BELL LABORATORIES RECORD
VOL. XXIX · NO. 5 · MAY 1951

Fig. 1—A position at a No. 5 switchboard used with the A4A system for handling delayed calls.

Problems in nationwide dialing

O. MYERS Switching Engineering

Nationwide operator toll dialing will be fully achieved only after the 4A toll switching system, now under development, is available for use. In the meantime many of the features of nationwide service are being adopted. The latest step in this direction is the A4A (advance 4A) toll switching system. Installations have already been made in Albany, Indianapolis, Baltimore, Washington, Kansas City, and Minneapolis. The A4A is an interim system that performs many but not all of the operations required to give full nationwide dialing. It will take care of the most pressing needs of the toll system, however, until the development of the 4A system has been completed.

Operator toll dialing was first employed with step-by-step intertoll equipment in isolated networks where the local dial equipment was step-by-step. The rapid growth of the toll business in recent years emphasized the need of improvements, and also of toll dialing facilities for panel and crossbar cities. The studies which followed resulted in the development of improved and longer range equipment for step-by-step areas[1] and of the No. 4 toll crossbar system[2] for panel and crossbar areas. The first No. 4 office was placed in service in Philadelphia on August 22, 1943, and has proved highly successful. Additional No. 4 systems are now in operation at New York, Chicago, Cleveland, Oakland, and Boston.

The No. 4 system introduced several desirable improvements. It was the first system using four-wire switching.[3] Transmission through the No. 4 is on a separate pair of wires for each direction of conversation. It was also the first to use multi-frequency pulsing,[4] both for operators keying into the system and for transmitting information[5] from a sender in one place to a sender in a distant place. Other features of the No. 4 provided improved facilities for handling delayed calls.[6]

Both step-by-step intertoll and No. 4 are arranged to handle direct and switched toll calls. Direct toll calls use only a single toll line. Switched toll calls without the assistance of intermediate operators are generally limited to two or three intertoll links in both systems. For direct toll calls the outward operator dials the listed directory number if she plugs directly into the toll line, but precedes the listed number by an arbitrary code if she reaches the toll line through the machine. For switched connections, the subscriber's number is always preceded by a switching or trunk group code. For each switching point, this code is a set of from one to three arbitrary digits in the step-by-

[1] Record, *May*, 1940, *page* 266; *May*, 1941, *page* 266. [2] *November*, 1943, *page* 101; *April*, 1944, *page* 355. [3] *May*, 1945, *page* 151. [4] *December*, 1945, *page* 466. [5] *September*, 1944, *page* 528. [6] *December*, 1944, *page* 614.

step system, and three arbitrary digits in the No. 4 system.

In both step-by-step and the No. 4 toll switching systems, the code prefixed to the subscriber's directory number represents a single toll route, and thus when a sequence of toll links is required to complete a call, the individual codes for the trunk groups involved must be combined in the proper order and dialed by the originating operator. Code 215, for example, is the trunk group code for the group from Cleveland to Philadelphia, 302 is the trunk group code for Philadelphia to Wilmington, and 17 is the trunk group code for Wilmington to New Castle, Delaware. A call from Cleveland to New Castle therefore uses the code 21530217 plus the subscriber's number. Moreover, there are many calls more complicated than this one. It can be readily imagined that very unwieldy digit combinations would be required if such a system were used with the full nationwide dialing plan, which permits a maximum of seven switches. Another objection to such trunk group codes is that a different set of code digits would be required whenever the operator selected an alternate route. Systems using codes in this fashion are thus clearly not suitable for full nationwide dialing where multi-switched calls and automatic alternate routing are essential parts of the plan.

When the desirability of full nationwide operator dialing* became clear, it was obvious that a different system would be needed. The objectives set forth for this system were the dialing of all toll calls to completion by the outward toll operators, the use of a universal numbering plan requiring a maximum of ten digits (eleven for party lines), essentially "no-delay" service, and arrangements which would place no impediments in the way of ultimate subscriber dialing of toll calls, if and when that should

*RECORD, *October*, 1945, *page* 368.

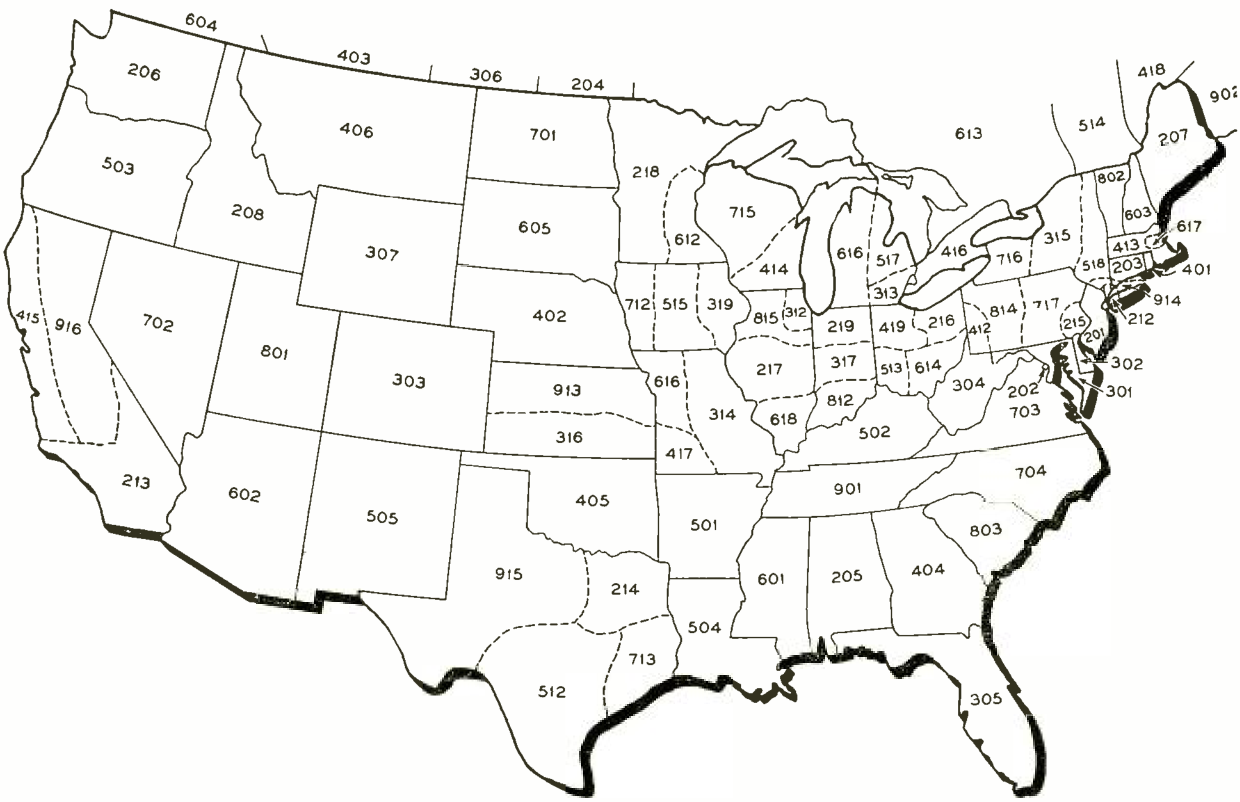


Fig. 2—Numbering plan areas and their codes that will be used for nationwide dialing.

be needed. It is this sort of service that the 4A toll crossbar system now under development will give.

For the ultimate nationwide dialing system, which the 4A will make possible, the United States and Canada have been divided into eighty-eight numbering-plan areas, each with a three-digit code having a 0 or 1 in the second position. The area code for Wyoming, for example, is 307 and for southern California it is 213. The 0 in the middle position indicates that the numbering-plan area covers a whole state and the 1 that it is part of a state. These areas and their codes are shown in Figure 2. Within each numbering-plan area, each central office is given a nonconflicting three-digit code such as CH3. If a call is for a place in the same area as the originating toll center, the central office code followed by the subscriber's number is dialed. If the call is for a foreign area, the area code of the called place is prefixed. Thus a maximum of ten digits (eleven if a party digit is used) serves to designate any telephone with a unique telephone address that will direct calls to it from any place in the country.

With such a system in effect, an originating toll operator receiving a call for some distant point will dial the three-digit area code for the area in which the called office is located, the three digits for the office in that area, and then the four or five digits for the subscriber's number. When there is only one route to the called area, the first three digits will cause the switching apparatus in the originating office to select an idle trunk of a preferred group over which that area may be reached. If the selected trunk goes directly to the area dialed, the sender at the called office will then transmit only the office code and station number. If there are intermediate switching points outside the called area, however, the sender will transmit the area code as well as the office code and station number. At each intermediate office, the area code will be used to guide the selection of a suitable trunk, and will be retransmitted at intermediate switching points until a trunk to a point in the called numbering area is selected. One of the things a sender in a 4A system must be told, therefore, is how many of the digits it received it should send on, or "spill forward" as this method of transmission is called.

This is only one of the many abilities that control equipment in the 4A system must possess. If there is only one route to an

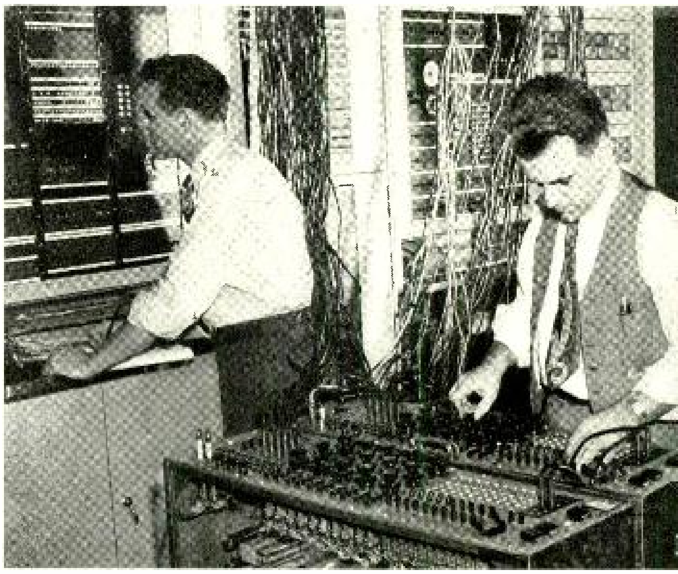


Fig. 3—Making load tests on the A4A system at Albany prior to cutover.

area, translation of the three-digit area code alone is sufficient to enable a marker to select a suitable route. Since to any one area there may be several routes by way of which offices in that area may be reached, however, the area code alone is not always sufficient. The three-digit office code that always follows the area code may also have to be translated. Once the marker has selected a suitable trunk as a result of this translation, the sender then spills forward the entire code or whatever part of it is required under the existing conditions.

It is economical in the nationwide switching plan to retain the existing step-by-step toll switching trains, which employ arbitrary trunk group codes. In such situations, the sender in the 4A office preceding the step-by-step train must drop the area code and the office code that had been used up to that point, and substitute an arbitrary code furnished by the decoder. It is necessary for the decoders, markers, and senders of the 4A system, therefore, to be able to take cognizance of all these facts, and at each switching point to send on the code required to reach the desired destination whether it is an area code and an office code, an office code and a station number, a station number alone, or one or more arbitrary trunk group codes to switch the call through step-by-step equipment. Besides having the ability to spill forward or not spill forward all the digits it receives, it must be able to delete some digits and substitute others. It must also be able, should it find all trunks of a particular group busy, to select an alternate route when available.

Certain of the conditions that require more or less special action on the part of the decoders and markers at the originating office are indicated in Figure 5. On a call from Cleveland to Philadelphia, for example, the outward operator probably knows that Philadelphia is in a foreign area and may remember the area code, but if she is in doubt she refers to her bulletin which tells her to dial "area code 215 + 2L +." She therefore dials 215 followed by two letters of the office name followed by five numbers. From Cleveland there are first-choice high-usage direct trunks to Philadelphia, and if these are busy, the equipment at Cleveland will try an alternate route. It is capable of trying several alternates up to and including a last choice, liberally-engineered, group. For this particular call, however, the first alternate via Pittsburgh is also the final group. If a trunk in this group is idle, the equipment will select it and spill all the digits to Pittsburgh. The Pittsburgh 4A tries the high usage direct group from Pittsburgh to Philadelphia and if this is busy, tries the group to New York. If this group also is busy, it selects an alternate route via St. Louis. From St. Louis there are permissible alternate routes to Philadelphia, made possible by use of universal destination type codes and liberal translating facilities.

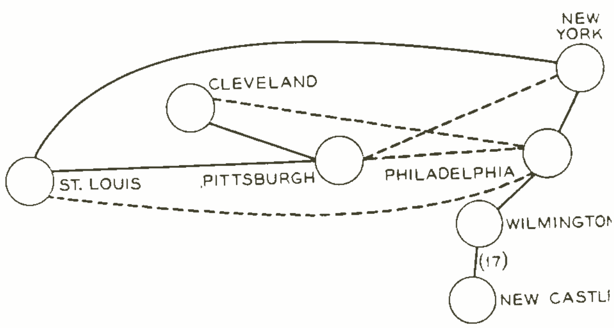


Fig. 5 – Routing of calls between Cleveland and Philadelphia. High-usage routes are shown dashed and final routes, solid.


Fig. 4–A ticket filing and rate quoting position in an A4A office.

The use of code conversion may be illustrated by a call from Cleveland to New Castle, Delaware. Since subscribers in New Castle have only four-digit numbers, the operator at Cleveland consults her bulletin and finds that the office code for toll dialing purposes is 638. She thus dials the area code 302 followed by the arbitrary national office code 638 followed by the numerical digits. The code digits dialed serve to reach Philadelphia, but from this point the arbitrary trunk group code digits 17 are required to drive the step-by-step switches at Wilmington to select a trunk to New Castle followed by the numerical digits to drive the switches at New Castle. The Philadelphia 4A must therefore drop the first six code digits and substitute 17. The code conversion feature of the 4A system permits it to do this.

The determination of what code information to use in the immediate 4A office and what to send ahead to the succeeding office which may be one of several kinds is one of the basic problems of the 4A system. The examples cited above could be supplemented by many others. However, these are quite typical and adequately illustrate the complicated nature of the code handling required. There are very many such coding problems encountered in nationwide dialing. They have all been studied and can be handled by the features which permit variable spilling (skip no digits, skip three digits, and skip six digits) plus code conversion. For alternate routing it is also necessary for the switching circuits to be able to determine when an area code has been dialed and what the area code is at the far end of the trunk used for alternate routing.

ment of the 4A system, it became evident that the work could not be completed in time to take care of the most necessary needs for new toll switching facilities. As a result, it was decided to get out an interim design to provide much needed additional toll dialing facilities until the 4A became available. This interim system is the A4A, already referred to. Besides giving some of the features to be provided by the 4A, it is designed to be readily converted to provide all of them when they become available. Until the completion of the 4A, the A4A

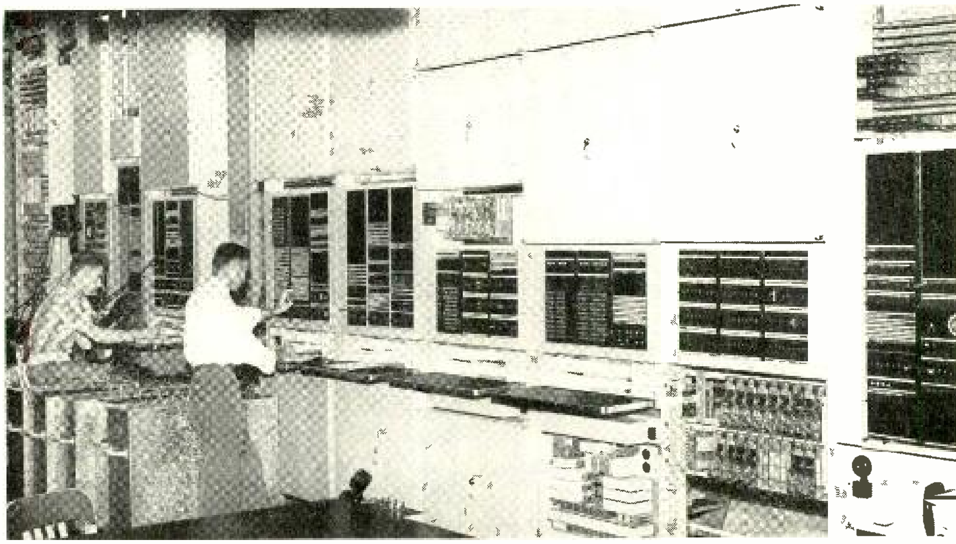


Fig. 6 — A maintenance center in an A4A toll office.

will be installed instead of the No. 4 system.

Destination type codes have two major advantages. They permit a universal coding scheme with a maximum of eleven digits, and they make automatic alternate routing practicable. To determine routing data from a destination type code, however, it is necessary to make a translation. In the 4A system this may be a translation of the area code alone, the area code plus the central office code or the central office code alone. The code digits translated are determined by the amount of information required to advance the call along the desired route. For example, if all calls to an area use the same route from a given 4A, then the area code alone determines the route. If there is a choice of routes into an area then both area and office codes are required. If the call has advanced to the called area then generally the office code alone suffices.

During the early stages in the develop-

The A4A can spill forward all the digits it receives, it is arranged for one-digit code conversion, and it provides for a limited amount of alternate routing. The provision of the spill-forward feature in the A4A, which permits it to send ahead everything it receives, makes possible the use of over 200 destination type codes. These codes have been temporarily assigned to frequently called dial cities on a systemwide basis. For example, the present system code for Akron, Ohio, is the arbitrary 042, and for Toledo, Ohio, it is the future area code 419. In a number of cases the system code assigned to a city is the area code which will be used for the numbering area in which that city is located when the nationwide plan is introduced. This permits the present use of the ultimate codes on a large number of calls. An outward operator in Chicago, for example, making a call to a New York City office via the Chicago No. 4, dials the ultimate area code 212 followed by the office code followed by the numerical digits.

A typical code layout for a few places reached from the Albany A4A system is shown in Figure 7. Calls for Toledo can be automatically alternate routed via the Cleveland No. 4 and calls for Akron take a first choice route via Cleveland and an alternate via New York. The codes shown in the diagram are all systemwide codes representing cities. For the call to Toledo from the Albany A4A, the operator dials or keys 419, the systemwide code for Toledo, followed by two letters and four numbers normally listed in the directory at Toledo, a total of nine digits. If the direct trunks from Albany to Toledo are busy, Albany will automatically try the trunks to Cleveland and select one if it is idle. It can do this for two reasons. Cleveland, although a No. 4 office, also uses the systemwide code 419 to reach Toledo, and Albany being A4A can spill forward the code 419 to Cleveland for use there after using it at Albany to try first a direct route and then to select the trunk to Cleveland. Of course, Cleveland being a No. 4 office uses up the first three code digits and therefore cannot send the first three digits ahead. Since Toledo needs only two letters of the office name and four numerical digits, and since these follow the code digits which will be absorbed, they can be sent by the Cleveland No. 4.

Another example of A4A coding is also

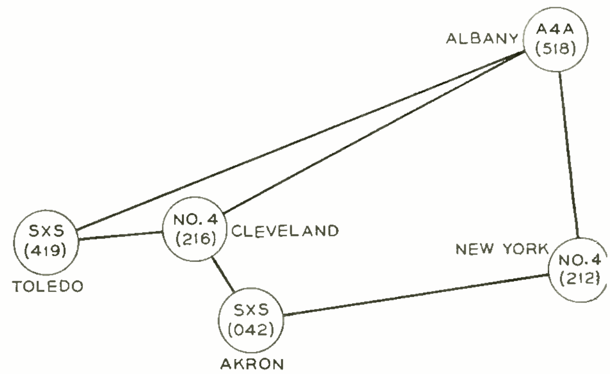


Fig. 7—Routing of calls that are made from Albany to Toledo and Akron.

illustrated in Figure 7. Calls from Albany to Akron take a first choice route via Cleveland and an alternate via New York. Here also, since the call originates at an A4A office which can spill forward what it gets, and since first choice and alternate routes are each via single No. 4 which uses a systemwide code for the called point, the destination type of code can be used. Whenever two No. 4's follow in tandem, or step-by-step follows a No. 4, trunk group codes are used.

