BELL LABORATORIES RECORD

INDEX

VOLUME 30
January 1952 to December 1952

Bell Laboratories Record

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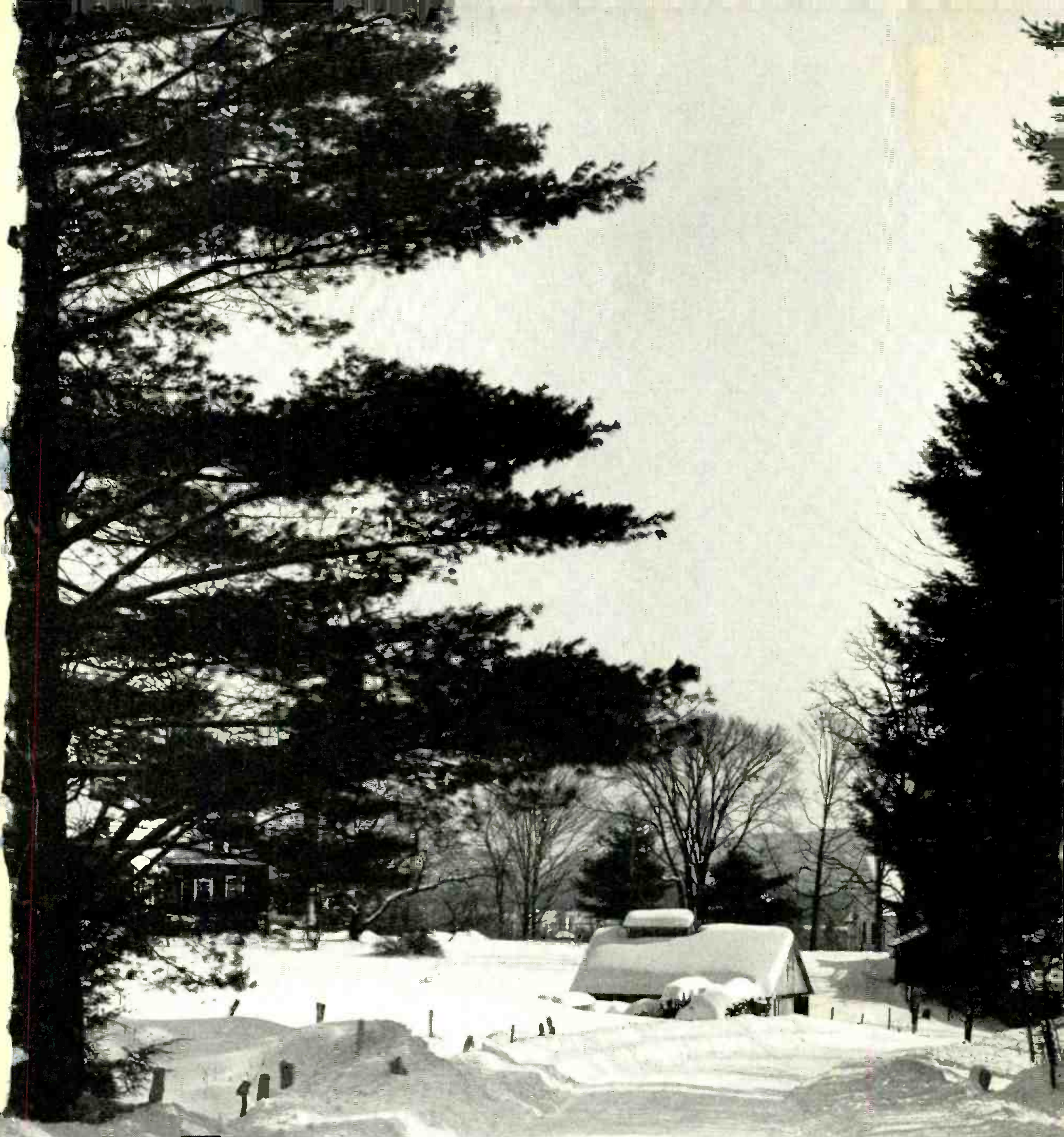
463 West Street, New York 14, N. Y.

LIST OF ISSUES IN VOLUME 30



The continuing high level of our programs for the Bell System and our nation's need in its present emergency for an expanded output from our Laboratories have made necessary an increase of 1,200 in our number during 1951. Every Laboratories member has contributed to the maintenance of our high standard of quality and effectiveness during this period of rapid expansion.

As we begin the New Year, it is my pleasure to welcome our new members and to express to all members of the Laboratories my appreciation for the excellence of the job and the spirit in which it was done, and to extend to each of you and to your family my wish for happiness and health in the coming year.

Mervin J. Kelly

Signal translation in hearing

L. O. SCHOTT
Transmission Research

From studies of hearing extending over many years, it is known that pressure waves of sound in the air falling on the ear drum are converted into negative voltage electrical pulses by the mechanism of the inner ear, and that these pulses are carried to the brain over some fifteen or twenty thousand nerve fibers, which constitute the auditory nerve. In the brain the terminations of these fibers are spread rather systematically over a small area, and thus for each sound striking the ear there is a mosaic-like distinctive pattern of pulses formed in the brain which the mind interprets as a particular sound. At the present stage of our work, we are interested primarily in the translation that converts the acoustic waves to electrical pulses, since important clues capable of explaining many results of past hearing studies are believed to lie in these translating processes.

To learn about these signal translations, it was decided to begin by investigating the generation of the separate pulses. In the inner ear, the auditory nerve fibers terminate in what are known as hair cells—so-called because of the hair-like projections from the end of each cell. These cells are essentially small generators that produce electric pulses when they are set in motion. The exact method by which the pulses are thus generated is not fully known, but the processing evidently includes chemical along with the mechanical and electrical operations. In rough correspondence to the number of nerve fibers, there are some fifteen to twenty thousand hair cells arranged in several rows and mounted on one side of a tiny spiral strip, the basilar membrane, suspended in the cochlea. The mechanical vibratory motions of this membrane in response to an applied sound—with the amplitude and the pitch or frequency selective features as described in an earlier issue of the RECORD*—provide the means for activating the hair-cell pulse generators. A single hair cell is pointed out in Figure 1. To learn more about what happens here, an electrical circuit analog of a single hair-cell unit was designed, based on available information about certain operating characteristics of real hair cells. From expanded studies with this single device, together with information about the

Above—The experimental analog "hair-cell" circuit, with Anthony Prestigiacomo of Transmission Research adjusting the "negative feedback" for "adaptation" control.

* RECORD, *November*, 1950, *page* 481.

location of the hair cells along the basilar membrane and about the requirements for making a single analog unit operate properly in conjunction with all the other units, it is possible to plot patterns on paper that roughly represent the actual patterns of the flow of pulses from the hair cells along the entire length of the basilar membrane. The exact physical shapes of the brain patterns (where the pulses are deposited) are not fully known, but we are not especially concerned with these here.

Major elements of the hair-cell analog circuit are indicated in the lower part of Figure 2. The thyratron T1 is arranged as a relaxation or saw-tooth oscillator. Its pulsating rate is controlled by the intensity of the input signal, the higher the intensity the higher the rate. Parenthetically, for an analog unit simulating a hair cell at a particular point along the basilar membrane, the intensity of its input electrical signal is related to the amplitude of vibration of the basilar membrane at that point. The relaxation oscillator is normally biased by P2 so that it may fire several times a second on a weak signal and up to about 1000 times a second for a signal 25 db or so higher. The saw-tooth waves are routed into the C6R6 network where they are differentiated (in the mathematical sense), thus producing the desired "negative" voltage pulses. The other four tubes—T3 and T4 as a timed single trip flip-flop, and T2 and T5 as suppressors—serve merely to limit the maximum pulsing rate to about 1000 pulses a second. This limiting feature is incorporated to conform with observations that a nerve fiber (and presumably its activating end-organ—the hair cell) has what is known as an "absolute refractory period", that is, a period of about 0.001 second im-

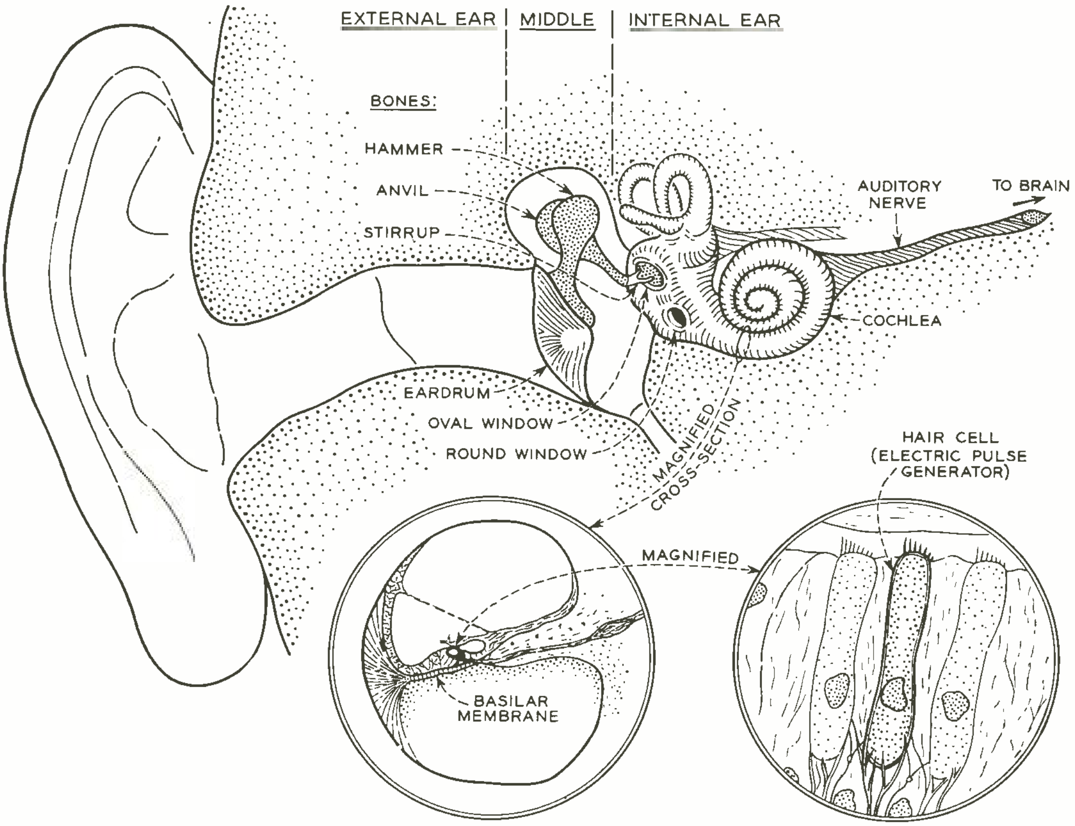


Fig. 1—Diagram of the ear with enlargements indicating the location and approximate size of one of the electric-pulse-generating hair cells. There are some 15,000 of these cells arranged in several rows and supported along one side of a 1¼-inch spiral strip, the basilar membrane.

mediately following a pulse during which the fiber cannot be re-fired in any way whatever by the stimulus, or input signal.

A nerve fiber ordinarily starts pulsing at a high rate, but becomes "adapted" rather quickly to the intensity of its stimulus, and then pulses at a related lower rate, generally not more than a couple hundred pulses per second maximum. This "adaptation" effect has been simulated by using negative feedback: routing a portion of the output pulse energy into the R1C1 network where it is smoothed somewhat and made to act as a desensitizing or suppressing bias on the grid of the oscillator tube T1. Incidentally, the kind of compressing action here is akin to that in certain automatic volume control devices, such as the Vogad*.

A few illustrations in the upper part of Figure 2 show typical wave forms of the operating voltage at several points in the circuit. Of the various voltages that one might examine internally along the circuit pathway, the saw-tooth waves for instance, it is not meant to be implied that these specific forms would necessarily be found (we do not know) operating in an actual hair cell—they are merely the kinds of

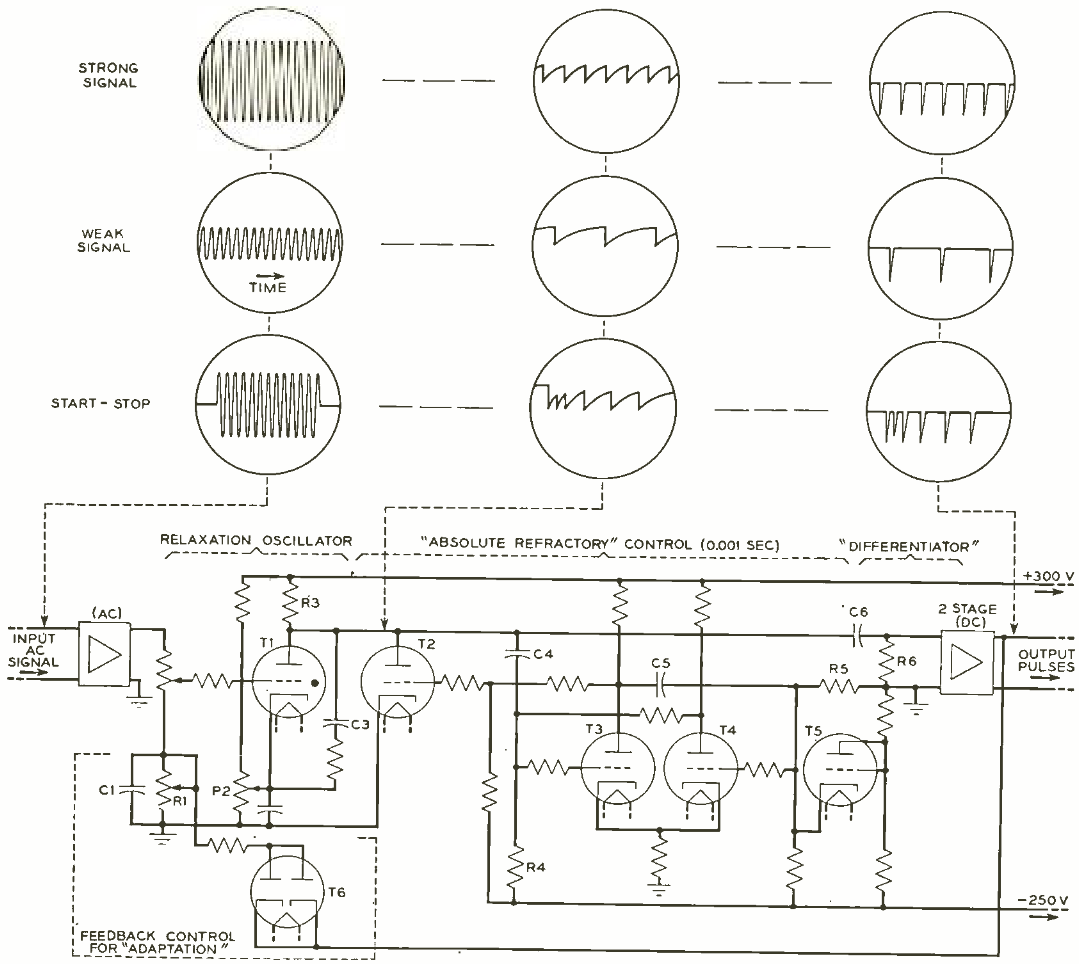


Fig. 2—Schematic of the analog "hair cell" pulsing circuit, with illustrations of several sample wave forms of the operating voltages.

* Record, *October,* 1938, *page* 49.

voltages that now appear to be necessary for the analog circuit in order to accomplish the over-all input-output simulations.

The analog hair-cell unit as devised for the preliminary experiments is shown on the first page of this article. The stimulating signal is provided by a standard sine wave oscillator, or by a thermal noise generator, or by some combination of the two, as desired; and it is applied directly into the input of the analog unit. One of the two cathode-ray oscilloscopes is connected to show the pulses being generated. The other oscilloscope is arranged to show the input signal with the pulses superposed, thereby enabling one to observe in what parts of the signal waves the pulses occur.

The most important characteristic of this pulsing unit is shown by the solid line curve in Figure 3. This indicates that as the intensity of the 2000-cycle stimulus is raised above threshold—threshold being about 35 db below 1 volt for this unit—the pulsing rate is increased smoothly from near zero up to about 150 pulses per second when the stimulus intensity is some 40 db above threshold; and that the rate varies almost linearly with the db changes over a considerable portion of the range. The long-dash curve, next above, is for an adjustment with less negative feedback; and the steep and rough short-dash curve is for no feedback. The obvious steps in this last curve reflect the manner in which the pulses occur: the horizontal portions indicate, respectively, when the pulses (for this 2000-cycle stimulus) occur quite evenly on every second wave, every third wave, fourth and so on, while the sloping portions relate to the uneven but orderly transitional shiftings of the pulse occurrences. The steps are quite effectively and desirably smoothed-out when the negative feedback is applied.

The solid line curve looks very much like the characteristics measured at Harvard University by R. Galambos and H. Davis while working with actual nerve responses*. In many other of the effects that may be demonstrated by the analog circuit—such as the pulse shapes, the refractory period mentioned earlier, the effects from bias adjustment or of small amounts of noise causing so-called "spontaneous discharges", the adaptation effects from the onset of a stimulus, mentioned earlier, the so-called "restoration" effects following the removal of a stimulus, and the manner in which pulses occur on different kinds of signals—it appears that the results conform quite well with studies of actual nerves.

Having certain information about the general features of the over-all pulse patterns sent toward the brain, and having a background of studies with this single ana-

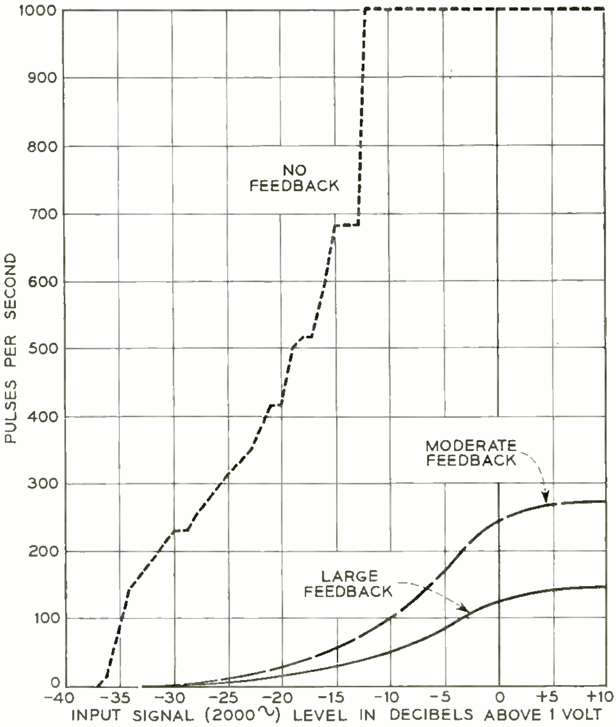


Fig. 3—Response characteristics of the analog "hair-cell" pulsing circuit.

log hair-cell unit, it appeared possible to construct a detailed over-all pulse pattern for each sound encountered: setting down side by side the contributions of the many analog units that would be required in a simulated ear. Incidentally, the studies at this stage revealed that the analog hair-cell units would require certain interacting controls to provide the necessary "adaptation" and suppressing effects—employing a type of cross-connection that might very well be the counterpart of actual nerve fiber interlinkages found in the real ear.

