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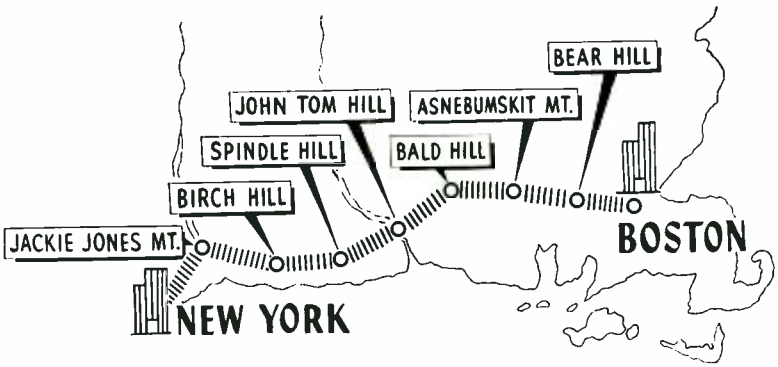


W. L. TIERNEY
Radio
Projects
Engineering

REPEATER BUILDINGS FOR THE FIRST RADIO RELAY SYSTEM

In desigining buildings for the repeater stations of the radio relay system* between New York and Boston, it seemed desirable to make a single structure serve both to house the equipment and to support the antennas. Not only would this tend to greater overall economy, but it would simplify and shorten the waveguide connections between the equipment and the antennas. A study of the space required for the apparatus indicated that a building approximately a 28-foot cube with two floors would adequately house the equipment, which is essentially the same at all sites. The proper heights for the antennas, however, are not the same at all sites since they depend on the elevation of the site itself, on the elevations of the adjacent sites, and on the nature of the intervening terrain. At four of the seven sites, however, the roofs of the proposed building would be high enough to permit the antennas to be mounted directly on them. For two of the remaining sites, an additional height of 14 feet was required for the antennas, while at one site an additional 24 feet was needed. It was decided to obtain these greater heights by continuing the building columns through the roof to support a platform at the height required. This resulted in the types of buildings shown in the accompanying illustrations.

Reinforced concrete is used for the floors and roof and for the supporting columns and beams, but the side walls are of cinder blocks painted white. These walls are double: an 8-inch outer wall and a 4-inch inner wall with two inches between them. Not only does the air space provide high

*RECORD, *December*, 1947, *page* 437.

insulating value, but it permits all moisture seeping through the outer wall to be drained off before reaching the interior of the building.

A central and four corner columns support the transverse concrete beams carrying the second floor and roof. For those stations requiring a raised platform for the antennas, the columns are continued through the roof to support the super-structures. The central column also carries a flue for the heating system and is extended well above the antennas to carry the furnace gases away from them. Diagonal and intermediate transverse concrete beams carry the load on the super-structure. Its floor consists of subway grating – flat steel strips on edge – to permit snow and rain to fall through, and thus keep the bases of the antennas clear.

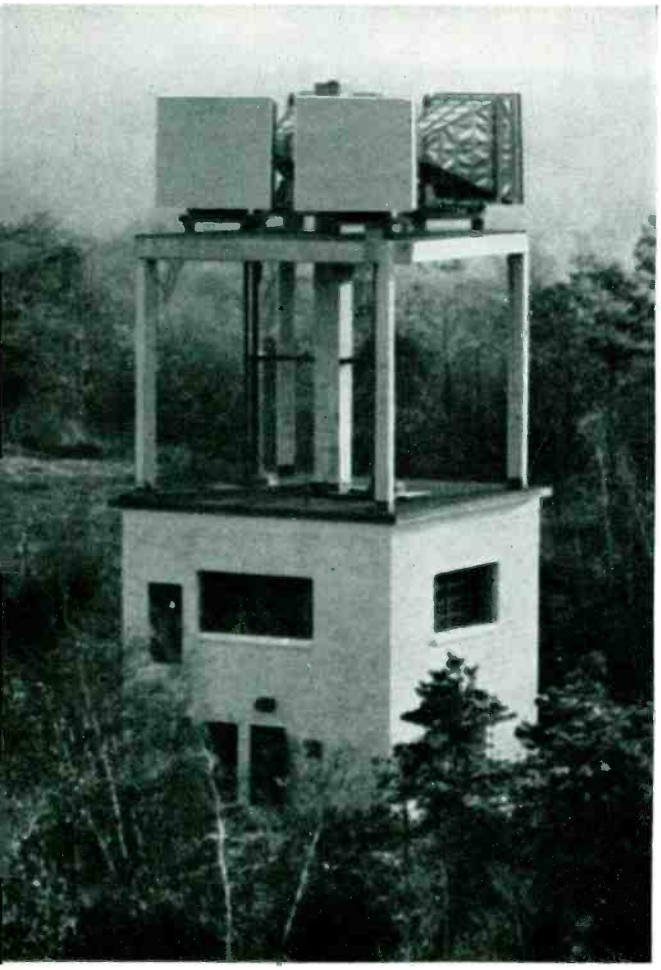


Fig. 1—The station on John Tom Hill is the only one with an antenna platform 24 feet above the roof

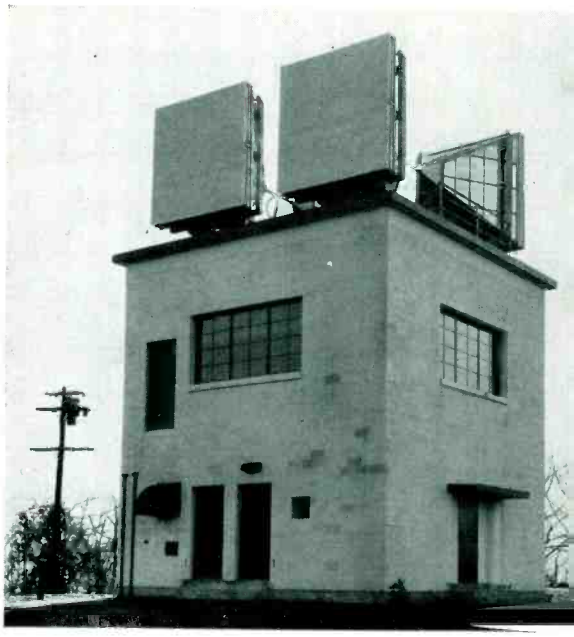


Fig. 2—Front, at the right, and left side of Bald Hill station. The two doors on the left side lead to the engine and furnace rooms

Each antenna must be precisely oriented in azimuth along the line to the associated antenna at the next station. The orientation of the building itself, however, was a compromise between the axis of transmission and the approaching road. These roads vary in length from 600 to 4,000 feet, and are brought from the nearest highway over grades up to 17 per cent. The direction from which they reach the top is thus determined largely by the local topographical conditions. It was necessary, therefore, to provide means for orienting the antennas independently of the position of the building. For the buildings with a raised platform, this was done by mounting 8-foot circular concrete plates over the diagonal crossbeams of the super-structure as evident in the accompanying illustrations. The antenna is carried on a skeleton base of angle iron to which it is fastened after the base is in place. The concrete plates are identically placed on all the platforms, while the position of the an-

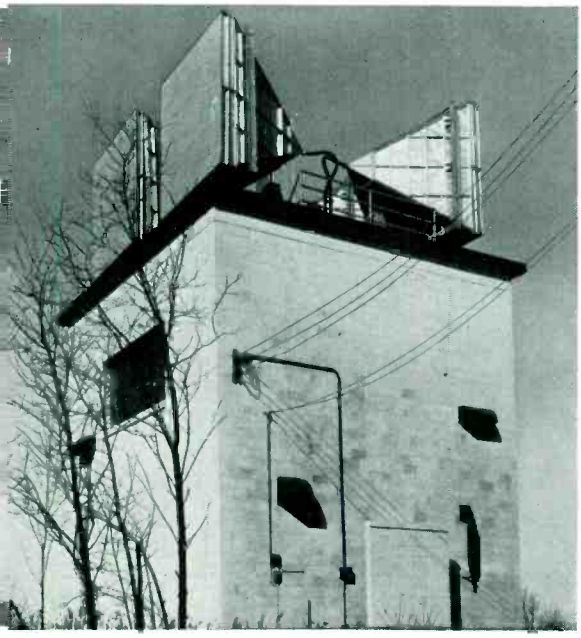


Fig. 3—*Right side, at left, and rear of Bald Hill station. Low wall opposite rear of building is to prevent back-drafts to the engine exhaust*

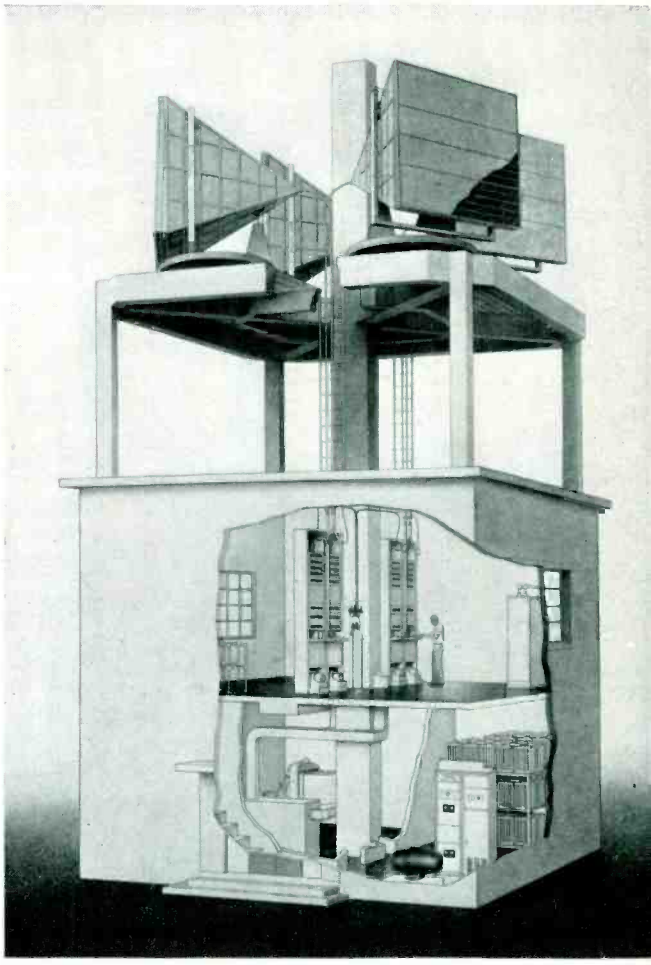
tenna base on the plate is determined separately for each antenna. In this way, the supporting members of the super-structure are all alike, regardless of how the antennas are oriented. For the buildings not carrying a super-structure, concrete piers from two to six feet in height are set on the roof slab at the proper positions, and the antenna bases are set on them. Plus or minus 2-½ degrees adjustment in azimuth — as well as plus or minus 5 degrees in elevation — is provided by the angle-iron bases themselves to take care of the final adjustment.

One of the important considerations in the design of a repeater station is the provision of an adequate and dependable power supply. A power line is brought in for each site, but at these exposed hilltop positions, high winds are almost the usual fare. Damage to the lines from wind and sleet must be expected, and thus stand-by emergency power, ready to take over the load instantly, had to be arranged for. This is provided by the system shown in simplified form in the accompanying diagram.

All power is supplied at 230-115 volts over a three-wire a-c circuit, which is normally fed from transformers on the commercial power lines. Two other sources of power, however, are available at each repeater station. One is a battery that drives a dynamotor type of converter set with a 230-115 volt a-c output. The other is a gas-engine driven a-c generator of similar voltage. The battery is kept on a trickle charge at all times through a rectifier, and is thus normally fully charged.

If the commercial supply fails, automatic switches at once start the battery-driven converter, and the main power leads are automatically switched by a contactor from the commercial supply to the battery-driven generator. The battery has sufficient capa-

Fig. 4—Cut-away view of repeater station showing interior layouts and structural features



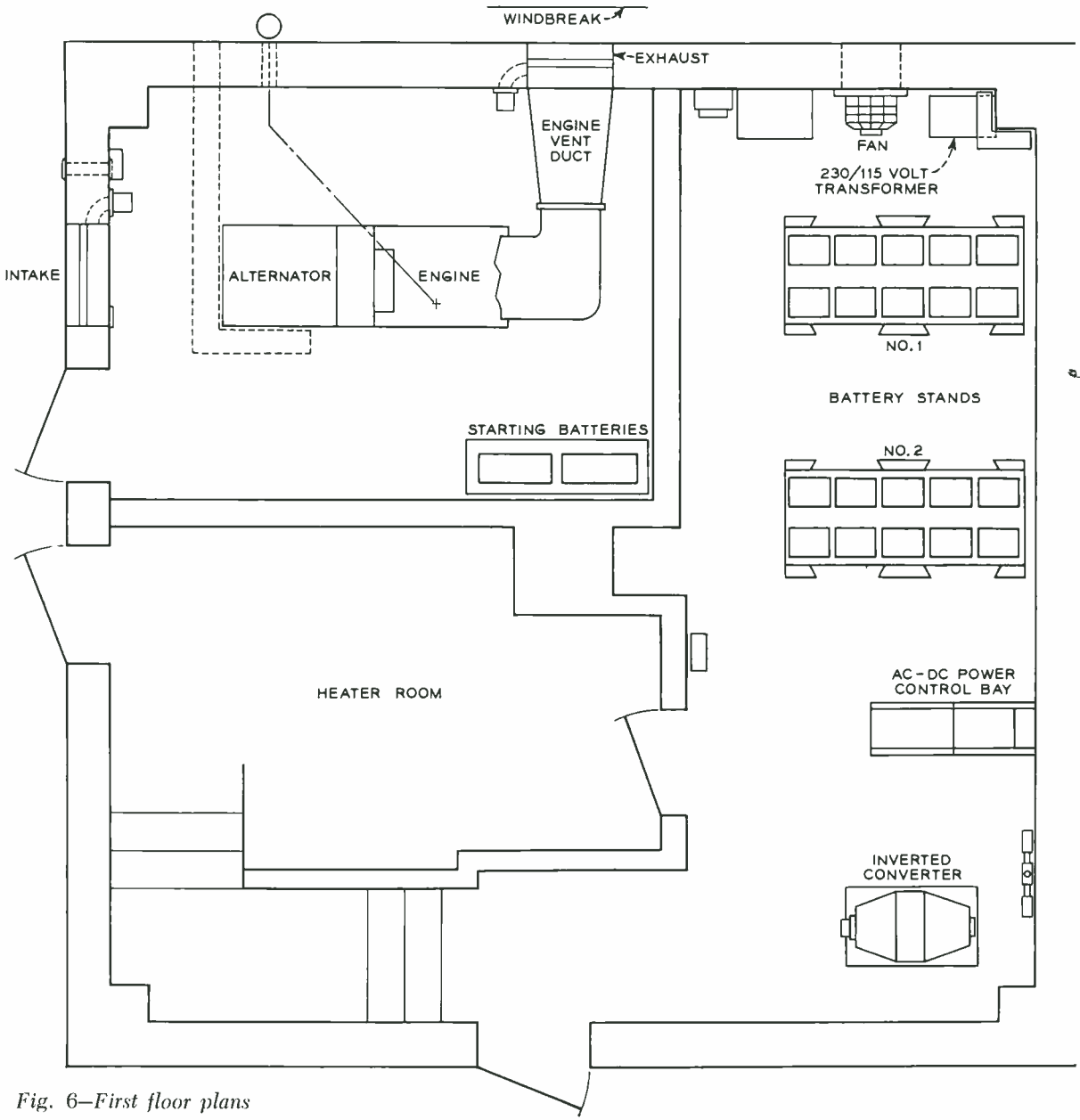


Fig. 6—First floor plans

city to carry the load for four hours, but to play doubly safe, the control circuit is arranged so that if the power outage endures more than two minutes, the gasoline engine is automatically started. After it has run long enough to be warmed up and in continuous operating condition, the load is automatically transferred from the battery-driven generator to that driven by the gas engine. When the commercial power comes back on, it will automatically take over the load, and all circuits and apparatus that are involved will be restored to normal conditions.

