BELL LABORATORIES RECORD

VOL. XXIX NO. 10 OCTOBER 1951

The Key West-Havana cable:

An electron tube for submarine repeaters

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Electronic Apparatus Development

In the early 1930's, when the decision was made to go ahead with the development of an electron tube for use in submarine repeaters, few of the requirements could be formulated definitely. Obviously long life was essential because replacing a tube would mean raising the cable, with attendant delay and expense. Ruggedness was also necessary to withstand the shocks of cable laying.

In most other respects, the design requirements were indefinite. However, as stated previously,* it had been agreed that the power for operating the repeaters would be supplied by transmitting direct current over the cable, all tubes being connected in series.

If filamentary cathodes were used, the plate voltage would be obtained from the drop across a resistor in series with the filaments. Thus a large part of the available power would be wasted. On the other hand, with indirectly heated cathodes, all of the power could be utilized, provided the total heater voltage drop was equal to the desired plate voltage. This consideration led to the adoption of the indirectly heated cathode.

It was recognized that cathode temperatures lower than customary at the time would be advantageous from a life standpoint. Also, low plate voltage, combined with low cathode current density, should prolong the useful life of the tube. From the over-all system standpoint, it was found desirable to use 0.25 ampere at 20 volts for cathode heating. This provided 5 watts for each cathode, about twice the power generally used for radio receiver tubes in 1933; the cathode area could, therefore, be relatively large.

*RECORD, *April*, 1951, *page* 149.

Table I—Typical Operation and Characteristics:	
Plate voltage	40 volts
Screen-grid voltage	40 volts
Control-grid voltage	−1.5 volts
Plate resistance	0.6 megohm
Transconductance	1050 micromhos
Plate current	1.5 ma
Screen-grid current	0.3 ma

Early work was concentrated on obtaining satisfactory thermionic life. Two tube types were studied—one a triode and the other a suppressor grid pentode, both designed to operate from a 40-volt plate supply. In other respects, the tubes had characteristics comparable to the commercially available tubes of the time.

Although some of these early tubes attained the objective of long thermionic life —some have now operated for about 120,000 hours, or over 13 years—a number of their mates failed relatively early due mainly to mechanical defects. Consequently it was necessary to redesign for greater mechanical reliability while preserving the promising thermionic performance.

Developments in negative feed back amplifiers resulted in the decision, in 1938, to concentrate efforts primarily on the pentode tube because of its high gain in comparison with the triode.

The final tube, shown on page 449, is decidely unconventional in appearance. In place of the usual base and grid cap, ceramic shells are used at each end, with the leads brought out to flexible braided strands to be permanently soldered in the circuit. When mounted in the repeater, the ceramic shells fit into rubber cushions that provide considerable protection against mechanical shock.

For the internal structure, great emphasis was placed on ruggedness. For example, all three grids are wound on molybdenum supports instead of the usual nickel, to obtain added stiffness. Liberal spacings between elements and rigid anchoring of all parts of the tube minimize the hazard of short circuited elements.

Table 1 shows the electrical characteristics of the tube. Relatively low transconductance is the price paid for the wide control-grid to cathode spacing. A family of plate voltage *vs* plate current curves is given in Figure 2, with the approximate operating point indicated at "A".

Assembly of the final lot of tubes from which those for actual use in the Key West-Havana cable were selected was done by experienced operators who had been assigned to this project only. All operations and processes were under close supervision. During assembly, each mount was subjected to many inspections, including those by engineering personnel.

Following evacuation of the tubes, they were checked by optical methods for glass strain. Any tube not considered absolutely safe was marked as not suitable for cable use. Then, after mounting in a temporary housing to simplify handling, the tubes were ready for a long series of electrical tests. These were made in a special test circuit designed and built especially for this one type of tube. Constant current rectifiers supply heater power and constant voltage rectifiers provide the other power requirements. All are adjustable over ranges so limited that accidental damage to a tube is prevented. A photograph of this test set is shown in Figure 2. At the upper left, 6 tubes in their temporary housings are in position for testing. The circuit is arranged so that one group of three tubes may be

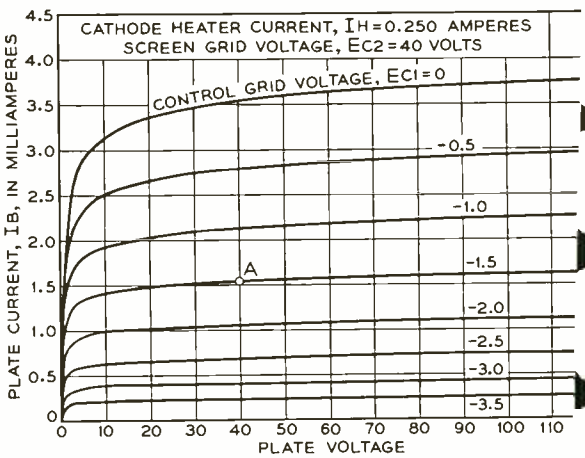


Fig. 1—Plate voltage vs plate current characteristics. The approximate operating point of the tube is shown at "A."

tested while another group of three is warming up so as to reduce waiting time.