Jl. Neurophysiol., 1943, 6, *page* 39.

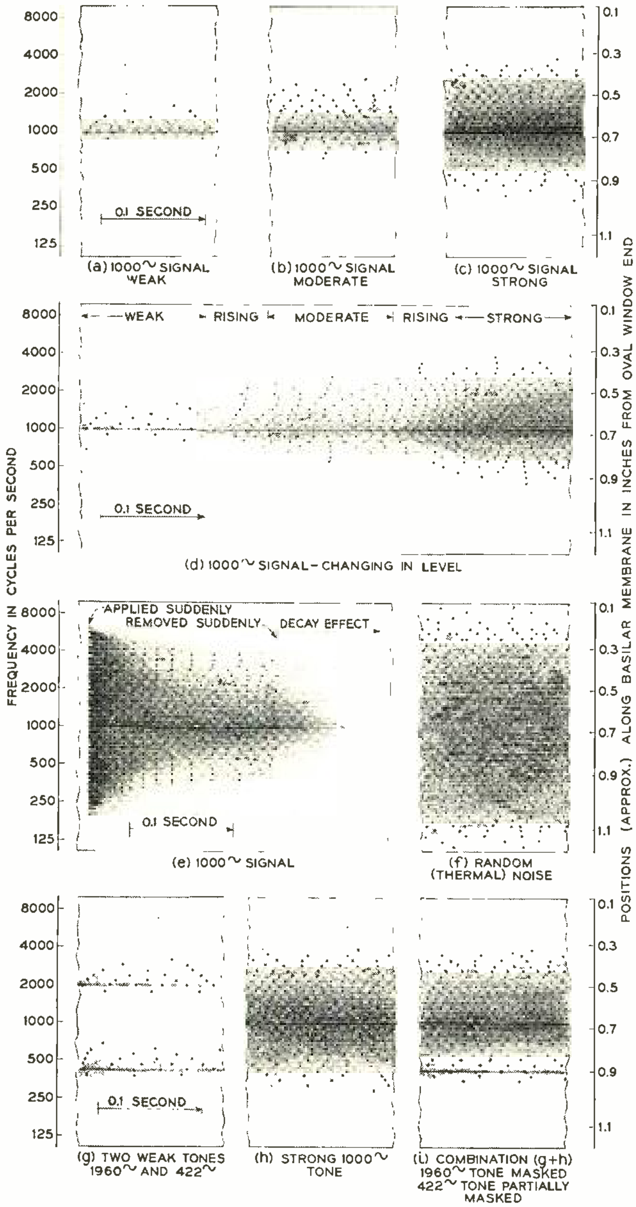


Fig. 4—Graph displays for several audible sounds illustrating (somewhat idealized) that a particular pattern of the pulses, as generated by the many responding "hair cells", will describe a particular sound. A pulse is represented by a dot.

Several of the manually-constructed pulse patterns for a few cases of simple sounds are shown in Figure 4, and these will be explained in some detail below. A pattern of this type appears to contain all of the essential clues for identifying a sound, with such clues residing in the tell-tale arrangement of the simple pulses. While an over-all pattern may appear quite complex, there seem to be certain underlying simplicities in its structure that we cannot overlook. In these studies, a chief interest is concerned with the question about where in the hearing mechanism we may find the purest form of clues which will unmistakably identify the various sounds that we hear. To mention a specific case, where and what are the bare and basic operations that enable the brain to distinguish between the vowels "a-e-i-o---" and the consonants like "v-s-t---"?

In a broad view, each picture in Figure 4, displayed on a frequency-versus-time chart, shows an arrangement of dots which represent the pulses generated in response to the applied signal. The individual dots or pulses along any one particular horizontal line are those that would be generated by a particular analog hair-cell unit; the dots along another horizontal line would be generated by another separate analog hair-cell unit; and so on, similarly, for all the horizontal lines in a picture. Each unit is assigned to a particular position along the frequency or pitch scale of the frequency-selective network—an electrical network representing the basilar membrane*—and thus it acts to show the response for that position. An added scale is shown at the right of Figure 4 to indicate the approximate positions along the basilar membrane of the hair cells producing the pulses represented by the various lines of dots. In these pictures, for simplicity, a system with only 50 analog hair-cell units has been assumed, covering the range from 100 to 10,000 cycles; and one may observe that this shortcut causes the patterns to appear rather rough-grained. Since the production of these charts involved certain computational assumptions, the individual pulses may not be located in a strictly accurate manner. Nevertheless, the charts will serve to illustrate some of the interesting features in this type of portrayal.

High dot density indicates greater energy concentration. The position of the greatest concentration along the frequency scale is related to the pitch of the principal stimu-

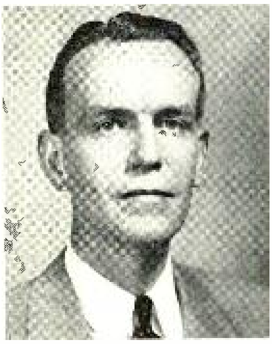
* RECORD, *November,* 1950, *page* 481.

lus; and there may be several such concentrations when there are several audible components of different frequencies. As a side interest, some background shading is included in these pictures to represent the decay of energy from one pulse to the next in a given line, due to integrating, smoothing, and storage effects like those believed operative in the brain at the auditory cortex. This shading matter was adopted to conform with observations that auditory sensation falls off gradually (during an interval of about 0.1 second) after the stimulus is suddenly removed, while the pulses appear to stop abruptly. The decaying sensation effect is represented on the right in part (e) of Figure 4, by the fading-out of the background shading. When a strong signal is applied suddenly, the dot rates will be initially high, as indicated on the left in (e), but will taper-off rather rapidly as the pulsing units become "adapted"—the burst or click sensation is believed related to this operation. Noise signals—the type of energy from which fricative consonants like "s-f-sh" are made—should produce patterns as in part (f), in which the dots are scattered in disorder and apparently at random. On the other hand, tonal signals—the type of energy from which vowel sounds are ordinarily made—would produce patterns in which the dots are arranged with regularities in various orderly configurations. The specific configurations noticed in a given pattern may not be duplicated exactly in another later pattern from the same stimulus. A good example of this may be seen by comparing (c) with the extreme right-hand section of (d): in general, the dot rates from each pulsing unit are the same in both cases, but the relative phases (or shifted positions) of the dots are different.

The patterns for several "beating" tones or for tones bearing harmonic relationships are not shown in Figure 4, but their pulse or dot arrangements would be expected to show a form of superposed rhythmicity, the type depending on the tonal relationship.

It may be noticed that the pattern for a single-frequency tone appears to spread rather widely across the frequency scale, contrasting prominently with the somewhat similar pictures produced by the standard sound spectrograph*. This calculated spreading is related to the important masking effects. The three patterns at the bottom of Figure 4 illustrate this. Two audible tones, 422 cycles and 1960 cycles are indicated in (g); but because these are weak and are well separated in frequency, there is no interference or masking. When these two tones are combined with a fairly strong 1000-cycle tone shown at (h), as is done in (i), the dominant 1000-cycle tone completely overshadows the 1960-cycle tone, but has only a slight effect on the 422-cycle tone. This covering-up of one and not the other is due to the general dissymmetry of the masking effect, having the tendency to mask or suppress more on the high-frequency side than on the low. In brief, the degree of masking depends, in a fairly complex way, on the relative strengths of the components, on their positions and separations frequency-wise, and on whether

* Record, *January*, 1946, *page* 7, and *June*, 1951, *page* 256.



THE AUTHOR: Lionel O. Schott graduated in Electrical Engineering from the University of Missouri in 1928. He then joined the D & R Department of the A T & T, where he was engaged principally in development and research on voice-operated devices for application to wire and radio circuits. After 1934, when the D & R was merged with the Laboratories, these activities continued until 1937, when he began concentrating on toll transmission studies. In 1942, he returned to development and research on devices in speech transmission systems. This led, in 1943, to his connection with the visible speech program, and later into the related studies of the speech and hearing processes. He is now engaged in the study of circuits employing Transistors.

the dominating component is above or is below the component in question.

The processing employed in the ear evidently puts all of the salient information about a sound in terms of the occurrence positions of the generated uniform pulses. Incidentally, this is something like the workings of a transmission scheme known as "pulse position modulation".* It is not known whether any further processing is carried on at or beyond the auditory cortex in the brain, such as might further enhance detection of the important attributes of sound. At any rate, for visual analyses, it is conceivable that we would wish to alter the patterns in some respects to make them more attractive and meaningful to the eye.

A great number of experimenters, both inside and outside the Laboratories, working over a good many years have made the progress discussed here possible. Their continuing experimental work is difficult and painstaking. The ear is contained in a space of only a few cubic centimeters, which is many orders of magnitude smaller than our present experimental apparatus. Along with learning about the meanings of the signal translations employed in the ear, the matters about how a sensory device actually performs its functions are also of interest.

* Record, *December*, 1945, *page* 457.

Shock testing of vitrified clay conduit

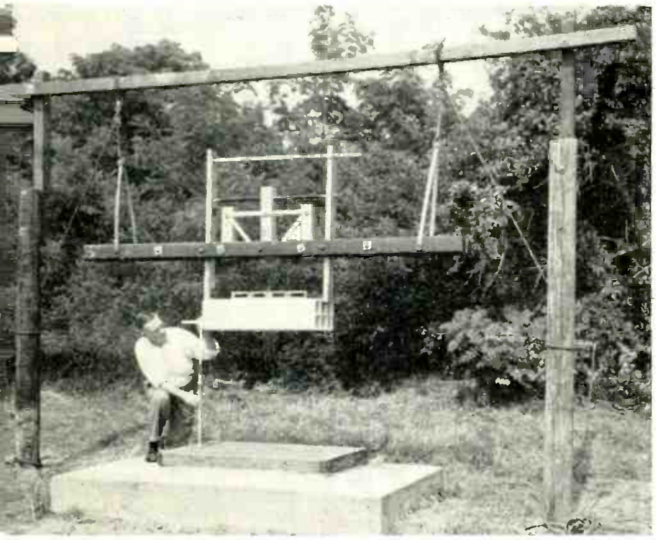


Fig. 1—J. H. Gray checks the height of fall of a six-duct conduit after it has been carefully leveled.

Vitrified clay conduit, used to house underground cables, is often subjected to shocks in shipping, handling, and installation, which may result in breakage if the conduit is not strong enough to withstand them. Consequently, resistance to shock is an important consideration in evaluating changes in design, materials, or manufacturing processes.

At the Chester Field laboratory, controlled tests are made on samples of conduit to compare the ability of specimens to withstand shocks. In these pictures, a full length section of six-duct conduit is being dropped by a release mechanism to a bed of hard, tamped, moist sand. The breakage that resulted was studied and compared with that occurring with other kinds of conduit subjected to the same test.

Fig. 2—The conduit shattered longitudinally along the bottom and one side.

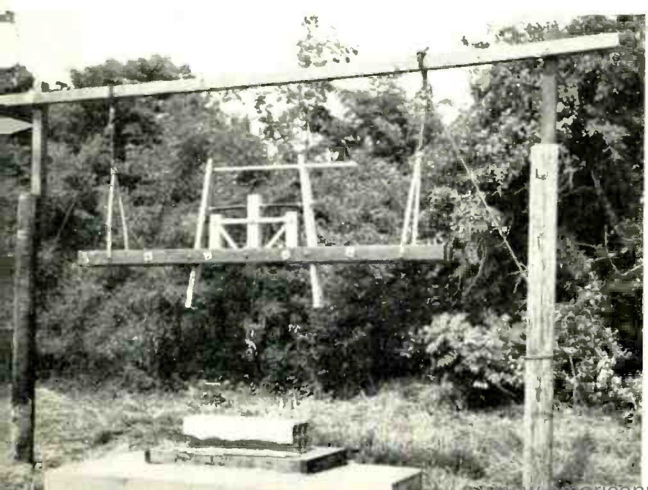


Fig. 3—Mr. Gray is examining the fragments, and will record his observations for future study.

Code patterns in telephone switching and accounting systems

J. W. DEHN
Switching Systems Development

In telephone switching and accounting systems certain information regarding each call must be transmitted and recorded quickly and accurately. In many cases, moreover, the same information must be transmitted and recorded many times. Most of this information is in the form of decimal numbers, of which the component parts or digits may have any of 10 values. The telephone number CH3-1074, for example, is equivalent to the decimal number 2431074, since as a glance at a standard dial will show, C is one of the three letters that is represented by 2, and H, one of the three letters represented by 4. Much other information regarding each call is also represented by decimal numbers. The physical location of each line in the switching equipment, for example, the trunk and other parts of the switching system used on the call, and the rate of charge, are all represented by decimal numbers. It is obvious, therefore, that the transmitting and recording of decimal numbers by electrical and mechanical means is very important in telephone systems.

In transmitting decimal numbers from place to place, each of the ten possible values of a digit must be represented by a unique electrical or mechanical condition. Both the mechanical and electrical representations of a digit are used in the familiar dial. The number of degrees in the arc through which the dial is mechanically rotated for a specific digit is proportional to the value of the digit—"one" being the smallest arc, and "zero" being the largest. The arc representing 0 is ten times that of the arc representing "one". The values "two" to "nine" are represented by arcs of intermediate value. When the dial is released by the calling subscriber, it produces, on its return to its normal position, a number of electrical impulses corresponding to the length of the arc through which it rotates, one impulse for the value "one", two impulses for "two", and so forth, with ten impulses for "zero".

In the central office, electrical and mechanical devices respond to these impulses and take one of ten positions dependent upon the value of the digit dialed. Thus a decimal number, such as 2431074, is transmitted from a subscriber station and recorded in the central office by means of a simple code, each digital value being represented by a discrete dial arc, a number of impulses, and a position of the recording device.

TABLE I—A FOUR-ELEMENT CODE USED FOR SOME PURPOSES IN THE BELL SYSTEM TO REPRESENT DECIMAL DIGITS. THE ELEMENTS OF THE CODE USED TO REPRESENT A DIGIT ARE INDICATED BY X'S: ELEMENTS NOT USED ARE INDICATED BY –

Decimal Digit Represented	Code Elements 1	2	4	5
1	X	–	–	–
2	–	X	–	–
3	X	X	–	–
4	–	–	X	–
5	–	–	–	X
6	X	–	–	X
7	–	X	–	X
8	X	X	–	X
9	–	–	X	X
0	–	–	–	–

This simple decimal code is frequently used to pass a number from place to place within a central office by providing ten conductors per digit between the two places and closing current to one and only one of these conductors. It is also used to transmit all or part of a decimal number to a distant office by means of electrical impulses similar to those generated by a dial.

Where transmitting and receiving devices must be simple, as in station equipment, this code is suitable. There are many cases, however, where more complex codes are used for purposes of economy, accuracy, or speed. The decimal code has ten elements, one for each of the ten values to be indicated. It is possible, however, to represent ten values with a code of fewer than ten elements by using combinations of two or more of the elements to indicate the ten values. A code having four elements, where a single element or a combination of two, three, or four elements are used, can represent as many as sixteen values, and, of course, ten of these sixteen can be used to represent a decimal digit. One practical code of this nature has its four elements designated 1, 2, 4 and 5, and the ten digital values are represented in Table I.

TABLE II—ANOTHER FOUR-ELEMENT CODE USED IN THE BELL SYSTEM

Decimal Digit Represented	Code Elements 1	2	4	8
1	X	–	–	–
2	–	X	–	–
3	X	X	–	–
4	–	–	X	–
5	X	–	X	–
6	–	X	X	–
7	X	X	X	–
8	–	–	–	X
9	X	–	–	X
0	–	–	–	–

It will be noticed that the sum of the elements equals the value of the digit. Another four-element code, shown in Table II, is also used, and again the sum of the elements equals the value of the digit.

Each of these two codes has certain characteristics which are desirable for specific purposes. In panel and crossbar No. 1 systems, for examples, the 1, 2, 4, 5 code is used for all digits except the thousands digit, which uses the 1, 2, 4, 8 code. There is an advantage in using 1, 2, 4, 8 for the thousands digit and 1, 2, 4, 5 for the hundreds digit because this facilitates translation from these two decimal digits to the incoming brush, incoming group, and final brush selections used in the panel system and *vice versa.*

Four-element codes such as the above have been in use in telephone switching systems since about 1914, when the call-indicator systems were installed in New York City for completing calls from the Metropolitan toll office in Walker Street to the various manual "B" switchboards throughout the city. Four impulses or spaces are transmitted for each digit. These impulses (or spaces if the impulse is omitted) are nominally 0.070 second in duration; so that 0.280 second is required for the transmission of each digit. Each of the four impulses or spaces is one element of the code. By suitable receiving equipment the decimal value is reconstructed. The higher average speed of the four-element code, compared with the ten-element code, permits more efficient use of the common control devices.

TABLE III—IN RECENT YEARS A FIVE-ELEMENT CODE HAS COME INTO EXTENSIVE USE

Decimal Digit Represented	Code Elements 0	1	2	4	7
1	X	X	–	–	–
2	X	–	X	–	–
3	–	X	X	–	–
4	X	–	–	X	–
5	–	X	–	X	–
6	–	–	X	X	–
7	X	–	–	–	X
8	–	X	–	–	X
9	–	–	X	–	X
0	–	–	–	X	X

The four-element code is also used to pass a decimal number from place to place within a central office. This is usually accomplished by providing four conductors for each digit between the two places concerned. This is a substantial reduction over the ten conductors required for the simplest code, and, although wires are not very expensive, the contactors and means for actuating them to establish multi-conductor connections between parts of a system are costly. Each of the four wires and the four devices actuated by them are the four code elements, and are used in the patterns shown.