The problems of routing discussed above are representative of those solved in setting up the nationwide toll dialing plan. It is obvious that the goal of having all toll calls handled on a dial basis entails a tremendous effort. Nevertheless the improvements in service and the economies that will result over present methods of handling toll calls will more than justify this effort.

THE AUTHOR: After receiving a degree of B.Chem. from Cornell University in 1921, Oscar Myers joined the Installation Department of the Western Electric Company where he installed and tested panel central offices until 1924, when he joined the Technical Staff of the Laboratories. At first he was with the circuit laboratory, where he tested various circuits, including the decoder sender, and the toll key-pulsing system. In 1929 he transferred to the sender design group where he worked on senders, decoders, and test circuits. In 1932 he took part in the fundamental design work of the crossbar system. Subsequent to that time he engaged in crossbar development and design, in connection with common-control circuits for both local and toll crossbar systems. For the past several years he has been in the Switching Engineering Department engaged in fundamental planning for nationwide dialing.

Ferrites:

New magnetic materials for communication engineering

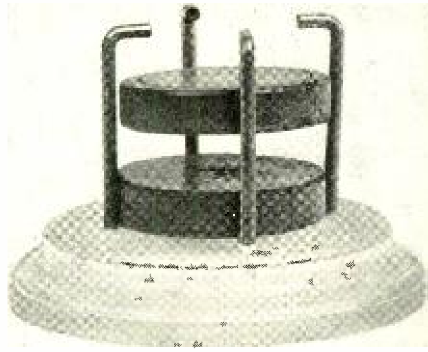


Fig. 1—"Floating" magnet made of cobalt ferrite permanent magnet samples, made in Bell Laboratories in 1937.

V. E. LEGG
Transmission Apparatus Development

"Ferrites," to the chemists, signify chemical compounds containing iron (ferrum) as an oxide, perhaps in combination with oxides of other elements, which may or may not be magnetic. A ferrite, Fe_3O_4, provided man's first knowledge of the phenomena of magnetism; it was found in Magnesia, a northern part of ancient Greece, and thus gave us the words magnetite, magnetism, and magnetic.

The ancients built a great mass of fact and fiction around the attractive properties of magnetite, and beclouded the thinking of later generations by confusing the attractive forces of magnetite with those of amber. Enough distinction was recognized, however, to give birth to the word "electric" for the forces connected with amber.

It remained for the father of modern electrical and magnetic understanding, William Gilbert, to cull over the ancient information and misinformation, and set the stage for today's knowledge of the subject. In a fit of impatience with some of the earlier theories, Gilbert said "as for the causes of magnetic movements referred to in the schools of philosophies to the four elements and to prime qualities, these we leave for roaches and moths to prey upon." Studying magnetite, or lodestone, intensively, he found that iron and steel took on magnetism and were more potent and convenient to work with than magnetite.

With this lead, scientists and engineers have delved for three centuries into the properties and uses of magnetic metals—iron, nickel, cobalt, and their alloys. Great strides have been made in the utilization of magnetic properties; these materials show much greater powers of attraction than lodestone and greater ease of taking on or losing magnetism, i.e., higher permeability. But there was still a troublesome "swamp" in the territory of magnetic developments—the low resistivity of metals.

When a magnetic core is inserted in a coil carrying alternating current, the core reverses its magnetism as the current reverses its direction. Conductors in the magnetic field therefore have voltages induced in them, and an alternating current will flow if a circuit is completed. Since a metal core is a conductor, current will flow as "eddy current" within it, with a consequent loss of power. Efforts to reduce this loss have been made by sub-dividing the core material into thin sheets, fine wires, or dust, more or less finely divided, depending upon the frequency of the current. For voice frequencies, sheet thicknesses of 0.006 to 0.014 inch have been common in silicon steel and in permalloy laminations. But for radio frequencies, sheet thicknesses must be much smaller and costs then become prohibitive.

It was recognized, of course, that eddy currents could be restricted by increasing the resistivity of the core material. Since Gilbert's lodestone has a resistivity about a million times that of the magnetic metals, the greatest advantage should come from abandoning metals and returning to lodestone. Some coils were, in fact, actually provided with magnetite cores, but although they had low eddy current losses, the permeability was so low that a large volume would be required to obtain the desired magnetic effects. Hence this simple ferrite had very little application, and the engineering profession kept on struggling with

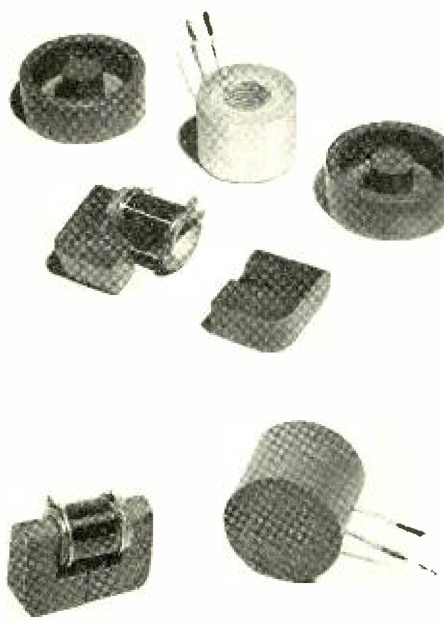


Fig. 2—Top, disassembled manganese-zinc ferrite cores with coils, made at Bell Laboratories; bottom, assembled cores with coils in place.

metals to make thinner laminations for use at higher frequencies.

The first steps in exploring other ferrites were taken by Japanese experimenters, who inquired into the effects of adding *magnetic* oxides to magnetite, either in chemical composition or in solid solution. They found that certain mixtures of iron oxides and cobalt oxides could be pressed into the desired form and fired at a bright red heat to induce chemical action. Such material, when magnetized while at a dull red heat and allowed to cool, produced magnets much better than magnetite and capable of replacing some metallic magnets. This process also resulted in a material of high electrical resistivity. Another feature of this material is its low density, about 2, which means that very lightweight magnets can be made for rotors of generators, motors, meters, etc.; Figure 1 demonstrates the light weight. Oxide magnet material is now made by the General Electric Company and others, and is called "Vectolite."

In spite of its high resistivity, the permeability is not much better than magnetite and hence it offers no advantages to engineers designing radio coils. The special need for high permeability is to permit reduction of coil size.

In December, 1946, the Philips Company, Eindhoven, Holland, published the results of their investigations in magnetic research.* As shown by their publication they had extended their attention to admixtures of *non-magnetic* oxides with magnetite. It had been found that mixtures of zinc oxide and manganese oxide served to lower the non-magnetic temperature from the high value for magnetite alone, to near room temperature.

This attracted our interest and for the past several years a development program on these ferrites has been in progress in the Laboratories. This work included studies of favorable chemical compositions and manufacturing procedures; it has led to materials with high permeability and low core losses. As shown by Philips and confirmed by our studies, the combination of high resistivity and high permeability produced a material that could be used in coils operating at carrier or radio frequencies, having high permeability, and without need for lamination or costly subdivision.

For example, a manganese zinc ferrite studied at the Laboratories yielded a permeability of about 1200, which remained practically unchanged up to frequencies above one megacycle, without lamination or subdivision below the ¼-inch thickness of the test ring used. Above two megacycles the permeability falls off rapidly. At the higher frequencies, of course, eddy currents tend to reduce the effective permeability but the observed decline is much more than

**Philips Technical Review, December,* 1946, *page* 353.

seems reasonably ascribable to this cause. It appears that there may be atomic or subatomic conditions that cause the decrease. Certain other compositions, yielding lower permeabilities at the start, maintain them over a much wider frequency range than the manganese zinc ferrite.

Manufacture of the ferrites consists of mixing the raw materials, mostly paint pigments, so thoroughly that chemical combination progresses readily when the mixture is heated to firing temperatures. The mixture is then poured into forms and compressed in a hydraulic press before firing. This insures that the final body will be chemically reacted and bonded into a ceramic solid.

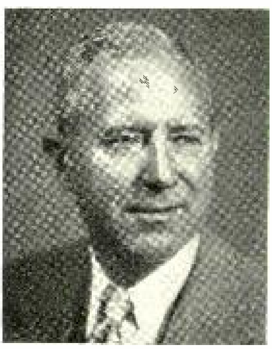
Since the ferrites are too hard to be cut with steel tools after firing, core designs should be simple, easily pressed in economical dies, and require minimum subsequent grinding.

A cylinder is the simplest form of core to make and this can be slipped into an ordinary coil, increasing its inductance by a factor of almost two over the air core inductance. If the cylinder is mounted so that it can be moved in or out of the coil, it can be used to adjust the inductance to a limited extent. The fact that the inductance can only be increased by a factor of two by use of the ferrite cylinder is due to the absence of a closed magnetic circuit. Completing the magnetic circuit by means of two U-shaped ferrite pieces joined together, increases the inductance of the coil to as much as 200 times its value with an air core only. Adjustability of the inductance in this case is lost, of course, but this sacrifice may be justifiable because of the increased inductance.

To reduce leakage of magnetic flux, which is inherent with both the cylinder and U-shaped cores, the coil may be enclosed in a shell of ferrite. An example of this is shown in Figure 2. This arrangement reduces leakage, which may lead to objectionable crosstalk in associated circuits. The effective permeability of the magnetic circuit can be made to approach the permeability of the ferrite by proportioning the air gaps in the magnetic circuit to very nearly zero. Actually, air gaps are often included in the magnetic circuit to reduce permeability somewhat and thus avoid magnetic instability resulting from superposed a-c or d-c fields, or temperature effects. Adjustment of effective permeability is desirable, moreover, to reduce the effective resistance of the core material to an optimum relationship with the resistance of the coil winding. Such factors generally lead to a choice of effective permeability of about 100.

With this permeability, a coil occupying less than a 1½ inch cube can be made for use at carrier frequencies (about 100 kc), having a "quality factor" Q of well over 500. Quality factor Q is the ratio of the reactance to the resistance, and is a gauge of the sharp-

THE AUTHOR: Following his graduation with an A.B. degree from the University of Michigan in 1920, V. E. Legg was employed by the Detroit Edison Company while working for his M.S. degree. After obtaining this degree in 1922, he came to the Laboratories, where his first job was investigating the effects of ocean temperatures and pressures on Permalloy tape as magnetic loading for the transatlantic telegraph cable then being designed. Later, he made studies of Perminvar and its application to submarine cable; incident to this work, he spent two years in Europe as a technical consultant in the manufacture of Perminvar and of cable. In 1931, Mr. Legg returned to this country and worked on magnetic materials, particularly compressed powders, for coil cores. He promoted the introduction of molybdenum Permalloy cores for voice frequency loading, and extended the use of this material to carrier frequency coils. He was in charge of a group working on the design of loading coils. During World War II, Mr. Legg was engaged in consulting services and manufacture of various types of magnetic detecting apparatus for the Naval Ordnance Laboratory. Since then, he has been in charge of a group engaged in the study of the properties and practical applications of magnetic materials for use in the Bell System.



ness with which the characteristics of a filter using such coils can be made to discriminate against any undesired frequency. It is, therefore, very important to have Q as large as possible. In the past, this has entailed building rather large coils, so as to minimize copper and core loss resistances. With ferrite cores, coils can be made relatively small and yet have a Q high enough to make them useful in filters—so high, in fact, as to permit replacement of crystals in some filters.

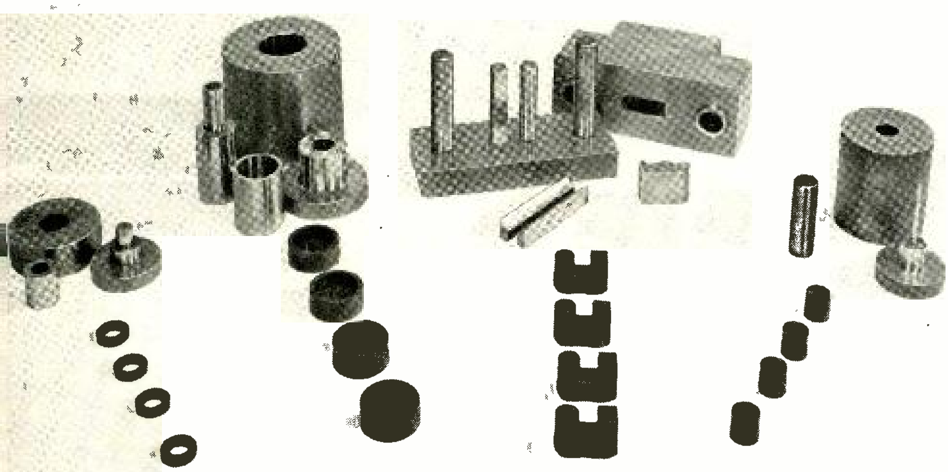
Enclosing the coil in the ferrite has several advantages. Besides furnishing good crosstalk shielding, it uses economical types of windings, is easy to assemble, and provides its own housing. Ferrite is not affected by humidity so that the coils will remain stable in any ordinary atmosphere.

Present-day ferrites have many of the properties we have been looking for and the Western Electric Company has begun experimental manufacture of them. Nevertheless, research work is being continued looking toward an even better product.

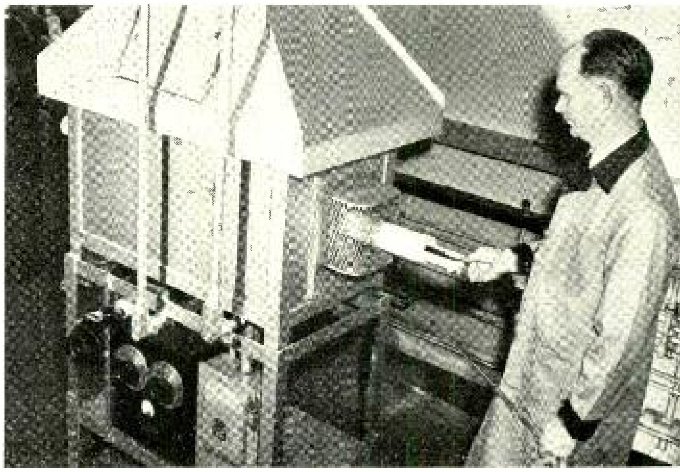
Experimental preparation of ferrites

Among the new and interesting magnetic materials are the synthetic ferrites described by V. E. Legg in the foregoing pages. A general investigation of these materials is being carried on jointly in the Chemical Laboratories and in the Transmission Apparatus Development Department. This series of pictures shows some of the steps in preparing the many varieties of experimental parts for the Laboratories' investigation of these materials.

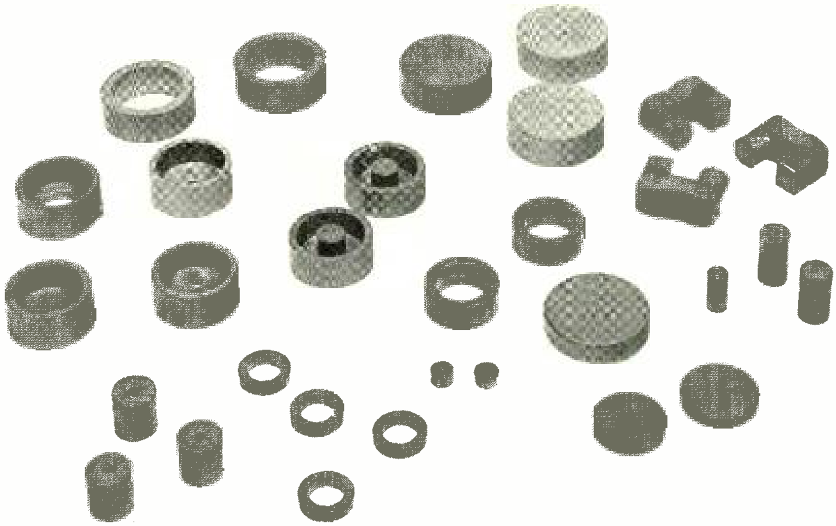
The first step in the preparation of ferrites is to mix intimately the zinc, iron and manganese compounds in the correct proportions. In this picture, O. J. Barton is adding the component powders in a motor-driven paste mixer. After the mixed powders have been calcined, binders are added to facilitate pressing the required apparatus parts.



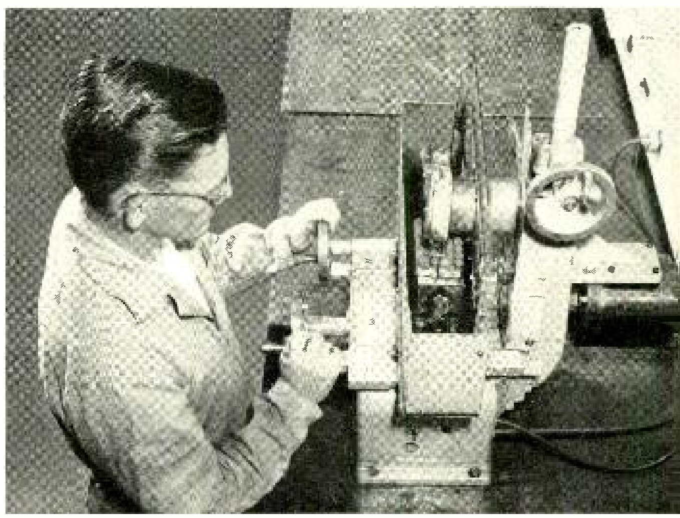
Ferrites are needed in many shapes for development studies. This photograph shows a few types of dies used in experimental production and the various parts they produce.



To form useful materials by reaction of the component oxides, the compressed parts are loaded in a ceramic boat and fired at high temperatures. Here H. G. Boyle is charging a furnace with parts to be fired.



A variety of experimental parts as they are removed from the firing furnace.



After firing, the ferrite parts are too hard to be cut with steel tools. Instead, they are placed on a magnetic chuck and the important surfaces ground to the desired flatness and dimensions. R. G. Conway is operating the surface grinder.

The fired parts are carefully checked for dimensional accuracy. Here F. R. Monforte is measuring the inside diameter of a toroidal core that is to be used in a retardation coil or transformer.

Measurement of magnetic quality is one of the final operations. Catherine Heddan is checking, on a Maxwell bridge, the toroid on the small shelf above her left hand.

Pulse code modulation for television

W. M. GOODALL
Radio Research

Pulse code modulation for long distance telephone transmission was given its first public demonstration in October, 1947[1]. Known as PCM, this technique is markedly free from noise and interference; it overcomes one of the difficulties of both radio and wire communication systems — the building up of noise with the many amplifications needed for a long distance hookup. With PCM, noise and distortion can be removed as limiting factors. To do this, it is necessary to represent the signal by a definite number of samples and to transmit each of these samples by a code group of pulses. At repeaters, these code pulses are retransmitted as new pulses for each repeater link.

It has been found that if a signal is sampled instantaneously at regular intervals and at a rate slightly higher than twice the highest signal frequency, all of the information of the original signal will be transmitted[2]. For example, a voice wave having an upper frequency limit of 4,000 cycles can be reconstructed without distortion from a set of very short samples of the wave taken at regular intervals at the rate of 8,000 per second. The AN-TRC-6

[1] RECORD, *November*, 1947, *page* 422.
[2] RECORD, *July*, 1947, *page* 265.