Following its initial test, each tube was placed on the aging racks and operated under normal conditions for 5000 hours. During this interval periodic tests were made. At the end of the period, the manufacturing and aging history of each tube was reviewed and a portion of the product was set aside as apparently satisfactory for repeater use. Almost an equal number of tubes, chosen as representative samples, were put on life racks for further study. The tubes finally selected for use in the cable thus came from groups which were continuing to give promise of normal life.

Eighteen tubes are now operating in the two Key West-Havana cables. Although it must be recognized that individual tubes may deviate from normal and fail prematurely, the life expectancies are extremely long. The very satisfactory record of this tube appears to justify optimism.

Fig. 2—D. L. Perry is making measurements on cable tubes using special test equipment especially designed and built for the purpose.

THE AUTHOR: Upon receiving a B.A. degree from the University of Oregon in 1927, E. A. VEAZIE joined the Technical Staff of the Laboratories. Here, with the vacuum tube development group, he engaged principally in the design of multigrid tubes for both low and high frequency uses. During World War II he turned his attention to tubes for computer, radar and other military and naval applications. During the post-war period his work has been primarily concerned with tubes for carrier telephone systems. Since 1938 development work on the submarine cable tube has been under his immediate supervision.

Fig. 1—Dorothy Schmidt loads the degreaser with quartz crystal units. Trichloroethylene from the reservoir at left is vaporized when pumped under a force of 100 lbs. per square inch as a spray against the wall of the cleaning compartment (not shown). The vapor collects on the crystal units in droplets which clean as they flow over the surface.

A degreaser for small parts

D. M. RUGGLES
Crystal Development

Dirt, even in amounts too small for the naked eye to see, can markedly degrade the electrical performance of quartz crystal plates. Before hermetic sealing, crystal unit assemblies must therefore be thoroughly cleaned, with extreme care to prevent damage. For this purpose there has been developed a new degreaser which can also be used to advantage with other small parts.

One method of cleaning crystal unit assemblies is to brush with a camel's hair brush in a bath of trichloroethylene and then rinse in a second bath. But the second bath becomes contaminated after a few rinses and must be replaced. If the second bath is not replaced often enough, it leaves an invisible film of dirt on the quartz plate and consequently the crystal unit does not function in the proper manner.

Vapor degreasers in which a heavy vapor rising from a hot bath condenses on the parts, are inadequate here because the heat capacity of the small parts is too slight to condense enough of the solvent.

An effective method is to spray the assemblies with a continuous supply of freshly distilled trichloroethylene. Ordinarily this method would involve storing a toxic fluid under high pressure with large quantities required for each unit. The new degreaser, Figure 1, achieves the same ends with safety and economy.

The device does not store the liquid under pressure but generates a force equiva-

lent to a pressure of approximately 100 pounds per square inch by means of a pump attached to the motor shaft. While a small amount of liquid spray directly impinges on the objects within the bowl the primary cleaning principle involves atomizing the spray by allowing it to come in contact with the wall of the bowl with such force as to break up the liquid into tiny particles that float around in the bowl and wet everything in the confining area. Particles continue to collect until they form droplets which run down over the surfaces carrying off the soluble contamination. This cleaning action is similar to that of the vapor degreaser.

The volumetric capacity of the device is approximately 120 cc of liquid per minute; 16 crystal units of the type shown in Figure 2 can be cleaned at one time. Each unit requires 3.75 cc of liquid for the standard running time of 30 seconds. The liquid is redistilled and used over again.

This method is used at the Laboratories and at Western Electric Company in the manufacture of quartz crystal units.

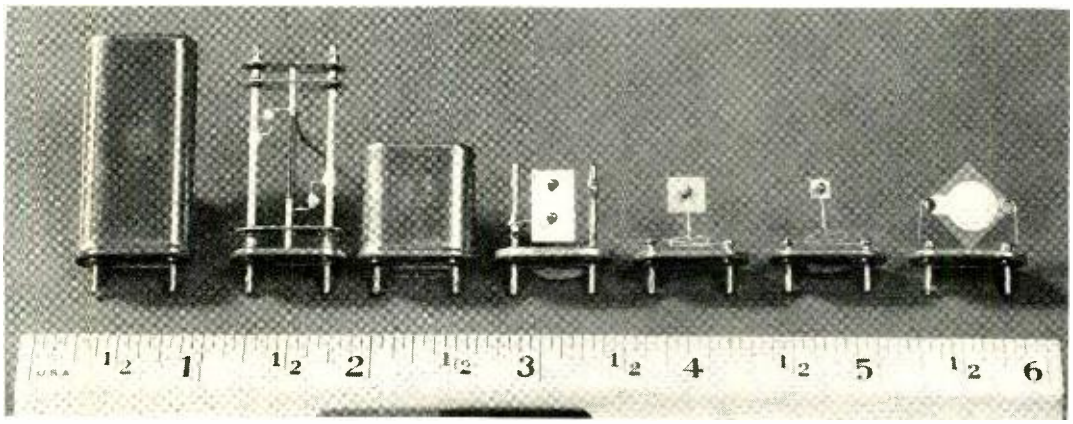


Fig. 2—Crystal units too small for standard degreasers are quickly and economically cleaned by the new degreaser.

