BELL LABORATORIES RECORD

VOL. XXVII • NO. 7 • JULY 1949

Mechanical development of EDT crystal units

A. W. ZIEGLER
Crystal Units

Crystal units using ethylene diamine tartrate have been designed to replace quartz crystal units in the electric wave filters of broadband carrier telephone systems. Taken by themselves, they embody the end result of a long-range development program undertaken a few years prior to the recent war in anticipation of shortages of natural quartz suitable for this application.* As the completed EDT crystal unit appears in Figure 1, it is not unlike the quartz unit that it replaces. Yet there were problems in the design of the newer EDT unit that were not present during the earlier development of the quartz counterpart. Mainly, the EDT plate is relatively fragile mechanically and requires more careful handling. Its wide differences in temperature-expansion characteristics require that it be well protected against thermal shock to prevent fracture. To avoid surface deterioration, the plate must not be heated for appreciable lengths of time beyond 250 degrees F. Also, it is soluble in water. These properties each presented new proc-

*RECORD, *May*, 1948, *page* 222.

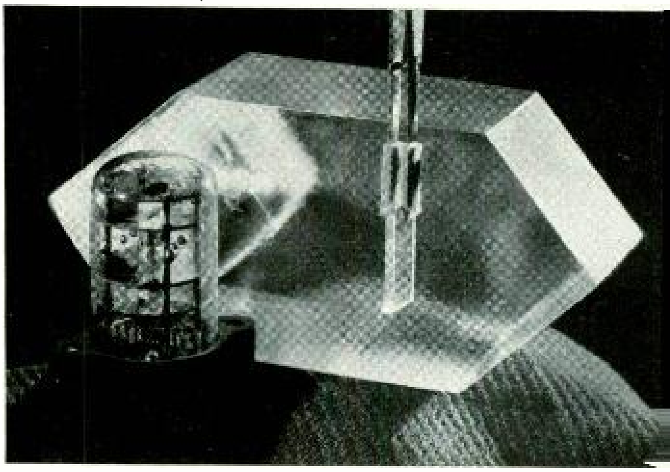


Fig. 1—A synthetic EDT crystal bar is shown in the background. Held by chamois-lined tweezers in the right foreground, a Y-cut plate, dimensioned approximately one inch long by 7/16 inch wide by 3/32 inch thick, is pictured in the relative position it occupied before it was sliced from a similar bar by the wet-string technique of Figure 2. At the left foreground, a completed crystal unit, designed for telephone system use, has the EDT crystal plate in the center, supported by lead wires in the cage of the tube. Resonant frequency is about 80 kilocycles per second for the unit of above cut and size

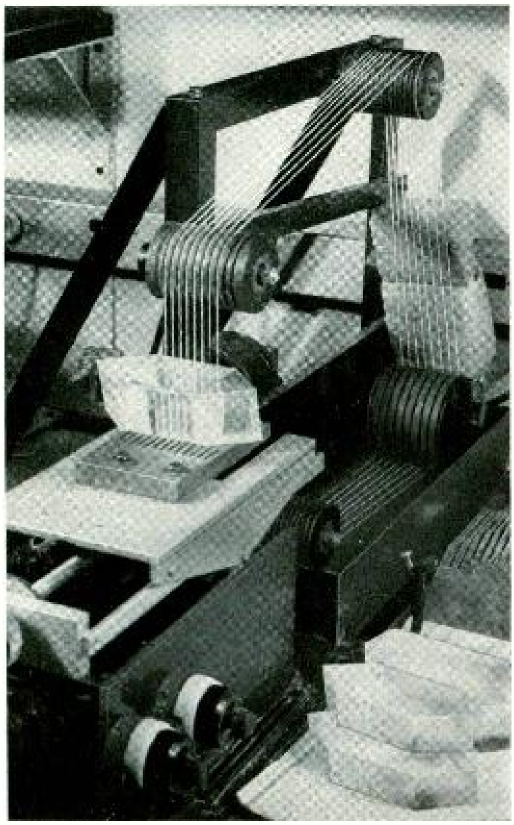


Fig. 2—Laboratory production, by multiple wet-string saw, of Y-cut wafers from an EDT crystal bar. From these wafers, plates are shaped to required dimensions by additional wet abrasive methods

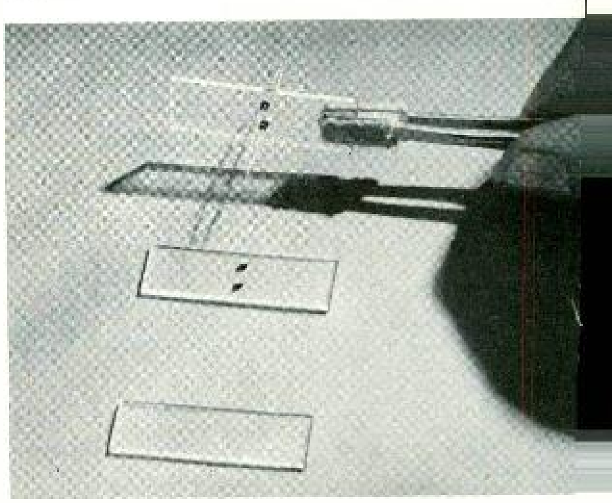
essing and mounting problems to be solved before a satisfactory EDT unit could be manufactured. The success of this project is the result of coöperative effort among Laboratories' physicists, chemists and development engineers.

Like the quartz plate, the EDT plate has vapor-plated metal electrodes of the divided type and is supported in a cage by four 8-mil diameter phosphor-bronze lead wires. The shock absorber assembly surrounding each end of the new plate includes a slotted bumper of polytetrafluoroethylene that is sandwiched between mica sheets, instead of the single slotted mica bumper permissible for quartz. The relative softness of this plastic cushion provides impact protection for the EDT plate if it is inadvertently dropped or roughly handled. As in the quartz unit, each lead wire has a solder ball of determinate mass located a specific distance from the surface of the plate to prevent energy of the vibrating crystal plate from passing to the cage. The cage assembly, containing a completed plate adjusted to a required resonant frequency, is sealed by the usual methods in an evacuated glass bulb 1⅛ inches in diameter. With the addition of a base, the crystal unit as a completed assembly has an over-all height of approximately 3 inches.

Since the EDT crystal is soluble in water, it may be cut into wafers by slicing with wet strings, as shown in the laboratory apparatus of Figure 2. From these wafers, plates are shaped to required dimensions by additional wet abrasive methods. Later in the fabrication of the crystal unit, this property of solubility also makes it feasible to wipe the ends of the individual plate with a moistened cloth to effect a final adjustment of the resonant frequency required for a particular application. After shaping, the plate, etched to prepare it for lead attachment and for electroplating, appears as shown in the foreground of Figure 3, below.

Attaching support leads to the EDT plate required the development of new techniques due to expansion characteristics of the several materials involved. Previous

Fig. 3—Foreground—EDT crystal plate prepared for disk attachment. Center—EDT plate with combination adhesive disks cemented in place, two on each side. Background—Plate with headed wires soldered to disks



success attained in the less complicated quartz crystal unit, in which the plate is supported by fine wires,* made it logical to try wires similarly for the EDT plate. Moreover, it was desirable from a manufacturing standpoint to use a solder to attach them. For this, small metal-surfaced areas, thermally insulated from the EDT plate, were required to permit soldering of mounting wires. Considerable experimentation produced a composition adhesive-coated metal disk like that sketched at the lower left side of Figure 4. When applied to the EDT plate under controlled conditions of temperature, pressure and time, this disk proved satisfactory for this special soldering operation.

The disk is punched from a preformed sheet of closely bonded solder, copper, and a special adhesive. It was necessary that this adhesive, of a thickness sufficient to secure the proper thermal insulation, should also be flexible enough to reduce the stress resulting from differences between the temperature coefficients of linear expansion of the metal disk, the EDT plate and the adhesive itself. The coefficient of thermal expansion for the copper is around 9 parts per million per degree F; and that of the adhesive about 200 parts. Stresses which might crack the fragile plate could result from temperature changes either in the soldering operation, or later with ambient temperature changes, as is evident when comparing these expansion coefficients with those in the Figure 5 graph for the typical Y-cut EDT crystal plate. The latter are negative as well as positive and cover a wide range of values up to about 160 parts per million per degree F., depending on the direction of measurement. Such coefficients cannot be matched by any physically realizable adhesive, so that inevitably, in a crystal unit subjected to extremes of temperature, the crystal and adhesive must tend to move through unequal distances. This dictated the use of an adhesive possessing enough flexibility for the limiting requirements, but not such dissipative or cold flow properties as would affect the frequency stability characteristic of the crystal unit during its service life.

*Record, *April*, 1945, *page* 140.

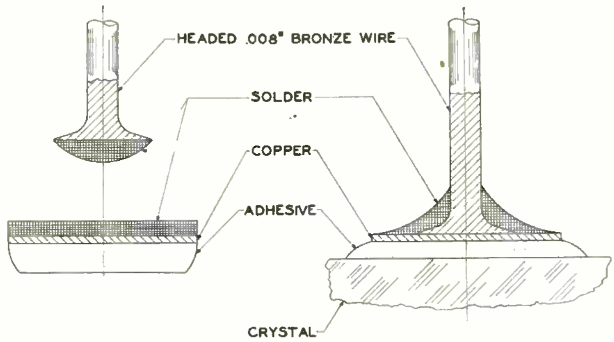


Fig. 4—Left, below, combination adhesive disk before cementing to EDT plate. Left, above, headed wire that will be soldered to the disk's solder layer. Right, combination adhesive disk after cementing to EDT plate and after headed wire has been soldered to the solder layer. Note overlap of adhesive that furnishes proper surface for electrical continuity between mounting wire and gold electrode

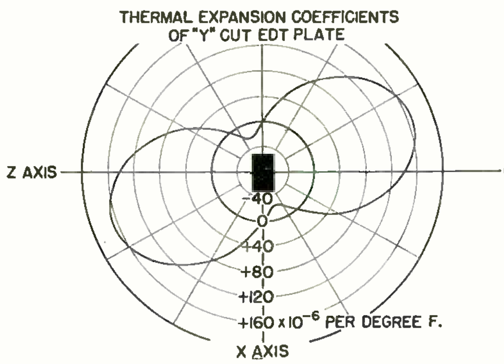


Fig. 5—Thermal coefficients of linear expansion in directions parallel to the major face of a Y-cut EDT crystal plate. The negative Y-axis extends toward the reader

In preparation for lead attachment, the EDT plate must be heated. This necessitated the development of techniques for conveniently handling the hot plate. A plate like the one shown in the foreground of Figure 3 is placed in a precision holder which consists of two partly slotted sheets of ⅛-inch stainless steel as pictured in Figure 6. The holder places no restrictions on plate dimensions up to a maximum of 1½ inches length, 1¼ inches width, and $\frac{3}{16}$ inch thickness. It provides, moreover, the mechanical protection needed by the relatively fragile EDT plate and insures a more uniform heating and cooling rate

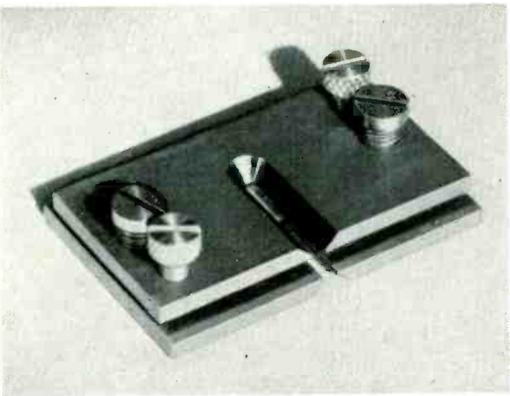


Fig. 6—An EDT plate holder in which plates are friction held. It accommodates any size of plate up to 1½ inches in length, 1¼ inches in width, and 3/16 inch in thickness, provides the mechanical protection needed by the plate, and insures a more uniform heating and cooling rate to minimize plate fracture from thermal heat

that minimizes the possibility of plate fracture from thermal shock. As indicated in Figure 7, the plate is positioned in the holder by cam movements of a centering fixture. Once positioned, the plate is held in place by friction.

In the initial step of lead attaching, the plate with its holder is heated to approximately 250 degrees F. and two disks are deposited by a compression action on each side along its width-wise center line. To position the disks accurately and insure a process control over this operation, a fixture similar to the one to be described later for the actual lead wire soldering is used. To avoid minute local fractures in the plate directly under the disks as their first contact is made with the hot crystal surface, the disks are also preheated in this fixture to approximately the temperature of the plate. The tapered formation of the adhesive illustrated in the right-side cross-sectional outline in Figure 4 is to allow subsequent gold-vapor plating to provide a continuous electrical path between the lead wire and the plate electrode. After disk attachments, the crystal plate with its holder is subjected to a baking period to condition the adhesive for lead wire soldering. The plate in this stage of processing appears in the center section of Figure 3 on page 246.

For lead wire attaching it is again necessary that the plate be heated to approximately 250 degrees F. and the usual practice is to carry out this operation immediately after adhesive conditioning, before the plate and its holder start to cool. The plate assembly is placed in the soldering fixture shown in Figure 8, where the soldering noses, after wire loading, are dropped to the soldering positions shown. Each headed wire registers in accurate alignment on its corresponding disk and is

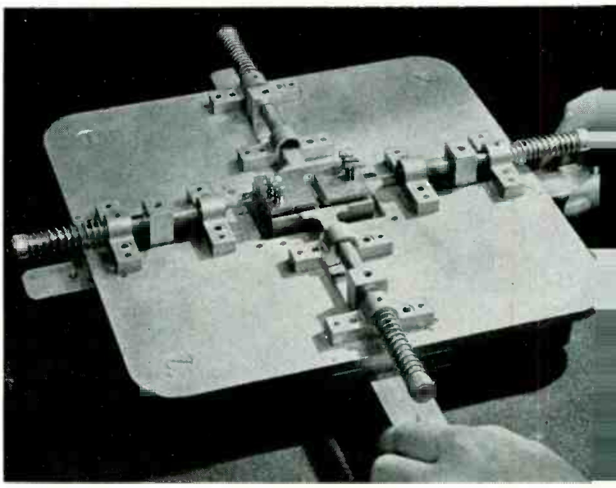


Fig. 7—Centering tool for positioning an EDT plate inside its holder

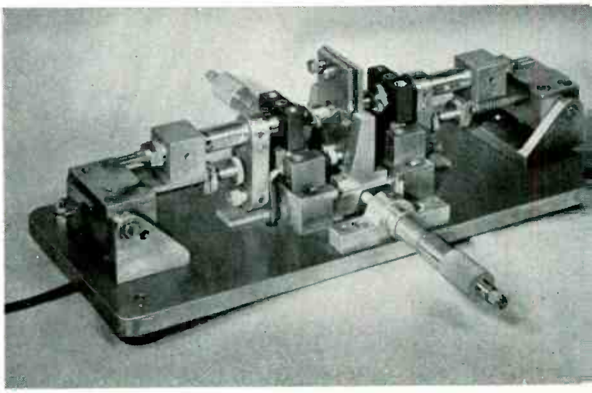


Fig. 8—Lead wire soldering tool with a plate holder containing an EDT crystal plate, with disks already attached, in center position. This tool, by interchangeable noses, is also used to attach the combination adhesive disks to the plate. Each headed wire registers in accurate alignment on its corresponding disk and is soldered in a radiation heat cycle for minimum thermal stress

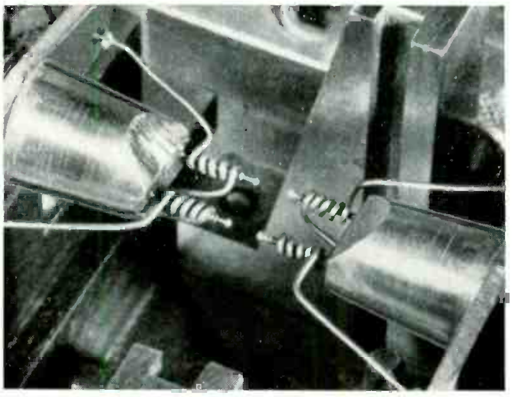


Fig. 9—Close-up of lead wire soldering tool to show details of soldering noses. The fixture provides for soldering all four wires to the disks simultaneously

soldered to the disk in a radiation heat cycle whereby the crystal plate is subjected to a minimum of thermal stress. Figure 9 is an enlarged view at the center of soldering action but with the holder assembly omitted. This fixture provides for simultaneous soldering of all four wires to the disks during a timer-controlled few seconds. Successful procedure on this basis demonstrated that multiple wire soldering was practicable without plate fractures. After a few additional seconds, the solder solidifies and the soldering noses are retracted. The plate holder and the crystal plate, with lead wires attached, are gradually cooled to room temperature. Removed from the holder, the plate appears as in the background of Figure 3. The strength of these wire attachments is comparable with that obtained for quartz plates and averages greater than three pounds.