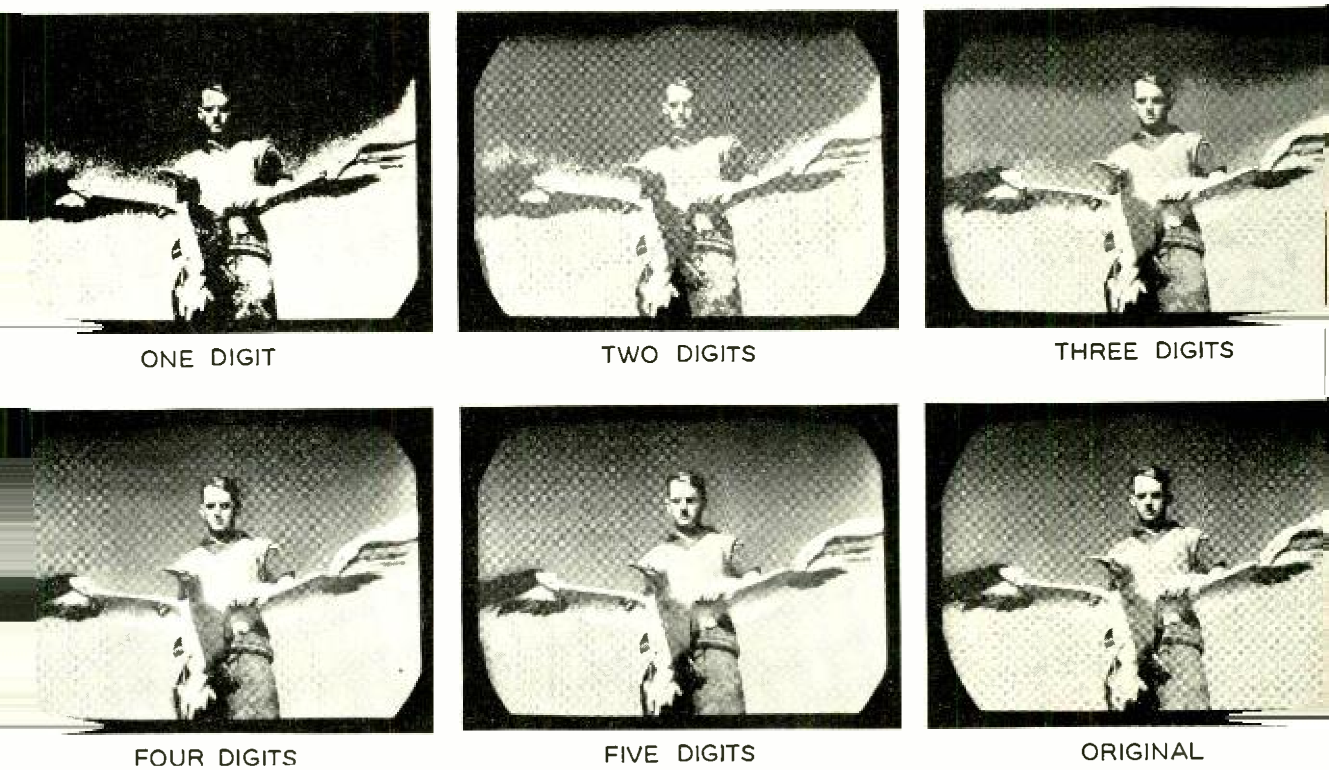


Fig. 1—Increasing the number of digits increases the number of levels of brightness of the image.

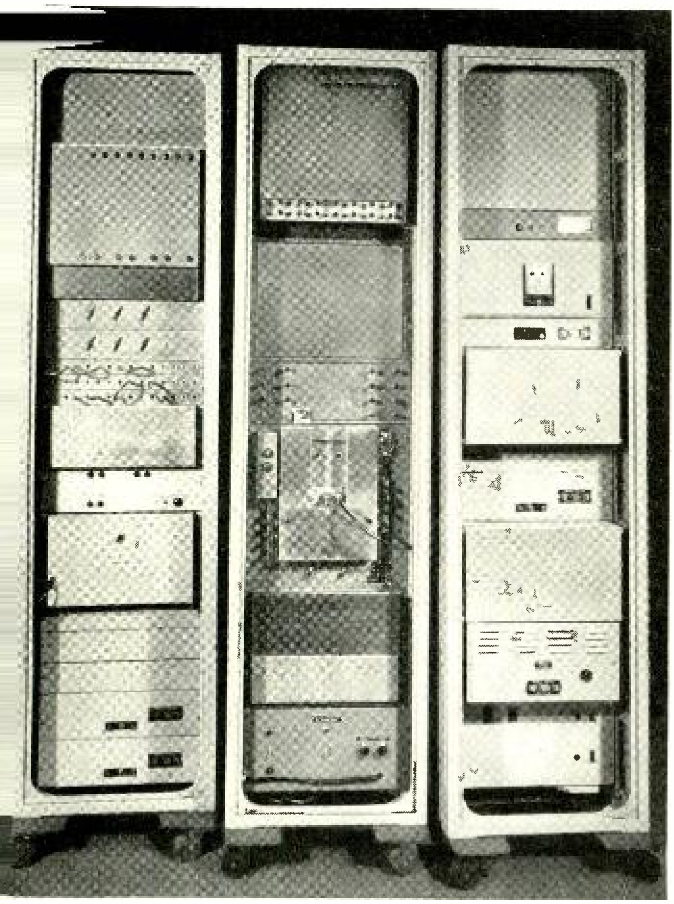


Fig. 2—Apparatus used to demonstrate television by PCM. The cabinet at the left contains the receiver, the center cabinet is the transmitter, and the right-hand cabinet is the power supply for both.

microwave relay system described previously[3] makes use of this principle, using short pulses of about 1 millionth of a second, transmitting 8 pulses in sequence for each of 8 channels, at the rate of 8,000 pulses per second.

Applying this system to the transmission of television signals is a problem in higher speeds of pulse communication. If the highest frequency in a television signal is 5 megacycles, then the number of samples required will be 2 x 5 or 10 million samples per second. As in speech transmission, each amplitude level of the signal is represented by a code group, which is a series of "on" or "off" pulses or digits. If a one-digit system were used, 10 million pulses per second would be required and the picture obtained would have two brightness levels, black and white. A two-digit picture would require 20 million pulses per second, and four levels of brightness would result, etc.; each time a digit is added, the number of levels of brightness increases by a factor of two—thus three, four, and five digits result in 8, 16, and 32 levels from black to white.

The results of using code groups having different numbers of digits is shown in Figure 1. Comparing these pictures, it is seen that the fineness of shading increases with the number of digits. The distortion in the form of abrupt changes in brightness, due to the limited number of levels. is easily apparent in the one, two, and three digit pictures. It is also present, although less objectionable in the four-digit picture. Although the photographs may not show it, careful study of the five-digit picture on the television viewing tube shows some of this effect. For many purposes, the amount of distortion in a five-digit system would not be serious.

A five-digit picture, 32 levels, gives good results for a picture signal that contains a moderate amount of noise since the noise tends to obscure the distortion. This is the type of signal which is typical of those commonly found for the better locations of home broadcast television receivers in the metropolitan area. Tests with a high quality, low-noise picture signal supplied by the television group at the Laboratories, suggest that six or seven digits would be needed for a very low noise picture.

A photograph of the equipment used in a demonstration of the PCM system, Figure 2, shows the general order of magnitude of the equipment. In round numbers. 150 electron tubes are used in the main circuits, with 30 tubes in auxiliary circuits and 60 tubes in the regulated power supplies. This is a five-digit system, and operates at 50 million pulses per second. This speed is about 1,000 times that required for a single telephone channel, or stated another way, 1,000-channel multiplex of telephone message circuits requires the same number of pulses as the single television circuit.

[3] Record, *December,* 1945, *page* 457.

This increased speed of operation was achieved by improvements in circuit techniques and by the use of a new type of coding tube developed by R. W. Sears of Electronic Apparatus Development. The older[4] type coding tube produced the code on a sequential or time division basis, while the present tube has a line beam and produces the code simultaneously on seven-digit output collectors, five of which were used in these experiments. For the purposes of the demonstration, these five digits were transmitted separately on short wire circuits connected between the transmitting and receiving terminals.

To send a television signal by a five-digit PCM system would require a minimum bandwidth five times that required to send the same signal by more conventional methods. The techniques required to transmit the PCM signal in this minimum band are difficult and complicated. For the present state of the art, a more realistic value would be from two to four times this minimum value, which means that a nominal 5-mc television signal would require a 50 to 100-mc band if transmitted by PCM.

In return for these wide bands, advantages would result that could be obtained in no other way than by the use of PCM. Foremost among these is the possibility of repeating without error. Regenerative repetition of "on" or "off" binary pulses at repeater points permits the relaying of the signal to great distances without introducing significant degradations due to noise or distortion arising in the medium.

[4] Record, *November*, 1947, *page* 422.

THE AUTHOR: W. M. Goodall came to the Laboratories in 1928 immediately following his graduation with a B.S. degree in Physics from the California Institute of Technology. His first assignment was making studies of long-wave antennas on a scale-model basis; following this, he engaged in studies of the different reflecting layers of the ionosphere using pulse transmission. He was also involved in the development of distortion measuring equipment for transatlantic short-wave transmitters. During World War II, radar modulators occupied his attention. Following the war, he was concerned with radio relay systems that culminated in the development of the New York-Boston microwave relay, and, more recently, has worked on the PCM system described in his article.

A 50-kc to 3.5-mc heterodyne oscillator

O. KUMMER
Transmission Apparatus Development

Development of broad-band carrier transmission systems, including television circuits, has established a need for continuously variable, direct reading, stable oscillators capable of supplying a wide range of frequencies for testing these systems. Basically, the heterodyne oscillator equipped with suitable stabilizing features, provides this wide range.

A simplified block diagram of this type of oscillator is shown in Figure 1. Briefly, it consists of two separate oscillators, one of fixed frequency and the other of variable frequency, a modulator to combine the oscillator outputs, a filter, and an output amplifier. To prevent the two oscillators from "locking in step" and thus producing frequency instability and severe harmonic distortion, buffer amplifiers are used to isolate each oscillator from the modulator.

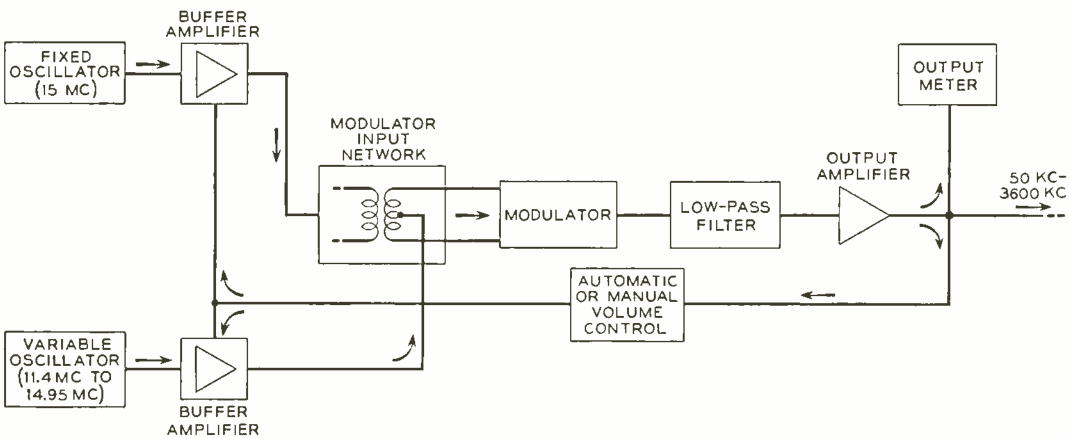


Fig. 1—Simplified block diagram of 25A oscillator.

The schematic of the variable oscillator and its associated buffer amplifier is shown in Figure 2. To minimize the effect of variation in the grid to cathode capacitance on the frequency stability of the oscillator, the grid of the oscillator tube is connected between the capacitances C_1 and C_2 of the tuned circuit, thus providing a voltage "step-down." A considerable improvement in stability of oscillation is obtained, because a variation in grid to cathode capacitance affects principally capacitor C_1, rather than the total capacitance of the tuned circuit. Similarly, the effect of plate to cathode instability is minimized by using a low mutual inductance M between the plate circuit of the oscillator and the tuned circuit, thereby providing voltage step-down from the tuned circuit to the plate of the oscillator tube.

Capacitor C_3 is the variable air capacitor that tunes the variable oscillator from 14.95 mc down to 11.4 mc, corresponding to the required output band of 50 kc to 3.5 mc. This capacitor has two stators engaged by a single rotor—thus eliminating troublesome brush contacts with the rotor, or inductance variation resulting from the use of a pigtail lead. Stator plates are aluminum, and those of the rotor are alternately of invar and aluminum. Capacitors C_1, C_2 and the minimum capacitance of C_3, form the capacitive tuning which determines the upper fre-

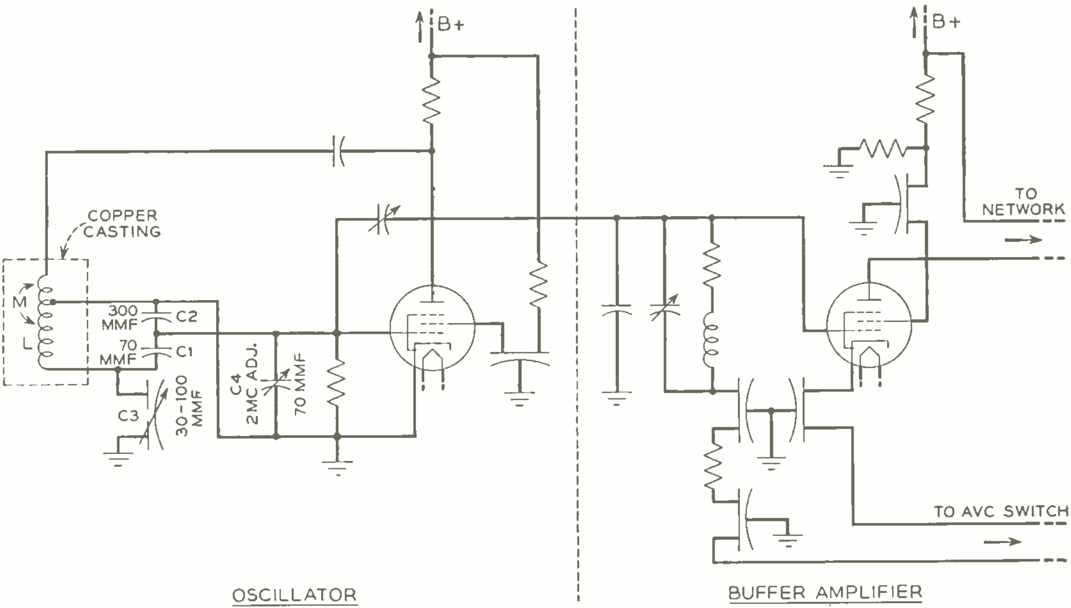
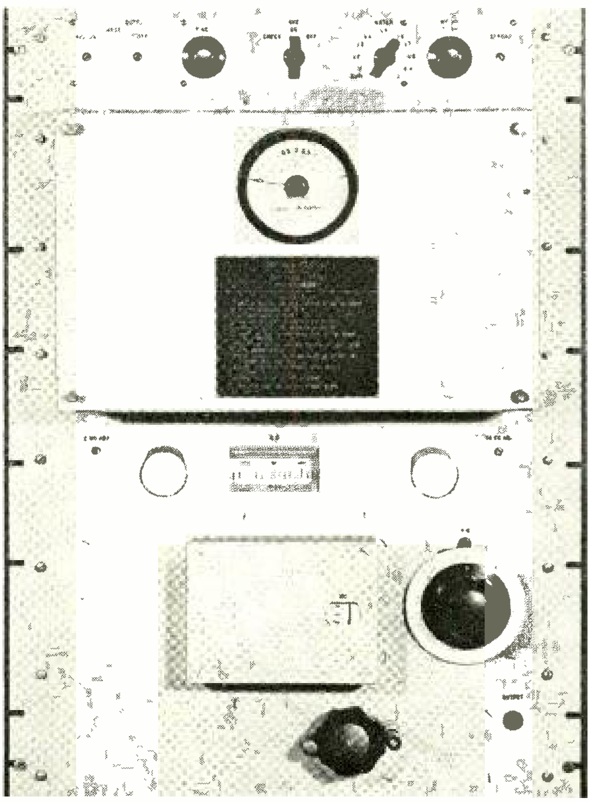
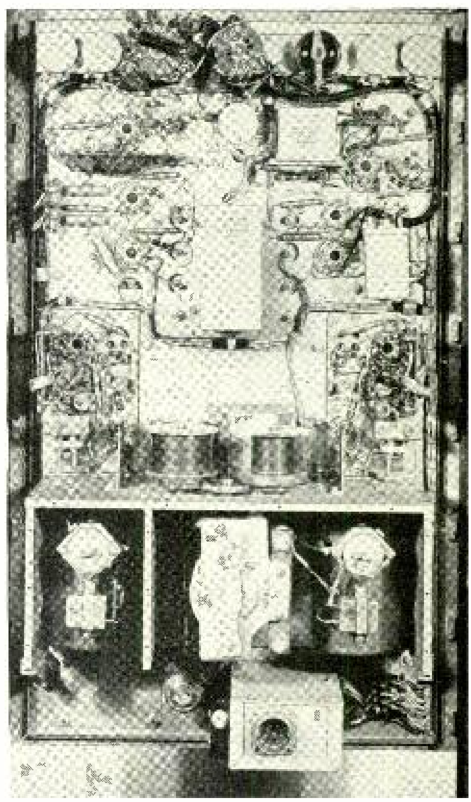


Fig. 2—Schematic diagram of the variable oscillator and associated buffer amplifier.

Fig. 3—Front and rear views of the 50-kc to 3.5-mc heterodyne oscillator.





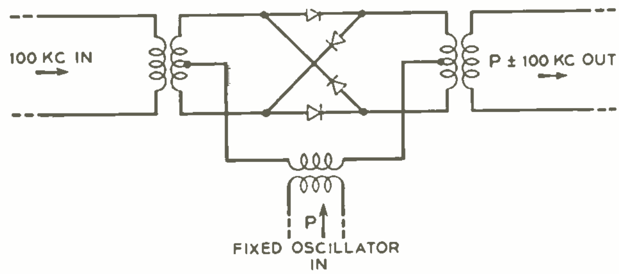


Fig. 4—A ring modulator is used to obtain two frequencies separated by a constant interval of 200 kc.

quency of 14.95 mc, of the variable oscillator. Capacitor C1 consists of alternate plates of invar and brass, mounted on a mycalex plate. The tuning coil is copper ribbon wound under tension on an Alsimag form, and is mounted in a heavy copper casting to reduce variations in inductance which might occur as a result of deformation if a lighter shield were used.

Frequency determining elements of both the fixed and variable oscillators are mounted beneath a shelf in the lower portion of the equipment, in order to isolate them from the heat generated by the associated electron tubes.

The fixed oscillator, which operates at 15 megacycles, employs a similar circuit, but uses a much smaller tuning capacitor in place of C3. This capacitor is used as an incremental frequency control, shifting the frequency by only plus or minus 1 kilocycle.

When the oscillator outputs are combined in the modulator, a number of frequencies are produced, only one of which, the difference frequency, is desired. If the fixed oscillator frequency is designated as P, and the variable oscillator frequency as Q, then the filter following the modulator must pass P-Q and reject all other frequencies that fall outside the transmission band. Since the combined fixed and variable oscillators cover the band 0.05 mc to 3.6 mc, the closer the frequencies P and Q are located to this band, the more stable the difference frequency will be.

As a result of the modulation process, however, there will be a number of "products of modulation"—harmonic frequencies such as 2P ± 2Q, 3P ± 3Q, and so on, that may fall within the particular frequency band which is of interest. By keeping the input voltage to the modulator low, the modulator electron tubes operate within the fairly straight part of the tube characteristic curve and thus lower the magnitude of these spurious frequencies. In addition, the use of a bridge input arrangement in the modulator and the low-pass filter on the output side of the modulator bring the unwanted frequencies to the desired minima. An amplifier of the "push-pull" type minimizes second harmonic distortion in the output stage of the oscillator.

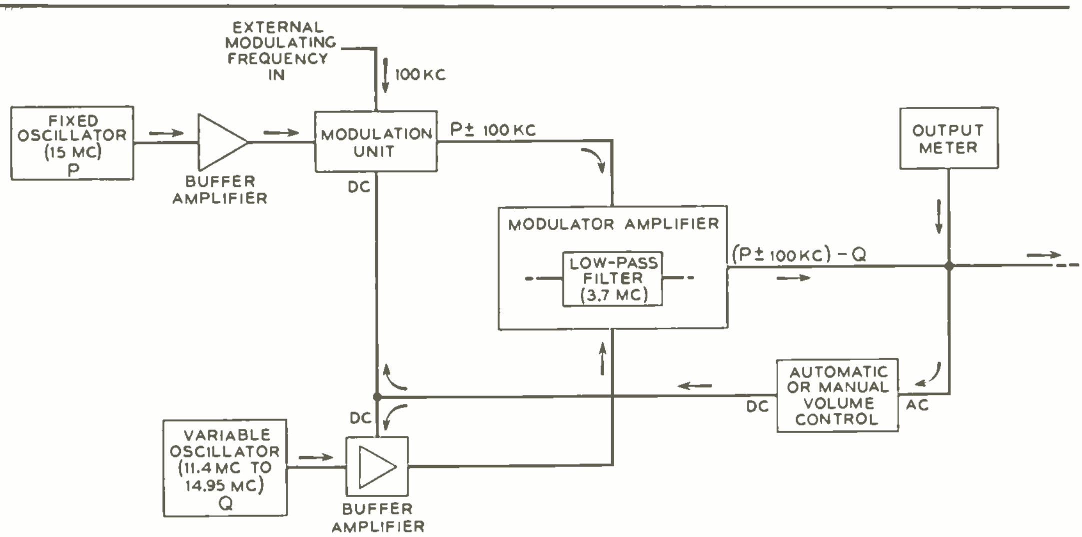


Fig. 5—Block diagram of the modified 25A oscillator to furnish two frequencies separated by a constant interval of 200 kc.

