

Abstracts of Technical Articles by Bell System Authors

*Recent Developments in Burying Telephone Cables.*¹ DONALD FISHER and TEMPLE C. SMITH. The term "buried cables" has come to mean those underground cables which have no conduit protection. Due to the accelerated demand for such construction in recent years, much effort has been expended in devising methods and developing machinery for burying cables. One of the earlier methods used in this and some foreign countries was to dig a trench by hand alongside the road; unreel the cable from a moving truck, thus laying it beside the trench; work the cable over into the trench by having 30 to 50 men handle it in relays; splice the cable in the trench, and finally backfill the spoil and tamp it by hand. Later variations of this method introduced one or more of the following units of machine equipment: Power trenching machines; Caterpillar tractors with trailers to straddle the trench, laying the cable directly from the reel into the trench; Drag-line or other types of power backfillers; Power tampers or rollers.

In order to further reduce the number of operations involved, speed up the installation, and reduce the cost, large plow trains have recently been developed which, except for splicing, in ordinary soil complete the job of burying a cable in one pass over the route. The idea of plowing cable into the ground is not new. In fact the great grandfather of all the cable plows was designed by Ezra Cornell long before he established the university. His "ponderous machine" drawn by a "long line of horses" was designed for laying telegraph cable in the early 1840's, but the development was dropped when the simple expedient of carrying wires on poles and insulators was conceived.

The large plow trains recently developed for installing telephone cable are capable of burying either a single cable or a pair of cables together with as many as three properly spaced lightning-protection wires, and of cutting a slot for them as much as 50 inches deep where such a depth is required. To provide the complete plow train has required the design of many pieces of equipment which the word "plow" does not suggest to one's mind. The plows and some of this equipment are discussed in this paper.

*A Frequency-Modulated Control-Track for Movietone Prints.*² J. G. FRAYNE and F. P. HERRNFELD. A 5-mil frequency-modulated track located between sound and picture areas is proposed to control reproduction

¹ *Elec. Engg., Transactions Section*, April 1942.

² *Jour. S.M.P.E.*, February 1942.

in the theater from one or more sound-tracks. A variation of approximately one octave in the control frequency provides a 30-db change in volume range which may be used in part for volume expansion of loud sounds or as noise reduction for weak sounds. The control-track frequency is varied manually and recorded simultaneously with the sound-track in the dubbing operation, the gain of the monitoring channel being varied in accordance with the control frequency to produce automatically the enhanced volume range desired from the release print. The track is recorded in line with the standard soundtrack and does not require separate printing or reproducing apertures. It is scanned by a separate photosensitive surface, the output being converted from frequency to voltage variations by a frequency-discriminating network identical to that used in the monitoring channel. The output from the network, applied to the grid of a variable-gain-amplifier in the sound channel, controls automatically the volume of the reproduced sound in accordance with that observed in the dubbing operation.

*Performance of Ground-Relayed Distribution Circuits during Faults to Ground.*³ C. L. GILKESON, P. A. JEANNE and J. C. DAVENPORT, Jr. An extensive oscillographic study has been made on power distribution feeders primarily to obtain data useful in the consideration of joint use of poles by power and telephone facilities. Some of the results, chiefly those obtained from three-phase, four-wire, multigrounded neutral feeders equipped with instantaneous ground relays and for immediate breaker reclosure, are believed to be of general interest and are presented herewith. Included are data on the performance of the protective devices utilized for clearing ground faults on the feeders included in the study, the effectiveness and certain limitations of these devices, and characteristics of the faults experienced.

*A More Symmetrical Fourier Analysis Applied to Transmission Problems.*⁴ R. V. L. HARTLEY. The Fourier identity is here expressed in a more symmetrical form which leads to certain analogies between the function of the original variable and its transform. Also it permits a function of time, for example, to be analyzed into two independent sets of sinusoidal components, one of which is represented in terms of positive frequencies, and the other of negative. The steady-state treatment of transmission problems in terms of this analysis is similar to the familiar ones and may be carried out either in terms of real quantities or of complex exponentials. In the transient treatment, use is made of the analogies referred to above, and

³ *Elec. Engg., Transactions Section*, January 1942.