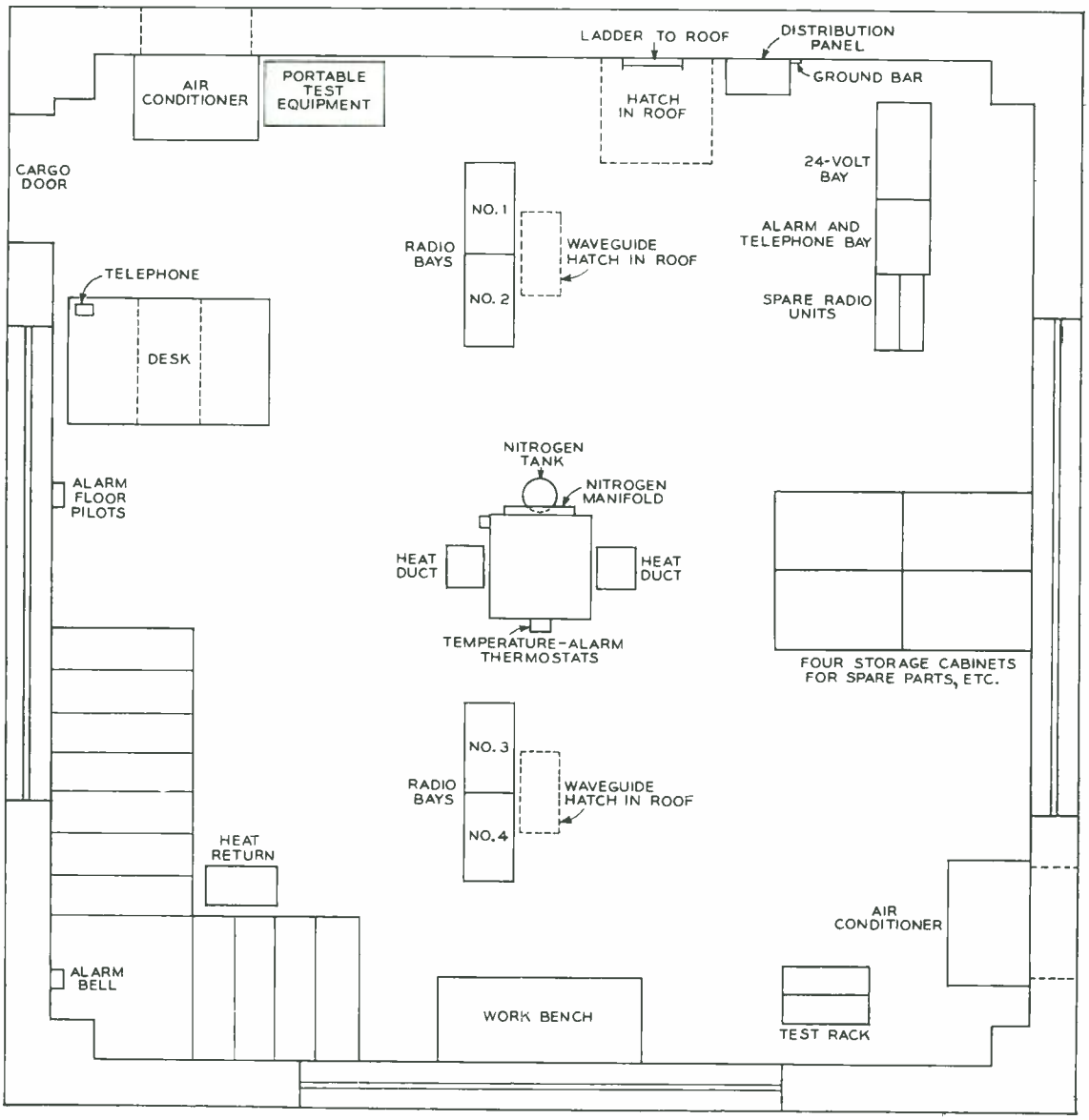


Fig. 6—Second floor plans

In the meantime, alarm signals have been sent to a maintenance center, where alarms show when the power fails, when the battery takes over, and finally when the load is transferred to the gas engine set. It is thus at once known that a power outage has occurred and that the load is being carried by the battery or the gas engine, as the case may be. From then on, the force of the maintenance center will take over supervision, seeing that steps are taken to restore commercial service, and visiting the station to make sure the gas engine is properly cared for. If it is evident

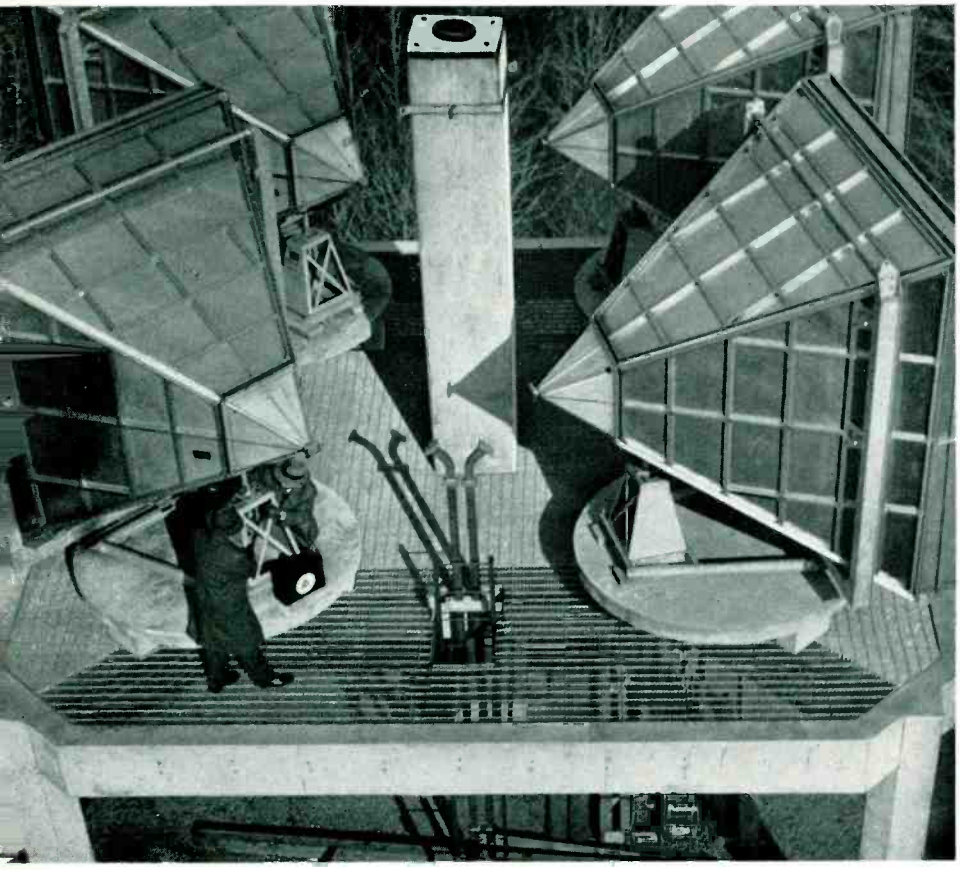


Fig. 7 — Antenna platform of Jackie Jones station showing antenna plates and the floor of subway grating

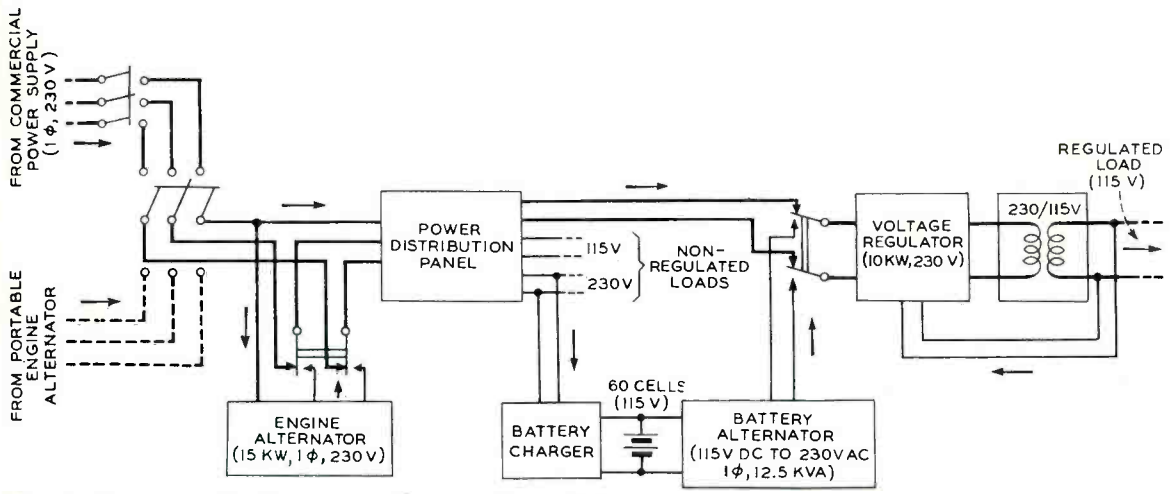


Fig. 8—Power supply diagram for the repeater stations

by the signals received that the gas engine has not taken over after five minutes, a man will at once go to the repeater station to attempt to locate the trouble and get the engine started. If because of some serious trouble the engine cannot be started, a portable gas engine set may be trucked to the repeater station to carry the load for as long as necessary. Switching arrangements for such portable supply are provided at each station.

This power supply equipment, together with the heating system and a washroom, occupies the entire first floor as shown in the accompanying floor plan. Except for two air-conditioning units, the second floor is devoted exclusively to the communication equipment and its maintenance. The main repeater bays are along the center at each side of the central column, while along the walls are cabinets for spare parts, work benches, a desk and two cabinets: one for 24-volt power and the other for order wires and alarms. Waveguide connections from the repeaters pass through hatches in the roof to the antennas above. The two air-conditioning units on the second floor have a refrigerating capacity of 1-½ tons each. Studies conducted by the Long Lines Department of air conditioning and simple blower ventilation systems had shown the costs of the two systems to be about the same if they were used only when the temperature without them would have exceeded 90 degrees F. It was decided, therefore, to install air conditioning to secure experience with this type of equipment at unattended offices.

Large windows are set in the middle of three of the walls on the second floor, and there is also a loading door on the left wall through which equipment is hoisted. Windows are omitted completely on the first floor except in the washroom. There is a main entrance with stairs leading to the second floor just at the left, and two other doors on the left wall -- one for the furnace room and one for the gas engine room, as may be seen in the accompanying

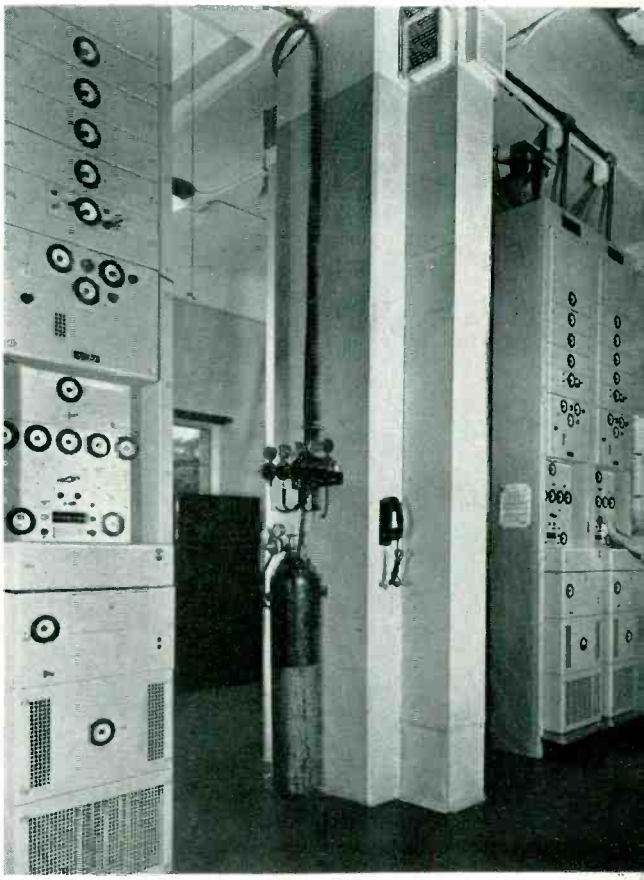


Fig. 9—Second floor of a repeater station showing the repeater bays at each side of the central column

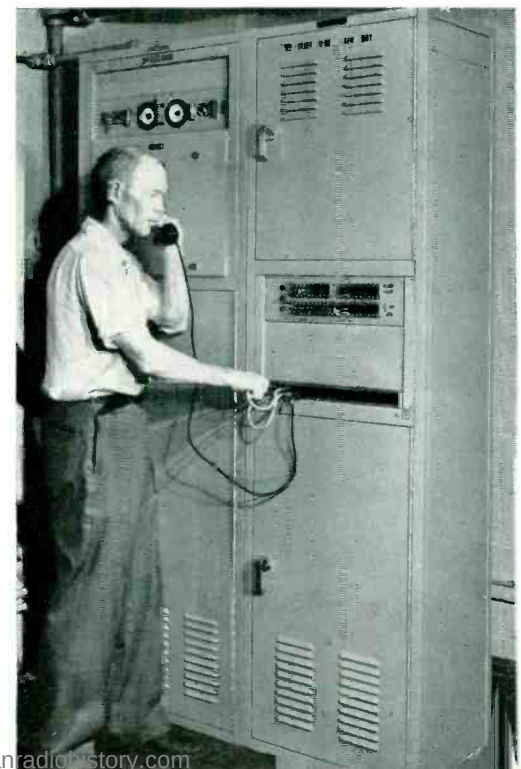


Fig. 10—24-volt power control cabinet and order-wire and alarm cabinet on the second floor of the repeater station

illustrations. The hooded openings evident in the photographs are for cooling air for the gas engine, a ventilator in the battery room, and for the air-conditioning system. Heating is by forced air circulation, using a completely automatic oil burner with alarms carried to the maintenance center. Large buried tanks carry oil for the furnace and gasoline for the emergency gas engine. Wells are driven at each site for the necessary water supply.

These buildings have already been in use for about a year and have proved very satisfactory. Even the cold and snowy winter just past found them well able to meet it.

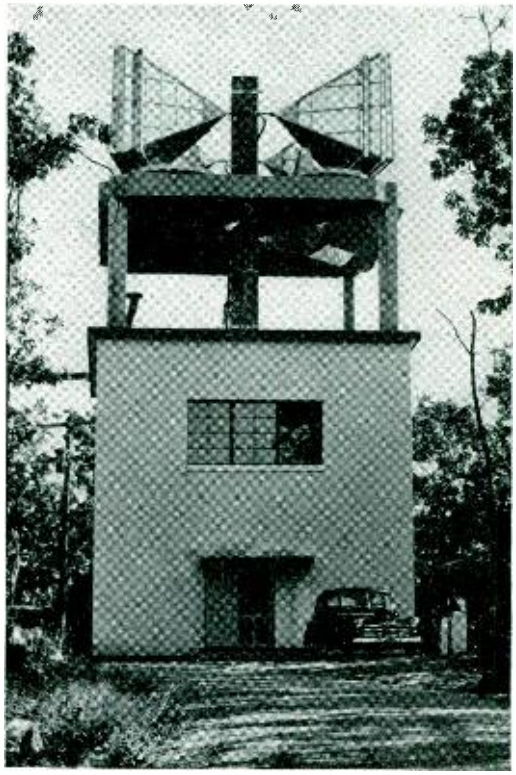


Fig. 11—Front view of Birch Hill radio relay station. This and the Jackie Jones station have antenna platforms 14 feet above the roof

THE AUTHOR: W. L. Tierney joined the Laboratories in 1925 and until 1940 was associated with the Specialty Products Department on field engineering of radio broadcasting and police radio systems. For nearly five years he was then at the Radiation Laboratory of Massachusetts Institute of Technology working on the Loran project. Upon return from war work he joined the Research Department where he has been concerned with field engineering problems on the New York-Boston microwave radio relay project.

H. C. FRANKE
Transmission
Engineering

RADIO CIRCUITS FOR THE DEATH VALLEY AREA

Telephone and teletypewriter service to the scattered settlements and resorts of Death Valley, California, was provided for years over a single pair of wires strung on a pole line of the old Tonopah and Tidewater Railroad from Baker through Silver Lake, Tecopa and Shoshone to Death Valley Junction. When the railroad suspended operations and pulled up its tracks, the Telephone Company continued to maintain the pole line.

The cost of maintaining the old pole line in difficult terrain became burdensome, and as the demand for telephone service increased the decision was made to abandon a part of the old open-wire line and to provide all facilities to the Death Valley area by means of radio. Radio transmitting and receiving equipment similar to that used in the land stations of an urban mobile telephone system was installed in the existing Specter Mountains, Nevada, repeater station on the Las Vegas-Reno line, and in a Quonset hut just outside the town of Death Valley Junction, California, both of which are unattended locations. Two separate single-channel two-way radio systems were used initially to provide two telephone circuits over this 28-mile path. It was the first point-to-point application of FM type radio in the 150 mc range in the Bell System's toll network.

Traffic growth now requires additional facilities, and these have been provided by superposing Type-H carrier channels on each of the existing radio systems. The standard Type-H carrier system is designed for equivalent four-wire operation over a single pair of wires using the upper sideband of a 7150-cycle carrier for east to west transmission and the lower sideband for west to east transmission. The radio system, however, is an actual four-wire facility, and it is therefore necessary to convert the H carrier system to this type of operation. Minor modifications can be made to adapt the H system to this use. In fact, two separate type H systems can be used, simultaneously, over the same four-wire facility. Including the voice circuit, this provides a total of three message circuits over a single radio system.

In the Death Valley systems, the arrangement illustrated in Figure 2 was used. Two H carrier terminals (one east terminal and one west terminal) were installed at each end of the radio system, with cross-connections as indicated. For the transmitting direction, the output from each carrier terminal is connected to the input of the radio transmitter, along with the voice channel, through proper filter and pad arrangements. In the receiving direction, the three channels are separated at the output of the radio receiver by suitable filters and the two carrier channels are demodulated in the carrier terminals.