The procedure for lead attachment to the fragile EDT plate, as outlined in the foregoing paragraphs, is dependent on these basic precautions:

(a) The plate with its disks is heated to the maximum temperature under which the crystal material will not deteriorate, thus minimizing the differential between plate temperature and the higher soldering temperature.

(b) The quantity of heat needed by the soldering operation is minimized by concentrating the heat only where wanted for the minimum time required for the entire soldering cycle.

(c) The cured adhesive, in addition to furnishing heat insulation, is flexible enough to absorb the mechanical stress caused by unavoidable temperature differences.

Additional mechanical design problems characterized the several processing steps remaining to complete the crystal unit. One example is vapor plating gold electrodes to the EDT plate to secure strong adhesion again without damage through thermal shock. A view into one of the vacuum chambers of the laboratory equip-

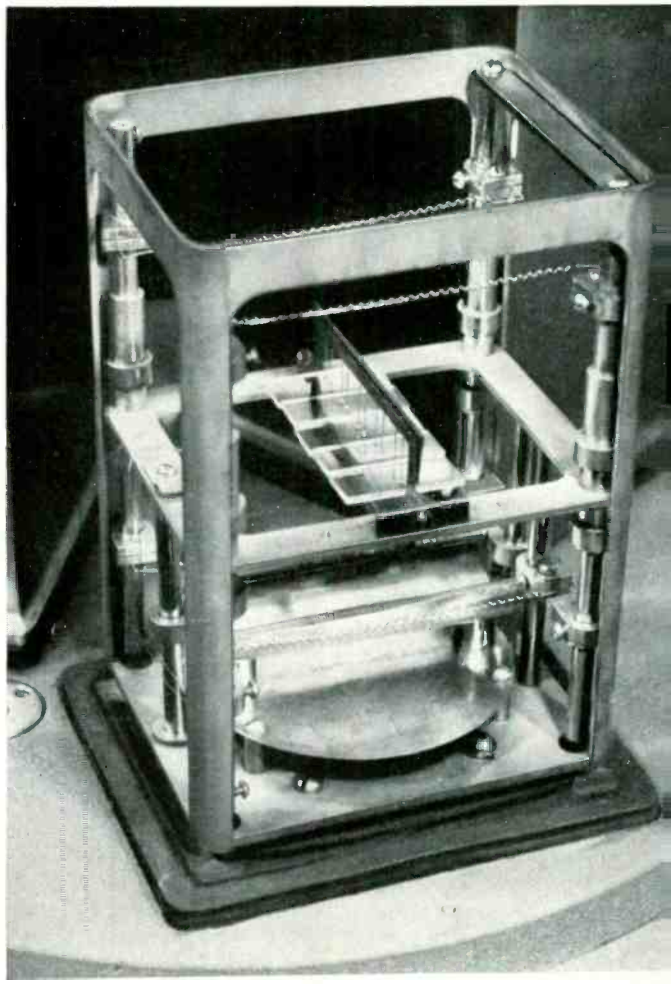


Fig. 10—Inside view of vacuum chamber showing arrangement used to vapor plate gold electrodes on EDT crystal plates. The small diameter wire coils, two of which are visible at top of fixture, are tungsten heaters in which solid gold wire is threaded. After high vacuum is attained, these heaters are made incandescent and the gold evaporates to cover the crystal plates with a film approximately 15 millionths of an inch thick

THE AUTHOR: A. W. Ziegler interrupted his engineering studies at the University of Illinois to become a naval aviator during World War I and then received his B.S. degree in Electrical Engineering in 1921. He joined the Engineering Department of the Western Electric Company in July of that year. His work was primarily on the development of switchboard lamps, vacuum thermocouples and ballast resistors. Later on, he aided in the design of filters and networks for voice frequency and power line carrier circuits. For the past several years he has been on the development of crystal filters, with emphasis given to improvements in crystal mountings and housings which played an important rôle in the communication field during World War II. Recently he has been engaged in the mechanical designs of synthetic EDT crystal units.

ment used in this operation is shown in Figure 10. A feature of this process is the suspension of the plates by their lead wires to permit simultaneous plating of both sides and to assure more uniform surface temperatures.

Ethylene diamine tartrate crystal units are in mass production by the Western Electric Company. Their test trials in transcontinental telephone lines evidence their ability to replace quartz in these and other important circuits.

The first delay lens and horn go up to the top of the hundred-foot Martinsville tower, first relay point on the New York-Chicago microwave system. This lens will look toward Long Lines headquarters, 32 miles away. Next jump is 28 miles to Buckingham, Pa. W. L. Tierney and R. R. Andres are consultants to Long Lines on this project.

A 15-KC carrier program channel

G. H. HUBER
Transmission Development

Although a sensitive ear is capable of detecting frequencies somewhat above 15,000 cycles, its sensitiveness at the higher frequencies falls off rapidly. Greatest sensitivity is in the neighborhood of 2,000 cycles, and a band 3,000 cycles wide is generally used for telephone communication. Good reproduction of music, however, requires a wider band. Nation-wide broadcast networks have transmitted a band of about 5,000 cycles for many years. Although facilities for the transmission of program material with a bandwidth of about 8,000 cycles have been offered to the broadcasters by the telephone companies since 1940, these have been used only to a limited extent. In the past year, however, requests have been received for 8,000-cycle program circuits and also for program circuits with a bandwidth of 15,000 cycles to be used in FM broadcast networks.

Intercity transmission of program material with a bandwidth of about 15 kc was first* demonstrated publicly in April, 1933, when a program of the Philadelphia Orchestra originating in Philadelphia was reproduced stereophonically in Constitution Hall in Washington. Special carrier terminals were employed as part of an experimental cable carrier system for the transmission. With special microphones, loudspeakers, and amplifiers, the music played by the Philadelphia Orchestra was heard in Washington with unusual realism by a large audience.

Because of the possible demand for high-quality program circuits, a 15-kc, carrier-

*RECORD, *May*, 1933, *page* 254; *March*, 1934, *pages* 194 and 209.

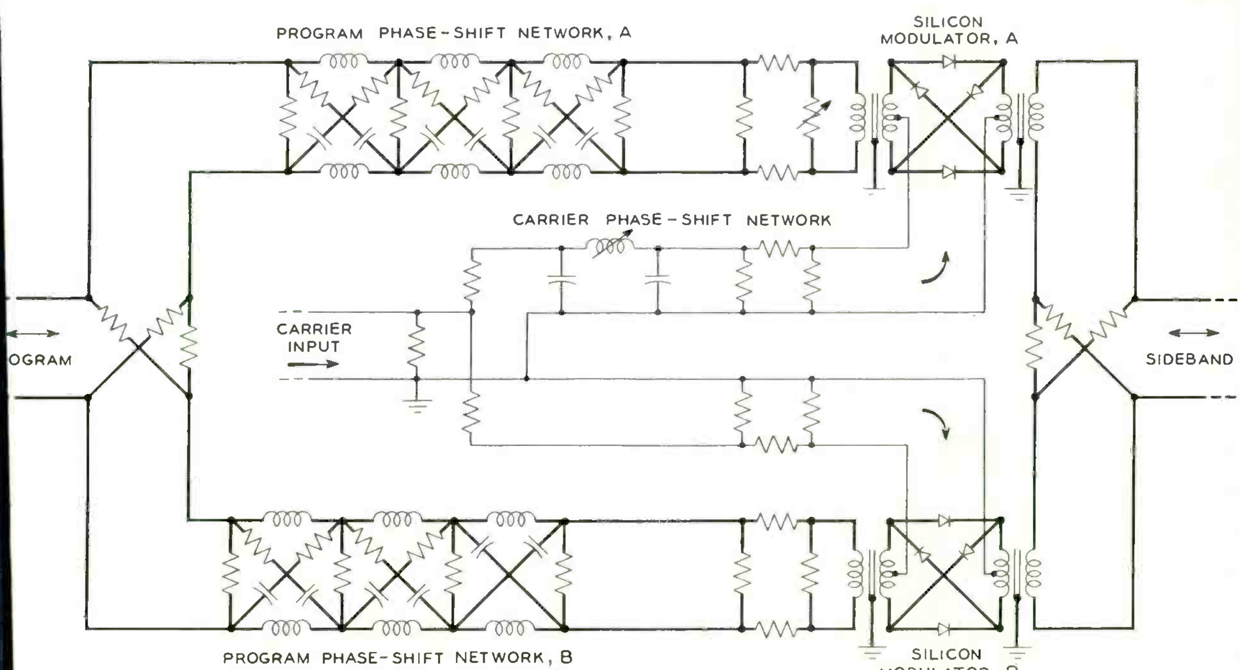


Fig. 1—Modulating circuit for the 15-kc program terminal

transmitted, double-sideband program channel was developed and demonstrated in January, 1941, over a 1,200-mile K1 system. The source of the program was again the Philadelphia Orchestra. Recently (February, 1948), this terminal equipment was placed in commercial operation between Washington, D. C., and New York, as part of an FM broadcast network. Although this is the first intercity 15-kc circuit, there are at the present time almost 200 short-haul links for FM broadcasters between studio and transmitter, which have been provided by voice-frequency lines adapted for 15-kc program service. While the channel between Washington and New York is giving excellent service, it is limited in application to relatively short underground K1 cable systems, primarily because the pilot regulating frequencies must be removed to provide sufficient band space for the double sideband.

These limitations are overcome in the new 15-kc single-sideband carrier suppressed program terminal designed for operation over long K1, K2, and L1 systems. As initially applied, the program channel occupies the 48-kc bandwidth normally required for twelve message channels, but the design is arranged so that the frequency space can be reduced in the future to that of six message channels by further development work.

In conventional single-sideband systems, the unwanted sideband is suppressed by band filters having rapidly rising attenuations outside the pass-band. Such filters employ either coil and capacitor elements at low frequencies, or crystal elements operating at 60 kc or higher.

For the new 15-kc circuits, it was desirable to use a carrier of 88 kc in order to place the channel in the most advantageous position in the group band. A design that would obtain the necessary bandwidth by the use of filters would be expensive since the required band width cannot be obtained with quartz band filter sections. High-pass and low-pass quartz filter sections could be used but these would result in a complex filter structure. The required band width could also be obtained with a complicated band filter with synthetic crystal elements.

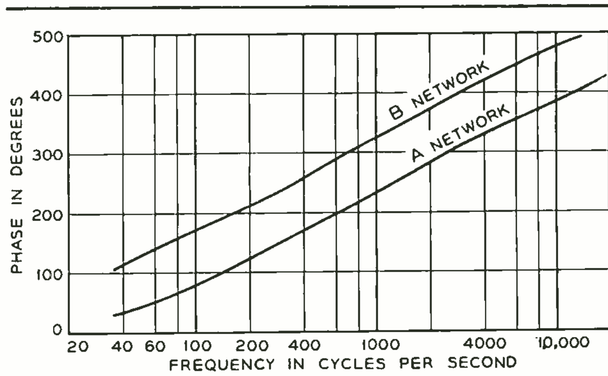


Fig. 2—Insertion phase shift of networks A and B

This filter design problem was avoided by the use of a method of suppressing the unwanted sideband and carrier devised in these Laboratories over twenty years ago. This method combines the output of two modulators whose input phase and carrier phase differ by ninety degrees. Modulators that performed as expected were constructed at the time of the original experiment, but it was not until much later that lattice network theory progressed to a point that made it possible to extend this method to as wide a band as is now employed for this new 15-kc channel.

The arrangement of the modulating circuit with its two modulators is shown in Figure 1. A phase-shift network is inserted in the path of the signal to each modulator,

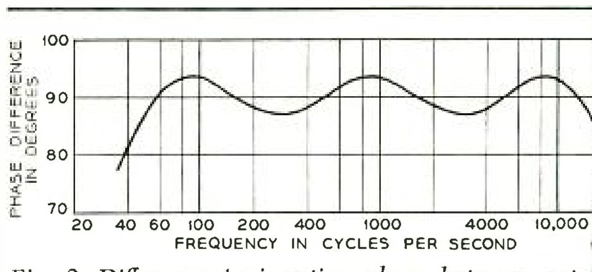


Fig. 3—Difference in insertion phase between networks A and B

and a phase-shift network is also inserted in the carrier supply to one of the modulators marked A in Figure 1. The network in the signal branch to the A modulator shifts the phase of all frequencies by 90 degrees plus an angle, θ, which varies with frequency, while the network in the branch to the B modulator shifts them by approximately the same angle θ. The carrier to the A modulator is shifted 90 degrees, while that to the B modulator is not shifted. As a result of these phase shifts, the upper sideband from modulator A has been rotated about 180 degrees from that of modulator B and thus the two sidebands cancel each other by a substantial amount. The lower sidebands from the two modulators are in phase and add. Whether the upper or lower sideband is suppressed depends on the poling of the signal to the two modulators. When operated in the reverse direction, this circuit acts in a similar manner to reject the unwanted sideband.

The amount of suppression obtained depends on the precison of the phase shift and the relative loss of the two modulators. The phase shift of the carrier and the loss in one modulator can be readily adjusted by the variable inductance in the carrier phase shifter and the variable resistance shunted across the input to modulator A. To obtain a relative phase shift of approximately 90 degrees between the two signal inputs, several sections of all-pass lattice network are placed in each branch. By this method, 90 degrees relative phase shift may be obtained to any precision and with any bandwidth desired. However, both increasing precision and increasing bandwidth require more sections of network.

Insertion phase shift of network A and network B is shown in Figure 2, while Figure 3 shows the difference in insertion phase between the two networks. To secure a combined modulator suppression and demodulator rejection of at least 52 db, three sections were used in each arm as illustrated in Figure 1. If the phase deviation from 90 degrees shown in Figure 3 were the only phase deviation and if the loss through both branches were identical, the over-all suppression plus rejection would have been 60 db.

A block schematic of the complete reversible terminal is shown in Figure 4. The contacts associated with the switching relays are shown operated in the transmitting direction. In this direction, the modulator is preceded by a low-pass filter to limit the passed band, and a predistorting network to emphasize the high-frequency portion of the program signal. In the receiving direction, the modulator is followed by a restoring network to return the signal components to their original amplitude relations, an amplifier, and the low-pass filter that is used also in the transmitting direction. The volume range is improved by the use of these networks. At the high-frequency end of the modulator, a band filter is included to prevent interference into or from the pilot frequencies associated with the various systems.