⁴ *Proc. I.R.E.*, March 1942.

their relation to the method of "paired echoes" is discussed. A restatement is made of the condition which is known to be necessary in order that a given steady-state characteristic may represent a passive or stable active system (actual or ideal). A particular necessary condition is deduced from this as an illustration.

*Paper Dielectrics Containing Chlorinated Impregnants.*⁵ D. A. McLEAN, L. EGERTON, G. T. KOHMAN and M. BROTHERTON. Chlorinated aromatic hydrocarbons are used extensively as impregnants for paper in electrical apparatus such as capacitors and transformers. They possess high stability toward heat and oxygen, nonflammability, and desirable electrical properties. However, the present study shows that under special conditions a type of decomposition occurs which liberates products so active chemically that, especially at elevated temperatures, under high potential gradients, and in contact with metals, autocatalytic decomposition reactions are initiated.

When aluminum electrodes are used and d-c. fields are applied, the deterioration manifests itself in a leakage current increasing with time and in the formation of partially carbonized areas in the paper. Evidence is presented that the decomposition starts by the splitting off of hydrogen chloride from the chlorinated compounds. This attacks the electrodes to form aluminum chloride, which decomposes the organic constituents of the insulation.

The deterioration is considered in relation to certain variations in composition; all components of the structure—the paper, the impregnant, and the electrode materials—play important roles in the reactions.

*Methods for Measuring the Performance of Hearing Aids.*⁶ FRANK F. ROMANOW. A hearing aid can be considered as a sound transmission system which is interposed in the path between the source of sound and the listener's ear. As such its performance can be judged by comparing the sound that reaches the ear first through the air path and then through the hearing aid. The experimental procedure to carry out this concept is, however, time consuming. To obtain a simple laboratory technique for comparative purposes, it is proposed, therefore, that the amplification of a hearing aid be measured by placing its microphone in a known sound field and observing the output of the receiver when terminated in an appropriate impedance. For an air conduction receiver this impedance takes the form of a closed cavity. For a bone conduction receiver the termination is an artificial mastoid. Since in a portable hearing aid compactness is desired,

⁵ *Indus. & Engg. Chem.*, January 1942.

⁶ *Jour. Acous. Soc. Amer.*, January 1942.

the indistorted pressure that can be developed by the set is limited in magnitude. Also the amplification is a function of the variation of the power supply voltages. Hence it is necessary that these characteristics be measured. As an illustration of the different factors involved, characteristic curves for a recently developed vacuum tube aid are shown.

*Some Mechanical Aspects of Telephone Apparatus. Part 1—Development of Crossbar Switch as a Typical Unit of Automatic Dial Telephone System.*⁷ J. D. TEBO and H. G. MEHLHOUSE. One half the telephones in the world are in the United States. A total of 100,000,000 calls a day are made on this equipment, on matters large and small—routine or emergency. Especially in these days of national emergency, communication facilities have become indispensable to our defense organizations, vitally assisting in speeding up the program of national safety.

Americans have grown to accept their telephones as a necessity, seldom realizing the vastness of the system and the spirit of service in the large organization constantly striving to maintain and improve a means of communication already unexcelled. Seldom is it realized that the equipment in the home or office is only a very small part of the facilities required in this business of telephoning. A network of wire literally covering the nation from coast to coast, and intricate switching devices for interconnecting the telephones throughout the nation and most of the world all combine to transmit the spoken word quickly and faithfully.

The vastness and complexity of such a service must of necessity require a wide range of equipment which, in the Bell System, totals 44,000 kinds of apparatus involving 170,000 different parts. Some of the mechanical aspects of such equipment are presented in this paper, particularly those having to do with design and manufacture, jointly handled for the Bell System by the Bell Telephone Laboratories and Western Electric Company. Obviously, the entire range of telephone equipment cannot be included. This paper is therefore intended to deal with a specific telephone switching mechanism, known as the crossbar switch, which is used in the latest dial telephone system.

⁷ *Mech. Engg.*, May 1942.