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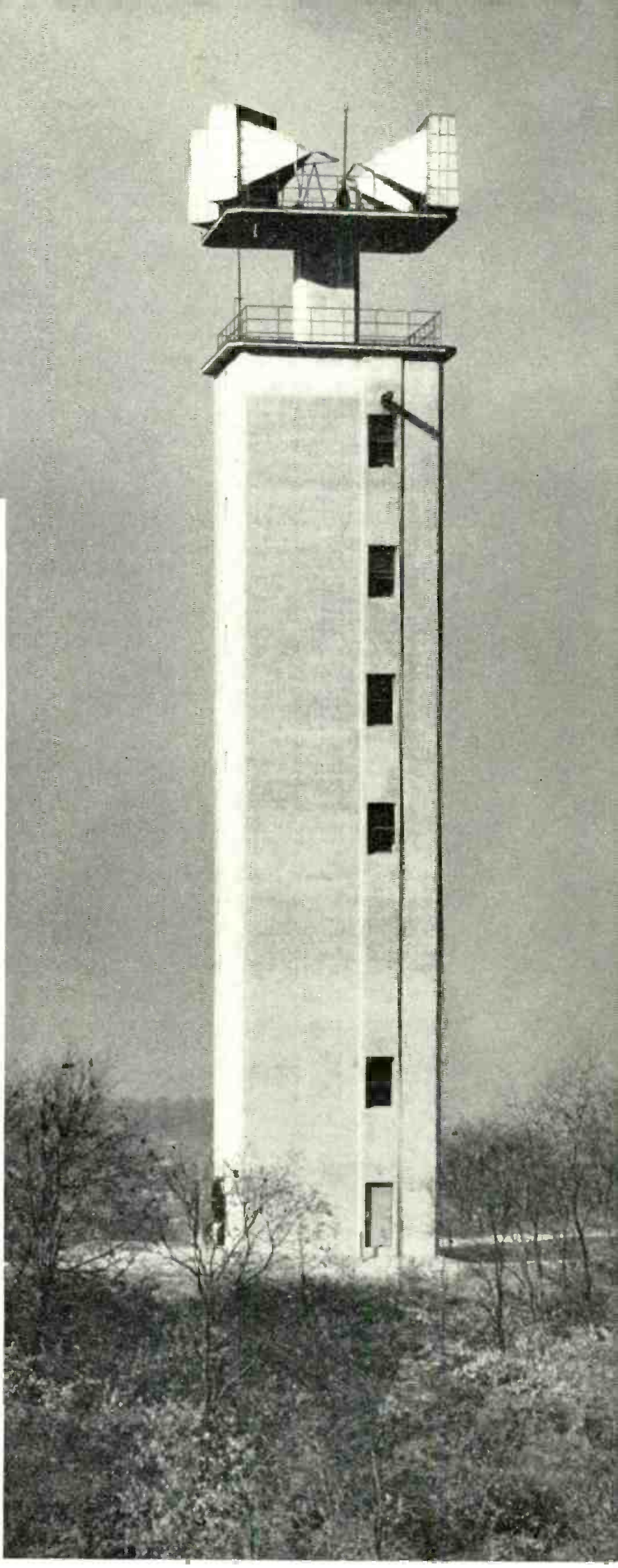

Antennas for the TD-2

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Transmission Systems Development

A motorist traveling the highways near the transcontinental TD-2 radio relay system can see many of the repeater station towers, usually with four antennas: two aimed toward the east and two toward the west. One of these antennas looking eastward toward the preceding station perhaps 25 miles away is a receiving antenna, and its mate looking westward toward a succeeding station is a transmitting antenna; the pair of them take part in relaying telephone messages and television programs from east to west at frequencies in the neighborhood of 4000 megacycles. The other two of the four take part in relaying traffic in the opposite direction. By means of a specially constructed lens, these antennas focus the radio waves in a narrow beam on the antennas of adjacent stations.

In outward appearance this antenna, known as the KS-5759 delay lens antenna, is a sheet aluminum structure consisting of a lens housing at the front, ten feet square and three feet deep, and a pyramid shaped

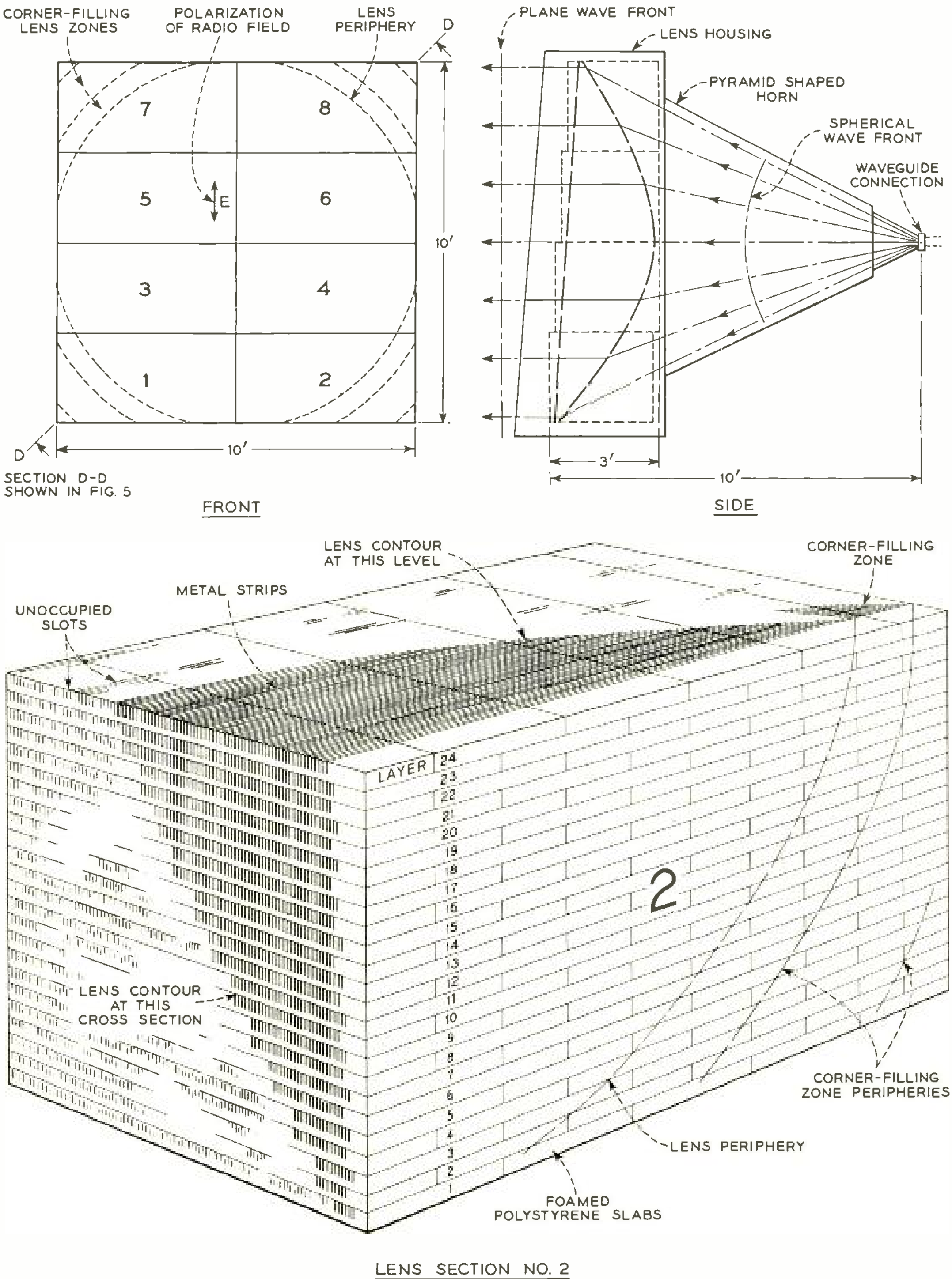

Fig. 1—Construction features of the delay lens antenna.

horn at the back. This horn feeds radio-frequency energy from the connecting waveguide to the lens. The lens inside the housing is protected from the weather on the front by a cover of resin impregnated fiberglas. This material is transparent to radio-frequency energy, and at the same time is mechanically rugged, and is capable of many years of exposure to all kinds of weather.

A cross-section of the housing showing the position of the lens within it is given in Figure 1. Radio waves from the waveguide connection at the rear of the housing diverge as indicated until they encounter the lens. Their phase velocity is then decreased by the lens structure, and the thickness of the lens at the center is enough to introduce delay equal to that of the geometrically longer path by way of the edge. The diverging rays from the focal point thus become essentially parallel rays at the front. Because of this action, the device is called a delay lens. A glass lens acts much in the same manner toward light, and is thus also a delay lens. The ratio of the velocity of the wave in free space to that in the lens is the index of refraction, which is about 1.5 for both a glass lens and the antenna lens. Based on this value, the lens shape is designed to produce a plane wave front at the front of the lens from the spherical wave front radiating from the focal point.

Because the radiated energy is concentrated into a narrow beam instead of being allowed to diverge in all directions as it would if there were no lens or other directing elements, the distant antenna receives much more energy than it otherwise would. The antenna is spoken of as having gain, which is measured by the ratio of the intensity of the energy at the receiving point when a lens is used to what it would be if the transmitting antenna radiated equally in all directions. The gain of the TD-2 antenna is nearly 40 db; the energy is concentrated in a beam only about two degrees wide at the half-power points. This is about the degree of concentration of a high quality searchlight.

As will be noticed in Figure 1, the face of the lens is not vertical, but is tilted back slightly. This is done to prevent the portion of the energy reflected by the face of the lens from being focused back on the wave guide outlet. The protective covering on the front of the antenna is sloped back for similar reasons. The reflections are further reduced by the construction of the lens itself, as will be described later.

Although the lens for the TD-2 antenna acts much the same as a glass lens, it actually consists of a large number of narrow aluminum strips held in place by slabs of foamed polystyrene. This material is very light and porous; it weighs less than two pounds per cubic foot, or about one-sixth as much as cork. Its dielectric constant is so nearly that of air, that it may be neglected in designing the shape of the lens. The retarding action of the lens is due entirely to the aluminum strips. Their effect is essentially the same as that of the molecules of the glass in retarding light waves. The strips are a much coarser array however, in proportion to the TD-2 wavelength, than the molecular structure of glass is with respect to light wavelength.

Fig. 2—After an aluminum template is properly placed it is sprayed around the edge to mark its position on the slab.

The lens for the TD-2 system is built up in eight sections, each about the size of an office desk and consisting of 24 layers of polystyrene foam slabs. Successive layers of each section are cemented together to form a single mass, which is then wrapped in polyethylene sheet for protection. The individual slabs are 1¼″ thick and either twelve or six inches wide, and are laid up brick-like as indicated in Figure 1. The use of two six-inch slabs in place of one twelve-inch slab in alternating layers enables the joints in one layer to lie opposite the center of the slabs above and below it. The top of each slab is slotted transversely every three-eighths of an inch, and into these slots are placed the aluminum strips that comprise the lens. Each lens contains about seven miles of such strip.

The strips, however, are not inserted over the entire slab, but only over the area that is to be used as the lens. This area is determined from the lens shape calculations by making ninety-six cross-sections—one for each layer of slabs. Half of each cross-section thus shows the area to be used in each layer in each of the eight sections. An aluminum template duplicating the half cross-section is prepared and is numbered with the section and layer to

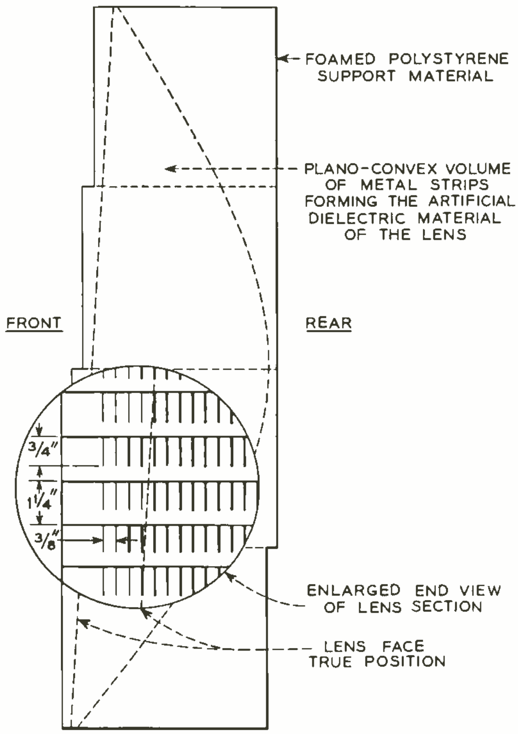

Fig. 4—Cross-section of lens with enlarged inset showing placing of strips to form front of lens. The slots into which the aluminum strips are placed are indicated by heavier lines.

Fig. 3 — Placing the aluminum strips in the slots.

which it applies. After the first layer of slabs of a section has been laid down, the proper template is placed on it, and dye is sprayed around its edge to mark the cross-section on the slab, as shown in Figure 2. The aluminum strips are then placed in all the slots within this cross-section. This operation is illustrated in Figure 3. Tabs from the template project over the edge of the slab and carry a stencil of the number of the template, and this number is sprayed on the edge of the slab so that after the section is complete, one can readily check that the proper templates have been used for each layer.

Since the face of the lens tilts backward, the successive sections are offset slightly back from the ones below them as indicated in Figure 4. Sections 1 and 2 are nearest the front of the housing, 3 and 4 are offset slightly back from them, and 5 and 6, and 7 and 8 are each stepped back the same

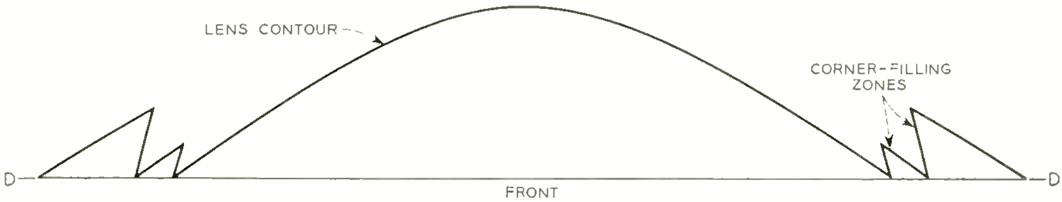

Fig. 5—Cross-section of lens along D-D (in upper left of Figure 1) showing corner lens sections.

amount. In placing the metal strips in the slots that will determine the face of the lens, the slot just in front of the ideal face of the lens is used in one layer and that just back of the face of the lens for the adjacent layers, and so on up through the entire lens. This in effect gives a roughening of the face of the lens that assists in making the reflected rays out of phase at the wave guide, and thus adds to the effect of tilting the face backwards. This staggering of the strips gives an effect essentially the same as that of a coated optical lens.

With a ten-foot diameter lens in a ten-foot square housing, there is an area in each of the four corners of the housing that has no lens, and the energy reaching these corners from the waveguide would not be directed toward the distant antenna. To avoid this loss of energy, lens contours have been designed to fill this corner area. Their general shape and position are indicated in Figures 1, 2 and 5. On the diagonal there are two of these corner lens sections, but farther around, as on slab 24 shown in Figure 2, there is only one. The vacant corners could have been avoided, of course, by making the diameter of the lens equal to the diagonal of the square and then not using the segments at the four sides. This would have resulted in a much thicker lens, however, and more material throughout.

Considerable investigation was necessary to secure a satisfactory adhesive to hold successive slabs together. Although polystyrene foam is a stable substance, it was found that the solvents used with many adhesives, which were satisfactory in radio-frequency loss, holding power, and aging, were not suitable for use with polystyrene foam. The adhesive selected is a dispersion of acrylic resin in water. It is applied by rolling on, much as are some of the well-known water-emulsion wall finishes. After nearly all the water has evaporated from the applied film, a pressure sensitive adhesive remains on the surface. The completed lens section needs merely to be clamped in a press for several hours under pressure to accomplish the bonding.

The gain of the lens is constant within about 1 db across the frequency band from 3700 to 4200 megacycles. The assembled antennas resemble each other in all their transmission characteristics to a rather high degree, high enough to make unnecessary any transmission measurements associated with shop production.

A fixed iris is inserted between the antenna waveguide flange and the connecting waveguide to compensate for the small reactive component of the antenna impedance. This reactance is undesirable be-

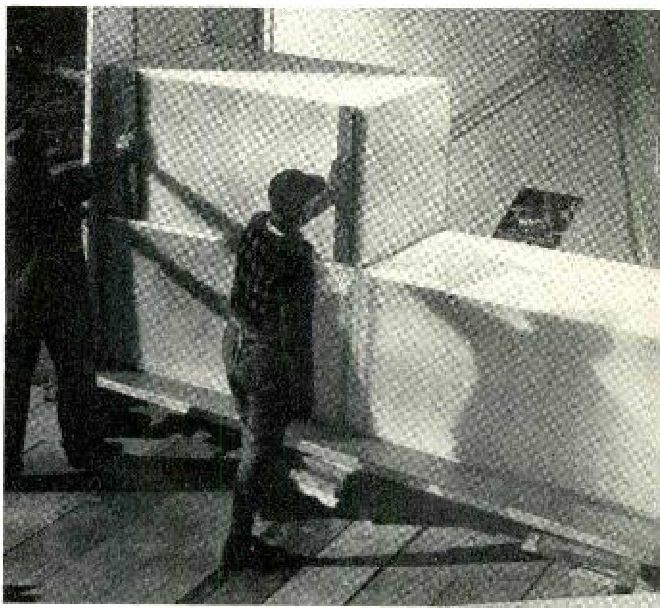

Fig. 6—Placing the lens section in the housing.

cause it represents an impedance mismatch and a source of reflections. Reflections of this kind would produce echoes in television pictures and crosstalk in telephone conversations. The iris is an inductive reactance located near the source of capacitive reactance of the same magnitude at the apex of the antenna horn.

The waveguide running between the repeater equipment and the antenna is often 100 feet in length, sometimes more, sometimes less, depending on the tower height and the location of the repeater room in relation to the tower top. Short sections of flexible waveguide join the antenna to this transmission line and join the line to the repeater bays. This flexibility isolates antenna vibration from the waveguide and permits dimensional changes due to summer and winter temperature variations.

To avoid impedance disturbances resulting from water of condensation that would collect inside the waveguide under certain cycles of humidity and temperature, the waveguide is blocked off by mica windows placed inside the waveguide near the antenna and the repeater bay. The entire length between these windows is filled with a dry atmosphere. Ordinarily a barrier of any material in the waveguide would be a source of reflection of transmitted radio energy. Since the level of reflections permitted by the broadband TD-2 system is low, steps had to be taken in the design of the pressure window to minimize the reflections introduced. This was accomplished by sloping the mica sheet comprising the window at a critical angle so that reflections from the upper and lower halves would cancel each other.

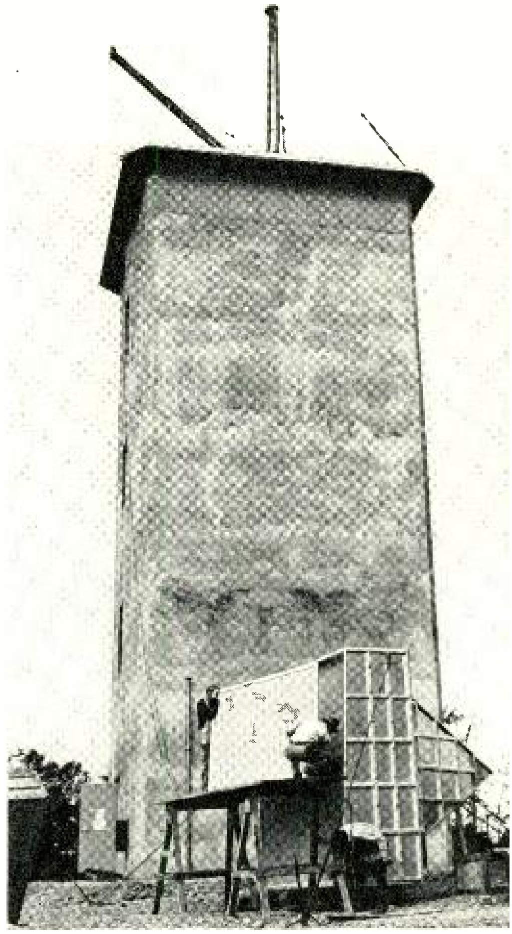

Fig. 7—A lens being assembled on the ground preparatory to hoisting to tip of tower.

The sheet aluminum housing and mounting details for the antenna were designed for manufacture in shops equipped for air-

THE AUTHOR: A. H. Lince joined the Technical Staff of the Laboratories in 1925 after receiving a B.S. degree in E.E. at the University of Michigan. From then until World War II he was engaged in the equipment development of switchboards for dial central offices and of automatic ticketing. During the war period his work on military developments was almost entirely concerned with the design of microwave antennas and their associated mechanical controls. Since then, as a member of the Transmission Systems Development Department, he has participated in the development of microwave path test equipment and assisted in the solution of problems of manufacture of submarine cable repeaters, in addition to his work on the TD-2 radio relay system antenna. He is currently engaged in a military project.

craft and similar fabrication, and require no unusual machinery or tools. The base and support details include facilities for aiming the antenna both laterally and vertically. At the apex of the horn where precise dimensions are necessary to achieve impedance uniformity, machined castings of aluminum alloy are employed. The antenna metal work and lens units are shipped to relay tower locations and assembled on the ground as shown in Figure 6 and 7 by contractors employing laborers usually in the rigger and bridge worker categories. The completed assembly is lifted by a temporary derrick or boom rigging on the building to a position on the antenna deck of the tower. The assembly instructions are in the form of Bell System Practices. Nearly 900 of these lens antennas are used in the nation-wide radio-relay system.