THE AUTHOR: D. M. Ruggles in 1927 graduated from Chicago Engineering Institute in Applied Electrical Engineering and up to the war period he was employed as an engineer in the Chicago area. In 1941 he joined the United States Army Signal Corps Depot in Philadelphia where he supervised the quartz crystal laboratory and taught radio courses to Army personnel. He came to the Laboratories in 1944 and has been concerned with development of quartz crystal units for use in oscillator circuits.

Basic AMA central office features

D. H. PENNOYER
Switching Systems Development

Automatic Message Accounting* not only takes the place of message registers and zone registration equipment, but in addition furnishes all the information necessary for the conventional detailed billing of short haul toll calls. The circuits act so quickly that there is no delay in the normal completion of the calls. In fact the subscribers would be unaware of the existence of the new facilities except that they are no longer required to place these calls with an operator. These new accounting facilities are available in both No. 1 and No. 5 crossbar offices; the fundamental features are the same in the two systems although some of the details vary due to differences in the two systems. All the necessary information pertaining to a call is perforated on a paper tape by common AMA control circuits with holding times in the order of 0.1 to 1 second.

A simple block diagram showing the various circuits associated with an AMA call in a No. 5 crossbar office is given in Figure 1. The digits dialed by the subscriber are temporarily stored in the originating register and then transferred to the marker as for a non-AMA call. The marker, through the line and trunk link frames, prepares a path to an idle AMA trunk. It also transfers to an outgoing sender the information needed for completing the call and for making the AMA record. This includes the calling subscriber's line location and party identity, the number of the recorder serving the selected trunk, and a digit known as the message billing index. This digit is determined from the class of service of the calling subscriber together with the office to which his call is directed, and constitutes the basis for determining the charging rate on bulk billed calls where the called number is not recorded on the AMA tape. The sender now signals the transverter connector for connection to a transverter, and transfers to it all the foregoing information.

From the message billing index, the transverter determines whether the call is to be bulk billed on a message-unit basis

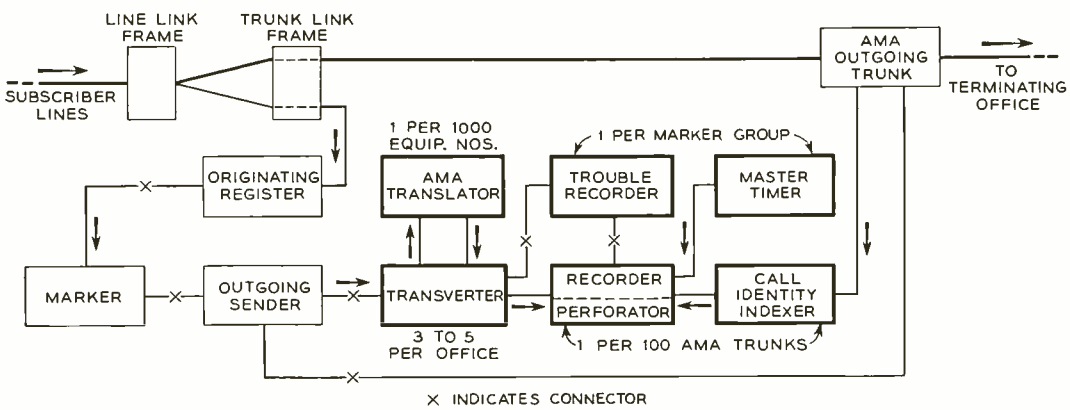


Fig. 1—Block diagram of the circuits associated with an AMA call in a No. 5 crossbar office.