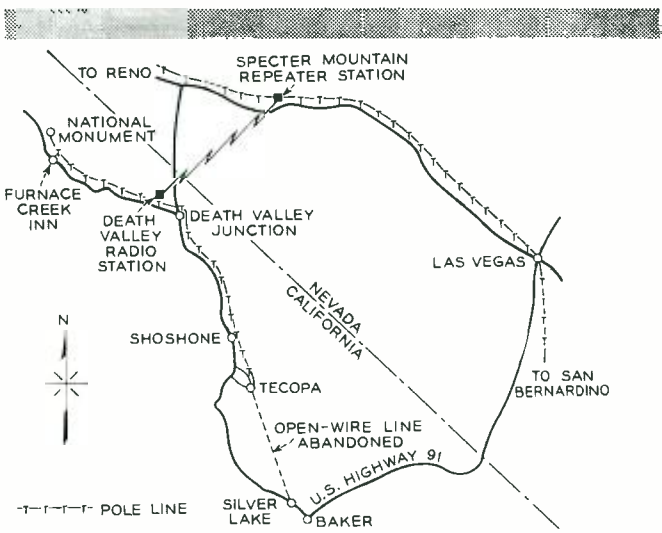


Fig. 1—How the radio link is integrated into the wire network. Telephones in Death Valley can ring each other; operator assistance is given in San Bernardino

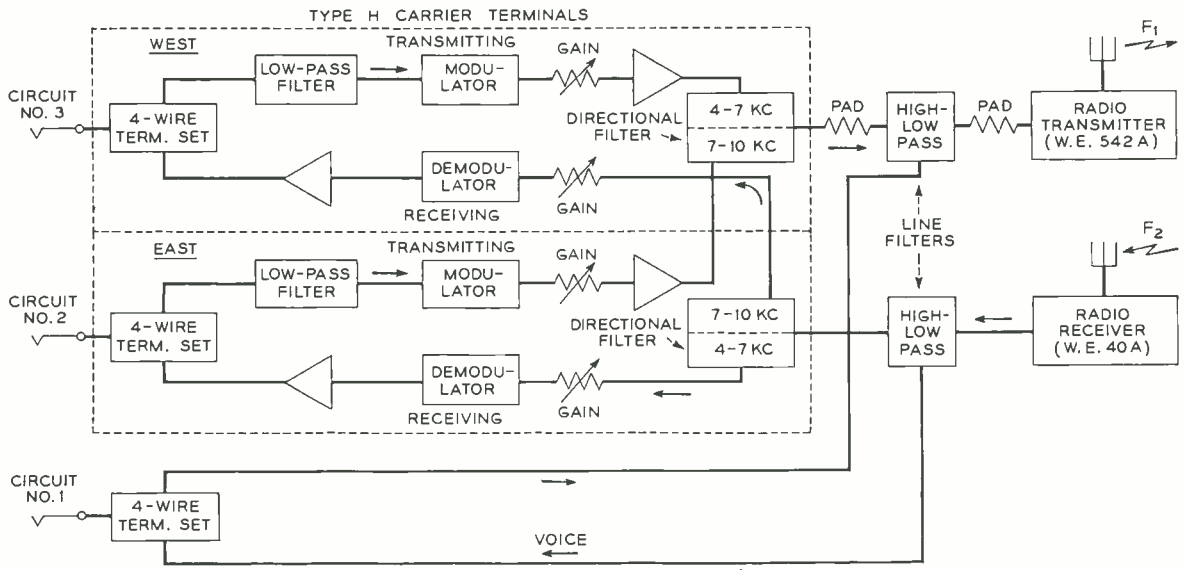


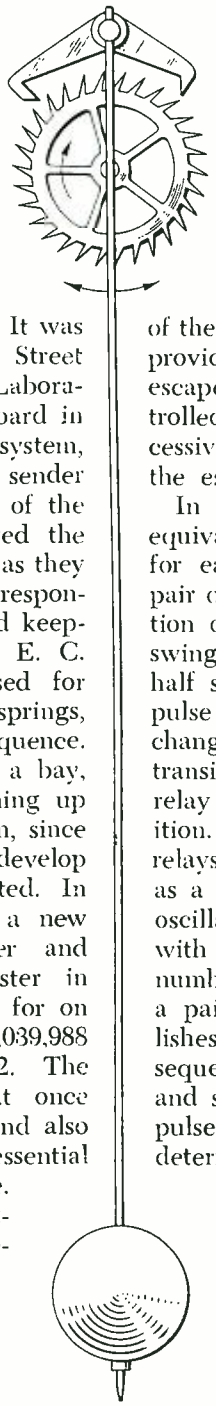
Fig. 2—Application of two Type-H systems to a radio terminal

Since the radio equipment was designed primarily for single channel use, minor modifications were required to adapt it to cover a 10,000-cycle band needed to transmit the two additional H carrier channels. For multiplex operation of the phase modulated radio system, low values of frequency deviations are used in order to reduce the cross-modulation between channels. Information on these modifications, interconnection of the H carrier equipment and radio equipment and recommended operating levels all had to be provided. The writer visited the radio sites during the planning period.

Since traffic requires only four telephone circuits at present, one of the two radio systems is provided with equipment for only one carrier channel, while the other is provided with equipment for two carrier channels, the second of which is used to handle a teletypewriter circuit. The open-wire line shortly will be abandoned between Tecopa and Silver Lake and all service will be furnished over these two radio systems. The Pacific Company has reported that the four radio message circuits (two voice frequency plus two H carrier) and the teletypewriter circuit (H carrier) are performing satisfactorily.

THE AUTHOR: H. C. Franke has been a member of the Laboratories' technical staff since he received his B.S. in E.E. from Cooper Union in 1935. He was initially concerned with problems relating to the stability of long haul carrier circuits in the Transmission Engineering Department. During the war he was engaged on various radio problems for the NDRC and the Navy. At present his work deals with the applications of short haul radio systems and the investigation of propagation at microwave frequencies. Mr. Franke is a member of the I.R.E.

HISTORIC FIRSTS: COUNTING RELAYS



In 1910, work on the panel system was actively under way, but a switching system of the rotary type using selectors with much larger banks than those of the step-by-step system had already been developed by F. R. McBerty of the Western Electric Company and was ready for trial. It was decided to install it in the West Street building — now Bell Telephone Laboratories — to replace the manual board in use at that time. Like the panel system, the McBerty rotary system used a sender to control the selectors, and part of the sender was a circuit that counted the pulses sent to it from the selectors as they progressed. Among the engineers responsible for adjusting the circuits and keeping them in working order was E. C. Molina. Each of the relays used for counting carried a number of springs, including a make-before-break sequence. These relays were at the top of a bay, and Molina was incessantly running up and down a ladder to adjust them, since a new contact trouble would develop about as soon as one was corrected. In desperation, he finally invented a new counting circuit — with fewer and simpler contacts and much faster in operation. A patent was applied for on September 14, 1911, and patent 1,039,988 was issued on October 1, 1912. The Molina counting circuit was at once applied to the McBerty system and also to the panel system, and in its essential features has been used ever since.

Perhaps the first automatic counting device was the clock escapement. With each half oscillation of the pendulum, the escapement swings in one direction to allow its escape wheel to progress, and on the next half oscillation it swings in the other direction to permit the wheel to progress another tooth. The amplitude of the pendulum's oscillation has no effect providing it is sufficient to release the escape wheel, and continuous uncontrolled motion is prevented by the successive releasing and locking actions of the escapement.

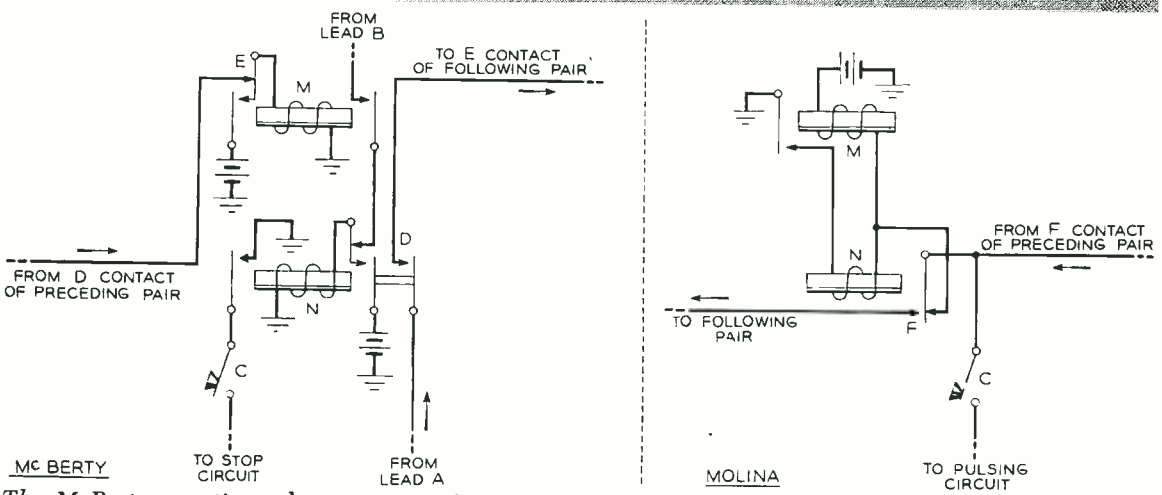
In using relays to count pulses, the equivalent releasing and locking action for each pulse is obtained by using a pair of relays. Just as a complete oscillation of the pendulum consists of a half swing in one direction followed by a half swing in the other, so an electrical pulse consists of two transitions, or changes in current value: a beginning transition and ending transition. One relay of the pair operates on each transition. Instead of using the same pair of relays to count successive pulses, however, as a single escapement counts successive oscillations, a chain of relays is employed with one pair for each of the greatest number of pulses to be counted. After a pair has counted one pulse, it establishes a connection to the next pair in the sequence which will count the next pulse, and so on. After the desired number of pulses has been counted — which is predetermined by the closure of a contact at the required pair of counting relays before the sender starts selection — the selector is stopped

through a contact of the last counting relay that has operated.

The original McBerty relay counting system, revealed in patent 1,127,466 — applied for on September 2, 1909, and issued on February 9, 1915 — employed this basic principle. Pulses from the selector operate and release a relay in the sender, which connects battery to an A lead when it is operated and to a B lead when it is released. A pair of the McBerty counting relays is shown at the left of the accompanying illustration, where one relay is marked M and the other N. A battery connection on the A lead, when the pulsing relay is operated, operates the M relay, which locks itself operated through one front contact and through another closes a connection from the N relay to the B lead. When the pulsing relay releases, thus placing battery on the B lead, the N relay operates, locking itself in through one front contact and making a connection from the A lead to the M relay of the next pair through another. Each N relay also has a front contact that connects ground to a key or other type of contact marked C. This key is closed at the counting pair corresponding to the number of pulses to be counted. When the N relay of this pair is operated, ground through C stops the selector. The first counting pair of the chain would have its E contact connected directly to the A lead, and thus the M relay of the first pair operates on the first closure of the pulsing relay. The pairs then operate successively until the pair is reached that has its C contact closed.

The much simpler counting circuit devised by Molina is shown at the right of the illustration. Only five contact springs are required for each pair instead of the twelve required by the McBerty pair, and no make-before-break sequence is required at all. Only one pulsing lead is used, and the pulsing relay connects ground to the lead when it operates and breaks the ground connection when it releases. Because of their lighter spring load and because only a brief open and closure is required of the pulsing relay. Also, the Molina chain begins operating with the relay pair at which the C contact is closed, and ends at the front relay of the chain, instead of in the reverse order as did the McBerty chain.

At the first closure of the pulsing relay, the M relay of the pair with its C contact closed will operate, thus closing ground to the N relay. At this time, however, ground is connected to both sides of the N relay, which thus does not operate. When



The McBerty counting relay circuit at the left and the Molina circuit at the right

the pulsing relay releases, ground is removed from one side of the N relay, which then operates through the winding of the M relay, and closes the path from the pulsing circuit to the winding of the next pair of relays. At the next closure of the pulsing relay, relay M of the next pair will operate, and this action continues through the chain to the end pair. A switch in the battery supply to the M relays of both the McBerty and Molina circuits permits the entire circuit to be released at the end of the counting process.

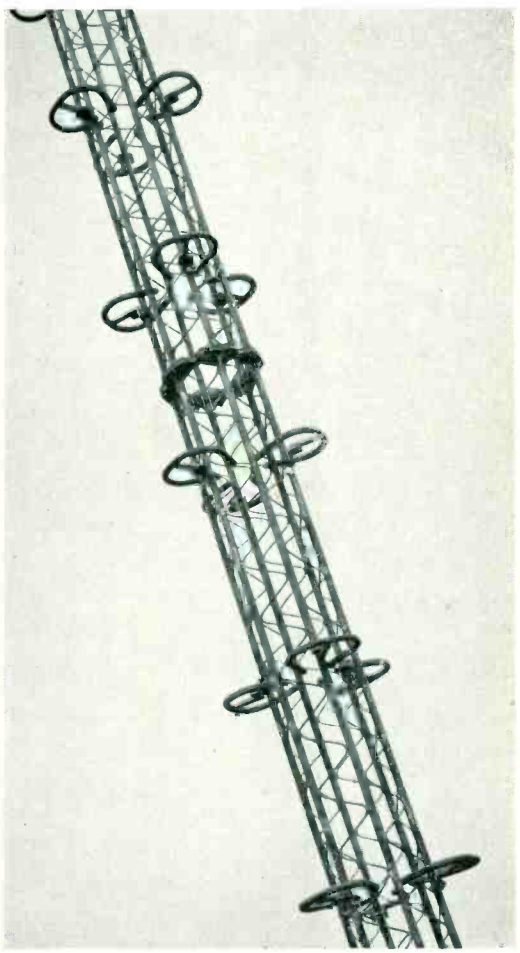
This circuit was used not only to count pulses from the selectors, but later to count the dial pulses received from the subscriber. For this latter application, the circuit was subsequently modified to employ only five pairs of relays instead of ten to count ten pulses. The basic circuit was not changed, but additional contacts were added to the relays so that after five pulses had been counted, the chain would start all over again to count the next five. The crossbar system also employs the same basic circuit for its counting relays. The Molina counting pair seems to have been reduced to its simplest form, and promises to endure for the higher speed circuits as long as counting relays are employed.

THE "CLOVERLEAF" ANTENNA

This is the new Western Electric Cloverleaf antenna, coded the 57A, now in production. Each of its radiating units consists of three "leaves", instead of four as with its predecessor the 54A. The three leaves, or radiating elements, are supported at their centers from alternate posts of a six-sided tower. The radiating elements receive their energy from vertical wires connected to their ends. Any individual wire connects alternately to the right-hand and to the left-hand ends of the elements, but the connections are just far enough apart that the currents at successive junctions flow in opposite directions. Net result is that the currents in all the elements are in the same direction. The wave radiated is "horizontally polarized" — a form less sensitive to certain kinds of interference. That, by the way, is why all FM broadcast receiving antennas are horizontal.

At the bottom of the tower, alternate wires are connected together and through a transformer to the antenna feed line. That makes the current-flow opposite in adjacent wires so that there is no radiation from the vertical wires.

Due to its six-sided construction, the tower can be built up to greater height, with consequent higher gain, than the original Cloverleaf, and can in addition support a television antenna.



THE 248A MARINE RADIO TELEPHONE EQUIPMENT

R. C. NEWHOUSE
Radio
Development

Ship-to-shore telephone service[1] was inaugurated with the installation on the Leviathan in 1929, and except during the war years, has been increasing in scope ever since. The ship transmitters have outputs of several hundred watts, and the entire equipment is in charge of radio operators, who select frequencies most suitable for the distance or time of day, and set up all connections. The emphasis has been on good overall performance rather than on simplicity of operation. These ships connect to Bell System land lines through "High Seas" radio stations at Ocean Gate and Manahawken, N. J., for the north Atlantic; at Dixon and Port Reyes, Calif., for the Pacific coast; and in the vicinity of Miami, Fla., for the south Atlantic and Gulf Coast.

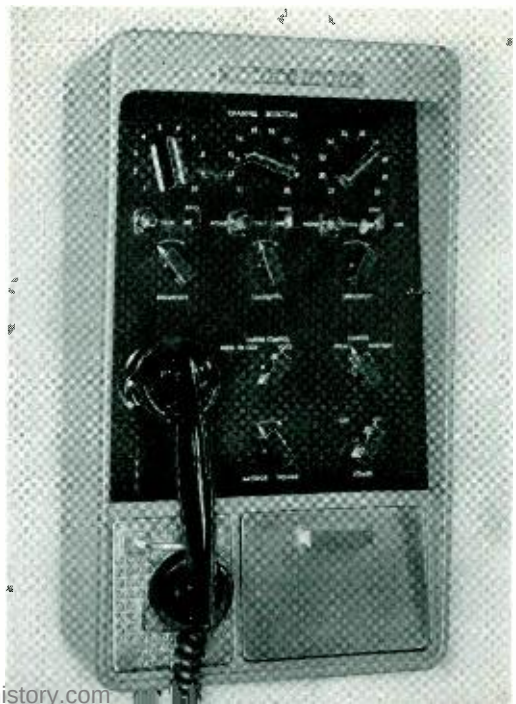
There has also been provided simpler equipment of lower power for fishing boats, yachts, and other small craft operating along the coast or in the harbors. Service[2] to vessels of this type started in 1932 with a transmitting station at Green Harbor, Mass., and has steadily expanded until there are now some fifteen "Coastal Harbor" stations along the Atlantic, Gulf, and Pacific coasts, as well as one each in Hawaii and Puerto Rico. Fifty-watt radio telephone equipment[3] has been provided for the larger vessels, and a 15-watt set[4] was designed for smaller vessels.

With the development of the 248A radio telephone equipment, the scope of marine radio telephony is now still further broadened. Designed primarily for tankers and freighters, either in coastal service or running to Caribbean, Central American, and South American ports, it is arranged for communication with either the coastal-harbor stations or with the high-seas stations. Its operating features, however, resemble those of the coastal radio equipment rather than the more elaborate high-seas equipment that has been designed for large passenger liners.