In 1942, a five-element code came into use in telephone systems. The five elements are given the designation 0, 1, 2, 4, and 7,

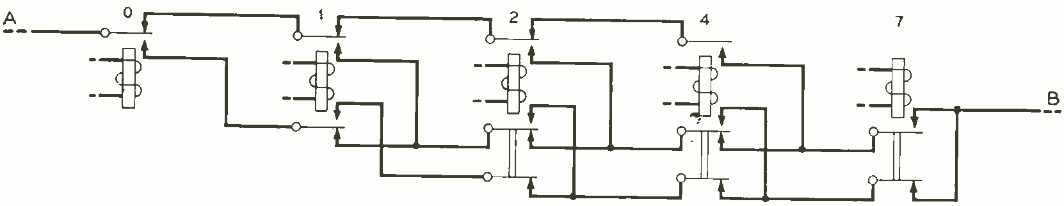


Fig. 1—One form of checking circuit used with the new five-element code.

and each digital value is represented by two of the elements, as given in Table III.

It will be noticed that for the values 1 through 9, the sum of the element designations is equal to the value which the combination represents. There are only ten combinations of five elements taken two at a time, and thus the remaining combination, 4 and 7, must be used for zero.

The principal advantage of this code is that devices can be readily designed to receive decimal numbers in this code, check for errors due to equipment or line faults, and to call attention to the trouble. Systems using the four-element code check intra-office wiring by an indirect method, which is somewhat slower than the direct method used with the five-element code. Inter-office pulsing using the four-element and similar codes is not self-checking. Checking with the five-element code is accomplished by arranging the transmitting or receiving device to demand that exactly two of the code elements are actuated for each digit. A lost element or an added element indicates trouble. Figure 1 shows a commonly used configuration of relay contacts, which assures that exactly two of the five relays are operated. The electrical path from A at the left to B at the right will be closed if any two relays, no more and no less, are operated for the digit. The path is, of course, extended through similar contact configurations for other digits of the decimal number, so that, if an error appears in any digit, circuit action is stopped, and trouble reported.

One use of the five-element code is for transmitting a decimal number from one office to another. Power supplies of five distinct frequencies are available at the originating office for use in combinations of two. The frequencies used and their corresponding code designations are:

0	1	2
700 cycles	900 cycles	1100 cycles
4	7	
1300 cycles	1500 cycles	

(*Continued on page 16*)

THE AUTHOR: J. W. DEHN has, during the past thirty-two years, been engaged in the development and design of switching circuits for the manual, call indicator, PBX, step-by-step, panel and crossbar systems. His work with the crossbar systems was principally on the common control circuits—markers and senders and their associated test circuits as used in the No. 1 crossbar, tandem crossbar, No. 4 toll crossbar, and the No. 5 crossbar systems. At present, he is supervisor of the group responsible for the development and design of the common control circuits for the No. 5 crossbar system. During World War II he developed communication systems for the Signal Corps, and trained military personnel in the operation and maintenance of the equipment. Mr. Dehn is a graduate of the Polytechnic Institute of Brooklyn with the degree of Electrical Engineer.

Historic firsts: Lettered dial

During the development of the panel system there had been considerable discussion as to whether it should be operated on a full, or only on a semi-mechanical basis. With full-mechanical operation, the subscriber dials the number as is now the general practice. With semi-mechanical operation, on the other hand, dials are not placed on the subscribers' telephone sets, and the subscriber gives the number he wants to an operator as in the manual system. The operator does the necessary dialing or its equivalent. With both methods, the same switching mechanism in the central office sets up the call, and thus a decision between full- and semi-mechanical operation could be postponed until fairly late in the development program. With many years' experience in dial operation behind us, it would seem to be an easy decision to make, but actually it was only the invention of a novel method of using letters in dialing central office names—made by W. G. Blauvelt of the Engineering Department of the A T & T—that tipped the scales in favor of full-mechanical operation.

With the earlier dial systems, the dials for the most part carried only the ten digits from 0 to 9, inclusive. Sometimes a single letter was placed with each digit on the dial, but the letters were used merely as a substitute for digits—generally because it was easier to remember a number consisting of letters and digits than one of digits only. In the larger cities where there was more than one central office, each office was designated by a one- or two-digit number listed in the directory ahead of the subscriber's line number, and thus the complete number would include five or six digits. The panel system, however, had been designed for the very large metropolitan areas where the greater number of central offices would generally make it necessary to use three-digit rather than two-digit office numbers. For a considerable time, moreover, there would be manual as well as dial offices in the same area, and if the well-established advantages of office names in manual operation were to be retained, each office would require a name as well as a number. This obviously would complicate the subscribers' operations as well as the listings in the directory, but more serious was the doubt that subscribers could correctly remember a string of seven digits.

Studies had indicated that while an office name and four digits were easily remembered, and that five-digit and even six-digit numbers could be remembered with a small

Fig. 1.—A dial of the type in use in 1917 with only numbers beneath the finger holes.

Fig. 2—A dial that came into use in the Bell System as a result of Blauvelt's invention.

percentage of failure, errors became numerous when the attempt was made to remember seven-digit numbers. The seventh digit seemed to be the straw that broke the camel's back.

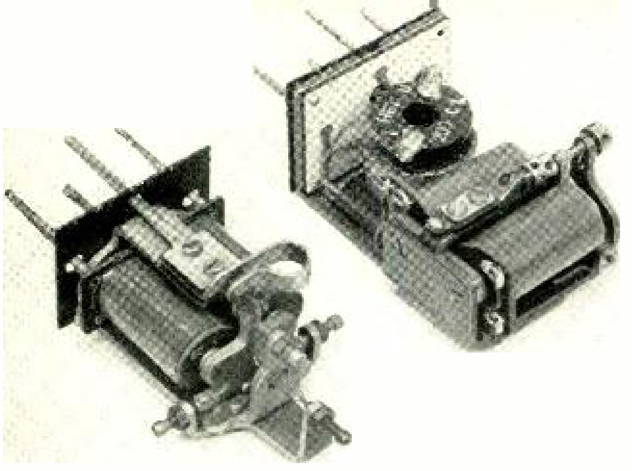
When plans were made for introducing mechanical switching after World War I, full mechanical operation was therefore decided on for the smaller cities, but semi-mechanical operation was proposed for cities where 6 or 7 digits were required, such as New York, Philadelphia, Chicago, and Boston. With the best information available at that time, this seemed the only way to avoid a deluge of wrong numbers that seemed inevitable if full-mechanical operation were to be adopted for areas requiring seven-digit numbers.

It obviously was not completely satisfactory to have some cities with full-mechanical and others with semi-mechanical operation, and among others Blauvelt had given the matter considerable thought. As a result, in 1917 he proposed the simple expedient of dialing "letters suggestive of the office name." Under his plan, directories would have the first two or three letters of the office name printed in bold-faced capitals, and the dial number plates would carry letters as well as digits. The subscriber would dial the initial two or three letters of the name, followed by the 4 numerals, and thus would have to tax his memory only with a name and four-digit number as before. Most of the office names already in use could be retained. As a result of this invention, it was decided to go to universal full mechanical operation, and the first office using the new numbering plan was cut into service in Omaha in 1921. An application for a patent on this invention was filed in 1918, and patent No. 1,439,723 was issued December 26, 1922.

For many years following the adoption of this invention, the first three letters of the office name were used for dialing in the largest cities. As telephone traffic grew, and the number of central offices increased, however, it became more and more difficult to find office names whose first three letters would give distinctive codes when dialed, since the same code is received by the central office for all three letters under any one finger hole. As a result it was decided to designate each office by the first two letters of the name and a digit, instead of by three letters. This gave considerably more flexibility in choosing names, and had the additional advantage of permitting two or more offices in the same general area to have the same name but a different number. Experience has shown that subscribers can satisfactorily handle numbers of the form PE6-9970, and this familiar method is now in general use in the larger cities. The use of this general principle has worked so well and now seems so commonplace, that it is difficult to realize that in 1917 and 1918 the whole course of dial development in the Bell System hung on this seemingly simple invention.

Fig. 3—The most recent type of Bell System dial.

Development of the nationwide toll dialing plan has been accomplished by a division of the entire country in a co-ordinated numbering plan which includes the "2-5" numbering method.



A new stepping relay

J. S. GARVIN
Switching Apparatus Development

Fig. 1—The old and new relays. The new relay is on the right.

Relays play an important part in telephone communication, and while many of them do a routine job of closing and opening circuits, others must perform their tasks in a certain way or under limitations that require special consideration in their design. Such a relay is the recently developed 268 type, shown in Figure 1, to replace the 207-type relay.

For many years, the 207 relay has been used as a "stepping" relay in both panel and crossbar system senders. It was designed in the early stages of the development of semi-mechanical switching systems, of which the first commercial installation was made in 1914. Since that time, it has been used in panel dial, No. 1 crossbar, No. 4 toll, and No. 5 crossbar systems, where it performs practically the same function in each system. Along with the 208-type "counting" relays, the 207 relay is used in a "revertive pulsing" circuit, so called because the pulses are produced in the terminating office and are counted in the originating office by the stepping and counting relays.

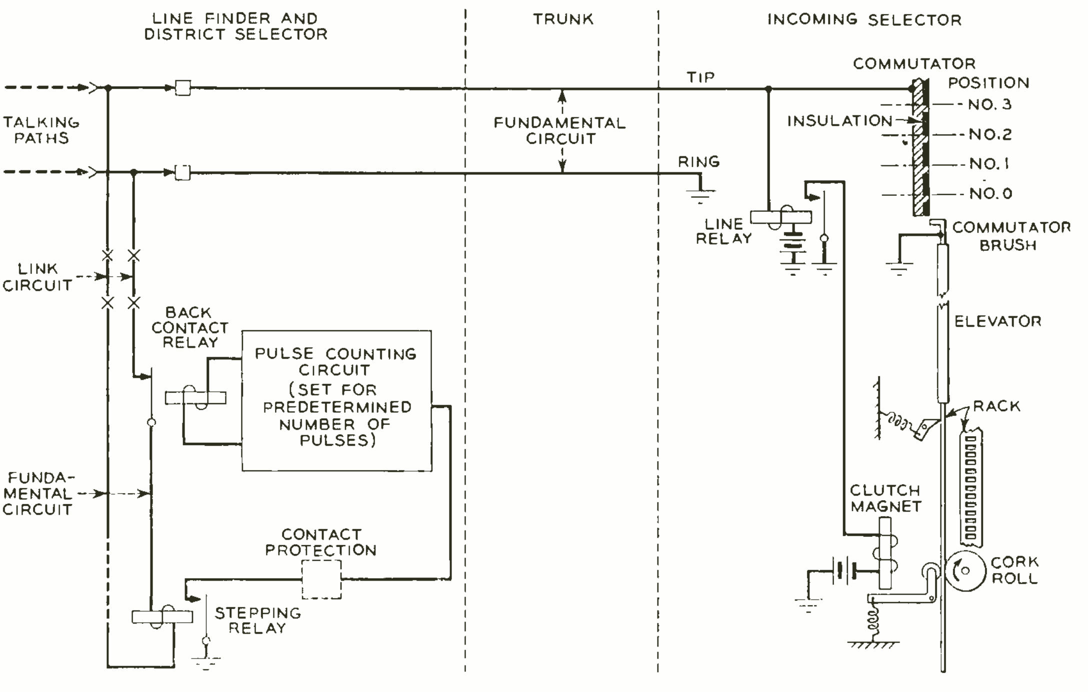


Fig. 2—Schematic of the fundamental circuit of the panel system. The stepping relay is shown at the lower left.

A schematic of the fundamental circuit of the panel system between two panel offices is shown in Figure 2, where the stepping relay in the originating office is required to function when the subscriber sender is connected to an incoming selector circuit in the terminating office. When the sender, located in the calling subscriber's central office, has recorded the number dialed, it closes the paths to the pulse counting circuit and inserts the stepping relay in the trunk or "fundamental" circuit. The L relay in the distant office and the stepping relay in the originating office are then operated in series, the former operating the clutch magnet, which forces the rack against the cork roll and raises the elevator upward.

As the elevator of the incoming selector in the distant office rises, the commutator brush comes in contact with the metal segments of the commutator, alternately grounding and ungrounding the tip side of the line. When the tip side is grounded, the stepping relay is short-circuited, causing it to release. The alternate operation and release of the stepping relay are counted in the pulse counting circuit and when the predetermined number of pulses corresponding to the thousandths digit of the numerical portion of the called subscriber's telephone number have been received, the back contact relay, controlled by the pulse counting circuit, operates and opens the pulsing loop. This also releases the distant line relay, thus stopping further upward motion of the rack. This entire process of trunk loop closure, pulse counting, and loop opening is repeated for the remaining digits of the called subscriber's number.

It may be seen, therefore, that the stepping relay is required to operate many millions of times during its life; in panel circuits, there are approximately 18 million operations per year. Besides the need for the stepping relay to operate millions of times, speed of operation and release are other important requirements, because the time to set up a connection is a delay to the subscriber and limits the traffic which a given amount of equipment can handle. Consequently, appreciable maintenance has been necessary to keep the 207 relay in proper condition.

Keeping in mind that the characteristics of speed, chatter, impedance, and over-all electrical performance of the 207 relay must be retained, the 268 relay was designed especially to provide longer life and greater stability. An exploded view of the new relay is shown in Figure 3.

Several improvements have been made in the new design. A heavy trunion bearing

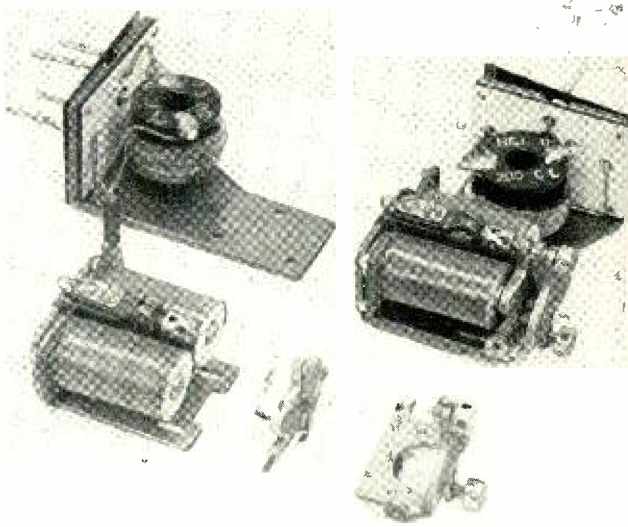


Fig. 3—Exploded view of the new 268 relay.

for the armature replaces the pivot bearings of the older relay to obtain better wearing properties, and a reed-type retractile spring on the armature insures a more uniform buildup of tension and greater stability over the coil spring previously used. Coil windings are of the cellulose acetate filled type, providing more uniform inductance and operating and releasing speeds, as well as economies in manufacture. Use of magnetic parts that have been annealed in hydrogen reduces magnetic aging of the iron and results in improved pulling characteristics with greater margins between the currents that operate and release the relay. Turning the relay at right angles to the mounting plate adds to its stability because the possibility of disturbing the magnetic or contact gaps while mounting the relay is eliminated.

Besides, maintenance is facilitated, since these gaps may be observed more easily.

Since the relay is subject to a great number of operations and the energy through the contacts is relatively large, a special contact protection is used. In addition to the usual capacitor and resistance placed across the contacts, a choke coil has been added as a part of the relay (Figure 4). This coil is connected in series with the contacts to suppress high-frequency voltages generated when the current through the contacts is interrupted; without the choke coil, high-frequency currents would circulate between the contacts and the capacitance of lead wires to ground.

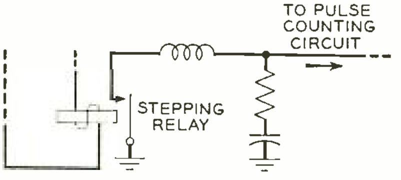


Fig. 4—Contact protection for the 268 relay.

The new relay has proved to be very satisfactory in all locations where the older 207-type relay has been used—so much so that the manufacture of the latter has been discontinued. Efforts in this development have produced not only a relay of improved operating characteristics, but one that can be manufactured at lower cost. Much of the early development was done by E. D. Mead, of the switching apparatus group, and the final design was that of P. E. Buch of the same group. W. Buhler of Switching Systems Development aided materially in testing samples under simulated circuit conditions.

THE AUTHOR: J. S. GARVIN was graduated from the University of Kentucky in 1910 with a B.M.E. degree. Shortly afterward he joined Western Electric Company in Chicago. A few months later he transferred to Western's Engineering Department in New York. For six years he participated in the development of telephone apparatus. In 1917 he joined the relay development group of the Apparatus Design Department, where he remained until his retirement in April of this year. As designer and supervisor, Mr. Garvin left his mark on nearly every type of telephone relay in use today.

(Continued from page 11)

Thus, to send the numeral three, frequencies of 900 cycles and 1100 cycles are transmitted. At the receiving office, filters separate the component frequencies, and actuate two of the five detectors.

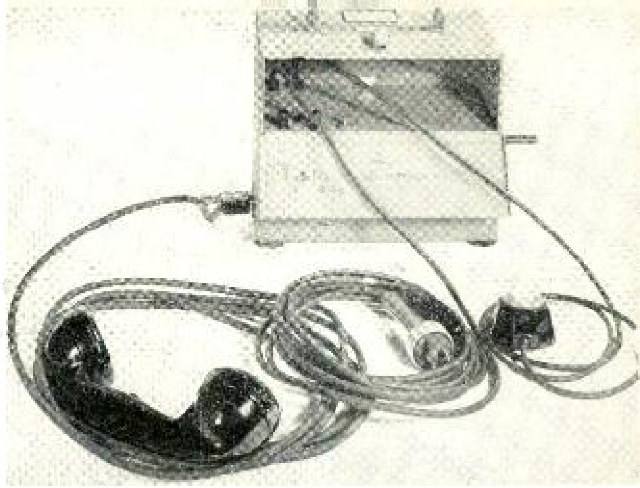
For transmitting a number within an office, five conductors are used for each digit, two of the five carrying current to convey the required numeral.

In the Automatic Message Accounting (AMA) systems,* the details of calls are perforated on a paper tape. Much of the information is in the form of decimal numbers, and is recorded in the five-element code. For each decimal digit, spaces are provided for five perforations, and, to record a particular numeral, the AMA recorder perforates two of these five spaces.

The above examples illustrate how widely the five-element (two-out-of-five) code is utilized in modern telephone switching and accounting systems. Because of the simplicity and speed of the self-checking facilities that can be designed for it, this code is being used wherever practical.

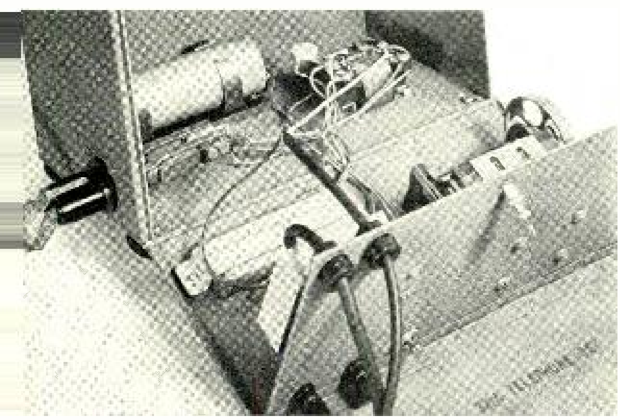
* RECORD, *September*, 1951, *page* 401.