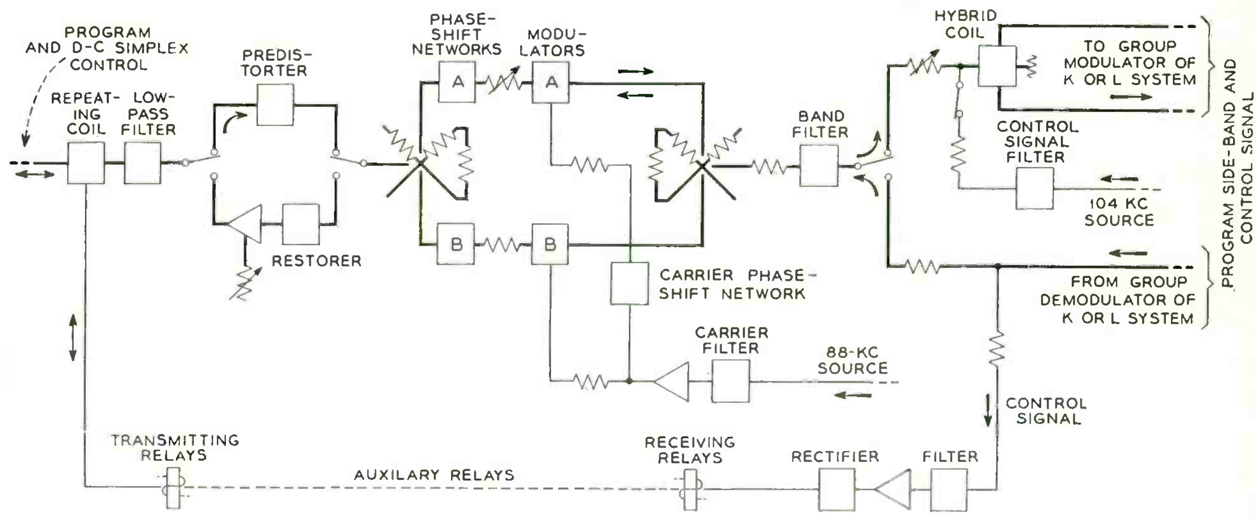
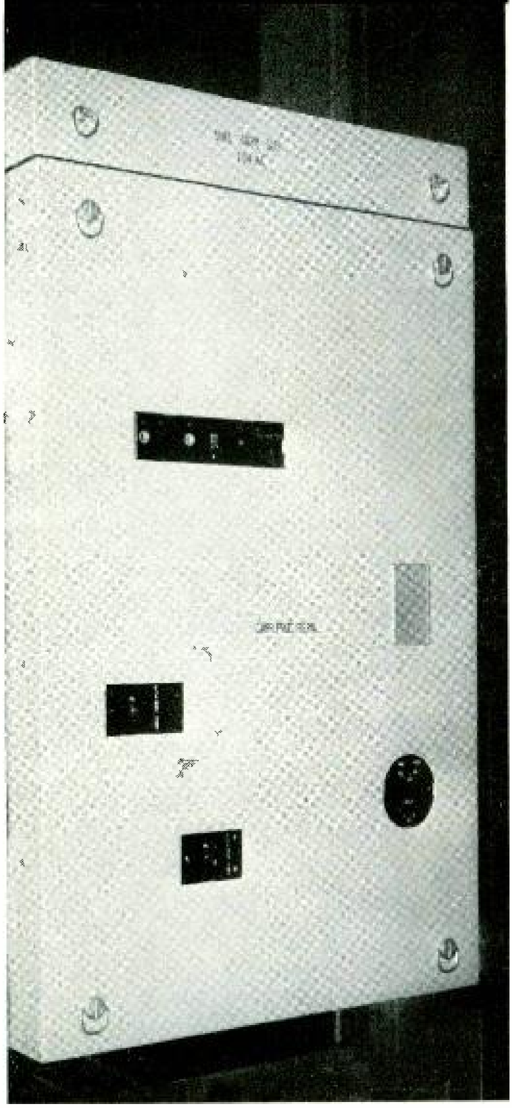


Fig. 4—Block schematic of a reversible terminal



The transmitting relays are operated by a d-c simplex control as indicated. A control tone is sent over the system, and at the receiving terminal it is selected, amplified, and rectified to operate the receiving relays. Auxiliary relays, not shown, keep the circuit in the same direction of transmission when the control is removed. Until the control is removed, a control tone from the other direction cannot reverse the direction of transmission. These features are similar to those described in the RECORD for September, 1948, page 377, in connection with the new 8-kc program circuit.

A front view of a 15-kc carrier program terminal is shown in Figure 5. It consists of an upper panel, the modulator-demodulator, which includes the phase-shift networks and the band filter; a center panel, which is the output voice-frequency amplifier; and a lower panel which contains the reversing circuit made up of the control tone amplifier-rectifier and the relays. These panels are under one cover, and require one-third of a relay rack bay per terminal.

Fig. 5—Front view of one terminal for the 15-kc carrier program channel

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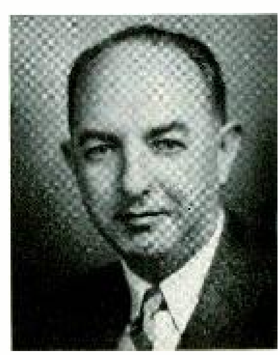
THE AUTHOR: GEORGE H. HUBER joined the Engineering Department of Western in 1920. Upon completion of the Technical Assistants' Course, and other evening studies, he became a member of the Technical Staff. With the Transmission Development Department, he has been engaged in the development of the C, J, and K carrier telephone systems. In 1935 he transferred to the Research Department to pioneer the development of a carrier telephone terminal for coaxial cable, and then returned to the Transmission Development Department to continue development of the L system. During the war years, his efforts were devoted to the development of radar test equipment and a radio-relay system for the Armed Forces. He and his group developed the 15-kc program channel for broadband carrier systems. He is a senior member of the I.R.E., a member of the A.I.E.E., the Acoustical Society of America, and the Armed Forces Communication Association.



John A. Barrett—about 1905

John A. Barrett

Pioneer in telephone research

R. B. HILL, ***General Staff***

During the year 1886, the first line of the newly formed Long Distance Company (The American Telephone and Telegraph Company) was completed between New York City and Philadelphia. This line, which originally carried twelve metallic circuits of hard drawn copper on three ten-pin crossarms, was the first instance of a considerable number of metallic circuits being placed on the same pole line. Although the effectiveness of a metallic circuit in reducing the crosstalk and noise pick-up inherent in ground-return telephone lines had already been demonstrated by Alexander Graham Bell, J. J. Carty and others, only a limited use had been made of this principle because of the extra expense involved. The short toll lines then in existence were still operated largely on a ground-return basis.

When the long distance line between New York and Philadelphia was built, it was hoped that the use of metallic circuits would eliminate crosstalk, even when a large number of circuits were carried on the same pole line. Tests soon showed, however, that these hopes were without foundation. The crosstalk was about as serious as it had been on the grounded circuits previously employed. As a result, E. J. Hall, Jr., General Manager of the Long Distance Company, engaged John A. Barrett as Consulting Engineer to make a study of the crosstalk problem and work out a solution.

Mr. Barrett, who was destined to play an important part in the early development of the telephone art, was born in Woodstock, Vermont, on April 30, 1858, the son of Judge Barrett of the Supreme Court of Vermont. After completing his education at Dartmouth and Middlebury Colleges, he entered the employ of the Western Electric Company in Chicago in 1882, where he assisted in the development of the Patterson cable—a core of cotton-insulated wires pulled into standard lead pipe and embedded in paraffin—the best telephone cable available at that time. The following year, Barrett left the Western Electric Company to engage in general consulting practice, but reëntered the Bell System a few years later to investigate crosstalk as already mentioned.

After several months of experimental work, Barrett solved the crosstalk problem by devising a simple system of transpositions, whereby the two wires of each metallic circuit were so interchanged in their position on the crossarm, through successive stages of their length, that each circuit was made practically neutral to the inductive fields created by the other circuits on the pole line. This was an achievement of the utmost importance, since without it there could have been no adequate development of toll and long distance services.

The most effective form for a transposition system depends on such factors as the number of crossarms and circuits on the pole line, the length of the line, and on the location of sources of noise external to the line. The first commercial system that resulted from Barrett's work was called the ABC transposition system. With this system, successive transposition poles, spaced about 1,300 feet—or ten poles—apart, were lettered ABCBABCBA, and so on. On poles designated by the same letter, the same circuits were transposed, as shown in Figure 1. The center pair of wires on each crossarm was transposed every mile, while the adjacent pair on each side was transposed every half-mile. The outside pairs were transposed every mile, but these transpositions were staggered with respect to those on the center pair. The transpositions on odd-numbered crossarms of a pole line were identical, as were those on even-numbered arms, but the latter, although following the same scheme, were staggered with respect to those on odd-numbered arms.

As the number of circuits on the pole lines increased, the ABC system was found to be inadequate, and was superseded about 1898 by the so-called Standard, or Four-Arm system, which took into account the crosstalk of each circuit into every other circuit of a forty-wire line. It practically balanced the line every eight miles, reducing certain cumulative errors that became important as the ABC system was applied to longer distances. This improved system, and the still more elaborate systems devised in later years, are all based on the fundamental conceptions of Barrett's original patent, No. 392,775, issued on November 13, 1888.

Transpositions were not the only object of Barrett's attention, however, during the

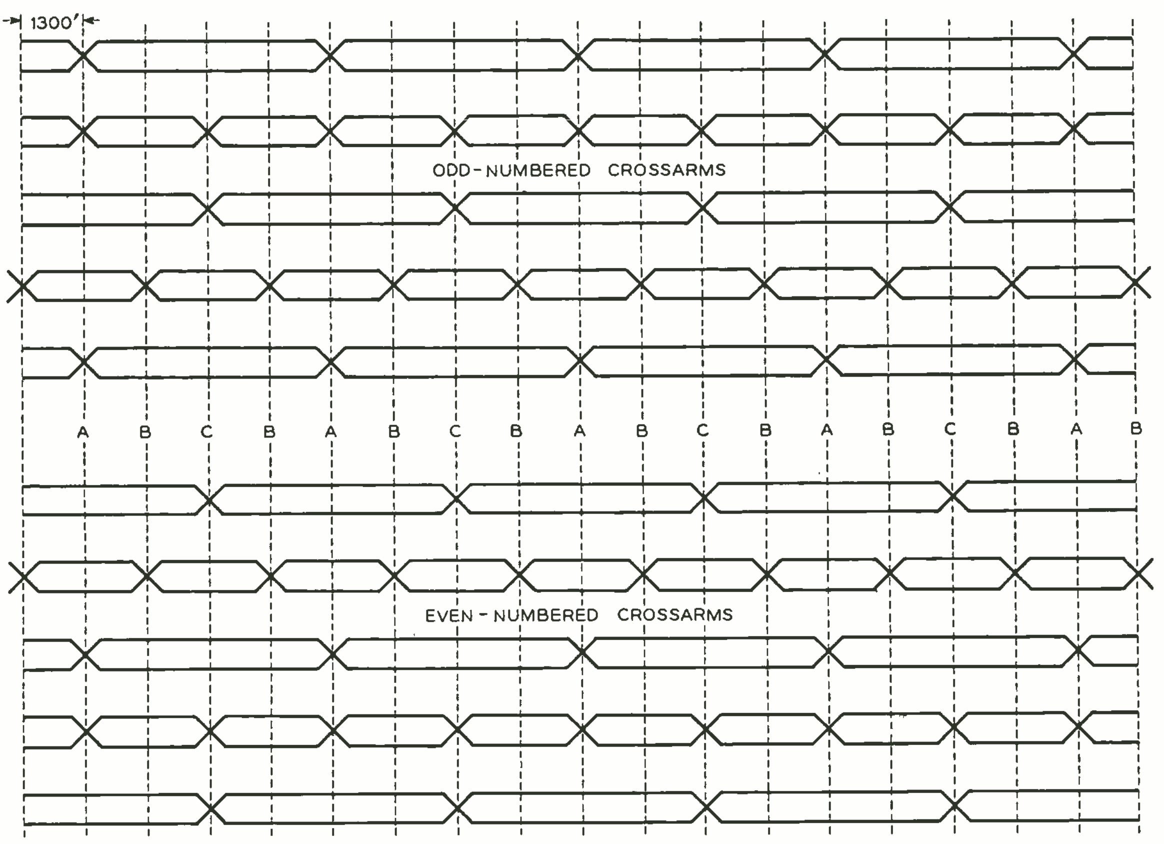


Fig. 1—The ABC transposition system, shown above, was the first to result commercially from Barrett's invention

years following 1886. The New York and New Jersey Telephone Company was planning, at this time, an underground cable system for Brooklyn, and W. D. Sargent, its General Manager, arranged with the Long Lines Company for Barrett to give consideration to their problems. Out of this arrangement came the dry-core paper-insulated cable with a continuously extruded lead sheath, which revolutionized the art of cable manufacture and brought about one of the most important improvements ever made in the telephone art.

At this time (1886), the best type of telephone cable available was one having its wires wrapped with cotton, like the Patterson cable Barrett had worked on earlier with the Western Electric Company. Since the cotton insulation absorbed moisture readily and no great confidence could be placed in the integrity of the lead pipe into which the cable core was drawn by hand, it was necessary to impregnate the core with a moisture-proofing compound. This was done by heating the pipe containing the core of wires and introducing the moisture-proofing material under pressure, thus assuring a snug fit between the core and pipe. This cable, in addition to being clumsy to manufacture, had a high electrostatic capacitance (about 0.20 microfarad per mile) and consequently caused such high transmission losses that it could be used only over relatively short distances. Moreover, with this type of construction, not more than fifty-two pairs of No. 18 B. & S. gauge conductors could be drawn into a lead pipe of two inches outside diameter.

It is true that hydraulic presses for applying a molten lead sheath directly upon a cable core had been devised and used to a limited extent, both in this country and abroad. They had not been perfected, however, to the point where they met the necessary requirements for telephone use: a covering of uniform thickness and flawless integrity, with a smooth exterior surface, that could be applied without injury to the cable core and would fit snugly over it.

Mr. Barrett, who had for some time been desirous of making telephone cables by forcing the lead sheath upon the core in a continuous process, was now presented with the proper opportunity. While investigating the state of the art among lead-pipe manufacturers and makers of lead presses, he made the acquaintance of John Robertson, a manufacturer of hydraulic lead presses in Brooklyn, who had invented a press for covering single electric light wires with a thin sheathing of lead. The particular virtue of this machine was in the internal construction of the die block, which equalized the pressure of the molten lead, thus ensuring a coating of uniform thickness. After Barrett and Sargent had convinced themselves of the feasibility and economy of employing a press of the Robertson type in sheathing telephone cable cores, a new machine was constructed capable of covering cores to an outside diameter of two inches or more. As the result of many months of experimental work, under Barrett's direction, in which cable cores were dried in ovens, boiled in a tank of sealing mixture and then run through the lead press, a machine was developed which was far superior to any that existed, both in its simplicity and in the perfection of its product. This process, which was adopted by the Western Electric Company in 1891, and has since then come into universal use, not only caused a tremendous speeding up of the cable-making operations, but produced a lead covering of practically flawless integrity, paving the way for the elimination of the moisture-proofing compound.

Fig. 2—Cross-section of 100-pair, No. 19 gauge, dry-core paper-insulated cable of 1892, with an extruded lead sheath

Fig. 3—A pictorial survey of full-sized Bell System exchange cables from the first paper-insulated lead-sheathed cable of Barrett's to the 2121 pair cable of 1939. Cables in the two bottom rows are 2⅝ inches outside diameter

While the development of the Robertson lead press was still under way, Barrett and Sargent, in searching for an insulating material that would have a lower electrostatic capacitance than cotton, and would absorb moisture less readily, hit upon the idea of using manila paper. Beginning in the year 1887, they tried this material in various ways, without much success, until they procured a quantity of wire covered with manila paper tape, laid on spirally with overlapping edges. Shop and field trials demonstrated that this was a great improvement over the cotton insulation, and resulted, in combination with the extruded lead sheath, in the adoption of a dry-core paper-insulated cable, shown in Figure 2, with an electrostatic capacitance of 0.080 microfarad per mile. This cable, which was standardized in 1892, afforded a firm foundation for the very great improvements that have been made since that date, which are summarized in Figure 3.

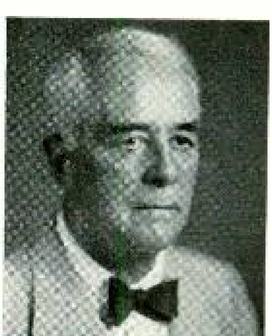
After completing his work on the transposition and cable problems, Barrett returned to his consulting practice, but his absence from the Bell System again proved to be short lived. In 1893, he reëntered the employ of the Long Distance Company to develop improved transposition systems, to work on telephone repeaters, and to study electrical interference problems, and cable manufacturing and testing.

In 1902, he transferred from the Long Lines Company to the Headquarters Engineering Staff of the parent Bell Company, then under the direction of Joseph P. Davis,* Chief Engineer. He remained with the Engineering Department until his death, on November 9, 1916, at his home in Maplewood, New Jersey. During this period, he investigated and made reports upon automatic switching and printing telegraph systems, methods of electrolysis prevention, and inventions submitted to the Company from outside sources.

His most important work during the latter part of his career, however, was in connection with the joint use of poles by telephone, electric light and power companies, and on high-tension interference problems. During the years 1904 and 1905, he represented the telephone company in an extensive investigation of the joint-pole problem in New Jersey, where an increasing number of injuries to telephone linemen, while working on jointly used poles, had created a serious situation. He took an active part in the negotiations with the electric light people, and in the preparation of the joint-use contract and specifications that resulted from this work. These were issued early in the year 1906 and formed the basis of safe joint-pole construction throughout the entire country.