An over-all automatic level control is used to keep the oscillator output to within its required ± 0.2 db flatness. This operates by rectifying a portion of the output in a pentode operated at cutoff. Variation in the d-c potential of the plate of this pentode is used to control the gain of the buffer amplifiers. An output meter has been provided which also may be used for checking tube currents during maintenance.

Originally, the oscillator was designated for transmission testing of the L1 carrier system and was designated as the 25A oscillator. Front and rear views of the oscillator are shown in Figure 3. A similar oscillator was used in the 3.6-mc phase and transmission set previously described,* with the addition of two buffer amplifiers for supplying frequencies for the synchronizing unit, and the range of the increment dial increased to cover 10 kc.

With the increase of television program transmission, a need arose for a rapid method of measuring the delay and adjusting the "mop-up" delay equalizers. This delay measuring set, designated as the 46A transmission measuring set, required an oscillator similar to the one described, but capable of delivering two frequencies separated by a constant interval of 200 kc. The 25A oscillator was modified to do this.

Modification consisted of adding a "ring" modulator between the fixed buffer amplifier and the original modulator. The new modulator uses four germanium varistors connected in a ring as shown in Figure 4. If the modulator is balanced to the P frequency, no P output frequency will be delivered. The second modulator, which previously had produced P-Q, now produces [(P ± 100 kc)−Q] consisting of two frequencies separated by 200 kc and variable over the range of 200 kc to 3600 kc. Figure 5 is a block diagram of the modified oscillator, designated as the 25B oscillator.

*RECORD, *July*, 1950, *page* 307.

THE AUTHOR: OSCAR KUMMER's first job after graduating from high school in New York City was that of a messenger at the Laboratories. This was in 1934; in that year he began a night school course at Cooper Union, this leading to his receiving a BS in EE degree in 1940. He has since taken graduate courses in Electronics at Stevens Institute. In 1937, Mr. Kummer became a Technical Assistant in the transformer laboratory. In 1939 he was assigned to the electronic measuring apparatus development group, working on oscillators and detectors, and in 1941, became a Member of the Technical Staff. During World War II, he was engaged in developing magnetic measuring devices for the Naval Ordnance Laboratory; since the war he has been concerned with oscillators, particularly of the type described in his article. More recently, his activities have been connected with analyzers for modulation studies on L3 repeaters and other frequency measuring devices.

Pulse generation and shaping at microwave frequencies

W. A. KLUTE
Transmission Research

As a part of the study of pulse-modulation techniques in these laboratories, the art of generating and shaping very short pulses of microwave energy at a high repetition rate has been considerably advanced. In an experimental project, it was required to transmit and receive independent pulse trains at a rate of 18,432,000 per second in adjacent frequency bands with 30 mc. spacing. The pulses were of the on-or-off type suitable for pulse code modulation. The filters used for combining and separating the frequency bands have been described in a previous article.* In each band a time interval of 0.054 microsecond, the reciprocal of 18,430,000, is allotted to each pulse. At the receiving end, the incoming signal is sampled over a brief interval at the middle of each of the 0.054-μs intervals, and if the incoming signal at that instant is above a certain value, a pulse is recognized, while if it is below this value, a null, or the absence of a pulse, is indicated.

*Record, *April,* 1951, *page* 164.

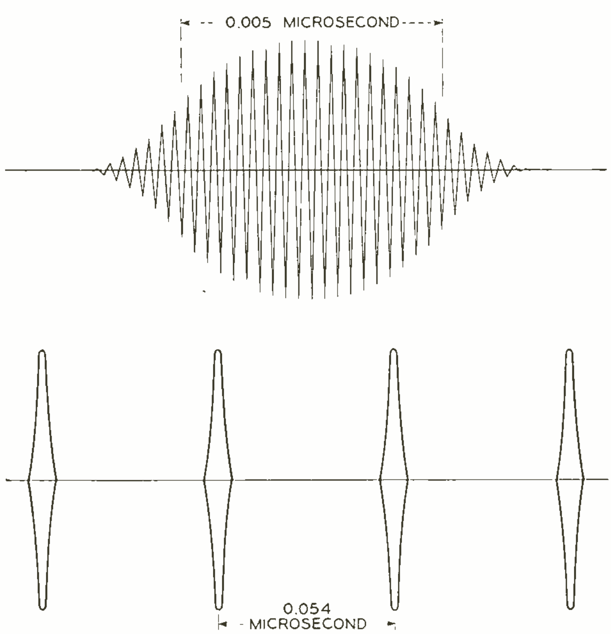


Fig. 1—One of the 0.005 μs pulses of 4000 mc carrier.

The system adopted generates a continuous sequence of pulses only 0.005 μs in duration between half amplitude points. These pulses occur at intervals of 0.054 μs peak to peak, and each pulse consists of a spurt of carrier whose frequency is about 4000 mc. Figure 1 shows a single pulse, above, and a sequence of four pulses to a different time scale below. An analysis of the frequency components of these pulses shows a broad spectrum, given in Figure 2, centered at the frequency of the carrier and with the individual components separated by 18.432 mc—the repetition frequency. Between frequencies where the components become insignificant relative to the mid-spectrum components, the spectrum is about 400 mc wide.

Four pulse trains of different mid-band frequency are obtained by applying this basic sequence of 0.005-μs pulses to four 30-mc band-pass filters of the wave-guide type that span the middle portion of the spectrum of Figure 2 as indicated by the dashed lines in the upper part of the diagram. Each of these bands will include only one or two of the components of the original spectrum, and since all four bands occupy only a comparatively small region near the middle of the spectrum of the original pulses, the components selected by each filter are of essentially the same magnitude. As indicated in Figure 3 the pulses are admitted to the filters through gates under control of the coding circuits which are not described in this article.

The brief application of the 0.005-μs

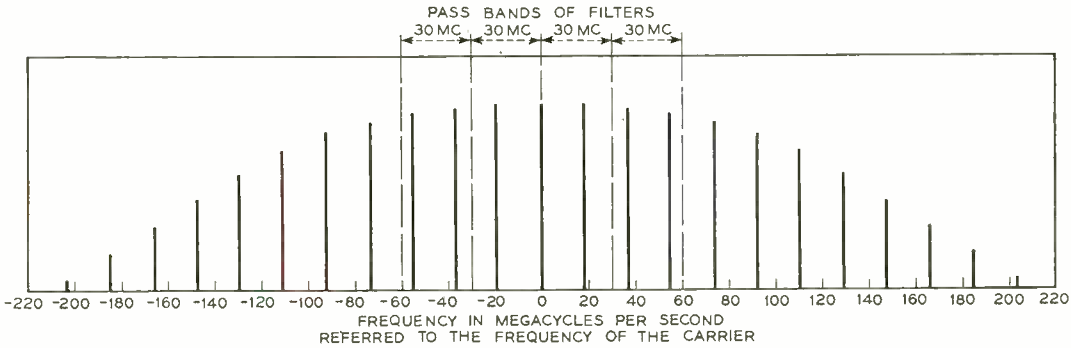


Fig. 2—Spectrum of 0.005 μs pulse. Above the spectrum is indicated the positioning of the four band-pass filters relative to it.

pulses induces oscillations in the filter structure itself that include only frequencies passed by the particular filter. Because of this restriction in the width of the frequency band, the spectrum of the pulses appearing in the output is much narrower than that of the 0.005-μs pulse. Also the pulses last longer; that is, the output for each pulse is not a single wave but a train of waves increasing to a maximum amplitude and then decreasing. This train is several times as long as the interval T between pulses and as a result there will be several pulses applied simultaneously to the sampling device. Let us designate two successive pulses as K, and L (Figure 4). To insure that at time K the sampling circuit at the receiving end will find a signal if a pulse is present and will not find one when a pulse is not present, it is desirable that pulse K have its peak at the sampling time and a null at the two adjacent sampling times, and that the following pulse L also have a null at sampling times. This idealized condition is indicated in Figure 4. Here the response to two input pulses is shown to indicate no interaction at the sampling time. The total widening effect of the combining and distributing filters of Figure 3 is not sufficient to bring this about, and a third filter, marked SHAPING FILTER in the diagram, was thus added. The widening effect of these three filters in tandem is just sufficient to give the required width of pulses.

Even with these three filters in the circuit, however, the pulses would not appear in the

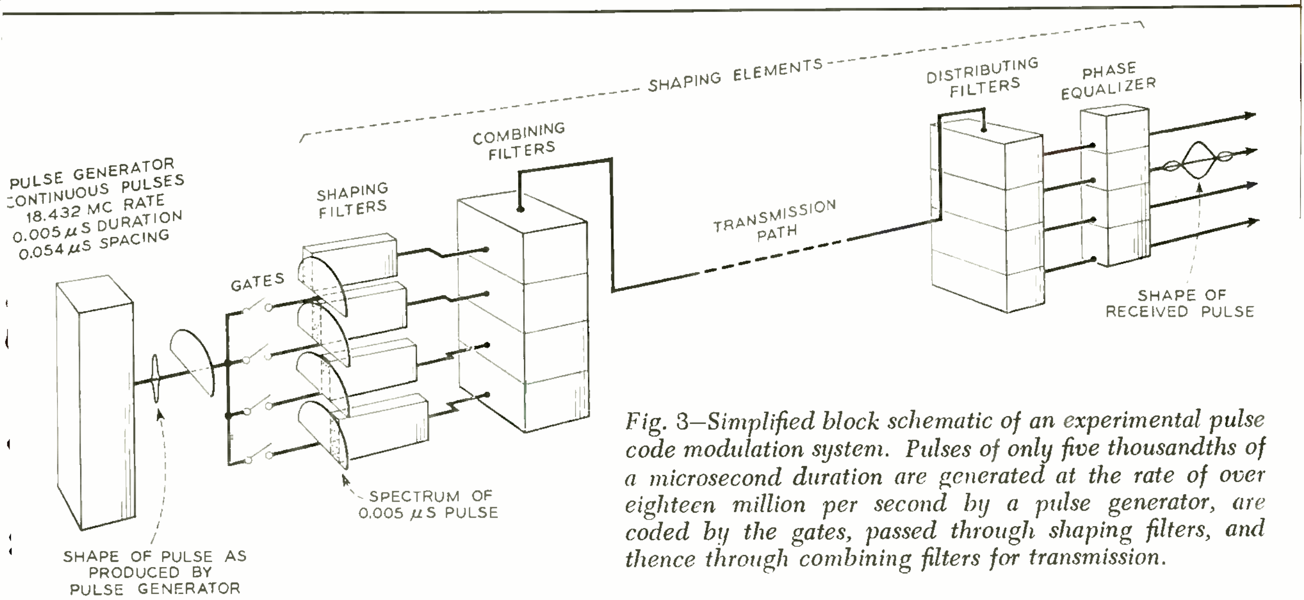


Fig. 3—Simplified block schematic of an experimental pulse code modulation system. Pulses of only five thousandths of a microsecond duration are generated at the rate of over eighteen million per second by a pulse generator, are coded by the gates, passed through shaping filters, and thence through combining filters for transmission.

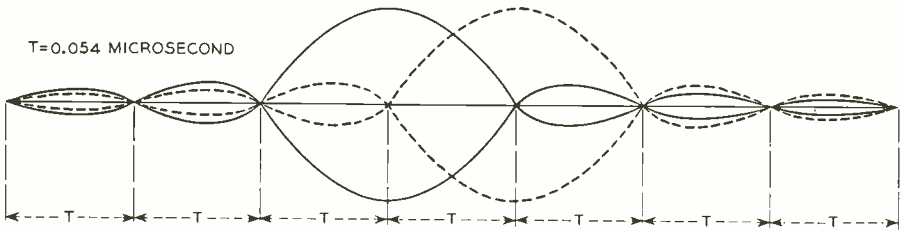


Fig. 4 – Ideal relationships between output pulses.

desired form shown in Figure 4 because the phase shift through the filters is not linear with frequency. As a result the pulses would not be symmetrical as shown in Figure 4; the peaks and nulls would not appear where desired. A phase equalizer was thus added at the receiver end to correct the non-linear phase shift of the filters. Only at the output of the phase equalizer in the receiving circuit, are the pulses of the proper shape.

The arrangement of these various elements in the circuit is shown diagrammatically in Figure 3. Four gates under control of the signal circuits are opened in the proper combination to transmit the proper code for each sample of each of the signal channels. The gates must thus be capable of operating 18.432×10^6 times a second. These pulses, after they have gone through the gates are applied to the shaping filters.

From the shaping filters the pulses pass to the combining filters and thence to the transmission line. At the receiving end, the pulses received from the line pass to the distributing filters, where they are separated into their respective channels, thence through the phase equalizer, and then to the decoding circuits that convert the code pulses into the original signals.

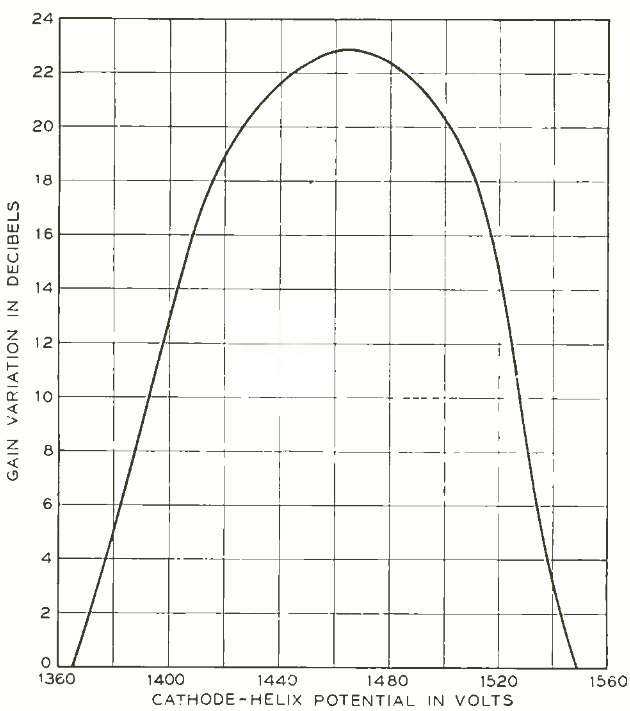


Fig. 5—Relationship between beam voltage and gain of traveling wave tube.

One of the basic problems in designing such a system is the generation of the sequence of very short pulses. Several methods are possible, but only the one built into the experimental system will be described here. This method is based on the critical relationship between the gain of a travelling wave tube and the difference in potential between its helix and cathode, which is called the beam voltage. This beam voltage controls the velocity of the beam electrons and hence the gain of the tube, since maximum gain occurs when the beam electron velocity and the microwave velocity in the helix are properly related. A curve of microwave gain as a function of beam voltage is shown in Figure 5. In using this method for the generation of short pulses, a microwave oscillator is connected to the input of the travelling wave tube. By applying a large 18.432-mc sine wave voltage between the helix and cathode, short microwave pulses appear in the output at half cycle intervals. This is illustrated in Figure 6, where the curve of Figure 5 is reproduced in smaller scale near the center of the diagram—the voltage scale being shown by the right-hand set of ordinates.

To this same voltage scale a 400-volt sine-wave voltage is plotted against a time scale in microseconds as abscissas. As the voltage

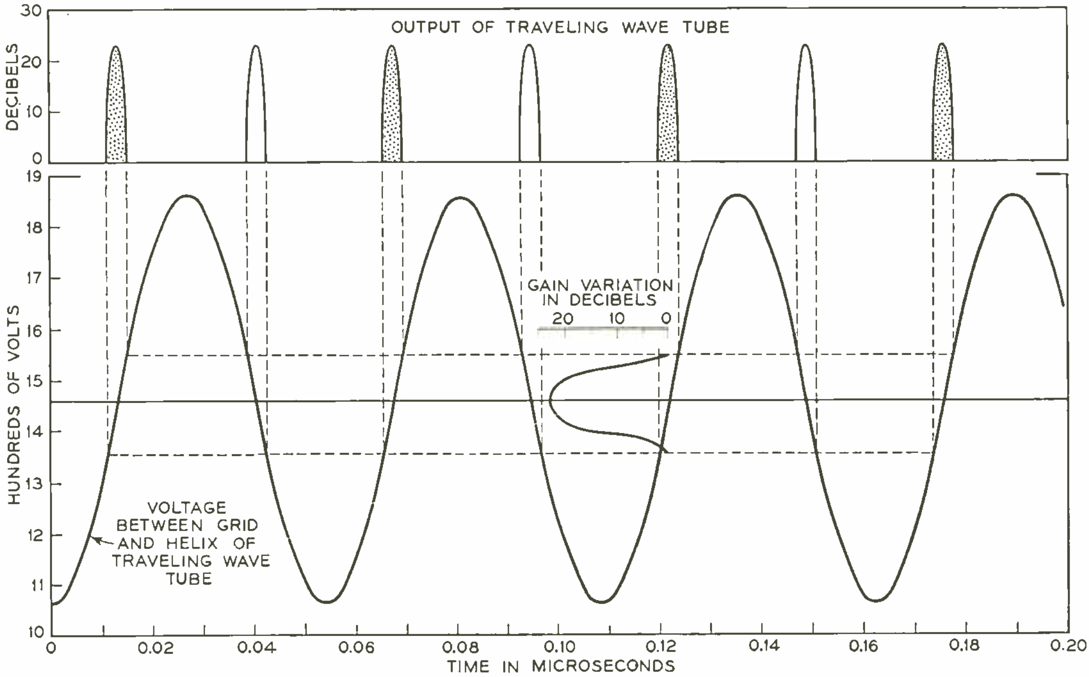


Fig. 6—Method of generating 0.005 μs pulses.

of the sine-wave increases, beginning at the left, the gain of the travelling wave tube increases about 23 db between voltages 1365 and 1460, and decreases 23 db between voltages 1460 and 1550. As a result there is a pulse in the output of the travelling wave tube as indicated in the upper part of the diagram. As the voltage decreases from 1550 to 1365 on the falling side of the wave, a similar pulse is formed. These two pulses are repeated for each successive cycle, and thus appear as along the upper part of the diagram.

Besides causing the change in gain of the travelling wave tube, a voltage change between helix and cathode also causes a frequency shift in the carrier transmitted that is proportional to the rate of the voltage change. At the rising side of the voltage wave, the frequency is increased and on the falling side, it is decreased. The carrier forming the pulses is thus higher than the input frequency in the pulses caused by an increasing voltage, and lower than the in-

THE AUTHOR: After receiving the degree of B.S. in E.E. from New York University in 1934, W. A. Klute at once joined the Laboratories staff. Until 1933 he worked chiefly on carbon for telephone transmitters. He then designed test equipment for telephone installations, and later developed sound operated devices such as noise reducers and compandors. During the war he was largely occupied with military projects. Since then he has been working on pulse code transmission systems.

put frequency in the pulses caused by a decreasing voltage. This shift in frequency is about 250 mc, and thus the shaded pulses of Figure 6 are 500 mc higher in frequency than the unshaded ones.

The latter are readily rejected, and thus leave the sequence of shaded pulses. These are about 0.005 μs wide and occur at 0.054 μs intervals—corresponding to the frequency of the voltage between the helix and cathode.

This method of pulse generation has proven very satisfactory, and is capable of producing pulses of a wide range in width. The larger the sine-wave voltage applied between cathode and helix, the narrower will be the pulses, since the width of each pulse is the time for the applied sine-wave voltage to increase about 200 volts over the steepest portion of the wave. Pulses as short as 0.001 μs have been generated.