Broadcast pick-up telephone



Telephone communication between the radio broadcast transmitter station and the technician at some remote point where the program is being picked up is usually necessary not only while the pick-up arrangements are being established but also during the broadcast itself. In studios, where most of the programs arise, the necessary communication facilities form part of the permanent equipment. When the pick-up is at some more or less temporary location, however, as when ball games or boxing matches are to be broadcast, such permanent facilities are usually lacking. The Bell System provides a direct line between the transmitter station and the pick-up point and leases suitable terminal facilities for the broadcaster's use. The portable magneto telephone set shown in the accompanying illustrations, coded the 331-A telephone set, has recently been developed to provide all the needed equipment.

It consists of a two-compartment carrying case with room in the upper compartment for apparatus used at some distance from the case, and a lower compartment for the permanently connected apparatus. A clasp on the top of the carrying case releases the door to the upper compartment, while the release of a wing fastener in the rear of the upper compartment allows the entire front and the partition between the two compartments to drop down to give access to the lower compartment.



Either a handset or an operator's headset may be used for talking, and is housed in the upper compartment. Here also are a lamp holder and a three-prong plug and cord for connecting to the telephone line. The handset is provided with a 12-foot cord to permit considerable freedom of movement to the technician using it; it is plug connected to the set through a jack in the side of the carrying case. The line-connecting cord and plug are used when the telephone line has been terminated in a standard three-point receptacle, but where this is not done, the line may be connected directly to the two binding posts just inside the top compartment. The lamp, in conjunction with a buzzer in the lower compartment, is used to indicate incoming calls.

For calling the distant end of the circuit, a hand-driven generator is provided in the lower compartment. The handle of the generator projects through one end of the case but may be removed and placed under a clip in the cover.

Beside the buzzer and generator, the lower compartment includes a fibre tube holding two flashlight cells for supplying transmitter current, the jack for the telephone cord, and a capacitor and induction coil. The weight of the set fully equipped is only a little over ten pounds.

With this 331-A telephone set the technician has all the equipment he needs to establish communication with a distant radio transmitter station, and the time and cost of making semi-permanent installations is avoided.

The 101-G power supply

For the first seventeen years of the telephone, two sources of power were required at each subscriber station: a battery to supply talking power, and a magneto generator for signaling. The development of a common-battery system, to replace talking batteries at the subscriber premises was one of the great forward steps in telephone progress.

Since then no power supply has been needed at the subscriber premises where there is only a single common-battery telephone or a telephone and an extension. During the last half century, however, some of the subscriber needs have become very complex, and a wide variety of PBX's, order turrets, key telephone systems, and key equipments are now available. Because of the need for intercommunication and signaling on the subscriber premises with these systems, low-voltage ac and dc power must be available locally. For the larger installations this is provided by a number of types of battery power plants more or less resembling those of central offices. For the very small installations, on the other hand,

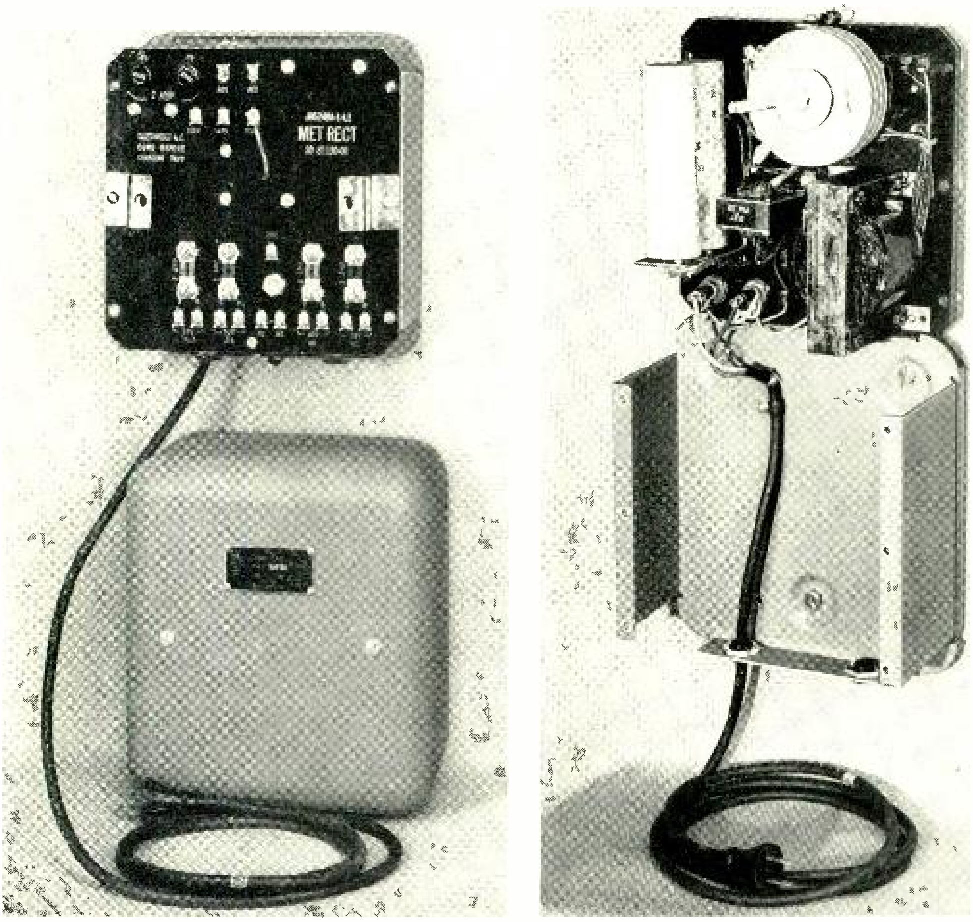


Fig. 1—The J86731A, List 1, power-supply unit furnishes low-voltage dc for talking, and 10 or 18 volts ac for miscellaneous uses.

talking and signaling power is usually transmitted over cable pairs from the central offices.

For a large number of intermediate size installations, however, such as the various key equipments and some of the smaller PBX's, a battery-type power plant cannot be justified economically, while the provision of power over cable pairs is generally uneconomical. Low-voltage dc supplies for talking and relay operation are usually required, and frequently a low-voltage ac supply for lighting lamps and operating buzzers, and a 20-cycle ringing supply are also needed. Until recently these have been available in the form of the J86205A rectifier, the 393A and KS-5714 transformers, and the KS-5585 ringing generator.

Now, however, two new combined power supply units, identified as the 101-G type power plants, have been developed. These are shown in the accompanying illustrations. The J86731A, List 1, which supplies low-voltage dc power for talking and also for signaling purposes, and low ac voltage for lamps and buzzers, will be used in place of both the J86205A rectifier and the 393A transformer or the KS-5714 transformer, and will occupy less than two-thirds the space they required. The J86731A, List 2, includes these two supplies and also a static type 20-cycle ringing generator. It may thus be used in place of all three of the earlier units, also with an appreciable saving in space. Not only are these new combined units smaller in over-all volume than the units they replace, but they have been specially designed for a smaller depth dimension so as to lie flat against the wall and thus be less likely to be damaged. The enclosures for these new power plants are designed to harmonize with proposed equipment cabinets for the 1A key telephone systems, with which they are primarily expected to be used, and like them, the exteriors are finished with a gray-green wrinkle.

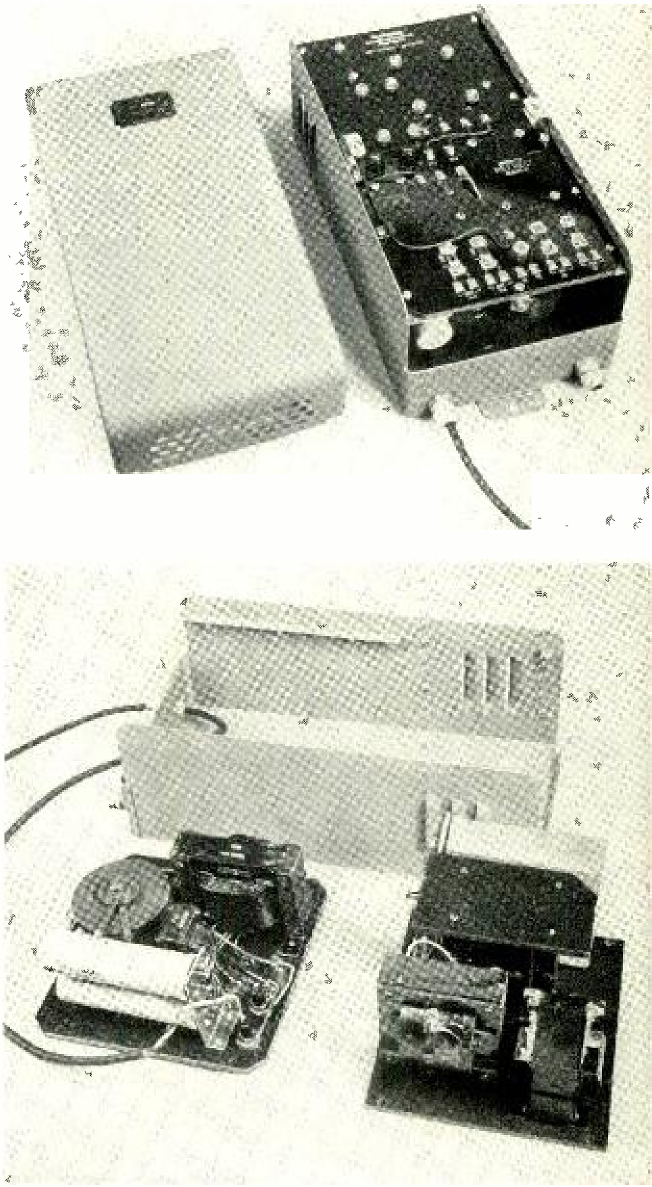


Fig. 2—The J86731A, List 2, power-supply unit furnishes the same low-voltage dc and ac by the same unit—shown at the left of the lower photograph—as does the List 1. In addition—by means of the unit at the lower right, it supplies 20-cycle signaling current.

The Key West-Havana cable

Electrical characteristics of repeaters and terminals

L. M. ILGENFRITZ
Transmission Development

The most outstanding feature of the new submarine cable system installed last year to bridge the hundred-mile gap of water between Cuba and the United States, is the "ocean-bottom" repeater. Three of these are used in each of two small diameter, one-way cables to provide many more "four-wire" carrier telephone channels than could be obtained without them. These repeaters are unique in that they have been used for the first time in ocean depths of the order of a mile and where a number are used in tandem. This article describes, first, the electrical design characteristics of the new repeaters, and then the new features of the carrier-terminal apparatus installed at Key West and at Havana.

An important requirement of the repeaters is that they remain free of trouble or need of replacement of parts over long periods of years. Servicing, even at intervals of several years would be undesirable, not only because of excessive costs, but there is always danger of damaging a cable if it is disturbed after reaching a safe resting place at the bottom of the ocean.

Because of the need for very long life, a basic choice had to be made between two alternatives: (1) to provide spare elements such as tubes having only moderate life together with switching apparatus to substitute worn out units as necessary, or (2) to provide the simplest possible circuit with inherently long life elements. The latter alternative was chosen and it is confidently expected that the repeaters will operate for a long period without failure.

The repeater circuit is shown in Figure 1.

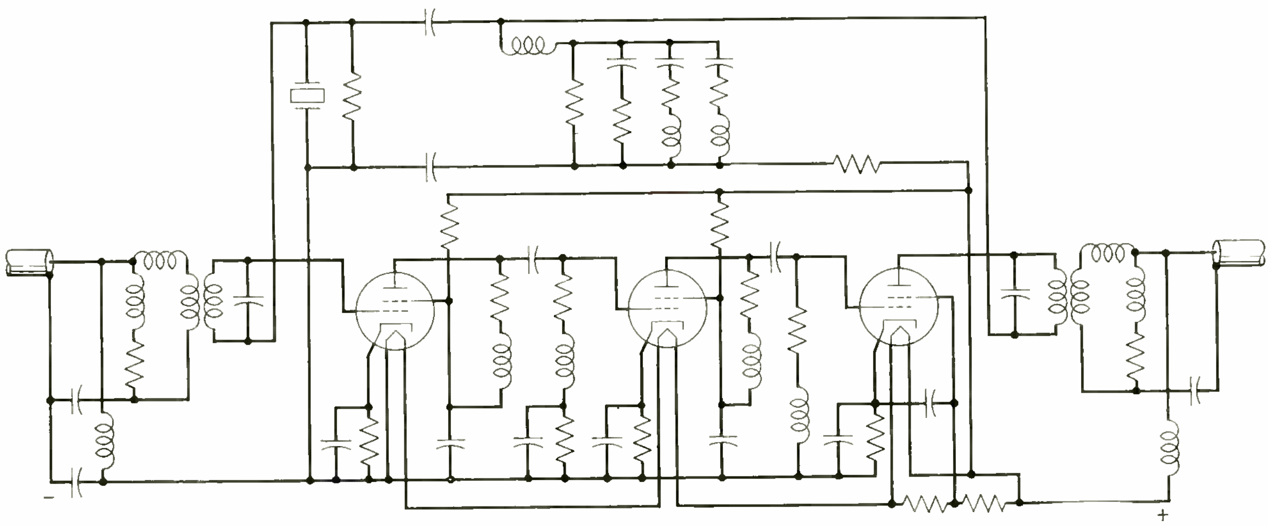


Fig. 1—The repeater circuit.

It uses three very special heater type electron tubes, with the heaters connected in series with each other and with the central conductor of the cable. Direct current for heating is supplied over the central conductor, and the total voltage drop across the heaters provides the necessary screen, plate and cathode potentials. The net gain of each repeater compensates very closely for the loss-frequency characteristic of 36 nautical miles of submarine cable in the frequency range of 12 to 120 kc. Matching of the repeater gain and cable loss is within a few tenths of a db per repeater section. Net insertion gain of the repeater at 108 kc is 65 db.

Extreme care was used in adjusting the repeater elements so that unusual uniformity of the manufactured product was realized. For example, measurements on the completed repeaters prior to installing them in the cable showed that they were within 0.02 db of each other at the highest reference frequency, 108 kc. This uniformity is highly desirable for detection and diagnosis of trouble, after sealing, by means of precise external transmission measurements. A very complete record of element deviation characteristics is, of course, essential in this connection and is available.

Since it is impractical to isolate and measure an individual repeater after it has reached the ocean bottom, a major problem that had to be solved was how the condition of each repeater could be watched from the terminals. If it had been permissible to add relatively complex elements, a number of ways of obtaining information could be used, but such complication was not practical with this cable.

Solution of the problem was accomplished by adding only one element to the repeater circuit—a quartz crystal that can be relied upon as a stable, trouble-free element. Each repeater has a crystal, of different resonance frequency, shunted across the feedback circuit. The resonant frequency is at some even hundred cycle value within the band between 120.0 and 121.3 kc. This band is above the highest frequency at which the repeaters normally operate. In this way, the stabilizing feedback of the repeater is largely nullified in a narrow band only about 1-cycle wide, in which there is the maximum change in repeater gain with change in tube activity. It is possible, therefore, to measure transmission over the cable system at one of these frequencies at which the gain of a particular repeater will be unstabilized but all other repeaters in line will be fully stabilized. Change in transmission at this frequency will thus indicate change in the total gain of the three tubes

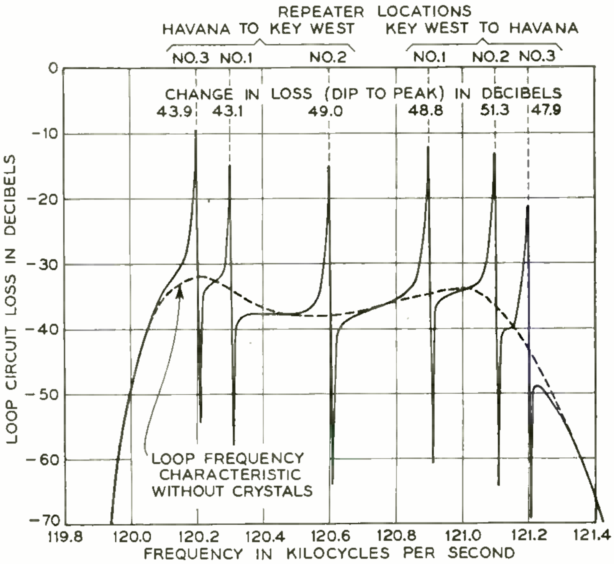


Fig. 2—Measured transmission characteristics of test frequency loop circuit showing the crystal peaks and dips. Tube performance of a particular repeater is indicated by the difference between its peak and closely adjacent dip loss.

in that repeater alone; thus the tube condition of the individual repeaters can be watched, as a function of time, by periodically checking transmission of these critical frequencies.