On the subject of high-tension interference, Mr. Barrett's best known work was

*Record, *November*, 1948, *page* 457.



THE AUTHOR: Roger B. Hill received a B.S. degree from Harvard University in 1911 and entered the Engineering Department of the American Telephone and Telegraph Company in August of that year. For several years thereafter he was engaged principally in appraisal and depreciation studies. When the Department of Development and Research was formed in 1919, he transferred to it, and since then has been largely concerned with studies of the economic phases of development and operation. He has been a member of the staff of Bell Telephone Laboratories since 1934, first in the Outside Plant Development Department and later in the Staff Department. In addition to his work on the economic side of the telephone business, Mr. Hill has exhibited a great interest in the early history of the telephone art, and has assisted with the preparation of several books and articles dealing with that subject.

in connection with the 11,000-volt single-phase alternating-current system first employed, in 1907, by the New York, New Haven and Hartford Railroad Company in electrifying its line between New York City and Stamford, Connecticut. This system, without remedial measures, would have induced such high voltages on telephone lines in the vicinity of the railroad as to put them completely out of business. Beginning in 1905, and for several years thereafter, Mr. Barrett took an important part in the investigation of this problem, in the negotiations with the railroad company and with the Westinghouse Company, who were installing the system, and in planning the measures that led to its solution.

During his long period of service with the Bell System, Mr. Barrett was granted about thirty United States patents. The most important of these was his fundamental transposition patent, No. 392,775, already referred to. Others which seem worthy of special mention were No. 582,107, of May 4, 1897 (with G. W. Whittemore and W. M. Craft), covering a selective signaling system for telephone party lines; No. 736,672, of August 18, 1903 (with L. A. Falk and H. E. Shreeve), covering a lineman's handset which found considerable use; and No. 940,658, of November 23, 1909, covering means for neutralizing inductive disturbances on telephone lines caused by high-tension circuits.

The Cover: Inductively Heated Vacuum Furnace

The removal of gases dissolved or occluded in the structural components of electron tubes has always been an important step in their manufacture. Without such degassing, the gases evolve slowly during the life of the tube, and cause a variety of undesirable phenomena. General practice is to heat the parts in hydrogen, which reduces surface oxides and lowers the gas content. In the subsequent baking operation, associated with the pumping cycle, additional amounts of the gases originally present and the hydrogen introduced by the previous treatment are removed. The completeness of degassing is dependent upon such factors as the ratio of volume to area, the compactness of the parts, and the time and temperature of baking. With the advent of magnetrons and other ultra-high-frequency tubes having a preponderance of metal components, the existing methods of degassing proved inadequate. Studies seeking better methods indicated that degassing in a vacuum was a far more effective procedure, but a survey of furnace manufacturers revealed no equipment was available that would meet our requirements. As a result, a vacuum furnace was designed by F. J. Biondi of the Chemical Laboratories. Including a number of new features, it is arranged in a self-contained unit capable of completing an average degassing cycle in two hours—far less than had been possible with the limited apparatus previously available.

As shown in the illustration on the cover, this new degassing unit consists of two easily removable Vycor tubes thirty inches long by 4⅜ inches inside diameter, which are held against gaskets in the hinged metal tops by cranks mounted at the bottoms of the tubes. A coil of copper tubing surrounding each tube supplies the high-frequency heating power from an external source.* The coil is mounted in a counterbalanced frame that slides up and down to apply the heat to the suspended objects. Water is passed through the tubing to keep it cool, and the Vycor tubes are cooled by a stream of air. Parts to be degassed or otherwise treated are suspended on wires from a hook in the cover. An oil diffusion pump mounted between and behind the tubes is capable of reducing the pressure to 8 x 10^{-5} millimeters of mercury in six minutes. Besides being employed for degassing, the furnace has proved very useful for brazing, sintering, and other treatments of parts of electron tubes.

*RECORD, *August*, 1937, *page* 391.

A harmonic generator for audible ringing

M. S. BURGESS
Switching Apparatus Development

When Mrs. Suburba, calling a friend on the telephone, thinks she hears the operator ringing the line, she is both right and wrong. She hears a something that seems to be about what she would expect to hear as a result of alternating current vibrating the clapper of the bell rapidly back and forth in the familiar manner. Moreover, she hears this sound just at the times the ringing current goes over the line to ring the bell. To this extent, therefore, she is right. What she hears, however, is not the current that actually rings the bell, and to this extent she is wrong.

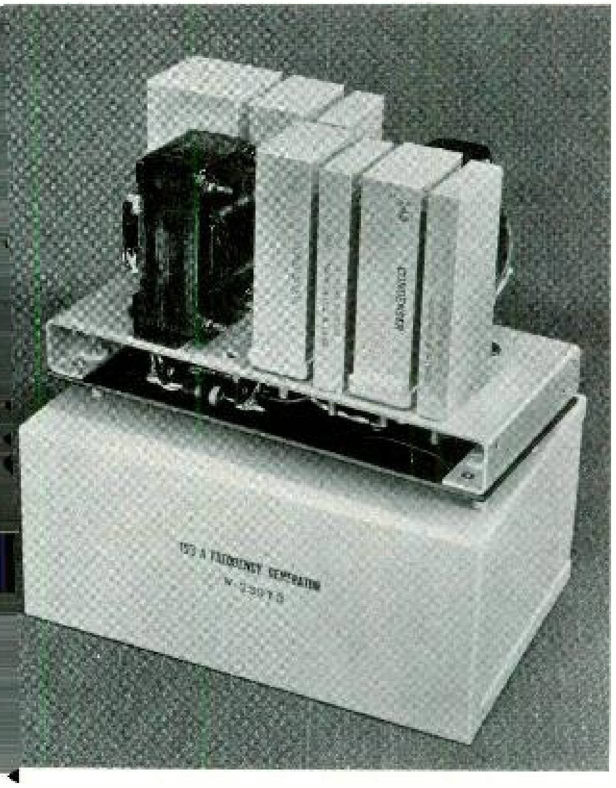


Fig. 1—The 103A frequency generator resting on the case in which it is housed when in use

Ringing is done by a twenty-cycle current, which readily passes over the telephone line and through the ringer and condenser in series with it at the called subscriber's station. Twenty-cycle current, however, is greatly attenuated by apparatus associated with a calling line in a central office, and thus if the twenty-cycle current sent over a called line were also connected to the calling line, very little of it would reach the calling subscriber. What little did get through would be so weak it could not be heard. It has been necessary, therefore, to supply to the calling subscriber a signal that sounds as though it were the ringing current, but actually is something else—something that is not greatly attenuated by the telephone set or by the apparatus associated with the calling line in the central office. This tone sent back to the subscriber is called "audible ringing."

In the early days of the telephone, no audible ringing was provided. The operator, if occasion demanded, would tell the subscriber that she was ringing. This was an inefficient and unsatisfactory method, and in seeking an automatic method of giving a ringing indication to the calling subscriber, it was found that short spurts of 300-800-cycle current recurring forty times a second would not only pass over the circuit to the subscriber without serious attenuation, but would sound to Mrs. Suburba as about what she would expect to hear as a result of the bell being rung. Several methods have been employed to supply this audible ringing. One in use for a number of years was to derive a pulsating current from the ringing generator, and to superimpose these pulses on the ringing current through a repeating coil. This method was later replaced by a tone alternator*—and a specially designed inductor alternator that produced a 420-cycle current modulated at forty cycles. These alternators had a relatively large capacity and were fairly expensive to build.

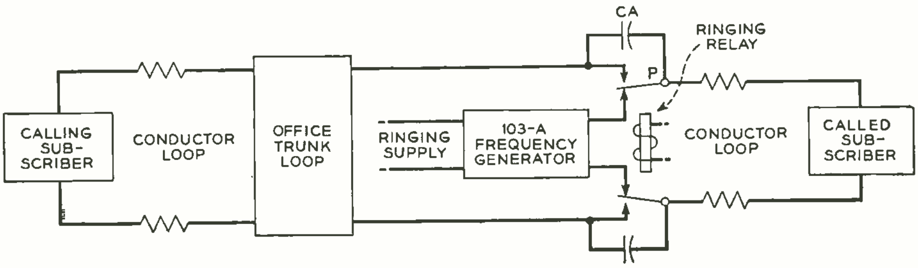


Fig. 2—Method of applying ringing current to the called line and audible ringing to the calling line

For the new No. 5 crossbar system,† a smaller and less expensive source of audible ringing was desired and, as a result, the 103A frequency generator has been developed. It has no moving parts, and mounts in a metal case only seven and one-half inches in its longest dimension. The assembly removed from its case is shown in Figure 1. Its operation is based on the use of a non-linear coil to produce harmonics as originally suggested by L. R. Wrathall. This method of producing harmonics is also used to obtain carriers for broadband carrier systems, as has already been described in the RECORD,‡ and has also found a number of other applications.¶

How the circuit is associated with the called line during ringing is shown in Figure 2. Current from the twenty-cycle ringing generator is passed through the 103A frequency generator, and thence to the front contacts of the ringing relay. The input to the circuit is thus a twenty-cycle current, and the output is the same twenty-cycle current with a short spurt of 420-cycle current supplied by the frequency generator superimposed on each half cycle, and thus recurring at a forty-cycle rate. Capacitor CA presents high impedance to the lower frequencies, and thus while the twenty-cycle component may flow over the line to the subscriber set, chiefly the 420-cycle component passes back to the calling subscriber, where it is heard as audible ringing.

The circuit of the 103A frequency generator is shown in Figure 3. Twenty-cycle ringing voltage is connected to the terminals at the left, and the major portion of the current passes through T2, which offers low impedance at twenty cycles, to the load, represented by RL. A small part of the current, however, passes through the shunt circuit, including T1, which is a non-linear coil that saturates at a low value of current, a resistance R2 that limits the current in the lower part of this shunt circuit, and a capacitor C1, which is of such a value as to maintain twenty-cycle sinusoidal current through this branch. The tuned circuit, consisting of C2 and T2, is anti-resonant at 420 cycles, and thus blocks current in the vicinity of this frequency but readily passes higher or lower frequencies.

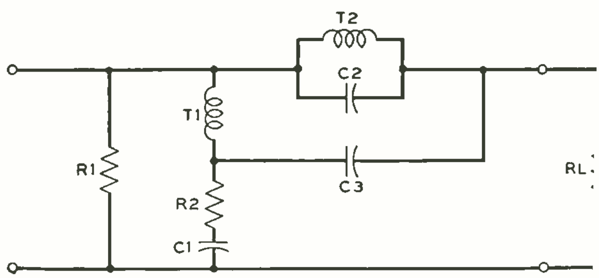


Fig. 3—Circuit of the 103A *frequency generator*

Ringing current through the T1 branch is represented on line A of Figure 4. The magnetic flux in T1 varies rapidly with the current while the current is small, but after

*RECORD, *September*, 1932, *page* 6.
†RECORD, *March*, 1949, *page* 85.
‡RECORD, *July*, 1937, *page* 357.
¶RECORD, *March*, 1946, *page* 102.

the core becomes saturated, the flux ceases to increase appreciably. Magnetic flux in the core would thus appear as shown on line B of Figure 4. All the graphs of Figure 4 neglect hysteresis and eddy currents and other incidental effects since they are very small and have little effect on the main ing rapidly, the inductance is high, while over the longer periods such as t2, during which the flux is essentially constant, the inductance is very small. The inductance and thus the impedance of the coil could be represented as on line C.

Voltage across T1 is proportional to the

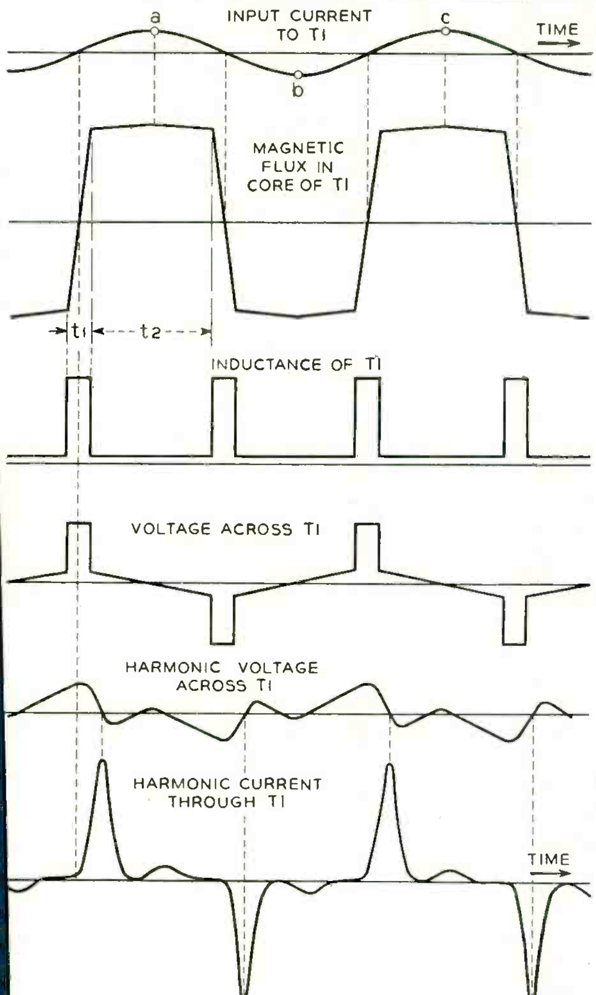


Fig. 4—Idealized curves of current, voltage, and inductance referred to in the description of audible ringing generation

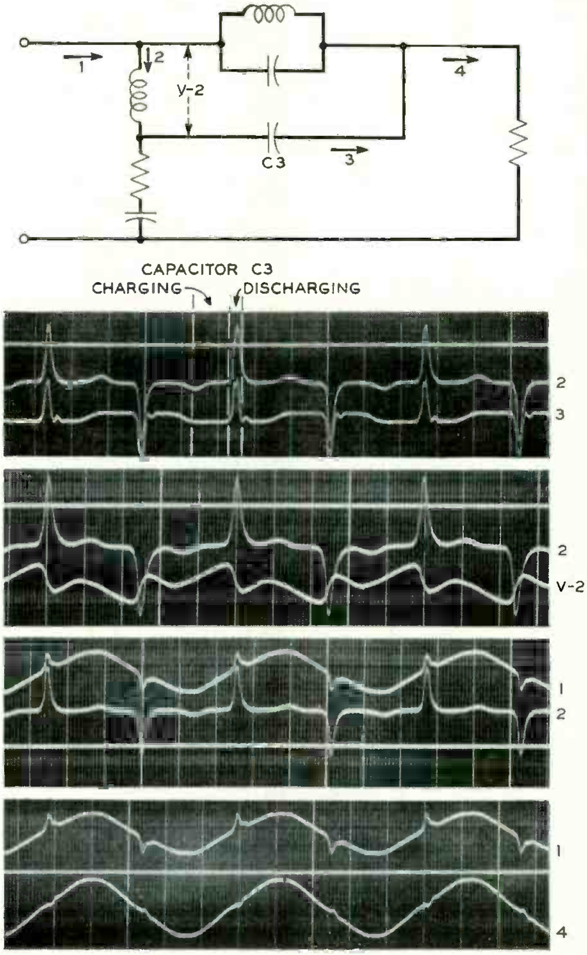


Fig. 5—Oscillograms of currents and voltages in harmonic generator network. Numbers at right indicate points at which measurements were made

action of the circuit, which depends principally on the saturation characteristics of the core.

The inductance of the coil, which chiefly determines its impedance, is proportional to the rate of change of flux. Over the short periods such as t1, while the flux is increasing rapidly, the inductance is high... product of the inductance, line C, by the rate of change of current, which may be roughly gauged from line A. From point a to b on this latter curve, the current is decreasing. Its rate of change is thus negative, and the voltage across the coil will be negative. From b to c, however, the current is increasing and the rate of change is positive, and thus the voltage across the coil will be positive. The resulting voltage drop is given on line D, which is an idealized curve. The actual voltage as recorded on an oscillogram, shown in Figure 5, is copied on line E to permit it to be compared with the idealized curve on line D.