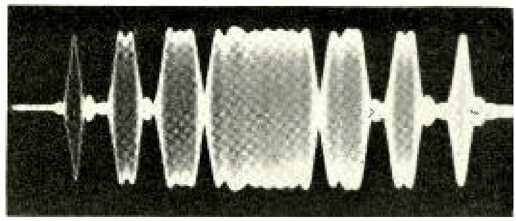


Fig. 7—Appearance of received signal for an arbitrary sequence of codes.

The appearance of the received signal for an arbitrary sequence of codes is shown in Figure 7. Here it will be noticed that the pulses in adjacent positions overlap considerably, as also indicated in Figure 4, but that the effect of the pulse shaping is sufficient to cause a peak at the middle of the pulse position when a pulse is present, and a minimum when no pulse is present.

Ohio Bell Offers Answering Service

The Ohio Bell Telephone Company has announced the inauguration of an automatic telephone answering and recording service for its customers. Equipment for the service, which was started in March on an experimental basis, will be supplied and maintained by the Ohio Company.

Here's how the new service will work. A subscriber who plans to be away from his telephone makes a "talk-out" record explaining his absence. Any one calling during his absence hears this recorded message over the telephone line, after which a 25-second period is provided for the caller to leave a message. A "beep" tone is sounded at the start and just before the finish of this period to indicate to the caller the time available for the recording of his message. When the subscriber returns, he can listen to messages left in his absence by picking up his regular telephone instrument, through which a play-back of any incoming messages will be heard.

The "talk-out" record can be made by the customer, using his regular telephone instrument. The records can be used repeatedly or new records can be made to fit particular circumstances. Thus, for example, a doctor who leaves his office several times during the day might use two or three messages to inform telephone callers where he could be reached at different times during his absence.

At present the answering and recording service is provided by means of a machine known as the Peatrophone, which is furnished by the telephone company and is connected by the company directly to the telephone line in the customer's home or office. Other means of furnishing the service are being studied and may be used in future installations.

The introduction of answering and recording service was preceded by field tests both in Ohio and New York, which indicated that some demand existed for such a service. At present the service is being offered only in Ohio, although it is expected that as additional equipment is acquired, offerings by other Bell System Companies will follow.

M. J. Kelly Elected President, O. E. Buckley Chairman of the Board

Mervin J. Kelly, Executive Vice President of the Laboratories, was elected President on April 20. He succeeded Oliver E. Buckley, who has accepted an appointment by President Truman as Chairman of the newly created Science Advisory Committee of the Office of Defense Mobilization. Dr. Buckley has been elected Chairman of the Board and thus continues his association with the Laboratories.

Dr. Kelly has had a distinguished career in the Bell System and is one of the nation's leaders in the field of industrial research. A native of Princeton, Missouri, he was graduated from the Missouri School of Mines and Metallurgy in 1914 and received his master's degree from the University of Kentucky in 1915. He received his doctorate from the University of Chicago in 1918 and immediately joined the engineering department of the Western Electric Company, subsequently incorporated as Bell Telephone Laboratories.

Dr. Kelly served as Director of Vacuum Tube Development for the Laboratories from 1928 to 1934 and as Development Director of Transmission Instruments and Electronics until 1936, when he was appointed Director of Research. In 1944 he became Executive Vice President, holding both positions until 1946 when he relinquished the duties of Director of Research to concentrate on his major administrative responsibilities.

During World War II, Dr. Kelly devoted virtually all his time to directing many of the war activities at the Laboratories. He supervised the research and development of a large part of the more than a billion dollars worth of electronic material and equipment designed for the Army and Navy. In recognition of this achievement, he received a Presidential Certificate of Merit which cited him "for outstanding fidelity and meritorious conduct in aid of the war effort."

Dr. Kelly, who lives in Short Hills, N. J., is a member of numerous professional societies and of the National Academy of Sciences and has been awarded honorary doctor's degrees by the Universities of Kentucky and Missouri.

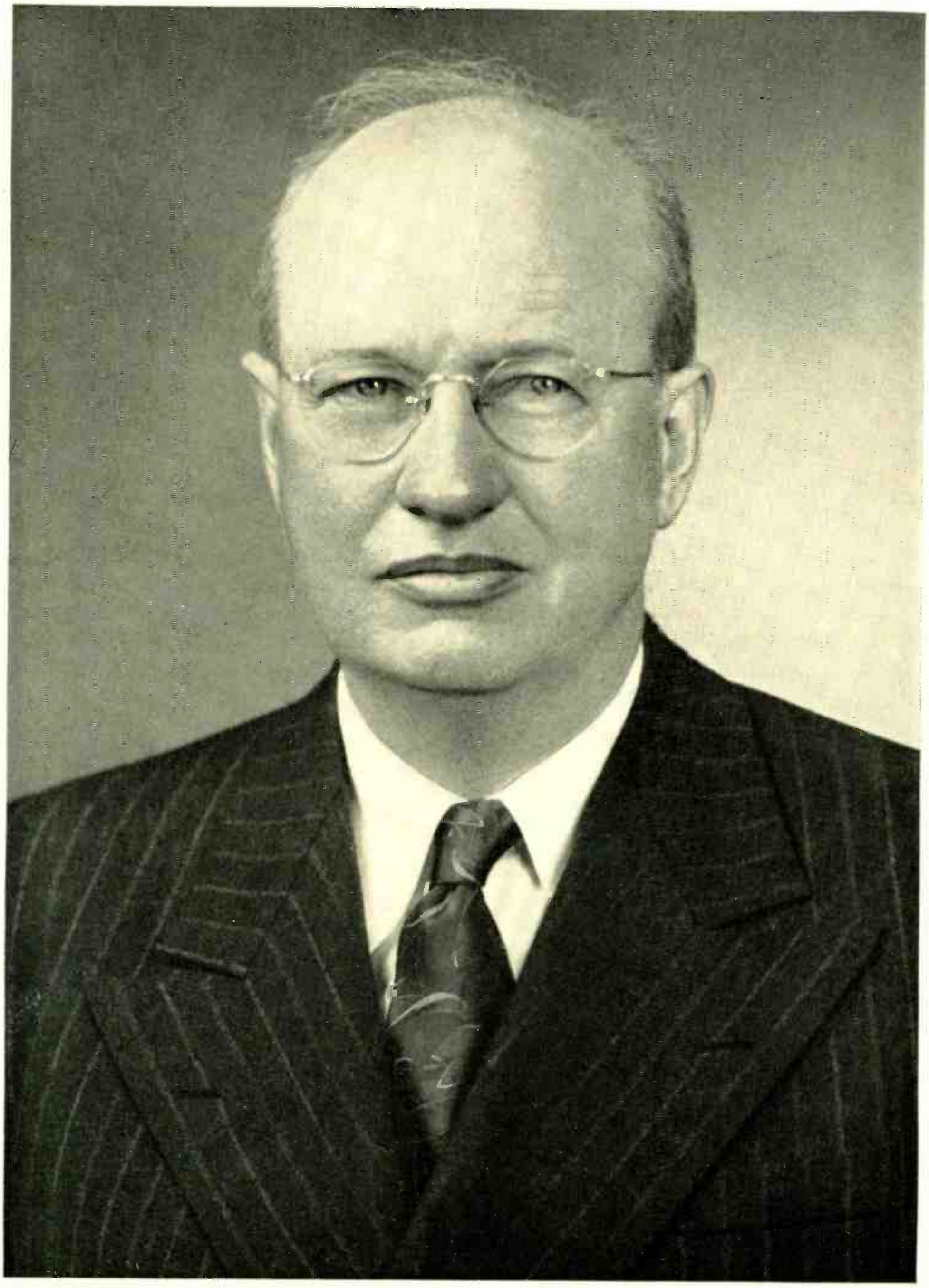
For the past year, at the request of the Secretary of the Air Force, Dr. Kelly has served in an advisory capacity to the Department of the Air Force to assist in the organization of research and development in that department.

Dr. Buckley has been President of the Laboratories since 1940. He was graduated from Grinnell College in 1909 and received his Doctor of Philosophy degree from Cornell in 1914. He served as Director of Research of the Laboratories from 1933 to 1936, and as Executive Vice President from 1936 to 1940.

During World War II, he was active in a number of national projects and was subsequently awarded the Medal for Merit for his services. Since 1948, he has been a member of the General Advisory Committee of the Atomic Energy Commission. He is also a member of the National Inventors Council. During World War I, he was a Major in the Signal Corps, in charge of its Research Section in Paris.

In his new post Dr. Buckley will be Chairman of a Committee of distinguished scientists who will be available to advise the Government, through the Office of Defense Mobilization, and to the President directly, on broad matters of scientific importance, particularly as they relate to the national defense program. The group will also provide liaison among the various Federal agencies concerned with the defense research and development effort, and with the Office of Defense Mobilization.

The other members of the Committee are Dr. Detlev W. Bronk, President of Johns



Oliver E. Buckley, Chairman of the Board

Mervin J. Kelly, President

Hopkins University and of the National Academy of Sciences; Dr. William Webster, Chairman of the Research and Development Board; Dr. Alan Waterman, Director of the National Science Foundation; Dr. Hugh Dryden of the Interdepartmental Committee on Scientific Research and Development; Dr. James B. Conant, president of Harvard University; Dr. Lee DuBridge, President of the California Institute of Technology; Dr. James R. Killian, President of the Massachusetts Institute of Technology; Dr. Robert F. Loeb, of the College of Physicians and Surgeons of Columbia University; Dr. J. Robert Oppenheimer, Director and Professor of Physics at the Institute for Advanced Study, Princeton; and Dr. Charles A. Thomas, President of the Monsanto Chemical Company.

As outlined by President Truman in his letter of invitation to Dr. Buckley, the Science Advisory Committee would advise the President as well as Defense Mobilization Director Charles E. Wilson in matters relating to scientific research and development. The Committee is to be available:

1. To provide independent advice on scientific matters especially as regards the objectives and interrelations of the several Federal agencies engaged in research of defense significance, including relevant relations and intelligence matters.

2. To advise on progress being made in dealing with current scientific research problems of defense significance and also concerning defense research matters which need greater attention or emphasis.

3. To advise concerning plans and methods for the implementation of scientific effort for defense.

4. For transmitting the views of the scientific community of the country on research and development matters of national defense significance.

Mr. Truman said in his letter that the Committee was established within ODM to be "in a direct position to participate in the mobilization program . . . as it affects scientific research and development."

In discussing his appointment, Dr. Buckley said, "Devotion to public service is the tradition in Bell Telephone Laboratories. This is true in our main activity of research and development for the improvement of telephony; it is true in the developments we undertake for the government in the interests of national defense; and it applies also in the outside activities of those of us who have the opportunity to serve in public undertakings for which our talent and experience fit us. It was thus only natural that I felt impelled to accept when Mr. Charles E. Wilson, Director of the Office of Defense Mobilization, asked me to consider the Chairmanship of a distinguished Committee to be appointed by the President and to be available to advise him and the President on scientific matters concerned with defense. With a strong organization to carry on in the Laboratories, and with an extraordinary opportunity to serve the nation in an important capacity, the answer was obvious.

"The new task will consume substantially all of my time but I am glad that I can still serve the Laboratories as Chairman of the Board and thus maintain contact with the work and my associates.

"With every assurance of support from the President and from the Director of Defense Mobilization, and with the advantage of personal advice and help from the members of the new Science Advisory Committee and others, I have faith that the venture will prove a useful one, a faith based on experience of accomplishment of men of good will and high intelligence working together in the spirit that has always guided us in the Laboratories."

Defense Projects in the Laboratories

During World War II these Laboratories undertook more than 1200 research and development projects for the armed forces, many of them in the field of communications but many others in fields for which our unique skills and experience particularly fitted them. Included were such important war projects as radar and its underwater counterpart, sonar; fire control, the gun director, magnetic mines, and the magnetic airborne detector.

Now that the country is again turning to national defense, the Laboratories are devoting more and more efforts to projects for the armed forces. For reasons of national security, many of these cannot be revealed even in general terms, although it is obvious that wide experience in the field of electronics fits us uniquely for preparing for electronic warfare.

In addition to these purely military projects, however, the Laboratories are again undertaking a number of research and development projects in the field of communications. Some of these can be described in general terms.

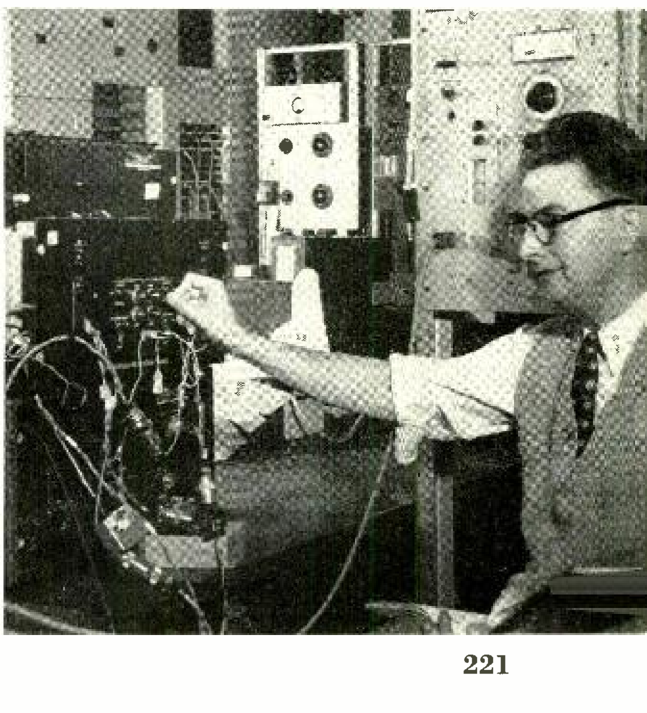
During World War II the Laboratories developed a 4-channel carrier system for use on spiral-four cable which proved very useful.* After the war, the system was re-examined for possible improvements and on orders from the Signal Corps, two new spiral-four systems, one with four carrier channels and one with 12 channels and a radio link, are being designed.

G. H. Huber is project engineer of the wire systems with C. W. Schramm and W. F. Miller responsible for terminal equipment. C. A. W. Grierson is in charge of group modulators, F. B. Anderson amplifiers and regulators and H. C. Fleming voice frequency order wire circuits. J. P. Hoffmann is in charge of equipment design and F. A. Brooks is preparing the Engineering Report. Considerable work on new basic designs of coils, filters and networks is being done by engineers of the Transmission Apparatus Development Department.

The radio link will operate at frequencies lower than the Bell System broad-band radio relay network. It will accept signals from either 4 or 12 channel wire carrier systems. J. G. Nordahl is project engineer with W. G. Hensel and G. Rodwin in charge of transmitter development. U. S. Berger is in charge of receiver development and V. I. Cruser is responsible for equipment design.

Gathered around W. C. Jones, project engineer for the new military telephone set, are (standing) J. R. Power and H. W. Bryant, (seated) W. C. Turnbull and F. S. Corso.

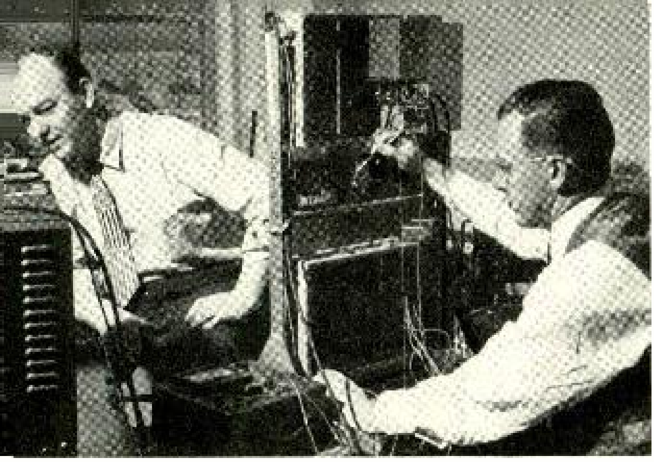
Development work has also been started on a new field telephone set for the Army to replace the set which has been used for many years. This will also be improved through the application of new art perfected since the last war, particularly some of the features of the Bell System's 500-type telephone set. This work



F. B. Anderson tests one circuit element of a new military carrier system.

---

*Record, *December* 1949, *page* 168.

Left—S. Bara and N. Lund at work on a twelve-channel radio relay system for military use. Right—Using a calibrated oscillator, R. H. Olsen and J. M. Barstow, Jr., work on the military carrier system.

has been done in Station Apparatus Development with W. C. Jones as project engineer and W. C. Turnbull, F. S. Corso, J. R. Power, H. W. Bryant and F. H. Graham in charge of details.

Another project involves the study of military switching systems for both forward and rear areas. These systems are designed for tactical use at theaters of operation rather than base training camp or other interior operations.

Laboratories people have cooperated closely with representatives of the armed forces in appraising existing systems and making plans for their improvement. Reports were prepared by R. S. Bailey who has since returned to A T & T, and by G. H. Peterson. These reports are now being studied by the Signal Corps. One of the programs calls for the development of manual switchboards for military service.

Telecommunication in Great Britain

In his inaugural address* as President of the Institution of Electrical Engineers, Sir Archibald J. Gill, Engineer-in-Chief of the British Post Office, reviewed the present state of communication in Great Britain, and commented on certain of its aspects and on possible trends in the future.

In speaking of the desirability of underground distribution and of its economic limitation to areas of high telephone density, he said: "In recent years the Post Office has adopted a system of distribution using street cabinets and pillars containing terminal blocks with cross-connecting facilities. These terminal blocks, which are rather intricate plastic mouldings, have relatively long surface paths between conductors which reduce leakage in humid conditions. The merit of the design resides in the use of bridging pins for making the connections between opposite terminals as required. When other than straight-through connections are required, they may be made by jumper wires without the need of soldering. This system permits a pair of conductors in a main cable to be disconnected from one branch cable and put through on a spare pair in another branch cable with a minimum of labour."

Party-line service, he pointed out, has been employed very little in Britain although it has been used extensively in other countries, particularly in the United States. In recent years, however, because of the need to get the utmost service with the limited capital available, it has come into much more extensive use. At the present time 230,000 subscribers have party-line service, and 60,000 of these are business subscribers. Although apparatus might have been provided to lock out all but the called (or calling) station on a party line, it was decided not to do this. As in American practice it was thought that the advantage of emergency break-in offset the disadvantages.

In reviewing switching systems, he pointed out that in the early twenties, after a study of possible alternatives, it had been decided to adopt the step-by-step system for Great Britain, and that he felt the decision had been a wise one. (The step-by-step system as used in Great Britain includes directors in the larger cities, which provide for these more complex areas some of the advantages derived in this country from senders and markers.) Although conversion to dial operation has been slowed down by the war and by restrictions on capital, about 70 per cent of Britain's five million telephones are now dial.

He discussed at some length the use of nation-wide dialing in Great Britain and its extension

---

**Proceedings of the I.E.E., January,* 1951, *pages* 1 to 11.

to the continent. Their present objective is that a controlling operator should be able to complete a call to any subscriber in Great Britain connected to a dial exchange without the assistance of another operator. He also reviewed the extensive use of various types of coaxial cable for carrier and telephone transmission.

In the submarine field Great Britain has made many developments in recent years, such as the application of carrier and the use of submerged amplifiers. In 1943 a submerged amplifier was laid in a coaxial cable between Anglesea and the Isle of Man. Since then many other installations have been made and are proving very satisfactory.

Changes in Organization

Military Systems Engineering

Due to increasing demands of military work programs W. A. MacNair has been relieved of his duties as Director of Switching Research and will devote all his time to the position of Director of Military Systems Engineering, to which he was recently appointed.

W. D. Lewis, formerly Assistant Director of Switching Research, has succeeded Mr. MacNair as Director of Switching Research.

Personnel Department

Effective April 1, D. W. Eitner, Labor Relations Coordinator, assumed charge of a new department reporting to F. D. Leamer, Personnel Director.

In addition to his duties as Labor Relations Coordinator, Mr. Eitner will coordinate Safety and Accident Prevention work in the Laboratories. L. E. Coon, Safety and Health Supervisor, has been transferred to the new department reporting to Mr. Eitner.