Besides watching the operating condition of each repeater from the terminals of the cable, the built-in crystals provide another potentially valuable purpose. While the repeaters have been designed and built for extremely long life, there is, of course a possibility, even though remote, that a trouble might develop that could not be located by ordinary fault location methods. It is only prudent to be prepared for such an eventuality. Suppose, for example, that a connection in the carrier-frequency transmission circuit of the repeater were to fail,

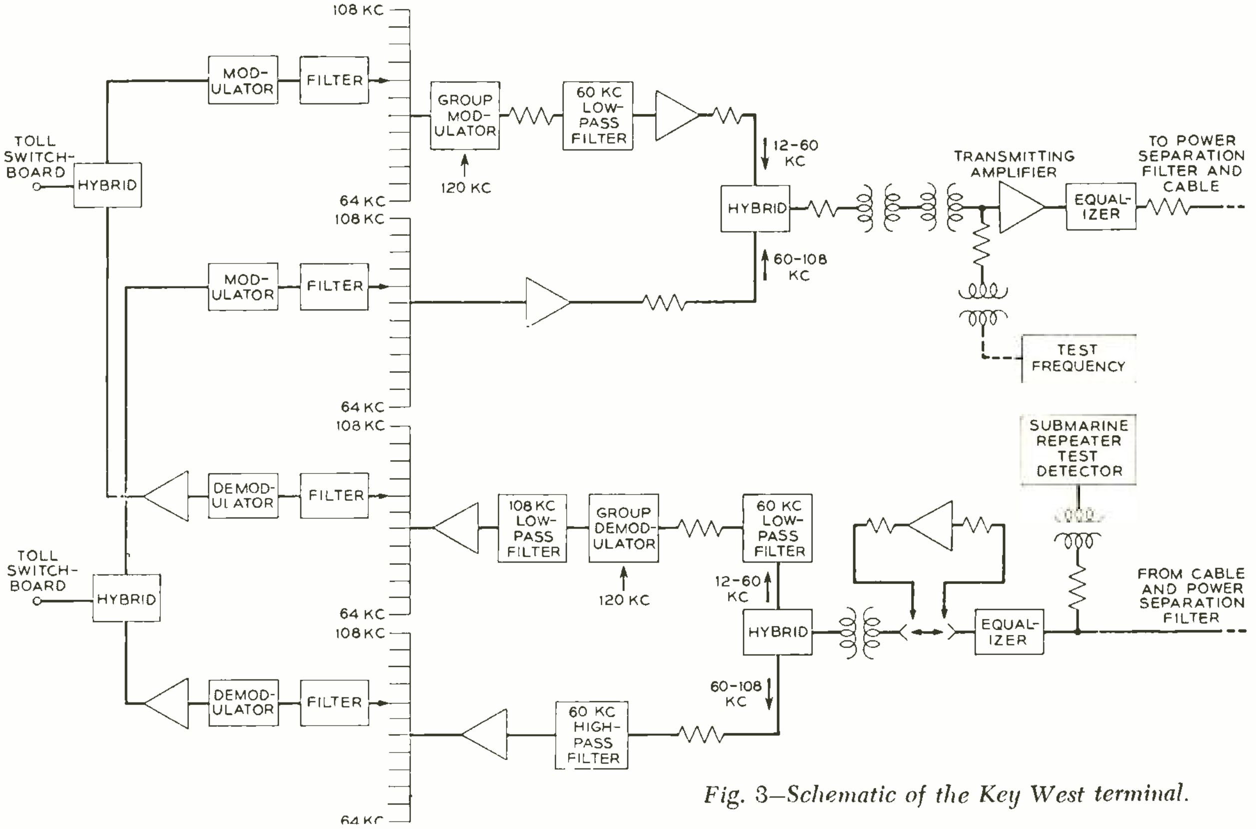


Fig. 3—Schematic of the Key West terminal.

leaving the vacuum tube heater circuit intact. The location of such a failure could not be determined by direct-current methods. On the other hand, it would be very important to determine which of the series of repeaters had failed so that the repair operation could be conducted efficiently and without disturbing any of the remaining operating repeaters. The crystal feature discussed in the foregoing also provides for this type of fault location, and, although it may never be needed, it would serve a very valuable purpose if it were.

This function is fulfilled in the following manner. At crystal resonance, the repeater gain is as much as 25 db above normal. The various repeater crystals, therefore, create a series of "gain spikes" in the band above 120 kc. Since thermal noise is the controlling repeater noise at the repeater input, the gain spikes result in thermal noise spikes being observed if a heterodyne detector having a 1-cycle band width is slowly swept across this band. The noise spikes may be considered in this usage as thermal noise "generators" and the frequency of each indicates the proper functioning of the repeater. When observed from the receiving end of the system, identification of the repeater "generators" which are operating or not, will indicate the location of a repeater failure.

To simplify the testing procedure in connection with the crystal measurements and to reduce the amount of testing apparatus required at the terminals, the 120.0 to 121.3-kc band is looped at Havana so that all such tests can be made on the six repeaters of both cables with one set of testing apparatus at Key West.

Results of a loop transmission measurement of this band are shown in Figure 2. The gain peaks are seen to be accompanied by gain dips about 10 cycles higher in frequency. At these frequencies, feedback is increased greatly by an anti-resonance, which is incidental to the preservation of proper phase relations in the repeater feed-

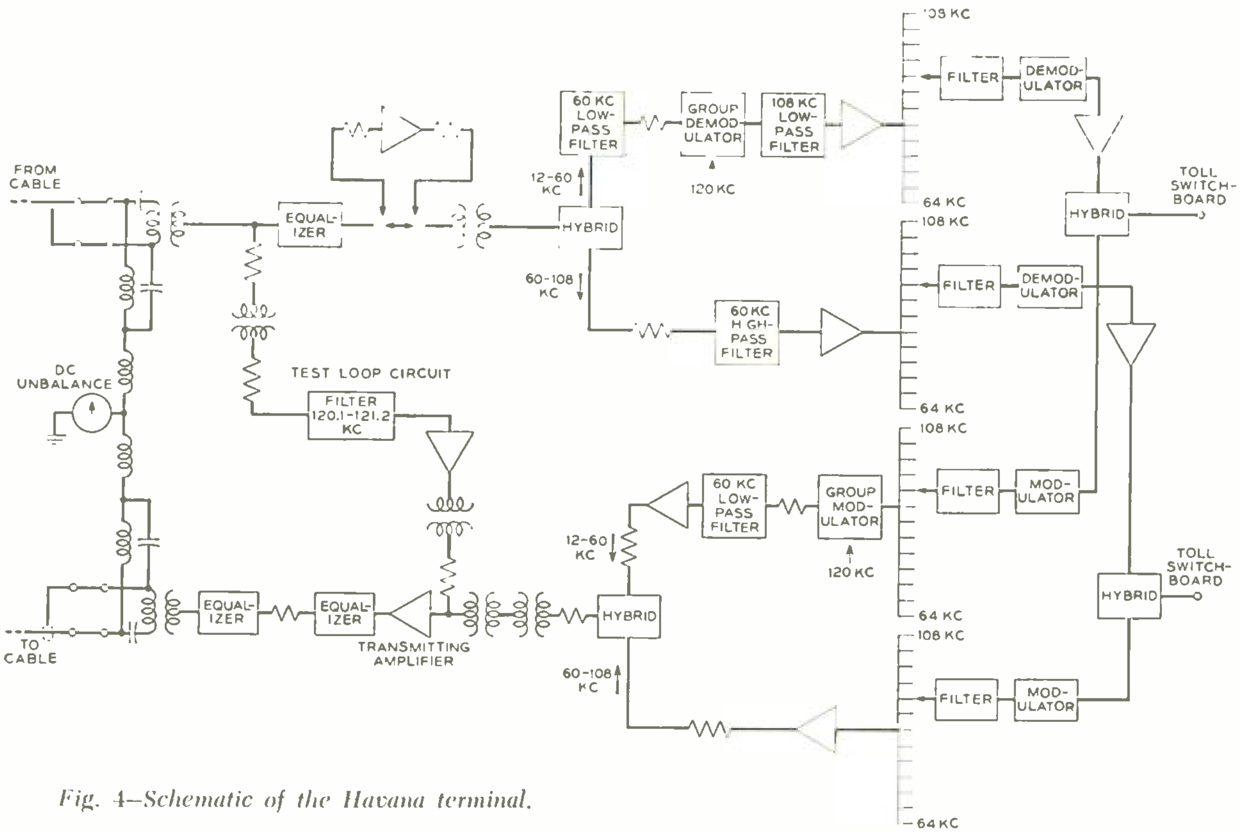


Fig. 4—Schematic of the Havana terminal.

back loop circuit. Since transmission at the dip is very highly stabilized by feedback, and since it is so close to the peak in frequency that shifts in characteristics of the loop circuit would be negligible, the difference in transmission equivalent between the peak and dip for a particular repeater forms an accurate index to the tube performance of that repeater. Moreover, the magnitude of the dip alone is indicative of the crystal resistance and thus serves as a check that the crystal element is performing its function satisfactorily. Time alone will prove the value of this crystal feature in monitoring repeater performance over a period of years.

Let us now consider the terminals of the system. When it was decided to provide 24 telephone channels initially on the two new submarine cables, there was no standard carrier terminal arrangement for giving a continuous spectrum of channels in the required frequency range, 12 to 108 kc, for transmission over the cables. This seemed to present no great problem, however, because it was possible to employ two standard 12-channel banks* with a special group terminal circuit. This group terminal circuit would pass one group directly in the range 60 to 108 kc, as it comes from the channel bank, and would group modulate the other by using a 120-kc carrier to shift it to the 12 to 60-kc range as is done in the type-K system terminal. The two groups would then be joined through a resistance hybrid network to give the desired continuous spectrum of telephone channels from 12 to 108 kc. This is shown in the upper central position of Figure 3.

There were two difficulties that had to be surmounted in carrying this out. In the first place, the 60-kc low-pass filter in the type-K system group modulator, was not designed to eliminate unwanted frequencies only a few hundred cycles above 60 kc, because such frequencies presented no in-

* Record, *May*, 1938, *page* 315.

terference problem in that system. In this submarine cable terminal, however, an unusually sharp discrimination characteristic is needed to permit separation of these groups in only a few hundred cycles at 60 kc. The requirements for this filter were worked out by D. B. Penick and the filter was designed by R. M. Jensen.

The other difficulty to be overcome lay in the fact that there was no auxiliary amplifier to cover the 12 to 60-kc band of frequencies. Moreover, available auxiliary amplifiers transmitted the range of only about 48 kc needed for one 12-channel group. Since an auxiliary amplifier was required in each branch of the special group terminal circuit, and also since it was then believed that a receiving amplifier would be required covering the entire range from 12 to 108 kc, it was decided to design a new all-purpose auxiliary amplifier that would transmit the entire frequency range.

This new amplifier, employing two 407A electron tubes, provides a maximum gain of approximately 44 db with a stabilizing feed-back of about 40 db. Its frequency range extends from 4 kc to 200 kc and its noise contribution to input resistance noise is very small. It is capable of handling a power output of approximately one-half watt. Being equipped with duplicate tube sockets, tubes can be changed without interruption to either telephone or telegraph service.

At each end of the system are transmitting amplifiers common to all 24 circuits. More powerful amplifiers than those within the cable can be used at the terminals, where power is readily available. This makes it possible to extend the distance to the first submarine repeater from either terminal beyond that separating the repeaters in the remainder of the cable.

These amplifiers are modified standard type-J system terminal amplifiers*. Although the type-J system amplifier was designed to transmit frequencies of 36 to 144 kc., it was found practicable to shift the operating range downward to meet the desired requirements of the new submarine cable system. This was done by increasing feedback at the lower end of the band, with some sacrifice at the higher end. The net gain characteristic was substantially unchanged by doing this.

Many of the developments described were brought to fruition with the help of members of Transmission Apparatus Development and J. P. Hoffmann, who did the major part of the terminal equipment design. R. W. Ketchledge and Q. E. Greenwood contributed greatly, both in conception and design effort, to the transmission features described. The cooperative effort of R. L. Tambling, L. F. Staehler, and many others was of great help in carrying the work to completion on schedule.

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* *Bell System Technical Journal, Vol.* 18, 1939, *page* 119.

THE AUTHOR: L. M. ILGENFRITZ entered the Development and Research Department of American Telephone and Telegraph Company in 1920, after receiving a B.S. degree in E.E. at the University of Michigan. As a member of the transmission development group, he worked on the development of all types of carrier telephone and telegraph systems and carriers for submarine cable. After World War II, during which he concentrated on defense work, he was engaged in the development of repeaters for submarine cables. In 1948 this work took him into the development of both the repeater and terminal equipment for the Key West Havana cable. Currently his studies are in submarine cable development.

Mr. Craig Talks at the Laboratories

Cleo F. Craig, President of the American Telephone and Telegraph Company, addressed a group of Laboratories supervisors in the auditorium on December 11. Introduced by M. J. Kelly, Mr. Craig expressed great admiration for the work of the Laboratories as he knew it from long personal association—"I don't think anyone could have a more lively appreciation of the importance of your work than I have, or greater admiration for your achievements."

After pointing out that in the postwar years the Bell System has faced some of the hardest problems we have ever had to meet—perhaps *the* hardest—Mr. Craig said: "We never could have met them so well without the practical new tools which you have put in our hands. That, however, is only the beginning of your influence. What you give us tomorrow is already as much a necessity as what you gave us yesterday and will give us today. Your associates in the Bell System gain strength from knowing that as they meet new problems you, in all probability, have anticipated their requirements and have started the necessary developments."

In meeting the tremendous problems which face the Bell System, Mr. Craig emphasized that in his estimation the governing factor in whether success is achieved is people.

"What we accomplish will, of course, depend on our human energies, on our human skills," he said, "but beyond that again, the results to my notion will depend very largely on whether every man and woman believes in the Laboratories, in the Bell System, and in the importance of his or her part in it. This is our business.

"You are the people," Mr. Craig continued, "who determine what kind of goods the Bell System has to sell. You stock our shelves. Our pastry mix comes from your kitchen and it can never be more salable, tasty or economical than your recipe permits. We can't serve a good pie until you make a better batter, and yet we need to keep on serving better pies at a lower cost. These are critical times both for the country and for the System. The demands on us are enormous and will become even greater. The situation calls for our very best efforts to safeguard the System and the service.

"We have conducted over a hundred rate cases and have some forty now pending, and there seems to be little doubt that still further substantial increases in cost are ahead which means again that more and more revenue will have to be obtained.

"You have an enormous opportunity to improve financial results by increasing the earning power of every dollar in the plant; by making it possible for every unit of labor to provide, with the same effort, more units of communication service."

In conclusion Mr. Craig asked to repeat something he had said at the start of his talk. "It was," he said, "that your work lies at the very heart of the Bell System morale. The habit of progress is ingrained in this business. We call it—and with good reason—a dynamic business. You are inside the dynamo. We have only to look back a few years to realize how amazing were the changes that your accomplishments have made possible. And so when we look to the future, it is no wonder that we think of you with pride, with admiration, and with the greatest possible confidence."

Deal-Holmdel Colloquium

At the November 2 meeting of the Colloquium, a very interesting group of talks on the properties and behavior of ferrites at microwave frequencies was presented by C. L. Hogan, A. G. Fox, W. W. Mumford, and L. E. Hunt. Theoretical background for an understanding of ferrite behavior was given by Mr. Hogan; theoretical aspects were further discussed by Mr. Fox, who illustrated the principles with a working model of a spinning electron. Mr. Mumford gave the results of measurements he had made of dielectric constant and permeability of a number of ferrites at 4,000 megacycles and 10,000 megacycles, while Mr. Hunt rounded out the program with a laboratory demonstration of some of the microwave properties.

On November 30, E. L. Nelson, retired military development engineer, was guest speaker at the Colloquium. Mr. Nelson is at present affiliated with the Signal Corps Engineering Laboratory at Fort Monmouth, N. J. His topic *Some Current Activities at Fort Monmouth,* was of necessity highly restricted concerning the nature of these activities, for reasons of military security. However, research and development of guided missiles predominated. Other projects in the field of communication consist of work in single side band and carrier transmission. He also dealt at some length on the organization of the Signal Corps Laboratories, which include Camp Coles, Camp Evans, and the Watson Laboratories, all located in New Jersey.

Change in Organization

L. S. Hulin, Supervisor of Occupancy Planning at Murray Hill, has become General Occupancy Engineer, reporting to S. H. Willard. Mr. Hulin replaces M. M. McKee, who recently transferred to the New York Area management organization.

F. P. Gilliland has replaced Mr. Hulin as Supervisor of Occupancy Planning at Murray Hill, reporting to J. G. Motley.

Stamp Club Activities

At the "Stamps for the Wounded" booth at the Third Annual Stamp Exhibition of the American Stamp Dealers Association, there were displayed stamp maps of the United States designed by the Laboratories Stamp Club and colored by the veterans at Kingsbridge Hospital. The accompanying illustrations show W. S. R. Smith exhibiting one of the maps filled in by veterans with stamps representing the forty-eight states; and the Laboratories Stamp Club at their annual dinner which preceded their visit to the Stamp Show.

Chief Engineers Visit Murray Hill and West Street

President M. J. Kelly welcomes the visitors to the West Street laboratories.

P. W. Blye demonstrating to the visitors special applications of the EI repeater in the Transmission Standards laboratory

H. N. Wagar describes the operation of the recording flux meter in the Switching Apparatus laboratory.

In the Power laboratory, A. D. Knowlton discusses the regulation of central office power plants under widely varying load conditions.

An all day visit to the Laboratories was made November 30, by Associated Company Chief Engineers accompanied by A T & T Long Lines and O & E department representatives. In the morning, the group, consisting of approximately 100 people, assembled in the Arnold Auditorium, where, following introductory remarks by A. B. Clark, J. B. Fisk spoke on transistors. Several talks on applications of the communication art to military purposes were then given by D. A. Quarles, W. C. Tinus, C. W. Halligan, G. N. Thayer, M. B. McDavitt and A. F. Bennett. R. J. Nossaman concluded the speaking with a description of Outside Plant activities.

Divided into small groups, the guests then made a tour of the Murray Hill Laboratories, where Analytical Methods and Instruments were described by J. B. Fisk and R. M. Burns, Transmission Measurements by L. G. Abraham, and the Digital Computer by E. I. Green.

Following luncheon, the visitors returned to New York, where M. J. Kelly gave a few words of welcome in the West Street Lounge, prior to a tour of the West Street Laboratories. Work in the Transmission Standards Laboratory was described by P. W. Blye; Switching Apparatus by H. N. Wagar, and Power Laboratory by A. D. Knowlton and D. H. Smith. Brief visits were also made to the Automatic Message Accounting Laboratory, where W. B. Groth gave a short talk; the Card Translator in the Switching Systems Laboratory was described by R. C. Davis and M. E. Esternaux, and No. 5 Crossbar by R. E. Hersey.

On December 5, the talks and tours were repeated for about 100 Bell System people from Headquarters. At this time, E. T. Mottram substituted for G. N. Thayer in giving a talk on Military Carrier and Radio, and the Digital Computer was described by D. T. Bell.

G. F. Fowler (right) who is our point-of-contact with New York City's civil defense organization, confers with L. P. Bartheld.

Civil Defense Drill

In cooperation with Civil Defense authorities of New York City, the Laboratories' New York locations carried out a successful air-raid drill in the morning of November 28, preceded by a rehearsal on November 23.

The civil defense organization of the Laboratories in New York is headed by L. P. Bartheld as Building Control Director. For First Aid he looks to D. W. Eitner, and for advice on chemical matters to H. W. Hermance. Deputy Building Control Director is M. M. McKee; on his staff are B. A. Nelsen in charge of water, gas and electricity, J. W. Tengstrom, in charge of the Demolition Squad, and W. A. Tracy, Deputy Zone Commander. Reporting to Mr. Tracy are J. P. Coggins, communications, A. S. Whitley, fire brigade, and D. O'Neill, chief of wardens and special duty force.