The development of the delay lens antenna was initiated by W. E. Kock, and the first antenna of this type—considerably smaller than those used with the TD-2 system—was built and tested under his direction at the Holmdel Laboratories.

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The E1 telephone repeater

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Checking E1 repeaters.

It was the development of the 22-type repeater,* following the invention of a simple balancing network,† that made transcontinental telephony practicable, and since then all two-wire repeaters have been of this type. Although these repeaters are simple and inexpensive enough for their purpose, they are really complex circuits of hybrid coils, balancing networks, equalizers, and repeating coils, as well as two vacuum tube amplifier circuits. They provide transmission gain up to 20 db, and although their characteristics have been improved and their size and cost greatly reduced‡ since the first repeater was installed, their essential features and the number of auxiliary components they require have not been changed.

With the growth of metropolitan areas and the resulting extension of the range of local calls, together with the use of finer gauge cables, and the increase in private lines, there has developed an increasing need for repeaters in exchange area circuits. Conventional types of two-wire repeaters have been used in many cases, but their cost has naturally limited the extent of their application. For local circuits, a large amount of gain is not ordinarily needed and generally could not be obtained if it were because of the lack of uniformity of these lines. As a result, the full capabilities of the 22-type repeaters cannot be taken advantage of. Moreover, additional elements must be added to the repeaters to by-pass or repeat the signaling and supervisory currents, which still further adds to the cost.

The need for a more economical repeater for the local plant has recently been met by the invention of a completely new type of repeater—the E1—which is already finding wide application in exchange area circuits. It differs fundamentally from the 22-type repeater in that the voice currents are amplified merely by inserting a "negative impedance" in series with the line. For this new repeater, hybrid coils and balancing networks are not required, and signaling and supervisory currents readily pass through it without requiring additional equipment. Not more than 8 or 10 db of gain can be provided, but this is adequate for the shorter circuits on which the E1 repeater will be used.

The general simplicity and compactness of the device can be seen from Figure 1, which shows the front and back views of the equipment. Two complete repeaters are supplied on a single 19-inch mounting plate measuring 1¾ inches in width. Each repeater consists of three principal parts: an input transformer, a single tube amplifier circuit, and a gain-adjusting network. The amplifier, or electronic, circuit is con-

*Record, *August,* 1931, *page* 579.
†Record, *November,* 1945, *page* 412.
‡Record, *January,* 1949, *page* 5.

tained in a single case, which has a tube socket on the front face, together with three small pin jacks for testing purposes. The gain-adjusting network contains various elements of resistance, capacitance, and inductance brought out to thirty-six external strapping terminals located on the front of the network under a removable cover. Terminals are provided on the back of the repeater panel for the line and power connections, and jacks are also located on this panel for making transmission tests. The three units, mounted as shown in the photograph, comprise the complete repeater, except for fusing and power supply. There are no line jacks for patching the repeater, and there are no variable gain controls, the gain being determined by the network strapping. Neither filter units nor equalizer units, as are required in other repeaters, are used with the E1 because these features are built into the amplifier and network circuits. No additional equipment is required. Thus, the only external wires required for the repeater are two pairs of line conductors and four wires for connection to the power supply.

The size of the E1 is most striking in comparison with other repeaters. Figure 2 shows the blocked out space for the 22A1, V1, V3, and E1 repeaters, including only their normally associated equipments. Compared on this basis, the E1 is only about one-third the size of the V3. Nearly 500 of a bank of 2000 repeaters in Jamaica, Long Island, are shown in Figure 3.

The simplicity and small size of the E1 were made possible by the circuit design, which constitutes an unusual departure from the operating principles of conventional repeaters. Although some of the principles incorporated in the E1 have been known for a number of years, the basic circuit design for this repeater is the work of J. L. Merrill, Jr., of the Transmission Engineering Department. Interesting features of the repeater are the way in which it is connected into the line and the principle upon which it provides gain. The repeater is wired in such a way that it presents an impedance in series with the line. This impedance is effectively made negative by action of the electronic circuit on the network impedance, and the negative impedance then neutralizes or compensates for a certain portion of the line impedance, so that the total impedance left to limit the line current is reduced. Voice voltages applied to the line will thus find a lower impedance and will cause greater line currents to flow. This increase in line current constitutes the gain introduced by the repeater. It makes no difference which way the signal is traveling down the line; the

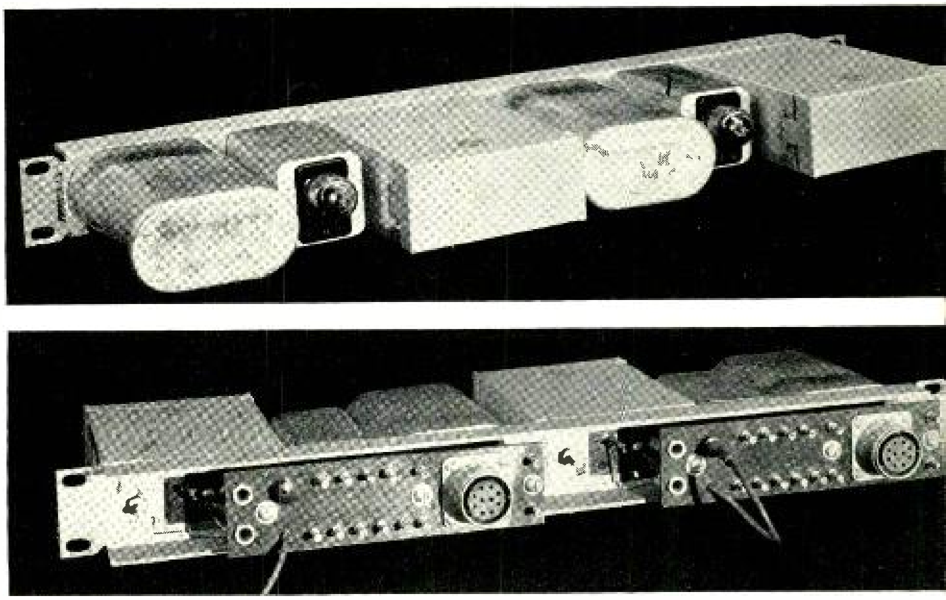


Fig. 1—Two complete repeaters are supplied on a single nineteen-inch plate: front view at the top, and rear view at the bottom. Each repeater, as shown from left to right on the front consists of an input transformer, an amplifier unit, and a gain-adjusting network.

currents are amplified equally in both directions. The amount of this transmission gain depends upon the magnitude of the negative impedance of the repeater, but at no frequency should the negative impedance be allowed to equal or exceed the positive impedance of the line circuit or uncontrolled oscillation would be likely to result.

A simplified circuit schematic of the E1 repeater is shown in Figure 4. Two balanced windings of the input transformer are connected individually in series with the two conductors of the line, and the resistance and inductance of these windings are kept relatively small so as to cause only small loss to signaling currents. The third winding, which is center tapped, connects to the amplifier circuits. The configuration of these windings is such as to place the input impedance of the repeater in two halves in series with the total impedance of the two lines.

The amplifier circuit employs a twin triode of the miniature type, with input connections to the cathodes, and plate circuit connections to the network. Negative and positive feedback arrangements within this circuit result in conversion of the positive or regular impedance of the network to its negative counterpart at the input. If the network consisted of a resistance, for example, it would appear as a negative resistance at the transformer. Similarly, in practice, complex network impedance is transformed as if it were multiplied by a minus sign. This occurs in the range from about 300 to 4,000 cycles. Outside of this range of frequencies, the character of the transformation changes and the gain drops. The special feedback features of the repeater circuit place the control of the gain upon the impedance of the network, and also result in removing to a considerable extent the effects of tube gain variations and any other variables that may occur within the circuit.

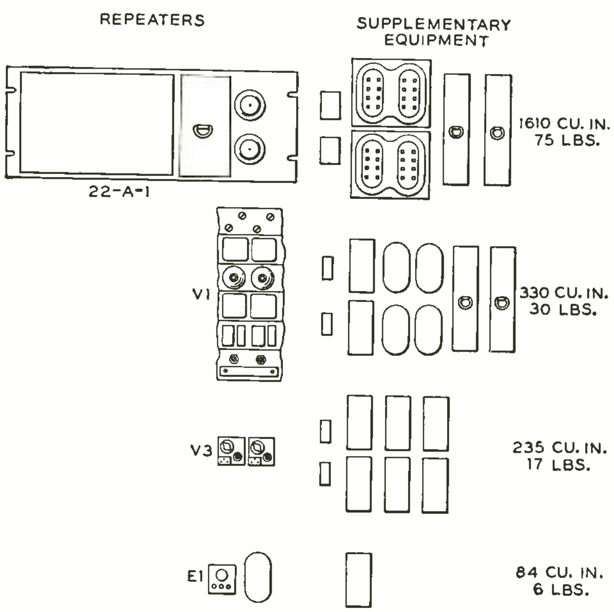


Fig. 2—Size of the E1 repeater compared to that of other types.

The network is the adjustable part of the repeater, since it determines the negative impedance, which in turn controls the gain. Stability is assured only if the negative impedance inserted by the repeater is less than the positive impedance of the line; hence, in practice, the network is always adjusted so that its impedance is less than that of the line by a safe working margin. The function of the E1 network is quite different from that of the networks in the 22-type repeater, the latter being adjusted to balance precisely the line impedance. The E1 network is complete in itself in that it contains all the elements for building the resistive, capacitive, and inductive components required in the application of the repeater. The arrows drawn through the components of the sample network configuration of Figure 4 indicate that they are variable. Adjustments, however, are not accomplished by dials or other controls, but rather by external strapping, which permits the elements to be combined with greater flexibility and accuracy. Strapping tables and instructions are available for fitting the repeater with whatever gain is required to practically all the different line conditions, such as gauge, length, loading, etc. For nonloaded lines, the network impedance can be proportioned so as to give more gain at the high frequency end of the voice band, and thus provide a certain amount of equalization for the attenuation frequency characteristic of such lines. For loaded lines, it is arranged to decrease the

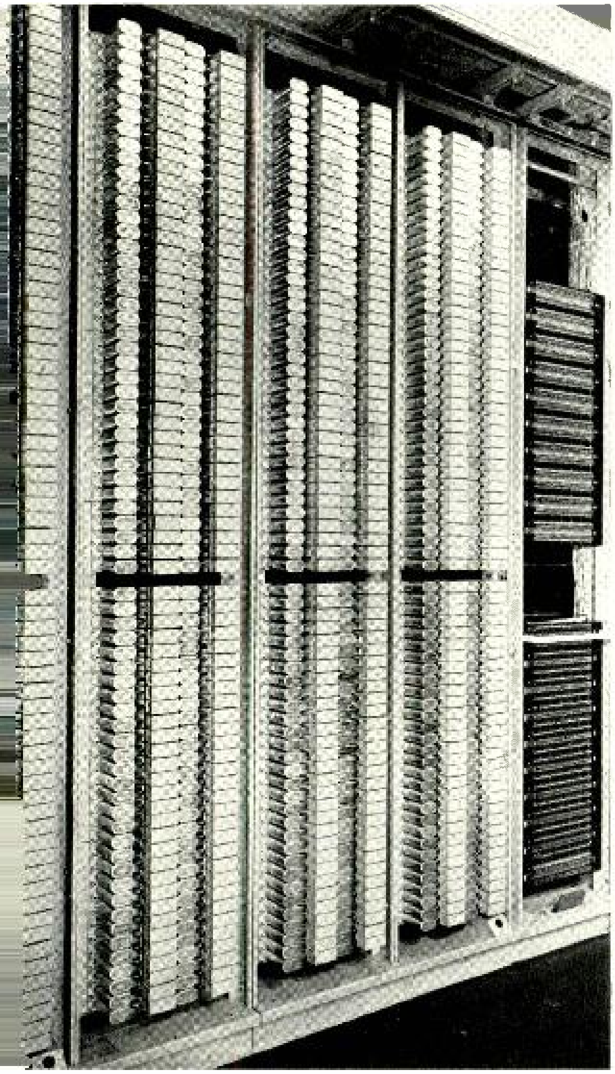


Fig. 3—A bank of E1 repeaters installed in the central office in Jamaica, Long Island.

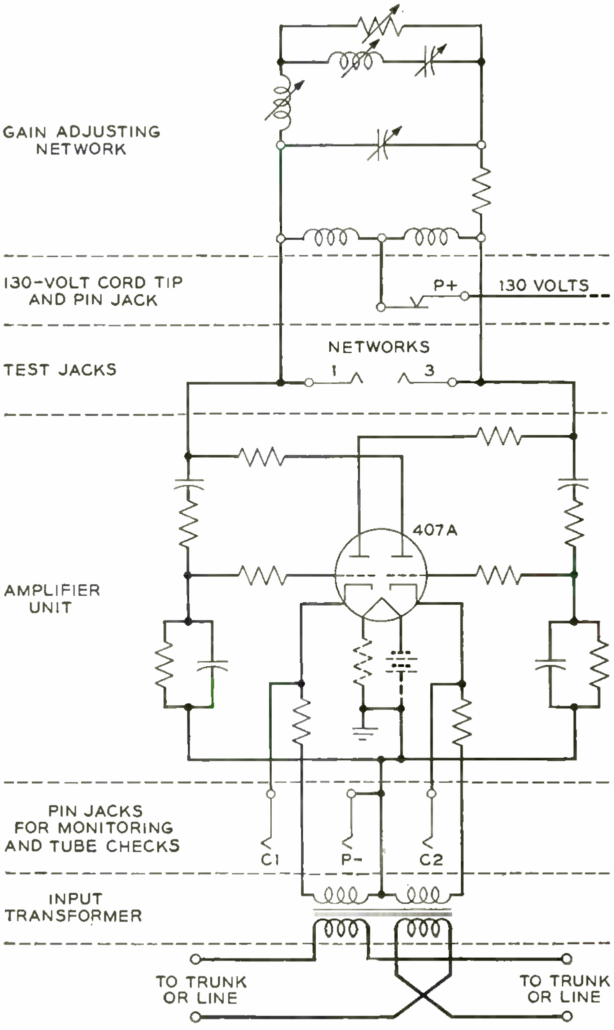


Fig. 4— Simplified schematic of the E1 circuit.

gain just below the cut-off frequency of the facility, so that the repeater is filtered and will not oscillate. In any case, the strapping of the network fixes the gain.

The E1 repeater can be used to provide gain in all types of exchange area lines or trunks, loaded or nonloaded, and combinations of such facilities. It is subject to the same limitations as any other repeater, however, in that the amount of gain depends upon the length and uniformity of the line. For most practical circuits, the maximum obtainable gain from the E1 will be enough to reduce the attenuation loss of the line to about one-half its former value, although more gain may be obtained on nonloaded lines. It can be located practically anywhere on the trunk or line—near the middle or at one of the ends. Since the gain depends upon how stable the line impedances are which face the repeater, more gain can usually be obtained near the middle of a line than at a terminal. Near the middle, the gain may be a maximum of 8 or even 10 db, but at a terminal, the gain can be no more than 3 or 4 db. In most cases of exchange plant usage, there will be only one repeater per line, since there is very little advantage to more than one repeater in a relatively short line. On very long circuits, however, more than one repeater can be used, and thus more gain can be realized.

The vacuum tube heaters of the repeater have been designed to operate directly on either the 24- or 48-volt battery supply normally available in central offices, and each repeater will draw 2.4 watts from this supply. In addition, the repeater requires 130 volts d-c for the operation of the tube plates, which consume 1.3 watts of this power. Individual heater and plate supply fuses are installed for each repeater.

Installation work and maintenance on the E1 should be small because of the general simplicity of the repeater and of such features as the methods of measuring the transmission gain and of testing the tube and the absence of line jacks and gain controls. Connection of the repeater to its assigned line consists of no more than making the cross-connections on the distributing frame for two pairs of wires and then strapping the network. For repeater gain measurements, a special test set is plugged into the multiconductor jack on the rear of the panel, evident in Figure 1, and measurements may be made while the repeater remains connected to the line. Proper strapping for the gain-adjusting network may be determined by opening the circuit to the variable part of the network and—by means of jacks 1 and 3 indicated on Figure 4—substituting a test network that forms part of the test set designed for use with these repeaters. The condition of the tube can be checked while the repeater is in operation without interfering with the conversations on the line. This is done by connecting a high impedance voltmeter to pin jacks on the front of the repeater, and measuring the voltage drop which appears in the resistance of the cathode circuit of each separate triode section. The repeater can be monitored by connecting a special high-impedance head phone to the same pin jacks.

Installations of sizable numbers of repeaters have already been completed and put into service in various parts of the country. The 2000 in Jamaica are for the most part being used in tandem trunks.

THE AUTHOR: John A. Weller received the degree of B.S. in E.E. from the University of Michigan in 1940, and then joined the Plant Department of the Southern Division of the Michigan Bell Telephone Company. In 1942 he transferred to the Laboratories where he worked on projects for the Armed Forces. Since the war he has worked in the Transmission Engineering Department on exchange area transmission problems and on studies of mobile radio-telephone service. For the past four years he has been a member of the group which developed the E1 telephone repeater and provided engineering information required for its application to telephone circuits.

The Key West-Havana cable: Repeater Components

M. C. WOOLEY
Transmission Development

In any communication system, freedom from service interruption is of major importance, especially when a system provides a number of speech channels. Failure of a single component may simultaneously affect many circuits—a situation that stresses emphasis on the reliability of the circuit elements that are involved.

Reliability takes on an even higher order of importance in the new Key West-Havana submarine cable, wherein the repeaters, installed as integral parts of the cable itself, and submerged as much as a mile under water, make frequent replacement of defective elements prohibitively expensive. Consequently, in the design and manufacture of components for these repeaters, every effort was made to assure a long and trouble-free life.

The obvious way to attain this objective is to include in each design an unusually large factor of safety, but space limitations precluded this for many of the elements. As an alternative, long experience, together with special tests, formed the basis for the designs. Then, too, no untried materials or processes were used in the construction of the parts.

Development and preproduction models of the repeater components were built in the special repeater laboratory described previously,* under controlled atmospheric conditions and by the same people who later were to construct the commercial apparatus. Many of these parts differ from the usual forms of such apparatus because of the method of mounting, but basically, they contain the same materials—oil-impregnated paper and silvered mica for capacitors, molybdenum, permalloy tape cores for transformers, permalloy dust cores for inductance coils, wire wound resistors – as normally used in such components. On the other hand, manufacturing tolerances for many of the components and the degree of control used in constructing all of them were far more exacting than normal.

Less common features were the methods of combining parts into single units to conserve space. Figure 1 illustrates a few of these. The hermetically sealed unit shown

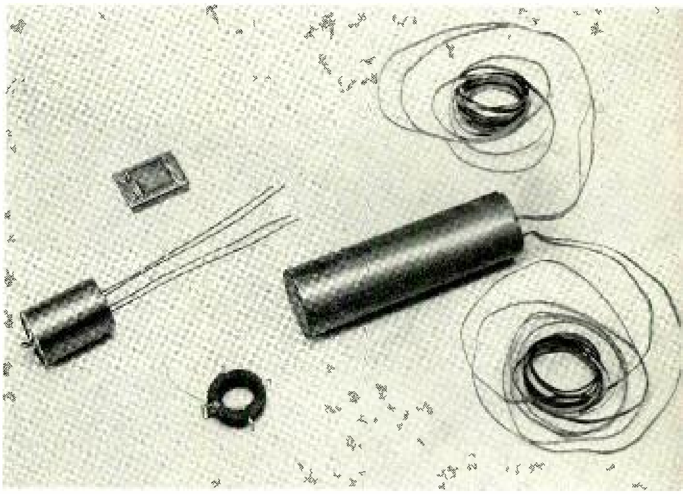


Fig. 1—Some of the components built for the submarine cable repeaters. The unit at the left contains three capacitances and a resistance hermetically sealed in an oil-filled container. The inductance below is combined with a resistance, and the mica capacitor contains two capacitances with a common terminal. The high voltage capacitor on the right has long tapes to avoid as many soldered connections as possible in the repeater.

at the extreme left contains three concentrically wound, castor oil impregnated foil-paper capacitances and a wire-wound resistor. The inductor below is combined with a resistor, and the mica capacitor above has two capacitances with a common terminal. Except for the oil filled capacitors, it was not necessary to seal components individually, because the repeaters are filled with dry gas and sealed. This made possible the conservation of much of

*Record, *June,* 1951, *page* 245.

the space, since inductors, transformers, and some resistors could be housed directly in the plastic containers. The toroidal coils were, in most cases, provided with radial plastic fins extending beyond the winding, to fit into slots in the assembly container, thereby providing a secure mounting without strain on the core or winding. Transformers and spool type inductors were likewise nested in suitably shaped recesses in the assembly containers so that spool and core were supported independently. Many of the resistors were made with mandrelated

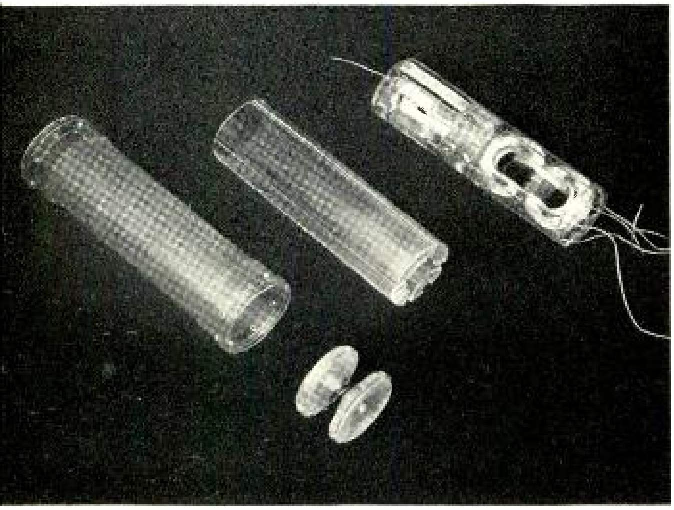


Fig. 2—Two small cores in a "figure-8" arrangement make possible a core of large cross sectional area for mounting in the restricted space.

wire, i.e., enameled resistance wire wound in a single layer on a flexible insulating core with silk serving over all. Flexible leads were secured to the ends of suitable lengths of mandrelated wire and the resulting resistor either coiled into a torus or laid out straight so that it could be dropped into a properly shaped recess in the mounting. These resistors were designed and built under the direction of A. H. Schafer and B. Slade. Mr. Slade was also responsible for the design and production of the inductors, while the transformer design was under the direction of E. F. Sartori.