General Accounting Department

J. W. Stoner has been appointed Accounting Results Supervisor, reporting to G. T. Selby, Comptroller. G. B. Small remains Assistant Comptroller reporting to Mr. Selby. Mr. Stoner's post as Cost Accountant has been taken by L. S. Armstrong, formerly Statistical Accountant, and that post has been taken by F. R. Till. Mr. Till and W. E. Marousek, Chief Auditor, now report to Mr. Stoner.

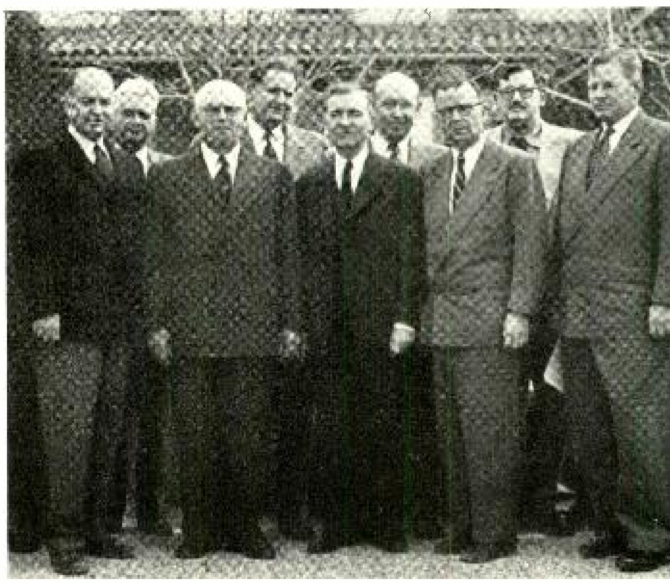
A. J. Daly, formerly Chief Accountant, is now Auditor of Disbursements, and C. W. F. Hahner, formerly Auditor of Disbursements, is now Chief Accountant.

Effective April 1, J. S. McDonough, as General Methods Supervisor, is in charge of his department reporting to B. R. Young, Assistant Vice President. Reporting to Mr. McDonough are the following, with responsibilities as indicated: W. F. Hoover, *General Methods;* W. J. Locke, *Equipment Investment;* and E. C. Walsman, *Office Standards.*

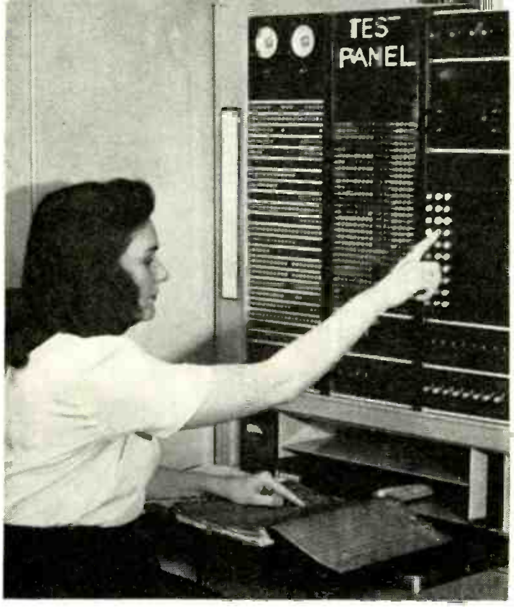
Mr. McDonough, in addition to his duties as General Methods Supervisor, has been designated as the Laboratories Security Representative, in which capacity he is responsible for liaison in matters of security between the Laboratories and Government representatives and between the Laboratories and the Western Electric Company, and for the dissemination of security regulations to employees.

General Staff Department

Frank Cowan, for a year and a half a staff department head at the Sandia Laboratory, has returned to West Street, where he will now be Commercial Relations Manager reporting to B. R. Young. Going to Sandia from the Laboratories' post of General Service Manager, Mr. Cowan was first Technical Staff Engineer. Later Sandia's business methods department and its technical library were added to his supervision.



M. J. Kelly and D. A. Quarles recently visited the Sandia Corporation in Albuquerque, New Mexico, where they were the guests of the Research Department. Front row, left to right, R. E. Poole, Director of Development; G. A. Landry, President; Mr. Quarles; Dr. Kelly; and R. P. Peterson, Director of Research. Rear, F. Schmidt, Vice President and Operating Manager; K. W. Erickson; G. E. Hansche; and C. W. Carnahan.



Kathleen Muccione setting up a computation routine on the digital computer. Miss Muccione is a graduate of New Jersey College for Women (1950) in mathematics. Her job is to analyze problems which require the services of the machine and lay out a procedure; then punch on a paper tape information which will tell the computer what to do.

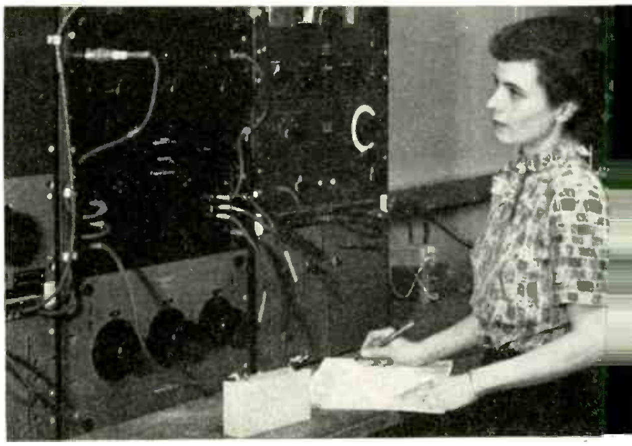
TECHNICAL ASSISTANT POSITIONS FOR WOMEN

The increase in Laboratories effort on military projects has opened up a number of interesting work opportunities for women with training or experience in the physical sciences and mathematics.

The need for women to assist engineers, mathematicians, physicists and chemists is being announced to Laboratories people with the hope that they, in turn, will publicize this need among their outside acquaintances generally and will refer to the Laboratories any young women who feel they may qualify for such employment. This invitation may be extended freely to prospective 1951 graduates having the indicated training. In the case of such people some contract with Bell Telephone Laboratories prior to graduation would be helpful.

Although college-trained people who have had a major sequence in physics, mathematics or chemistry are preferred for this work, others with somewhat less science training or with analogous experience in such fields as technical computing, technical writing or editing, teaching, or technical aide experience elsewhere in college or industry will be given consideration.

Some of the available assignments are in experimental laboratory work and some are in technical work at desk or drawing board. Most



Marguerite Galt measuring the characteristics of a transmission network. Left to right, the oscillator which furnishes testing current, the measuring circuit and the detector panel. Mrs. Galt is a Bryn Mawr graduate (1944) in Physics. Her husband is a solid-state physicist in the Laboratories.

Mary Campbell measuring the acidity of a resin in the Chemical Laboratories. A graduate of Hunter College (1943) in Chemistry, Miss Campbell then joined the Laboratories in the analytical group. Recently she has been working on the development of analytical methods. She received her Master's degree in 1950.

of them are at Murray Hill but there are a few at Whippany. All can be performed by industrially inexperienced persons. Most of them offer considerable latitude for the use of any applicable experience.

Persons desiring to be interviewed for these positions, and all requests for further information should be referred to Phyllis Taylor or to Dorothy Dodd. The New Jersey offices of the Personnel Department are open Monday through Saturday, inclusive.

Laboratories Honored by ECA for Marshall Plan Aid

A Marshall Plan Certificate of Cooperation was awarded to the Laboratories by the Economic Cooperation Administration in recognition of assistance given to visiting foreign experts brought to the United States to study American methods under the ECA Technical Assistance Program. During the past several months, technical experts from France, Holland, Norway, Denmark, Sweden, Greece, Italy and Western Europe had visited Murray Hill to obtain first-hand information on various technical projects.

Similar certificates have been awarded other companies throughout the nation as a part of the third anniversary celebration of the Marshall Plan. In announcing the awards, ECA stated that they were a means of thanking these organizations that have contributed to the economic recovery of Western Europe and increased its defense potential by sharing their technical knowledge with members of the Marshall Plan teams.

Presentation of the Laboratories' certificate was made by Mayor P. M. Bland of Summit, at a ceremony in the Summit Municipal Building on April 3. S. B. Cousins accepted the certificate in behalf of the Laboratories.

Rumford Premium to Dr. Ives

In recognition of his contributions to optics, the Rumford Premium for 1951 has been awarded to Dr. Herbert E. Ives by the American Academy of Arts and Sciences.

During his long career in the Laboratories, Dr. Ives headed several outstanding projects. He was in charge of our initial development of picture transmission, which in 1924 produced the first practical long distance system. He was also in charge of our early work in television, leading up to the first transmissions over long distances in 1927, color television in the same year and two-way television in 1930. He retired in July, 1947.

POWER PLANT SAFETY COMMITTEE

Discussions of safety problems occupy the attention of the Power Plant Safety Committee at its monthly meetings. This Committee is composed of representatives from several occupational groups in the Power Plant. Personnel of the Committee changes every fourth month, so that each individual in the Power Plant serves as a member of the committee and also has an opportunity to act as chairman. Below, left to right, B. P. Herbort, supervisor; J. L. Murphy, representing the watch engineers; P. Higgins, representing firemen and boiler room helpers; A. Megraw, chairman of the committee and representing the power service operators; J. F. Wursch, representing the elevator mechanics; and B. A. Nelson, supervisor.

Nossaman Talks on Outside Plant

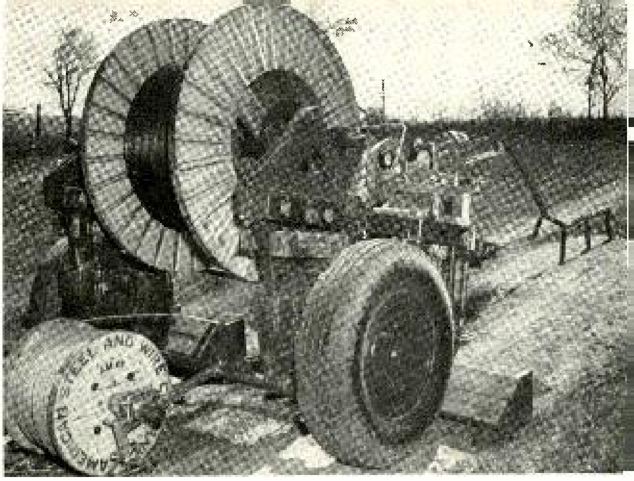
If an exchange outside plant system were to be constructed, complete from subscriber's station to central office main frame protector, using new components now available or in advanced stage of development, it would be found that virtually every major element of such plant would be of a type not available before the war.

This was the thesis of a talk by R. J. Nossaman, Director of Outside Plant Development, in the out-of-hours series at West Street on March 19 and at Murray Hill on March 21.

Station wires are now individually insulated and commonly jacketed with thermoplastic, affording a structure of circular cross section and smooth finish which can be applied neatly to interior walls and trim by means of machine driven staples. This wire replaces the twisted structures which were held in place by means of hammer driven large headed tacks. The new station protector makes use of cylindrical carbon blocks in a metal cartridge which, when screwed in place, affords a much better moisture seal than was possible with the older rectangular blocks covered with a plastic dome. Preparations for the manufacture of a fuseless type of protector employing the new blocks are under way. Neoprene jacketed drop wire and a new type of drop wire clamp replace the older cotton braid covered wire and clamp.

In the new types of distribution cable terminals, the protectors form an integral part of the terminal itself. The cylindrical carbon block protector cartridges, similar to those used in station protection, are screwed into wells molded into the cable terminal faceplate which is cast from thermosetting plastic and achieves a gas-tight connection between binding posts and cable pairs. Cables themselves have a variety of new kinds of sheaths using various combinations of Polyethylene, aluminum, lead and steel layers according to the particular service requirements. The conductors in cables may be insulated with Polyethylene rather than paper and may include new types of shielded video pairs for short haul television such as between studios and broadcasting stations.

M. W. Bowker (left) and R. F. Graham (right) demonstrate to two New York Telephone men a new device which "sniffs out" gas leaks in cables.



An experimental machine which lashes cable to strand before they are placed on poles. The "praying mantis" at the right is to prevent twisting while pulling.

Poles may be of species not commonly used before and may have preservative treatments of new types. Corrosion-resistant strand and hardware have been made available. Underground conduits without glaze and in longer unit lengths reduce the cost and improve the quality of underground construction. At the central office end of the circuit, a new type of central office protector is undergoing field trial.

Not only would the component parts and material be of new and improved types but recent development work in construction and maintenance methods would be reflected in placement cost economies and better operating performance. Among these developments are the prelashing of cable to strand while the two are being placed simultaneously rather than separately as has always been the standard practice. An inductive talking set has been developed by means of which a line placing crew is able to communicate during construction activities over distances up to a mile or more if there is some non-grounded metallic structure along the route over which communication is desired. No metallic connection is required. Gas pressure systems have been worked out for use on exchange cables.

New methods and techniques of detecting incipient subscriber line trouble by means of line insulation testing are now in widespread use. The problems still awaiting solution indicate a useful role for many years for the Department, and interesting careers for its members.

Bridge at West Street

Winning the championship of the Metropolitan Commercial Bridge League this year is the culmination of several years of "almost." Two years ago, the Laboratories team tied for first place, lost by one match point in the playoffs; last year, they were in second place. But this year they carried off first place honors by winning 11 out of 14 matches.

Representing the Laboratories in the league were: C. L. Deelwater, captain, Edna G. Aamodt, G. C. Lord, E. G. Walsh, J. W. Brubaker, C. F. Bischoff, Marion C. Gray, Beatrice Koukol, K. M. Fetzer, G. H. Downes, Walter E. Grutzner, H. A. Miloche, and T. V. Curley. Mr. Deelwater, highest individual scorer in the League, is also president of the League, and Mr. Lord is the chairman of the West Street Club.

Playing in the Silver Anniversary Eastern States Regional Contract Bridge Championship Tournament, the Laboratories team of Edna Aamodt, C. L. Deelwater, T. V. Curley and G. C. Lord took fourth place, competing against 26 other teams in the Commercial and Industrial Division. This was a two-night affair, bringing together most of the leading teams of commercial organizations in the East.

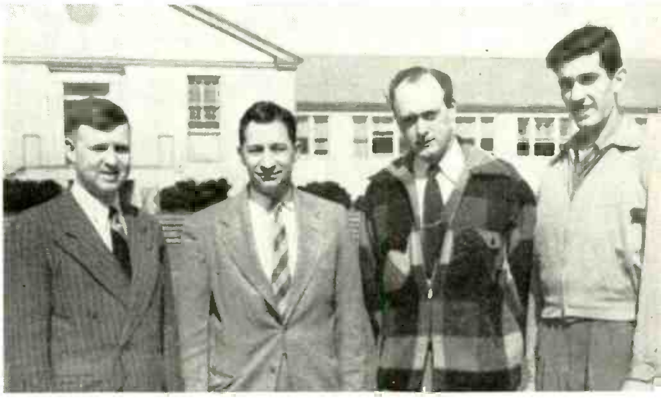
The usual spring pair tournament of the Metropolitan League was held in April, with four pairs of Laboratories people entered. These are: C. L. Deelwater and Edna Aamodt, G. C. Lord and E. G. Walsh, J. W. Brubaker and C. F. Bischoff, and Marion C. Gray and T. V. Curley.

American Physical Society Meeting at Pittsburgh

The 304th meeting of the American Physical Society was held in Pittsburgh, March 8, 9, and 10, 1951. Several of the Laboratories people took part in the meeting. On Friday morning, W. Shockley gave a paper on the *Behavior of Holes and Electrons in Germanium*. He presided at the Friday afternoon symposium on Luminescence, Photo-Effect, Electron, and Exciton Migration. Charles Kittel spoke on *Antiferromagnetism and the Néel Theory of the Ferrites* at the Saturday morning symposium on Ferromagnetism and Antiferromagnetism. In the afternoon, at a session on Magnetism: Non-Metallic Crystals, H. J. Williams, F. G. Foster, and E. A. Wood presented a paper on *Observation of Magnetic Domains by the Kerr effect*.

Technical Assistants at Whippany

Four new Technical Assistants who have been employed in Military Systems Engineering to work on airborne projects. They are, left to right, E. J. Aridas, L. E. Sebring, E. Geruntho, and D. E. Davey. Below, Mr. Aridas is shown making precision measurements on small synchro motors. Right, below, Mr. Geruntho with the apparatus which he has built for testing specially selected tubes.



NEWS OF THE TELEPHONE PIONEERS

A. F. Bennett and guests doff their rainwear and register in the lobby.

The Misses Hollopete have refreshments.

T. J. Crowe collects refreshments while Dorothy Storm (left) surveys the well-filled lobby.

The New Jersey Council held a Regional Get-together on Friday evening, March 30, in the Arnold Auditorium at Murray Hill. The "Evening of Music and Fellowship" was enjoyed by another capacity audience of Pioneers, life-members and guests.

J. G. Walker introduced H. J. Delchamps, Council Chairman, who extended the greetings of the council to the audience. The Murray Hill Chorus and the Murray Hill Symphony each presented a program which was climaxed by the joint performance of Sibelius' *Onward, Ye Peoples*. The chorus, under H. Thomas Miller, and the Symphony, with Paul B. Oncley conducting, gave exceptionally fine performances.

The New Jersey Council Women Pioneers were represented by Marie Wright, Lydia Covalence, Dot Storm, Ella Munk, Ada Corcoran, May Gregory, Miriam Harold, Betty Klarmann, Aggie Connors and Helen Keiningham. The

The Murray Hill Chorus presented the first half of the evening's program. The chairs on stage were arranged for the Murray Hill Symphony Orchestra which performed later.

Dorothy Storm, Marie Wright, Ella Munk, Miriam Harold, Ada Corcoran, Lydia Covalence and Mary Gregory prepare for the post-show rush. Hostesses not in the photo were Helen Keiningham, Agnes Connors and Betty Klarmann.

ladies greeted and registered guests and served as hostesses during the refreshment period following the performance. A. J. Akehurst managed the stage setting and lighting, and Frank Fossetta was around with his ever-inquisitive camera.

Life Member Club

Sixty-seven Pioneers of the Life Member Club met at 463 West Street on Thursday, March 22. Most of them had lunch in the cafeteria and then went up to the auditorium where the meeting started at 12:40 P. M. The program opened with Easter music by the Bell Laboratories Choral Club. Afterward there were talks by M. J. Kelly and M. H. Cook.

Pioneer Picnic

The Telephone Pioneers of the Frank B. Jewett Chapter are planning another picnic to be held at Farcher's Grove, Union, N. J., during the afternoon and early evening of Saturday, June 9. The program will be similar to that of last year and will include sports, dancing and children's activities. Further details will be given in other announcements later. This is an event in which the entire chapter can participate and it promises to become an annual occasion. Other types of entertainment are limited to smaller groups and have therefore been delegated to the council organizations.

Murray Hill Chorus Spring Concert

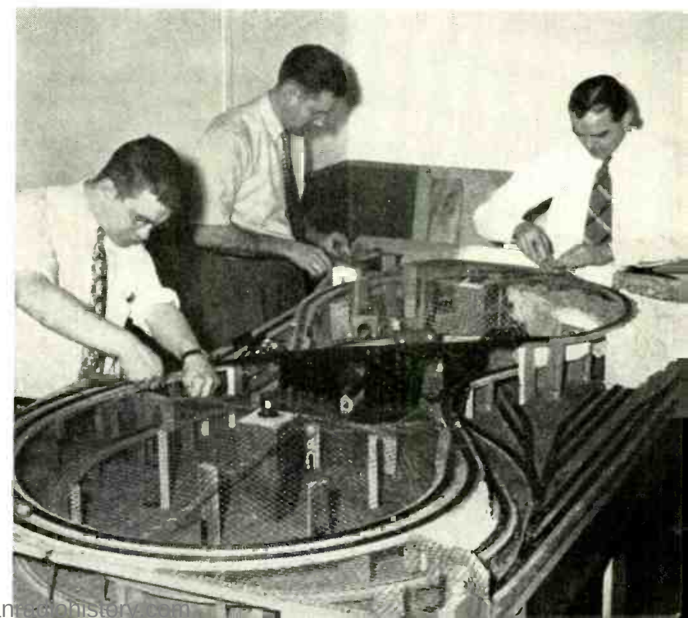
The sixth annual Spring Concert of the Murray Hill Chorus will be presented Tuesday evening, May 22, 1951, at Chatham High School. Featured performer is Mrs. Dorothy Kautzman, noted violinist of the Summit area. Mrs. Kautzman is the wife of former chorus director, Daniel Kautzman. She will be accompanied in her several selections by Phyllis Mansfield Carlini.