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

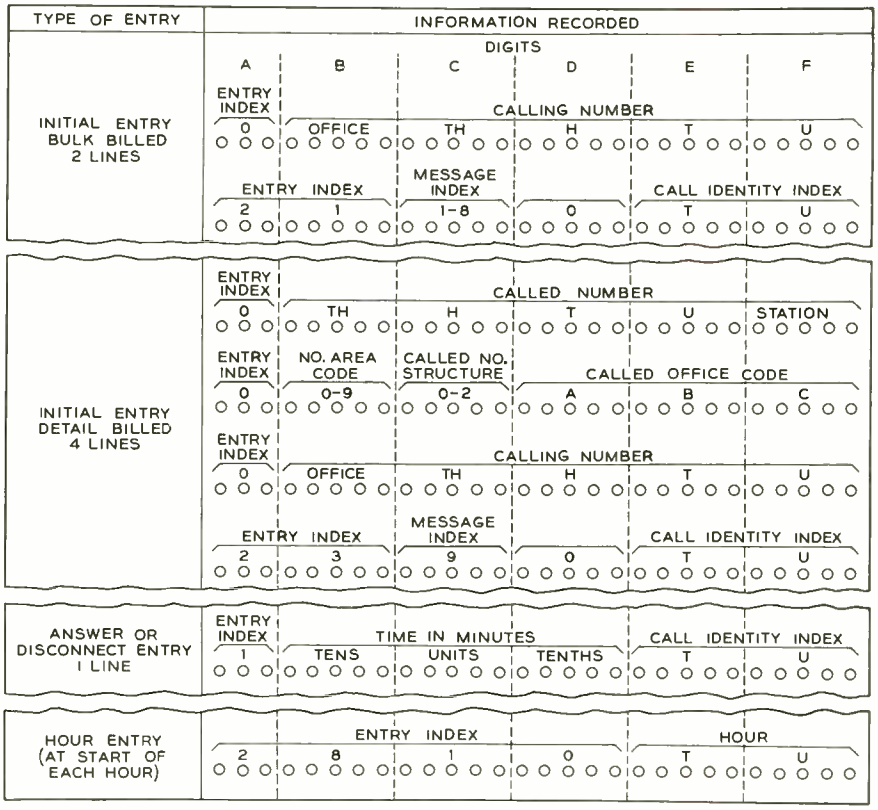


Fig. 2—Arrangement of the more common entries on an AMA tape.

or detail billed to include the called number; for a bulk-billed call a two-line initial entry is adequate, while for a detail billed call, a four-line entry is required. The transverter then summons the translator and obtains from it the directory number corresponding to the calling subscriber's line and party assignments. The transverter also causes the call identity indexer to furnish the call identity index to the recorder. This completes the information required for the initial entry. Primed with this information, the transverter engages the recorder assigned to the outgoing trunk selected, and causes it to operate the proper perforator magnets one line at a time. The actual perforation of the tape is accomplished by a perforator which is individual to the recorder circuits. This initial entry is normally recorded while the switching circuits are completing the connection to the called subscriber's line in a distant office.

The arrangement of the information on the central office tape for the more common entries is shown in Figure 2. Six digits are recorded in each line in positions designated A to F from left to right. For the A digit, one of the three punch positions is perforated to designate digits 0, 1, or 2, while for the digits B to F, two out of five punch positions are perforated to designate digits 0 to 9. The first few digits of each line comprise the entry index, and indicate the type of information the line contains.

At a central office, the lines are perforated in the order from top to bottom of Figure 2. At the accounting center, on the other hand, the tapes are read in the opposite direction, and thus for a two-line initial entry, the accounting center will first read the line whose entry index is 21. This index indicates a two-line entry, and the zero entry index in the next line identifies the second or supplementary line of this entry. The message billing index, or message index, appears at the right of the

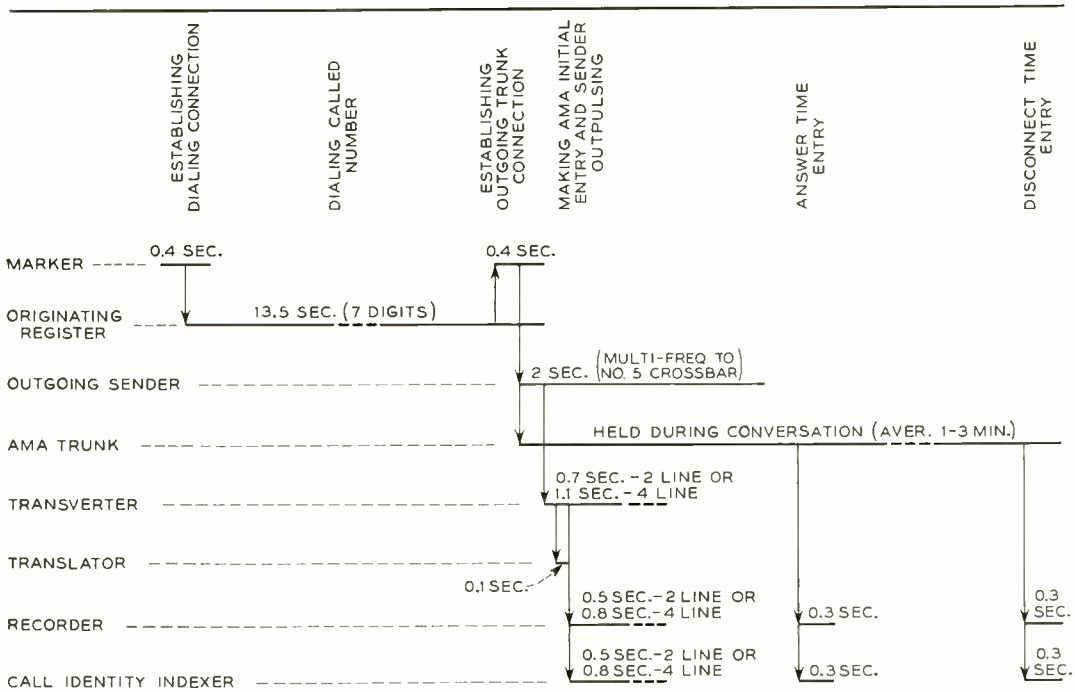


Fig. 3—Holding sequence of the circuits on an AMA call in a No. 5 crossbar office. Circuit holding times are approximate.

entry index, and may be any digit from 1 to 8, inclusive. Next is an unused digit zero, and beyond it are the tens and units digits of the call identity index, which in the No. 5 crossbar system is the trunk number. Two digits are adequate, since no more than one hundred such circuits are associated with a single recorder. In the second line of the initial entry, a single digit suffices to designate the office in which the calling subscriber is located since no more than ten offices are served by a common group of originating equipment, known as a marker group and identified elsewhere on the tape as described later. The calling subscriber's directory number appears in the remaining four digits of this line.