Wardens were appointed throughout the building on the basis of not more than fifteen people per warden. Their duty is to see that everybody in their area leaves for the shelters. When the area is cleared each warden reports to his chief warden and with him proceeds to the shelter area assigned. Smaller floors have one chief warden; large floors two or three. All are identified by yellow overseas caps.

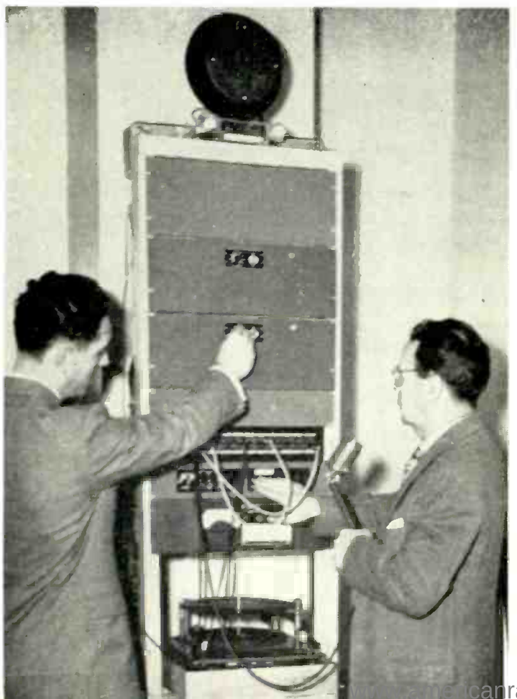
The special duty force under Mr. O'Neill consists of two groups; the uniformed guards, posted at the doors of the building; and volunteers from the American Legion, who take charge of any passers-by who may wish to take shelter in our building and of those in the various reception rooms.

First Aid people, identified by red caps, are distributed throughout the building to care for any casualties.

Communications facilities are centered in a control room near the first floor entrance to Section H. There are ten private lines from shelter areas and four from the special squads—First Aid, Fire, Demolition and Utilities. A public address system working through a jack panel enables the control room to talk to the entire building or to any of the shelter or squad areas. Siren signals from a phonograph record are used for the alert and the "all-clear."

Both the drill and the previous rehearsal went off with great smoothness. Wardens donned their caps and took their posts; other employees rose from their places and followed the routes marked by signs to the shelter area. In the rehearsal it took 9 minutes to clear the building; in the drill, 8½ minutes.

Talking to the Demolition Squad is A. Megraw; Mr. Berka adjusts the gain.



Receiving chief wardens' reports on the private line from the shelter area: D. C. Tyrrell, S. J. Fulton and J. C. Berka. Seated behind them is M. M. McKee; standing, W. A. Tracy.

Laboratories locations in the Graybar-Varick and 14th Street buildings were alerted by bells from the control room; on the signal the people there left their work-places and gathered in the shelter areas assigned; the wardens then reported by telephone.

Plans are in progress for air raid drills at the Murray Hill and Whippany locations.

Air Force Officers

Seventy-three Air Force Communications Electronics officers from the Maxwell Air Force Base, Alabama, spent November 7 at West Street and Murray Hill visiting several laboratories at both locations. Following an introduction and talk on the organization and general functions of the Laboratories by R. K. Honaman, the group made visits to the West Street nationwide dialing laboratory (explained by M. E. Esternaux), No. 5 crossbar (by R. E. Hersey), and step-by-step (by R. O. Rippere). The visitors then traveled to Murray Hill where W. C. Jones spoke to the group on telephone instruments, including the military field telephone set. Visits were then made to the free space room, electron tube research, military carrier system laboratory, microwave laboratory, concourse exhibits, outside plant laboratory, instrumentation laboratory and the metallurgical laboratory. Following these visits, R. M. Ryder spoke on transistors before the group in the Arnold Auditorium.

Stock Transfer Bankers

Murray Hill was host to about 80 members of the New York Stock Transfer Association November 29. This association, of which A T & T is a member, is composed of officers of a large number of banks, trust companies, utility companies, manufacturing corporations, mining companies, and oil companies throughout the United States and Canada.

Following brief addresses by M. B. Long and R. K. Honaman in the Arnold Auditorium, W. E. Kock gave a demonstration lecture on *Microwave and Acoustic Lenses.* After luncheon in the conference dining room, the guests were conducted on a tour of the Laboratories.

Whippany Christmas Party

Whippanyites began the Yule season on December 20 by making the 1951 Christmas dinner and dance the merriest yet. The party sponsored by the Whippany Radio Laboratories Post of the American Legion, was held at the White Meadow Lake Inn in Rockaway.

Members of the Christmas Party Legion Committee were Chairman R. R. Cordell, W. Ness, J. McLay, J. P. Swart. Members of the Whippany Committee were Pat Callahan, Eunice Cottrell, Marie Dempsey, Rosemary Ginder, Ann Harris, Carol Heaton, Fanny Nobile, Audry Henning, Eunice Jordan, Maryann Kufta, Joan Leissler, Helen Monahan, Virginia Mooney, and Margaret Seldney.

Dallas-Houston Coaxial Cable Placed in Service

Long distance telephone calls began traveling over the new coaxial cable connecting Dallas and Houston, Texas, on October 6. Designed to handle the rapidly growing long distance traffic in south-central Texas, the cable was built at a cost of $6,800,000 including one main and thirty-three auxiliary repeater stations along the 251-mile route. The cable will be used jointly by Long Lines and the Southwestern Bell Telephone Company.

Women Pioneers Run a Successful Christmas Bazaar

For the benefit of their Fellowship Fund, the Women's Activities Committee of the New York Council, Telephone Pioneers of America, ran its first Christmas bazaar at West Street on Thursday evening, November 15, and Friday noon, November 16. The bazaar was a success socially and financially. Pioneers had sewed, knitted, crocheted, cooked and baked for days before the bazaar, and their efforts were rewarded. Homemade bread, cake, cup cakes and candy drew crowds, as did the handmade aprons, toys and jewelry at other counters.

Speaking in Chinese, Yee Yut Seul, addressed the people of China. Not having close relatives in the Communist-ruled part of that country, she did not have to conceal her identity. The Economic Cooperation Administration sponsored the program and made recordings available to The Voice of America, Radio Free Europe, and the American Radio Transmitter in Tokyo.

Laboratories Girl Broadcasts To Radio Free Asia

Eight members of the Laboratories, including Yee Yut Seul of the Military Electronics Department at Fourteenth Street, participated in a unique gesture of good will on December 6 as members of the Metropolitan Bell Symphony Orchestra when they presented a concert which was recorded and later transmitted to all Marshall Plan countries by the E. C. A. It was also furnished to Radio Free Europe, the Voice of America, and the American Transmitter in Tokyo.

For the first time a major orchestra of working people without discrimination as to rank, color, or creed and with members of many national origins demonstrated that American industrial employees have the time and means to achieve happiness and distinction through avocation pursuits. Sixteen musicians of the orchestra greeted European and Asiatic nations in twelve languages. There were greetings in Chinese, Russian, Polish, Turkish, Armenian, Serbian, Finnish, German, French, Greek, Italian, and English. The government chose the Metropolitan Bell Symphony Society because of the unusual character of its membership. Ranging from office boys, stenographers, and telephone operators to engineers and executives, the musicians are members of the Bell System in the metropolitan area.

Yee Yut Seul spoke to the people of China. She said in part:

我從小就喜愛音樂。更喜歡小提琴(VIOLIN)。現在，我是在電話公司(BELL TELEPHONE LABORATORIES)工作。有空的時間，就參加他們的樂隊。

Translated this means: "I play second violin in the Metropolitan Bell Symphony Orchestra and I am a clerical worker for Bell Telephone Laboratories. It gives me a great thrill to greet the people of China and all overseas Chinese because my family came from Canton, China. It makes us happy indeed to play for you tonight."

Bell Laboratories Record

Yee Yut Seul's work is in Military Electronics at Fourteenth Street where she is a parts cataloguer. A graduate of Villa Julienne in Dayton, she attended the University of Dayton.

Grace before meals is a family custom in the Yee household.

Chopsticks are always used at mealtime, as is rice. Here are Yee Yut Seul, her husband who formerly lived in China, and their ten-year-old daughter Fung Mei.

A lullaby for Fung Mei before symphony practice is a part of the schedule on rehearsal nights. Fung Mei attends Transfiguration School on Mott Street where she studies English and Chinese.

A goodnight kiss for Fung Mei at the door of their modern apartment in Chinatown before her mother heads out for rehearsal with the Bell System Symphony orchestra at 195 Broadway.

E. F. Hill received his fifty-year emblem from Dr. Kelly.

H. O. Siegmund was master of ceremonies.

H. J. Delchamps presented flowers to Mrs. Hill.

Pioneer Open House

West Street Building, December 6, 1951

Murray Hill Popular Orchestra, as L. J. Speck its leader played a trombone solo.

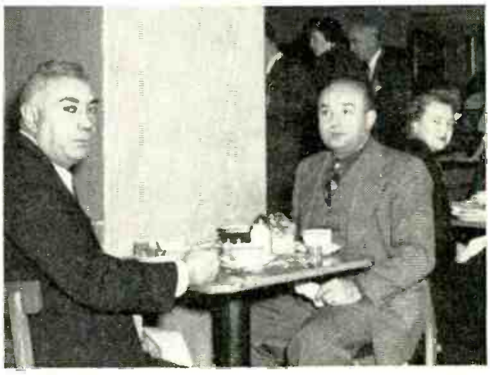
Over fourteen hundred Pioneers, their families and friends, attended the Open House at West Street on December 6, in an evening of good fellowship. To handle the throngs, all the tours, dinners, demonstrations and entertainment were given three times. Highlights of the Open House were the Hobby Show, where crowds milled around in fascination all evening, and the Blueprint Department where an issue of the "Pioneer News" came off the printers as Pioneers passed along. The Murray Hill Popular Orchestra and the West Street Chorus provided entertainment for the evening.

Left to right—Johnny Marko; R. P. Yeaton and the West Street Chorus; and the Belletones—Connie and Arlene Carlson, Shirley Brodley.







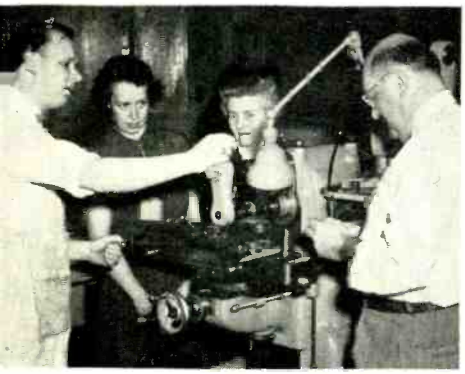




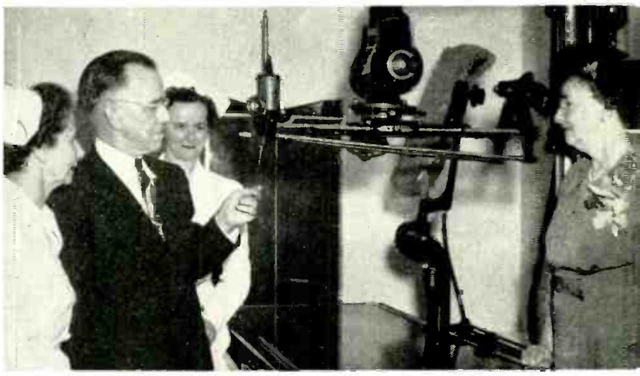
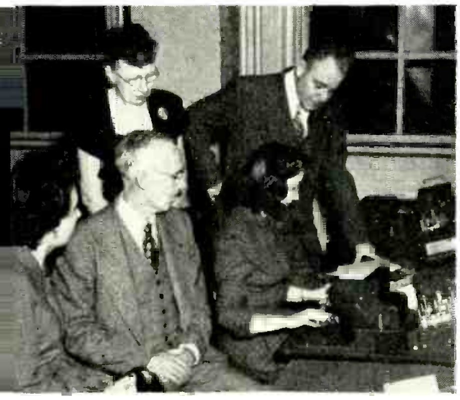



The Hobby Show, of which H. A. Milmoe was chairman, and the tour of rehabilitated sections of the West Street Building, of which F. T. Meyer was chairman, were high spots of the evening celebration. Photography, model railroading, stamp collecting, ceramics, archery, bird carving and needlework exhibits showed the craftsmanship of the Pioneers. Machine Shop, wiring groups, files, drafting, Transcription and Medical were included in the tour.

Center, above—E. F. Hill, who celebrated his fiftieth anniversary on December 6, is showing his fifty year emblem (on a ring) to Margarita G. O'Brien, who celebrated fifty years of service in 1950.



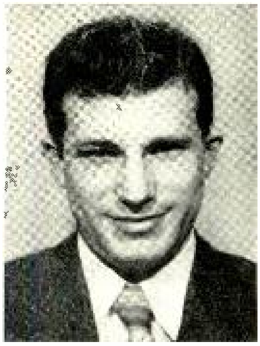


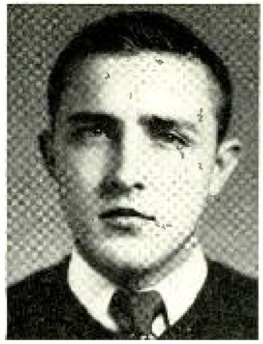




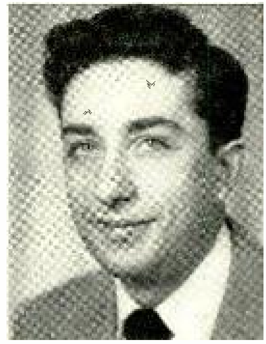
Victor Payse, Jr.



C. R. Arzberger



R. M. Struble



G. N. Russo

CALLED TO ACTIVE DUTY

CHARLES R. ARZBERGER, who was a draftsman in the Specifications and Drafting Department at West Street, has been recalled to active service with the Signal Corps. Mr. Arzberger graduated from Valley Stream Central High School and attended the University of Delaware.

VICTOR PAYSE, JR., had transferred from the Pacific Telephone and Telegraph Company in September to work as a member of the Technical Staff in Military Electronics at Whippany. He was called back into the Air Force in November. Mr. Payse received his engineering degrees at the University of California.

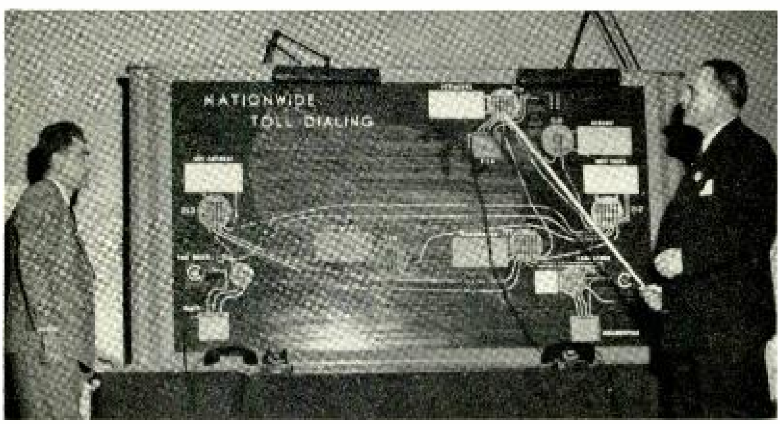
GEORGE N. RUSSO, a photostat operator in Area Management at Murray Hill, had been a member of the Laboratories since 1948, shortly after he graduated from Central High School in Newark. He was drafted into the Marine Corps.

ROBERT M. STRUBLE, a graduate of Westfield High School, had been an assembler in the Electronic Apparatus Development Department at Murray Hill before he enlisted in the Navy.

New Long Distance Telephone Center Planned

Tentative plans calling for the construction of a long distance telephone building in White Plains, have recently been formulated by Long Lines. Contracts to purchase property on the north side of Hamilton Avenue between Church Street and North Broadway have been obtained subject to a change of zoning. If negotiations can be completed, the Company plans to erect a building on the site to house a long distance telephone center. It was pointed out that the proposed White Plains building is needed to take care of the growth of long distance calls passing through, as well as originating and terminating in, Westchester and surrounding counties.

Construction of the new building, which would be designed to harmonize with the sur-



Pioneers and their families at the Open House were intrigued by a demonstration of nationwide toll dialing put on by M. E. Esternaux (with pointer) and R. F. Dusenberry. Using an animated display panel designed and built in a training course, Mr. Esternaux traced a call from a subscriber in San Diego through the toll operator and intermediate switching points to a subscriber in Syracuse.

rounding area, is dependent upon the granting of a modification in the zoning ordinance. A petition will be submitted to the White Plains Common Council at an early meeting requesting the necessary changes.

A.I.E.E. Committee Roster

Members of the Laboratories serving on general committees of the A.I.E.E. for the year 1951-52 are: *Board of Examiners*, R. A. Heising, H. E. Ives (retired), F. J. Scudder (retired) and H. M. Trueblood (retired); *Membership*, C. Clos, Vice Chairman; *Public Relations*, R. K. Honaman; *Safety*, L. S. Inskip; *Standards*, R. D. deKay; *Publication, Sections, and Technical Advisory*, J. D. Tebo; and *Technical Program*, E. I. Green.

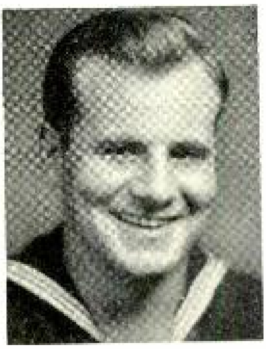
D. A. Quarles represents the Institute on the *United Engineering Trustees Inc.*, H. M. Trueblood on the *National Association of Corrosion Engineers, Inter-Society Committee on Corrosion*, and R. D. deKay is an alternate member of the *Electrical Standards Committee, A.S.A. and U. S. National Committee of the International Electrotechnical Commission.*

Members of professional group committees are: *Edison Medal*, R. I. Wilkinson; *Management*, D. A. Quarles; and *Award of Institute Prizes*, H. A. Affel.