Electrical connections within components and throughout the repeater were made as few as practicable to minimize possible sources of contact and connection troubles. Figure 1, right, shows a high voltage capacitor in which the tapes that make connection to the foil electrodes are brought out as terminals, made long enough to reach the point in the repeater where one connection serves for it as well as for other components. Mica capacitors were stacked with silvered laminations interleaved with fine silver tapes which were soldered to the terminals in order to insure a stable, low resistance contact between the laminations and the external terminal. These stacks were in most cases cemented into recessed plastic bases by means of which they were mounted in the network sections.

Shapes of the network containers sometimes dictated the shape of the component. An illustration of this is in Figure 2, where, to obtain the desired electric characteristics, a large cross section of core was necessary for an inductor. To obtain the large cross section without exceeding dimensional limitations, two smaller cores were cemented in the mounting in a "figure-8" arrangement, and the coil wound through both. Also partly visible in Figure 2 are a small toroidal inductor, a mica capacitor, below which is a transformer, all imbedded in the plastic mounting. Figure 3 shows a completed transformer ready for assembly in the plastic mounting together with the interwinding separators, insulators, air gap clamp, and other parts that are used in its construction.

Use of these special designs made necessary the development of special techniques for their production. For example, a machine was built to wind inductors and transformers that had closed cores with spools previously assembled on them. This machine held the core stationary, rotated the spool to receive the wire, and counted the turns of the spool by means of a photoelectric cell. Other types of inductors were wound by hand so as to produce as uniform a product as possible, avoiding crossing of turns, and without splices.

While final designs were being established, procurement of raw materials for manufacture was started. Advantage was taken of Western Electric Company inspection, by purchasing material from that company whenever possible. For example, capacitor paper that had been outstanding in its ability to pass the Western Electric's continuous voltage test was obtained; it was then reinspected by building sample capacitors from each roll, using impregnant and foil from the same lots to be used later on, and life testing these capacitors under accelerated conditions. Rigid chemical, mechanical and electrical tests were given all other raw materials.

Actual construction of the several types of components was done under very close engineering supervision. Process tests were made whenever possible, and, at each step of manufacture, careful inspection was made of the operations immediately preceding it. Completed parts were given extraordinarily complete and searching electrical and mechanical tests and, in the case of paper capacitors, samples from each lot were given destructive life tests from the results of which an estimate of the ultimate life under actual service conditions was made. Only those lots were used which met unusually severe life and stability criteria.

In some instances, initial manufacturing tolerances were only one-fifth as wide as usual precision commercial practice. This required accurate control of physical dimensions as well as manufacturing processes; even then it was sometimes necessary to rely on selection where it was not possible to adjust a completed element to meet certain stringent requirements. Not only were the initial repeater requirements severe, but it was desired that the completed product stay within a relatively small range during its life in the repeater. Consequently, all parts made of plastic were heat-treated to minimize subsequent changes and some completed components were stabilized by cycles of high and low temperature; these sometimes required as much as two or three months' time. Capacitors, in addition to destructive sampling tests, were given continuous voltage tests for periods of the order of six months, the voltages being in excess of the maximum to which they would be subjected in service.

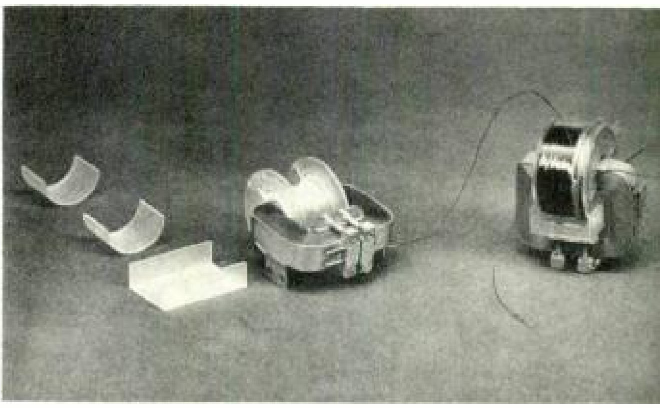


Fig. 3—A completed transformer with its parts.

Such procedures of manufacture and inspection would obviously be prohibitive for normal commercial production. But when repeaters are located in a place so inaccessible, except at great expense and delay, as the bottom of the ocean, only the best that can be built is permissible. Much credit for the production of high-quality components is due the Development Shops personnel for their painstaking and conscientious efforts and willingness to try again when a product representing hours, or even days of work, was rejected and destroyed by the rigid inspection used.

THE AUTHOR: M. C. Wooley received the B.S. degree in Electrical Engineering from Ohio Northern University in 1929. Coming directly to the Laboratories, he joined the Apparatus Development Department, where he engaged in the design and development of inductance coils until 1935. Capacitor development then occupied his attention until 1949, concluding with the development and production of capacitors for the Key West-Havana submarine cable repeaters. Since then he has been concerned with fundamental development, primarily on materials and processes used in capacitors.

The Mass Spectrometer

N. B. HANNAY
Chemical Research

Modern instrumental analysis is playing an increasingly important part in the solution of many chemical, electrical, and mechanical problems in various areas of Laboratories work. In the field of gas studies, low-pressure analytical techniques have demonstrated their usefulness for many years in a variety of problems. Other types of gas analysis problems, however, have been beyond the limitations of ordinary chemical means. A powerful tool for the solution of many of these has been found in the mass spectrometer.

This is a device that separates gaseous ions according to their mass by means of electric and magnetic fields. The instrument has been known for many years, but in the last ten years its use has spread rapidly to new fields of application. Formerly employed chiefly for measuring relative isotopic abundance and precise atomic masses, it has more recently found many new applications; among these are the rapid analysis of hydrocarbon and other gas mixtures, the detecting of isotopes used as tracers in chemical, metallurgical, and biological problems, a very sensitive method for locating gas leaks, and the routine control of industrial plants. With the rapid development of these new methods, and the availability of commercial instruments, the mass spectrometer has now become an important tool in the solution of many chemical and physical problems originating in research and development associated with electronic and telephone equipment.

The basic principles underlying the mass spectrometer are indicated in Figure 2. In

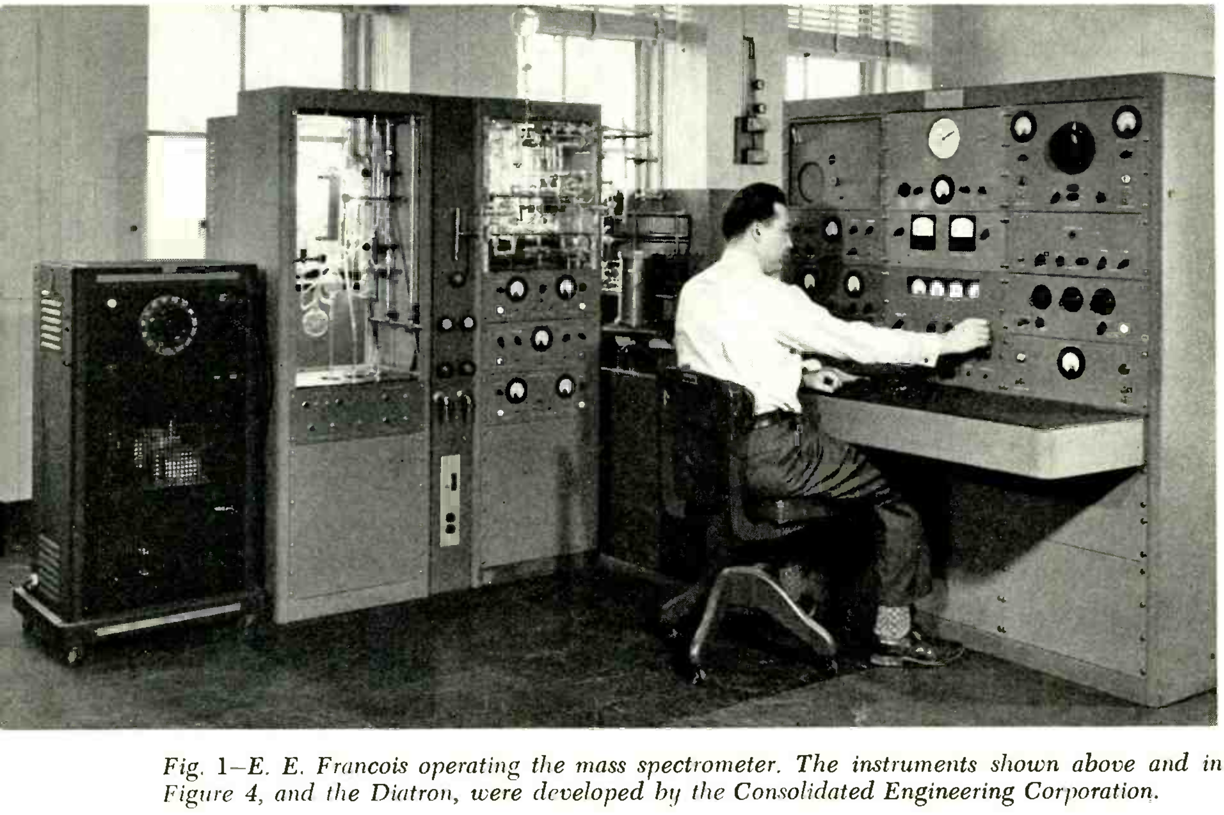


Fig. 1—E. E. Francois operating the mass spectrometer. The instruments shown above and in Figure 4, and the Diatron, were developed by the Consolidated Engineering Corporation.

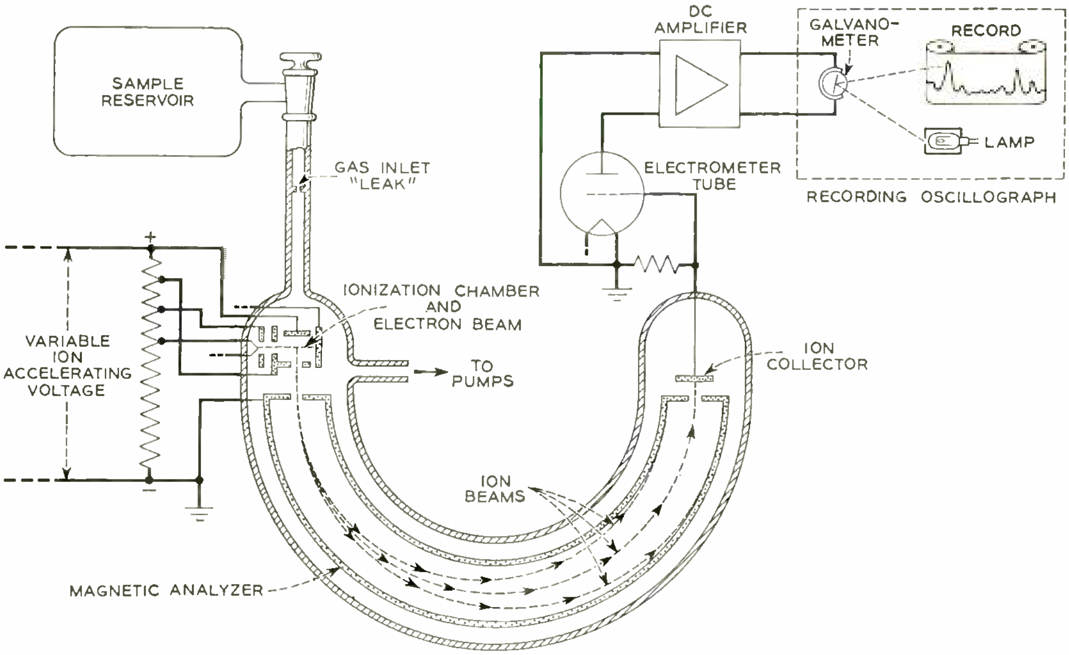


Fig. 2—Schematic diagram indicating the principles of operation of a mass spectrometer.

general, it has three major components: a source for producing a beam of ions; an analyzer that resolves the ion beam into its characteristic mass components; and the detecting system for recording these separated ion beams.

When the material under study can be obtained in a gaseous form, the usual source for the ion beam is an electron bombardment source. A beam of electrons, emitted from a filament, is directed into an ionization chamber, filled to a low pressure with the gas under study. The molecules of this gas normally are electrically neutral, but the impact of the electrons upon them results in the formation of ions, which are molecules or molecular fragments bearing a positive or negative charge. Gas from a sample reservoir is introduced into the ionization chamber through a very small glass opening, or "leak." The ionization chamber, in turn, is connected to a high-vacuum pump system, so that the gas flows continuously from the sample bottle, through the ionization chamber, and out the pumps, with a low pressure of the gas maintained in the region where the ions are formed.

Ions are pulled out of the ionization chamber, by an electric field, through a system of slits which serves to collimate the beam along paths indicated by dashed lines in Figure 2. Potentials ranging from hundreds to thousands of volts are required. When accelerated in this way, the ions have a kinetic energy of:

$$\text{Kinetic Energy} = \tfrac{1}{2}mv^2 = Ve \quad (1)$$

where m is the mass of the particle, v is its velocity, V is the accelerating voltage, and e is the charge on the ion, which is a small integral number of unit electronic charges (most frequently one, corresponding to singly charged ions, but occasionally two or even more).

This ion beam, homogeneous in energy, next passes through a region of uniform magnetic field at right angles to the direction of motion (perpendicular to the paper in Figure 2). A charged particle moving in a magnetic field is subjected to a force so as to move in a curved path. The centrifugal force of this motion balances the magnetic force, and thus

$$Hev = \frac{mv^2}{r} \qquad (2)$$

where H is the strength of the magnetic field, and r is the radius of curvature of the ion path. Substituting for the velocity v by means of equation (1), gives:

$$\frac{m}{e} = \frac{r^2 H^2}{2V} \qquad (3)$$

This shows that each ionic species, with its particular ratio of mass to charge, will traverse a path with a unique radius of curvature determined by the field conditions. In practice, since the radius of curvature is fixed by the dimensions of the analyzer, the different ions are brought successively to this path by altering the magnetic or electric field strength. The instrument in Figure 2 is of the 180-degree type; that is, the ions go through 180 degrees in the magnetic field in passing from the entrance to the exit slit of the analyzer. For a given set of field conditions, only the ions of a particular value of m/e will go through the slit; ions with different values of m/e will strike the analyzer walls and go to ground. The ion paths shown in Figure 2 represent three different kinds of ions; one is passing through the analyzer, and the others, with masses either too small or too large for the magnetic and electric field settings, are hitting the analyzer walls. The ion beam has thus been divided into separate beams each corresponding to one mass.

The ion current flowing through the exit slit is electrically recorded, and since it may be as low as 10^{-15} amperes, the d-c amplifier must be very sensitive. The scheme shown in Figure 2 is one method of making a record of this current as the various separated ion beams corresponding to the different masses are successively passed through the exit slit by altering the electric or magnetic fields.

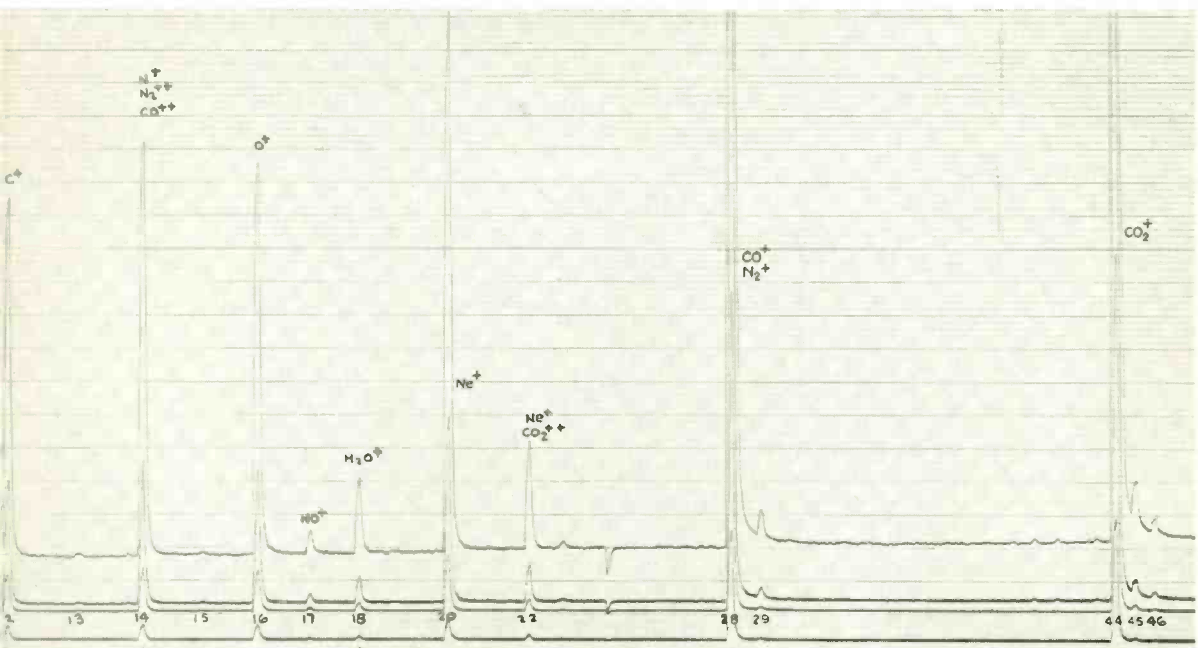


Fig. 3—Mass spectrum of a mixture that is composed of neon, carbon dioxide, carbon monoxide, nitrogen and water.

In Figure 1 is shown the gas analysis mass spectrometer installed at Murray Hill. The cabinets at the left contain the gas handling and inlet systems, with the gas "leak." In the center, rear, may be seen the large electromagnet, between the pole pieces of which are located the ionization chamber and analyzer. The cabinet at the right contains the power supplies for the magnet and the ion source, and the recording circuit.

Figure 3 shows a mass spectrum obtained with this instrument for a synthetic mixture of five gases. The horizontal axis is the mass scale, corresponding to a continuous sweep over the various masses by means of a sweep of the accelerating voltage. Whenever a mass corresponding to ions that are present is reached, the amplifier records a peak in the vertical direction, four galvanometers of different sensitivities recording simultaneously. In this case, the gas mixture contains neon, nitrogen, carbon dioxide, carbon monoxide, and water. For those gases whose molecules contain only a single atom, such as helium and neon, peaks appear at masses corresponding to the various isotopes of these atoms. For helium, there is only one isotope, at mass 4. Many elements have several isotopes, however. With neon, for example, peaks appear at both mass 20 and 22, in a characteristic ratio corresponding to the relative abundance of the two isotopes. The molecules of most gases contain two or more atoms; many organic molecules contain a large number. In such cases, the mass spectra are more complex. Not only does the mass of the molecule itself appear, but also peaks appear corresponding to all the molecular fragments produced by the electron bombardment process. Thus the carbon dioxide molecule, CO_2, shows peaks at mass 44 (one carbon, two oxygen atoms), mass 28 (one carbon and one oxygen), mass 16 (one oxygen), and mass 12 (one carbon). Furthermore, the pattern is even more complex, since both carbon and oxygen have more than one isotope, and thus other peaks appear corresponding, for example, to masses of 45, 46, etc. Every compound shows a characteristic pattern, and thus once these patterns are determined for the various gases of interest, a mixture of the gases can be quantitatively analyzed. The peak heights are proportional to the amount of the gas present.

The mass spectrometer is the most versatile, rapid, and sensitive general purpose method known for gas analysis. It is particularly valuable for analyzing inert gases, such as nitrogen and the rare gases, and for other gas mixtures whose chemical properties are not suited to chemical analysis, since it is independent of any chemical properties of the gas; and also for detecting very small traces of impurities in gases, because of its very great sensitivity.