H. Thomas Miller will direct the chorus in the performance of a varied program of gay familiar music which is especially suitable to the happy mood of Spring. The accompanist for the chorus, Capitola Dickerson, will be heard also in the role of contralto soloist. An added feature of the program is the inclu-

Model Railroad Club Activities

The Model Railroad Club at West Street has been active recently in building a portable model railroad layout. Hard at work on this project during one of their lunch hours are P. Mallery, C. W. Haas, Jr., and L. F. Kniffin.

Formed primarily to acquaint model railroaders at the Laboratories with each other, the Club makes occasional visits to other clubs in this area who operate large, well established layouts. One of the club's most useful functions has been to provide information to the beginner; any one intending to start in the hobby of model railroading is encouraged to join.



sion of several of Mr. Miller's choral compositions and arrangements.

Though the Spring Concert is the highlight of the activities of the Murray Hill Chorus, they also sang at other programs during the season. One appearance was at a meeting of the Frank B. Jewett Chapter of the Telephone Pioneers. The group gave one noon hour performance in March, and will sing at Lyons Veterans Hospital again this month. The season will end with their annual Chorus party.

F. R. Kappel Talks to Supervisors

F. R. Kappel, Vice President of A T & T in charge of the Department of Operation and Engineering, spoke to a conference of Bell Laboratories supervisors on April 5. That the Bell System has in good measure the three ingredients for success—sound financial structure, a sound organization with imaginative leadership, and facilities geared to the future—was the substance of Mr. Kappel's talk. He was introduced by O. E. Buckley.

News Notes

While visiting Atlanta, M. J. Kelly conferred with the Southern Bell management and staff. With D. A. Quarles he visited the Western Electric Radio Shops at Winston-Salem and Burlington on March 12 and 13. On March 15, Dr. Kelly gave a lecture on *Research and Development in Telecommunications* at the Industrial College of the Armed Forces in Washington.

Dr. J. O'M. Bockris of the Department of Physical and Inorganic Chemistry, University of London, addressed a conference at Murray Hill on April 4. His subject was *Absolute Calculation of the Rate of Proton Discharge*. Dr. Bockris made a tour of this country, in the course of which he delivered the Richards Memorial Lecture before the Electrochemical Society.

At Allentown, N. Y. Priessman, J. R. Flegal, W. L. Tuffnell, A. H. Inglis and G. K. Teal discussed the production of silicon carbide varistors for the 500-type telephone set.

May Service Anniversaries of Members of the Laboratories

E. C. Wente

35 years

W. L. Betts
A. C. Gilmore
R. J. Hopf
F. A. Muccio
V. B. Pike
E. C. Wente

30 years

Ida Wiberg

25 years

W. Breslin
J. C. Bylander
W. E. Campbell
America Cuervo
T. T. Hagen
J. J. Mahoney, Jr.
A. J. McGuiness
E. A. Perpall
T. Slonczewski

20 years

J. E. Grygotis
O. Halvorsen
H. Sagefka

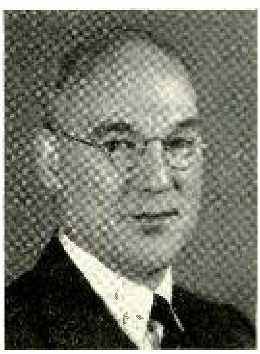
15 years

Charlotte Bortzfield
H. R. Butfiloski
T. H. Chegwidden
P. P. Crowe
J. R. Glaser
P. Hannes
L. H. Hofmann
Helen Kehr
R. T. Monahan
Eleanore Pape
G. W. Schuell
L. J. Scott
D. F. Skelton
B. C. Slack
A. B. Watrous
G. J. Wolters

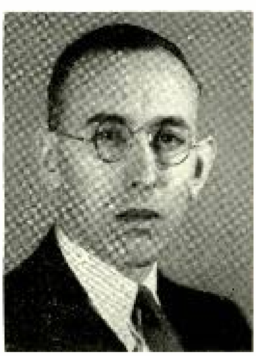
10 years

R. L. Eilenberger
R. H. Funck
C. W. Harrison
P. K. Prothero
D. N. Ritchie
Marie Tighe
J. J. Turley
R. G. Voss
V. C. Wade
W. P. Weiler
E. T. Wojciechowski

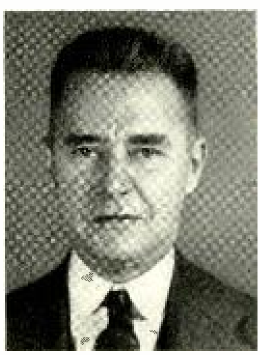
R. J. Hopf



V. B. Pike



A. C. Gilmore



W. L. Betts

F. A. Muccio

Called to Active Duty

M. J. Godwin

As of March 31, 34 members of the Laboratories have been granted Military Leaves of Absence. During March, two young men went into the service:

Michael J. Godwin, messenger at West Street, enlisted in the Navy, and is now at the Great Lakes Naval Training Station. He came to the Laboratories in July, 1950, and, except for about three months in the blueprint room, had been in messenger service.

Robert H. Wagner, who came to the Laboratories in September, 1950, was employed in the mail room and in messenger service. He has enlisted in the Air Force, and is now at Sampson, New York for preliminary training.

R. H. Wagner

"A Fair Profit for Utilities...Is in the Public Interest"

The vital part that profit plays in utility operation was stressed in a recent speech given by Schuyler L. Marshall, a member of the Michigan Public Service Commission and longtime newspaper editor and publisher.

Following are excerpts of Mr. Marshall's address, which should be of particular interest to telephone people:

"I favor a fair profit for utilities. It is in the public interest.

"I am *not* against big business. Big business is big because the public makes it big—by demanding its product.

"I believe inflation is the greatest threat to America today. I fear inflation because it distorts value by changing the yardstick of value—the American dollar . . . I recognize as never before the fundamental services of utilities—electric power, gas fuel, telephonic communication and rapid transportation—to be foundation stones of our state and national economy. These services affect economic life of every family, every commercial and industrial concern.

"In the past six years I have observed that nothing can have such a disastrous and adverse effect on the economy of a given area as a poorly managed, improperly financed utility . . .

"Utilities are not immune from the effects of inflation. Utilities have been hit by the same economic cross-currents which have made the 1940 $5,000-home cost $10,000 of today's 57-cent dollars. This same inflationary influence has made the 35-cent haircut cost $1.00; the $1,000 small car cost $2,000; the $35 suit of clothes cost $65 to $85, etc.

"There are three general classes of people who are directly concerned with the rates of utilities:

"(1) The consumer who pays the rates. In terms of hours worked, bushels of wheat, pounds of beef or pork—or almost any other commodity—utility services are today, the biggest bargain on the market.

"(2) The utility workers whose wages are dependent upon the utilities income. Utility wages have been increased apace the cost of living and are comparable to those paid in other industries.

"(3) The investing public whose savings-dollars are loaned to pay for utility plants in service. Dividends to the common stockholders continue to be held to 6 per cent to 7 per cent—without regard to the decreased purchasing power of the dollar . . .

"On the one hand, the Public Service Commission is designed to protect the public from exorbitant rates and to define and regulate conditions of service to the public. On the other hand, it is charged with the responsibility of allowing utilities to earn a fair return on the fair value of their property—enough to enable them to give good service and enough to enable them to attract capital for expansion . . .

"Among the utilities, the telephone business is the most hazardous. By its nature it requires a much larger per cent of personnel than any other utility and its expenses are affected in a greater degree by increased wages than any other utility. Contrasted with the electric industry, the telephone companies are much more vulnerable to fluctuating economic conditions.

"As contrasted with gas and electric industry, the telephone industry requires no capital investment from its subscribers, while to install either gas or electric service the average home owner must invest in appliances and wiring which may cost as little as $250 or as much as $1,000. Obviously, in times of depression, electric and gas facilities are continued in the average home while the telephone may be the first to be discontinued . . ."

Ferromagnetism

To the many investigators of magnetic phenomena and users of ferromagnetic materials, R. M. BOZORTH's new book *Ferromagnetism** will be a welcome addition to the literature on this subject. In this comprehensive book, DR. BOZORTH has provided a unified account of ferromagnetic theory, ferromagnetic properties of materials, and discussions of the many alloys used for obtaining specific magnetic characteristics. Outlines of manufacturing methods, with special reference to those materials of commercial importance—permalloys, grain oriented silicon iron, alnicos, and the ferrites—are also included.

The book is divided into two main parts—properties of magnetic materials and the nature of magnetic phenomena. When discussing materials, the approach is mainly descriptive and nonmathematical; in discussing theory, the emphasis is on physical concepts. A large number of illustrations, averaging about one per page, aids in clarifying the exposition.

Chapter 1 reviews the concepts of ferromagnetism. In Chapter 2, the factors affecting magnetic quality are discussed, including the effects of chemical composition, heat treatment, impurities, and mechanical working. Discussions of the magnetic properties of materials are given in Chapter 3 to 8 inclusive; metallurgical data, together with phase diagrams, are correlated with the magnetic properties of a large number of both the commonly used alloys, such as the nickel-iron series, and the newer non-metallic ferrites, as well as less well-known substances. Permanent magnets and the properties of the materials used in them are described in Chapter 9.

* D. Van Nostrand, Co., Inc.

Working at her potter's wheel, putting the finishing touches on a bowl, Anne Witherspoon is one of the Laboratories' amateur artists and craftsmen who plan entries in the Sixth Annual Exhibition to be held at West Street, beginning on May 22. Miss Witherspoon is a member of the ceramics class.

Charles de Coutouly (left) gets his relaxation from the week's engineering tasks, when, most every Saturday night for the past 15 years, he and Charles Woolsey of the Weston Electrical Instrument Corporation indulge in "Bach, Beethoven, and Bock" with crackers and cheese—at the end of their private concert.

Magnetic phenomena and theories are reviewed in Chapters 10 to 18 inclusive. These include the domain theory first stated by Weiss in 1907, and the recent advances in methods of observing the domain boundary characteristics of iron alloys. Special problems in domain theory are considered in Chapter 18.

Measurements of magnetic qualities—basic relations, common methods, and special methods—are described in Chapter 19. Special methods include measurements on liquids and gases, para- and diamagnetic material, and the production of high fields.

Appendices list the symbols used in the text, the physical properties of the elements, values of some constants, and magnetic properties of various materials. An extensive bibliography lists publications on magnetism from 1842 to 1951.

The Copper Situation

Restrictions on the use of copper, a strategic material, is of considerable importance to the Telephone System. While the Bell System is striving to meet the country's increasing demand for service, under the limitations on the permitted usage of copper, efforts to effect some decrease in requirements for copper are being made. Some ways in which this has been accomplished are the use of more steel line wire in place of copper, reduction of the percentage of copper from 40 to 30 in copper-steel line wire, increased use of smaller gauge conductors in exchange cable, and the substitution of galvanized steel in drop wire clamps.

Storm restoration work also included ways of conserving copper. Substantial savings have been obtained in rebuilding open-wire lines that were extensively damaged by the sleet storm that hit the South late in January. For example, in Louisiana, a 51-pair, 19-gauge cable was used to replace a 9-mile length of open-wire lines previously used for shorter haul trunks and subscriber's circuits. This alone means a saving of about 22 tons of copper.

Western Electric's consumption of copper was about 82,000 tons last year, or about 5 per cent of the total consumption in this country.

News Notes

TWO CONFERENCES to discuss the work of the Mathematics Research Group have been held in Arnold Auditorium, Murray Hill, recently, in which the general subject was *Signaling Alphabets to Combat Noise*. On March 28, the program consisted of talks by B. MCMILLAN on *Geometrical Description of the Signaling Problem* and D. SLEPIAN on *Efficiencies of Various Alphabets*. On April 4, L. A. MACCOLL discussed *Geometry of a Signal Space as Dependent on the Means Used for Detection*, and R. W. HAMMING spoke on *Error-Correcting Alphabets*.

AT A CONFERENCE on April 11 in Arnold Auditorium to discuss the work of the Physics of Solids Research Group, J. K. GALT spoke on *Motion of a Domain Wall in Magnetic Iron Oxide and Its Relation to the Permeability of Ferrites*.

T. J. GRIESER presented a paper entitled *A Multichannel Radio Relay System for Long Distances* at the Connecticut Section of the A.I.E.E. at Waterbury.

A. H. HEARN visited Libby, Montana, in connection with studies of the pressure treatment of western larch and lodgepole pine poles. Poles of these species are being used to supplement the supply of southern pine poles in the sizes used jointly by telephone and power companies and that are currently in greatest demand.

A TUBE TESTER by the Hickok Electrical Instrument Company is now being placed in production in which the basic circuits have been modified by the Laboratories to secure certain improvements for Bell System use. A. A. HEBERLEIN recently discussed with Hickok engineers at Cleveland the results of Laboratories test on a tool-made sample.

MANY PROBLEMS that arise during manufacture of switching apparatus can best be solved by verbal discussion, rather than through correspondence between the Laboratories and Western Electric. Correct interpretation of requirements, permissible tolerances, and changes in methods of manufacture on step-by-step, panel, and crossbar apparatus were discussed with Western Electric engineers at Hawthorne during March by D. H. GLEASON, V. F. BOHMAN, G. E. PERREAULT, and E. P. WILLIAMS.

Scouting's distinguished honor, the Silver Beaver, was awarded A. H. Smalenbach of Systems Engineering at the eighth annual Scouters banquet of the Alhtaha Council, Passaic County, N. J. The photograph shows Mr. Smalenbach receiving the award from E. J. Thimme of the Council and previous winner. Two other previous winners, Deputy Police Commissioner Peter Roe and executive board member E. J. Cassidy are in the background.

A. P. JAHN has been appointed to the Advisory Committee on Corrosion of the American Society for Testing Materials.

ANNUAL BOWLING TOURNAMENT AND DINNER OF THE QUALITY ASSURANCE DEPARTMENT

Above—Group at Roxy bowling alleys. Left to right, standing, R. M. Moody, B. R. Eyth, H. P. Kneen, E. G. D. Paterson, W. G. Freeman and J. H. Shepard. Seated, G. R. Gause, R. E. Friedley, F. Huebsch, J. A. Seifert, J. L. Belfi, R. S. Plotz and H. W. Nylund.

Left—General view of dinner that was held at the Abbey Chop House.

Left—Winning quartet in whistle playing contest. Left to right, R. O. Hagenbuck, N. C. Norman, L. N. St. James and F. J. Daniels.

Lower left—G. S. Mueller, left relinquishing "Growler" for low score to E. J. Zillian.

Below—M. A. Specht presenting prizes to R. Tonn and J. H. Shepard, respectively.

Laboratories Field Engineers Hold Conference

Members of the Field Engineering force, Quality Assurance Department, gathered in New York during the week of April 2 to renew personal contacts, discuss various phases of the Field Engineering job, and be briefed on some of the current Laboratories developments and activities. On Monday morning W. H. Martin and G. D. Edwards welcomed the group and opened the conference with an outline of the meetings and objectives. F. D. Leamer talked briefly about some of the recruiting problems of the Personnel Department and outlined ways in which the Field Engineers may be of some assistance. Monday afternoon and Tuesday were spent in planned conferences with the several groups of complaint investigators in the Quality Assurance Department.

On Wednesday the group went out to the Murray Hill Laboratory where A. F. Bennett, H. F. Hopkins and L. E. Krebs presented some of the new developments in station apparatus, and H. A. Affel, P. G. Edwards and L. Pedersen discussed N1 and O carrier systems. R. J. Nossaman gave a luncheon talk on Outside Plant developments, followed by an afternoon of demonstrations at the Outside Plant laboratory located at Chester.

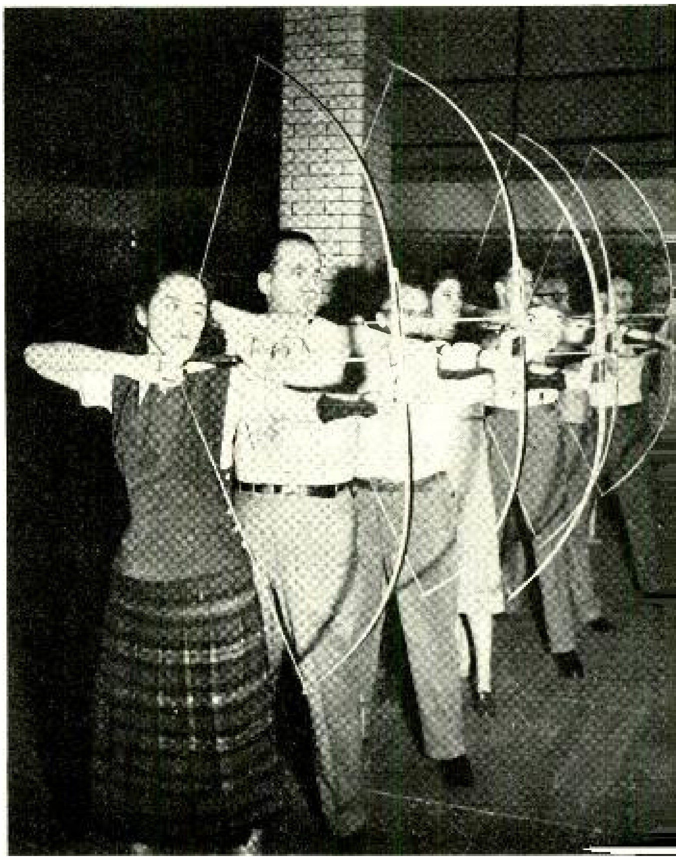
On Thursday afternoon the Switching Engineering group under A. M. Elliott demonstrated the newly developed machine intercept equipment, and briefly discussed ten-cent coin operation and extension of loop ranges in step-by-step areas. The rest of Thursday was occupied principally by discussions of Field Engineering methods and procedures. On Friday morning, C. W. Halligan told the group about his proposed field organization of Air Division Engineers. Also H. F. Dodge discussed Inspection Practices and some of the factors which go to make up the Quality Report issued quarterly by the Quality Assurance Department. After further sessions on strictly Field Engineering matters such as office rentals and service arrangements, the conference was concluded with a talk by G. D. Edwards.

Social events during the meeting included a dinner at the University Club, after which M. J. Kelly talked about the functional organization of the Laboratories, and about the effects of military projects on our telephone work. Other evening activities were attendance at a television broadcast, the annual dinner and bowling tournament of the department and a supper party for present and former field engineers and their wives at the home of H. M. Craig.

News Notes

To IMPROVE insulating materials—plastics, rubbers, waxes and resins—physical chemists seek a better understanding of the large organic molecules of which these materials are composed. D. EDELSON was chairman of a Symposium on *Dielectric Properties of Macromolecules* held at the Polytechnic Institute of Brooklyn.

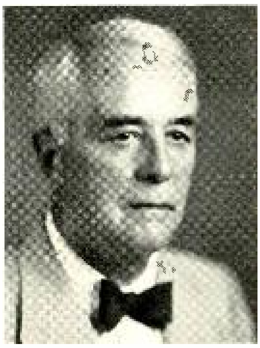
HOW TO DEVELOP synthetic rubbers which remain flexible in the Arctic is a principal objective of the Advisory Committee on Plastics and Elastomers of the Quartermaster Corps, a meeting of which C. S. FULLER, R. BURNS and W. O. BAKER attended in Philadelphia.



West Street Archery Club

Members of the Laboratories at West Street who are interested in the grand old sport of archery still have time, before the club activities end for the season in June, to attain proficiency in this art. Equipment for beginners and instructions for all are available at the range in Washington Irving High School every Wednesday evening at 6:30 p.m.

RETIREMENTS



R. B. Hill

R. C. Mathes

J. S. Garvin

Recent retirements from the Laboratories include J. S. Garvin with 41 years of service; R. B. Hill, 39 years; R. C. Mathes, 37 years; Howard Hall, 33 years; J. R. P. Goller, 28 years; and Fred Cornelison, 8 years.