Since the T2-C2 circuit has low impedance except in the vicinity of 420 cycles, the capacitor C3 is in effect connected directly across the coil T1, and thus the voltage impressed across it is that across T1. During the interval t1, while the inductance of the coil is high, capacitor C3 will

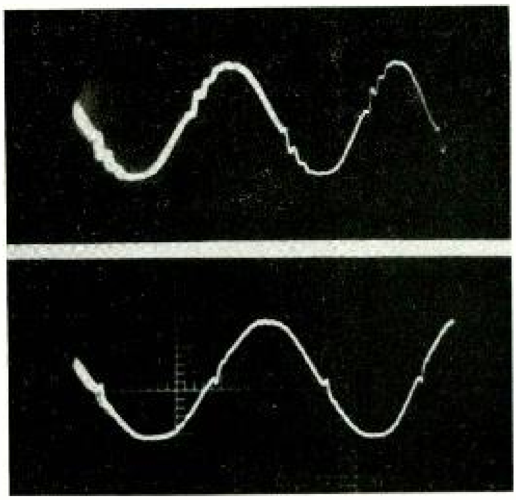


Fig. 7—*Oscillograms of voltage at generator output terminals. The no-load condition is shown above and full load, below*

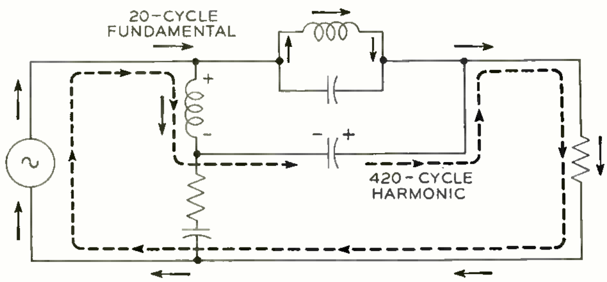


Fig. 6—*Current paths for fundamental and harmonics*

be charged more rapidly than during the preceding interval. At the end of the period t1, however, the inductance of the coil drops nearly to zero, and thus the charge built up in the capacitor during t1 will discharge in a rush, the current reaching very high values because of the low impedance of T1. An oscillogram of the charging current and the succeeding discharge pulse is shown in Figure 5A, together with an oscillogram of current through the non-linear coil T1. The oscillogram of current through the coil is transferred to line F, Figure 4, for comparison with the oscillogram of voltage across the coil and the idealized curves. The wave shape of the current on line F shows the effect of the capacitor discharge on the sinusoidal component of current at line A. It is seen that the current through the coil reaches large peak values corresponding to the capacitor discharge peaks, and that the peak is reached when the voltage across the coil passes through zero. A symmetrical wave like that shown on line F having positive and negative peaks may be shown by Fourier analysis to contain all odd harmonics of the fundamental.

Since the anti-resonant circuit T2-C2 forms a low impedance path across the capacitor C3 for all frequencies not in the vicinity of 420 cycles, very little voltage is impressed across the output terminals at these frequencies. In the vicinity of 420 cycles, however, the impedance of T2-C2 approaches infinity, and thus voltage at this frequency appears across the output. The components of the discharge from capacitor C3 in the vicinity of 420 cycles, therefore, follow the dotted path outlined on Figure 6. The effect of the discharge pulse on the sinusoidal current in the input branch is shown by the oscillogram in Figure 5C. Since the impedance of the ringing generator and the coil T1 is small relative to the load impedance RL, the greater part of the voltage drop is impressed across the load. The output current of the harmonic generator, therefore, would be the normal ringing current with these components of the discharge current in the vicinity of 420 cycles superimposed upon it. An oscillogram of this current is shown in Figure 5D. The basic ringing current at the harmonic generator output is much larger than that in the shunt circuit shown on line A of Figure 4, and thus the discharge current, although large relative to the normal cur-

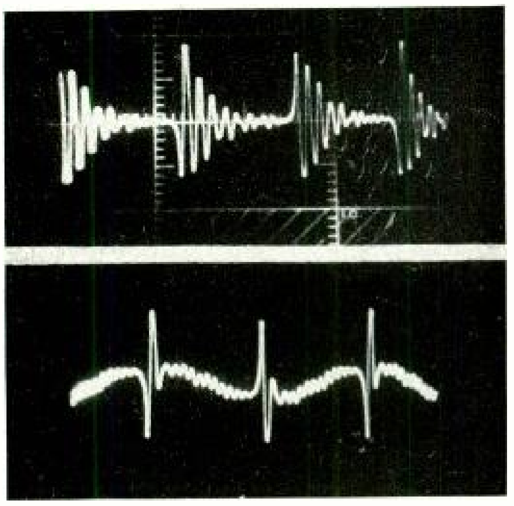


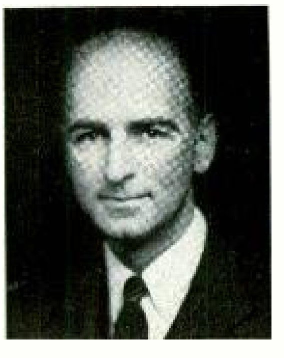
Fig. 8—Oscillograms of ringing voltage applied to the calling subscriber. The no-load condition is shown above and full load, below

rent through the T1-R2-C1 branch, is small compared to the ringing current.

Actual oscillograms of the voltage across the load are shown in Figure 7 for both no load and full load. As already pointed out, the voltage impressed on the calling subscriber line includes principally the 420-cycle pulses occurring at a forty-cycle rate. Oscillograms showing these at no load and full load are illustrated in Figure 8.

This 103A frequency generator was employed as part of the 805C ringing plant in the first No. 5 crossbar office in Media, Pennsylvania, and has proven very satisfactory. It has sufficient output capacity to handle 12,000 busy hour calls. A frequency generator similar to this design is being developed to provide double this capacity for use in the 804C ringing power plant now under development.

THE AUTHOR: Montague S. Burgess received the degrees of S.B. and S.M. in Electrical Engineering from the Massachusetts Institute of Technology in 1928 and 1929, respectively, after completing the coöperative course in conjunction with the General Electric Company. In September of the latter year he joined the Department of Development and Research of the A T & T as a member of the Transmission Development Department, and was transferred to the Laboratories in the 1934 consolidation. His work was concerned with transmission studies relating to carrier and coaxial systems, picture transmission, television and special problems. In 1937 he transferred to Transmission Apparatus Development, where he became engaged in the design and development of input and output transformers and repeating coils for carrier and radio frequencies. In 1941 he transferred to the power transformer design group, where he has been concerned with the development and construction of high and low voltage transformers and retardation coils used in regulated rectifiers, aircraft, and radar equipment. He has also designed and developed several types of static frequency generators using non-linear magnetic coils, one of which is described in the foregoing article. Since June, 1948, he has been in the Switching Apparatus Development Department, where he is engaged in the analysis of the performance of new and improved switching equipment.



N. Y. Daily Mirror

Tunnel Fire Disrupts Communication Circuits

Explosions and fire in the eastbound Holland Tunnel, deep under the Hudson River, on May 13, turned the famous thoroughfare into a blazing inferno and caused the most serious communications interruption due to lost toll and long-distance circuits in history. The disaster occurred about 9 a.m., when a load of carbon disulphide exploded on a truck passing through the vehicular link between New Jersey and Manhattan, and started a raging fire which swiftly engulfed other vehicles.

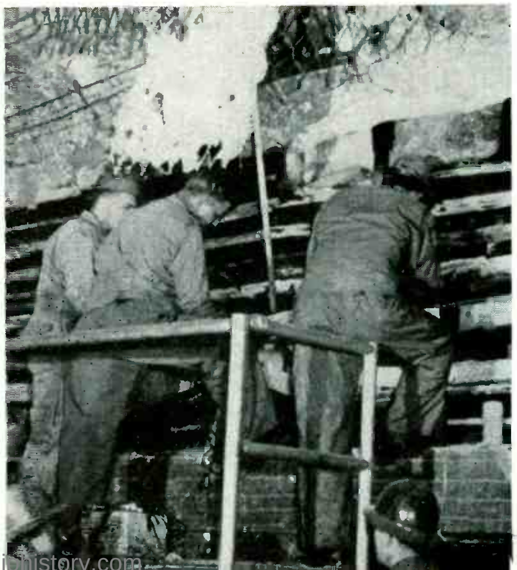
The intense heat, estimated at about 4,000 degrees F., disintegrated five major cables carried in the tunnel's wall. Almost 3,000 Long Lines circuits to the South and West, nearly half of the total in use, and intercity trunks between New York and northern New Jersey, in a separate 900-pair cable, went out of service at 9:15. The cables, which are maintained by the New York Telephone Company, were burned out for about 150 feet, with intermittent damage extending as far as 850 feet.

Alternate routing made possible the restoration within a few hours of 1,500 of the cut-off Long Lines circuits and 700 of the New York-New Jersey toll circuits. Thanks to the tireless efforts of plant men who worked under severe handicaps, service was almost completely restored in three days.

The severed lines were some of the main arteries from New York to Los Angeles, San Francisco, Chicago, Miami, Philadelphia and Washington. In addition, private lines serving the press, Government, financial and industrial firms and the four major radio networks were knocked out, and sections of coaxial tube used for television were destroyed.

Donning crash helmets and rubber boots, crews of New York Company cable placers and splicers plunged into the job of restoration as soon as the fire had been beaten down. Block-long rows of cable reels, collected from the emergency stocks of the New York and

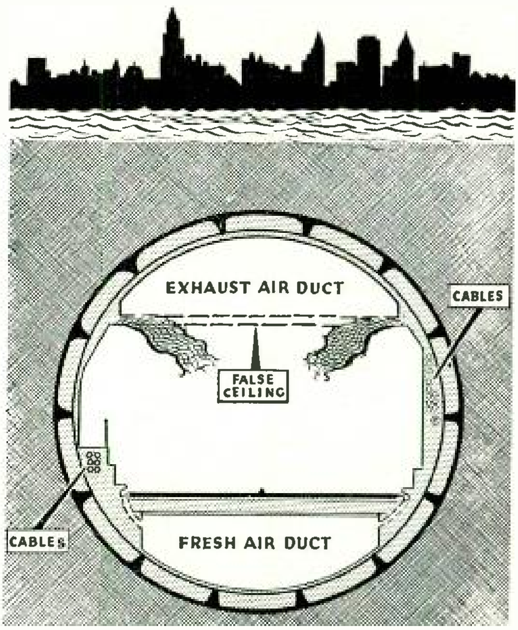
New York Company plant men at work restoring burned out cable



New Jersey Companies, were already at the scene, while Long Lines hurriedly shipped coaxial replacements from Princeton. Fire boats patrolled the river overhead to watch for air bubbles that would give warning of a major break in the tunnel.

"The destruction was unbelievable," one of the first telephone men on the disaster scene related. "Tile and steel were melted and twisted; at least twenty wrecked cars and trucks were inside the tunnel. Cans of tomato juice carried by one of the trucks had exploded, and added a gory touch to the indescribable confusion."

It was not until 6 o'clock in the evening that the first cable crew was able to start work, after clearing away some of the debris and erecting scaffolds along the tunnel wall. Laboring under extremely difficult conditions —with tunnel repairmen directly above and behind them using air hammers, pneumatic drills and bulldozers—they reëstablished, in 24 hours, enough long-distance circuits and intercity trunks to handle traffic requirements.



John Fleck—N. Y. Herald Tribune

Dotted area is the 14-inch reinforced concrete shell of the tunnel. Burned out Long Lines and New York Company cables are shown at right. The cables at left are electric lines which were slightly damaged

Eight splicing teams and two crews of cable placers worked on each of the twelve-hour shifts, while two chauffeurs brought in vital supplies and equipment. The Empire City Subway Company, a subsidiary of the New York Company, sent in ten workers who stayed at their posts through the night.

"It's hard to describe the conditions those men were working under," another man said. "There was no hesitation either—wonderful spirit and eagerness to go in and get the job done as quickly as possible."

Noise was the most distracting part of the job. Sixteen air hammers behind the plant men set up an incessant chatter, and cable workers, testing from both the New York and New Jersey ends of the cable, had to shout to make themselves understood. It often took as much as ten minutes to identify one pair because of the racket. Once the work was completed, awnings of plywood had to be erected over the open splices to protect them from steel being cut away from the ceiling.

The coaxial cable to Philadelphia was knocked out by the fire, but a new coaxial, running through the Hudson and Manhattan Tunnel, was thrown into advance service. Final testing of the cable had been completed shortly before the disaster.

H. A. Frederick to Retire

At his own request, H. A. Frederick, Director of Switching Apparatus Development, will retire from the Laboratories on September 23 next, when he will be succeeded by A. C. Keller. In anticipation of this change, Mr. Keller has been appointed Assistant Director of Switching Apparatus Development.

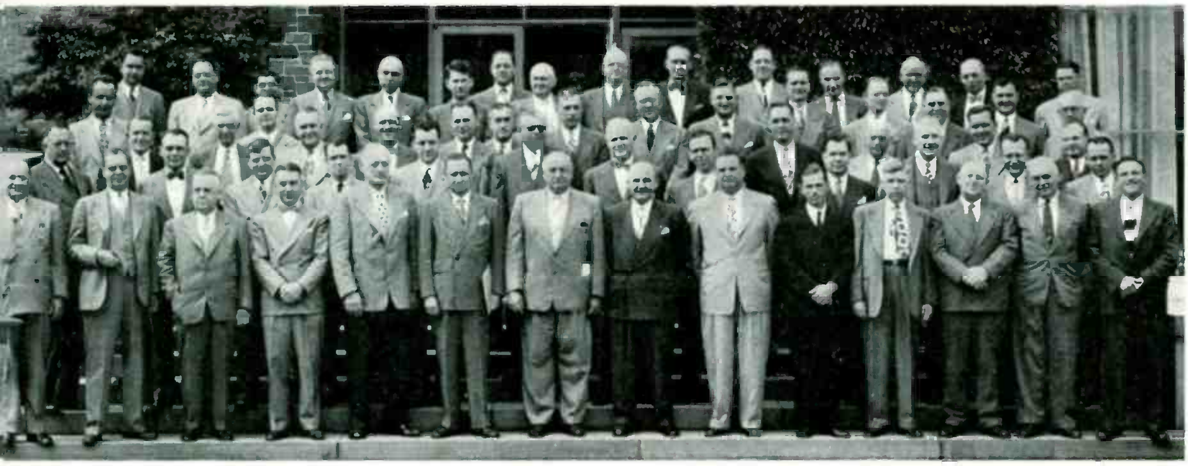
On August 1, C. A. Lovell will take charge of the switching apparatus group now headed by Mr. Keller.

F. R. Lack Heads Armed Forces Communications Association

Frederick R. Lack, Vice-President of Western Electric, was elected President of the Armed Forces Communications Association at the organization's third annual meeting in Washington, D. C. Mr. Lack, who has been serving as a director of the Association, succeeds Brigadier General David Sarnoff, Chairman of the Board of the R. C. A.

The Armed Forces Communications Association is composed of more than 10,000 American citizens who served their country in World War II in communications, electronics, and photography, both with the Armed Services and in industry.

In the New York chapter of the Association, Morton Sultzer is a member of the Board of Directors; T. N. Pope, Treasurer; and L. L. Glezen, Chairman, Membership Committee.



Bell System Lecturers' Conference

To inform Associated Company lecturers of telephone developments and research projects at the Laboratories, a working conference was held from May 17 to 27. Seventy-seven men from all parts of the System attended the conference. Working on an intensive schedule, they heard many of the engineers who are advancing the telephone art, met them, saw their laboratories, and in this way were able to form an intimate picture of the aims, methods and atmosphere of the research developments being created for the Bell System.

