

Abstracts of Technical Articles from Bell System Sources

*Phenomena in Oxide Coated Filaments.*¹ JOSEPH A. BECKER. A theory of the changes in activity in oxide coated filaments is proposed. From a comparison of the behavior of these filaments and filaments with composite surfaces such as thorium on tungsten, caesium on tungsten, and caesium on oxygen on tungsten it appears probable that oxide coated filaments owe their high activity to adsorbed metallic barium. The changes in emission from a coated filament produced by changes in plate potential and by currents sent into or drawn from it, are ascribed to electrolysis of the oxide. When electrons are sent into a coated filament barium is deposited on the surface and the activity increases until an optimum is reached beyond which the activity decreases. When current is drawn from the oxide, oxygen is deposited on the surface. If the oxygen is beneath the adsorbed barium, it increases the activity; if it is above the barium, it decreases the activity. Both barium and oxygen diffuse readily from the surface into the oxide and vice versa. This theory is tested, confirmed, and extended by numerous experiments.

An experimental technique is employed by which relative rates of evaporation of small amounts of electropositive and electronegative materials can be determined with considerable precision. The same technique might be useful in a number of similar investigations. Metallic barium or oxygen which evaporate from a coated filament are allowed to deposit on one side of a flat tungsten ribbon whose thermionic activity is followed. When the plausible assumption is made that an optimum activity is obtained when the tungsten is covered with a single layer of electropositive material, the relative rates of evaporation can be converted to absolute rates. This technique is also employed to determine the factors which control the evaporation of oxygen from a coated filament.

*Estimation of the Volatile Wood Acids Corrosive to Lead Cable Sheath.*² R. M. BURNS and B. L. CLARKE. The detection of volatile acids in the air drawn from creosoted wood conduit corrosive to lead cable sheath made desirable the development of a suitable method for the extraction and estimation of volatile wood acids. Such a method consists in the condensation of the volatile constituents of wood sawdust removed under reduced pressure and titration of the conden-

¹ *The Phys. Rev.* Nov. 1929.

² *Indust. and Eng. Chem.*, Jan. 1930.

sate using a modified differential potentiometric electrode. Acidity data have been obtained for Douglas fir, western hemlock, southern yellow pine, western pine, spruce, redwood, cedar, and oak, and a correlation is attempted between these acidities and the observed corrosive character of the woods.

*Electron Waves.*³ C. J. DAVISSON. This paper is a brief review of the experiments made on the diffraction of electrons by crystal during the first two years following the discovery of this phenomenon, and an indication of the paths along which future experimentation may be expected to proceed.

*Television in Colors by a Beam Scanning Method.*⁴ HERBERT E. IVES and A. L. JOHNSRUD. It has been recognized ever since the practical achievement of television, and indeed before, that television might be achieved in colors by utilizing the principles used in three-color photography. The requirements in the two cases are very closely parallel. Three-color photography had to wait for its practical achievement, on photographic materials sensitive to all colors of the visible spectrum. The parallel requirement in the case of television is for photoelectric cells similarly color sensitive. The requirements of television as to primary colors to be used for the synthesis of the colored image are relatively more difficult of fulfillment than in the case of color photography because in television we need not merely colored light sources, but light sources which shall be capable of following the variations of the television signal current with high speed. If, however, these two requirements, namely color sensitive photoelectric cells and high speed-colored lights, are met, television in color could conceivably be realized by utilizing any one of a number of devices for analyzing and recombining images which have been successfully applied in three-color photography.

*Air Transport Communication.*⁵ R. L. JONES and F. M. RYAN. The successful operation of an air transportation system depends in no small degree on the communication facilities at its command. Rapid and dependable communication between transport planes in flight and the ground is essential. Two-way radio telephony provides this necessary plane-to-ground contact.

The design of a radio telephone system for this service requires quantitative knowledge of the transmission conditions encountered in

³ *Jour. The Franklin Inst.*, Nov. 1929.

⁴ *Jour. Opt. Soc. of Amer.*, Jan. 1930.

⁵ *Jour. A. I. E. E.*, Jan. 1930.

plane-to-ground communication. An experimental investigation of these conditions over the available frequency range has been carried out and the results are described.

A complete aircraft radio telephone system designed for the use of air transport lines and an airplane radio receiver designed for reception of government radio aids to air navigation are also described.

*A Study of Noise in Vacuum Tubes and Attached Circuits.*⁶ F. B. LLEWELLYN. The noises originating in vacuum tubes and the attached circuits are investigated theoretically and experimentally under three headings: (1) shot effect with space charge, (2) thermal agitation of electricity in conductors, (3) noise from ions and secondary electrons produced within the tube.

A theoretical explanation of the shot effect in the presence of space charge is given which agrees with experiment insofar as a direct determination is possible. It is shown that the tubes used should be capable of operating at full temperature saturation of the filament in order to reduce the shot effect.

In the computation of the thermal noise originating on the plate side of a vacuum tube, the internal plate resistance of the tube is to be regarded as having the same temperature as the filament.

Noise produced by ions within the tube increases as the grid is made more negative.

With tubes properly designed to operate at temperature saturation it is possible to reduce the noise on the plate side to such an extent that the high impedance circuits employed on the grid side of the first tube of a high gain receiving system contribute practically all of the noise by virtue of the thermal agitation phenomenon.

*On the Nature of "Active" Carbon.*⁷ H. H. LOWRY. Practically all investigators have used for their measure of "activity" the adsorptive capacity of the carbon (charcoal) under certain arbitrary conditions. In several previous papers data have been given which indicate that the adsorptive capacity of carbon is increased by any process which increases either the total surface per unit weight or the degree of unsaturation of the surface atoms, or both. No exceptions to this generalization have been encountered. Since the adsorptive capacity is dependent on two factors which may be independently varied, it seems hardly logical to continue its use as a measure of the activity of carbon. Since it is generally recognized that the forces effective in adsorption processes are a result of the unsaturation of the surface

⁶ *Proc. The Inst. Radio Engineers*, Feb. 1930.

