kT/\pi) \int_0^\infty R(\omega) |Y(\omega)|^2 d\omega$ .  $I$  is the observed current in the thermocouple,  $k$  is Boltzmann's gas constant,  $T$  is the absolute

<sup>8</sup> *Journal of the A. I. E. E.*, Vol. XLII, No. 6, pp. 437-440, June, 1928.

<sup>9</sup> *Physical Review*, Vol. 32, No. 1, pp. 110-113, July, 1928.

<sup>10</sup> *Physical Review*, Vol. 32, No. 1, pp. 124-132, July, 1928.

<sup>11</sup> *Physical Review*, Vol. 32, No. 1, pp. 97-109, July, 1928.

temperature of the conductor,  $R(\omega)$  is the real component of impedance of the conductor,  $Y(\omega)$  is the transfer impedance of the amplifier, and  $\omega/2\pi = f$  represents frequency. The value of Boltzmann's constant obtained from the measurements lies near the accepted value of this constant. The technical aspects of the disturbance are discussed. In an amplifier having a range of 5,000 cycles and the input resistance  $R$ , the power equivalent of the effect is  $\bar{V}^2/R = 0.8 \times 10^{-16}$  watt, with corresponding power for other ranges of frequency. The least contribution of tube noise is equivalent to that of a resistance  $R_c = 1.5 \times 10^6 i_p/\mu$ , where  $i_p$  is the space current in milliamperes and  $\mu$  is the effective amplification of the tube.

*The Voltage-Current Relation in Central Cathode Photoelectric Cells.*<sup>12</sup> THORNTON C. FRY and HERBERT E. IVES. This paper presents a theoretical basis for the interpretation of the experimental results described in the paper which follows. It considers a source of photoelectrons located on the inner of two concentric spheres; derives the trajectory of an electron shot off at any angle with any speed; and then makes use of this information to compute the current which would be received by a small collector located anywhere on the outer sphere upon very general assumptions as to the directional distribution and velocity distribution of the photoelectrons. This theoretical study is followed by graphical presentation of results computed for several typical cases of special interest in connection with the experimental study.

*The Distribution in Direction of Photoelectrons from Alkali Metal Surfaces.*<sup>13</sup> HERBERT E. IVES, A. R. OLPIN and A. L. JOHNSRUD. An experimental study of the distribution in direction of photoelectrons emitted from alkali metal surfaces irradiated by light incident at various angles and polarized in different planes. The alkali metal surfaces used were of two sorts: (1) liquid alloys of sodium and potassium, (2) thin films of potassium or rubidium on polished platinum. In all cases the alkali metal surface was at the center of a large spherical enclosing anode, provided either with collecting tabs at various angular positions or with an exploring finger. It is found that the emission closely obeys Lambert's law, but that the ellipse by which the emission is represented, in polar coordinates, is more elongated normally to the surface for perpendicularly incident light than for obliquely, when the direction of the electric vector is in both cases parallel to the surface, and still more elongated for obliquely incident light with the

<sup>12</sup> *Physical Review*, Vol. 32, No. 1, pp. 44-56, July, 1928.

<sup>13</sup> *Physical Review*, Vol. 32, No. 1, pp. 57-80, July, 1928.

electric vector in the plane of incidence. The distribution curves are all perfectly symmetrical about the normal to the surface, showing no tendency to follow the direction of the electric vector.

*Oscillographic Observations on the Direction of Propagation and Fading of Short Waves.*<sup>14</sup> H. T. FRIIS. The short-wave transmission path is generally but not always located in the vertical plane through the transmission and receiving points.

Direction finding depends upon determining the direction of the wave at the receiving point; it does not give accurate results when the twilight zone is in the way of the wave path.

The angle between the earth and the direction of short-wave propagation varies continuously and the changes in this angle are much larger than the changes in angle of propagation in the horizontal plane.

The observations are consistent with the view that the fading is mainly caused by wave interference.

*An Improved Permeameter for Testing Magnet Steel.*<sup>15</sup> B. J. BABBITT. The increasing use of cobalt steel in the manufacture of permanent magnets has created a need for a permeameter that is capable of determining accurately the magnetic properties of such steel in bar form. The common commercial permeameters are not capable of producing the high magnetizing forces required for this purpose. Commercial permeameters are chiefly of two types, the yoke type and the Burrows type. The latter is difficult to operate and requires an experienced operator for a reasonable output; it cannot be adapted to the testing of cobalt steel unless it is practically rebuilt throughout. The yoke type of permeameter may be adapted to the testing of cobalt steel by the use of extensions to the poles so that the distance between them is much less. In this way the greater part of the magnetomotive force is distributed over a short portion of the magnetic circuit and the magnetomotive force per centimeter is correspondingly greater. The permeameter that is described below has been developed by the Magnetic Materials Division at the Hawthorne Works of the Western Electric Company to overcome the chief objections common to present commercial permeameters.

*Corrosion of Cable Sheath in Creosoted Wood Conduit.*<sup>16</sup> R. M. BURNS and B. A. FREED. This paper deals with the identification of a corrosion of lead cable placed in creosoted wood conduit, and with the

<sup>14</sup> *Proceedings of the Institute of Radio Engineers*, May, 1928, Vol. 16, No. 5, pp. 658-665.

<sup>15</sup> *Journal of the Optical Society of America and Review of Scientific Instruments* Vol. 17, No. 1, pp. 47-58, July, 1928.

<sup>16</sup> *Journal of the A. I. E. E.*, Vol. XLVII, No. 8, pp. 576-579, August, 1928.

determination and application of methods of allaying it. The trouble was experienced mainly on the Pacific Coast where, although Douglas fir conduit was introduced about 1911, the first case of corrosion which could definitely be ascribed to the creosoted conduit did not occur till 1921.

A search for the cause of the trouble led to making systematic analyses of the air present in the conduit and these analyses revealed the presence of acetic acid in sufficient amount to account for the corrosion in the presence of carbon dioxide which was also shown to be present.

After much experimenting a method was developed to stop the corrosion by pumping ammonia into the ducts. Results have been very satisfactory and seem to indicate that a single treatment is sufficient.

*Small Samples—New Experimental Results.*<sup>17</sup> W. A. SHEWHART and F. W. WINTERS. This article reviews briefly the Theory of Errors of Averages, paying particular attention to some of the most recent work in connection with small samples. New empirical results are presented showing the advantage that arises from the use of the latest error theory and pointing out the effect of the limitations imposed upon it. The information contained in this paper indicates that further theoretical studies are necessary in order that the application of small sample theory may give more accurate solutions to the problems that arise in practice.

<sup>17</sup> *Journal of American Statistical Association*, New Series, No. 162 (Vol. XXIII), pp. 144-153, June, 1928.