Roger B. Hill

Roger B. Hill attended, in succession, the two oldest schools in the United States – Boston Latin School and Harvard University–graduating from the latter in 1911 with a B.S. degree. He entered the Engineering Department of the American Telephone and Telegraph Company in August of that year. For several years thereafter he was engaged principally in appraisal and depreciation studies. He was transferred to the Department of Development and Research upon its formation in 1919, and since then has been largely concerned with the economic phases of development and operation. He has been a member of the Laboratories since 1934, first in the Outside Plant Development Department and later in the Staff Department.

In addition to his work on the economic side of the business, Mr. Hill has spent a large amount of time in the preparation of information dealing with the technical development of the telephone art, and is an authority upon the improvements that were made during the first thirty years of the business. He has assisted in the preparation of several books and articles on that subject, and in recent years has been the author of a number of biographical articles for the Record dealing with the advances in the telephone art contributed by some of the early pioneers. Mr. Hill's home is in Summit.

John S. Garvin

On graduation from University of Kentucky, (B.M.E. 1910) John Garvin entered Western Electric's student course and a few months later came to West Street to work on transmission apparatus. Two big jobs of the next few years were the Transcontinental Line and the Arlington-Paris radio telephone experiments, to both of which he contributed. In 1917 he joined the relay development group where, as designer and supervisor, he has left his mark on nearly every type of telephone relay in use today. His efforts extend over the period from the "torpedo" type relays, and the "knife-edge" designs of the early manual systems through the Craft flat type relay designs to the versatile, stable, and compact relays of today. Drops and signals, ringers, and message registers have also been part of his responsibility at different times. Tripping relays, counting relays, stepping relays, line relays, and many other telephone relay types all bear evidence of his flair for design. Among the newer developments, he remembers particularly his work on the 266 type polarized relay, widely used on two-party message rate lines. His latest development was the 280 type relay–newest and best of our polarized relay family; it uses a die-cast base, a small Remalloy permanent magnet, and a Permalloy shield. Twelve patents have been issued to him.

A few years ago the Garvins moved into Manhattan from New Jersey. Except for a motor tour in the West, they expect to remain here, near their two daughters and four grandchildren.

Robert C. Mathes

For a time after Mr. Mathes came to the Laboratories in 1913, he worked on repeaters for the Transcontinental Line. Then he began his long association with voice-operated devices, which included the echo suppressor, the vodas, the vogad, the compandor and the volume limiter. Over the years he has contributed to a great variety of transmission problems such as the correction of telegraph signals from long submarine cables, privacy systems, picture transmission, testing and signalling devices, negative impedance circuits. Eighty-eight patents record his contributions and a number are pending.

The largest war-time job under Mr. Mathes' supervision is still under security but in addition his group worked on magnetic pulsing coils, timing circuits, servo-mechanisms, glass-enclosed relays, the close-spaced triode in its early stages, and the application of statistical methods to interpreting laboratory measurements.

Since the war, Mr. Mathes has headed a group on transmission studies in Transmission Research. One of their principal projects has been the study of the information-bearing elements of speech as a basis for new transmission and control applications.

Mr. Mathes is the author of a number of professional papers, one of which on television signals, written jointly with Frank Gray and J. W. Horton in 1927, received an A.I.E.E. "best paper" prize. He has been a member of the American Physical Society, a senior member of I.R.E., and a fellow of A.I.E.E., A.A.A.S. and the Acoustical Society. He is a graduate of University of Minnesota (B.S. 1912, E.E. 1913).

On retirement, Mr. and Mrs. Mathes will take a trip to Europe, and will then make their home in Escondido, California. In addition to planting a few acres to avocados and the likelihood of doing some consulting work, he looks forward to reading some of his accumulated thousands of books, organizing a specialized collection of German inflation stamps and assisting Mrs. Mathes in collecting and restoring dolls of the past.

Howard Hall

Joining us during World War I, Mr. Hall first worked on sound detectors for gunfire ranging apparatus. Following the war he was in the printing telegraph group and then designed tools for use in the installation of panel offices. Later he joined the research design group and for several years was occupied with the development of the apparatus that was used in connection with the New York-Azores cable.

In 1926 Mr. Hall handled the mechanical design of the first demonstration of television and in the later two-way television between 195 Broadway and West Street. He holds several patents in pictures in relief, color and microscope photography, X-ray and music reproduction. During World War II he was engaged on mechanical design of electronic test sets and precision components for military material. Since the war he has been assisting in the development of various tools and techniques for reducing contact troubles in central offices. After retirement Mr. Hall will be engaged for a while on design engineering in connection with National Defense. He hopes eventually to devote all his time to his large farm in South Jersey and develop it to its full productivity.

Fred Cornelison

During the war—1943 to be exact—Mr. Cornelison joined the Whippany Laboratory as a building and grounds utility service hand. The words are accurately descriptive of Fred's usefulness—he could turn his hand to lots of things that need doing around a rural laboratory—drive a car, service the blueprint and vending machines, and deliver mailbags. To those formal contributions he added the gift of humor, which earned him the nickname "Corny."

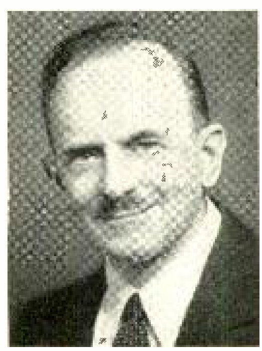
After retirement, Mr. and Mrs. Cornelison will live in Toledo, where their son is employed.

J. R. P. Goller

With considerable background in electrical power engineering, Mr. Goller entered the Laboratories in 1922. He had graduated from Union College (B.E. 1917), had been commissioned in the Signal Corps and had been an engineer for Consolidated Edison. His first work here was designing power plants for the recently acquired dial system in Los Angeles; later he designed the power plant for the Netcong radio receiving station. In 1929 he helped to organize and became the first head of the Power Laboratory. In addition to directing its operation, Mr. Goller designed testing circuits, many of them automatic. When the Bell System took up en-

Fred Cornelison

J. R. P. Goller



Howard Hall

F. E. GISSLER
1904-1951

WM. BUHLER
1897–1951

ANNA KIERNAN
1894–1951

WM. CARROLL
1880–1951

Recent Deaths

FRANK E. GISSLER–*March 21, 1951*

Frank E. Gissler, a Member of the Technical Staff in Transmission Systems Development, began his Bell System career in 1943 at Western Electric in Hawthorne, after teaching science in St. Philips High School in Chicago for twelve years. He taught radar at Western Electric, and, as a member of the Western Electric Field Force, was assigned to the Laboratories in 1944, where he also taught radar. Since the war, he has been engaged in development work on mobile radio.

For one year prior to joining Western Electric, he was in the Army, teaching at Wayne University and the University of Chicago.

He is survived by his wife, Dorothy G. Gissler, and daughter Carol Ann.

ANNA A. KIERNAN, March 30.

Miss Kiernan's first Laboratories job, in 1911, was distribution of typing assignments to the other girls in Transcription. Practically her entire service was in that department; she became a supervisor in 1921, and in 1925 she became Transcription Department Supervisor. Last year she was placed in charge of all Transcription service in New York.

During her long association with Transcription, hundreds of girls began their careers under her supervision. Her own career ended only a few days after its high point, on March 10, when her fortieth anniversary* made evident the respect and affection which were widely hers throughout the Laboratories.

WILLIAM BUHLER–*April 9*

Before coming to the Laboratories after service in World War I, William Buhler spent a year in the inspection department of the New York Telephone Company. His first work at the Laboratories was the preparation of circuit descriptions for manual and panel machine switching systems.

Becoming a member of the Technical Staff in 1924, he transferred to the relay requirements group of the Switching Systems Department; later, he was concerned with the development and testing of pulsing circuits in crossbar systems.

During World War II, he contributed to the development of air raid warning devices. Since the war, he has been engaged in tests of a new pulsing relay, tests of improved counting relays, improved contact protection for pulse counting relays, and tests of a new message register that provides high accuracy and long life.

He is survived by his wife, Hilda W. Buhler.

WILLIAM CARROLL–*March 28*

William Carroll, who, until his retirement in June 1945, was a Uniformed Watchman, was well known by the many Laboratories people who came into the West Street building. He was born in Belmont, Kings County, Ireland, and came to the Laboratories in December, 1900.

Mr. Carroll's first job was in the Shop. In 1917, he was made a night watchman; in the succeeding years, he became an elevator operator, and later on, a Uniformed Watchman. He is survived by his wife Anna and their only son, J. J. Carroll, who is in the General Accounting Department.

*RECORD, *April*, 1951, *page* 186

"Telephone Hour"

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

May 7	Eileen Farrell, *soprano*
May 14	Ferruccio Tagliavini, *tenor*
May 21	Jose Iturbi, *pianist*
May 28	Blanche Thebom, *mezzo soprano*

News Notes

THE CONVENTIONAL WAY to hermetically seal a cover to a can is to have the flange of the cover overlap the can and solder a joint on the outside. By placing the cover's flange inside, the can may be made larger without increasing the mounting area required for the unit. This space gain offers important advantages in housing miniaturized apparatus assemblies but with small covers the soldering operation may be brought uncomfortably close to the lead-in terminals. Methods of soldering inside-mounted covers were discussed by A. W. ZIEGLER, P. D. BUHRKE and B. S. WOODMANSEE during a visit to the Scovill Manufacturing Company.

BASIC KEY to a material's performance is its chemical composition. In Pittsburgh, E. K. JAYCOX attended a meeting of an A.S.T.M. Committee which is in the process of standardizing more than fifty methods of spectrochemical analysis. With W. G. GULDNER, Mr. Jaycox also attended the Conference on Applied Spectroscopy and Analytical Chemistry.

A "TEST LINE" is not, as might be thought, a transmission line, but is rather a circuit located at a toll office which a test man in a distant office can use to make a test on the toll circuits between the two offices. A new "test line" has recently been developed for use in measuring two-way transmission between toll offices, and one of them is now on trial at the New York toll office. Recently, A. J. PASCARELLA and G. M. PHILLIPS visited toll offices in Cleveland, Detroit, Grand Rapids, Harrisburg, Baltimore, and Charleston to discuss with the maintenance forces at these locations the methods of reaching and using this new "test line."

WHISKERS—filamentary growths which corrosive agents develop on metal surfaces—were discussed in a paper presented by K. G. COMPTON, A. MENDIZZA and S. M. ARNOLD before the New York meeting of the National Association of Corrosion Engineers. They also talked on *Effect of Packaging on Corrosion of Zinc Plated Equipment,* a subject of prime importance when equipment is stored in damp, poorly ventilated warehouses.

AT THE NINETY-NINTH annual meeting of the Electrochemical Society in Washington, April 18-24, R. L. TAYLOR and M. WHITEHEAD presented a paper entitled *Tantalum Electrolytic Capacitors for Telephone Plant Use.*

F. E. LADD of the Whippany Laboratories has an article in the April issue of QST on *A Band Switching Converter for 144 to 21 Megacycles.*

WHILE IN CHICAGO recently to run down a case of trouble on video lines, C. N. NEBEL assisted local telephone people to equalize some of these lines. R. H. Dougherty of O & E accompanied Mr. Nebel.

75th ANNIVERSARY OF THE TELEPHONE

Some of the girls examine the old-style telephone instruments on display in the West Street cafeteria, while Mabel Benz, left, finds the 1895 desk set greatly different from the modern one she uses in her work as Receptionist.

W. C. Somers (right) Superintendent of Building Operation and Maintenance, congratulates Frank McConville, Uniformed Watchman, for his perfect attendance record during 1950. Paul Kashtelean, Utility Service Hand, who also received congratulations, looks on. Other members of this group with perfect attendance are: P. Burke, V. Burns, J. Connor, T. Dolan, T. Dolly, P. Doorly, F. Gritson, J. J. Hanley, O. Halvorsen, B. P. Herbort, G. Johnson, H. Jones, L. Kramer, W. Lichte, H. McCabe, Martha Maus, P. McLaughlin, A. Mogilski, J. Mogilski, J. Murphy, J. Rohr, J. Twomey, C. Vassallo, and M. Walsh.

M. J. Doody, left, discusses the 1951 Intra-mural Softball League with D. D. Haggerty, Bell Laboratories Club Executive Secretary. Plans are being made for the use of the Stevens Institute, Hoboken, Athletic Field, as was done last year. Persons interested in playing should get in touch with Mr. Doody.

ON MARCH 15, at a conference in Columbus of Business Office Supervisors of the Ohio Bell Telephone Company, F. J. SINGER gave a talk on *Recent Developments in Telephony*. He described some new developments made in the Laboratories such as the Transistor and special relays, and particularly the Automatic Message Accounting centers.

L. H. HINRICHSEN, T. E. BATTAGLIA and P. O. BOSCHAN have become supervisors in the Drafting Department. W. N. BUTLER, formerly a laboratory mechanic in Outside Plant Development, has become a Technical Assistant. FRANZES KUNZ, an assembler in the experimental tube construction group, and AUDREY MULLER, a messenger, have become junior draftsmen in the Drafting Department. LETITIA BROOME, LENORA DEVITA, ROSITA GARCIA, MARY MCDERMOTT, JOAN SNOPEK and FLORA VELLETRI, messengers, have become junior clerks in the Drawing and Specification Files.

J. W. Schaefer of Whippany puts the finishing touches on his make-up for his role in "Outward Bound" staged by the Morristown Little Theatre at Alexander Hamilton School, Morristown, N. J., in February. Helen Benz, who edits the Little Theatre's "Cue Sheet," was house manager. In April Mr. Schaefer played the villain in "On the Bridge at Midnight."

COMMUTATORS at the top of panel frames play an important part in the switching of panel calls, but they have to be cleaned periodically to insure satisfactory contact. To avoid this routine manual attention, an automatic wiper has recently been developed for these commutators, and J. O. JOHNSON spent three days in

Chicago supervising the trial installation on frames in the Wabash-Harrison central office.

H. H. ABBOTT, A. E. RUPPEL, C. C. TAYLOR, J. G. NORDAHL, and W. E. REICHLE of the Laboratories, with representatives of the A T & T and Western Electric, visited Schenectady to investigate new apparatus which the General Electric Company has developed for selective signaling of mobile radio units, and to witness tests in connection with adjacent-channel interference requirements for radio receivers.

S. P. SHACKLETON was recently in Denver as the Laboratories representative at a conference considering situations that may arise with the advent of long range customer dialing. This was the last of a series of five such conferences, and Mr. Shackleton has represented the Laboratories at all of them.

M. BROTHERTON represented the Laboratories at a recent meeting of Bell System advertising men in New York. An outcome was a visit to the Laboratories by the New England Telephone and Telegraph Company's Advertising Manager William B. Blake and General Information Manager Emerson Hunt. Accompanied by representatives of the Cabot Agency, which is responsible for the company's advertising, they also toured the Western Electric's plant at Kearny. The object was to get a first-hand picture of the research and manufacturing units behind Bell System service.

M. C. BISKEBORN gave a lecture on *Telephone Cables* at the Westinghouse Auditorium in New York City on March 29, under the auspices of the A.I.E.E., which is sponsoring a series of talks on power and telephone cables.

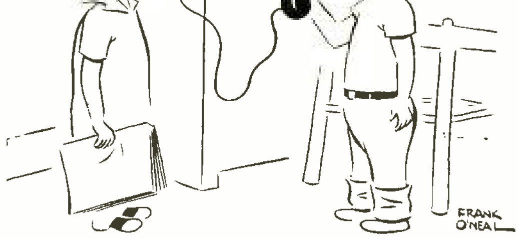
K. K. DARROW's activities recently have included his attendance at the American Physical Society meeting at Pittsburgh March 10-12, presentation of his lecture on *The Particles Called Elementary* before the staff of the National Bureau of Standards in Washington on March 23, and his attendance at the M. I. T. Conference on Electronics on March 29-31. Dr. Darrow also spoke on Recent *Developments in Magnetic Resonance* at the general meeting of the New York Section A.I.E.E.

J. LEUTRITZ and L. R. SNOKE made an inspection of small stake specimens at the Orange Park, Florida, test plot with representatives of creosote producers interested in cooperative creosote investigations. This study is being carried out under the general auspices of the U. S. Forest Products Laboratory. They also applied chemical brush control methods with a view to determining the efficacy of herbicides in suppressing vegetation in the roadways and fire

"No, this isn't Murray Hill Shipping. How do the dial numbers look to you? A little blurred or fuzzy on the edges, perhaps?"

lines on the test plot, where the character of the soil and the palmetto and grass cover present different problems from those encountered along northern rights of way.

WHILE IN SAN FRANCISCO recently, E. W. HOUGHTON conferred with engineers of the Pacific Company regarding test equipment for the transcontinental radio relay system which is now being installed. Up to now equipment for tuning the radio circuits, checking the intermediate frequency amplifiers and measuring radio frequency power has been grouped in a test console at each station. Plans are being made to package the various items separately so that a maintenance man can take them with him from station to station as needed. Mr. Houghton also brought back some comments from the engineers as to the system as a whole.



"Let's call my Old Man—he's in the bathtub!"

Easter Seal Girl

Brett Downes, daughter of Chesapeake and Potomac Telephone Company repairman E. V. Downes, Jr., of Hampton, Virginia, really made headlines this spring. A golden-haired youngster of four, Brett is a victim of crippling cerebral palsy, one of the many diseases fought by the National Society for Crippled Children and Adults. Selected as the Easter Seal Girl for 1951, her picture appeared on billboards, posters, TV, and in motion pictures, newspapers, and magazines as part of the society's month-long drive for funds which wound up Easter Sunday.

Brett's dad has been a telephone man since 1939. Her mother was a service representative for the C & P for eight years in the Hampton, Virginia, office.

The plucky youngster, responding to treatment, can now walk without braces and is well on her way to performing the normal activities of any child in her age group.

News Notes

Between Miami and Key West the highway is largely over water, and the aerial section of the telephone cable, which carries important Havana circuits, is sometimes on poles and sometimes hung under the bridges. Some sections of the cable are also buried, while others are submerged in water. Although the corrosion exposure of the aerial section is severe, rainfall somewhat mitigates the effect of salt on the cable supporting strand and lashing wire. Under the bridges, where the sea is close and no rain penetrates, it is another story. Recently K. G. Compton, A. Mendizza and J. B. Dixon inspected the more severe exposures.

Toward the end of March, Binney Dysart visited Lyons, Georgia, and Jacksonville to install and test out laboratory models of a special equalizer for the Charlotte-Atlanta line of coaxial cable. Following that, he went to Birmingham to measure the performance of selenium rectifiers installed on the Atlanta-Dallas coaxial.

At the Sprague Electric Company, North Adams, Mass., C. R. Steiner and W. J. Kiernan demonstrated the application of a new synthetic enamel finish to electrolytic capacitors. Electrically nonconducting, the new finish will simplify the problem of insulating the metal containers, thus accelerating the production of capacitors needed for the Bell System.

When a new system is ready to go into service generally, it is customary to hold a "normal school" to train men from each company who will in turn train their own people in maintenance procedures. Such schools were held at Indianapolis in January and February at which instructors were trained on the new N-1 carrier system. C. H. Rumpel was the instructor at both schools on the 2-T maintenance test set.

Engagements

Joan Glasson*—James B. Preston*
Beatrice D. Menne—Gene V. Hitter*
Virginia M. Wallerd*—George J. Rochko*
Elaine Golding*—Rudolph C. Bruckenthal
Elinor M. Brodhead*—Kenneth F. Wilson, Jr.
Ruth Higgins*—George J. Wilson
Dorothy E. Roschke*—Thomas McFadzen

Weddings

Virginia Van Gorder*—John F. Reilly, Jr.
Eunice M. Pfeifer*—William M. Kellogg*
Ruth W. VanWinkle—George B. Troussoff*

Births

Barbara Jean Evenson, March 23, to Mr. and Mrs. Richard K. Evenson. Mr. Evenson is in Transmission Apparatus Development.

Alice Elaine Herbert, March 23, to Mr. and Mrs. N. J. Herbert. Mr. Herbert is in Transmission Apparatus Development.

*Members of the Laboratories. Notices of engagements, weddings and births should be given to Mrs. Helen McLoughlin, Sec. 11A, Ext. 296.