Abstracts of Bell System Technical Papers Not Appearing in this Journal

Commercial Loading of Telephone Cables. W. FONDILLER.[1] The application of loading coils to exchange area cable and to toll cable is discussed and data given on the loading coils and the transmission characteristics of loaded cable circuits.

An important section of the paper deals with the requirements for loading phantom circuits. In particular, the crosstalk and noise requirements for phantom loading are analyzed.

The paper concludes with a comparative study of three systems of phantom loading which are in commercial use, viz., the Campbell-Shaw, the Ebling and the Olsen-Pleijel system. It is concluded that the Campbell-Shaw phantom loading system, which has been adopted as standard by the Bell System, as well as by many European Administrations (notably the British Post Office), has marked advantages over the other two systems which have been used to a minor extent in continental Europe.

The Schottky Effect in Low Frequency Circuits,[2] by J. B. Johnson. This effect, discovered by Schottky, which depends on the probability of fluctuations of electron emission from a filament, has been measured over a considerable range of conditions in resonant circuits of which the natural frequency was varied from 8 to nearly 6000 p.p.s. The effect is much larger in the lower range of frequencies than the theory predicts. With a tungsten filament, the ratio of observed to theoretical effect e'/e is about .7 for frequencies above 200, but increases rapidly to 50 at 10 cycles per sec. With an oxide coated filament, the ratio increases from 1 at 5000 cycles to 100 at 100 cycles. This is interpreted to mean that the emission of electrons is not strictly chaotic but is influenced by irregular temporal changes in the cathode emissivity. In a high frequency circuit these changes become imperceptible and the emission is effectively random. When current is limited by space charge the Schottky effect decreases because of the interaction of the electrons, and other disturbances may act upon the space charge so as to completely mask the remanent Schottky effect. The magnitude of the disturbances in amplifying vacuum tubes can therefore not be predicted from measurements on the true Schottky effect.

A Note on Schottky's Method of Determining the Distribution of Velocities Among Thermionic Electrons,[3] C. Davisson. Limiting con-

[1] Electrical Communication, July, 1925.
[2] Physical Review, Vol. 26, No. 1, page 71, July, 1925.
[3] Physical Review, Vol. 25, No. 6, page 808, June, 1925.

ditions for Schottky's formula for the thermionic current from a filament to a coaxial cylinder.—The formula must fail when, due to space charge, the potential at any distance x(r—x—R) from the axis is less than $Vr^2 (R^2-x^2)/x^2(R^2-r^2)$, V being the potential of the filament with respect to the cylinder, and r and R the radii of filament and cylinder respectively. This is more restrictive than the condition for failure which has been previously assumed.

Variation of the Photo-electric Effect with Temperature in the Alkali Metals,[4] Herbert E. Ives and A. L. Johnsrud. Special cells having a hollow central cathode were immersed in liquid air for an extended period to condense any gases present on the outer alkali metal coated walls. By a stream of evaporating liquid air, the temperature of the cathode was held at temperatures between +20 and —180°C. In these cells the variation of photo-electric current with temperature in sodium, potassium and rubidium is continuous. The effect is relatively small for sodium, showing hardly at all for blue light or white light, but clearly for yellow light. The behavior of rubidium is similar to that previously reported for potassium. In a second form of cell, potassium was collected in a deep pool. By slowly cooling the metal from the molten conditions, smooth crystalline surfaces were obtained. With these annealed potassium surfaces, the variation of photo-electric current with temperature is represented by curves varying systematically in shape with the color of the light, and the effect is far greater than previously reported, amounting, for yellow light, to a variation of 10 to 15 times between room and liquid air temperature. When the surface is roughened curves of the previously reported type are obtained. Small pools give erratic effects, showing changes in opposite directions for different portions of the temperature range. It is concluded that the variation of photo-electric effect is intimately connected with the strains produced in the surface by expansion and contraction with temperature.

Echo Suppressors for Long Telephone Circuits,[5] A. B. Clark and R. C. Mathes. A device has been developed by the Bell System for suppressing "echo" effects which may be encountered under certain conditions in telephone circuits which are electrically very long. This device has been given the name "echo suppressor" and consists of relays in combination with vacuum tubes, which are operated by the voice currents so as to block the echoes without disturbing the main transmission.