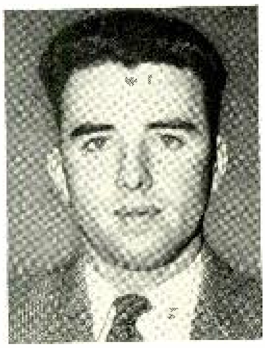
Members on Technical Committees are: *Communication Division Committee*, H. A. Affel, Vice Chairman, L. G. Abraham, and John Meszar; *Communication Switching Systems*, John Meszar, chairman, W. Keister, secretary, and R. C. Davis; *Radio Communication Systems*, A. C. Dickieson, Vice Chairman; *Telegraph Systems*, R. B. Shanck, secretary, and E. F. Watson; *Wire Communication Systems*, L. G. Abraham, chairman, and P. G. Edwards secretary; *Feedback Control Systems*, J. G. Ferguson; *Protective Devices*, and *Transmission and Distribution*, P. A. Jeanne; *Science and Electronic Division Committee*, E. I. Green, chairman, W. H. MacWilliams, Jr., and J. D. Tebo; *Basic Sciences*, R. M. Bozorth, Vice Chairman, J. A. Becker, and W. H. MacWilliams, Jr.; *Computing Devices*, W. H. MacWilliams, Jr., chairman; *Electronics, Metallic Rectifiers*, and *Electronic Power Converters*, D. E. Trucksess; *Instruments and Measurements*, E. P. Felch, Jr., and J. G. Ferguson; and *Magnetic Amplifiers*, A. B. Haines.

Subcommittees of the Technical Committees include the following: *Mobile Radio*, A. C. Dickieson; *Facsimile (Telegraph)*, E. F. Watson; *Fault Limiting Devices*, P. A. Jeanne; *General Systems*, P. W. Blye; *Electric Circuit Theory*, R. L. Dietzold; *Electrical Properties of Gases*, L. H. Germer; *Energy Sources*, J. D. Tebo; *Magnetics*, R. M. Bozorth, chairman, and R. A. Chegwidden; *Dielectrics*, G. T. Kohman; *Semiconductors and Transistors*, J. A. Becker; *Computer Bibliography*, W. H. MacWilliams, Jr., *Hot Cathode Power Converters*, D. E. Trucksess; *Mechanical Rectifiers*, D. H. Smith; *Papers Review (Electronics)*, S. B. Ingram; *High Frequency Conductors, Cables, and Connectors*, W. J. King; *Instruments and Measurements Organization*, E. I. Green; *High Frequency Measurements*, E. P. Felch, Jr., *Industrial Spectroscopy*, E. K. Jaycox; *Recorders and Controllers*, J. G. Ferguson (also represents I. and M. Committee on Feedback Control Systems Committee); *Magnetic Amplifier Applications, Magnetic Amplifier Definitions*, and *Magnetic Amplifier Non-Linear Circuit Theory*, A. B. Haines; *Ratings of Magnetic Amplifiers*, B. E. Stevens; *Metallic Rectifier Definitions*, D. E. Trucksess; *Joint Subcommittee on Electronic Instruments*, W. H. Tidd, vice chairman; and *Lightning Protective Devices*, L. S. Inskip.

RETURNED FROM SERVICE



J. A. Ceonzo



G. F. Boyle

JOSEPH A. CEONZO, who was recalled to service in August, 1950, returned November 26 to the Switching Systems Development Department where he is a technical assistant. While in the Navy Mr. Ceonzo served on the *U.S.S. Sproston* as a Chief Petty Officer. During World War II he was a soundman aboard the destroyer escort *Powell* and the destroyer *McCormick*

GUY F. BOYLE has returned to the Murray Hill Laboratories where he is a member of the Photocopy Department, operating a reverse negative camera. Mr. Boyle had spent a year from September, 1950, to September, 1951, in the Marine Corps with the Maintenance Corps. From 1943 to 1946 he had served overseas in the Asiatic Pacific Theater of War and on Okinawa. He is the son of F. J. Boyle of the Financial Department.

RETIREMENTS

Among recent retirements from the Laboratories are H. H. Hall with 45 years of service; H. W. Weinhart, 39 years; E. F. Kingsbury, 31 years; and J. C. Vogel, 28 years.

Harry H. Hall

Joining Western Electric in 1906 when it was making telephones at West Street, Harry Hall was first a clerk on shops materials. After some years he transferred to the Engineering Department, predecessor of the Laboratories, to become a service man. For two years during World War I he was in the Army; he received the Purple Heart after an action on the Vesle River. Returning, he continued in service work until 1923, when he transferred to accounting. In 1929 he became a supervisor in Purchasing, taking charge of requisition and invoice checking and other services.

During World War II Mr. Hall was in Commercial Relations. During that period, the Laboratories turned out many millions of dollars worth of military devices on "pre-production" orders; Mr. Hall was responsible for checking the invoices against orders to see that shipments were complete and properly identified. When war work was finally wound up, he joined the Commercial and Staff Service group. One of his big jobs was for Trial Installation, in connection with the Boston-New York radio relay system. Recently he has had charge of service to Switching Apparatus Development, and to the lecture aids group in the Publication Department.

A native and continuous resident of Brooklyn, Mr. Hall married a Brooklyn girl—Elza Rowalt—who at the time was a member of the Laboratories. The Halls have left on a leisurely motor trip to the Coast; when they return it will be to their home in Mill Basin. His home, his garden and interests as a church trustee and civic worker will keep him busy.

Howard W. Weinhart

When Howard Weinhart became the late H. D. Arnold's technical assistant late in 1912, he was detailed to the experiments on the mercury arc repeater. When our work on the vacuum tube was initiated the following year, Mr. Weinhart was among those who constructed the first tubes made in our laboratories. Very soon the first transcontinental line was engaging the attention of engineers and he worked on the development of vacuum tube repeaters for that project. At about the

H. H. Hall

H. W. Weinhart

same time the power amplifier tubes for the Arlington-Paris radio demonstration were developed and built with his assistance.

Continuously since then Mr. Weinhart has been concerned in the development of many types of vacuum tubes. The cathode-ray oscillograph and the photoelectric cell are among the devices to which he contributed. The glow tubes and the cathode-ray tubes used in the various television demonstrations were all built under his direction or with his active participation.

In the middle Thirties Mr. Weinhart was given the problem of developing production equipment and techniques for applying a metal coating to quartz crystals by evaporation of metal in a vacuum. These crystals had come into general use for stabilizing the frequency of oscillators for radio transmitters. With the advent of war, demand for these crystals soared, and the evaporation process was widely used to produce millions of crystals for the Armed Forces. Mr. Weinhart then turned to production techniques for deposited-carbon resistors, and supervised the construction of many thousands of them for military uses. By the evaporation technique Mr. Weinhart was responsible for the early developments of metallized condenser paper, a product now in large-scale commercial production. In recent years he has been a research engineer, designing the physical facilities for many researches in electronics.

Mr. and Mrs. Weinhart have not made plans beyond remaining in their home in Elizabeth; his interest in handicraft and his home workshop will keep him occupied until his health improves.

Edwin F. Kingsbury

While Mr. Kingsbury was with United Gas Improvement in Philadelphia, he worked with H. E. Ives on the theory of the Welsbach

Mantle. This led to a Longstreth medal from the Franklin Institute and to a distinguished career in Bell Laboratories.

Graduating from Colgate (B.S. 1910) Mr. Kingsbury was with U. G. I. until he entered the Air Corps to work on airplane camera development. After a year with Eastman Kodak he joined the Laboratories, working first on contact studies; introduction of copper-palladium alloy as a contact material was an outcome of this work.

When Dr. Ives took up the development of a telephotograph system, Mr. Kingsbury studied the relations between transmission and picture quality. Soon after the successful demonstration of long distance picture transmission in 1924, the Ives group took up the development of a television system, and Mr. Kingsbury concerned himself chiefly with photoelectric cells. When the system was ready for demonstration, he was in technical charge at the Washington transmitting point. He continued with television through the successful demonstration of a two-way system in 1930, and then took up several electro-optical problems, such as the Kerr cell as a light valve for television projection and the development of photoelectric cells.

During World War II Mr. Kingsbury worked on detection of infra-red radiation through use of the wavelength converter tube, and on the detection of enemy messages concealed in minute "dots" of photographic film. He then took up the early optical development for the card translator, photoelectric cells and multipliers for television.

Long a member of his church's official board, Mr. Kingsbury is well rooted in Rutherford. After a trip to Florida he and his wife will return there, where his garden and his interest in physiological optics will give him plenty to do in his new leisure. He is a member of the Franklin Institute and the Optical Society of America, and a fellow of the American Physical Society and of the American Association for the Advancement of Science.


E. F. Kingsbury


J. C. Vogel

Julius C. Vogel

On graduating from Stevens Institute (M.E. 1908) Mr. Vogel worked for a year for a consulting engineer and then for the Weston Electrical Instrument Corporation in Newark on the design of meters and transformers. In 1923 he joined the Laboratories, designing special coils, shielded bridges, oscillators and amplifiers. He became an expert on the mechanical design of measurement and electronic apparatus and saw many of his designs go into substantial production. During the war he worked on oscillators for underwater sound development and Signal Corps applications. Most recently he has collaborated on the design of highly precise measurement equipment needed in the production of computer networks for military purposes.

In his home town of Jersey City, where he expects to remain, Mr. Vogel has long been active in church work. His daughter is married and he has three grandchildren on whom he practices his hobby of picture taking which includes a very high grade of movie making. Currently he is president of the Metropolitan Motion Picture Club of New York.

Automatic Switching of Long Distance Calls Starts in Dallas

Telephone operators in Dallas, Texas, this week began to dial directly to telephones in distant cities through new automatic switching equipment placed in operation by the Long Lines Department of the American Telephone and Telegraph Company and the Southwestern Bell Telephone Company. Dallas became the fifteenth city in the United States with machine switching equipment for handling long distance telephone calls.

Besides permitting direct long distance dialing to more than 1200 communities by telephone operators in Dallas, the equipment automatically switches calls that are routed to and through Dallas from other cities. The $6,000,000 system, installed over a period of ten months, will handle approximately 25 per cent of the long distance traffic originating, terminating, or switched at Dallas. About 110,000 long distance calls pass through the Dallas central office daily.

H. D. MacPherson, D. H. Wetherall, R. C. Pfarrer and W. B. Callaway of the Laboratories were present at the cutover.

Murray Hill Doll and Toy Committee.

Whippany Legion Post spent many busy lunch hours painting the toys.

Dolls and Toys — 19

Members of the Laboratories contributed a thousand dolls in handmade clothes and several thousand toys to Santa Claus' pack for children in dire need in charity beds of Greater New York and New Jersey hospitals, in boarding homes, orphan asylums and settlement houses. Exhibits of the dolls and toys, an annual institution at the Laboratories for over fifteen years, were held during the last week in November in New York and Whippany and during the second week in December at Murray Hill. Included in the exhibits were gifts from members of the Laboratories at Allentown, Deal, Holmdel and Kearny. Laboratories members at Winston-Salem and Burlington participated in their local doll and toy campaigns under Harry Doll's leadership.

In New York where Second Vice-President of Bell Laboratories Club Eugenia Wyckoff was chairman, 525 dolls were dressed and 2500 toys bought with the contributions of $1619.78 There were many highlights which added color to the campaign. From Morocco came a letter and a doll, a rare collector's item, sent by Lieutenant B. G. Hemmendinger (on military leave) who is on duty in that country.

Ida Tassi of the West Street restaurant was responsible for having 125 dolls dressed, some by restaurant girls but most of them by her neighbors in Greenwich Village. Among those

Below, right—H. W. Nylund's daughter and her friends dressed these dolls. Madeline Samek and Elizabeth Garrow are the Committee representatives.

Below—Whippany Doll and Toy Committee.

New York Doll and Toy Committee.

ROGRAM A HUGE SUCCESS

was a laundry worker who took two dolls to Harlem and dressed them. When she was a child, she told Miss Tassi, her Christmases had been made happy by dolls donated by the telephone girls.

At Murray Hill the Doll and Toy Committee, under chairmanship of Eileen Gilburn, dressed 285 dolls and donated 590 toys. This year the polio children in Sister Kenny Foundation and well children who are detained on a floor of Jersey City Medical Center, pending their disposition by the courts, were added to the list of needy children who became recipients of the dolls and toys donated by members of the Laboratories at that location.

This year's doll and toy display at Whippany, under the chairmanship of Alice Charlton, featured a toy shop as the main point of interest. These were distributed through the Council of Social Agencies which apportions them to hospitals, State Board of Welfare, and various medical institutions in Morris County. One hundred gift-wrapped dolls and toys were distributed personally by the Committee.

Whippany Radio Post 329 of the American Legion conducted a Tide of Toys program wherein they collected many dolls and toys which they repaired and painted. These were also displayed and were distributed by the Committee prior to Christmas.

Below—R. P. Martin, Jr., writes a poem each year for the exhibit at West Street.

Above—Ida Tassi's contribution.

Below, left—A Village laundry worker dressed two dolls for the Doll and Toy Committee.

Below—The exhibit at Murray Hill.

L. T. Cox

SERVICE ANNIVERSARIES

Members of the Laboratories who will receive Service Emblems on the January dates noted

Helen Ryan

45 Years

L. T. Cox 21st

35 Years

Helen Ryan 15th

30 Years

R. B. Bauer 3rd
J. Cameron 30th
J. S. Clark 9th
P. Higgins 23rd
F. S. Kammerer . . . 13th
Florence Metz 12th
D. W. Pitkin 14th

25 Years

W. Arelt 31st
M. A. Basedow 31st
Mary Brainard 3rd
Marion Canavan . . 29th
J. H. Kronmeyer . . 18th
Rose Rovegno 25th
F. W. Steele 31st
E. E. Szymanski . . 17th
R. Weihs 31st

20 Years

A. J. Kisley 24th
W. A. Waechtler . . . 7th

15 Years

C. B. Brown 29th
G. Bukur 20th
G. E. Campbell . . . 17th
F. Caroselli 21st
R. F. Heinrich 25th
J. W. Hoell 22nd
A. O. Jagau 26th
R. E. Johnson 9th
M. Konash 26th
E. T. Lundgren 4th
J. R. May 28th
J. W. McRae 11th
G. E. Oram 11th
W. L. Rohr 15th
C. J. Schnoor 18th

10 Years

J. R. Andersen 30th
W. A. Anderson . . . 30th
A. D. Beers 15th
L. C. Brown 15th
H. T. Casey 19th
J. J. Coleman 27th
R. W. Coons 5th
M. F. Cottone 12th
C. W. Ferguson . . . 15th
S. N. Foster 12th
R. A. Fritts 19th
Frances Garrett . . 30th
R. P. Graef 12th
J. J. Headd 6th
H. G. Holner 26th
R. J. Huben 28th
W. M. Lightbowne . 15th
E. J. McGarry 19th
P. P. Melkonian . . . 14th
F. J. Miglino 28th
F. R. Misiewicz 5th
L. Paxton 12th
Anna M. Perrotta . . 12th
W. E. Poliakoff . . . 27th
E. Sesso 28th
A. T. Stiller 9th
A. R. Suneson 12th
T. R. Trauerts 28th
S. R. White 19th
A. R. Winslow 20th
S. J. Yantosh 2nd

Naval Electronics Students

Twenty-one post-graduate students of the U. S. Naval Academy made their annual visit to the Laboratories December 3, 4 and 5. On the first day, the group was taken to 180 Varick Street, where they were shown the 81-type automatic teletypewriter switching system (described by G. J. Knandel), the 43A1 frequency shift carrier telegraph system (R. A. Vanderlippe), and a No. 28 teletypewriter demonstration (B. S. Swezey).

Luncheon was held at Murray Hill, followed by inspection of the Concourse displays. S. A. Schelkunoff gave the visitors a lecture on *Propagation of Waves* after which J. G. Ferguson described the measuring and testing techniques employed in the Laboratories. The final talk of the day was a lecture demonstration of acoustic lenses by W. E. Kock. Continuing the visit on December 4, the morning program included talks on the development of the Transistor by H. A. Affel, G. L. Pearson, R. M. Ryder and A. E. Anderson. In the afternoon, work of the crystal laboratory was described by A. C. Walker; this was followed by a visit to the electron dynamics laboratory.

Whippany was visited on December 5. Following introductory remarks by W. H. C. Higgins, several radar developments, fire-control systems, and guided missile developments were described by the following: J. W. Smith, A. A. Lundstrom, J. B. Bishop, S. C. Hight, R. C. Newhouse, R. R. Hough, F. E. Nimmcke, J. M. West, H. G. Och and M. J. Berger.

Acoustical Terminology Standard

An "American Standard Acoustical Terminology" has just been issued by the American Standards Association. It supersedes the 1942 edition and has a much greater scope: Among the new subjects covered by definitions are ultrasonics, underwater sound, recording and reproducing, shock and vibration, and acoustical units. It represents a joint effort by the Acoustical Society of America and the Institute of Radio Engineers. Co-chairman of the committee were E. Dietze (deceased) and C. F. Wiebusch who had previously headed corresponding committees in these societies. Co-secretaries were M. S. Richardson, and W. D. Goodale, Jr., who is now chairman of the I.R.E. Committee on Electroacoustics.

Completion of this Standard culminates four years of work involving approval of a number of technical organizations, including, among many others, A.I.E.E., American Institute of Physics, Radio-Television Manufacturers Association, and the Society of Motion Picture and Television Engineers.

News Notes

LIEUTENANT ERNEST F. NEUBERT, ace flier, whose heroic exploits in World War II were recorded on several occasions in the newspapers and the RECORD, is again in the limelight. His story, featured in recent Associated Press releases, tells of his destroying MIG's in air battles over northwest Korea. When he was released from service in 1946, Lieutenant Neubert returned to the Laboratories for a short time, and then decided to enter college. He was recalled to active duty before his education had been completed.

VARIOUS CLASSES of calls to the auxiliary services operators in a dial office obviously have different priorities. Circuits designed to recognize this have been incorporated in the No. 23 operation room desk, of which the first was put in service in Harrisburg last summer. Cutover of the second desk at Canton was attended by H. W. STRAUB of the Laboratories and E. N. Chamberlain, G. L. Goudy and H. F. Parker, all of O & E Traffic.

AS PART of the civil defense program, a group of 200 members of the Laboratories at New York locations are currently being trained in First Aid. The course is a general survey of the material in the Red Cross Standard Course. Those who complete this course will be allowed nine hours credit towards a Red Cross certificate provided they complete a thirteen-hour supplementary course within a reasonable time. L. E. COON is in general charge, with instructors, in addition to himself, R. P. JUTSON, RUTH ROBINSON, W. G. SMITH, M. L. WEBER and A. L. JOHNSRUD. There will be four sessions at weekly intervals.

"The Telephone Hour"

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

January 7	Lily Pons, *coloratura soprano*
January 14	Zino Francescatti, *violinist*
January 21	Clifford Curzon, *pianist*
January 28	Ferruccio Tagliavini, *tenor*
February 4	Ezio Pinza, *basso*
February 11	Barbara Gibson, *coloratura soprano*
February 18	Robert Casadesus, *pianist*
February 25	Lucile Cummings, *contralto*

THE LABORATORIES' miniaturization program on message registers, of which several thousand may be installed in a central office, has progressed to the point where a new register, the 14-type, is about to go into manufacture. This register is considerably smaller than its predecessors, the No. 5 and the No. 12, but still it must be mounted in the same frames with them for additions to existing installations. Not only is appearance involved, but the numbers displayed must be in the same plane as in the earlier registers, so that all may be photographed at the same time. W. W. BROWN visited Hawthorne recently to discuss suitable equipment arrangements for the new register with Western Electric engineers.