Below the two-line initial entry of Figure 2 is a four-line initial entry used for detail billed calls. The first two lines, in the order read by the accounting center, are similar to those of the two-line entry except that the entry index of the first line is 23 to indicate three additional or supplementary lines, and the message index is always 9. The last two lines of this four-line initial entry both have zero as the entry index, and contain the called office code and the number dialed, a numbering area digit, and a called number structure digit. Since the called office may be outside the local area, it is necessary to identify the area as well as the office, and the called area digit is used for this purpose. Calls to outside areas require special prefix digits for control of the switching equipment, and these digits cause the proper numbering area code to be perforated. The called number structure digit serves to indicate whether the numerical portion of the called number is made up of three digits, four digits with or without a party letter, or five digits as in numbers above 9999; this digit is used by the accounting center for proper printing of the called number.

At the start of conversation, the call identity indexer, under control of the trunk, brings the recorder in on the connection a second time to perforate the time of answer. At the end of conversation, the process is repeated for the purpose of entering the time of disconnect. One of these

entries is shown in Figure 2 below the four-line initial entry. The entry index for this line is a 1, which indicates to the accounting center that the line is an answer or disconnect entry, no differentiation being required between the two. The B, C, and D digits in this line show the time at which the recording was made in terms of tens and units minutes and tenths of a minute past the hour. Digits E and F contain the call identity index for later use by the accounting center in associating this entry with the proper initial entry.

Since the answer and disconnect entries show only the number of minutes past an hour and do not specify the hour, it is apparent that some record of the hour is needed. This is obtained at the turn of each new hour by automatically recording the new hour on the tape of each recorder. Such an entry, with the identifying entry index 2810 followed by the tens and units digit of the particular hour is shown in the last line of Figure 2. The hour information is obtained from the master timer.

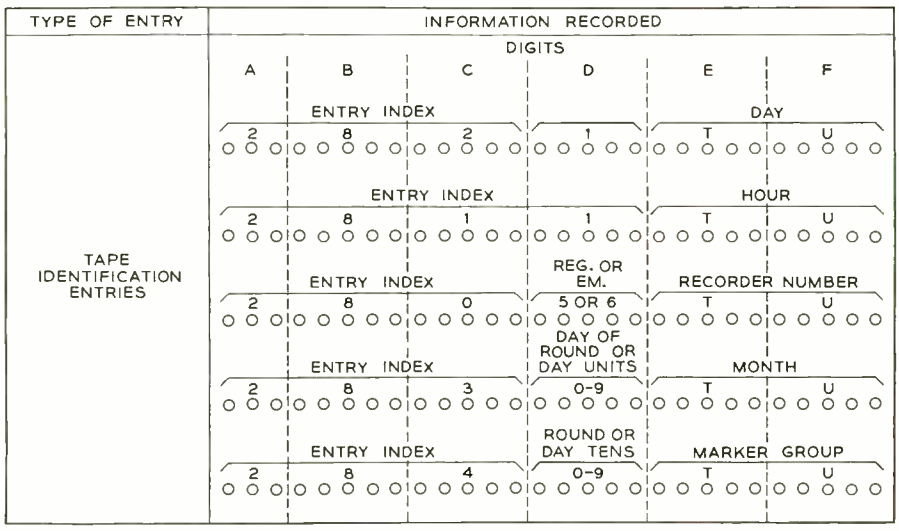


Fig. 4—Tape identification entries, which are perforated on a tape before and after cutting.

An interesting feature of the AMA equipment is its high speed of operation. This is important to insure against delay in the normal completion of calls and also to obtain short holding times for the common control circuits to permit a small number of these circuits to handle all the AMA traffic for an entire central office or group of offices. Figure 3 shows the time sequence in which the various major circuits come into play for both the switching and the AMA tape recording of a call in a No. 5 crossbar office. Approximate circuit holding times are indicated, and (for the AMA control circuits) range from approximately 0.1 second for the directory number translator to 0.7 second for the transverter in handling a two-line entry. A four-line entry engages the transverter for about 1.1 seconds. Between the common control circuits are connectors (not indicated separately in Figure 3) which follow conventional patterns and use preference and chain relay features to avoid interference between simultaneous calls.

The principal function of the master timer is to keep a running record of time in steps of six seconds. This record includes the month, day, hour, tens and units minutes digits, and the tenths of a minute digit. A running record of the time within each hour is delivered to each recorder where it is always available for the recording of answer and disconnect entries. With the turn of each hour, the timer directs the perforation of an hour entry on all recorder tapes as previously mentioned.