This new equipment includes a 250-watt radio transmitter and three receivers, thus permitting calls to be monitored simultaneously on three frequencies. Two of the receivers will usually be set to respond to the nearest shore stations, while the third will be adjusted to the ship-to-ship frequency to permit calls to be received from other vessels. Although calls from other ships are heard over a monitoring loud speaker, selective ringers* are included to permit calls from shore stations to be indicated by the ringing of a bell.

*RECORD, *April*, 1936, *page* 255.

Fig. 1—The control unit for the 248A equipment is designed for mounting on a bulkhead in the wheel-house or chart room



[1]RECORD, *January*, 1930, *page* 204. [2]RECORD, *November*, 1932, *pages* 62 *and* 77. [3]RECORD, *June*, 1938, *page* 358. [4]RECORD,, *September*, 1938, *page* 21.

With a transmitting power of 250 watts, the radio transmitter operates at any of thirty frequencies, located in groups of three in ten bands within the spectrum from 2 to 18 megacycles. These bands are determined by the tuning coils supplied. Each receiver provides ten channels which may be selected as desired within its band. Normally, one of each of these two types of receivers will be installed so as to cover both the coastal and the high seas frequencies. A third receiver of either type

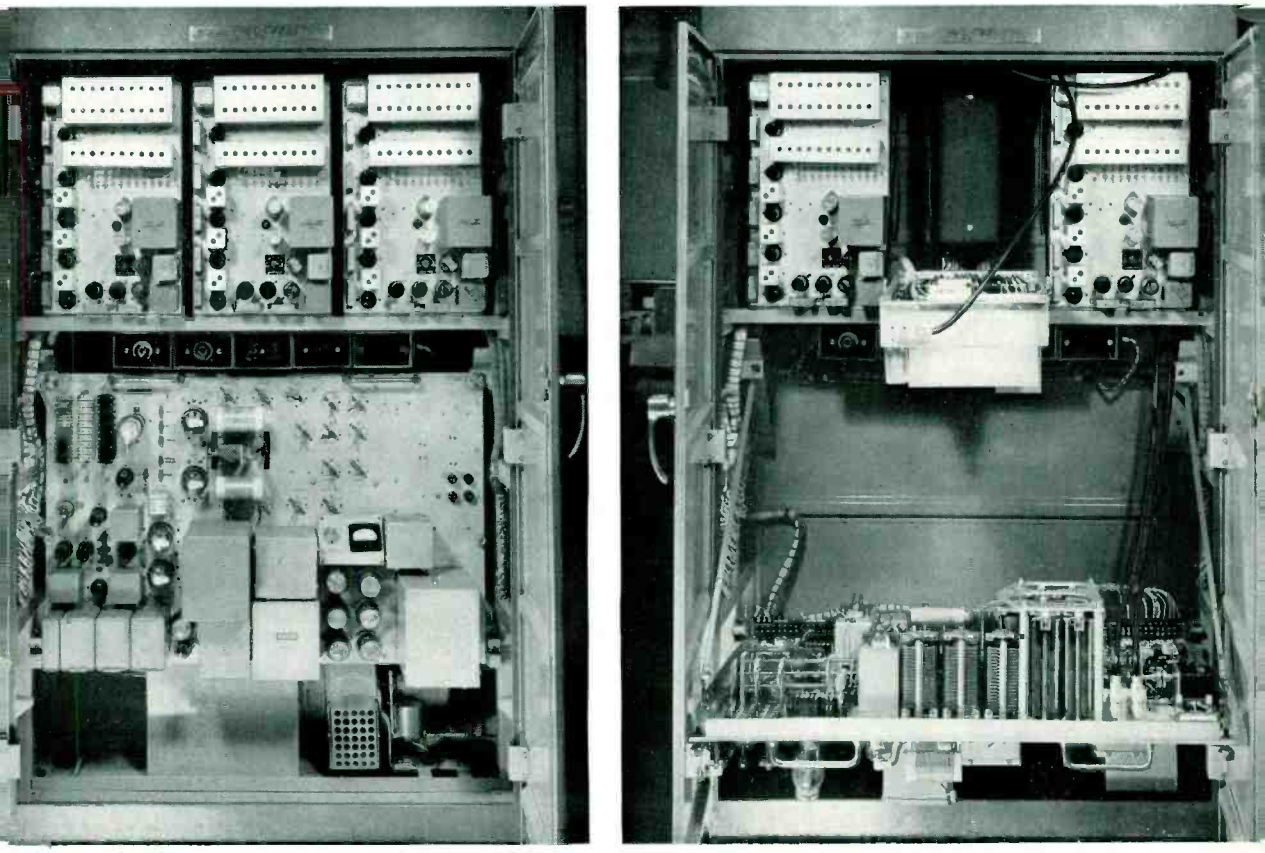


Fig. 2—The main transmitter-receiver cabinet: normal position, at left, and with receiver and transmitter tipped forward to the servicing position, at the right

Each coil has sufficient tuning range to provide a band five per cent wide. For each installation the coils are chosen so that the thirty frequencies they permit—three in each of ten bands—will cover the shore stations with which the vessel may need to communicate. Thirty crystals are provided—one for each channel.

Two types of radio receivers are available: the 48A covering the 2180 to 6485-kc band, and the 48B covering the 4160 to 22715-kc band. The first band includes all of the coastal-harbor assignments and the lowest group assigned to high seas service. is optional, and can be installed if additional channels are desired. Both types of receivers employ a sensitive super-heterodyne circuit with crystal control of the beating oscillator, delayed amplified automatic gain control, and peak noise limiting.

The complete radio telephone equipment consists of four units: a control unit, a main transmitter-receiver cabinet, and two transmitting antenna tuning units. The control unit, shown in Figure 1, is arranged for bulkhead mounting in the ship's wheelhouse or chart room. To make it possible to use the equipment at night without

turning on lights and thus impairing the night vision of the wheelhouse personnel, the channel designations are of a fluorescent substance which glows red when energized by ultra violet light. This invisible radiation is provided by a tubular lamp and a filter behind the overhang at the top of the panel. Power for the entire equipment is obtained from a 115-volt 60-cycle single phase supply, and is controlled by the OFF-ON switch at the lower right of the panel.

At the top of the panel, there are three channel selector switches, one for each of the three radio receivers included in the main cabinet. Besides setting the receivers to the desired frequency, each of these switches sets up the corresponding frequency for the transmitter. When one of the keys below the selector switches is thrown to the TALK position, the transmitter is turned on and is automatically switched to the channel indicated by the selector switch above.

An incoming call from a shore station will be indicated by the ringing of a bell in the control unit and by the lighting of the lamp below the corresponding channel selector. To answer this call, the key to the right of the lamp is thrown to the TALK position, the handset is picked up, and the conversation proceeds in the usual telephone fashion. At the conclusion of the call, the key is thrown back to either the RING or MONITOR position, and the handset returned to its hook. If the handset is hung up without first restoring the key, an alarm will sound to warn the operator to set the key so that calls can again be received.

A call is made to a shore station by setting the channel selector to the desired channel, throwing the key to the TALK position, removing the handset from its hook, listening for a moment to determine that the shore station is not busy, and then calling the station by speaking into the transmitter. Usually, provision will be made to have one channel set for the ship-to-ship frequency. The telephone keys below the channel selectors are provided with a third or monitor position in addition to the talk and ring positions, and when

Fig. 3—The antenna and its tuning unit

the selector knob is set to the ship frequency, the key for that receiver will be thrown to the monitor position which connects the receiver to the loud speaker (in the lower left-hand corner of the control unit) and energizes its manual sensitivity control. The sensitivity knob permits the operator to adjust the noise level received through the loud speaker to a level which is not objectionable when no signal is being received from another ship. The monitor volume control at the lower center of the panel permits the loud speaker signal to be adjusted to a suitable listening level when an incoming ship signal is received.

A carrier-control knob, immediately above the monitor volume control, has two positions: PRESS-TO-TALK and VOICE. When the carrier control is in the press-to-talk position, no transmission occurs unless the operator presses the button in the center of the handset handle. In the voice position, transmission occurs whenever the operator speaks into the transmitter of the handset. Most talkers will probably prefer to use the automatic voice control. Those with experience with push-button control, however, may prefer to use the press-to-talk operation.

Immediately above the OFF-ON switch is a three-position handset switch. This permits an extension handset to be used either in the captain's cabin or elsewhere as required. Incoming calls may be transferred to the extension handset by the use of this switch. Outgoing calls can also be made from the extension provided the channel switches are in the correct positions and the key has been thrown to the talk position on the required channel. In the middle position, the two handsets can be used as an interphone without energizing the radio transmitter.

A card file is provided behind the door at the lower right of the control unit. The channel and station assignments are listed on cards in this file to permit ready reference to determine the proper channel settings for the desired stations.

The main transmitter-receiver cabinet is designed for deck mounting and may be located at any convenient point in the ship, not necessarily close to the control unit. An internal view with the units in the normal operating position is shown at the left of Figure 2. Three receivers are mounted across the top with the transmitter below. At the right of Figure 2, the center receiver and the transmitter are shown tipped forward in the position for servicing. One of the three selective ringers, which are mounted behind the receivers, is also shown.

Audio modulation of the transmitter carrier is accomplished by a high level modulator which varies the plate voltage of the power amplifier stage. The audio system includes a compressor amplifier so that a high level of modulation will be maintained for talkers having widely different voice levels. The audio amplifier system also includes a voice control circuit for turning on the transmitter when the operator speaks into the handset.

Transmitting antennas will be installed to fit the frequencies employed in each installation. In general, two antennas will be used for full coverage for each type of service. Each antenna will be connected to a tuning unit, shown in Figure 3, which will match its impedance to the coaxial transmission line to the radio transmitter. Provision of two tuning units, each with its separate transmission line, permits two antennas to be independently installed in the most suitable locations. A single additional antenna will be used for receiving.

THE AUTHOR: R. C. NEWHOUSE, Radio Development Department, received a B.E.E. degree from Ohio State University in 1929. After three months as a Member of the Technical Staff in the Toll Systems Department of the Laboratories, he returned to Ohio State under a fellowship granted by the Guggenheim Fund for the Promotion of Aeronautics to permit work on a radio altimeter. He received an M.S. degree in 1930 and immediately rejoined the Laboratories Technical Staff. As a member of what is now the Specialty Products Development Department, he engaged in the development of aircraft radio transmitters, and acoustical and radio altimeters. He received the 1938 Lawrence B. Sperry award from the Institute of the Aeronautical Sciences for the development and first practical application of the radio altimeter. In 1939 he transferred to the television research group. With the approach of the war emergency in 1940, he returned to Specialty Products where he supervised the circuit development of a number of radars for aircraft and ground service. He now directs the efforts of a group engaged in the development of radar for marine applications and of radiotelephone sets for aircraft and shipboard service.

ANALYZING RELAY CHARACTERISTICS

E. R. MORTON
Switching
Apparatus
Development

Although a relay is conceptually a simple thing, its behavior and characteristics are found on analysis to be exceedingly complex. Since relays are used in very large quantities in the telephone system, and are called upon to operate under a very wide range of conditions, their characteristics are a subject of almost continuous study, and many methods of analysis have been devised to make it easier to predict their behavior and discover their limitations. For the various relay structures used by the Bell System, curves are available showing the relationship between air gap and pull for various ampere turns, and by comparing these curves with any desired load characteristics, the required winding may be determined as previously described.* In designing new relays, however, or in attempting to improve existing ones, a more elaborate analysis is sometimes required. For this purpose, a convenient graphical method was devised some time ago that has proven helpful. It uses a set of curves for different numbers of ampere turns representing the relationship between pull and air gap for an ideal relay — that is, one whose entire magnetizing force is available at the air gap. On the graph may be plotted the test results for any given relay, and by analyzing the differences between the ideal and actual characteristics, improvements become obvious.

A generalized form of relay may be represented as shown in Figure 1. Current flowing in the winding tends to move the armature so as to close the air gap with a force proportional to the area of the air gap times the square of the flux density. The pull may be thus expressed as:

$$(1)\quad p=k_1 A\beta^2$$

where β is the flux density in the air gap, and A is the area of the air gap.

*Record, *July* 1929, *page* 459.

The magnetizing force in ampere turns required to produce a given flux density is directly proportional to the product of the flux density and the length of the magnetic path and inversely proportional to the permeability of the material. The ampere turns may thus be expressed as:

$$(2)\quad NI=k_2 L\beta/\mu$$

Since the magnetic circuit of a relay is of two materials, each with widely different values of permeability, the total ampere turns may be divided into two parts: one for the air gap with a permeability of one, and the other for the iron. For the air gap,

$$(2a)\quad NI_A=k_2 L_A\beta$$

and for iron,

$$(2b)\quad NI_M=k_2 L_M\beta/\mu$$

where L_A is the length of air gap, and L_M, the length of the iron path. It is the former part of the ampere turns that is directly useful in producing a pull on the armature, and for ordinary conditions it is much greater than that for the iron path. An ideal relay would be one for which all the ampere turns were effective in producing air gap flux, and the relationship between pull and ampere turns for such a relay may be determined by solving equation

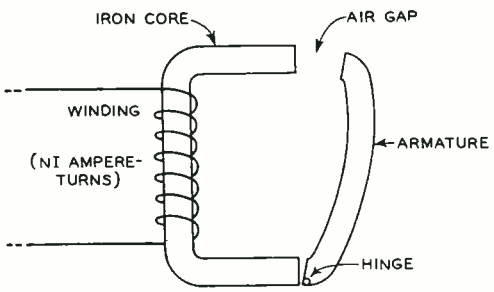


Fig. 1—Generalized form of relay

(2a) for β, and then substituting this value of β into equation (1). This gives:

$$(3)\quad p/A = k_3 (NI)^2/L_A^2$$

which expresses the pull per unit of pole area for each value of ampere turns and length of air gap. If the pull is expressed for p/A = 6400 intersects the gap for 0.02.

Such curves represent the operation of an ideal relay; the curve for any actual relay will be lower because of the three losses. One of these is due to the ampere turns required to force flux through the

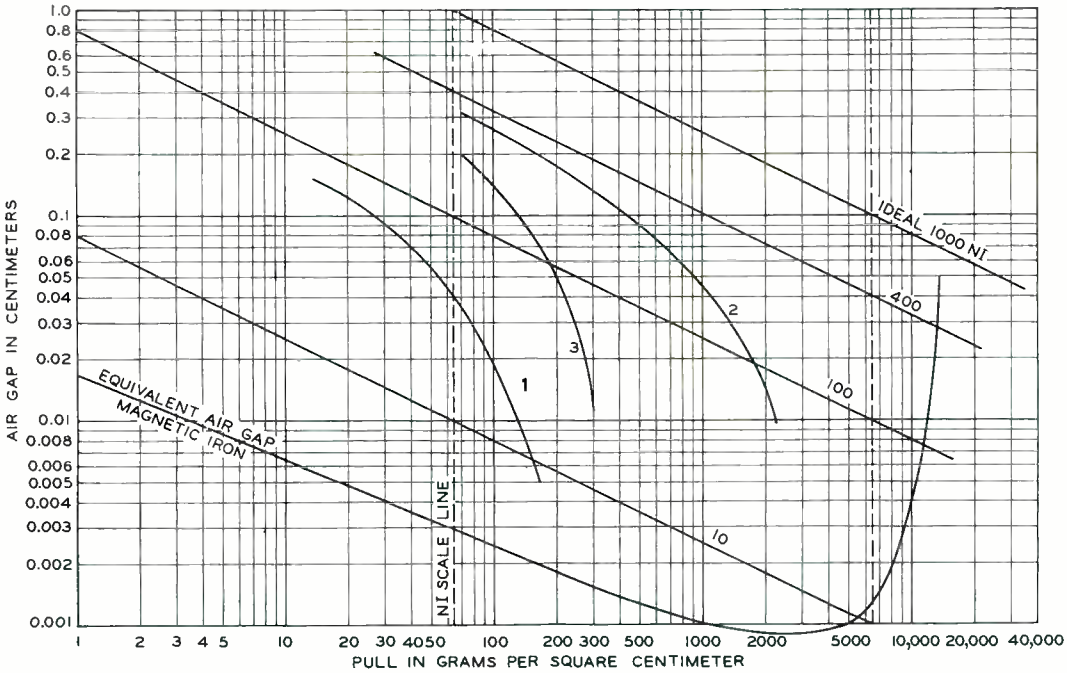


Fig. 2—Curves for studying relay operation

in grams, the length of the air gap in centimeters, and the area of the air gap in square centimeters, the constant k_3 is 6.4×10^{-5}. This relationship plotted on logarithmic paper for different values of ampere turns becomes a series of straight lines as shown in Figure 2. To simplify the drawing of curves for other values of ampere turns as they are needed, dashed vertical lines are drawn at values for p/A of 64 and 6400. With these values substituted into equation (3), the air gap is one-thousandth and one ten-thousandth, respectively, of the ampere turns. A curve for 200 ampere turns, for example, would thus be a straight line between the point where the p/A = 64 line intersects the line for a gap of 0.2, and that where the line

iron path of the circuit. Another is due to the existence at the hinge of a small air gap that is not usable in producing pull. The third is due to leakage flux that tends to saturate the core without passing through the air gap.