ECONOMIES in copper begin in strange places. Smaller wires in cables mean longer "operate" time for pulsing relays; but the extra milliseconds can be chiseled out of the hundred or so allowed for a dial pulse only if satisfactory margin against error in dial and relay adjustments can be retained. Taking advantage of the accuracy attainable in the dials of the 500-type telephone set, relays were adjusted in the long subscriber loops in the Trenton and Elmira offices last spring. Recently, F. B. BLAKE and R. O. RIPPERE inspected the tests at Elmira and were gratified to find the adjustments holding up well.

A. C. DICKIESON spoke on *Radio As It Is Used in the Bell System* at West Street on November 19 in the second of a series of informative lectures designed to acquaint members of the Laboratories with certain areas of work. Mr. Dickieson, in his talk which was illustrated with slides, surveyed briefly the transmission and allocation picture, and the growth, present status and future prospects of the Bell System radio services. He repeated this talk at Whippany and Murray Hill.

DR. P. L. VIGOUREUX, of the Admiralty Research Laboratory, Teddington, visited Murray Hill on November 26. Dr. Vigoureux, who has also worked at the National Physical Laboratory, is internationally known for his work in vibration, electricity, and electro-acoustics. He spoke on *Problems in Electro-Acoustics*.

G. R. GOHN was in Philadelphia to attend the fall meeting of the A.S.T.M. Administrative Committee on Papers and Publications, planning the technical program for the fiftieth anniversary meeting in June 1952. Mr. Gohn was appointed to a third three-year term on Papers Committee and Chairman of Special Committee in charge of Technical Program for the fiftieth anniversary meeting.

"Hark the Herald Angels Sing" resounded through the Auditorium on December 21 as the West Street Chorus gave its annual Christmas concert under direction of R. P. Yeaton. The Chorus also sang for a second year at the New York Savings Bank.

M. Sparks talked to the Physics Colloquium at the University of Syracuse on *Fundamentals of Transistors.*

V. T. Wallder participated in the D-20 Subcommittee of A.S.T.M. meetings in Niagara Falls, Ontario, discussing specifications for polyethylene and low temperature testing of thermoplastics. He also discussed switchboard and inside wiring cable jacketing materials with engineers at the Tonawanda plant. Mr. Wallder was appointed a member of the Society of Plastics Industry Committee on Aging of Thin Film and Sheeting. He and J. B. DeCoste attended a meeting of this committee in New York City.

H. E. Kern, J. J. Lander, N. B. Hannay and L. A. Wooten attended a Symposium on Thermionic Emission held by the Physical Society in Washington.

Gorden Raisbeck discussed *Applications of Junction Transistors* at a meeting of the Boston Section of the Institute of Radio Engineers, and *Developments in Transistor Circuit Theory* at meetings of the Long Island and Monmouth subsections.

In order to improve reliability of service on Nantucket Island the New England Telephone and Telegraph Company has decided to place the cable plant on the Island under air pressure. Dry air at the correct pressure for aerial cable is supplied by a compressor-dehydrator designed by these Laboratories. T. A. Durkin and R. A. Broomfield visited Nantucket with New England Company engineers to assist in preparing the system for operation.

At a symposium on ferrites held at Rutgers University J. K. Galt spoke on *Initial Permeability and Related Losses in Ferrites.* Assisted by E. A. Nesbitt and J. G. Walker, H. J. Williams presented recent developments in magnetic domain theory to the Rutgers Physics Colloquium. The lecture included the Laboratories film *Action Pictures of Ferromagnetic Domains.*

W. P. Mason and H. J. McSkimin attended the meeting of the Acoustical Society of America in Chicago. Mr. McSkimin presented a paper on *Measurement of the Shear Impedance of Viscous Liquids by Means of Traveling Torsional Waves.* K. B. McAfee also spoke, presenting a paper by himself, W. Shockley and M. Sparks on *Pressure Dependence of Zener Current in Germanium.*

At the Solvay Conference in Brussels, W. Shockley spoke on *Dislocation Models of Grain Boundaries.* In London he talked on *Recent Developments in Transistor Electronics* before the Institution of Electrical Engineers. He also participated in a discussion conference on Transistors arranged by Sir John Cockroft.

An Invitation to speak took W. Shockley to the National Academy of Sciences meeting at New Haven. His subject was *Transistor Electronics.* He also led a colloquium at the Department of Physics, University of Rochester.

Winners of the 1951 bowling trophy in the Trades League, left to right, Hans Brunjes, Alec Howitt, William McAndrew, Thomas Dorsey and Joseph Grygotis, painters at West Street, are striving to claim their prize again in 1952.

M. W. Bowker and D. C. Smith at Carlisle, Pa., witnessed the performance on a Long Lines cable of a leak locator designed by the Laboratories. This device detects small amounts of a halogen gas (freon) escaping from a charged cable by the change in current through an element sensitive to the presence of the gas. This change unbalances a circuit and causes an alarm to be sounded.

A property of germanium of potential usefulness in nuclear research is its ability to generate current pulses when bombarded by charged particles. K. G. McKay discussed this and related topics in a talk entitled *Crystal Counters* at an American Physical Society meeting in Houston, Texas.

L. H. Campbell visited the U. S. Department of Agriculture laboratory at Beltsville, Maryland, and the du Pont laboratories at Wilmington, Del., in connection with studies involving chemical control of insects reported to be attacking Alpeth cable on a limited scale in California.

During October and November S. C. Hight, M. E. Campbell, H. Morrison, B. McKim, F. A. Polkinghorn and J. M. Trecker of Whippany, and W. O. Arnold, W. C. Babcock, D. E. Brenneman, R. B. Curtis, P. V. Dimock, R. M. Gryb, D. L. Moody, G. H. Peterson, H. M. Pruden, W. Strack, Jr. and L. E. Weinberger of West Street participated as observers in Operation lantflex, the first major fleet exercise since the outbreak of the Korean War. A total of 200 ships, 800 planes and 90,000 Navy and Marine personnel participated in this tremendous war game which extended from Puerto Rico up the coast of the United States and terminated in a grand amphibious assault on Onslow Beach, N. C.

The 25th and 35th service anniversaries of members of Station Apparatus Development were observed at the annual departmental dinner which was held at the Chi-Am Restaurant on November 20. Each of the ten guests of honor was presented with a distinctive multicolored motar board of fantastic design, symbolizing the completion of his service period, and a fountain pen desk set bearing an engraved plaque. The guests of honor are shown in the photograph after having been persuaded to express in song their gratitude for the honors bestowed upon them. They are, left to right, R. T. Jenkins, R. E. Polk, R. E. Wirsching, H. P. Lynch, L. E. Arnold, F. L. Crutchfield, E. C. McDermott, L. E. Krebs, F. E. Engelke, and J. M. Rogie. Mr. Jenkins and Mr. Engelke have completed 35 years of service and the rest, 25 years.

S. M. Arnold, J. B. Dixon, A. P. Jahn and A. Mendizza, with Ohio Bell people, inspected specimens on the corrosion test rack at Steubenville, Ohio, and some of the earliest plant installations on corrosion resistant steel strand and lashing wire.

A. P. Jahn and A. Mendizza, with A T & T and New Jersey Bell engineers inspected drop-wire installations in the Atlantic City area. These were the first installations of neoprene jacketed drop wire and have been in service ten years. Aluminum drop-wire clamps installed a year ago were inspected for corrosion. Mr. Jahn visited the A.S.T.M. test plot at Fort Hancock, Sandy Hook, N. J., to inspect corrosion test wire specimens.

R. C. Pfarrer spoke at Dallas in connection with the A4A cutover there on November 25. Mr. Pfarrer studies traffic flow through each A4A office and then presents results of the traffic flow studies to Plant and Traffic representatives. W. B. Callaway, A. A. Hanson and D. H. MacPherson, also attended the cutover. Mr. MacPherson held conferences at Dallas on problems common to control circuits.

RECENT DEATHS

May Reilly

W. E. Stephens, Jr.

H. L. Bostater

May G. Reilly

May Reilly died in the early morning hours of November 19 during a fire in her apartment. Born in New York in 1887, Miss Reilly was graduated from Cathedral High School. She was working in Wanamaker's book department when a Western Electric patent executive, impressed by her memory each time he visited the store, asked her to join the Patent Department. For thirty-two years Miss Reilly's keen memory, coupled with her meticulous supervision of patent files and library and her genius for good housekeeping, served the Laboratories in good stead. At the time of her retirement in March 1951 she was Patent Librarian in charge of the library and files. She is survived by her sister and two nieces.

William E. Stephens, Jr.

William E. Stephens, Jr., had been a calibrator and tester in the Coil Shop at Murray Hill since he joined the Laboratories in September, 1951. He was born in Montville, N. J., August 6, 1929, attended elementary school there and was graduated from Boonton High School in 1947. Following two years in the Navy where he studied in electronics and radar schools, he was engaged in machine shop work before entering the Coil Shop.

Mr. Stephens was killed driving near his home on November 28. He is survived by his wife and two small children.

Herbert L. Bostater

Mr. Bostater, who retired from the Laboratories on April 1, 1939, after 34 years of service, died on December 8. He was formerly a Member of the Technical Staff in the Systems Department. Born March 20, 1874, Mr. Bostater was graduated from Ohio State University with an M.E. degree in 1904. In 1906 he joined the Western Electric Company at Clinton Street, Chicago, on equipment engineering and in 1907 moved to Hawthorne where he was supervisor of equipment engineering on small central-office switchboards. In 1912 he came to New York where he was assigned first to the circuit laboratory and later to the group working on semi-mechanical dial systems. From 1918 to 1921 he was in charge of circuit work in connection with the introduction of a step-by-step system. Following this he made fundamental development studies of various telephone systems. From 1928 until he retired Mr. Bostater was in equipment development making cost studies of manual and dial equipment. He is survived by a wife and daughter.

Charles H. Prescott Dies

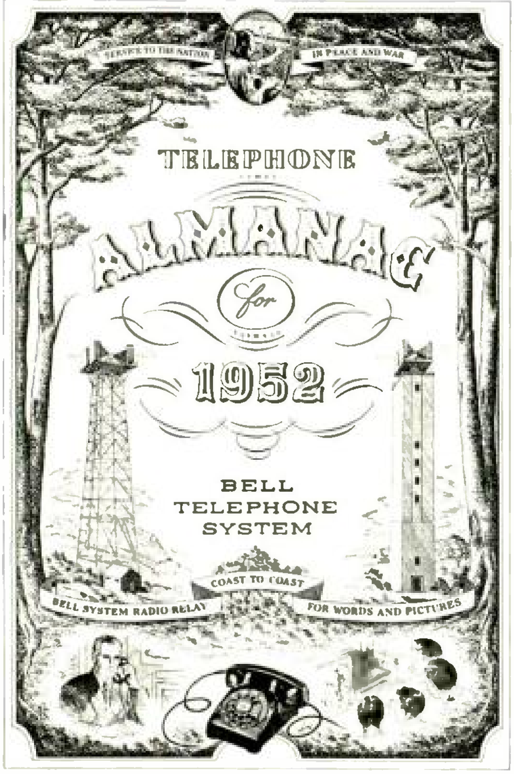
Word has been received that Charles H. Prescott, formerly of the Electron Tube Department and Chemical Laboratories, died of burns received in an explosion at an electronics plant in California October 24.

Dr. Prescott came to the Laboratories in 1928, having received his B.A. degree from Yale in 1922 and the Ph.D. from California Institute of Technology in 1926. From 1928 until 1938, he was engaged in the study of the physical and chemical properties of oxide coated cathodes for use in electron tubes for telephone purposes. In 1938 he transferred to the Chemical Laboratories, and in 1942 he was granted a leave of absence to engage in work for the NDRC at the University of California at Berkeley. This continued until 1946, when he resigned from the Laboratories.

News Notes

J. R. Townsend has been elected a member of the Board of Directors and the Finance Committee of the American Standards Association.

R. Burns and G. H. Williams visited the Dow Chemical Company at Midland, Mich., in connection with engineering control of polystyrene foam for TD-2 radio relay equipment.



The Bell System's new coast-to-coast radio-relay network is a feature of the 1952 Telephone Almanac for 1952. For employees in New York locations, copies will be available in the Club Store on the catalogue table. The almanac will be placed in the libraries at Murray Hill, Whippany, Holmdel, and Deal, and a self-service system will be in effect.

At Niagara Falls, Ontario, G. Deeg, J. J. Martin and E. E. Wright attended meetings of the A.S.T.M. Committee D-9 on Electrical Insulating Materials and D-20 on Plastics. K. G. Coutlee attended subcommittee meetings of A.S.T.M. Committee D-9 on Insulating Materials. His improved test method for rapid dielectric loss classification of mica used in capacitors, vacuum tubes and other critical low loss applications received Committee approval and will be incorporated in A.S.T.M. D748 Specifications for Mica for Capacitors.

C. M. Hill attended the Rubber and Plastics sessions at the American Society of Mechanical Engineers annual meeting in Atlantic City on November 27.

I. V. Williams visited Hawthorne to discuss methods of specifying raw materials on government drawings. Mr. Williams spoke before the Chicago Chapter of American Society for Metals on the subject, *Substitutions for Non-Ferrous Materials.*

J. J. Lander presented a paper, co-authored by H. E. Kern and A. L. Beach, on *Solubility and Diffusion Coefficient of Carbon in Nickel* at the Physical Electronics Conference in Washington.

C. J. Calbick attended the Electron Physics Symposium on Electron Optics and Electron Microscopy at the National Bureau of Standards. This is one of a series of Symposia in celebration of the fiftieth anniversary of the National Bureau of Standards. With J. B. Johnson, K. K. Darrow also attended the Symposium and gave the principal after-dinner speech. Dr. Darrow attended meetings of the Physical Society at Houston on November 30 and December 1 and of the New England Section of that Society at Hartford on November 3. On December 4 he lectured at Tulane University, New Orleans on *Physics as Science and as Art*. Mr. Calbick also attended a meeting in Philadelphia of the Electron Microscope Society of America where he delivered a paper on *Special Techniques of Sur-*

In the transmission standard laboratory, G. C. Reier (center) demonstrates the improvement in telephone transmission over the years to F. R. Kepler (left) of A T & T and Hester Murray of Ohio Bell. The demonstration was part of a tour which later took the visitors to Murray Hill. Mr. Kepler is editor of 195 Bulletin; Miss Murray handles memos to supervisors and news briefs circulated in her company.

Engagements

Gloria A. Mancini*—Malcolm W. Clark
Naomi DeHart*—W. Dennis Coughlin
Evelyn Karski*—Robert G. Kaltenbach*
Mary Therese Lebbach—Laurance A. Weber*
Joan Sprague—William W. Diener, Jr.*
Marilyn Stevens*—Ralph Hepplewhite*
Ruby Vickery*—J. M. Woitovich*
Mary Wiggins*—Ralph Blackman*

Weddings

Joan Burke*—Charles H. Leissler, III
Shirley Dedrickson*—Ralph Ericson
Helen Kucharski—Robert G. Voss*
W. Lorraine Micone*—Paul F. Nielsen
Betty Mocksfield*—William L. Shaffer*
Eleanor A. Ramspeck*—Roland A. Albert
Emma Yautz*—Frank Messina

Births

Jocelyn Ruth, November 15, daughter of Mr. and Mrs. Reginald T. Jenkins. Mr. Jenkins is a member of the Station Development Department.

Arthur Dwight, November 27, son of Mr. and Mrs. Arthur C. Mehring. Mr. Mehring is a member of Switching Systems Development Department.

Stephen William and Paul Joseph, November 11, twin sons of Mr. and Mrs. William S. Miller. Mr. Miller is a member of Circuit Drafting Department.

*Members of the Laboratories. Notices of engagements, weddings and births should be given to Mrs. Helen McLoughlin, Room 1321, Ext. 296.

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face Replication. These meetings, and more especially the National Bureau of Standards meeting, were marked by the presence of a large number of European physicists, particularly those specializing in Electron Physics with special reference to electron optics and electron microscopy.

BECAUSE many teletypewriter stations are located at long distances—up to a hundred miles and more—from the nearest telegraph control office, distortion on the connecting lines has to be held within limits. Measurements must be made from the patron's premises by a maintenance man; for that purpose a light portable distortion measuring set is under consideration. Recently a preliminary model was tried out by S. I. CORY and PETER ROSENBAUM on teletypewriter lines working out of Kingston, New York.

W. E. REICHLE, with R. Bright of A T & T and L. C. Withers of Western Electric, discussed with engineers of the Federal Communications Commission in Washington requirements for obtaining type acceptance of radio transmitters used in the maritime services.

J. B. HARLEY spent several days in Chicago during November visiting the Motorola Company for the purpose of discussing problems pertaining to Motorola mobile radio equipment which is purchased by the Western Electric for installation as part of the Bell System mobile telephone equipment.

JOHN LAIDIG was elected secretary of the newly formed Citizens Advisory Committee to the Mine Hill Township Board of Education. The committee was formed to study the needs of the township for new school facilities and to act as an advisory group in selecting the site and general design of a new school building.

R. N. VARNEY, G. H. WANNIER, F. E. HAWORTH, L. H. GERMER and J. A. HORNBECK attended a Conference on *Gaseous Electronics* held by the Division of Electron Physics of the American Physical Society, at Schenectady. Mr. Hornbeck spoke on *Probability of the Formation of* He_2^+, Ne_2^+ *and* A_2^+ *from Excited Atoms.*

THE ADVERTISEMENT on the back cover features E. P. Felch (left) and G. N. Packard (upper right). Theirs was the task of bringing together the latest electronic techniques and components as well as the many skills needed to perfect this new frequency standard at Murray Hill. It went into service last January. Before that, frequency signals emanated from the West Street standard, now dismantled, originally developed by W. A. Marrison.

Picture Credits

Front cover, Bob Isear.

1 and inside back cover, Harold M. Lambert.

25, Victor Keppler.

40, Center and lower left, A. L. Johnsrud (Whippany).

Back cover, left and upper right. Nick Lazarnick, and lower right, Camera Associates.

All other photographs were taken by A. Edwards, F. G. Fossetta, S. O. Jorgensen, P. Mucci, J. Popino and J. Stark of the Laboratories' Photograph Departments at West Street and Murray Hill.