Following a welcoming luncheon on Tuesday, May 17, R. K. Honaman and J. O. Perrine spoke briefly to the group in the West Street Auditorium and were followed by D. A. Quarles, who spoke on *The Place and Function of Bell Telephone Laboratories in the Bell System;* A. R. Thompson on *Organization of the Laboratories;* and J. Campbell, Jr., on *Telephone Fundamentals.* On Wednesday morning J. M. Shaw gave a brief talk, followed by C. D. Hanscom, who selected *Background Information* as his topic; and R. K. Honaman, *Translating Technical Data to the Public.* Trips through West Street were taken immediately before luncheon and again during the afternoon. The Thursday, May 19, session was held in the Arnold Auditorium at Murray Hill, where the lecturers heard W. C. Jones on *Telephone Instruments;* J. A. Morton on *Varistors, Thermistors and Transistors;* W. E. Kock on *Acousitcs;* H. J. Kostkos and L. A. Meacham on *Pulse Modulation;* and W. H. Martin on *Philosophy and Economics of Development.* On the following day, Friday, they returned to the West Street Auditorium where the first subject was W. Keister's *Switching* and the second, T. C. Fry's *Probability and Its Applications.* After luncheon, J. Meszar spoke on *Mechanization,* and C. D. Hanscom on *Lecture Aids.* The half-day session on Saturday, May 21, held in the New York Telephone Company Auditorium, 140 West Street, was devoted to a demonstration and discussion of lecture methods by S. D. Page, A. G. Schermerhorn, I. Mattick and L. Blasius.

Returning to Murray Hill on Monday, May 23, the lecturers heard J. R. Townsend introduce the subject of *Materials,* followed by A C. Walker, who showed his movie on *Crystals* and spoke on the subject. G. T. Kohman then spoke on *Ceramics,* and R. Burns on *Plastics.* After luncheon, B. S. Biggs discussed *Wire Coverings and Rubber;* V. T. Wallder, *Polyethylene Cable Sheath;* and E. E. Schumacher

During the Conference, C. D. Hanscom (center) demonstrated new lecture aids. T. J. Crehan, left, and Harry Gruelle of the Indiana Company, right and others, *Metals*. On Tuesday they journeyed to Kearny to visit that plant and on Wednesday, May 25, came back to West Street where, before lunch, R. W. Sears and A. R. D'heedene spoke in the auditorium on *Vacuum Tubes* and *Filters*, respectively; and in a display room on the sixth floor, H. O. Siegmund described and demonstrated *Relays*. During the afternoon session, P. W. Blye discussed *Carrier Transmission* and G. N. Thayer, *Radio Transmission*. Trips through Murray Hill were taken on Thursday and on Friday, the last day of the conference, through the Long Lines Building, 32 Avenue of the Americas, in the morning. Following luncheon at 195 Broadway, C. W. Phalen, A T & T Vice-President, Information Department, spoke briefly and then introduced several other executives to the group. The lecturers then visited the New York Telephone Company Auditorium to hear J. L. Richey and H. N. French present a new lecture and demonstration on carrier telephony.

J. O. Perrine, Assistant Vice-President of A T & T, who is responsible for the Bell System's general lecture program, initiated the conference and extended the invitations to representatives of the operating companies. C. D. Hanscom arranged and supervised the conference, under the direction of R. K. Honaman and A. R. Thompson, and was assisted by other members of the Publication Department.

Chief Engineers at Laboratories

Chief Engineers of the Bell System Companies visited our Laboratories on May 12 and 13. A Murray Hill visit on May 12 opened in the Arnold Auditorium with a welcome by Dr. Buckley. Dr. Kelly then summarized the general research and development situation in the Laboratories, and the transition now being made from the "blitzes" of the immediate postwar years to the orderly programs of the future. Following Dr. Kelly's talk, J. W. McRae presented a picture of the Apparatus Development job. Several laboratories were then visited, as follows:

Metallurgy and Electron Microscope, R. M. Burns; *Wood Preservation*, J. R. Townsend; *Sound Measurements Reference System*, F. F. Romanow; *Contact Physics*, L. H. Germer; *Electron Dynamics*, J. R. Pierce; and *Transmission by Time Division and PCM Multiplexing*, W. H. Doherty and W. M. Goodall.

After lunch, Ralph Bown talked about the research philosophy of the Laboratories. The group then gathered in the Arnold Auditorium under the chairmanship of W. H. Martin. A talk on the new telephone set, more economical coding, and proposed changes in the design of the coin collector was made by A. F. Bennett. R. J. Nossaman followed with an illustrated talk on new types of cable sheaths and exchange plant maintenance studies. The day concluded with a summary talk by W. H. Martin, in which he stressed the influence of investment and maintenance costs on development activities.

On the following day, the Chief Engineers assembled in the Switching Equipment display room in the rear of the West Street Auditorium, where such items as full selective ringing, information desks, lighting studies, etc., were shown. The following laboratories were then inspected:

Systems Development, Including AMA, Toll Dialing, No. 1 and No. 5 Crossbar, A. J. Busch; *Switching Apparatus Development*, H. A. Frederick; *Telegraph*, E. F. Watson; *Type N Carrier*, P. G. Edwards; and *Television*, H. A. Affel.

During an afternoon session in the Auditorium under the chairmanship of A. B. Clark, a talk on selection of sites for radio relay was given by G. W. Gilman, and one on traffic studies for No. 5 crossbar by M. B. McDavitt. The following laboratories were then visited:

Transmission Standards, P. W. Blye; *Traffic Simulating Machine*, R. I. Wilkinson; *The 416A (Morton) Electron Tube*, J. R. Wilson; *Microwave Radio Relay*, G. N. Thayer; and *Switching Research*, W. A. MacNair.

Returning to the Auditorium, the group heard a final talk by Mr. Clark on the current objectives of Systems Development.

General arrangements for the visits were coördinated by R. S. Plotz, with Messrs. Bown and Martin making arrangements for Murray Hill and W. A. MacNair for New York.

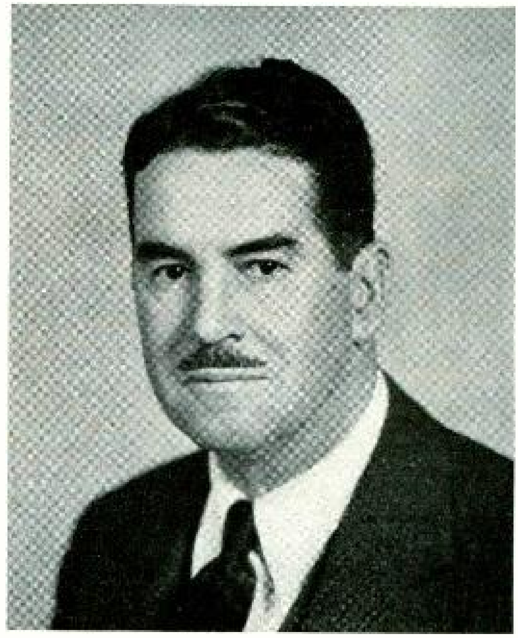
Earlier sessions of the Chief Engineers' Conference were attended by M. J. Kelly, A. B. Clark, W. H. Martin, H. H. Lowry, G. W. Gilman and M. B. McDavitt.

Chemists Return From Europe

Returning late in May from a tour of European laboratories, S. O. Morgan and A. N. Holden reported a gratifying reception from research men abroad, and an awareness of the rôle played by the Laboratories in scientific advancement. Immediate purpose of the trip was to attend a conference on crystal growth held April 12-14 at Bristol under the auspices of the Faraday Society. Mr. Holden presented a paper at this conference.

During the following week, Messrs. Morgan and Holden visited various laboratories in London, Cambridge, Oxford, Eindhoven, Leyden, Paris and Zurich.

Richard A. Haislip



Robert J. Nossaman

R. A. Haislip Retires, R. J. Nossaman New Director

By the year 1919, progress of the art indicated that the Engineering Department, which had served A T & T for many years, should be divided into "Operation and Engineering" and "Development and Research." In the latter department, there was an opportunity for a supervisor under F. L. Rhodes, and Richard Haislip was appointed. Cable development, on which he had been working since he joined A T & T in 1912, was part of his assignment as well as outside plant apparatus. When Mr. Rhodes retired in 1932, Mr. Haislip succeeded him as Outside Plant Development Engineer. With the D & R consolidation in 1934, he moved to the Laboratories, and in 1940 he became Director of Outside Plant Development.

Since a purpose of that department is to develop the most economical line structures for the various needs of the Bell System, Mr. Haislip has influenced projects of great importance, such as pulp-insulated cable, K-carrier cable, coaxial, the use of 24 and 26-gauge wire in cables, the cable lasher, the sleeve rolling tool, and timber preservation. To them he has made many contributions for which he never sought credit, because in his view, his job was that of guiding and facilitating the work of others. For himself, he has felt a primary obligation to see that the people under his direction recognized their responsibilities and the dignity of their positions, as well as their privilege in working in such an interesting and rewarding field.

Mr. Haislip's telephonic career began while he was still in his teens with two summers' work in his home town of Staunton, Virginia. After his studies at V.P.I., he went to work in 1904 for the Bell Company in Pittsburgh; then for Western Electric and the Pacific Company, where, as exchange outside plant engineer, he had supervision over plans and estimates for the entire company. In 1910 he went to the British Columbia Telephone Company, where he set up and for two years directed that company's Engineering Department.

Mr. and Mrs. Haislip are residents of West Caldwell, New Jersey, where he served for twelve years on the School Board, five years as president. In retirement, which began June 1, he expects, besides undertaking some long-deferred house maintenance, to continue his hobby of investigating certain physiological effects of electricity.

Widely known and liked in the Bell System, Dick Haislip has a reputation for his care in statement of ideas, for his unfailing courtesy, and for his devotion to the telephone business.

Succeeding R. A. Haislip as Director of Outside Plant Development is Robert J. Nossaman, a member of the Laboratories since he was graduated from University of Colorado in 1922. During his first three years, he was stationed in Chicago, New York and Newark on engineering inspection and quality matters. From 1925 to 1928, he was a field engineer assigned to various Bell System Company headquarters, and subsequently until 1930 was in New York in charge of field engineers. In that year, he transferred to Outside Plant Development, where he was concerned with terminals, joining and maintenance procedures for telephone cables. From 1934 to 1939 he was engaged in studies of maintenance and requirements for outside plant apparatus, and in 1946, as plant systems engineer, he also became responsible for the integration of outside plant apparatus into complete systems. In 1948 he became Assistant Director of Outside Plant Development.

Mr. Nossaman is a resident of Madison, N. J., where he has been for three years vice-president of the Board of Education.

New Jersey Executives at Murray Hill

W. A. Hughes, President; J. B. Rees, Vice-President; and H. T. Sweeney, General Traffic Manager of the New Jersey Bell Telephone Company, were guests of Dr. Buckley at the Murray Hill Laboratory on May 19 for a tour of the buildings and a demonstration of work of particular interest to them.

Greater New York Fund

In response to the Greater New York Fund annual appeal, the Bell Laboratories Club sponsored its twelfth campaign in the New York Laboratory during May. The campaign was opened by O. E. Buckley, who spoke to 210 volunteers who personally solicited their associates for contributions to help support 423 hospitals, health and welfare agencies in New York City. Members of the Laboratories in New York had contributed $5155 toward the fund when this issue of the RECORD went to press.

Vail Medals Awards

For their courage and devotion to duty in the face of extreme danger, four telephone employees have been awarded Silver Vail Medals, each accompanied by $500 in cash, and a group of employees have received a special bronze plaque. Those receiving the Silver Medals were:

Eugene J. Magnuson, splicer's helper, Long Lines, who rescued a splicer, made unconscious by illuminating gas, from a manhole in Lake, Wisconsin.

Robert William Case, splicer's helper, New York Telephone Company, who rescued a splicer from a blazing aerial platform enclosed by a tightly laced tent on a new cable at Salina, New York.

Mrs. Frieda M. Allen, agency manager, The Pacific Telephone and Telegraph Company, for continuing to give telephone service when the town of Stites, Idaho, was flooded and water in the exchange reached a height of nearly three feet in the operating room.

Wesley R. Schulz, station installer of the Pacific Company, who rescued one man in a construction crew digging a sewer trench in Portland, Oregon. A cave-in covered two men with twelve feet of dirt. He managed to get to one man and save his life, but by the time he reached the second, the man had died.

The special bronze plaque was awarded to a group of eleven employees of the Pacific Company who remained on duty in the exchange at Vanport, Oregon, until just before the flood waters of the Columbia River swept over the building and destroyed the entire city.

Dr. Buckley opened the campaign for the Greater New York Fund in the auditorium at West Street where he spoke on the benefits of having a single appeal for all 423 New York City hospitals and health agencies

FAY HOFFMAN

J. A. ST. CLAIR

F. E. DEMOTTE

Bell Laboratories Club Elects New Officers

J. A. St. Clair, *President*

Since James St. Clair joined the Quality Control group at Hawthorne, following graduation from the University of Colorado (B.S. in M.E.) in 1922, he has been engaged in that type of work continuously with the exception of one year which he spent in Equipment Development. He has been field engineer in Seattle, Atlanta and San Francisco, and since 1930 has been in charge of the Field Engineering section of the Quality Assurance Department. A native of Colorado, he married a graduate of the state university and his younger daughter is now attending college there. An older daughter was graduated in 1948 and is working in Port Washington, where the St. Clairs live.

F. E. DeMotte, *First Vice-President*

Representative of the Club at Whippany for the past two years, Frank DeMotte has been active in Club activities at that location since he went there eight years ago. He plays on tennis, volleyball and softball teams and sings with the Whippany Men's Glee Club. Mr. DeMotte joined the Laboratories in 1936 following graduation from Purdue University, where he received his degree in Electrical Engineering. His first assignment was at Graybar in Systems Development, where he was engaged in carrier terminal development.

He went to Whippany in 1941, married and bought a house there in 1944.

Fay Hoffman, *Second Vice-President*

As a member of the D & R, Miss Hoffman came to the Laboratories with that organization in the 1934 consolidation, as a Technical Assistant. She is now a member of the Transmission Engineering Department engaged in analyzing data relating to radio and wire transmission studies.

Miss Hoffman, who lives in Forest Hills with her mother and sister, is interested in interior decorating.

She is a member of the Frank B. Jewett Chapter of the Telephone Pioneers and is particularly concerned with women's activities. Her duties involve enlisting new members and sending flowers and greeting cards to the Shut-ins and Life Members.

Symphony Concert

The Murray Hill Symphony Orchestra, conducted by Paul B. Oncley, presented a noon-hour concert on May 31 in the Arnold Auditorium to a full house and overflowing foyer. With thirty-two members playing, the orchestra played Sibelius' *Finlandia;* Brahms' *Hungarian Dance No.* 5; Romberg's *Desert Song;* Gould's *Pavanne;* and Gliere's *Russian Sailors' Dance*. They also presented a concert during the 50th Anniversary celebration recently held by the city of Summit.

Joint Stamp Club Meeting

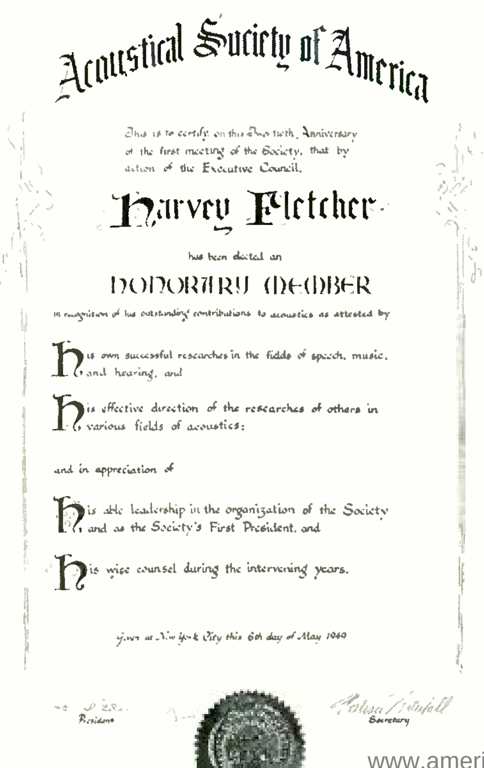
The Murray Hill group of the Bell Laboratories Stamp Club held a joint meeting and exhibit on May 19 with the West Street Bell Laboratories group and the Western Electric Kearny Stamp Club at the Murray Hill Laboratory. The program included a very interesting talk by Stephen G. Rich on his collection of Zululand and the Cape of Good Hope Triangles, an auction and a viewing of the exhibit with awarding of prizes.

The exhibit, judged by P. W. Blye, L. W. Giles, and N. J. Eich of the Laboratories, awarded the prizes to B. Bauder for best of show and first in the miscellaneous class with his collection of Netherlands Syncopated Perfs. Other awards were honorable mention, miscellaneous, L. G. Kersta; first prize, covers, H. C. Meier, second prize, W. Kuhn; first prize, foreign, W. Kuhn; first prize, United States, W. Kuhn, second prize, W. A. de Mars.