The length of air gap lost because of the ampere turns required to force the air-gap flux through the iron path is found by equating (2a) and (2b) to be:

$$(4)\quad L_A = L_M/\mu$$

In other words, the length of the iron path divided by the permeability of the iron gives the length of the air gap that is equivalent to a core L_M centimeters long. The magnetization curve for the particular iron, on the other hand, gives the value of permeability for each value

of flux density, and thus the air gap equivalent to the iron path for each value of flux density may be determined. By equation 1, however, there is one value of pull corresponding to each value of flux density. It is thus possible to draw a curve on Figure 2 that represents for any particular magnetic material and length of path, the equivalent air gap lost because of the NI required to force the air-gap flux through the iron. Such an equivalent air-gap curve has been drawn on Figure 2 for one particular material and for a length of path of 10 cm. It is now possible to use Figure 2 for a complete graphical analysis of a relay that has a 10-centimeter constant-area iron path of the material for which the equivalent curve was drawn.

The first step is to run a test on the relay at some low value of ampere turns and to plot the data on Figure 2. Such a curve for 100 NI is marked 1 on Figure 2. By subtracting the values of air-gap for this curve from those for the ideal 100 NI curve, the total loss in effective air gap is found, and by subtracting from these values the values from the equivalent air-gap curve for the core, there remains the loss due to hinge gap. Carrying out these subtractions for curve 1 gives a gap of about 0.055 cm for all values of pull. The fact that these differences are constant indicates that no appreciable leakage is present, since the leakage effect would tend to increase with flux density. It may be assumed, therefore, that for this relay the hinge gap is 0.055 cm.

To study the behavior of the relay at some higher magnetizing force, say 400 NI, 0.055 cm hinge gap is added to the gaps for the iron core, and subtracting these sums from the ideal 400 NI line, curve 2 may be plotted. This would represent the operating curve of the relay for 400 NI if there were no leakage. By running a test on the relay for 400 NI, the actual characteristics can be determined and plotted. Such a curve is marked No. 3 on the chart. Comparing curves 2 and 3 shows an additional loss due to leakage. If there were no leakage, a pull of 2000 grams could be obtained at a gap of 0.01 cm, but with the actual relay the maximum pull is only about 300 grams.

Leakage flux, which varies with the existing ampere turns is present at all times, but only when the sum of the leakage and air gap flux is great enough to result in a decreasing permeability does it reduce the pull. If the air gap flux were the only flux, saturation would not begin until after the pull were greater than 3000 grams, since as may be seen from the equivalent air-gap curve, maximum permeability occurs at a flux density which corresponds to this pull. When saturation effects are pronounced at pulls as low as 300 grams, as for the relay yielding curve 3,

THE AUTHOR: E. R. Morton graduated from Stevens Institute of Technology in 1917 with the degree of M.E. During the next five years he engaged in a variety of work, chiefly in electrochemistry, optics, and mechanical design, and also took a year's graduate work at Harvard University. In 1923 he joined the technical staff of the Laboratories, where with the Special Products Department, he engaged chiefly in the design and development of power apparatus. He worked on the motors for the television system developed by the Laboratories and also on those for sound-picture recording and reproducing and on regulators for voice-frequency carrier telegraph generators and on other regulating apparatus. Following this he engaged in relay studies and design until the war when he was responsible for the electrical and mechanical design of components for a variety of war projects, most of which are still confidential. Since the war he has returned to relay development.

Photo by Von Behr

it is evident that there must be a large leakage flux — large enough to increase the total flux from that corresponding to 300 grams to that corresponding to well above 3,000 grams, where the equivalent air-gap curve begins to rise.

One of the advantages of this type of chart is that it makes such situations evident at a glance. In addition, however, it enables both hinge gap and leakage effects to be determined, and thus permits the behavior of the relay to be predicted for any conditions. The information it yields also indicates the type of changes that should be made in the relay structure to secure other chacateristics. For new designs it provides a background against which the desired operating requirements may be set to reveal the characteristics the relay structure should have to meet them.

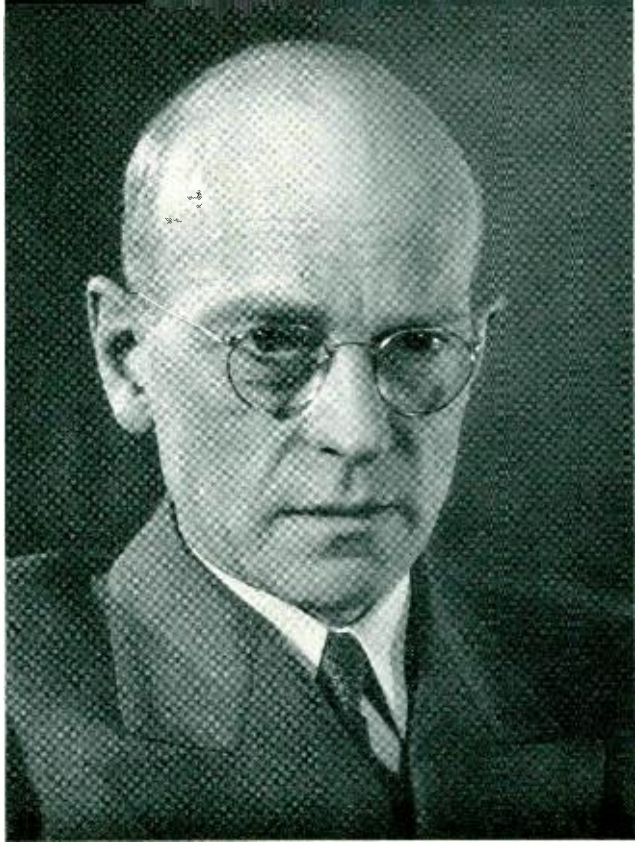
A HIGH-PRECISION TEST SET GOES TO WASHINGTON

A capacitance-conductance measuring set has recently been constructed for the National Bureau of Standards in Washington, D. C., to facilitate its standardization work and its calibration service. Another of these test sets was made for our Murray Hill laboratories. The set is capable of measuring capacitances from 0.002 microfarad to 1.1 microfarads, and conductances from 0.00003 microhos to 1110 microhos over a frequency range from 200 cycles to 150 kilocycles. In spite of the extremely wide range covered by the test set, its precision is 0.03 per cent — making it one of the most precise sets of its type known. It is completely operated from a 110-volt 60 cycle source. The set includes an oscillator, a detector, and a bridge assembled in a special mobile cabinet as shown in the illustration. The oscillator is at the upper left side, and the detector, at the upper right, with its indicating meter mounted slightly below. The bridge is the No. 12 type capacitance-conductance bridge developed some years ago and already described.* S. J. Harazim designed the cabinet for the test set and L. E. Herborn was responsible for its overall design and operation.

The bridge is centrally located, and for convenience of operation is tilted back from the vertical so as to be at a height convenient to the operator whether sitting on a high stool or standing. Two shelves, adjustable in height, are provided. One is for holding the standard under calibration near the bridge test terminals, and the other is a writing shelf for the laboratory note book. The side and back panels of the cabinet are all removable to give access to the different units.

F. R. Merritt of the Physical Research Department checking a capacitance standard at the Murray Hill laboratories

*RECORD, *January*, 1942, *page* 133.



JOHN MILLS 1880-1948

Following his retirement as Director of Publication, John Mills became an advisor to undergraduates at California Institute of Technology, a post which he found most congenial. Early this year he visited Rochester, N. Y., where his son John, Jr., is associated with Eastman Kodak. One June 14, after several months of illness, he passed away.

Mr. Mills is survived by his son; and by two daughters: Mrs. Marion Mills Giannini of Far Hills, N. J., and Miss Theodora Mills of Washington, D. C. His wife, the former Emma Gardner Moore, died two years ago.

John Mills was born in a Chicago suburb in 1880. He graduated from the University of Chicago in 1901 and after a fellowship in physics at the University of Nebraska he received a Master's degree in 1904. There followed seven years of teaching at Western Reserve, M.I.T., and Colorado College. In 1911 he entered the engineering department of A T & T, where he had an active part in the transmission phases of the development of transcontinental telephony. His appreciation of the importance of impedance smoothness on repeatered lines was fundamental in the success of the project. For a time he worked on the transatlantic radio telephone project and later transferred to the engineering department of Western Electric. During World War I he trained engineers in the then new art of radio.

The rapid expansion of the company following the war drew Mr. Mills into Personnel, of which department he later became the head. With the incorporation of the Laboratories in 1925 he became its first Director of Publication, a post which he held until his retirement in 1945.

Those were the landmarks* in John Mills' career but not the career itself. Dates and places have substance—they can be written down, and verified. It is the less tangible part of a man's life that characterizes him to his colleagues — his ideals and attitudes, the warmth and color of his associations with his fellows. John Mills was a dreamer—but one who kept constant contact with the physical world. So his dreams expressed themselves in practical dress—a conception of electrical echoes and the way to suppress them, a mass technique for letting people hear themselves talk. And because he dwelt much within his own mind, he gave thought to the minds of others, and formulated principles for understanding and predicting their acts. An early contribution was a new viewpoint in

*Further details of Mr. Mills' career will be found in the RECORD for May, 1945, page 165.

selection of personnel: that college graduates should be hired, not to fill a particular job, but for their possibilities of growth. He proposed six "man specifications" – intellectual curiosity, ability to study, habituation to study, ability to learn from men, ability to cooperate with them, and ability to lead them.

With the creation of Bell Telephone Laboratories, the new organization felt the need of its own house magazine and one of John Mills' first concerns as Director of Publication was to chart the direction which such a publication should take. It should, he thought, be concerned more with ideas than with people; and be of interest outside the organization as well as within. On page 1 of Volume I, Number 1, he wrote:

"We wish to know more of each other, to learn from each other's methods, to enjoy our group achievement, to have a record and a medium for our information. And hence this magazine. Our editorial policy is to provide for ourselves that information of a personal, scientific, or organization character which will be of interest and value to us as members of Bell Telephone Laboratories."

Those were the stated aims of BELL LABORATORIES RECORD but anyone who knew John Mills will understand that he had still others. Literary style must be beyond reproach: each article must be fit for use as a model in Engineering English I. Illustrations, typography, presswork must be on a par with the Laboratories' technical output. Presentation of the subject-matter must make it acceptable to a wide range of reader interest, from the non-technical executive who might read the first two paragraphs to the engineer or scientist working in a related field. Mr. Mills even had a "difficulty curve" – starting at zero, rising slowly through those two "busy executive" paragraphs, then more rapidly to a plateau in which there would be "dips", or changes in pace, to recapture lagging interest. He recognized, too, that throughout the Bell System there were hundreds of technicians and junior engineers who had a keen interest in technical progress, but no ready access to the basic disclosures, which should of course be made through the engineering societies. As the usefulness of the RECORD in this area came to be appreciated, its circulation through the Bell System Companies steadily grew until it nearly equals that inside the Laboratories.

Still another aim of the RECORD was to provide a measure of personal satisfaction to the men who did the work. Every article was to have as author someone, usually not a supervisor, who had played an active part in the project being described. The formality of joint authorship was to be avoided; not, to be sure, without argument in the early days.

With the RECORD firmly established, John Mills turned his attention to other things. As educational director, he had been instrumental in organizing the out-of-hour courses which have contributed so much to our intellectual growth. Many of these courses, being in fields in which the Laboratories had been pioneers, required the creation of texts. Initially these were mimeographed and, as educators heard of them, inquiries were made for copies. John Mills suggested that certain ones be turned over to a publisher and made generally available. The list is now an imposing one; it comprises some sixteen titles with others under way.

When it was determined that the Bell System should exhibit at A Century of Progress at Chicago in 1933, John Mills was given responsibility for plan and execution. This exhibit, as well as those at New York and San Francisco in 1939-1940 illustrated his philosophy of "audience participation". "Oscar", the binaural dummy, at Chicago, enabled the audience to listen with receivers at both ears; the audition, at New York, gave some people a chance to talk and all of them to listen to the reproduction of their voices; the hearing tests, at San Francisco and New York, were self operated; the souvenir telephone calls at all three fairs indulged the temptation to eavesdrop, and offered the excitement of chance as the numbered balls whirled in the air-blast. "Pedro the Voder", as well as Oscar, illustrated another Mills' theory – that the public liked to see some first-rate scientific novelty; given that, they would give attention to an explanation of the more mechanical elements of our business, such as telephone switching.

John Mills' retirement party brought together not only Bell System executives, high and low, but many of the younger men who were there because at some time or other he had contributed the encouragement, the analysis of a problem which became for them a turning-point in a fruitful career. Those for whom it was the final contact can long recall him as he moved happily and confidently toward new horizons.

Columbia University Honors Dr. Buckley

On June 1 Dr. Buckley received the honorary degree of Doctor of Science from Columbia University. He was cited by acting president Fackenthal as "physicist and research administrator; native of the Midwest, who turned eastward as a young man and found a future in the rich fields of communications research; associated for two decades with Bell Laboratories, and during the war years administered its resources in the interest of a thousand military projects within its scope; directing this great and many-sided tool for the study of telephony and the sciences which support it — a pioneer in the wilderness of the future."

Four Mississippi Telephone Operators Win National Vail Medals

Four Mississippi telephone operators, who remained at their switchboards last September 19 while a hurricane toppled buildings all around them, have been awarded silver Vail Medals and $500 in cash each for their courage and devotion to duty.

The Bell System National Committee of Award also awarded special bronze plaques to two groups of Bell System employees — one in recognition of the restoration and maintenance of essential telephone service at Woodward, Okla., devasted by tornado in April 1947, and the other for continuing necessary service in an emergency at Bar Harbor, Me., stricken by forest fire last October.

The four telephone operators who won silver Vail Medals were Mrs. Gerry Martin Bishop and Miss Nellie Bourdin, of Pass Christian, Miss., and Mrs. Victoria Swanner Becker and Miss Marie Lucinas Strong, of Bay St. Louis, Miss. All were employees of the Southern Bell Telephone and Telegraph Company, which received two bronze plaques in commemoration of the operators' deeds.

One of the two special bronze plaques was awarded to a group of Southwestern Bell Telephone Company employees "in recognition of their loyalty and devotion to duty in the restoration and maintenance of essential telephone service" following the tornado which swept Woodward, Okla., on April 9, 1947. The storm struck the city of about 5,500 population shortly after dark, leaving it without electricity, water or communication. A hundred persons were killed and 1,000 more injured. A hundred city blocks were demolished, leaving 3,000 persons homeless.

The other special bronze plaque was awarded to employees of the New England Telephone and Telegraph Company for similar loyalty and fortitude in maintaining essential service when a gale-driven forest fire swept into Bar Harbor, on Mount Desert Island, Me., on October 23, causing $10,000,000 property loss and threatening to destroy the entire business section of the town.

In making its selections, the National Committee considered 27 noteworthy acts per-

formed by telephone people in 1947 and early 1948. The deeds involved 33 individuals and two groups, to whom bronze Vail Medals had previously been awarded by committees within the various Bell System companies. In the 28 years since the Theodore N. Vail Memorial Fund was established in the name of the former president of the American Telephone and Telegraph Company, 1,311 awards have been given to telephone men and women throughout the country for unusual acts and services in emergencies.

Changes in Organization

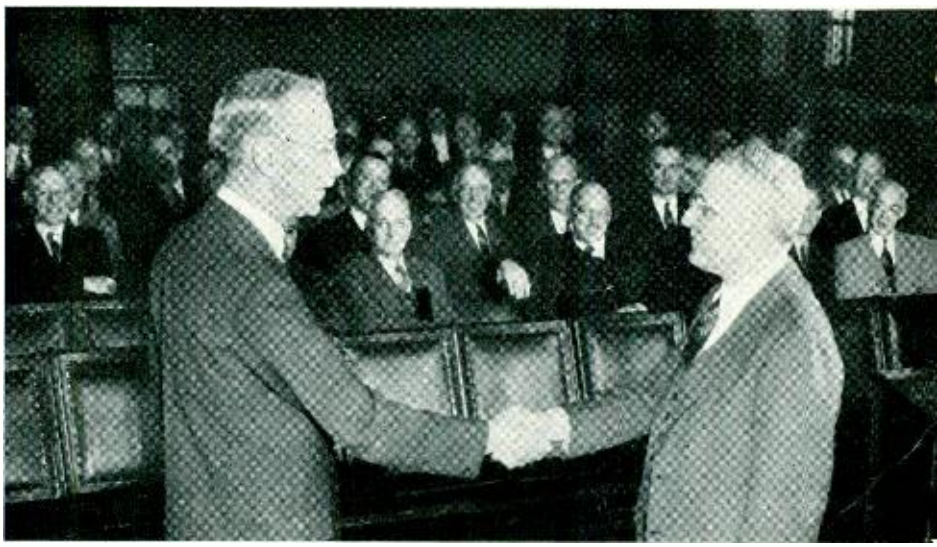
F. J. Scudder, Director of Switching Development, will retire on August 1. In anticipation of Mr. Scudder's retirement, the following changes in organization were effective June 1, 1948: A. J. Busch was appointed Assistant Director of Switching Development and will become Director of Switching Development on Mr. Scudder's retirement. F. A. Horn was appointed Switching Development Engineer, succeeding Mr. Busch in this position.

C. G. Miller has been transferred from Switching Engineering to Systems Engineering and was appointed Systems Practices Engineer, reporting to M. H. Cook, Director of Systems Engineering. Mr. Miller will be responsible for the preparation of certain Bell System Practices and will continue to be in charge of the training material and of the school group that has been under his supervision during the past several years.