Gas analysis problems arise in many areas of laboratory work. Electron tubes, microphone carbon, rectifier materials, cables, resistors, transistors, and insulation materials are but a few of these. Gases used in heat-treating parts for electron tubes and many other types of apparatus are analyzed for purity, since many impurities have great effects on the electrical, chemical, or mechanical properties of these parts. The gases used as the filler gas for cold cathode gas discharge tubes must be free from harmful impurities, as also must the gases used to fill other apparatus, such as carbon resistors, and coaxial cables. In many cases, specific problems arise, and gas studies can help in understanding and solving them. Variations in electrical properties of certain metals, for example, may often be correlated with gas content, and cathode-poisoning or contamination effects in electron tubes can often be attributed to harmful traces of gas. In addition, gas studies of insulators, microphone carbon, and other materials, of the corrosive products produced in electrical breakdown in gases, of gas blending and purification procedures, and many other problems become of considerable importance. There are also many important research applications for the instrument, either using the mass spectrometer as a direct part of the experiment, or as an adjunct to provide gas analyses. To mention only a few such uses, studies of molecular ionization potentials, of breakdown processes in oxide cathodes, of the adsorption and desorption of gases on clean metals, and of depolymerization products from high polymer materials, have all been carried out with the mass spectrometer.

Another instrument of very recent development appears to be a valuable supplement to the gas analysis instrument. This is the Diatron, which is similar in principle

Fig. 4—E. D. Morris testing a 1555 magnetron with the helium leak-detector.

and in general function to the gas instrument, but which is very much simpler and smaller in physical dimensions, although it lacks the precision and resolution of the larger instrument. In the Diatron, the ionization chamber, analyzer and collector plate occupy a space not much greater than that occupied by the ordinary ionization manometer used to measure pressures in high-vacuum systems. This simple construction lends itself to baking and degassing much more readily than does the larger instrument, which is a very important factor in high-vacuum experiments. A very much smaller magnet can be used with it, and the circuits can be much simpler.

The Diatron was first studied and adapted for high-vacuum work in the Laboratories by J. P. Molnar. It was found that it could be used advantageously as a substitute for the ionization manometer on high vacuum systems where it is desirable to know not only the total pressure of gas in the system, but also its composition, and where this composition could be followed continuously with time. The primary usefulness of such a device in the Laboratories lies in this type of work. The study of contamination effects in electron tubes, pumping problems in electron tubes and high vacuum pump stations, and the study of the rate of clean-up of gases and the ultimate pressure attained with various electron-tube getters are important examples of the type of problem for which the Diatron is now being used by J. Morrison and J. J. Lander.

A very different application of the mass spectrometer in the Laboratories is in the field of leak detection. The instrument used for this work is a simple mass spectrometer in which the analyzer slits and the magnetic and electric fields are fixed in such a way as to record only the presence of helium gas. Helium is a very suitable gas for leak detection work, since it flows very readily through even the smallest pinhole, and is essentially absent from the atmosphere. The apparatus to be leak-tested may be handled in two ways. In the first, it is evacuated and attached to the leak-detector inlet, and the exterior either is surrounded by a helium atmosphere, or, in the probe method, a fine jet of helium is used to locate exactly the leak. The second method consists of filling the apparatus to above atmospheric pressure with helium, and then sampling the air in its vicinity with a small probe connected to the helium-sensitive leak detector. The mass spectrometer leak-detector is the most sensitive method that is known for the detection of small leaks in vacuum or pressure equipment. It can detect a leak so small that the time required to pass one cubic centimeter of air through it is thirty-one years.

The mass spectrometer leak-detector is used extensively in testing electron tubes during the course of their assembly and after their completion. Many of these tubes contain metal-glass seals, brazed joints, or metal-ceramic seals, which must be extremely vacuum-tight, and the detection of leaks during the course of construction of the tube can insure the production of a vacuum-tight unit. The leak-detector is used similarly during the construction of other high-vacuum apparatus, and for pumping equipment in research work.

A still different form of the mass spectrometer, used in a very different application, is that designed and constructed by H. D. Hagstrum of the physical research group. This instrument was shown on the cover of the June, 1950, RECORD. Briefly, a mass spectrometer is used to produce a beam of ions, with the kinetic energy, or velocity, of the ions variable. This beam is used to bombard a target, and the electron ejection from the target induced by the ion impact is studied. This is one of the processes of fundamental interest in the glow discharge process, and with this instrument the behavior of cathode surfaces under bombardment by various ions can be studied.

The extensive development of the mass spectrometer in recent years, and its continually expanding fields of applications indicate its further usefulness in the development of electronic equipment. It appears likely that new techniques and uses, as well as new instruments, will appear in the future in the Laboratories.

THE AUTHOR: After N. B. HANNAY received a B.A. degree from Swarthmore College, he went to Princeton University where he received his M.A. (1943) and Ph.D. degree (1944). He then joined the Laboratories. During World War II he was engaged in work on the Manhattan project and then joined the chemical electronics group where he has since been engaged in fundamental work on thermionic emitters. He has also been responsible for the application of the mass spectrometer to various problems in the Laboratories.

Bell System to Try Aluminum Wire If Metal Can Be Obtained

Telephone calls may eventually make part of their round trip between telephone users over aluminum wire. This new departure for the Bell System is forecast in an appeal to the National Production Authority for an allotment of aluminum during the first quarter of 1952.

If NPA can allot it, the metal will enable Bell System engineers to advance experiments with aluminum wire to the test installation stage. The Bell companies are determined to provide telephone service to just as many people as possible and are intensifying their search for substitutes to offset shortages of raw materials.

Ability to produce aluminum wire cable in quantities large enough to make a substantial response to the demand for telephone service, however, will depend on future availability of increased quantities of aluminum, as well as steel, polyethylene and other materials used in its manufacture.

Use of aluminum wire poses a number of problems in cable design, manufacture and installation. For example, joining ends of wire together, a relatively simple operation when copper is used, calls for the development of new and more costly splicing techniques. Trial installation of the aluminum wire cable will make it possible to study these problems under conditions of actual usage.

Basic features of the AMA center

JOHN MESZAR
Switching Systems Development Engineer

Although the charging information for telephone calls is recorded in the individual central offices, all the work of telephone message pricing, billing, and bookkeeping for the Bell System is concentrated at about a hundred accounting centers. When one recalls that the Bell System has upwards of twenty-five million customers, and that the total number of accountable messages per month is close to two hundred million, the truly impressive proportions of the message accounting job are readily appreciated. In addition to its magnitude, this message accounting job has, of course, very exacting requirements of accuracy and promptness. Perhaps the most challenging factor in message accounting is, however, the need for the highest efficiency, since the accounting costs must add but a negligible amount to the low price of billable telephone messages, about 65 per cent of which are priced at fifteen cents or less.

Fig. 1—Above, A view of the AMA center in Philadelphia.

These basic characteristics of the message accounting job had a controlling influence on the design of the machinery for the AMA center, which is generally in or readily accessible to the existing Accounting Centers. As has been brought out in preceding articles*, the original message data for the AMA system are recorded in central offices as patterns of perforations on paper tapes. These tapes are then sent periodically to the accounting center where machinery performs the various data-processing tasks peculiar to message accounting. The ultimate AMA objective is, of course, the development of completely mechanized data-

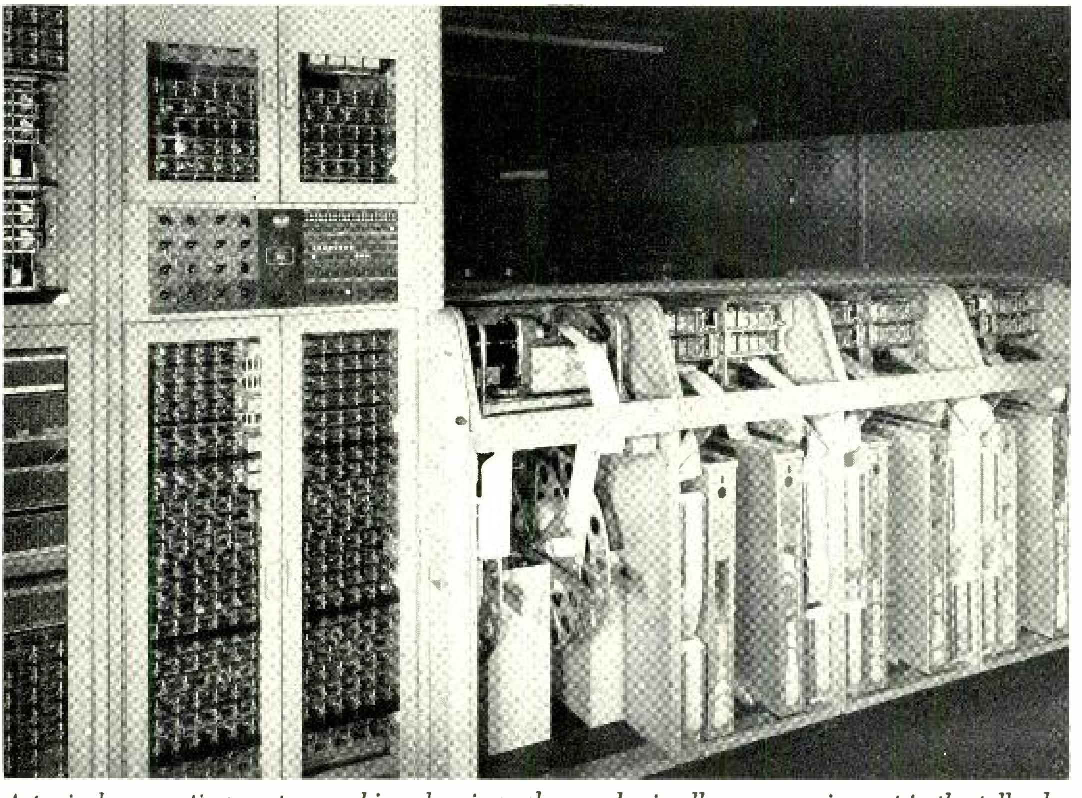
* Record, *September,* 1951, *page* 401; *October,* 1951, *page* 454; *November,* 1951, *page* 504; *and December,* 1951, *page* 565.

processing techniques to deliver printed customer-bills. However, the initial phase of the development had a more modest goal, and the machines that are at present available carry the automatic processing only part of the way toward this ultimate goal.

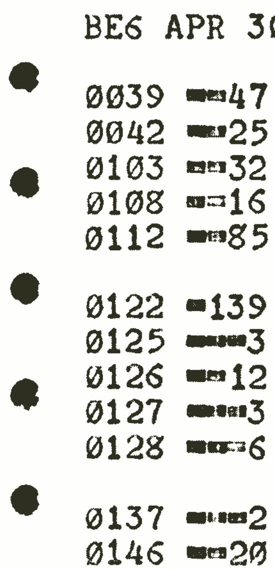
The processing technique is based on putting the central office data sequentially through different types of machines, each of which has been designed for a specific purpose. All of the machines receive their input information on tapes perforated in the preceding stage. Each machine "reads" its input tape, performs its assignment, and perforates its output on fresh tapes. The exception is the last machine whose output is in the form of typed alphabetical and numerical characters for use by the accounting center personnel.

A typical accounting center machine is shown in Figure 2. The low cabinets contain the input tape reader with its tape reeling mechanism, and the output tape perforators with their fresh tape supply and perforated tape receiving bins. The taller cabinets house the functional circuitry of the machines. Each machine has only one input tape reader, but the number of output perforators and the size of the functional circuitry varies from machine to machine. The principal machines, in the order of their usage, are the assembler, the computer, the sorter, the summarizer, and the printer.

After it is received at the accounting center, the reel of central office tape is first put into the reader of the assembler. As was brought out in the articles on central office AMA recording techniques, the billing data for thousands of telephone calls are perforated on this tape in the order in which the data became available. The data for a particular call are thus interspersed with corresponding data on other calls. The first step in the accounting center is therefore to assemble all the recorded data on each call, so that subsequent processing can deal with complete information per



A typical accounting center machine showing relays and miscellaneous equipment in the tall cabinets at the left, a reader in the first low cabinet, and perforators in the other low cabinets.


BE6 APR 30

0039 ■■47
0042 ■■25
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0122 ■139
0125 ■■■3
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0128 ■■■6

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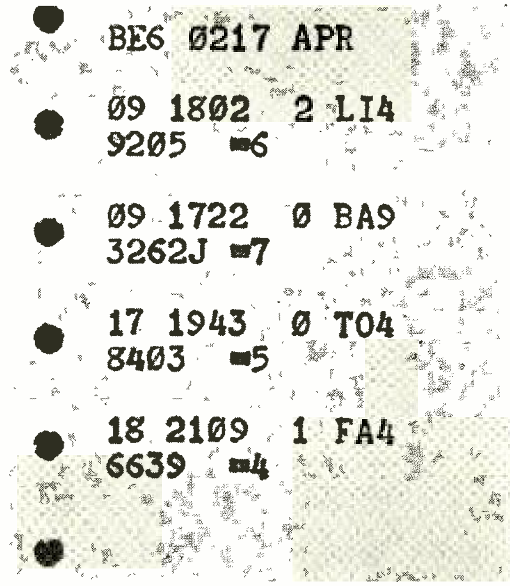
Fig. 3—A message-unit summary list as it comes from the AMA printer.


BE6 0217 APR

09 1802 2 LI4
9205 ■6

09 1722 0 BA9
3262J ■7

17 1943 0 TO4
8403 ■5

18 2109 1 FA4
6639 ■4

Fig. 4—A toll slip from the printer for telephone number BE 6-0217 for April.

call. This is accomplished by the assembler which perforates assembled messages on its output tapes. Assembling is basically a two-stage sorting process. The fragments of information belonging to a particular call are identified by a two-digit call identity index number and their time sequence on the central office tape, and the assembler sorts the fragments in accordance with these call identity indexes without disturbing the chronological order of the calls.

After the calls have been assembled, the required computations can be conveniently carried out. This is done by the computer into which are fed the output tapes of the assembler. For toll or detail-billed messages, the computer at present only computes the "chargeable interval" in minutes. For local or bulk-billed messages, the computer evaluates the chargeable time into "message units," in accordance with the applicable rate structure. Uncompleted calls are of course automatically discarded. The computer perforates separate output tapes for the local or bulk-billed messages and for the toll or detail-billed messages. It also perforates other miscellaneous output tapes for calls whose segregation is desired for various reasons.

Since the objective of the accounting center processing is to determine the total charges applicable to each telephone customer, the computed messages are next arranged by the sorter according to the telephone numbers of the calling customers. On the output tapes of this machine the calling customers' telephone numbers appear in ascending order, and all the messages originated by the same customer are perforated adjacent to each other. Sorting is a four-stage process, one stage of sorting being required for each of the four digits of a telephone number. Local and toll messages are sorted at different times.

After all the local messages chargeable to a customer have thus been brought together, it is feasible to summarize their message unit values for bulk billing. This is accomplished by the summarizer, which perforates on its output tape the total number of message units chargeable to each customer for a designated period.

The last machine of the existing accounting center series is the printer. Since the accounting work beyond this stage is to be done by the staff of the accounting center, the main function of the printer is to present the output of the AMA system in a form readily understandable by human beings. Accordingly, the printer types a message-unit summary list from the message-unit summary tape. A segment of such a list is shown in Figure 3. In the AMA system, zeros are printed with a slant line through them to distinguish them from the letter O. At the top of the summary list is the calling office and the last day included in the list. The four-digit numbers in the left column are the subscriber numbers, while the figures in the right hand column represent the total number of message-units billable to each subscriber.

Besides these message-unit summary lists, the printer types toll slips for each customer. These show the pertinent billing information on each customer's toll messages. The messages are presented in order of date, and the slips are automatically stacked by the printer in the order of the customer's telephone numbers. A toll slip with the record of three messages is shown in Figure 4. The subscriber's telephone number and the month are given at the top of the tape, while the data for each call are given by a two-line entry. In the upper line of each entry is the day of the month, the hour and minute of the day, the called area, and the called office, while the lower line gives the called number and the chargeable time in minutes. The time of day is given on a 24-hour basis, and thus the 1722 of the second entry represents 5:22 p.m.

A diagram of the over-all accounting center processing scheme is shown in Figure 5. Each of the accounting center machines will be described more fully in succeeding articles. Their most outstanding characteristic is accuracy. Features are incorporated in each machine which enable it to continuously check its own internal actions. One basic checking principle is to insure that circuit components—such as relays—always act in a designated pattern. If, for instance, a group of ten relays is used to represent the ten values of a digit (decimal code), the machine checks that in every use of

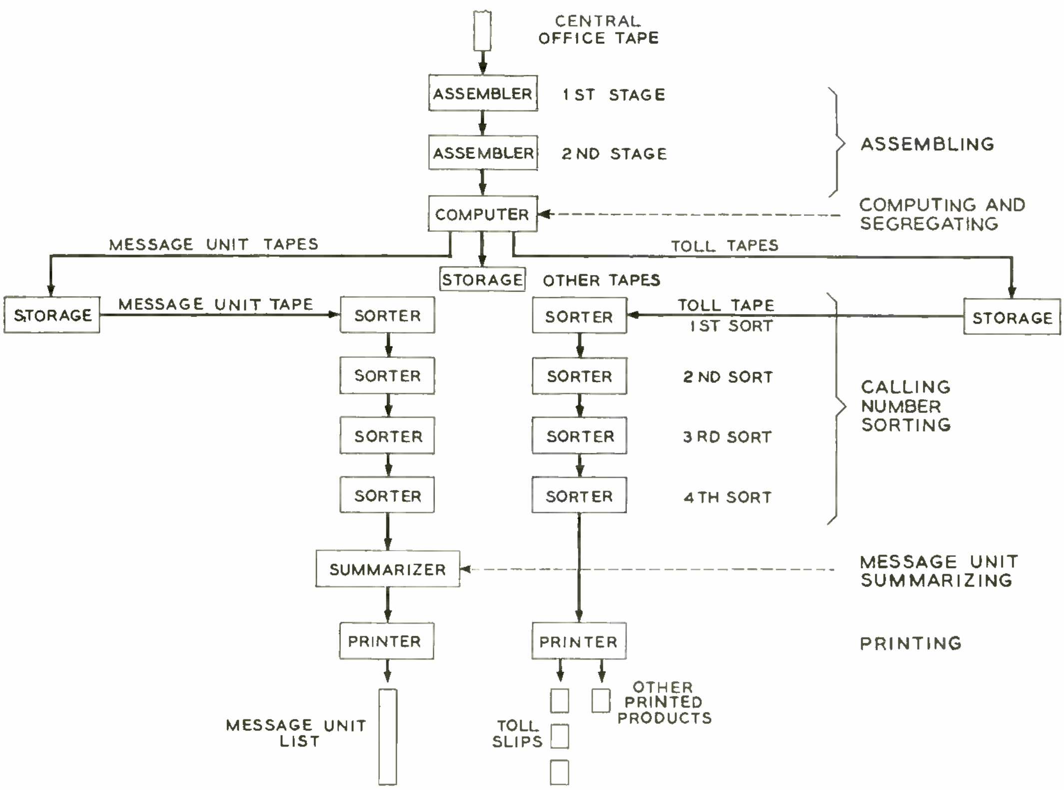


Fig. 5—Block diagram of an accounting center.

this group of relays one and only one relay is activated. Or, if the digit is represented in the so-called 2-out-of-5 combinational code, the machine checks that in every use of the five relays two and only two are activated. These and other types of rigorous self-checking features are woven throughout the whole circuitry of each machine, and include also an examination of the perforation pattern of the input tapes. If any internal irregularity or tape defect is experienced by the machine, it stops and signals the attendant to take appropriate corrective action. The machines are even capable of discovering human operational errors. For instance, if the wrong tape is put into a machine, it refuses to proceed with the processing. Accuracy tests run on the system have shown not only that the number of errors is extremely small, but that the few that are made result in an undercharge rather than an overcharge, which was one of the objectives in designing the checking features.

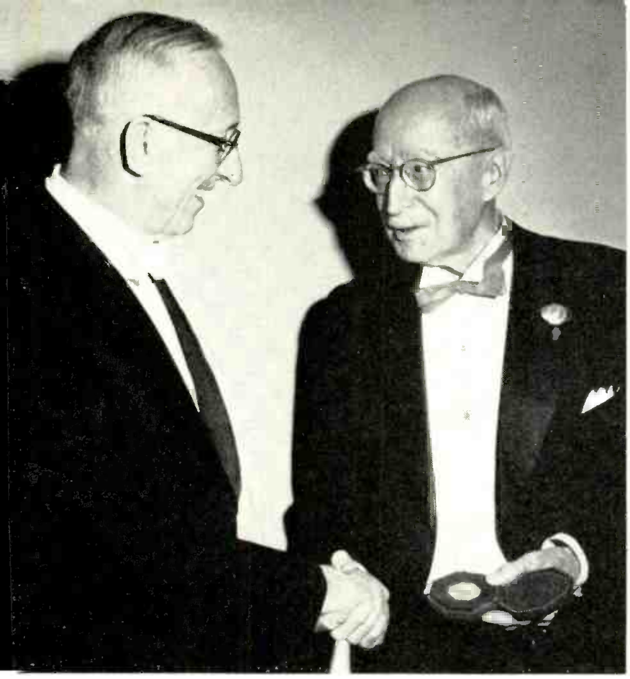
A second important characteristic of the machines is their reliability. This has been obtained simply by the use of time-proven central office type of apparatus and circuit design techniques.