Talk on Microwave Spectroscopy at Murray Hill

Dr. B. Bleaney of the Clarendon Laboratory of the University of Oxford addressed a group in the Arnold Auditorium on May 16 on the subject *Microwave Spectroscopy of Gases, Liquids and Solids*. Dr. Bleaney discussed the microwave spectrum of ammonia as a function of pressure, stressing how the behavior of gaseous ammonia approached at high pressures the behavior of polar liquids. He went on to report on the discovery by Penrose of hyperfine structure effects in electron spin resonance in paramagnetic salts. He ended his talk by pointing out how improved microwave detection methods enable one to detect minute traces of paramagnetic impurities in crystals.

Harvey Fletcher has the distinction of being the second person ever to receive honorary membership in the Acoustical Society of America, the other person having been Thomas A. Edison. Dr. Fletcher's certificate has been reproduced below


Acoustical Society of America

This is to certify on this Twentieth Anniversary of the first meeting of the Society, that by action of the Executive Council,

Harvey Fletcher

has been elected an

HONORARY MEMBER

in recognition of his outstanding contributions to acoustics as attested by

His own successful researches in the fields of speech, music, and hearing, and

His effective direction of the researches of others in various fields of acoustics;

and in appreciation of

His able leadership in the organization of the Society and as the Society's First President, and

His wise counsel during the intervening years.

Given at New York City this 6th day of May 1949

President

Secretary

Television at Medical Convention

A HALF-MILE radio link for television was provided by New Jersey Bell during the recent convention of the American Medical Association in Atlantic City. Operations performed at the Atlantic City Hospital were displayed in full color to doctors at an exhibit in the Convention Hall.

Retired But Active

R. R. Williams, formerly Chemical Director of the Laboratories, spoke on *The World Food Situation* before the International Relations Group on May 16 in the Arnold Auditorium. Since his retirement, Dr. Williams has been

C. Kittel demonstrates magnetic resonance absorption in a paramagnetic salt to Dr. Bleaney of the Clarendon Laboratory of the University of Oxford

Director of Grants for Research Corporation, which administers patents for the support of a wide research program. He is also a member of the Food and Nutrition Board of the National Research Council.

News Notes

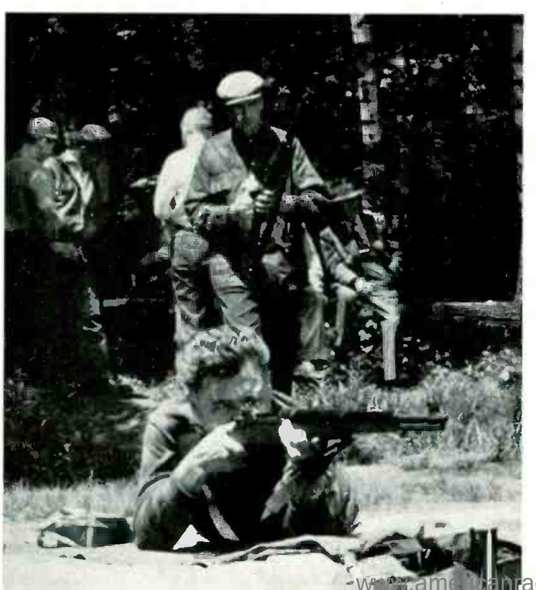
THOMAS N. LACY of Detroit, president of the Michigan Bell Telephone Company, has been elected president of the Telephone Pioneers of America for the year beginning July 1. Mr. Lacy succeeds Carl Whitmore, president of the New York Telephone Company.

D. R. BROBST and V. T. WALLDER conferred with the Phalo Plastics Company in Worcester on hook-up wire. Mr. Brobst also went to Hawthorne on step-by-step bank wire and enameled wire problems and to Detroit on hook-up wire.

W. A. Blikken firing at 200 yards, R. E. Strebel spotting

Rifle Club

The Rifle Club finished the small bore gallery season in sixth place in the final standing of the New Jersey Civilian Rifle League competition. Eight Northern New Jersey rifle clubs participated. The three highest scorers on the Laboratories team were C. L. Hastings, W. A. Blikken, and R. E. Strebel with averages of over 186 out of a possible 200. The averages for these three shooters differed by less than 0.3 point. The Laboratories Club won from the Equitable Life Assurance Company Rifle Club by a score of 928 to 907 in a post-season match held April 21. Calibre .30 shooting will be the principal activity of the Rifle Club during the summer and fall months. A qualification match was held at the range of the Roxbury Rifle and Pistol Club on May 21. Fourteen club members qualified under the Army "C Course."



News Notes

O. E. Buckley, D. A. Quarles and Ralph Bown were in attendance at the dedication of the Johns-Manville Research Center at Manville, New Jersey, on May 24, when the Research and Administration Building was formally opened. Dr. Bown participated in the Forum on laboratory construction held on that occasion.

Dr. Buckley attended the Bell System Presidents' Conference in New York, May 3-5, and the Western Electric Administrative Conference at Skytop, Pa., on May 26.

A group of executives including O. E. Buckley, A. B. Clark, Ralph Bown, W. H. Martin, J. W. McRae, J. R. Wilson, and A. H. White visited the Allentown plant of the Western Electric Company on May 27.

M. J. Kelly attended the Western Electric conference at Skytop from May 24-27.

R. Bown attended the 1949 annual meetings of the Industrial Research Institute, Incorporated at Asbury Park, May 23-25.

O. C. Eliason with the M1 Garand service rifle

The Industrial Conference at the M.I.T. Research Laboratory of Electronics, held on June 1 and 2, was attended by Messrs. Buckley, Kelly, Bown and McRae.

R. K. Honaman was in Washington on June 1, 2 and 6 conferring with the Chesapeake and Potomac people regarding the *Looking Forward Exhibit*, prepared by the A T & T primarily for stockholders, and now being shown in other cities of the country.

←L. D. Michaelson, chairman of the Rifle Club, firing from prone position at 200 yards

The Murray Hill Popular Orchestra, left to right: Harry Geetlein, program and music chairman; Rose Mancuso, Jean Ferry, Connie Carlson, Ray Biazzo, Frank Dempsey, Anthony Prestigiacomo, librarian; Eugene McDermott, William Doherty and Frank Crutchfield, membership chairman. Seated, front row, left to right: John DeFeo, Henry Lecour, secretary-treasurer; Ray Chegwidden, executive chairman; Charles Wallschleger, music director; Eugene Sartori and John Potter, properties chairman

Popular Orchestra Gives Show

The first musical show of the Murray Hill Popular Orchestra, held in the Arnold Auditorium on June 2, was so well received that it was necessary to give a repeat performance on the following day to accommodate all who wanted to attend. Under the direction of Charles Wallschleger, the orchestra played seven pieces of popular and semi-classical music, including in their program two numbers by The Harmonettes, members of the orchestra, Jean Ferry, Rose Mancuso and Connie Carlson; and vocal solos by Lou Claybrook and by Marilyn Wojtech.

The Harmonettes and the Murray Hill Rhythm Trio, consisting of Harry Geetlein, John DeFeo and Ray Biazzo, performed at the Summit 50th Anniversary celebration.

News Notes

R. J. Williamson, while on a recent visit to Haverhill, Massachusetts, discussed the improvement in manufacturing the 274-type retardation coil.

A. R. D'Heedene attended the joint meeting of the New York section of U.R.S.I. and I.R.E. in Washington. The meeting covered the work of four commissions of the American section.

P. W. Rounds gave a lecture before the Audio Engineering Society in New York on *Attenuation Equalizers.*

B. S. Woodmansee, I. E. Fair and R. A. Sykes attended a symposium on *Frequency Control Devices* at the Squier Signal Laboratory at Fort Monmouth on May 18 and 19. Mr. Sykes also attended a meeting of the Research and Development Board Subcommittee on Frequency Control Devices at Fort Monmouth.

L. F. Koerner and W. E. Smith conferred with engineers of the Reeves-Hoffman Company, Standard Piezo Company, and Hunt Corporation at Carlisle, Pennsylvania, and the Biley Electric Company at Erie, Pennsylvania.

J. D. Tebo and R. E. Coleman visited the Nela Park Division of the General Electric Company, Cleveland, Ohio, on projection lamp problems.

"The Telephone Hour"

NBC, Monday Nights, 9:00 p.m.

July 11	*Claudio Arrau*
July 18	*Polyna Stoska*
July 25	*Lucile Cummings and Edwin Steffe*
August 1	*Jascha Heifetz*
August 8	*Gladys Swarthout*
August 15	*Ezio Pinza*
August 22	*To be announced*
August 29	*Licia Albanese*

RECENT DEATHS

J. T. Butterfield
1884-1949

G. W. Burchett
1875-1948

A. C. Powell
1894-1949

Joseph T. Butterfield, June 5

Mr. Butterfield, who was retired in 1946, received the B.S. degree from the Worcester Polytechnic Institute in 1907 and the E.E. degree from Purdue University in 1910. Coming immediately to the Laboratories, his first work involved the development of an improved insulator for open-wire lines. This was followed by the development of the magnetic structure of the 54-type retardation coil. He then became engaged in the early research work on magnetic materials and in this connection produced the first loading coil cores made from finely divided electrolytic iron dust by the electrolytic cell process. He designed the molds for the production of annular iron dust cores.

During World War I, Mr. Butterfield was in charge of the development of switchboard lamps, vacuum thermocouples and vacuum fuses and also made important contributions to range-finding apparatus developed for the Government. He then supervised the development of electrolytic condensers and later contributed to the study made of bearings and lubrication. More recently he was concerned with the development of improved methods of maintenance for base metal contacts used in the panel system. Mr. Butterfield was responsible for the invention and development of the flexible multiple brush, which is now standard on panel dial equipment and which has been successful as a means to alleviate contact noise in panel systems.

Patrick Byrne
1897-1949

C. G. Wennerberg
1895-1949

George W. Burchett, May 12

At the time of his retirement in 1940, Mr. Burchett had completed twenty-nine years of service, which began in the Special Apparatus Department of the Western Electric manufacturing organization in 1911. In the succeeding years, he transferred to the Model Shop, then to the printing telegraph group where, during World War I, he assisted in the design and development of various printing machines, and in 1921 to one of the laboratories of the Physical Research Department, where he, as an expert mechanic, was associated with the developments of that group until he retired. Mr. Burchett was granted patents for his work on the 540 AW loudspeaking telephone and for his work on the artificial larynx. After his retirement from the Laboratories, he worked for seven years at Columbia University, first on defense projects and later on the Manhattan Project until 1947, when he went to California, where he died.

Albert C. Powell, May 22

Early in his Bell System career, Mr. Powell worked with the Bell of Pennsylvania, and later with Western Electric. During World War I, he served with the Navy in the radio field. His early work at the Laboratories had to do with the development of interconnecting equipment between manual and dial systems. Following that he engaged first in the development of modifications of the panel dial system and later in the development of various forms of service observing equipment for dial offices. Toward the end of World War II, Mr. Powell began working on one of the developments which the Laboratories has recently released—the automatic message accounting system. He was concerned with the accounting center part of the development for which he was one of the design engineers. He aided in the design of the first field trial circuits for the Washington field trial and following that he engaged in the development of accounting center equipment required in connection with its commercial application. The initial installation of the AMA was made at Philadelphia. In connection with his design activities, he was granted eight patents.

Interested in boating and navigation since he served in the Navy, Mr. Powell was a member of the New York Power Squadron and of a Westchester yachting club.

PATRICK BYRNE, June 1

A member of the Laboratories since 1928, Mr. Byrne had been a member of the Building Service group during all of his Bell System service. Beginning as a utility man, he was promoted to patrol watchman and during the war became a uniformed watchman assigned to guarding essential war materials, and admissions to, and exodus from, the various buildings. He had been assigned to the Davis Building as a uniformed watchman.

CHARLES G. WENNERBERG, May 28

Mr. Wennerberg's Bell System service began in 1928, when he joined the Development Shop as a machinist to assist in building experimental models of new Laboratories' developments. During the war, he was engaged in work for the Armed Forces, particularly on magnetrons, wave guides and radar equipments. Since then, he had done considerable lathe work for experimental models of recent developments for Electronics Research.

News Notes

F. J. GIVEN gave a talk on *Design Trends in Components for Airborne Electronic Equipment* at the June 4 meeting of the Dayton Section of the F.R.E.

M. WHITEHEAD conferred at P. R. Mallory and Company in Indianapolis on capacitors.

H. W. FLANDREAU went to Vineland, New Jersey, for the No. 5 cutover on April 17.

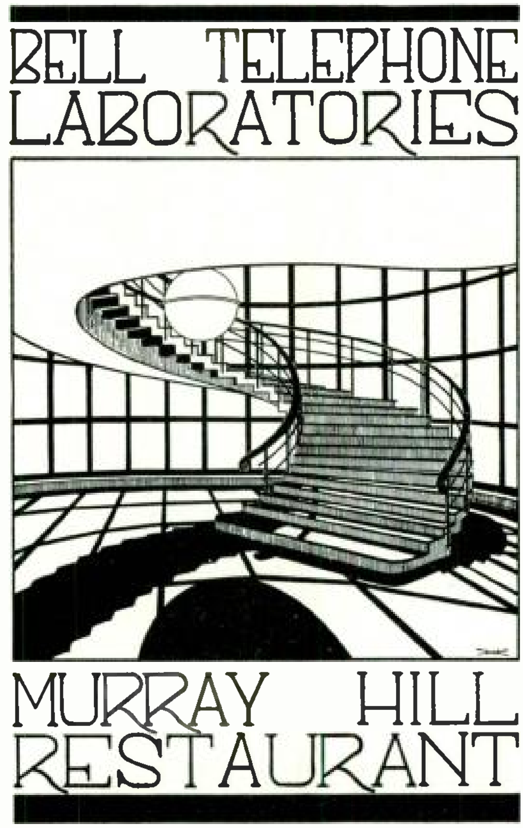
R. H. GUMLEY, F. A. BONOMI and T. A. MCCANN visited Media on April 11, 12 and 13 with regard to the adjustment of the polar-type relay.

B. MCWHAN and F. B. BLAKE, with J. V. Moses of A T & T, visited Los Angeles in connection with automatic ticketing installations at Van Nuys and Beverly Hills.

W. B. GRAUPNER and P. E. HOGIN went to Towson, Maryland, and E. A. KUENZLER to Rheinland, New Jersey, in connection with No. 5 crossbar systems.

A. C. GILMORE studied lighting facilities for toll operating rooms at the Bourse Toll Office, Philadelphia.

J. N. WALTER studied the operation of the signaling and switching equipment in the No. 4 toll crossbar system at the Race Street Toll Office in Philadelphia.



This is the cover, designed by D. H. King, for the menus in the new Murray Hill restaurant

C. F. KNEPPER, C. R. GRAY and A. O. ADAM assisted in acceptance testing of No. 5 crossbar at Troy, New York.

R. K. MCALPINE and M. E. KROM visited No. 5 crossbar office at Towson, Maryland.

D. RITCHIE, JR., investigated crosstalk on operator training equipment at Detroit.

F. W. AMBERG and ESTHER RENTROP have been conducting open-wire crosstalk tests in New Mexico and Oklahoma.

A. J. AIKENS and R. M. HAWEKOTTE have been making noise studies on cable in Wisconsin.

Deal-Holmdel Party

Following the final Deal-Holmdel Colloquium for the 1948-49 season, Laboratories men at the two locations held an informal dinner at the Willowbrook Restaurant in Fair Haven on May 6. W. J. Albersheim acted as toastmaster. The group was led in singing by L. R. Lowry with A. B. Crawford at the piano. Several skits based on the doings at Holmdel and Deal were presented. Pictured below, in one of them, are S. A. Johnson as *Andy* and C. F. P. Rose as *Amos*, who discussed, in their inimitable manner, the development of microwave systems. This skit was one of the many which made the evening a memorable one.

News Notes

M. SALZER and F. M. PEARSALL, JR., observed the action of trouble recorders in the field at the Troy and North Troy, New York, and the Ambridge and Coraopolis, Pennsylvania, central offices.

M. O'CONNELL went to a meeting of the Radio Manufacturers Association that was held in Chicago in connection with the standardization of vacuum tube sockets.