H. H. Abbott and F. F. Shipley of Switching Engineering have been appointed Switching Engineers, reporting to M. B. McDavitt, Assistant Director of Switching Engineering. Mr. Abbott will be responsible for the engineering of station systems, small exchange switching systems, manual switchboards, and signaling. Mr. Shipley will be responsible for the engineering of large switching systems, both exchange and toll.

Greater New York Fund Closes

When the Greater New York Fund drive came to a close on June 11, $6,537.25 had been donated by 2,295 members of the Laboratories in New York. Under the chairmanship of D. D. Haggerty, executive secretary and treasurer of the Club, a desk to desk campaign was carried on by one hundred and eighty volunteer solicitors at all the New York locations of the Laboratories.



Harvey Fletcher, right, welcomes R. A. Haislip as the 1948-1949 president of the Frank B. Jewett Chapter of the Pioneers

Pioneers and Life Members Elect Officers

Members of the Frank B. Jewett Chapter of the Telephone Pioneers and Life Member Club held elections on May 27 during their annual meetings at West Street. Following a short business meeting, the Chapter elected R. A. Haislip, president; A. O. Jehle, treasurer; and Hattie Bodenstein, secretary. R. E. Poole, J. R. Townsend and Marion Haggerty will remain on the executive committee to serve another year while P. W. Spence, R. J. Nossaman and C. E. Swenson have been elected to serve a two-year term.

Officers of the recently organized Pioneer Life Member Club. Left to right, A. G. Kingman, secretary-treasurer; Helen Craig, executive committee; S. B. Williams, president; and A. E. Petrie, executive committee. A. F. Gilson, vice-president, and J. G. Roberts, executive committee, were not present for photographing

The Life Member Club held its first business meeting and elected for its first president, S. B. Williams; vice-president, A. F. Gilson; secretary-treasurer, A. G. Kingman; and members of the executive committee, A. E. Petrie, J. G. Roberts and Helen Craig. A. B. Kvaal was elected to serve as active Chapter member on the committee. After the meeting Life Members heard P. B. Findley's talk *Glorious Guatemala*, illustrated with colored moving pictures and slides.

Mobile Radio Prevents Grade Crossing Accident

The cartoon on page 187 of the RECORD for April, 1948, showing a man telephoning from his car on a grade crossing was not too far from the truth. Recently when an automobile became wedged between the tracks at a grade crossing of the Nickel Plate Railroad at Dunkirk, New York, the use of a mobile telephone in a passing taxicab resulted in stopping a train before it reached the crossing. The cab driver used his mobile telephone, part of a system owned and operated by the taxicab company, to call his dispatcher who notified the New York Telephone Company switchboard operator of the situation. The operator called the railroad signal tower and a signal was set which stopped a train shortly before it was scheduled to reach the crossing.

Institute of Radio Engineers Welcomed to Murray Hill

At the Northern New Jersey Sub-section of the Institute of Radio Engineers, held on May 12 in the Arnold Auditorium at Murray Hill. L. A. Meacham and R. W. Sears, respectively, gave descriptions of the pulse-code modulation system and the electron-beam coding tube. S. W. Michaels demonstrated a speech and music recording of a Laboratories' PCM experimental system. R. K. Honaman, Director of Publication, made a brief address of welcome to the assembled 149 engineers and their guests. A short business meeting and a questioning period were also included in the session.

Murray Hill Chorus Elects New Officers

Newly elected officers for the 1948-49 season of the Murray Hill Chorus are Phyllis Taylor, executive chairman; Brockway McMillan, assistant executive chairman; Sara Sykora, secretary; F. J. Black, treasurer; and Mary Lou Powers, librarian. Concluding the 1947-48 season with its annual spring party at the Y.M.C.A. in Summit, the chorus gave an informal entertainment, refreshments were served, after which Chairman W. E. Matthews read his annual report.

The Male Quartet of the Chorus sang on May 30 at the Veterans Hospital and on June 8 at the Spring Get-Together under the auspices of the A.I.E.E., New Jersey Division of the New York Section, at the Federal Telecommunications Laboratory, Nutley, N. J. At Plainfield on June 12, the Quartet won first prize in a Barber Shop Contest, sponsored by the Junior Chamber of Commerce of the Plainfields.

Bell System Committee to Study Aerial Cable Sheath

To study methods for halting the deterioration of aerial cable sheath, a Bell System committee, consisting of representatives of the O & E, Long Lines and the Laboratories, has been appointed under the chairmanship of T. C. Henneberger. Other Laboratories' members are: W. J. Lally, D. T. Sharpe, J. A. Carr and G. M. Bouton. Field studies have already begun along the New York-Reading cables near Morristown, N. J., where sheath conditions, especially at pole locations, are under investigation.

Long Island Golfers Hold Tournament

Laboratories golfers in the vicinity of Long Island held their annual tournament under the auspices of Bell Laboratories Club on June 12 at Beth Page Park. Prizes in Class "A" went to J. A. Burwell, 82, low gross; K. F. Rodgers, 76, low net; and H. M. Yates, kicker's. In Class "B", H. S. Winbigler took low gross with 90; R. E. Kuebler had a low net with a score of 80; and S. J. Brymer and W. L. Willdigg tied for kicker's prize. In Class "C", L. W. Drenkard took low gross with 98; A. J. Sarka and R. P. Muehlsteff tied for low net with 81; and K. Billson won the kicker's prize.

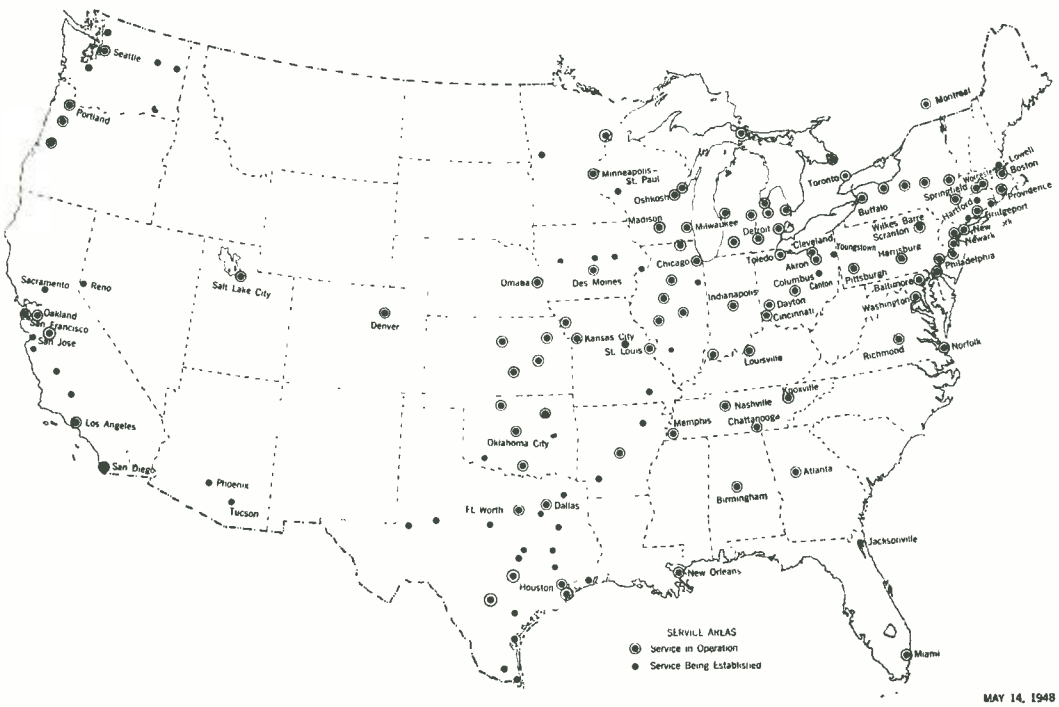
Mobile Telephone Service Triples Size in Second Year

Passing its second milestone in June, Bell System mobile telephone service took a quick look in the rear-view mirror and discovered that while it is twice as old as it was a year ago, it has grown just about three times as big. This service has traveled a long way since its inaugural at St. Louis in June 1946. By the end of its first twelve months, more than 1,400 automobiles, trucks, buses, taxis, switch engines and boats were placing and receiving about 10,000 telephone calls a week in 39 American cities and towns.

Since then, business has just about tripled. Today nearly 5,000 vehicles of all types, including fast passenger trains and harbor craft, are handling 30,000 calls a week through mobile systems established in nearly 100 different cities and towns. In addition, service is now scheduled for about 50 other localities. While the record to date is impressive, it is only a step toward what may be expected when sufficient radio channels become available – judging from the present waiting lists.

The past twelve months have witnessed progress in other ways. Representatives of the Bell System and the United States Independent Telephone Association have worked out a plan for coordinating their efforts to bring mobile service within the reach of all who want it. This arrangement, among other things, will insure continuous coverage of highways traversing both Independent and Bell exchanges, enabling any mobile service

BELL SYSTEM MOBILE RADIO SERVICE



customer to take full advantage of the service while in either Bell or Independent territory.

During its second year, too, mobile service underwent continuous improvement. To improve the quality of service and to enlarge radio coverage in mobile service areas, land transmitters were re-located or increased in number where required, and additional auxiliary receiving stations installed. Marked progress was also made in operating techniques and in the quality of transmission and reception through reduction of radio interference.

Those who have mobile service like it. The telephone companies have received hundreds of letters from customers expressing satisfaction with the service and pointing out its value in routine business operations as well as in emergencies and other unusual situations.

News Notes

O. E. BUCKLEY presented the award for first prize in the A.I.E.E. District 3 prize paper contest for 1948 to J. B. Walsh, senior of the Department of Electrical Engineering at Manhattan College, on May 7, at the annual district student convention luncheon. Dr. Buckley spoke on *The Scholar's Contribution to Industry in a Free Society* during the annual meeting of the Associated Harvard Clubs, May 14-16, in Philadelphia. At Cornell on May 25, he attended a meeting of the Engineering College Council of which he is a member, and on May 27 and 28, the Western Electric President's Conference at Skytop.

DR. BUCKLEY, A. B. CLARK and D. A. QUARLES attended the dedication of the Microwave Campanile and new Research Laboratories of the International Telephone and Telegraph Corporation in Nutley, N. J. Mr. Clark, Mr. Quarles, G. W. GILMAN, R. E. POOLE and A. TRADUP attended the celebration of the 85th anniversary of the Signal Corps at Fort Monmouth.

M. J. KELLY visited the Southwestern Bell Telephone Company at Kansas City, Missouri, on May 14. From May 25 to 28, Dr. Kelly attended the Western Electric President's Conference at Skytop.

A. B. CLARK selected *Communication Trends* as the subject of his lecture for students and faculty members of the Communications Special Staff School at Gunter Field, Alabama, on May 12, and for those of the Air Command and Staff School, Air University, Maxwell Field, Alabama, on the following day.

July Service Anniversaries of Members of the Laboratories

40 years

H. D. MacPherson

35 years

D. G. Blattner
J. V. Kelly
F. T. Meyer
Morton Sultzer

30 years

W. L. Black
C. A. Frank
E. T. Herwig
W. J. Hill
R. N. Hunter
A. B. Kvaal
A. D. Liguori
S. H. Lovering
H. B. Nienstedt
William Spangenberg
J. W. Stoner
C. E. Sunderland
Philip Venneman
F. E. Ward
H. O. Wood

25 years

L. G. Abraham
J. G. Chaffee
P. A. Ciampa
J. E. Clark
T. L. Corwin
R. E. Crane
J. D. Cummings
Otto Drost
O. D. Engstrom
R. O. Ford
G. W. Gilman
C. R. Gray
L. E. Harrison
H. W. Herrington
O. J. Jambory
V. L. Johnson
R. E. King
R. G. Koontz
Francis Kuchas
E. A. Kuenzler
A. C. Laite
G. C. Lord
H. I. Miller
C. Erland Nelson
H. T. O'Neil
Charles Schneider
J. L. Sherry
Walter Steinmetz
J. R. Stone
A. C. Walker
C. D. Walker
D. H. Wetherell

20 years

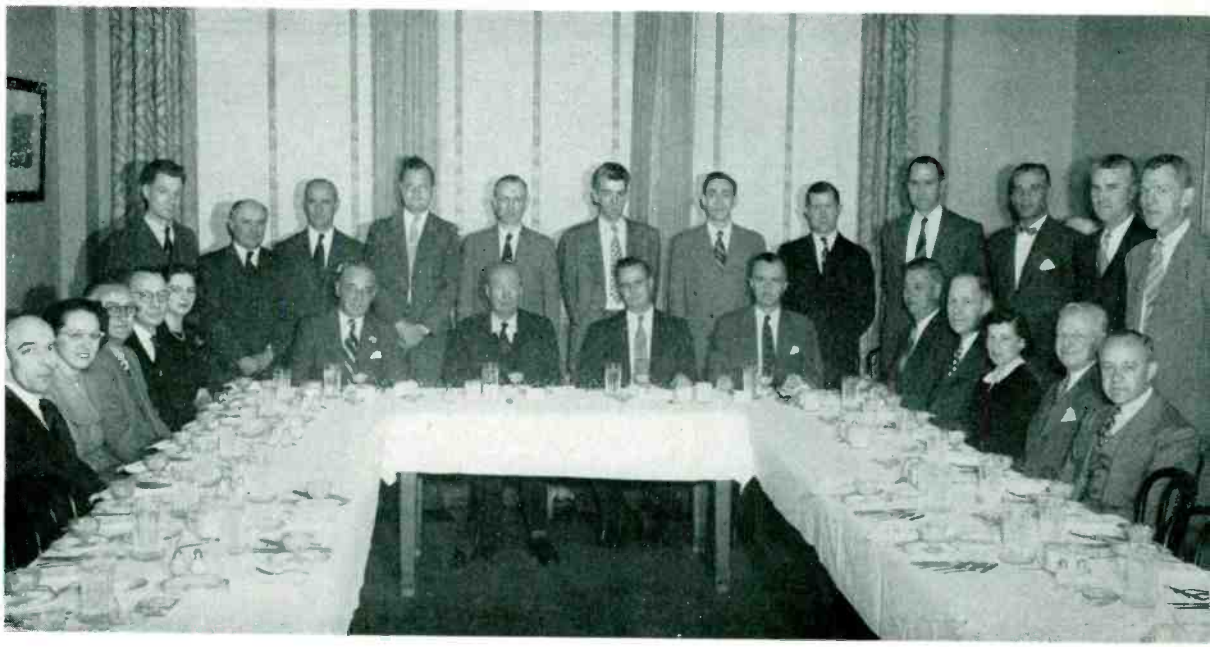
L. E. Abbott
H. W. Augustadt
F. P. Balacek
A. C. Beck
C. F. Benner
J. B. Bishop
E. M. Boardman
Arthur Boratto
W. F. Brown
F. A. Coles
W. L. Cowperthwait, Jr.
C. B. Dalphin
T. E. Davis
R. G. Dolbear, Jr.
C. B. H. Feldman
Joseph Fischer
A. D. Fowler
H. G. Geetlein
Casimir Glazar
W. M. Goodall
W. B. Harris
K. G. Jansky
A. S. King
H. M. Knapp
S. J. LaRoche
J. G. Matthews
Patrick McLaughlin
E. E. Mott
W. A. Niewandt
F. C. Ong
L. G. Petrich
A. C. Peyman
R. J. Phair
Esther Rentrop
T. E. Roche
W. C. Royal
W. M. Sharpless
H. A. Skou
B. E. Stevens
W. D. Stratton
J. J. Strodt
S. M. Sutton
R. L. Taylor
R. E. Thiemer
Wilbur Van Haste
J. G. Walker
Joseph Wall
E. J. Walsh
E. C. Walsman
H. A. Wenk
G. W. Wheeler
W. A. Yager

15 years

L. S. Cooper
A. A. Machalett

10 years

D. K. Batchelor
J. W. Bell
S. J. Elliott
G. N. Packard



Bell Laboratories Club marked its twenty-fifth anniversary at a luncheon which was presided over by O. E. Buckley and which was attended by the old and new officers. Seated clockwise round the table are G. H. Reuble, Mildred Hoogstraat, second-vice president for 1948-9, *N. R. Pape, R. A. Deller, Christine Smith, D. D. Haggerty, Dr. Buckley, G. N. Thayer, retiring president of the Club, E. K. Eberhart, newly elected president, F. D. Leamer, F. J. Singer and Florence McGuire, retiring vice-presidents, J. C. Kennelty, first vice-president for* 1948-49 *and O. Kimmell. Standing are left to right, J. E. Shafer, L. S. C. Neeb, C. H. Haynes, F. E. DeMotte, R. B. Miller, G. E. Perreault, E. R. Casey, C. A. Naughton, J. Marshall, A. J. Kuczma, E. W. O'Hara and R. L. Shepherd*

R. L. Jones presided as Chairman of the Standards Committee of the American Institute of Electrical Engineers at the meeting held on May 7 in New York.

R. W. King's article *How to Price Political Liberty Out of the Market* was published in April, 1948 issue of *Electrical Engineering*. His article, *A Plan for Reviving Private Support of Pure Science in the United States*, was published in the Spring Issue, 1948, of *American Scientist*.

Ralph Bown attended the annual meeting of the Industrial Research Institute at White Sulphur Springs, West Virginia.

Harvey Fletcher represented the American Physical Society at a ceremony on June 1 at the Universal Chapel, New York, on the occasion of the transfer to France of the body of scientist Jean Perrin who is to be buried in the Pantheon.