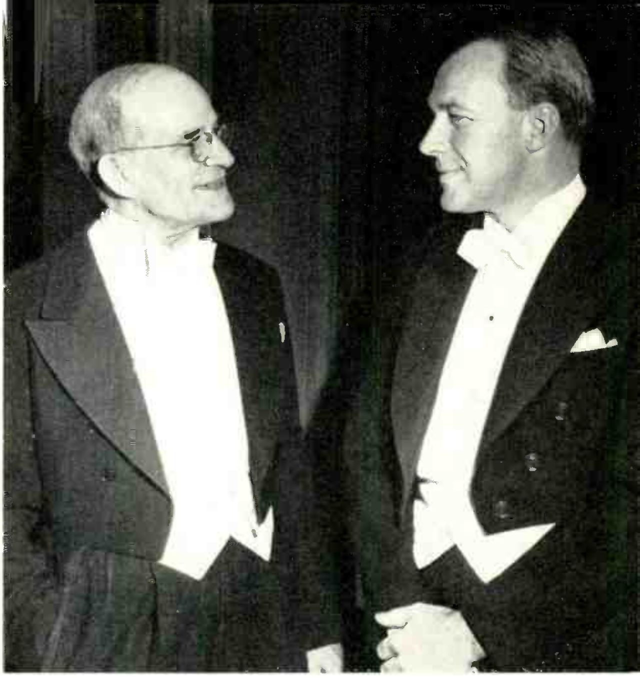
The third notable characteristic of the accounting center machines is their speed of operation. With the exception of the printer, all the machines are capable of reading their input tapes and performing their required functions at the rate of approximately 1000 tape-lines per minute. The average speed of the computer—and to a smaller extent of the assembler—is a function of the types and relative quantities of the various calls, and is, of course, somewhat lower than its capability. The printer's speed in turn is determined by its output typing mechanism, which is rated at 100 words per minute.

One more common characteristic of the accounting center machines worthy of emphasis is their load capacity. All of them have been designed with input and output tape capacities sufficient for several hours of unattended running. Once an operator loads and starts a machine, it requires no further attention until the processing of the load is finished, at which time the machine shuts itself off and signals the operator both audibly and visually.

These are some of the primary attributes of the accounting center machines. Over and above these important physical characteristics, however, is the amount of built-in intelligence such machines possess. A little reflection on their main functions—reading, writing, computing, summarizing, sorting, checking, etc.—brings out the sharp similarities between the doings of such machines and human activities classified as intelligent.

THE AUTHOR: John Meszar was graduated from Cooper Union in 1927 with a B.S. degree in E.E. He has been employed by the Laboratories since 1922 when he began work as a technical assistant working on the testing of toll switching circuits. In 1942, after several years as a supervising engineer in toll switching circuit design work, he became an instructor in the Laboratories' School for War Training. Since the war, he has returned to circuit design supervision and devoted much of his time to AMA. Last year the American Institute of Electrical Engineers awarded him first prize for the best paper in the communication division presented during 1950.



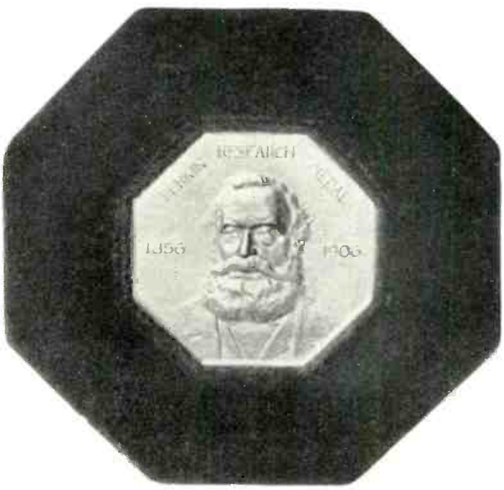


Left—Presenting the Perkin medal to Dr. R. M. Burns is Dr. Marston T. Bogert (right), of Columbia University, Senior Past President of the Society of Chemical Industry. Right—Dr. R. R. Williams, (left), formerly Chemical Director of the Laboratories and now Chairman of the Research Corporation, chats with Dr. Robert C. Swain of the American Cyanamid Company, chairman of the American Section, Society of Chemical Industry, who presided. Dr. Williams described the medalist's career and achievements.

R. M. Burns Receives Perkin Medal

R. M. Burns, Chemical Coordinator and Director of Chemical and Metallurgical Research of the Laboratories, was the recipient of the Perkin Medal, highest award of achievement in American industrial chemistry, at a dinner given January 4, by the American Section of the Society of Chemical Industry, at the Waldorf-Astoria. R. R. Williams, Chairman of the Research Corporation and a previous recipient, who was Chemical Director of the Laboratories until his retirement six years ago, described the medalists' career and achievements. Presentation of the medal was made by Dr. Marston T. Bogert of Columbia, Senior Past President of the Society of Chemical Industry. In his response, Dr. Burns described the chemical problems of a consumer of chemical and metallurgical products and gave examples of how fundamental and applied chemical research in these laboratories has contributed to the production of new chemical products of value to the telephone industry and profitable to the chemical manufacturer. He stressed the importance of the electronics industry as it will be supplemented by the development of the transistor and stated that it would be, in his opinion, the only rival in size of the chemical industry. He also mentioned the increasing need for enlargement of our programs of training young men for the kind of work they will have to do in their future careers, emphasizing the need for chemists trained broadly in industrial technology.

Dr. Burns received the 46th impression of the Perkin Medal. The medal was founded in 1906 in honor of Sir William Perkin, who that year celebrated the 50th anniversary of his discovery of the first synthetic dye, and who received the first impression of the medal in honor of that event. The medal is awarded annually to "a member of the chemical profession residing in the United States for outstanding work in applied chemistry."



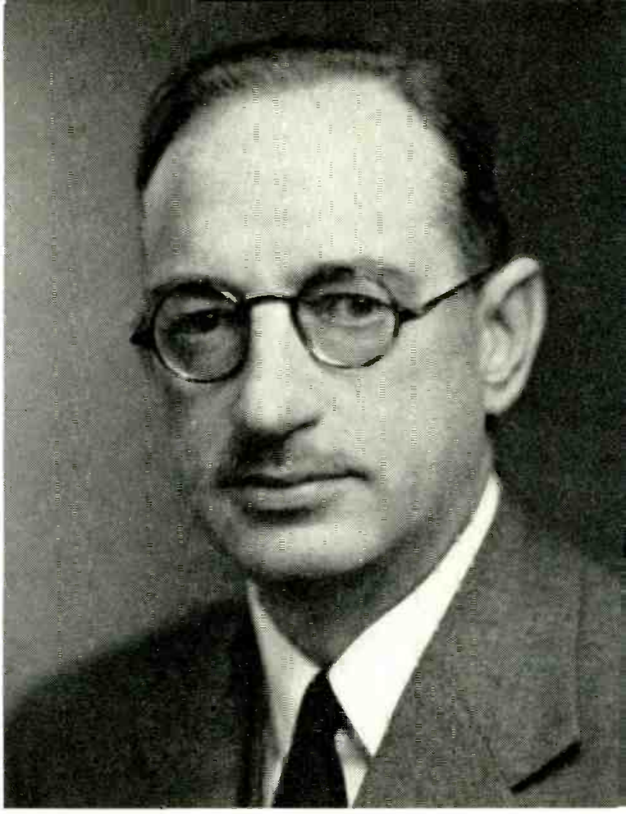
Ralph Bown Named Vice President

Other Changes in Research Department

Ralph Bown, Director of Research for the Laboratories since 1946 and a member of the Bell System for more than thirty years, has been appointed Vice President in charge of Research.

General department heads who report to Mr. Bown are J. B. Fisk, who has been appointed Director of Research in Physical Sciences; H. T. Friis, appointed Director of Research in High Frequency and Electronics; W. H. Doherty, appointed Director of Research in Electrical Communications; and R. M. Burns, appointed Chemical Coordinator in addition to his duties as Director of Chemical and Metallurgical Research, reporting to Dr. Fisk. P. J. Keenan continues as Executive Assistant handling staff activities. Mr. Fisk will act for Mr. Bown when he is absent from the Laboratories.

Mr. Fisk's organization is composed of the following department heads: H. W. Bode, Director of Mathematical Research; S. Millman, Director of Physical Research; R. M. Burns, Director of Chemical and Metallurgical Research; W. O. Baker, Assistant Director of Chemical and Metallurgical Research; L. A. Wooten, Director of Chemical Physics; and J. R. Townsend, Director of Materials Applications Engineering. E. E. Schumacher is appointed Chief Metallurgist, reporting to Mr. Burns.



Ralph Bown

Mr. Friis's organization has as department heads, J. C. Schelleng, Director of Radio Research; J. R. Pierce, Director of Electronics Research; and L. Espenschied and E. C. Wente, Research Consultants.

Mr. Doherty's department heads are R. K. Potter, Director of Transmission Research; W. D. Lewis, Director of Switching Research; A. G. Jensen, Director of Television Research; W. E. Kock, Director of Acoustics Research.

Mr. Bown, who has been widely recognized

R. M. Burns, W. O. Baker, J. R. Townsend, L. A. Wooten, H. W. Bode, S. Millman and J. B. Fisk.

J. C. Schelleng, E. C. Wente, H. T. Friis, J. R. Pierce and Lloyd Espenschied.

for his pioneering research and development work in the broad field of communications engineering, received the Morris Liebmann Memorial Prize from the Institute of Radio Engineers for 1926, and in 1949 he received the Institute's annual Medal of Honor. In 1927 he served as president of the I. R. E. Mr. Bown received his degrees from Cornell University, where he also taught in the Physics Department while pursuing his graduate studies. He served as a captain in the Signal Corps in World War I, prior to joining the Development and Research Department of A T & T.

Much of Mr. Bown's work has been concerned with various aspects of radio broadcasting and ship-to-shore and overseas telephony. He was a division member and consultant of the National Defense Research Committee, specializing in radar, and in 1941 visited England to study radar operations under combat conditions. He also served as expert consultant to the Secretary of War. He

W. E. Kock, W. H. Doherty, R. K. Potter, A. G. Jensen and W. D. Lewis.

was named Assistant Director of Radio Research for the Laboratories in 1934, Director of Radio Research in 1936, Director of Television Research in 1938, and in 1944 was appointed Assistant Director of Research.

Mr. Fisk, who has been Assistant Director of Research and Director of Physical Research since 1949, has been associated with the Laboratories since 1939, except for the years 1947-1949 when he was Director of Research for the Atomic Energy Commission and simultaneously Gordon McKay Professor of Applied Physics at Harvard. He holds a bachelor's and a doctor's degree from the Massachusetts Institute of Technology, was a Junior Fellow at Harvard, and later Professor of Physics at the University of North Carolina. When the potentialities of the microwave magnetron for radar applications were discovered, he was selected to head the development group at the Laboratories, and under his leadership the Laboratories became the outstanding industrial organization in this field during the war.

E. E. Schumacher
Chief Metallurgist

Mr. Burns joined the Western Electric Company in 1922 and has been associated continuously with the chemical activities of the Laboratories, since 1945 as Chemical Director. He holds a bachelor's degree from Colorado State University and a doctor's degree from Princeton. He is a past president of the Electrochemical Society, and has been active in the American Chemical Society for a number of years, having served as chairman of the New York Section. The Society of Chemical Industry recently announced the award of its 46th Perkin Medal to Mr. Burns. (See page 75.) Mr. Burns also holds an honorary doctorate from the University of Colorado.

Mr. Friis, who joined the Western Electric Company in 1919, has been associated with the Laboratories at Holmdel since 1930, in charge of short-wave research studies and, more recently, transmission studies of waves in the centimeter range. He and his group have made important contributions in these and allied fields. Since 1946 he has been Director of Radio Research. A native of Denmark, Mr. Friis holds engineering and doctor's degrees from the Royal Technical College in Copenhagen and he, too, has been awarded the Morris Liebmann Memorial Prize of the Institute of Radio Engineers.

Mr. Doherty, who holds degrees from Harvard, joined the Laboratories in 1929, and at Whippany took part in the development of high-power radio transmitters for transoceanic service and broadcasting. Later he participated in pioneering work in the fire-control radar field, and throughout World War II supervised a development group which was responsible for the design of a number of radars widely used on naval surface ships and submarines for fire and torpedo control. He continued in military electronics work until 1949, when he became Director of Electronic and Television Research. He holds an honorary doctorate from Catholic University, and he, also, was awarded the Morris Liebmann Prize.

Transistor Discussed at AAAS

At the 118th meeting of the American Association for the Advancement of Science held in Philadelphia during the last week in December, J. A. Morton and W. Shockley spoke on the subject of transistors at the Section B1 Symposium on Semiconductors. Mr. Morton stated that progress in the development of the point-contact transistor had been so successful that it is expected to be put into trial use in the Bell System in about a year. The first application will be in the nationwide toll dialing program, where transistors will be an integral part of equipment for automatically determining direct and alternate routes across the nation's telephone networks.

Dr. Shockley described later the junction transistor, which derives its name from the two positive-negative junctions between layers of germanium. He pointed out that the newer type is much more efficient than the earlier, and consumes far less power.

Joint Computer Conference

A joint A.I.E.E.-I.R.E. Computer Conference was held December 10-12, in Philadelphia, specifically to review accomplishments in the field of large scale digital computer engineering. Among the papers from some twelve computing groups, manufacturing organizations, and research laboratories, was one given by J. H. Felker who spoke on *The Transistor as a Computer Component.* W. H. MacWilliams, Jr., gave the keynote address preceding the formal presentation of the papers, in which he summarized briefly the present state of the computer art. A number of Laboratories people attended the conference.

Dr. Darrow Honored By France

K. K. Darrow has been awarded the decoration of the French Legion of Honor with the rank of Chevalier. The award, made December 18, 1951, in New York City, is for "services rendered to the international relations of Science and to the cultural relations between France and the United States."

Dr. Darrow's acquaintance with France began in the distant days before World War I, when he was a student at the University of Paris and where, during this time, he saw many French physicists and mathematicians whose names are now classic. It was fortified in later years, when he made repeated journeys to France, visited many laboratories, attended scientific congresses in France and other continental countries, and won the friendship of a number of French physicists. He has been able to render occasional services to French physicists visiting the United States, and to arrange for speeches by several of these before the American Physical Society. He has been a member of the French Physical Society for many years, and served for a term on its Council. In 1949 he received the honorary doctorate of science from the University of Lyons.

Dr. Darrow was graduated from the University of Chicago in 1911 with the degree of Bachelor of Science. During 1911 and 1912 he studied at the Universities of Paris and Berlin. Returning to Chicago, he received his degree of Ph.D. there in 1917, having specialized in physics and mathematics. He then came to the Laboratories, where his work has included the study, correlation, and representation of scientific information for his colleagues to keep them informed of current advances made by workers in fields related to their own activities. As a corollary to this work, Dr. Darrow appears before audiences to lecture on current topics in physics and the related sciences. He is the author of several books, among which are *Introduction to Contemporary Physics*, *The Renaissance of Physics*, *Electrical Phenomena in Gases*, and *Atomic Energy;* and of a large number of articles in *The Bell System Technical Journal* and other journals. Since 1941 he has been Secretary of the American Physical Society.

The Legion of Honor was instituted by Napoleon Bonaparte on May 19, 1802, as a general military and civil recognition award. Extraordinary services in time of war and extraordinary services in civil life qualify one for

K. K. Darrow (left) receiving the medal of the Legion of Honor from M. Roger Seydoux, French Consulate General in New York.

membership. The President of the French Republic is the grand master of the order and the administration is in the hands of a grand chancellor who has a council of the order nominated by the grand master.

New Section Formed in AAAS

A new Section on Industrial Science known as Section P, has been established by the American Association for the Advancement of Science. The purpose of this section is to provide an area of interest within the Society for those concerned with the application of the broader principles of science to industrial operations and developments. It should also serve as a common meeting ground for scientists whose primary interests may be along the lines of pure research, such as in the fields of chemistry, engineering, physics, etc.

As an important step in the formation of this new Section, a three-day program of talks by outstanding representatives of research laboratories, educational institutions, and manufacturing corporations was held in Philadelphia on December 28, 29 and 30. This program followed the theme of *Industrial Science Today*, *Industrial Science Tomorrow*, and *Public Aspects of Industrial Science.* At the session on *Industrial Science Today*, J. B. Fisk spoke on *The Communications Industry.*

New Method of Artificial Respiration

Telephone workers throughout the Bell System are learning a new method of artificial respiration approved by the American National Red Cross.

The new "back-pressure arm-lift" method adopted in December replaces the Schafer prone-pressure technique that has been taught to Americans for more than a generation.

Research that led to the change was begun prior to World War II when the Red Cross started extensive studies on various methods of restoring breathing of victims of accidents, drownings, and illness.

The Armed Forces also became interested in artificial respiration in connection with poison gas or nerve gas warfare. About two years ago the Army Chemical Corps assigned four research teams to compare all proposed methods.

The combined research proved that an artificial respiration method suggested years ago by Col. Holger Neilsen of Denmark, with certain adaptations, was twice as effective as the Schafer technique in moving air into and out of the lungs.

Here's how the back-pressure arm-lift method is applied:

The victim is placed on his stomach with arms folded under his head and his cheek resting on the crossed arms. The operator, kneeling at the patient's head, places his hands on the victim's back so that the thumbs touch each other and the heels of the hands are below a line running between the arm pits.

Keeping his elbows straight, the operator rocks slowly forward until his arms are approximately vertical; then he moves backward, slowly sliding his hands to the patient's arms just above the elbows. The operator continues to rock backward, raising the arms of the subject until resistance and tension are felt at the victim's shoulders. He then drops the arms and repeats the cycle 12 times a minute.

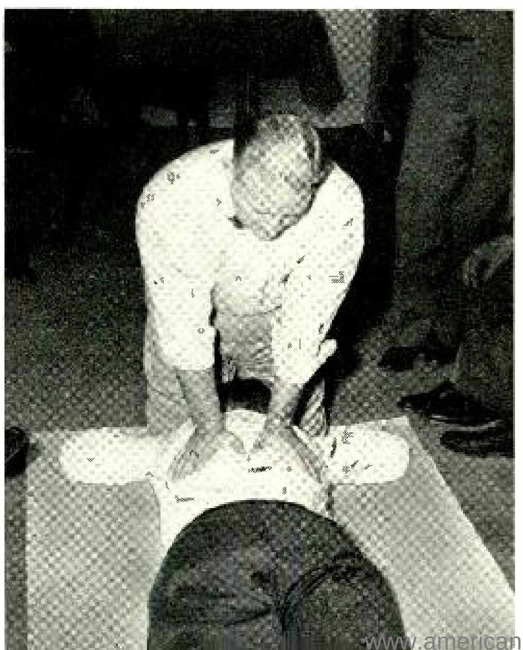
The Red Cross has found the new method not only more effective but easier to teach and perform than the prone-pressure method. It helps to force air into the lungs as well as to expel it, where prone-pressure forces air out, and relies solely on the elastic recoil of the chest and internal organs to pull fresh air into the lungs.

Eighteen organizations have adopted the new method. In addition to the Red Cross and the Bell System they include all branches of the Armed Forces, Bureau of Mines, Boy Scouts of America, Camp Fire Girls, American Medical Association, Federal Civil Defense Administration, Girl Scouts of the U. S. A., Public Health Service, and the YMCA.

It will be included in Red Cross first aid and life saving courses as soon as possible. Three million supplements to first aid and water safety textbooks are now being printed. Supplements will be available through Red Cross chapters without charge.

The Red Cross points out that the changeover cannot be accomplished immediately. Millions of persons already trained in the prone-pressure technique, which has saved many lives, should continue to use it until they have received training in the new method.

In the new method of artificial respiration the first step is to lean forward from a kneeling position to apply pressure on the victim's back.



Then the rescuer rocks back, sliding his hands to the patient's arms. The elbows then are raised, pulling air into the victim's lungs.

Members of the Laboratories Go To Sandia

To meet the need for sharp increase in research and development activity at Sandia, the following organization changes have been made:

W. A. MacNair, relieved as Director of Military Systems Engineering of the Laboratories, has been appointed Director of a newly created General Department at Sandia, the Systems Research Department. R. P. Petersen, Director of Research, Sandia; G. A. Fowler, Director of Field Testing, Sandia; and H. W. Bode, J. O. McNally and J. W. T. Youngs, in their capacities as Sandia Consultants, now report to Mr. MacNair. F. J. Given, granted a leave of absence from the Laboratories to accept employment with Sandia Corporation, has been appointed Director of Apparatus and Materials Engineering, Sandia, reporting to Mr. MacNair. L. G. Abraham, granted a leave of absence from the Laboratories to accept employment with Sandia Corporation, has been appointed Director of Electronics, Sandia, reporting to Mr. MacNair.