Once a day, at 3 A.M. when the traffic is low, a series of special lines is recorded on all tapes to permit cutting them preparatory to transportation to the accounting center. These special lines start with one set of tape identification entries as shown

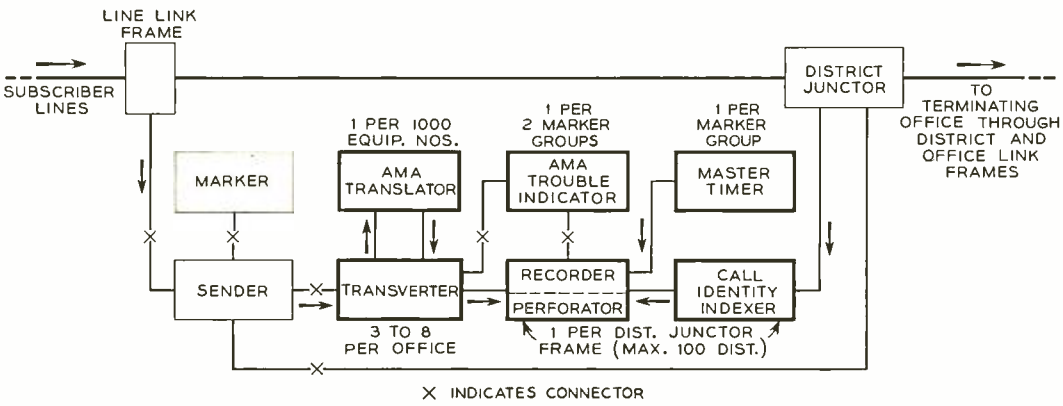


Fig. 5—Block diagram of the circuits associated with an AMA call in a No. 1 crossbar office.

in Figure 4, and are followed with about six feet of a uniform "splice" pattern. A second set of the tape identification entries completes the 3 A.M. record. With this arrangement the tape may be cut anywhere in the splice pattern, and the tape identity information will be available on both sides of the cut.

As shown in Figure 4, the lines of tape identification entries are characterized by three-or four-digit entry indexes, each starting with a 28 and followed by a digit 0 to 4 which identifies the particular line in the entry. These lines, in the order read by the accounting center, start with the one whose entry index is 284. The D digit, together with a corresponding digit in the following 283 line, identify the day on which the tape is perforated, either in terms of calendar day, or round and day of round. A round is a group of consecutive days the business for which is handled as a unit in certain parts of the accounting processes. In some accounting centers it is used in place of the more conventional calendar day. The marker group data is carried by the E and F digits of the 284 line and identifies the unit of common control equipment known as a marker group, which serves one or more offices in the same building. The identity of this unit, together with that of the particular recorder in the unit as provided in the 280 line, will completely identify any recorder tape in an entire accounting center area for a particular day. The D digit in the 280 line is a 5 on regular recorder tapes and a 6 on the tape of the emergency recorder which may be substituted for any regular recorder in trouble. In the latter event, the recorder number shown is that of the regular for which the emergency is substituted. The 282 line records the day, while the 281 line records the hour. The D digit in the 282 line is not used, and its position is filled in with a 1, since every position must have a digit or a trouble will be recorded. In the 281 line, however, the D digit, which is also a 1, forms part of the entry index, which is thus 2811. There are thus two types of hour entries that may be found on a tape: the one just described with an entry index 2811, and the one described in connection with Figure 2, with an entry index 2810. Since these two hour entries may require different treatment at the accounting center, they are differentiated by 0 or 1 as the fourth digit of their entry index.

Many safeguards are designed into the AMA circuits to insure against incorrect charging in the event of equipment failures. For example, digit information is conveyed by the "two out of five" method, and a check is made to determine that no more or no less than two leads in the group of five are grounded before the information is accepted. Critical leads are checked for opens, crosses, and false grounds. If a trouble is encountered, the trouble recorder is summoned and a trouble card is produced showing the condition of the significant relays at the time of failure. In addition to the ability of detecting trouble

on service calls, there is provision for making test calls on all the service circuits.

The above description has been specifically concerned with AMA in a No. 5 crossbar office. In No. 1 crossbar, the basic equipment and circuit features are similar but some of the details are different because of differences in the detailed circuit operations of the two systems. The AMA tapes are identical in the two types of offices, as indeed they would have to be to avoid the need for dissimilar handling at the accounting center. Figure 5 shows a block diagram of the principal circuits involved in AMA recording in a No. 1 crossbar office. In this system the subscriber's dialing is registered directly in the sender instead of initially in a register as in No. 5. Also, the transmission circuit is a district junctor instead of a trunk. In both systems the sender seizes a transverter via a transverter connector, and the operations of the AMA circuits in recording the data on the tape are the same.

THE AUTHOR: D. H. PENNOYER was graduated from Harvard University in 1924 with a B.S. degree in E.E. That year he joined the Laboratories, where he has since been engaged in various phases of design and development work on dial switching equipment for telephone central offices. This originally involved the design of both operating and testing circuits for panel and crossbar types of offices. Later, after helping in the development of facilities for automatically printing tickets on subscriber-dialed toll calls, Mr. Pennoyer, as resident engineer in Los Angeles, participated in the initial installation of this equipment. During World War II, he contributed to the design of a radar project for the Army. Since then he has been concerned with the development of AMA circuits and facilities for central offices, and is now in charge of a group doing this work.