W. Shockley spoke on *Ferromagnetic Domains* at a colloquim at Princeton on May 13, and at another at the University of Pennsylvania on May 19. Dr. Shockley, K. K. Darrow and C. Kittel attended the National Academy of Sciences' conference on low temperature physics at Shelter Island. Dr. Kittel spoke on *The Theory of Ferromagnetic Domains* and R. R. Newton, on *The Effects of Metastabled Atoms in Townsend Discharges* at a New York University Physics Colloquium.

W. A. Shewhart addressed a dinner meeting of a group of students in industrial statistics at Massachusetts Institute of Technology on *The Future of Statistics in Industrial Research and Quality Control*.

Elizabeth Wood spoke on *Crystals in Polarized Light* before the Philadelphia Mineralogical Society.

S. O. Morgan selected *Piezo-Electric Crystals* for his topic when he spoke in Plainfield to the New Jersey Mineralogical Society. Mr. Morgan's son, Robert, was a winner of a national scholastic writing award in the competition co-sponsored by *The Newark News* and the radio station WNJR.

The three illustrations of these two pages were among the prize winners of the 22nd Annual Photographic Exhibition of the Bell Laboratories Club

J. F. Neill

C. HERRING's subject was *Some Considerations Concerning Theories of the Oxide Cathode* when he spoke at the Physical Electronics Research Group conference in the Arnold Auditorium at Murray Hill.

A. N. HOLDEN, G. T. KOHMAN, W. P. MASON and R. A. SYKES attended a meeting held by the Signal Corps at Ft. Monmouth's Squier Laboratory on the production and properties of quartz and synthetic crystals.

R. M. BURNS visited Princeton University as a member of the Advisory Council to the Department of Chemistry. He also went to Washington as a member of the Advisory Committee on *Metallurgical Program of the National Bureau of Standards*. Dr. Burns has been named Chairman-Elect of the New York Section, American Chemical Society. He was also in Columbus for the Electrochemical Society convention and in Chicago for that of the American Chemical Society.

C. V. LUNDBERG discussed rubber-covered wire problems with engineers at the Point Breeze plant of Western Electric.

G. N. VACCA has been reelected treasurer of the North Jersey Section, American Chemical Society; C. S. FULLER and W. O. BAKER, National Councilors from the North Jersey Section; and B. S. BIGGS, an Alternate Councilor.

K. G. COUTLEE attended a meeting of A.S.T.M. Committee D-9 on *Insulating Materials*, at Philadelphia. He also attended the convention of the American Ceramic Society and an A.S.T.M. meeting of Committee C-14 on *Glass*, and then visited the Western Electric Company at Hawthorne on insulating material problems. With G. H. WILLIAMS, S. M. ARNOLD, and members of Western Electric, at the American Instrument Company, he inspected humidity control equipment.

D. B. HERRMANN and V. T. WALLDER visited the Western Electric Company at Point Breeze to discuss insulation resistance measurements of rubber compounds.

K. G. COMPTON was at the Forest Products Laboratory at Madison, Wis., to discuss the project sponsored by the Laboratories in which the Leutritz soil-block method of testing wood preservatives is being standardized for the wood preservation industry. J. M. WILSON and R. H. COLLEY were also in Madison for a discussion with packaging engineers of the Western Electric Company and the Forest Products Laboratory on problems of pack-

A. J. Pascarella

aging for domestic shipment. Mr. Compton also engaged in the packaging meetings and, en route, visited Hawthorne to discuss chemical problems.

W. E. CAMPBELL was elected Chairman of the New York Section, American Society of Lubricating Engineers.

H. PETERS went to Hawthorne in connection with telephone booth flooring mats.

M. D. RIGTERINK gave a talk on *Some Factors Affecting the Dielectric Properties of Steatite* at a meeting of steatite production men and graduate students at Rutgers University.

C. J. CALBICK and G. K. TEAL attended the meeting of the American Physical Society in Washington.

J. R. WILSON, N. Y. PRIESSMAN, J. R. FLEGEL, G. K. TEAL and J. G. WHYTOCK discussed semi-conductor devices at Allentown.

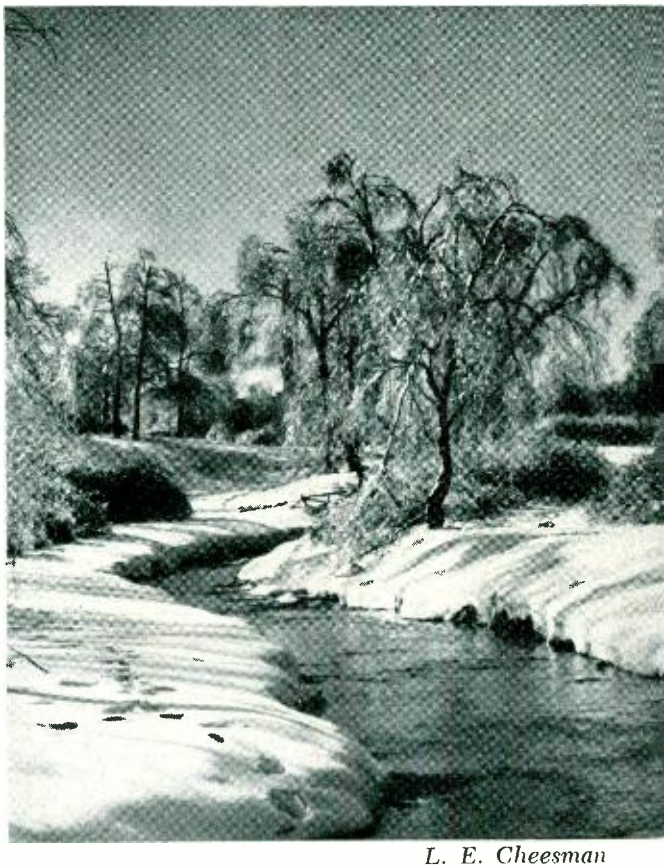
H. A. BIRDSALL, D. A. MCLEAN, C. A. WEBBER and H. H. STAEBNER visited the R.C.A. plant in Camden to discuss high frequency heating of cotton yarn.

H. CHRISTENSEN and C. J. CALBICK gave a paper entitled *Sintering Process Study by Electron Micrography* at the Washington meeting of the American Physical Society.

C. C. HIPKINS addressed a gathering of paint formulating chemists on *The Evaluation of Organic Finishes*, under the auspices of Wayne University and the Detroit Paint, Varnish and Lacquer Association, in Detroit.

J. R. TOWNSEND, as a member of the John Wesley Hyatt Award committee for achievement in plastics, attended the seventh annual award ceremonies on May 25 in the White House where President Truman made the presentation to the Research Director of the Formica Insulation Company.

K. G. COMPTON visited Hawthorne for discussions on finishes and materials. With A. Mendizza, he also visited offices of the Southwestern Bell Telephone Company in St. Louis for conferences on corrosion. At a National Association of Corrosion Engineers meeting in St. Louis, Mr. Compton spoke on *Building Organic Protective Coatings to Special Requirements*. Another paper, *Corrosion of Telephone Outside Plant Material*, coauthored by Mr. Compton and A. MENDIZZA and presented by the latter at the meeting. Mr. Compton attended the American Electrochemical Society convention at Columbus.



L. E. Cheesman

G. H. WILLIAMS' visit to the Dow Chemical Company at Midland, Michigan, concerned the engineering control of polystyrene foam for radio relay systems.

R. BURNS attended conferences at Hawthorne on insulating material problems in crossbar and step-by-step apparatus.

J. J. MARTIN and W. ORVIS discussed laboratory facilities for coating and impregnating papers and fabrics during visits to the Micarta Plant of the Westinghouse Electric Corporation at Troffard, Pennsylvania, and at their Research Laboratories at East Pittsburgh. They also visited the laboratories of the Reichhold Chemical Company at Detroit. Mr. Orvis visited Hawthorne and the Archer Avenue plants on plastics molding problems.

L. A. WOOTEN participated in the M.I.T. Electronics Conference. With W. G. GULDNER he attended the American Electrochemical Society meeting in Columbus where he presented a paper, coauthored by Mr. Guldner, entitled *Reactions of Zirconium with Gases at Low Pressure*.

E. H. Chatterton Retires

Although he had been engaged with the Western Electric for two short periods in 1905 and in 1917, E. H. Chatterton's Bell System career really began in 1920 when he took up the preparation and checking of specifications in our Apparatus Development Department. In 1921 he took charge of a group handling specifications on carrier and transmission testing apparatus and, later, apparatus developed by the Commercial Products Department. Late in 1936 he went to the Graybar-Varick building where he was in charge of the group handling the specification work for the Commercial Products Department. From 1939, when he returned to the Apparatus Specifications Department at West Street he was responsible for specification methods and general engineering projects until a year ago when he was confined to his home by illness. At his own request he was retired as of June 17, 1948.

For more than thirty years he has spent his vacations at Lake Minnewaska in Ulster County, New York. The Chattertons live in Castle Village in Upper Manhattan overlooking the Hudson River. Mr. Chatteron was prominent in many Laboratories tennis and bridge tournaments and for many years has been a member of the Men's Bowling League. He is a member of the Telephone Pioneers.

News Notes

W. G. GULDNER conferred on various chemical procedures for analysis at the American Rolling Mill Research Laboratory in Middletown, Ohio.

R. D. HEIDENREICH spoke on *Electron Metallography* at the first international symposium for light and electron microscopists, sponsored by the Armour Research Foundation of the Illinois Institute of Technology and the Physics Department of the Institute. A. F. PREBUS presided over the session on Instrumentation for Electron Microscopy.

W. O. BAKER spoke before a symposium on *Advances in Rubber Technology* at Brooklyn Polytechnic Institute on *Microgels and Other Structural Elements of Synthetic Rubbers.*

G. T. KOHMAN attended a National Research Council committee meeting on chemical laboratory design at the Mellon Institute, Pittsburgh. He also discussed physiological effects of ethylene diamine tartrate under investigation at the Mellon Institute.

L. E. ABBOTT's visit to the Simplex Wire and Cable Company, Cambridge, and Thomson Gibb Company, Lynn, concerned welding problems of copper wire.

W. BABINGTON was in Philadelphia to attend a special meeting of an A.S.T.M. Committee on *Die Cast Metals.*

G. Q. Lumsden, J. Leutritz, Jr. and A. H. Hearn, inspection triumvirate, in the "sapling" section of the decay test plot at Gulfport, debate the "goodness rating" to be given a specimen just removed from the ground. Approximately 8,000 *such specimens were examined during a complete inspection of the test plot last March. Results are being correlated with those of the Leutritz soil block test, the most rapid now in use. Interpretations are being used as guides for the inspection of poles in the telephone plant.– This photo was taken by K. G. Compton with Mr. Lumsden's camera*

W. A. MARRISON participated in a conference on microwave frequency standards held on May 6 at the National Bureau of Standards in Washington.

W. A. MUNSON attended a meeting of the Advisory Panel for Vision and Hearing Research Work of the Office of Naval Research at the University of Michigan.

B. W. KENDALL was elected First Vice President of the New York Electrical Society at its annual meeting on May 22 at the United Nations' Building at Lake Success.

A. L. DURKEE spoke on the *New York-Boston Microwave Repeater System* before the spring meeting of the Manufacturers Association in Syracuse.

E. E. ALDRICH visited the American Transformer Company in reference to oil-filled transformers for FM radio transmitters. Mr. Aldrich and H. S. FEDER went to Kearny in connection with the manufacture of molded parts for power transformers.

C. A. BRIGHAM attended conferences on the construction of experimental transformers at the Sperry Gyroscope Company.

W. T. MCMAHON's trip to Haverhill concerned manufacturing problems on frequency generators and voltage regulators.

W. P. MASON, H. J. MCSKIMIN, J. F. MULLER and G. W. WILLARD attended the meeting of the Acoustical Society of America in Washington. The following papers were among those presented: *Energy Losses in Sound Waves in Metals Due to Scattering and Diffusion* by W. P. MASON and H. J. MCSKIMIN; *Mercury Delay Lines*, H. S. MCSKIMIN; *Design of Focusing Radiators*, G. W. WILLARD; and *Effects of High Intensity Ultrasonic Radiation*, J. F. MULLER and G. W. WILLARD. Mr. Mason has been elected to the Executive Council of the Society and M. B. GARDNER and ROGERS H. GALT, Fellows.

IN THE PHYSICAL REVIEW, May 1, 1948, J. B. JOHNSON has written on *Secondary Electron Emission from Targets of Barium-Strontium Oxide*; and W. P. MASON, W. O. BAKER, H. J. MCSKIMIN and J. H. HEISS, *Mechanical Properties of Long Chain Molecule Liquids at Ultrasonic Frequencies*. *The Letters to the Editor* columns contain letters by L. H. GERMER and F. E. HAWORTH on *A Low-Voltage Discharge Between Very Close Electrodes;* by A. J. AHEARN on *Conductivity Induced in Diamond by Alpha-Particle Bombardment and its Variation Among Specimens;* and by R. R. NEWTON on *Ejection of Electrons by Ions at High Fields*.

W. M. GOODALL has written on *Experimental Studies of a Remodulating Repeater* in the May, 1948, *Proceedings of the Institute of Radio Engineers*.

K. K. DARROW's article *The Experiment of Davisson and Germer*, in which he disserts on the discovery of the wave-like qualities of the electron appeared in the May issue of *Scientific American*.

K. G. JANSKY, on May 6, participated in the conference on *Radio Astronomy* at the Naval Research Laboratories in Washington.

"The Telephone Hour"

NBC. Monday Nights, 9: p.m.

July 12	*Chloe Elmo*
July 19	*Polyna Stoska*
July 26	*Polyna Stoska and a special opera program*
August 2	*Gladys Swarthout*
August 9	*Claudio Arrau*

Bell Labs championship bowling team at the Western Electric Radio Shops in North Carolina look over their trophy. Standing, left to right, are A. F. Jacobsen, L. V. Pray and H. Z. Hardaway. Seated are V. J. Vierling and R. C. Snook

These six chauffeurs won an award from the Greater New York Safety Council for accident-free driving in 1947. *They covered* 37,323 *miles in Laboratories cars, mostly in heavy city traffic. Martin Quinn holds the citation; behind him are John Landers, Albert Jost, William Gebhard, Patrick Burke and John Hanley*

W. W. MUMFORD presented a paper entitled *Filters in Wave Guides* in Washington before the May 4 joint meeting of the URSI and the Institute of Radio Engineers. L. C. TILLOTSON also attended.

C. T. GRANT visited the Electronic Laboratory of the General Electric Company in connection with filters for radio apparatus.

C. N. HICKMAN broke three Bell Laboratories Archery Club records during the last meet in May, with a high score of 764, the greatest number of perfect ends at 4, and the highest number of golds (arrows in the bull's eye) at 69.

R. A. SYKES attended a Research and Development Board meeting of the Sub-Panel on Frequency Control Devices in Washington.

I. E. FAIR and A. W. WARNER, at the Standard Piezo Company in Carlisle, Pa., discussed crystal problems.

I. E. FAIR and L. F. KOERNER visited the Radio Shop at Burlington to discuss problems of oven manufacture for crystal units.

F. S. KAMMERER visited Point Breeze in connection with cord development problems.

E. I. GREEN, W. L. CASPER and N. BOTSFORD were at Haverhill for a discussion of apparatus for type-N carrier. Mr. Green, Mr. Casper, F. J. GIVEN, E. B. WOOD, R. O. GRISDALE and R. A. SYKES visited the Allentown plant in connection with switchboard lamps and crystals.

E. B. WOOD, D. R. BROBST and H. C. DEVALVE conferred with Western Electric engineers at Tonawanda on enameled wire and switchboard cable.

D. G. BLATTNER and H. A. LARLEE observed how the equipment returned for repair purposes is handled at the Repair Shop in Boston, from the standpoint of making our repair specifications most convenient to the customer.

R. A. HECHT visited the Western Electric plant at Point Breeze to discuss rubber jacketed plugs.

E. C. ERICKSON attended standardization meetings on screw threads and American gage design in Washington.

S. D. WHITE was elected president of The Stelton Improvement League of Raritan Township. This association aims to develop, through meetings, conferences and projects, a better community in which to live.

H. C. LLOYD has returned from Winston-Salem after having spent several months there assisting in the production of airborne equipment.

J. R. LOGIE, JR. conferred at the Philco Corporation at Philadelphia on various production problems.

"Daddy, my telephone won't work anymore"

R. L. MATTINGLY visited the Gorham Company at Providence in regard to waveguides.

J. H. HERSHEY inspected navy equipment at Boston on two occasions.

J. B. D'ALBORA consulted with Allentown engineers on vacuum tube problems.

F. E. NIMMICKE and H. T. BUDENBOM's visit to Washington was for vacuum tube production conference with the Navy.

H. A. BAXTER studied gear problems at the Palmer-Bee Company in Detroit.

J. H. COOK has left for an extended visit to the Douglas Aircraft Company at Santa Monica.

AT WINSTON-SALEM recently, A. B. DOORNHEIM, F. E. DEMOTTE and L. W. BERRY conferred on airborne equipment and its production; and F. E. NIMMICKE, J. B. D'ALBORA and J. H. HERSHEY on naval equipment.

H. T. BUDENBOM attended a meeting of the RMA Waveguide Committee in New York.

H. E. MARTING, K. G. COMPTON, J. M. WILSON and A. MENDIZZA discussed packing of equipment with members of the U. S. Signal Corps Laboratories at Fort Monmouth.