R. E. Poole will continue as Director of the General Department at Sandia responsible for development. The following Sandia organization now reports to Mr. Poole: R. W. Henderson, Director of Engineering I; L. A. Hopkins, Director of Engineering II; L. J. Paddison, Director of Quality Assurance; H. J. Wallis, Superintendent of Development Staff Services; and J. R. Townsend and C. N. Hickman, in their capacities as Sandia Consultants.

K. O. Thorp, granted a leave of absence from the Laboratories to accept employment with Sandia Corporation, has been placed in charge of Transition Engineering, Sandia, reporting to Mr. Henderson.

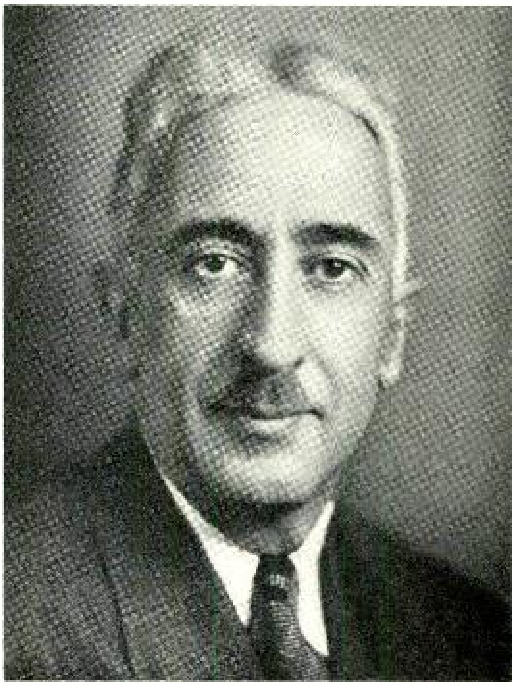
The Research and Development Operations of Sandia Corporation are under the direction of Bell Telephone Laboratories. Mr. Poole and Mr. MacNair will report to D. A. Quarles, Vice President of the Laboratories.

The following changes in organizations reporting to W. C. Tinus, Director of Military Electronics Development have been made:

The title of W. H. C. Higgins has been changed to Director of Military Systems Development. The organization reporting to Mr. Higgins is R. R. Hough, Military Development Engineer; L. W. Morrison, Military Development Engineer; H. G. Och, appointed Military Development Engineer; and O. H. Danielson, appointed Military Development Engineer.

A. K. Bohren has been appointed Director of Military Equipment Development. The organization reporting to Mr. Bohren is J. F. Wentz, Military Development Engineer; J. W. Smith, Military Development Engineer; A. A. Lundstrom, appointed Military Development Engineer; and D. G. Blattner, appointed Military Development Engineer.

J. M. West has been appointed Director of Military Systems Engineering. The organization reporting to Mr. West is R. C. Newhouse, Military Development Engineer; and S. C. Hight, Military Development Engineer.



W. A. MacNair

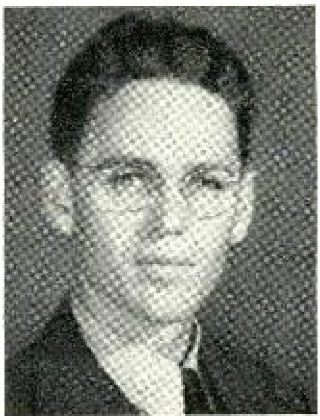
E. A. Bescherer has transferred from Whippany to Burlington, N. C., to replace K. O. Thorp as head of the Laboratories group at that location. Mr. Bescherer reports to E. H. Bedell, Military Development Engineer. J. H. Hershey is also transferred from Whippany to Burlington where he will be in charge of a new Engineering group in Mr. Bescherer's organization.

Other Organization Changes

The following changes in the organization of G. N. Thayer, Director of Transmission Development, have been made:

F. J. Given

L. G. Abraham



J. M. West

A. K. Bohren

The organization of A. C. Dickieson, Director of Transmission System Development I is as follows: P. G. Edwards continues in charge of the department which is primarily responsible for the development of short haul carrier systems. W. E. Reichle has been appointed Transmission Systems Development Engineer; he will have direct responsibility for the mobile radio group. T. J. Grieser continues in charge of the department which is primarily responsible for the development of long-haul microwave radio relay systems. A. A. Oswald has been appointed Transmission Development Engineer; he will have direct responsibility for the overseas radio group.

The organization of E. T. Mottram, Director of Transmission System Development II, is as follows:

C. H. Elmendorf has been appointed Transmission Systems Development Engineer; he will become project engineer for the L3 coaxial system and continues to be directly responsible for the development of L3 line equipment. J. J. Gilbert, Submarine Cable Engineer, continues in charge of his department. H. B. Fischer is in charge of a department which now consists of the test equipment group and the L3 television terminal group. H. A. Lewis remains in charge of his department; his responsibilities have been increased to include supervision of the special carrier group. R. E. Crane continues in charge of his department which consists of the general carrier group and the equipment group now developing the L3 telephone terminal. In Mr. Crane's continued absence, Mr. Lewis will act for him.

R. O. Grisdale has transferred from the Transmission Apparatus Development Department to the Physical Research Department, reporting to S. Millman. Mr. Grisdale's responsibilties will remain essentially unchanged and the group presently reporting to him will continue under his supervision as members of the Physical Research Department.

J. C. Steinberg has transferred from Transmission Research to Underwater Systems Development reporting to C. F. Wiebusch.

E. G. D. Paterson has been appointed Assistant Director of Quality Assurance. In this capacity he will assist G. D. Edwards, Director of Quality Assurance, in the general supervision of the department and will be in charge of the department in his absence.

Reporting to Mr. Edwards and Mr. Paterson are: W. G. Freeman, Central Office Quality Engineer; G. R. Gause, Station Quality Engineer; R. C. Koernig, Outside Plant Quality Engineer; H. F. Dodge, Quality Results Engineer; and J. A. St. Clair, Field Activities Engineer.

Mr. Martin Talks at N. Y. U.

W. H. Martin spoke to the Junior and Senior Electrical Engineering students at the weekly convocation of New York University students on January 10. In his talk, Mr. Martin said that the basis of his remarks was his own experiences as an engineer. He described the type of organization of the Laboratories, stressing the thought that in our business we "sell service"—the major goal of our efforts being to provide equipment and methods of operation to give the customer the largest ratio of service value to the costs that affect the charges for service. "Engineering," said Mr. Martin, "has a strong appeal because it provides a means of satisfying in our work the creative instincts.

There is satisfaction in doing things for the first time, or in doing things others have thought impossible. There is satisfaction in making something better than it has been, or in producing it with less effort and materials. This satisfaction applies not only to those who have created some of the fundamental ideas, but to those who have added their contribution to the design, its production, and to the necessary and desirable improvements as its use continues. To see the results of one's activities embodied in physical things which are serving a useful purpose is to me one of the big satisfactions of engineering."

R. F. Mallina's Trip to Europe

R. F. Mallina's trip to the continent was a combination of business and pleasure. Accompanied by his fourteen-year-old daughter, Mitzi, he flew to Holland, and toured France, Italy, Switzerland, Austria and Belgium. Mitzi also travelled in Sweden, Norway and Denmark. For Mitzi, whose best friend was on a similar jaunt, the trip was an education in itself. For Mr. Mallina it meant a chance to visit his family in Vienna, to sight-see and to visit European plants whose work is somewhat similar to that of the Laboratories. During his business trip he visited the International Telephone and Telegraph Company; the N. V. Philips Laboratories in Holland; the Bell Telephone Manufacturing Company in Belgium; and the *Laboratoire Central de Telecommunications* in France.

Long Lines Summary of 1951 TV Network Growth

Summarizing the Bell System's progress in the provision of nationwide intercity network television facilities, H. I. Romnes, Director of Operations for A T & T's Long Lines Department, pointed out that, "during 1951 Long Lines added about 6,500 miles of TV channels bringing the total to over 24,000. Four cities were added to the network during the period making available live network programs to 14 stations not served in 1950. Investment in facilities used for TV rose to $85 million.

"Highlight of 1951 was the establishment of coast-to-coast service over the new transcontinental microwave radio relay system, linking Salt Lake City, San Francisco, and Los Angeles to the network, and thus enabling viewers on the Pacific Coast, as well as those of the Middle Western and Eastern states, to enjoy live telecasts simultaneously for the first time."

Reviewing some of the postwar communication developments Mr. Romnes pointed out that, "Toll telephone messages for the average day jumped from 4.6 million in 1945 to more than 6 million in 1951. Demands for service poured in from the military and government: networks of telephone and teletypewriter circuits were required for air and civilian defense as well as for the nation's industries gearing for all-out production. Since January, 1946, Long Lines has added almost $350 million of new plant to serve the growing needs of the nation's long distance telephone users and has a program under way for the construction of $180 million more in the near future.

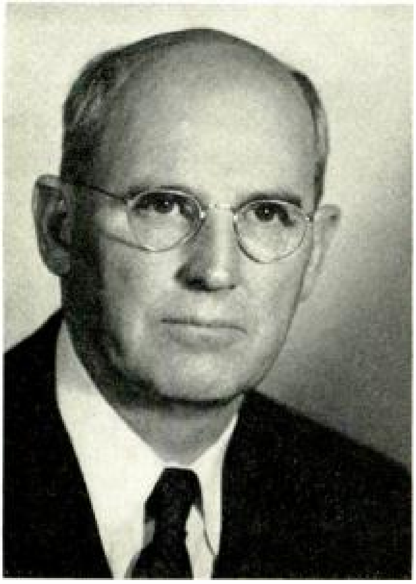
"The rapid development of intercity television networks since the war is best illustrated by the fact that on January 1, 1947, only five years ago, the Long Lines network consisted of two channels interconnecting stations at New York and Washington for a total of 476 miles. Now 24,000 channel miles provide service to 86 stations in 46 cities."

Among the Out-of-Hours courses offered by the Laboratories for its members is the course in "Problems in Radar Systems Design" given by S. C. Hight and members of Military Electronics at Whippany. Fifty-nine are taking Mr. Hight's course. In all there are eleven courses under way at present with 355 members of the Laboratories participating. Mr. Hight is shown demonstrating the radar range calculator which was described in the Record *for July, 1951.*

Old-Fashioned Virtues in the Telephone Business Today

John B. Rees, Vice President—Operations, New Jersey Bell Telephone Company, at a reunion of the Telephone Pioneers.

I would like to talk about the New Jersey Bell. The Telephone Company is as modern as anything in this modern world. This is true of our organization, our methods, our physical facilities. It has always been true. You Telephone Pioneers have had a very large part in introducing new things and you have contributed your full share of new ideas. But I do not want to talk at this time about this more material side of the telephone business. I want to talk about another side of the business—its old-fashioned side.



John B. Rees

A few weeks ago ex-President Hoover pleaded for a return to the old-fashioned virtues—honesty, truthfulness, sincerity, faith, hope, charity. After looking at the telephone business from various viewpoints over a period of 37 years, I have come to the firm conclusion that the telephone company has never laid these old-fashioned virtues aside. I want to tell you why this is true and what it means.

It is not because of the way the Bell System is organized. It is not because of the work of Bell Telephone Laboratories. It is not because of our relations with the Western Electric Company. It is not because the American Telephone and Telegraph Company is the largest corporation in the world. All of this is important, but the real reason lies much deeper and is much more permanent than any of these.

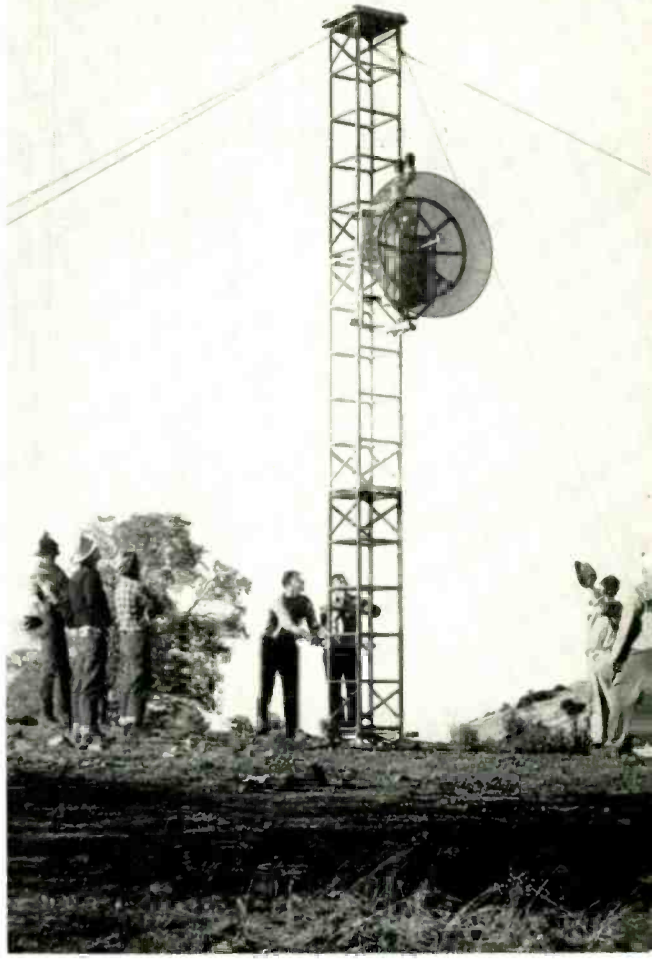
Practically all of us came with the Telephone Company when we were very young. Youngsters have high ideals. They may try to keep the high ideals from showing but they are there nevertheless, ready to be strengthened or impaired. The old saying, "As the twig is bent . . . " applies to people as well as to trees. Soon after we came to work we found that the public would not accept anything but good telephone service. We found that good telephone service is dependent on the proper operation of each item of plant, on the accurate completion of each telephone call, on patience and consideration in dealing with the public and with each other. In short, we found that anything worth doing in giving telephone service was worth doing well. We found no place for shoddy work, and no place for double talk or shady tricks. We found no skeletons in the telephone closet. We found all the cards face up on the table. It follows that the youngster's old-fashioned ideas of right and wrong, his or her sense of honesty and truthfulness and fair dealing, became more firmly rooted with the years. In passing, I might say that each of us—clerk, apprentice workman, operator, engineer, master craftsman, foreman, chief operator, accountant, district or division head, department head or officer of the Company—is this same youngster at a different stage of his or her career.

You Telephone Pioneers in this auditorium and the nearly 6,400 New Jersey Bell Telephone Pioneers are these same youngsters after 21 years or more of service. The deep-seated integrity, stability and sincerity of the Telephone Pioneer and of the 16,000 younger telephone workers of the state who are following in his and her footsteps is what forms the character and reputation of the New Jersey Bell Telephone Company. This is what makes me say that the New Jersey Bell has an old-fashioned side. This is what makes me say that the Telephone Company has never laid aside the old-fashioned virtues.

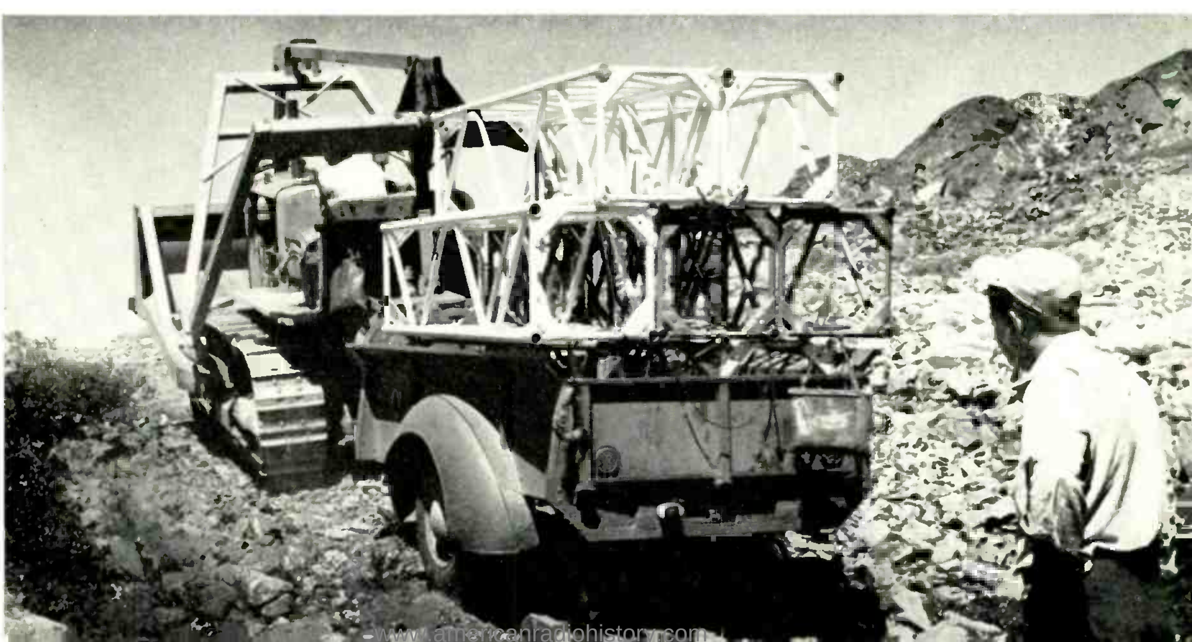
Now I would like to say what all of this means, as I see it. You and I during our years in the business have seen many things come to pass—inventions, developments, new services. We have had good years and bad. We have had peace and war. We have taken on various forms of organization as the years have gone by. We have run into fads and fancies. We may run into all of these things in the years ahead. But the faith, the integrity, the sense of fair play, which has become so deeply engraved in the hearts and minds of telephone men and women means to me that none of these things can divert us from our purpose of furnishing the best possible telephone service to the state and to the nation. Also, it means to me that we shall continue to keep the respect and confidence and friendship of the people we serve. But above all, it means that both as individuals and as a company we shall continue to keep faith with ourselves. Finally, this old-fashioned side of the telephone business means that both the Telephone Company and each of us as individuals can look forward to the future with great confidence, no matter what it may bring.

Switching Research Discussed at the Deal–Holmdel Colloquium

W. D. Lewis addressed the Deal-Holmdel Colloquium held at Deal on December 21. In his talk on *Some Thoughts on Switching Research*, Mr. Lewis discussed the work being done by the Switching Research Department at the present time. A considerable effort is being devoted to research in electronic methods of switching. Electronic switching permits much greater speed, with a resulting economy in plant. Mr. Lewis concluded his talk in a speculative vein concerning the status of the switching art in some 20 to 30 years from now.



Part of the job of creating a microwave relay route is the survey which tells whether there is a satisfactory line-of-sight transmission path between two proposed station sites. It is made by setting up portable towers developed in the Laboratories (Record, *January, 1948, page 6*) *and running a movable antenna and reflector up and down. These pictures were taken by G. M. Eaton of the Pacific Company.*



Townsend Named Consultant on Materials Conservation

J. R. Townsend, Director of Materials Applications Engineering of the Laboratories, has been named by Director of Defense Mobilization Charles E. Wilson as consultant to Mr. Wilson on problems of conservation of materials. In this assignment, which Mr. Townsend will carry out on a part-time basis for a period of time estimated by Mr. Wilson to be from six months to a year, Mr. Townsend will collect and organize information on materials conservation and will promote throughout industry the idea of conservation and the use of substitute materials.

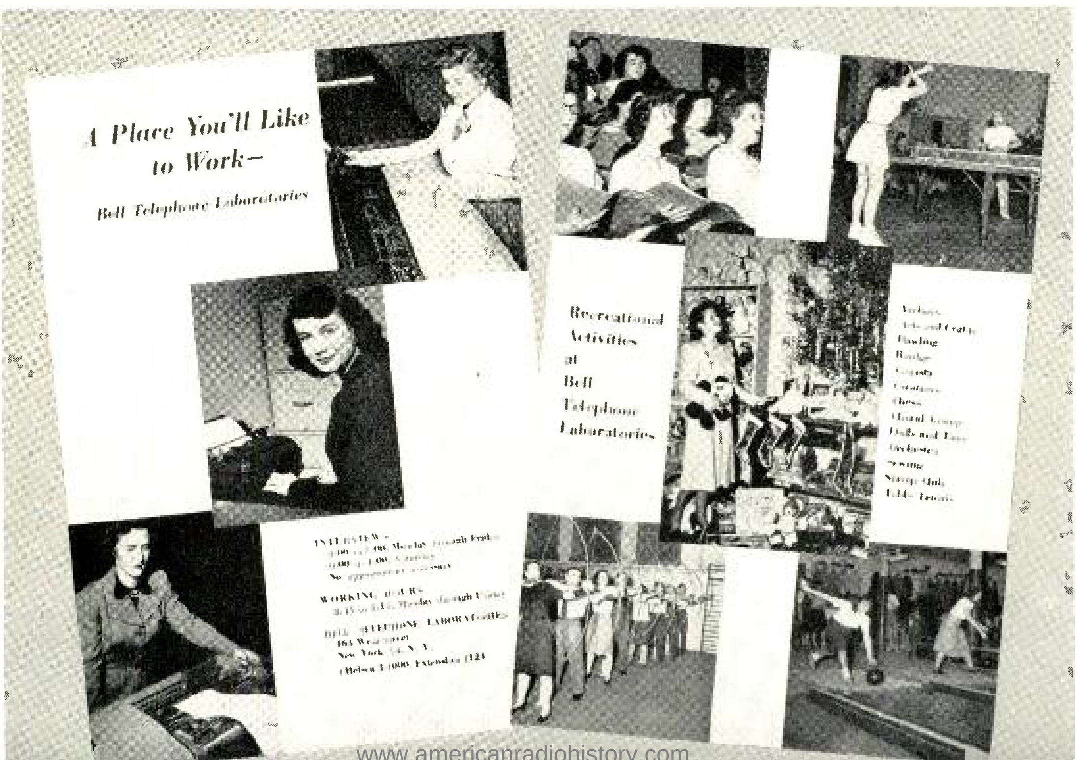
Assisting Mr. Townsend in the project will be the American Society for Testing Materials, a society of 7000 members, including professional men and individuals representing some 2500 companies. This society will serve as a center for committee organization and as a medium for liaison with industry. Through the society, Mr. Townsend will seek the help of the nation's best engineering talent in relieving the present shortage in certain materials in the interests of the national defense program.