A. A. HANSEN and C. A. DAHLBOM initiated a trial installation of new type single frequency signaling equipments at the Richmond, Virginia, and the Philadelphia toll offices. Mr. Hansen and C. LUCEK visited the Glens Falls, New York, toll office in connection with performance tests of single frequency signaling units being prepared for service at that office. Mr. Dahlbom, Mr. Hansen and N. B. ROWE visited the Philadelphia No. 2 toll office in connection with the trial installation of single frequency signaling equipment.

G. A. HURST's and W. I. MCCULLAGH's visit to Ambridge, Pennsylvania, was in regard to the cutover of the new No. 5 crossbar office.

R. G. RAMSDELL witnessed switchboard cord trials at Atlanta and New Orleans.

A. BURKETT and M. P. Woodard of the Western Electric Company visited the North Electric Manufacturing Company on community dial office problems. Mr. Burkett and F. W. METZGER went to the Northwestern Bell at Des Moines for consultations on community dial office matters.

J. A. POTTER discussed rectifier problems with the Power Equipment Company at Detroit. He also attended a local section meeting of the A.I.E.E. at Jackson, Michigan, where a discussion of capacitors was held.

W. L. BETTS conferred with engineers of the Hertner Electric Company at Cleveland and the General Electric Company at Fort Wayne upon the designs of charging generators.

H. T. LANGABEER and W. V. FLUSHING made tests on the power plants at the Ambridge, Pennsylvania, and Willoughby, Ohio, No. 5 crossbar offices.

C. S. KNOWLTON observed power plant operations on the No. 5 crossbar offices at Baltimore and Troy.

V. T. CALLAHAN discussed new designs of both diesel and automatic gasoline engine alternators with the General Motors Corporation engineers at Cleveland, the Duplex Truck Company at Lansing, and the Hercules Motor Corporation at Canton, Ohio.

R. H. ROSS conferred with engineers of the General Electric Company at Fort Wayne upon new designs of large 400-cycle motors.

D. E. TRUCKSESS visited the Fan Steel Metallurgical Corporation at Waukegan, Illinois, in connection with receivers.

J. H. STELLJES observed the operation of AMA accounting center No. 1 at Philadelphia in connection with the preparation of maintenance information for use by the Plant forces.

L. B. COOKE attended several A.S.A. meetings on symbols during the month. Mr. Cooke and R. A. MILLER were present at the R.M.A. TR-10 audio facilities committee meeting which was held in New York City.

F. E. BLOUNT visited Media for several days studying the monitor circuit of the No. 5 crossbar system.

W. I. MCCULLAGH attended the Willoughby, Ohio, cutover of the No. 5 crossbar system on April 16 and 17.

G. I. Wells discusses his Choir Boy *with a group of visitors to the exhibit*

Arts and Crafts Exhibit

Members of the Laboratories exhibited more handicraft, ceramics and sculpture and fewer paintings than in previous years during their fourth annual exhibition of arts and crafts, May 10-12, in the West Street Auditorium. Current classes in sculpture and ceramics, under auspices of the Arts and Crafts Club and also of the women Pioneers, were a reason for the large number of entries in these categories. In sculpture, W. T. Wilder took first prize for his *Resentment and Contentment;* P.

←Nurse F. Manderbach and Anne Roeder of Medical and K. A. Williams, who painted the prize-winning picture and also several of the other paintings

Sculpture holds a great deal of interest for visitors to the recent arts and crafts exhibit

Mertz, second; Fred Frampton, third; with honorable mention, Vivian Alling, Lillian Eberle and Ruth Boyajian. In ceramics, Anna Marshall won first and Louise Jentschke second prize for a green dish and lamp base, respectively. K. A. Williams' *Tug Boat* won first prize in oil paintings and Fred Frampton's *Tide Is Out*, second prize, while in water colors, C. E. Luffman's *City Outskirts* won first and Mary Donnelly's *East River Park*, second prize. In the handicraft class, Elsie Dittmar won the first prize for a crocheted spread, *Evensong;* Betty Engstrom, second, for her needlepoint; Gwen Rannier, third, for her afghan, *Spring Flowers;* and A. F. Dock, fourth, for silver jewelry; C. N. Hickman, fifth, for his archer's bow of radical design; and E. Breichle, sixth, for his bust of a woman. *Choir Boy,* an oil painting, by G. I. Wells, won the popular vote.

This year's exhibit was under the chairmanship of Fred Frampton, whose committee members were J. J. Burke, Charles Doe, Alice Loe, Ruth Lundvall, P. Mertz and H. Maude.

News Notes

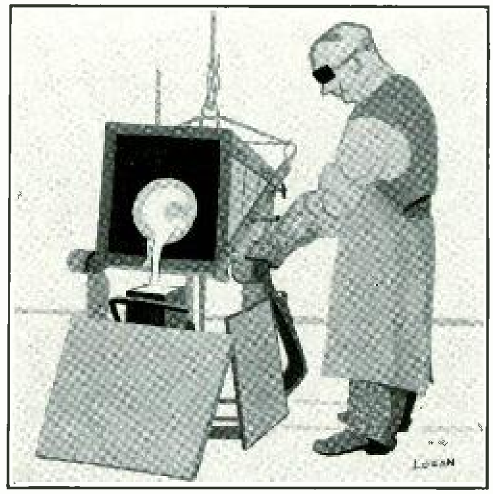
L. R. Snoke initiated field trials of chemical brush control along a cable right-of-way in Pennsylvania.

J. H. Gray was in Ohio in connection with the installation of the Dayton-Toledo buried cable.

V. H. Baillard, T. C. Henneberger and C. Shafer, Jr., discussed exchange cable maintenance measures at Philadelphia.

C. Shafer, Jr., was in Birmingham, Alabama, in connection with the line insulation test method of detecting cable sheath troubles before service is affected.

A. H. Schirmer attended the meeting of the National Fire Protection Association in San Francisco in connection with the revision of the National Electrical Code.



R. Pope investigated corrosion of underground cable sheath at Montgomery, Alabama.

S. A. Schelkunoff attended meetings of Commission 6 of U.R.S.I. in Washington.

David A. Katcher, editor of *Physics Today*, visited Murray Hill Laboratory on June 3, where he spoke on *Reporting Physics Today.*

N. B. Hannay and E. E. Francois attended a mass spectrometer group meeting sponsored by the Consolidated Engineering Corporation in New York City at which Mr. Hannay presented a paper on *Some Mass Spectrometer Applications in the Electronic Industry.*

H. W. Hermance and T. F. Egan, on visits to central offices in Pittsburgh, Cincinnati, Cleveland, and Buffalo, studied the performance of panel contact lubrication. Mr. Hermance conferred in Cleveland with members of the Society of Heating and Ventilating Engineers on dust analysis and sampling.

U. B. Thomas went to a number of Long Lines repeater stations in Illinois in connection with storage battery problems.

R. M. Burns, H. E. Haring, U. B. Thomas, V. J. Albano and E. A. Thurber attended the Electrochemical Society Convention in Philadelphia. Mr. Thomas and R. L. Taylor attended the Signal Corps Battery Conference in Red Bank.

J. H. Scaff gave a demonstration lecture on *Transistors* to the local section of the American Chemical Society in Chattanooga. While there he visited the American Lava Company plant.

J. R. Boettler, at the Keystone Carbon Company, St. Marys, Pennsylvania, discussed powder metal development.

J. B. De Coste was at Point Breeze on matters of plastics on wire and cable.

L. E. Abbott visited the Western Electric Company at Winston-Salem, and the N.R.K. Manufacturing and Engineering Company at Chicago, to discuss aluminum brazing.

V. T. Wallder discussed plastic jacketed hook-up wire at the Phalo Plastics Company, Worcester, Massachusetts. He has been appointed to Subcommittee III of Section H, A.S.T.M. D-20, on brittleness temperature of plastics.

C. M. Hill and J. B. Howard attended the spring meeting of the Rubber Division of the American Chemical Society in Boston, May 23-25.

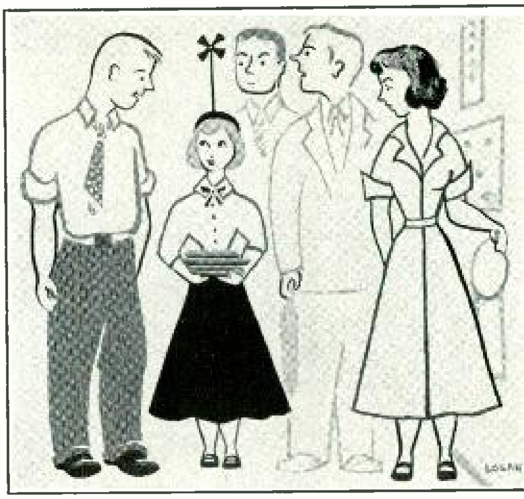
A. C. Walker discussed progress made in the growing of quartz crystals with Signal Corps engineers and representatives of industry interested in this subject at Fort Monmouth. Mr. Walker also gave a talk on *Growing Crystals* before the New Jersey Mineralogical Society in Plainfield.

F. J. Biondi visited the General Electric Cleveland Wire Works and the Cleveland Tungsten Company to discuss tungsten wire problems. He and E. J. Becker spent several days at Allentown on the 311A loop equalizer.

H. A. White visited the Bureau of Aeronautics, Department of the Navy, on May 11, and E. A. Bescherer, F. C. Ward and H. D. Maddox on May 27, on questions in connection with development and manufacture of aircraft radio equipment.

E. L. Nelson and J. W. Smith attended a symposium on the subject *Undersea Warfare* in Washington.

R. B. Ardis, R. A. Buckles, W. L. Keefauver, D. W. Phillion and C. S. Rhoads of the Patent Department have recently been registered to practice before the United States Patent Office in Washington.



"It keeps me from being lost in the crowd"

E. J. Thielen and R. C. Fremon visited the Special Devices Center of the United States Navy at Sands Point during the annual field trip of the National Association of Training Directors of which they are members. Mr. Thielen and W. W. Schormann attended the conference of the Association held on May 6 in New York City.

E. K. Jaycox presided at the session on emission spectroscopy at the Symposium on *Theory and Application of Spectroscopy* sponsored by the Society for Applied Spectroscopy and the Polytechnic Institute of Brooklyn, held at Polytechnic Institute.

R. C. Shaw and W. C. Hunter assisted The Ohio Bell Telephone Company at Dayton in the checking of a new two-frequency land station transmitting system in the urban mobile telephone band.

J. G. Nordahl, U. S. Berger, C. G. Reinschmidt and W. C. Hunter spent May 23 and 24 at the Winston-Salem plants of the Western Electric Company on test and production and microwave equipments.

At Hawthorne, A. O. Adam and R. E. Hersey studied the system manufacture of No. 5 crossbar systems; G. S. Bishop, J. G. Ferguson, O. J. Morzenti and G. E. Stowe discussed No. 5 equipment; F. N. Rolf, E. W. Flint and T. A. Marshall conferred on AMA accounting center manufacture; L. A. Kille, A. R. Bonorden and T. A. Marshall discussed questions regarding AMA accounting center manufacture; G. E. Dustin conferred with Western Electric engineers on step-by-step equipment; H. A. Miloche attended a conference on various relays; E. M. Smith discussed AMA accounting center equipment;

J. E. RANGES, loading coil cases; F. W. CLAYTON, step-by-step solderless banks; G. A. RITCHIE, combined sets; E. T. BALL, crossbar equipment; W. L. TUFFNELL and L. VIETH, coin collectors and telephone sets; L. J. COBB, handsets; and R. R. STEVENS. transmitters.

J. M. DUNHAM and C. C. HOUTZ went to the Sprague Electric Company factory, North Adams, Massachusetts, in connection with M1 carrier problems. Mr. Dunham attended a meeting of the A.I.E.E. power group carrier current committee on May 24 at Cleveland.

H. B. NOYES has been carrying on cable crosstalk studies in Florida.

J. H. KING visited the Victor Products Company in Cincinnati in connection with ventilators for telephone booths.

C. H. AMADON and C. R. BREARTY studied the application of new specification requirements on Douglas fir crossarms in Oregon and Washington. Mr. Amadon also visited Douglas fir treating plants on the Pacific Coast to continue development work on preservative treatments of northwest pole timbers.

G. Q. LUMSDEN assisted in an investigation of pole breaks in Kentucky.

A mixed table tennis match. Players, foreground: Theresa Treanor and A. F. Mott; rear, J. J. Carroll and Mary Ann Bowe; seated, T. J. Doherty, E. Ley and H. K. Krist during noon hour at Graybar-Varick

L. J. COBB, who appears in the facing advertisement, is responsible for the development of test facilities for telephone instruments at Murray Hill. Recently the development of transmitters and receivers was added to his responsibilities.

July Service Anniversaries of Members of the Laboratories

40 *years*

George Dobson
William Fondiller
W. C. Jordan
H. E. Marting
R. G. Ramsdell

35 *years*

A. F. Bennett
O. E. Buckley
Rodger Clifford
R. A. Heising
E. T. Hoch
A. F. Inglis
E. C. Matthews
R. M. Moody
J. G. Motley
G. B. Small
J. R. Weeks, Jr.

30 *years*

John Baumfalk
J. W. Beyer
G. E. Dustin
E. L. Getz
Henry Giroud
G. L. Glaser
W. R. Goehner
L. G. Hoyt
L. A. MacColl
Cordelia Mattice
L. E. Melhuish
C. G. Miller
Franklin Mohr
L. A. O'Brien
H. M. Pruden
C. S. Rhoads
Henry Schucht, Jr.
May Schupp
J. E. Shafer
L. C. Swicker
C. V. Taplin

25 *years*

G. A. Benson
W. C. Buckland
A. F. Burns
T. J. Crowe
C. R. Eckberg
R. A. Ehrhardt
A. A. Elwood
A. G. Ganz
P. R. Gray
George Hecht
T. A. Jones
G. J. Knandel
J. O. McNally
L. S. C. Neeb
W. F. Ottemann
D. B. Penick
D. H. Pennoyer
J. W. Smith
W. P. Sohn
A. C. Thompson
W. L. Tuffnell
H. S. Winbigler
G. R. Yenzer

20 *years*

J. P. Ahrens
Avelino Ballesteros
S. C. Bates
R. W. Benfer
Edith Betz
P. O. Boschan
E. H. Bueb
R. W. Buntenbach
J. J. Burke, Jr.
R. S. Caruthers
J. J. Cebak
H. E. Curtis
Sidney Darlington
G. W. Davis
K. H. Davis
W. H. DeZavala
B. A. Diggory
William Dougherty
H. E. Ehrich
E. P. Felch
C. J. Frosch
E. P. Furst
B. C. Gaughran
T. F. Gleichmann
G. R. Gohn
F. A. Goss, Jr.
Q. E. Greenwood
Warren Gronros
O. O. Gruenz, Jr.
C. H. Hamill
J. J. Hanley
R. L. Hanson
F. K. Harvey
F. V. Haskell
E. E. Helin
G. J. Herbert
H. C. Hey
W.H.C.Higgins,III
C. P. Koch
C. A. Lovell
L. B. Luckner
J. J. Lukacs
R. F. Mallina
C. R. McIver
J. H. Mogler
A. R. Morris
C. M. Morris
Robert Mueller
C. A. Nickerson
K. M. Olsen
D. M. Osterholz
J. E. Paplin
G. L. Pearson
W. S. Pratt
L. G. Rector
H. A. Reise
J. H. Scaff
H. F. Schreiber
W. C. Schumann
F. G. Shane
Ella Suda
U. B. Thomas, Jr.
F. R. Till
Ambrose Vallely
F. C. Ward
M. C. Wooley
L. R. Wrathall

15 *years*

M. K. Asdal
J. C. Berka
W. J. Fullerton, Jr.
G. A. Gawel
J. P. Griffin
Alexander Howitt
W. H. Lockwood
C. V. Lundberg
Anthony Majlinger
Edna Marquette
C. E. Merkel
J. W. Nile
C. J. Norton
J. P. Quinn
G. A. Schiehser
W. H. Webber
C. F. Wollner
V. J. Wycheck
A. M. Zillian

10 *years*

M. M. Algor
F. A. Braun
M. R. Dungan
T. R. Finch
W. P. Frawley
F. C. Griese
J. W. Kittner, Jr.
P. P. Koliss
Regina Lynch
J. F. O'Sullivan
W. A. Tyrrell
K. L. Warthman