J. A. POTTER conferred on the paralleling of high-current regulated rectifiers with the Power Equipment Company at Detroit.

H. M. SPICER observed new power transformer designs at the Superior Electric Company's plant at Bristol, Conn.

T. A. DURKIN, at Tonawanda, discussed development problems on inside wiring cable.

J. B. DIXON and O. B. COOK observed aerial cable lashing in Baltimore.

J. G. BREARLEY and H. D. BREINER made electrical tests on buried cable in South Carolina and Georgia.

F. E. DeMotte recently presented this trophy to F. B. Vreeland for the Whippany Shop-Service softball team, while B. C. Guinter, G. DeVries, F. Dormer, J. J. Turkovic, J. Reinert, R. G. Dolbear and A. S. Allocco watch the proceedings

R. A. CUSHMAN and R. W. BENFER went to the Warner and Swasey Company, Cleveland, and the Vinco Corporation, Detroit.

F. G. COLBATH and L. F. WRIGHT visited the Western Electric Company at Hawthorne to discuss circuit engineering problems.

J. A. BECKER, J. R. WILSON and J. J. KLEIMACK, in Washington, discussed thermistor bolometers with Navy representatives. Dr. Becker and J. N. SHIVE attended the Washington meeting of the American Physical Society at which H. CHRISTENSEN and C. J. CALBICK presented a paper entitled *Sintering Process Study by Electron Micrography.*

M. C. WALTZ and ELIZABETH MERRELL spent three weeks in Allentown in connection with work on germanium varistors.

V. T. CALLAHAN and L. D. FRY attended the cutover of the Malden (Mass.) crossbar office, in which the first two 150-kw Diesel engine alternator sets had been installed for emergency power supply. Mr. Callahan also visited the Sheppard Diesel Engine Company's plant at Hanover, Pennsylvania, to discuss the manufacture of their engines.

S. M. SUTTON observed the manufacture of special unglazed clay conduit for field trial purposes during a visit to the Brazil (Ind.) Hollow Brick and Tile Company.

R. M. C. GREENIDGE discussed cable terminals at Point Breeze.

L. VIETH and H. C. CURL visited the Bureau of Ships in Washington in connection with beach master announcing equipment.

H. S. HAMILTON 1893-1948

MARION HUNDRIESER 1910-1948

Recent Deaths

HAROLD S. HAMILTON, May 21

Mr. Hamilton, a retired member of the Laboratories since October 1937, died at East Derry, New Hampshire, where he had attended school as a child. He entered the New England Telephone and Telegraph Company as an operator in 1915 and worked evenings a year until he was graduated from Tufts College in 1916 with a B.S. degree in Electrical Engineering. He then transferred to the Engineering Department of A T & T and with the division of that department in 1918 became a member of the D and R. In the 1934 consolidation, Mr. Hamilton became a member of the Laboratories Technical Staff. During all that time, he had engaged in development pertaining to toll transmission including telephone repeaters, program transmission and carrier systems. Mr. Hamilton's wife survives him.

MARION L. HUNDRIESER, June 5

Mrs. Hundrieser, who was known at the Laboratories as Miss Leworthy, joined Transcription on August 27, 1928, and shortly thereafter was transferred to the Personnel Department as a stenographer for the Employment and Benefit groups. In 1935 she became engaged in secretarial duties in the Apparatus Development Department and was secretary to D. G. Blattner just prior to her retirement in January, 1946.

News Notes

A. A. HEBERLEIN, A. R. RIENSTRA and F. A. BROOKS visited the Long Lines repeater station at Princeton in connection with the maintenance of 311A vacuum tubes in K1 carrier system. Mr. Heberlein, F. B. ANDERSON and P. T. HAURY spent two days at Albany closing out a trial of special 374A type vacuum tubes which had been conducted in the Albany office for several months. Mr. Heberlein attended the A.I.E.E. conference on Electron Tubes at Philadelphia.

H. A. LEWIS, P. T. SPROUL and J. R. BRADY observed, at the Race Street toll office in Philadelphia, the first television network control center then being installed for service during the national political conventions.

D. C. SMITH, C. T. WYMAN and W. L. FRENCH visited Providence to discuss aerial cable matters with the New England Telephone and Telegraph Company.

A. J. WIER observed EDT crystal culture at the Allentown plant of Western Electric.

Classroom instruction is given weekly at Whippany as part of the drafting assistant training program. B. W. Bennett of the Personnel Department is instructor. Left to right, R. E. Hornbruch, J. V. Sagarese, A. J. Rosselet, A. Hanzl, Mr. Bennett, E. W. Van Wyck, J. P. Swart, E. W. Wintermantel, E. W. Hayford, O. W. Reisenauer and J. A. Donlevy. Not present, A. J. Hickson and J. N. Spiewak

Transcription at Davis building is comprised of the following girls, under the supervision of Mabel Healy in the foreground, who render typing and stenographic service to patent engineers and attorneys: front to rear, first row, Florence Guillaume, Virginia Lent; second, Emily Juiliano, Ida Phillips, Diana Lalli; third, Florence Conley, Gladyce Farber, Anne Kalfa; fourth, Kathryn McGaughin; foreground, Helen Kubu, Jean Cameron; fifth, Hannah Sarfaty

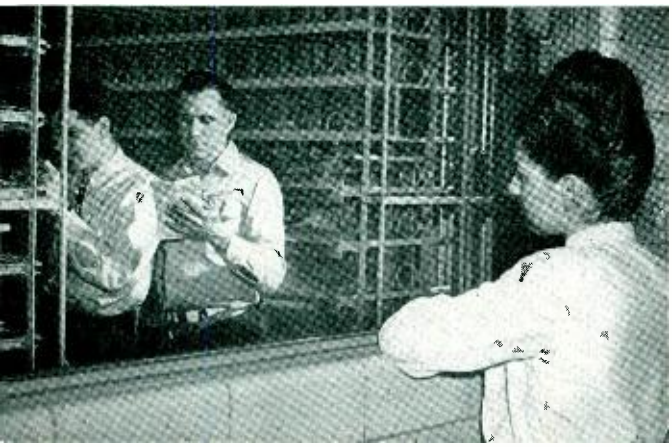
R. W. LANGE and O. D. ENGSTROM participated in field tests of the 46A transmission measuring system which is a visual instrument for observing delay distortion on the L-1 coaxial system. These tests were made at New York and Philalelphia. Purpose of these observations is to obtain satisfactory delay equalization for the transmission of television.

F. H. KING and G. B. THOMAS, JR. have started work on another N-1 trial on exchange area trunks, between the East 13th Street telephone office in New York City and White Plains.

E. H. PERKINS went to Watertown, Wis., in connection with a trial of the new N-1 carrier system between Milwaukee and Madison. R. M. HAWEKOTTE made a rapid survey of the cable route in preparation for noise tests which he is to undertake. J. W. DEIST, on loan from the Wisconsin Telephone Company, is acting as field representative for the Laboratories on this trial, and H. F. LOEFFLER, also of the Wisconsin Company, is participating in the trial activities.

R. I. GAME visited Mobile and Atlanta for the installation of carrier program on J carrier.

Under the direction of Mary Simone of Loeser's Department Store in Brooklyn, a class of ten Pioneers are taking sewing instructions on Wednesday evenings at West Street. Left, Miss Culbert again learning about the use of an electric machine from the assistant instructor Gloria Lundell. Right, Rose Rovegno, Hattie Bodenstein, Anna Kiernan, Miss Simone measuring Eleanor Ringel, and Elizabeth Culbert



An interesting feature of the new River Grove central office, near Chicago, is the plate glass window which allows the public to see the dial equipment without going into the equipment room. As demonstrated here, the window gives visitors an unobstructed view, and serves the added purpose of protecting the delicately adjusted contact points of relays and switches from the dust and lint which might be brought in on clothing

W. G. DOMIDION, JR., supervised the installation of the Hartford servicing center of the New York-Boston microwave radio relay system. This visit followed an eight weeks' training course for Long Lines personnel assigned to the servicing center, which was conducted by Mr. Domidion at the Laboratories.

J. P. HOFFMANN visited St. Louis to observe the heating effect of miniature apparatus.

W. L. TUFFNELL, R. C. MINER and J. F. DALTON were at Archer Avenue, Chicago, to discuss the station handset.

R. BLACK attended a microphone committee meeting of the R.M.A. in Chicago.

J. M. ROGIE, at the Montgomery Company in Windsor Locks, discussed hearing aid cords.

J. R. POWER participated in the discussion on hearing aids at the Walter Reed Hospital in Washington, held under the auspices of the United States Medical Corps.

C. T. MOLLOY, of the Station Apparatus Development Department, has received his Doctor's degree from New York University.

THE LABORATORIES were represented in interference proceedings at the Patent Office during May by R. J. GUENTHER and G. T. MORRIS before the Primary Examiner, H. S. WERTZ before the Examiner of Interferences and J. C. MORRIS before the Board of Appeals.

J. M. EGLIN has been appointed to an I.R.E. Subcommittee on Definitions and Symbols for Video Signal Transmission, and L. W. MORRISON, a member of the Audio and Video Techniques Committee of the Institute of Radio Engineers for 1948.

WHEN AN OHIO woman's house caught fire recently, she led her two children to safety, then returned to telephone the fire department. As the flaming building was too hot to enter, she broke a window beside her telephone, only to find the instrument burning, too. She tried it anyway and her call went through to the fire department.

THE MILLIONTH TELEPHONE has been installed by the General Telephone Corporation, the largest group of operating telephone companies in the United States outside the Bell System. The installation was made at Richland Center, Wisconsin, by the Commonwealth Telephone Company, a subsidiary. General Telephone Corporation owns thirty companies operating more than 1,000 exchanges.

E. F. SMITH was elected President and Director of the New Providence Township Civic Association, succeeding N. J. EICH who has served for the past two years.

R. O. COVELL was at the Patent Office in Washington relative to patent matters.

MANFRED BROTHERTON gave a lecture demonstration on *Microwave Magic* before the Princeton Engineering Association during their annual dinner and meeting at the Princeton Club of New York. Dr. Brotherton was assisted in the demonstration by J. W. POLLIO.

THE PHOTOGRAPHIC FORUM of Bell Laboratories Club visited Pavelle's color processing laboratories on May 19. Thirty Club members enjoyed an instructive inspection tour guided by Lloyd Varden, supervising process engineer, of Pavelle. He demonstrated unique custom-built printing machines that not only measure exposure time electronically, but also automatically correct many of the amateur's errors. Rigid control of many process steps is constantly monitored by a staff of twelve technicians and chemists.

R. R. ANDRES instructed crews in erecting microwave path testing equipment towers in connection with the New York-Chicago television circuit at Pittsburgh and Fairview, Pa., in the Long Lines Division 2 area and at Bryan and Wauseon, Ohio, in the Long Lines Division 6 area.

A. A. Oswald, F. A. Hubbard, E. J. Howard, H. L. Holley and G. Rodwin, at Burlington, attended production conferences on Type-LE radio equipment. Mr. Oswald spoke before the Winston-Salem Engineers Club on *Overseas Radio* while on a visit to Winston-Salem.

M. L. Almquist and R. W. Chesnut conferred at Des Moines, Dallas and Atlanta with the Associated Telephone Companies concerning the nature of prospective telephone plant growth in those territories.

D. B. Penick, A. J. Aikens and G. P. Wennemer visited Atlanta and Birmingham to participate in a preliminary test of 8-kc carrier program operation over Type-J facilities between those cities.

B. Dysart observed the performance of L-1 systems for VF telegraph transmission in tests between Erie and Cleveland.

C. H. G. Gray attended a meeting of the ASA Sectional Committee on Acoustical Measurements and Terminology, Z-24, in Washington. Prior to the Sectional Committee Meeting, Mr. Gray called a meeting of Subcommittee C of Z24, of which he is Chairman. D. F. Seacord attended the subcommittee meeting on Noise Measurement and Sound Level Meters. Mr. Gray discussed with engineers of the Bell of Pennsylvania, at Philadelphia, transmission problems in the exchange area plant.

"I'll bet that's where they got the idea!"

W. Koenig presented a paper *Quantitative Amplitude Representation in Sound Spectrograms* at the 35th meeting of the Acoustical Society of America in Washington.

O. D. Grismore, M. E. Campbell, J. P. Ralcliff, F. A. Hinshaw and E. J. Buckley participated in tests of L-1 system performance with line amplifiers incorporating recently developed improvements at Dallas.

C. W. Schramm studied newly developed testing and adjustment procedures for L-1 amplifiers at Atlanta and Dallas. He also went to St. Louis for discussions of the new methods of testing.

A double anniversary celebration honoring Louise Muller Coker and Laura Tinelli on reaching thirty years of service in the Laboratories was marked by a dinner at the Gramercy Park Hotel roof garden given by their friends and associates in the Accounting Department. Those present at the main table included Ethel Sauter, Marion Haggerty and the guests of honor, Mrs. Coker and Mrs. Tinelli

F. A. Brooks, A. A. Heberlein and A. R. Rienstra inspected vacuum tubes at the Princeton repeater station which have given six years service in K-1 systems.

J. R. Davey and A. L. Matte have been awarded by the A.I.E.E. Committee on Award of Institute Prizes, the National Prize for Best Paper in the Field of Engineering Practice presented in 1947, entitled *Frequency Shift Telegraphy, Radio and Wire Application*. The award carries a Certificate of Award for each author and $100 in cash.

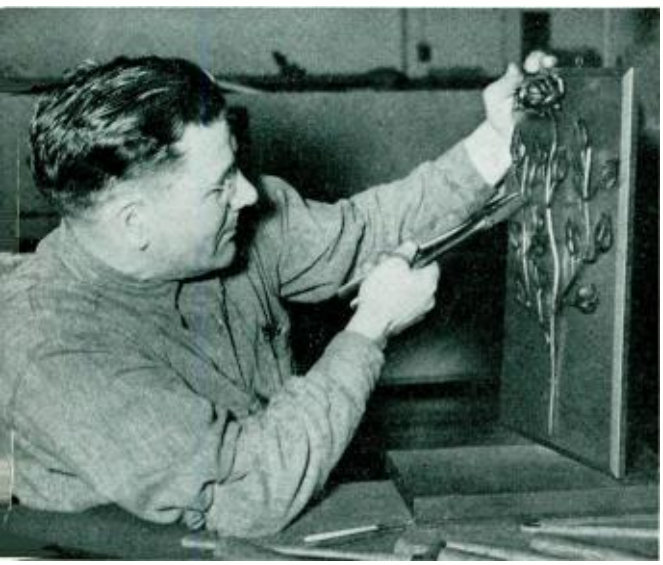
H. W. HEIMBACH, W. B. GRAUPNER and W. E. GRUTZNER were at Hawthorne in connection with equipment development on No. 5 crossbar.

J. G. FERGUSON, E. A. KUENZLER and R. L. LUNSFORD were at Media regarding trial installation of No. 5 crossbar equipment.

W. F. MALONE was also at Media and F. H. MARTIN in Philadelphia on the installation of special equipment.

THE FIRST through highway mobile telephone system on the Pacific Coast was placed in service recently, connecting Portland, Salem and Eugene, Oregon, a distance of 115 miles.

TELEPHONE SERVICE between the United States and the Anglo-Egyptian Sudan was opened recently by Long Lines. The new 6,850-mile communications link consists of a short-wave radiotelephone circuit between New York and Cairo, and wire circuits between Cairo and Khartoum. The rate for a three-minute call is $14.40.



THIS PRIZE WINNING COPPER ROSE, exhibited at the West Street hobby show, is a sample of the work Henry Elhome does in his spare time at home. A sheet metal worker in the Building Shop, Mr. Elhome's assignments include the fabrication of ventilating ducts, guards for machinery, incidental laboratory equipment items and roof repairs.

W. B. CALLAWAY investigated the testing requirements of the single frequency toll line signaling trial at Philadelphia.

CANCER FACTS

Pain is seldom a symptom of early cancer, bu there are other danger signals that should promp one to consult a doctor immediately. They are:

Any sore that does not heal readily, particularl on the mouth, tongue or lips.

A painless lump, especially in the breast, or similar thickening on the lip or tongue.

Bleeding or abnormal discharge from any natura body opening.

Progressive change in the color or size of a wart mole or birthmark.

Persistent indigestion or any significant change i any function of the digestive tract.

Persistent hoarseness, unexplained cough or dif ficulty in swallowing.

F. S. ENTZ and T. W. THATCHER, at Richmond, studied testing reed signaling for urban mobile telephones.

R. B. HEARN, A. J. PASCARELLA and R. W. BURNS visited Philadelphia regarding field tests of the 1A signaling test set.

J. G. CHAFEE was in Boston during the first week of May in Connection with tests on the New York-Boston microwave repeater system.

AMERICANS used the telephone more in 1947 than ever before. More than 37,300,000,000 calls were handled last year by Bell System companies; of this number 35,520,000,000 were local calls, the rest toll and long distance. These figures represent a gain over 1946 of 2,355,000,000 exchange calls and 10,123,000 toll and long distance calls.

W. H. Lockwood, pictured in the Laboratories advertisement on the facing page, is a technica assistant in the rubber laboratory at Murray Hil His job is to compound new mixtures and measur their various properties. Mr. Lockwood is a grad uate of Bridgeton High School and has taken nigh courses at Newark Technical College. He entere the Laboratories in 1934