A veteran of more than thirty years service in the Bell System, Mr. Townsend has devoted much of his effort to problems involving the application of materials to communications facilities. He is a past president of the A.S.T.M., chairman of the Standards Council of the American Standards Association, and chairman of the Panel on Materials, Ordnance Committee, Research and Development Board. He has received a number of awards and citations in recognition of his contributions both in military and civilian aspects of materials applications problems, among them the Dudley Medal of the A.S.T.M.

A native of Baltimore and a graduate of Baltimore City College, Mr. Townsend served in the Ordnance Department prior to joining the Western Electric Company's engineering department in 1919. With the incorporation of the Laboratories, Mr. Townsend was named Materials Standards Engineer. He became Materials Engineer in 1945 and assumed his present post this year.

Government service is no novelty to Mr. Townsend; during World War II he was associated with several agencies, including the National Defense Research Committee, the War Production Board, the Atomic Energy Commission, the U. S. Army Ordnance Department, the Office of Scientific Research and Development, and the Technical Intelligence Committee of the U. S. Army, for whom he spent two months in Europe.

To acquaint high school girls with opportunities at New York locations, Personnel people from West Street visit schools in New York and nearby New Jersey and talk with placement advisors. A pictorial leaflet for these occasions was prepared by the Publication Department using for its first and fourth pages (pictured) some illustrations from recent issues of the Record. *Inside pages tell the story of Joan Hoffman, junior draftsman, as it appeared on pages 534 and 535 of the November issue.*



End of Two Careers

When Dr. Charles E. Birch, a physician of White Plains, New York, retired recently his old, goose-necked telephone retired with him. Dr. Birch, 88, had served his community well for 60 years. For the last 54 of those years, a wall telephone set of the No. 1 Common Battery type provided dependable service for the doctor. Many times over the years the telephone company offered Dr. Birch a more modern instrument, but he preferred to keep the old, familiar telephone on the wall. The No. 1 type was superseded by the famous "85 type" which in turn was superseded about 1912 by a more compact form.

RETIRING: "GOOSENECK" AND DOCTOR

Dr. Charles E. Birch, White Plains, N. Y., physician, with telephone that served him well for 54 years.

Year's Progress Reviewed By A T & T

The nation's telephone network was strengthened in 1951 to meet growing defense and civilian needs, the American Telephone and Telegraph Company reports in its review of progress during the telephone's 75th anniversary year. Highlights of the Bell System construction program to expand and improve service included opening of a seventh coast-to-coast voice highway over which telephone calls and television signals are relayed by radio beam, the start on a trial basis in Englewood, N. J., of customer dialing of long distance calls, and the addition of 2,100,00 telephones during the year.

The new cross-country radio relay route was opened for telephone service on August 17. The first transcontinental television program was carried over the new system on September 4, when America saw the historic Japanese peace treaty conference.

The Englewood trial makes it possible for 10,000 telephone users in the New Jersey suburb to dial 11,000,000 telephones in areas as far away as San Francisco. Direct dialing of toll and long distance calls by operators also continued to increase, with 38 per cent of all long haul calls being handled in this manner in 1951.

Bell Telephones in use rose to 37,500,000, double the number in service ten years ago. However, demand for telephone service continued to grow and the construction program to be carried out next year will be another big one if materials can be obtained, the company said. The Bell Companies have on their books at the end of the year almost 800,000 orders for new service and 1,800,000 orders from party line customers for service that better meets their specific needs.

Long distance traffic was greater than in any previous year, averaging over 6,000,000 calls a day, as the upswing in out-of-town calling continued. Several hundred thousand miles of toll circuits were installed in 1951 to help handle these calls.

Cleo F. Craig, President of A T & T, said that national defense continues to be the first order of business with the Bell System. In addition to meeting the communications demands of the armed forces, the telephone companies pushed their program to assure essential service during emergencies. This program includes arrangements and facilities for shunting telephone traffic around disaster points, provision of standby power units at all central offices, utilization of mobile radio and portable telephone units at strategic locations during emergency, and preparation of detailed plans for restoral of essential lines of service.

Financial history was made in May when the number of owners of A T & T stock reached the million mark—the first time that any company had achieved such broad ownership.

Mr. Craig stressed the need for adequate rates for telephone service and a sufficient supply of raw materials in 1952.

News Notes

W. A. Shewhart has been elected to Fellowship in The New York Academy of Sciences "in recognition of his outstanding scientific achievements."

The familiar flat type resistor, several milion of which are manufactured annually is to be constructed in a new and less costly way. Ways and means of furthering this project were discussed by E. C. Hagemann and R. M. C. Greenidge during their visit to Haverhill. In Chicago A. H. Schafer visited the Western Electric Company's new plant at Fullerton Avenue to help initiate the production of precision wire resistors. The new plant is a part of Western Electric expansion to meet military needs. Resistors of the pyrolytic carbon type took E. M. Tolman to Hawthorne.

The Watchung Area Council Boy Scouts of America held a district court of honor at Summit High School on December 17, 1951. A certificate of merit and five Eagle Scout awards were presented. A presentation was made to S. O. Morgan for citizenship by the Plainfield Chapter of the Sons of the American Revolution in recognition of his work in scouting.

SERVICE ANNIVERSARIES

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

★★★★★★★★★

D. D. Haggerty....9th

★★★★★★★

C. J. Beck........7th
Agnes Kerr 13th
A. A. Mayer......7th
C. E. Ramsbotham.7th

★★★★★★

J. W. Behan.......6th
Elizabeth Culbert ..1st
Heloise Giles 25th
C. Hartley 14th
D. H. King........1st
W. V. K. Large...20th
J. R. Riker........1st
C. W. Stevens....2nd

★★★★★

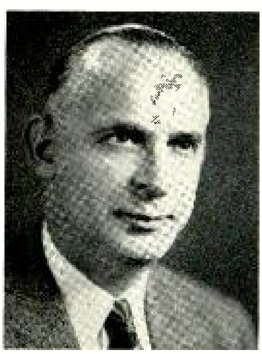
R. B. Blackman...10th
R. A. Broomfield...8th
K. E. Gould......14th
J. R. Haviland....17th
E. H. Johnson....27th
P. Larkin 14th
H. Lofsgaard 14th
A. J. Lovecky.....2nd
E. J. McCarthy...25th
G. J. Mihm......28th
Edith Nolan 16th
H. C. Rorden....15th
T. Ryan 8th
A. A. Skene.......1st
W. E. Smith......1st
A. L. Stillwell....7th
E. J. Thielen.....24th
R. J. Tillman.....2nd
L. E. Van Damme.15th
W. O. Waldecker..10th
Augusta Welsh ...7th
A. Wright 9th

★★★

R. S. Allan.......16th
P. R. Brookman...15th
W. P. Connery....15th
L. Ehrmann 1st
H. C. Fleming....23rd
W. L. French.....10th
G. L. Gamble.....5th
J. Giossmann 1st
W. H. Kossman...11th
Stella Madigan...20th
P. M. Ness......23rd
R. S. Williams.....2nd

★★

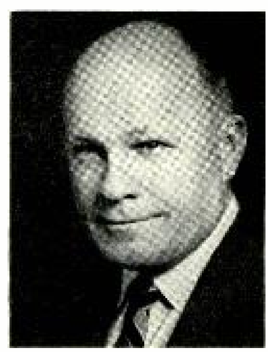
H. W. Anderson...2nd
J. T. Bangert.....28th
Mildred Beckner...4th
G. W. Carlson....10th
A. J. Chick.......6th
P. Connolly 10th
G. Dabog 6th
C. A. Davison....16th
A. F. Dietrich....19th
G. N. Flournoy....4th
Mary Galligan 9th
H. A. Gorenflo.....9th
Marion Greenberger 20th
C. H. Hamann...10th
E. A. Hults......24th
J. A. Joyce........4th
J. B. Kennedy.....2nd
Margaret Kerrigan.12th
T. Logan........13th
F. G. Merrill.....22nd
W. L. Mraz......19th
H. C. Muller.....11th
M. J. Murphy.....15th
A. H. Nicoll.......5th
J. R. Poli........24th
C. H. M. Quintana.11th
J. B. Seiders.......4th
W. P. Smith......11th
L. J. Speck.......9th
Marion Stoughton.13th
E. H. Strobel.....26th
W. C. Sylvernal...17th
R. W. Tomb......24th
R. G. Treuting....21st
J. J. Viggers......27th
W. Watt 9th
Evelyn Wood 16th
T. A. Young.......6th



A. A. Mayer

D. D. Haggerty

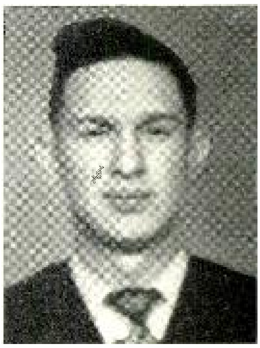
C. E. Ramsbotham



C. J. Beck

E. T. Markey

D. L. Schultz



D. H. Staudt

CALLED TO ACTIVE DUTY

As of December 31, 72 members of the Laboratories had been granted military leaves of absence subsequent to the outbreak of the war in Korea (June 25, 1950). Of this number, 5 leaves have been completed and the 67 members of the Laboratories on military leaves of absence as of that date were in the following branches of service: Air Force, 13; Army, 18; Signal Corps, 5; Navy, 25; Marine Corps, 4; and Waves, 2.

EUGENE T. MARKEY has enlisted in the Air Force and is now at Sampson, N. Y. Mr. Markey had been a member of the drafting group at Whippany for nine months. A graduate of Seton Hall High, he had attended Seton Hall College for one year before joining the Laboratories.

DONALD L. SCHULTZ was a Naval Reservist at the time he entered the Drafting Department on March 26, 1951. Mr. Schultz previously attended Hillside High School in Hillside, New Jersey.

DEAN H. STAUDT attended Clifton and Irvington High Schools in New Jersey and the Newark School of Fine and Industrial Arts. He joined the Laboratories on March 22, 1951, as a draftsman and was called to Service December 10, 1951.

W. Shockley gave the Stewart Lecture at the University of Missouri. His subject was *Mobility of Electrons in High Electric Fields.* He also spoke on transistor physics at a public lecture of the National Academy of Sciences that was held in Washington.

J. A. Hornbeck addressed the physics colloquium at the College of Liberal Arts of Northwestern University on *Atomic and Molecular Ions of the Noble Gases.*

The international relations group of Murray Hill, an activity sponsored by the Bell Laboratories Club, has had several interesting guest speakers recently to address members of the group in the Auditorium at the Murray Hill Laboratories. Victor Scales, who by profession is a public relations counsellor, described the relationship existing between The Netherlands and Belgium and the United States. At another meeting, Dr. Robert E. Marston, pastor of the Stanley Congregational Church in Chatham, gave his observations of the international situation based on personal discussions he had with average Europeans while on an extended tour last summer. Programs of this kind, as well as occasional panel discussions and the circulation of periodicals and books are intended to give the members of the International Relations Group and others at Murray Hill an opportunity to familiarize themselves with the problems affecting our relationships with other peoples.

Helen McLoughlin participated in the Industrial Editors Seminar, held jointly by the Graduate School of Journalism of Columbia University and the House Magazine Institute, January 14-16, at Columbia. Ronald S. Callvert, Western Electric Publication Supervisor, served as chairman of the Seminar. Other Bell System editors who attended were Martin Duffy of *GHQ;* Annette Herber of *Voiceways;* and William Poor of *The Telephone Review.*

U. B. Thomas and R. L. MacDonald visited the Plantation Central Office in Pittsburgh to make performance tests on the lead-calcium storage batteries which were among the first installations of this new type of battery, now being widely used throughout the System.

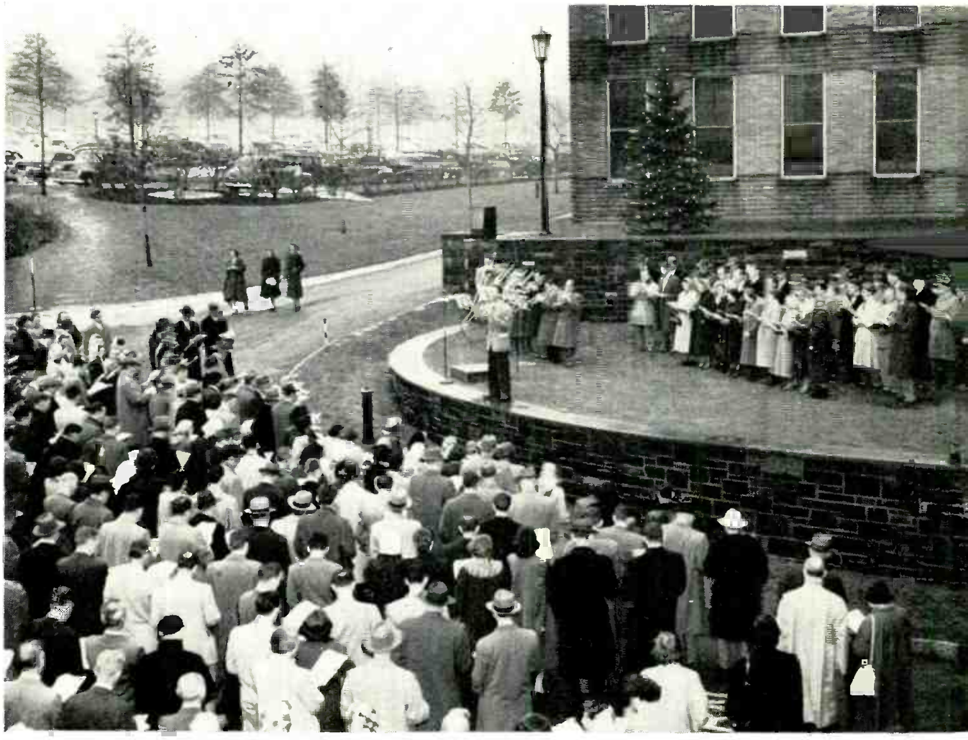
Each year at Christmastime thousands of children receive presents from the Doll and Toy Committees.

'Twas the Day Before Christmas— a day of carols, chorals, toys, dolls— and fellowship

Above—Arthur Jackson delivers a package to Ellen Cummins at the Restaurant Christmas party. Below—The two Santas at Whippany.

Forty-five members of the West Street Chorus under the direction of R. P. Yeaton, sang on the balcony of the New York Savings Bank during the noon hour on December 20. Grace Wagner was the accompanist for the chorus.

The group at Murray Hill singing the Christmas season carols. The chorus was composed of members from the various singing groups at Murray Hill and the six brasses were members of their Symphony or Popular Orchestras. The leader was G. B. Thomas, Jr. Ralph Bown gave the general greetings during an interval between two of the seven vocal numbers.



A village in miniature by A. V. Loog of the West Street Drafting Department gave pleasure to members of the Laboratories and their guests at Christmastime when it was displayed in the West Street lounge. From the school house came the voices of children caroling; from the church, chime and organ music; and from the ice cave came the Skaters' Waltz.

RETIREMENTS

Among the recent retirements from the Laboratories are E. F. Hill with fifty years of service; F. J. Aimutis and D. K. Martin, thirty-two years; William Wynn, thirty-one years; and D. J. Malone, eight years.

EDWARD F. HILL

Hale and hearty, Edward F. Hill retired from the Laboratories on January 10 in his fifty-first year of Bell System service. A biography of Mr. Hill which appeared in the December, 1951, RECORD recalled his joining Western Electric at West Street on December 6, 1901, as a messenger in the Mailing Department. He studied nights, became a draftsman, and except for two short periods in his career, continued in that field. He was a consultant on loading coil cases at the time he retired from the Laboratories.

Mr. Hill was honored by a dinner party at Stouffer's Restaurant attended by a hundred of his coworkers on January 11. He received a gift of money, albums of cartoons and of pictures taken during his golden jubilee and at the Pioneer open house on January 6, the usual Pioneer retirement pass in a wallet and Pioneer Life Member certificate.

E. F. HILL

F. J. AIMUTIS

D. K. MARTIN

D. J. MALONE

FRANK J. AIMUTIS

When Frank Aimutis came over from Lithuania in 1909, he worked for a few years in New England factories, then attended Ohio Northern University (B.S. in E.E. 1917). After three years with Westinghouse he joined A T & T in 1920 where he worked on noise problems in the inductive coordination group. With his department he transferred to the Laboratories in 1934. Four years later he went into cross-talk studies. He assisted in the practical application of transposition designs to open-wire lines carrying Type J systems. A need for additional Type C channels on alternate-arm transposed lines required a new transposition scheme which was worked out by Mr. Aimutis, resulting in the "C1" carrier telephone system.

More recently he has been working on a transposition design for the Type O carrier system. Out of his long experience he has compiled a transposition manual which will be used for reference and training.

Mr. and Mrs. Aimutis will shortly leave Madison for a trip across the country to the Coast; they'll stay there or return East, as their fancy goes.

DELOSS K. MARTIN

At sixteen years of age, D. K. Martin had a radio station, with an electrolytic detector and an automobile spark coil; at nineteen he was a shipboard radio operator along the Pacific Coast. Feeling the need for technical training, he attended an engineering school at Oakland, and later the University of California. After two summers as a fisheries radio operator in Alaska, he enlisted in the Navy during World War I and rose to the rank of ensign. At the end of that war, he was working with Western Electric subchaser radio telephone sets at the New London Naval Base.

Entering A T & T in 1919, Mr. Martin helped to formulate requirements and programs for the early ship-to-shore radio telephone experiments at Cliffwood and Deal, and was one of a small group of engineers that established the first commercial point-to-point radio link between Catalina Island and the mainland in 1920. He took an effective part in the Bell System's first radio broadcasting stations and in the beginning of network broadcasting. Transferring to the Laboratories' Radio Development Department in 1928, he soon became supervisor of a group working on systems engineering for the early airplane-to-ground radio telephone project.

In the late thirties, Mr. Martin was associated with the quartz crystal oscillator development group. War-stimulated demand forced crystal production into the millions and brought many problems in manufacturing methods which he helped to solve. In 1944 Mr. Martin became one of the Laboratories' "Consultants to the Secretary of War," and was sent to Europe. There he got into problems of radio relaying for the Air Force and traveled extensively in France, Belgium and Germany, selecting sites for radio repeaters.

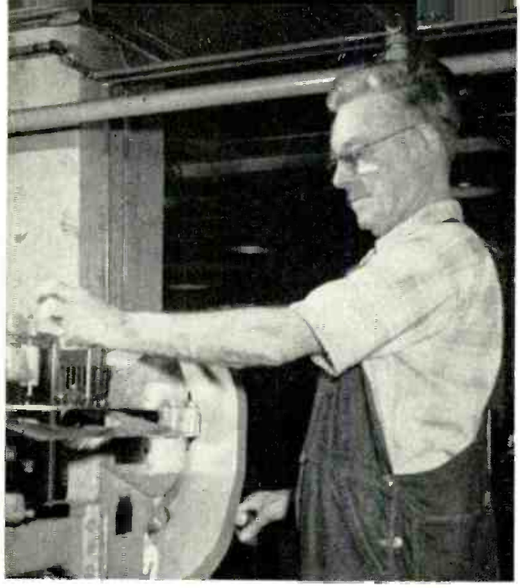
Immediately after the war the Laboratories detailed Mr. Martin to the study of development trends in air traffic control; following this he made studies of public telephone service to airplanes and trains. For over a year he was engaged in microwave transmission measurements across the salt flats of Utah preparing for the transcontinental radio relay system.* Recently he has worked on military projects.

On retirement, Mr. Martin has accepted a post as Director of Development with the Air Navigation Development Board in Washington.

William Wynn

William Wynn's career at the Laboratories has been devoted entirely to sheet metal work. Since he came here in 1920 he has assisted in the layout and building of cabinets, boxes, chassis, trays, pans, separators, and the many other items of sheet metal used in these laboratories. Mr. Wynn has also fabricated and installed ventilating and exhaust ducts, skylights, and protective guards for machinery used throughout West Street. He retired on January 31 after thirty-one years of service.

* Record, *September*, 1949, *page* 334.



William Wynn

The Wynns live in Bellmore, Long Island. They have two sons, a daughter who lives nearby, and four grandchildren. In retirement Mr. Wynn plans to catch up with interior decorating on his home, and to do occasional sheet metal work that interests him.