A Bible of Early Electrical Literature

Unheralded and forgotten these days is a remarkable book which catalogues the literature of early magnetic and electrical discovery. This is the two-volume "Catalogue of the Wheeler Gift," published by the A.I.E.E., 1909. It is still available to members of the A.I.E.E. at the original price of $5.00 from the Engineering Societies Library. Second-hand book catalogues quote it at from $7.00 to $15.00. Well edited, and attractively illustrated, the book lists in chronological order, with interpretative annotations, some 6,000 books and pamphlets, running from the 1400's to about 1890. The originals of these entries are in the Engineering Societies Library, where they may be consulted.

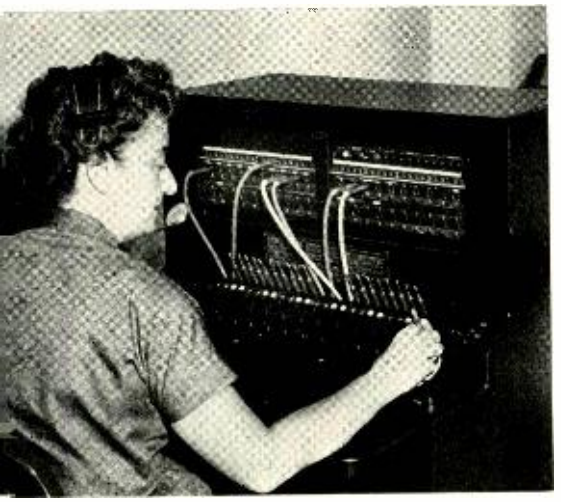
There exist in the world two great collections of early electrical literature. One was made by Francis Ronalds, of early electric telegraph fame in England. This collection is owned by the British Institution of Electrical Engineers, and is the subject of the Ronalds Catalogue published in 1880. This catalogue is now so rare that it is almost impossible to obtain.

The other collection was made by a follower of Ronalds, Latimer Clark, who had taken a prominent part in the early exploitation of the telegraph and submarine cable, in England. When Clark passed on, his collection was purchased in London and given to the A.I.E.E. in 1901 by Dr. S. S. Wheeler of the old Crocker-Wheeler Company of Ampere, N. J. Andrew Carnegie, who subsequently gave the Engineering Societies Building, donated a fund to catalogue and house the Wheeler gift within its Library.

LLOYD ESPENSCHIED

The 740-E PBX

R. D. WILLIAMS
Switching Systems Development



The manual attendant's switchboard that forms part of the 740-E private branch exchange.

For many years now, private branch exchanges of the dial type have been widely used as important adjuncts of Bell System service. The largest standard PBX is the 701-A*, which is capable of serving as many as 9600 station lines. Two smaller dial PBX's, the 740-A†, and the 755-A¶, serving a maximum of 88 and 20 station lines, respectively, have been available for the smaller installations, but many of the 701-A's have been installed where less than 88 lines are required because of their capability of expansion. The upper limit of 88 lines for the 740-A makes it uneconomical when the prospect of growth might call for its replacement by the 701-A.

Another feature that has sometimes made the 701-A preferable to the 740-A is its use of a manual switchboard for the attendant's position instead of the key turret used by the 740-A. On receiving an incoming call, the attendant at the 740-A PBX has to dial the station called even though the line is busy, since there is no indication of busy lines at the attendant's cabinet. When there are many incoming calls, this dialing may absorb an appreciable amount of the attendant's time, and many users, therefore, prefer a manual board so as to make more of the attendant's time available for other purposes. To avoid the need for installing a 701-A in place of a 740-A under these conditions, a manual board has sometimes been supplied with the 740-A, the combination then being known as the 740-AX.

To provide a small PBX that can not only readily be expanded to accommodate considerably more than 80 lines but that has a manual switchboard for the attendant's position, the 740-E PBX has recently been developed. Besides employing a manual board and permitting considerable expansion, the 740-E includes a number of other features new to the small PBX field, such as dial repeating type tie trunks from associated PBX's, and automatic line hunting.

Like the 701-A and the 740-A, the 740-E uses step-by-step switching. When there are not enough lines to require three-digit numbers, the 740-E employs only line finders and selector-connectors, as does the 740-A. The circuit arrangement is indicated in the simplified diagram of Figure 1. On its seven lower levels, the selector-connector acts as a connector: the first digit dialed selects the desired level, and the second digit moves the wiper around the selected level to the position of the called station. On the upper levels, however, the selector-connector acts as a selector: the single digit dialed selects the level, and then the wiper hunts over this level to find the first idle trunk. The number 0 level is generally reserved to reach the at-

*RECORD, *September*, 1929, *page* 36.
†RECORD, *August*, 1928, *page* 399.
¶RECORD, *June*, 1938, *pages* 332 *and* 336.