⁷ *Jour. of Phys. Chem.*, Jan. 1930.

atoms, the ratio of the adsorptive capacity to the total adsorbing surface would appear to be much more satisfactory for a measure of the activity.

The data shown graphically in this paper show that starting with a given raw material, i.e., an anthracite coal, an increase in the temperature to which the material is heated above 1000° decreases the adsorptive capacity per unit pore volume. It is pointed out that the pore volume may be considered a measure of the extent of adsorbing surface and that the activity of an adsorbent carbon (charcoal) should be measured by the amount of gas adsorbed per unit area of its surface. The data, therefore, indicate that the activity of a charcoal is independent of the atmosphere in which it is prepared and dependent only on the maximum temperature to which it is heated. At any temperature between 900 and 1300° an increase in the adsorptive capacity is most probably accompanied by a proportional increase in the extent of the adsorbing surface. For example, although the adsorptive capacity of the samples prepared at 1100° ranged from 1.8 to 23.1 c.c. carbon dioxide per gram at 0° and atmospheric pressure, the actually measured values of activity ranged from 0.201 to 0.295, while the weighted average for all the samples prepared at the same temperature was 0.27; the variations observed are believed to be due to the limitations, which have been discussed, of the measure of the surface area rather than to a real difference in the activity.

*The Operation of Modulators from a Physical Viewpoint.*⁸ E. PETERSON and F. B. LLEWELLYN. The mathematical expressions which occur in the treatment of non-linear devices as circuit elements are interpreted in terms of a graphical physical picture of the processes involved. This picture suggests, in turn, several useful ways of applying the equations in cases where the driving forces are so large that the ordinary power series treatment becomes prohibitively cumbersome. In particular, the application has been made in detail to the calculation of the intermediate-frequency output to be expected from a heterodyne detector having an incoming radio signal and locally generated beating oscillator voltage applied on its grid and a circuit of finite impedance to the intermediate frequency attached to its plate.

*A Study of the Output Power Obtained from Vacuum Tubes of Different Types.*⁹ H. A. PIDGEON and J. O. McNALLY. Economical operation of the large number of tubes involved in the Bell System makes necessary the adoption of common supply voltages. This requires that

⁸ *Proc. The Inst. Radio Engineers*, Jan. 1930.

⁹ *Proc. The Inst. Radio Engineers*, Feb. 1930.

repeater tubes of various types be designed to operate at a fixed plate voltage. For this reason the design of amplifier tubes to give as large a power output as possible at the operating plate voltage is of considerable importance.

In the case of three-electrode tubes it is possible from theoretical considerations to compute, approximately, the electrical parameters a tube must have in order to give the maximum output power of a given quality obtainable under fixed operating conditions.

The electrical characteristics and output of fundamental, second, and third harmonics of two of the more common telephone repeater tubes are given.

It is of considerable interest to determine whether greater power output of comparable quality can be obtained from tubes containing more than one grid. Since no sufficiently exact theoretical analysis of multi-grid tubes is yet available to permit the determination of the parameters of optimum tubes, a comparative experimental investigation of a number of such structures has been undertaken. The electrical characteristics and output of fundamental, second, and third harmonics of several such experimental tubes are given. The power output of multi-grid tubes and of three-element tubes is compared. The reasons for the comparatively large power output of certain types of multi-grid tubes are discussed.

*Effect of Small Quantities of Third Elements on the Aging of Lead-Antimony Alloys.*¹⁰ EARLE E. SCHUMACHER, G. M. BOUTON, and LAWRENCE FERGUSON. The data presented in this paper definitely show that small quantities of certain elements when added to lead—1 per cent antimony alloys have a very marked effect on the rate at which antimony is precipitated from supersaturated solid solution. Some suggestions of the mechanism of this change can be had from a consideration of the experimental findings in conjunction with the pertinent equilibrium diagrams.

Although the literature shows that the third elements studied are insoluble in lead in the solid phase, no results have been reported on alloys containing these elements in very low concentrations. Even though they should be insoluble in lead, antimony may so change the lead lattice that they become soluble in lead-antimony. Furthermore, since these elements form either compounds or solid solutions with antimony, there are forces of attraction between them which may be strong enough to carry small quantities of the third elements, along with the antimony, into solid solution in the lead. The resulting ter-

¹⁰ *Indust. and Eng. Chem.*, Nov. 1929.

nary solutions, by their different energy relations, may cause the observed effects on the rate of precipitation of antimony.

*The Tube Method of Measuring Sound Absorption Coefficients.*¹¹
E. C. WENTE. The general principles underlying the tube method of measuring sound absorption can be derived conveniently from the analogous equations for the electrical transmission line. These equations show that the actual method of measurement is capable of many modifications, some of which have already been adopted by various experimenters. However, if reliable results are to be obtained, it is important that the apparatus be so designed that the propagation along the tube be rectilinear and the attenuation small, and that the tone be kept free from harmonics.

In the tube method the absorption is measured at perpendicular incidence, whereas in the reverberation method it is measured at random incidence. A theoretical study of the absorption of sound by porous materials as a function of the angle of incidence shows that in some cases there may be a considerable discrepancy between the values obtained by the two methods. The tube method may also give impracticable results for materials which are to be used in the form of large panels and absorb sound largely by virtue of inelastic bending rather than because of their porosity.

¹¹ *Jour. of the Acoust. Soc. of Amer.*, Oct. 1929.