[4] Physical Review, Vol. 25, No. 6, page 893, June, 1925.
[5] Jour. A. I. E. E., Vol. XLIV, No. 6, page 618, June, 1925.

This paper gives a brief description of this device, together with a discussion of its possibilities and limitations. A number of echo suppressors have been operated on commercial telephone circuits for a considerable period so that their practicability has been demonstrated.

Recent Commercial Development in Short Wave Transmitters and Receivers.[6] S. E. ANDERSON, L. M. CLEMENT, and G. C. DECOUTOULY. This paper describes the transmitter and receiver recently developed for use by the United States Coast Guard. This apparatus is for operation on wave lengths between 100 and 200 meters. In describing the development of the transmitter a short summary of the various circuit considerations is included. The actual transmitter finally developed is also described together with its operating characteristics.

In considering the radio receiver the various problems to be met in the design of a radio receiver of this character are dealt with at some length. The frequency characteristics of the radio receiver, as developed, are shown, and the method of determining them is described in detail.

The transmitter and receiver performed very satisfactorily under conditions more severe than will be met in actual service.

The Distribution of Initial Velocities Among Thermionic Electrons.[7] L. H. GERMER. The method used was to measure the number of electrons from a straight tungsten filament which were able to arrive at a co-axial cylindrical electrode against various retarding potentials. In order to eliminate certain disturbing factors, particularly photoelectric effects, this electrode was made in the form of a very fine grid and those electrons passing between the grid wires were collected upon an outside electrode and there measured. A rather complicated intermittent heating current arrangement allowed emission from the filament only when its surface was at uniform potential, and insured that the retarding potential had exactly the desired value. A current regulator kept the heating current constant to 1/30 per cent.

Electrons from Tungsten. Measurements of the variation of electron current with voltage were made at eight different temperatures ranging from 1440°K to 2475°K. Correction was made for the contact potential difference between filament and grid. At each temperature it was found that, except in the range of voltage where the current was limited by the space charge phenomenon, the current varied with voltage in just the manner calculated upon the assumption that the electrons leave the filament with velocity components distributed according to Maxwell's law for an electron atmosphere in temperature

[6] Proc. of I. R. E., Vol. 13, No. 4, page 413, August, 1925.
[7] Physical Review, Vol. 25, No. 6, page 795, June, 1925.

equilibrium with the hot filament. At 2475°K the assumed Maxwell distribution was verified up to a retarding potential so great that only one electron out of 10^{10} emitted electrons was able to reach the collector. It is believed that the present results are more reliable and extensive than any hitherto obtained, and that they are conclusive for electron emission from tungtsen in a high vacuum.

Electrons from Oxide Coated Platinum. Subsequent measurements by Dr. C. DAVISSON have shown that the electrons emitted from Wehnelt cathodes also have velocity components distributed according to Maxwell's law.

Automobile-Noise Measurement.[8] H. CLYDE SNOOK. Automobile noise, although useful as a detector of mechanical imperfections of car operation, is otherwise so extremely undesirable that elaborate methods for analysis with a view toward preventing or suppressing such noise are warranted. The author presents an illustrated and detailed description of the mechanism of human hearing, according to studies made in the interests of telephonic transmission of maximum effectiveness, enumerating and explaining the devices developed for evaluating the sources of sound and its modes of propagation and amplification.

An automobile can be considered to be composed of a number of acoustic resonators having varied degrees of coupling between them, and comparisons are made of the velocity of sound propagation through the different materials with that of its transmission in air, the velocity being greater in the structural material. The apparatus used for the detection of noise and its measurement consists of varied types of equipment, divided into two classes; one includes the contact type and the other the air-impact type, both being demonstrated.

Following an enumeration of the different detectors and auxiliary apparatus in use and comments upon the methods employed, it is stated among other conclusions that it seems advisable to base loudness measurements of automobile noise upon the difference of energy between the measured sound and an arbitrary standard of sound which is the threshold of normal hearing; that, to locate the origin of automobile noise, it frequently is sufficient merely to detect the noise without measuring its loudness; and that, to identify the origin of automobile noise, it often is of value to ascertain its component frequencies.

[8] Jour. Soc. of Automotive Engineers, Vol. XVII, No. 1, page 115, July, 1925.