David J. Malone

David J. Malone, a worker on buildings and grounds at Whippany since 1943, shifted his employment to the Laboratories be-

When Howard Weinhart retired last month, the glassblowers in his group presented him several samples of their art. The craftsmen and their work, here pictured, are A. A. Machalett, a miniature vacuum pump; V. L. Lundahl, four birds on a bird-bath; W. H. Aug, birds on a tree; G. J. Wolff, a miniature vacuum-plating machine (not shown); E. D. Deery, "the frustrated glassblower"; and B. G. Bleecker, a dancing sprite. Third item on the table from the left is a "peanut tube" containing a genuine peanut. Seated, Mr. Weinhart.

Herbert Hoyle with the coastal steamer which won the first prize in the Laboratories' Arts and Crafts Exhibition in May, 1951.

cause he "liked the people who work in there." As a result, he says, "the last eight years have moved along pretty fast."

Living in nearby Cedar Knolls, both he and his wife find plenty to do. Mr. Malone was one of those who organized the Cedar Knolls Fire Department—in the days when the equipment consisted of a four-man hand pump and a large barrel. He had a gasoline station too, and one of his sons became an auto mechanic. Dave also likes to work on cars; however he has not made up his mind yet as to which one of several possible plans he will follow.

Ship Modeling As a Hobby

Herbert Hoyle, who makes prize winning ship models, feels that while the birth of any hobby generally starts early in life, there is no reason why a hobby may not be undertaken later on in life.

Mr. Hoyle says that in his hobby of ship modeling, there is so much to learn that many enthusiasts look at the intricate rigging of a brig or the metallized appearance of an ocean liner, throw up their hands and dismiss the matter from their minds. "I could never do that," they say. To those people Mr. Hoyle's advice is: "Analyze the problem and you will find that the job is not so difficult."

For the beginner, he suggests one of the excellent kits available for ship models. The hull is already carved and the fittings are furnished in the kits.

"Don't let the lack of workshop facilities prevent you from going ahead," he warns. "As astonishing as it may seem, only a few facilities are required."

An example of Mr. Hoyle's contention in this respect is the model of a coastal steamer which he recently displayed and which won

LABORATORIES

first prize at the Laboratories' Arts and Crafts Exhibition in May, 1951. "It is essentially a kitchen table-made model," he said. "The fittings are made from eyelets, parts of terminals and binding posts, scraps of wire, wood and

Dressmaking classes are sponsored by the Pioneer Women's Activities Committee at West Street. Margaret Naughton, left, is busy making a suit for her honeymoon. Estelle Potter, foreground, is also making a suit.

Vera Monahan (left) of Telegraph gets help with a dress she is making in the West Street sewing class from the instructor, Mary Simone. A new series of sewing classes is planned for Spring.

When these three members of the Murray Hill staff began to study up on kites and fly them at noontime, they soon crossed strings with Alexander Graham Bell. The inventor of the telephone in later years was quite a kite-flyer and wrote several monographs on the science. Murray Hill's "fliers" are David Slepian, E. N. Gilbert and Brockway McMillan.

HOBBYISTS

cardboard. It is surprising what will turn up in a 5- and 10-cent store that can be altered slightly and result in a fitting almost to scale. For instance, while the smoke stack on this model looks like a difficult job, it is actually made out of a talcum powder can with the bottom cut out, cardboard bands cemented around it and mounted bottom side up so as to make use of the rolled edge of the can as the top of the smoke stack. The tiny antenna insulators are made from looped brass wire over which varnished insulating tubing has been drawn in such a way as to leave a loop of wire at each end. Tiny washers are then pushed over the varnished tubing to complete the effectiveness of the insulators."

Summing the matter up, Mr. Hoyle said, "The art of ship modeling depends entirely upon desire, determination and patience. All through the process of planning and construction the modeler has been expanding his education and at the same time has been enjoying a pleasant pastime. It is recreation to him and an escape from the problems of life."

Audrey Jackson, draftsman at the Whippany Radio Laboratory, painted this Vermont farm scene. She is shown here with W. C. Somers of Whippany Area Management when the oil painting was ready to be hung in the lounge adjoining Whippany's restaurant. Mrs. Jackson studied under Kusanano in New York, James Carlin in Newark and Carl Ruggles in Vermont. She lives in Mendham with her four-year-old daughter, Laurie.

RECENT DEATHS

Elmer G. Conover

Elmer G. Conover, Assistant Purchasing Agent since 1948, died on December 29, 1951. Mr. Conover was born July 22, 1897, received his A.B. degree at Oberlin College and studied at the University of Cincinnati before joining the Laboratories in 1922. As a supervisor in charge of the Staff Department of Research, he was responsible for the administration, transcription, storeroom, and mathematical groups in Research from 1923 until 1937. In that year he transferred to the Commercial Relations Department as a specialist on commercial relation operations concerned with telephone systems and equipment. When the General Service Department began in 1939, Mr. Conover became Local Service Manager, responsible for all local services, as well as shipping and receiving. In 1941 he became Merchandising Manager of the Laboratories, a position he held until his appointment to the Purchasing Department in 1948.

E. G. Conover

T. M. Benseler

Michael O'Connell

F. G. C. Volkert

Mr. Conover was a veteran of World War I, in which he served as a flier. He was a resident of Mountain Lakes where he had been fire chief of the community. He had also served on the consistory of the Mountain Lakes Community Church for many years.

Mr. Conover was president of the Conover Association comprised of the descendants of the Kohen Hoven family who settled in New Jersey in the late 17th century. He is survived by his wife, a son Robert who is studying for his doctorate at Yale University, a son Thomas at Oberlin College, and a daughter Margrit who is a high school senior.

Theodore M. Benseler

Theodore M. Benseler of the Patent Service Staff died January 2, 1952, following an illness of two months. After serving in the Infantry in World War I, he joined the Methods Department as a clerk investigator in 1920, and shortly after transferred to the Patent Department. Since 1925 he had been responsible for the accounting work and general methods of that department. He was also responsible for the Patent Index of technical subject matter. At the time of his death he was engaged in collating patent material to be used in forthcoming litigation.

Mr. Benseler was treasurer of the Calvary Evangelical United Brethren Church in Queens Village. He is survived by his wife, a daughter Mrs. Ruth Peters, and a son Theodore, a student at the Kirksville College of Osteopathy and Surgery, Kirksville, Missouri.

Michael O'Connell

Michael O'Connell of Switching Apparatus Development, who was born April 6, 1895, joined the Engineering Department of Western Electric in 1917 as a draftsman. Before joining the Laboratories he had several years' experience in technical shop work. He attended engineering courses at Cooper Union in the evening.

After a few years at drafting Mr. O'Connell was transferred to the apparatus engineering group and was concerned with the design of naval communication systems, army field switchboards, and portable telephone sets for the Signal Corps.

After World War I, Mr. O'Connell was assigned to design problems on miscellaneous central office apparatus such as plugs, jacks, jack mountings, terminal strips, and lamp sockets and their mountings. During World War II his work was directed toward the application of that type of apparatus to war needs and to the determination of substitute materials for telephone parts in place of those in short supply. More recently he had been engaged in work on components for a new switchboard for the Signal Corps. Mr. O'Connell represented the Laboratories on the RTMA Committee on receiving and transmitting vacuum tube sockets.

He died on January 1, following a brief illness. He is survived by his wife and six children, Robert and John who attend Fordham University, Norene of Georgetown Medical School, William in high school, and Gerald and Geraldine, twins, in grammar school.

FREDERICK G. C. VOLKERT

Frederick G. C. Volkert retired from the Laboratories in 1943 after thirty-nine years of service. He was born on March 27, 1882, and joined Western Electric Installation in 1904. Within a short time he transferred to the Engineering Department where he engaged in power engineering and order editing. After being in charge of the latter division for several years, he transferred to the Foreign Sales Department, where his responsibility was the editing of foreign orders. From 1911 to 1919 he was in Montreal as a supervisor of the power division of Equipment Engineering in the Northern Electric Company.

Upon his return to New York, Mr. Volkert joined Systems Development and was associated with that department until his retirement. During those years he had charge for a time of the preparation of recommendations and specifications for power plants to be used with step-by-step equipment. In 1925 he became responsible for the special equipment engineering group which handles analyzation questions relating to power plant equipment. During World War II, Mr. Volkert was engaged in special projects for the Signal Corps.

He is survived by his brother Charles and two sisters, Mrs. Theresa M. Hayes and Mrs. Elizabeth Hoelzer.

"The Telephone Hour"

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

February 4	Ezio Pinza, *basso*
February 11	Barbara Gibson, *coloratura soprano*
February 18	Robert Casadesus, *pianist*
February 25	Lucile Cummings, *contralto*
March 3	Jascha Heifetz, *violinist*
March 10	Marian Anderson, *contralto*
March 17	Eileen Farrell, *soprano*
March 24	Bidu Sayao, *soprano*
March 31	Clifford Curzon, *pianist*

News Notes

F. G. FOSTER has been elected vice-president of the New York Microscopical Society.

AT TORONTO A. J. CHRISTOPHER assisted in the preparation of R.T.M.A. Standards on Ceramic Dielectric Capacitors which are to serve as procurement specifications in the entire Radio and Television industry. Mr. Christopher is also a member of a Research and Development Board Sub-panel on capacitors, and recently attended a meeting of the panel at the Massachusetts Institute of Technology.

OF FUNDAMENTAL INTEREST in magnetic materials is the existence of domains in each of which the electron spins and hence the direction of magnetization have a preponderant direction. In an applied field domain boundaries shift so that more spins favor the direction of the field. J. K. GALT discussed the phenomenon in a talk, *The Motion of Ferromagnetic Domain Wall in Magnetic Iron Oxide* before an M.I.T. colloquium. Among the techniques through which magnetic action may be detected are those of X-ray and neutron diffraction. With R. M. BOZORTH, H. J. WILLIAMS and P. W. ANDERSON, Mr. Galt attended a conference on these techniques at Brookhaven National Laboratory.

H. E. IVES (retired) addressed the Royal Dublin Society on October 30, commemorating the 100th anniversary of the birth of George Francis Fitzgerald. Dr. Ives also broadcast over the Irish Broadcasting System on the life and work of Dr. Fitzgerald, who touched off the Poincaré principle of relativity and its implementing Lorentz-Poincaré transformations.

AMONG SEVERAL current lines of inquiry into the properties of matter in the solid state is the search for a better understanding of how electrons are liberated from metal surfaces. At an American Physical Society meeting at Berkeley, California, H. D. HAGSTRUM discussed some recent findings in his paper, *Ejection of Electrons by Ion Impact*. The generation of current pulses by germanium when bombarded by charged particles was the topic of K. G. MCKAY's paper, *Crystal Counters*, at Rensselaer Polytechnic Institute at Troy.

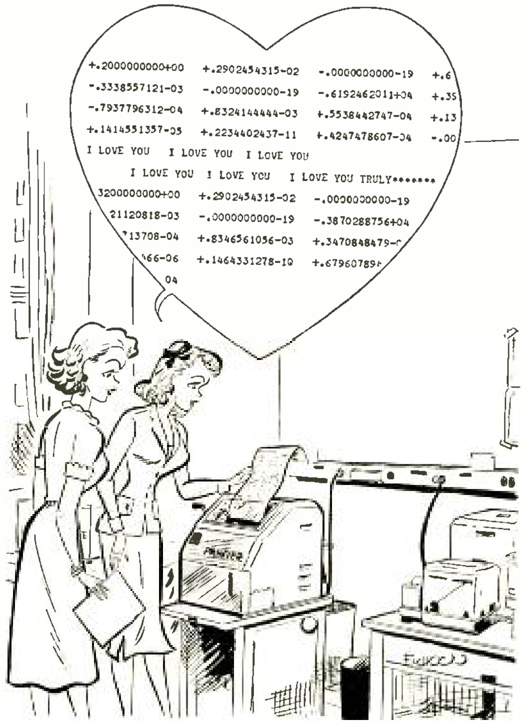
R. W. SEARS, R. R. ANDERSON, F. T. ANDREWS, B. L. LEWIS and A. E. JOEL, JR., attended a symposium in Washington held by the National Bureau of Standards on the subject of the Williams storage tube. Following its introduction in England, this device has attained considerable success in this country as the memory component in some digital computors. The two-day symposium was held to acquaint scientists with the latest information in this field.

"Talking" Pegs and Talking People

There are 10,000 pegs in this machine which Catherine Durnan is working, representing 10,000 subscribers in a No. 5 crossbar telephone exchange. The No. 5 is the latest switching system which handles calls with split-second swiftness. The pegs, representing many types of uses, are starting on a journey through a unique machine, popularly known colloquially as the "throwdown" which analyzes the performance of dial equipment in a typical central office. Miss Durnan is one of a team of four technical assistants in the Switching Engineering Department who divide their time between operating the throwdown machine and making statistical analyses of its results and of related traffic problems.

Miss Durnan started as a messenger, spent a year preparing spare parts lists for military and communications equipment, before entering the group which applies probability and statistics to the solution of traffic and other telephone problems. A resident of Syosset, Long Island, she is active in alumni and church work. At the Laboratories, she is Chairman of the Women's Bowling League, and Assistant Treasurer of the Doll and Toy Committee. Like many other girls at the Laboratories, she actively participates in outdoor sports, makes her own clothes, and enjoys the social life in her home community.

Catherine Durnan starts a subscriber's call on its journey through the "throwdown" machine. It will obtain dial tone some minutes later as recorded on the call slip in her left hand.



On St. Valentine's Eve, the digital computer interrupts its lonely vigil to print an "answer" in keeping with the occasion.

News Notes

The new L3 carrier system demands components having uniform and precise control of electrical characteristics and, accordingly, requires a unique line amplifier transformer design. W. L. Brune and C. W. Thulin visited the Haverhill plant of the Western Electric Company the week of December 10 to witness the production of the initial models of this transformer for use in the New York to Philadelphia trial.

K. B. McAfee visited Professor P. W. Bridgman at Hardvard University. Professor Bridgman's high pressure apparatus was used to study the effect of pressure on the conductivity of germanium.

The acceleration of chemical and physical changes in materials under electrical stresses at high temperatures can severely limit the capabilities of paper capacitors operating in military equipment at temperatures which may exceed the boiling point of water. Fortunately, as Laboratories research in capacitors has revealed, a quinone compound added to the oil greatly retards the deterioration of oil impregnated paper dielectrics. At a meeting of the Conference on Insulation, National Research Council, in Washington, D. A. McLean and H. A. Sauer explained, in their paper, *Stabilized Mineral Oil Capacitors,* how the quinone treatment increases the direct voltage life of hot capacitors more than thirty times.

First tryout under heavy load came to the new No. 23 operating room desk in Harrisburg during the Christmas holidays. A combination of heavy travel and bad weather filled the hotels and brought many calls to reassure worried relatives. Every operating position was occupied, and H. W. Straub, who was observing for the Laboratories, reported that calls for rate, route and called number information were answered promptly.

Conversion of a large toll office to nation-wide dialing involves the installation of many bays of equipment and the modification of other bays which are meanwhile out of service. To do this without hindering telephone traffic means careful scheduling by Operating Company people. To make their own experience available, J. W. Behan, S. J. Brymer and D. H. Wetherell visited Washington to discuss the impending conversion of the A4A office there.

What will be the Bell System's largest single "circuit," the new AMA assembler-computer, will shortly go into production at Hawthorne. It will contain 4000 relays of various kinds and will read and process accounting tapes at the rate of 25 lines a second. A. A. Burgess and George Riggs recently conferred with Western Electric engineers at Hawthorne on cabling and testing arrangements.

The problem of insulating metal apparatus containers can be neatly solved by employing a new synthetic finish which is a very good insulator. At the Sprague Electric Company, North Adams, C. R. Steiner and W. J. Kiernan demonstrated the application of this non-conducting finish to electrolytic capacitors and established requirements for control of quality.

Loading coils for the power supply in L3 carrier, in addition to being adjustable and exceptionally compact, must withstand 4,000-volt power supply voltages. The incident problem of suppressing corona discharges in these coils was discussed by J. R. Bardsley at Haverhill. For another new carrier system—the M1 for short haul open wire—there is the problem of developing sources of supply for power inductors. In Cleveland and Chicago S. G. Hale explored the problem in company with W. L. Stolberg and J. H. S. Acheson of Western Electric Purchasing and A. Lampariello of Haverhill.

Engagements

Phoebe Barrett*—Robert C. Pickett
Beulah Bartholomew*—Dwight Kohs*
Eleanor Brown*—William Staubitser, Jr.
Janet Bullock*—Emil A. Novak
Ruth Clendenning—George R. Smith*
Madeline Dowling*—Stanley Sumski*
Millie Greco*—Robert L. Fresella
Judy Guerino*—Lewis Peccarelli
Carol Hulser*—Pvt. William J. Curley
Helen Monahan*—J. Raymond McEntee
Virginia Mulford—Arthur J. Hickson*
Rachel Longo—Edgar Hansen*
Constance Prohaska*—Alan Parr
Louise Snipes*—Harold C. Byron

Wedding

Antoinette Fandetta*—Robert Damore

Births

Karen Lynn, on December 4, to Mr. and Mrs. C. H. Dalm. Mr. Dalm is a member of the Drafting Department.

Melinda, on December 20 to Mr. and Mrs. Willard Gabel. Mr. Gabel is a member of the Military Electronics Department.

Michael, on November 12, a son after seven daughters, to Mr. and Mrs. A. B. Van Liew. Mr. Van Liew is a member of the Switching Systems Development Department.

Deborah Ann, on December 21, to Mr. and Mrs. Harry G. Hill. Mr. Hill is a member of the Military Electronics Department.

Linda, on December 22, to Mr. and Mrs. A. F. Hughes. Mr. Hughes is a member of the Military Electronics Department.

Marianne Louise, on November 11, to Mr. and Mrs. Paul Mallery. Mr. Mallery is a member of the Switching Systems Development Department.

Kathryn June, on October 28, to Mr. and Mrs. Fred J. Schaefer, Jr. Mr. Schaefer is a member of the Military Electronics Department at Whippany.

James M., on December 30, to Mr. and Mrs. James Heffernan. Mr. Heffernan is a member of the Telegraph Development Department.

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

News Notes

Development work to provide automatic message accounting equipment in tandem offices is well under way. M. E. Maloney and A. A. Burgess visited Washington to confer with A T & T and Chesapeake & Potomac Company engineers with regard to installation of equipment in their uptown toll office.

H. H. Abbott and A. Burkett attended conferences in Des Moines, Iowa, concerning an experimental trial of full-selective ringing on rural telephone lines at Patterson, Iowa. An objective of this development is to make it possible to ring subscribers individually rather than to use code ringing in which subscribers on a rural line identify their calls by the number of rings of their bells.

M. D. Rigterink and G. T. Kohman of the Chemical Research Department and T. R. Finch of the Apparatus Development Department visited the Corning Glass Works. The purpose of the visit was to discuss the application of new developments in glass technology to the construction of new electrical components for the L3 system.

Several members of the Laboratories were represented in the 5th Annual International Photography-in-Science Salon sponsored by the *Scientific Monthly* in cooperation with the Smithsonian Institution. The picture showing the focusing of sound waves, used in the February, 1951, Record advertisement, was accepted and exhibited at the annual meeting of the A.A.A.S. in Philadelphia. This entry was the joint effort of W. E. Kock and F. K. Harvey with S. O. Jorgensen, the photographer.

The third annual prize paper contest was a feature of the eighth annual National Technical Conference of the Society of Plastics Engineers for which the theme *Plastics Horizons* was chosen. The conference was held in Chicago, January 16 to 18, under sponsorship of the Chicago Section of the S. P. E. The technical papers examined the role of plastics in our present economy and in the National Defense Program. Carl J. Frosch served as chief judge. The contest, designed to encourage the younger members in the preparation of technical papers, offered prizes totaling $350.

A scientific approach to the provision of switching equipment and trunk plant requires a knowledge of the quantitative relationship between traffic load, amount of equipment and paths provided, and the resulting grade of service. The various formulas in common use for predicting grade of service, given the other variables, were described by R. I. Wilkinson in his talk, *The Use of Probability in Bell System Facilities Engineering*, given on December 17 in New York. Discussion included the variable elements which comprise traffic loads, the actions of subscribers under poor service conditions, and the problem of defining an adequate grade of service. Mr. Wilkinson's talk was the third of a series of informative lectures being given to acquaint employees with certain areas of the Laboratories' work.

M. Sparks addressed the physics colloquium at the University of Syracuse. His subject was *Fundamentals of Transistors*.

J. D. Tebo was chairman of a group of four engineers representing several of the Engineering Societies at a student guidance meeting for the senior boys at the Verona, New Jersey, High School, December 11. Because of the shortage of engineers in the United States and the fact that enrollment in the nation's engineering schools is decreasing at an alarming rate, efforts are being made to counteract this decline and to stimulate greater interest among high schools in the study of engineering.

Another successful regional event of the New Jersey Council of the Pioneers took place on December 12 when 557 Pioneers and their guests attended *The Desert Song* at the Paper Mill Playhouse, Millburn. Door prizes, drawn by Council Chairman A. R. Brooks, were won by C. O. Brosch, West Street; Mrs. Rowland Young, wife of R. L. Young, life member; Mrs. H. Baarens; Mrs. Fred Search, wife of a New Jersey Bell Pioneer; Sally Emling, daughter of J. M. Emling, West Street; Mrs. R. K. McAlpine; and Dorothea Bell, daughter of D. T. Bell.

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