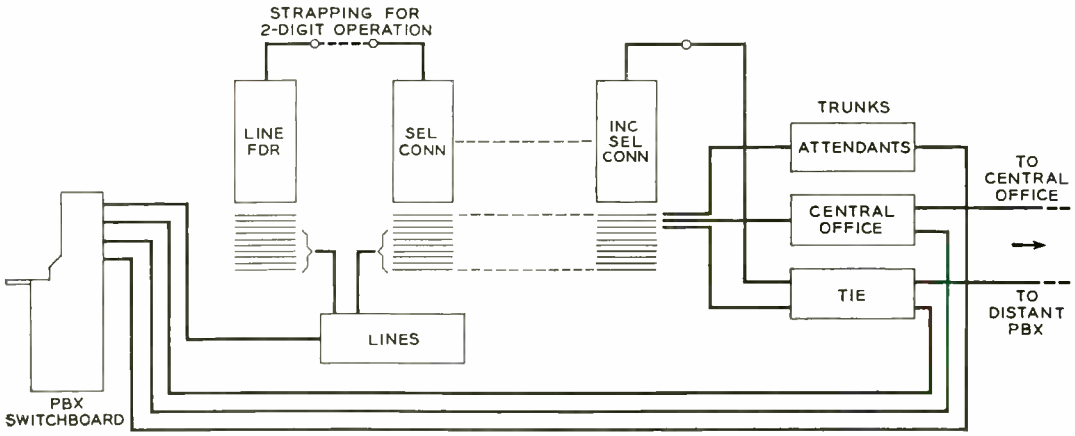


Fig. 1—Circuit arrangement of the 740-E where three-digit numbers are not required.

tendant, the number 9 level to reach central-office trunks, and the number 8 level to reach tie trunks. The 740-E, however, is not restricted to this particular use of the various levels. If there are more tie trunks than can be accommodated on a single level, for example, two levels, such as 7 and 8, might be used. It is also possible to use two digits for trunk designations. When this is done there might, for example, be three groups of trunks on a single level. Thus dialing 81 would cause the selector-connector to step to the 8th level and then to hunt over the first three trunks on that level; dialing 84 would cause it to step to the 8th level, then to the 4th position, and then hunt over the next three, and so on. Considerable flexibility is provided in the assignment and coding of all such trunks. Also incoming selector-connectors may be employed when it is desirable to permit

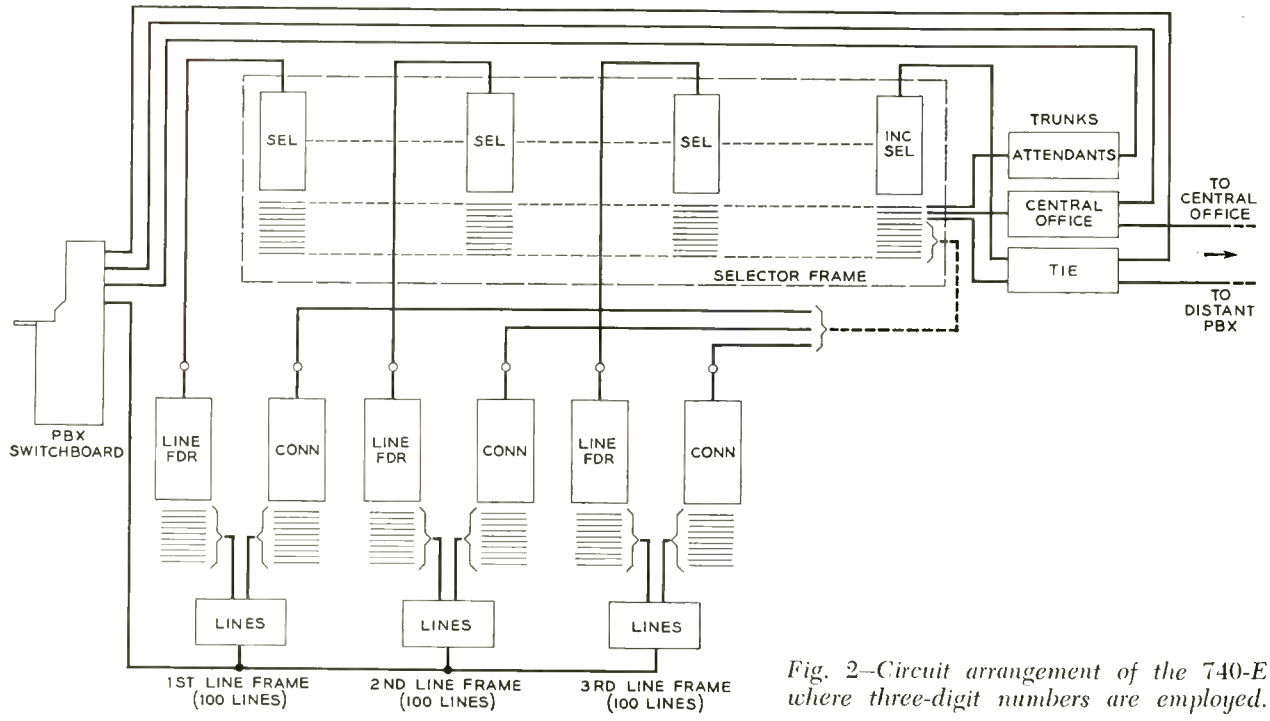
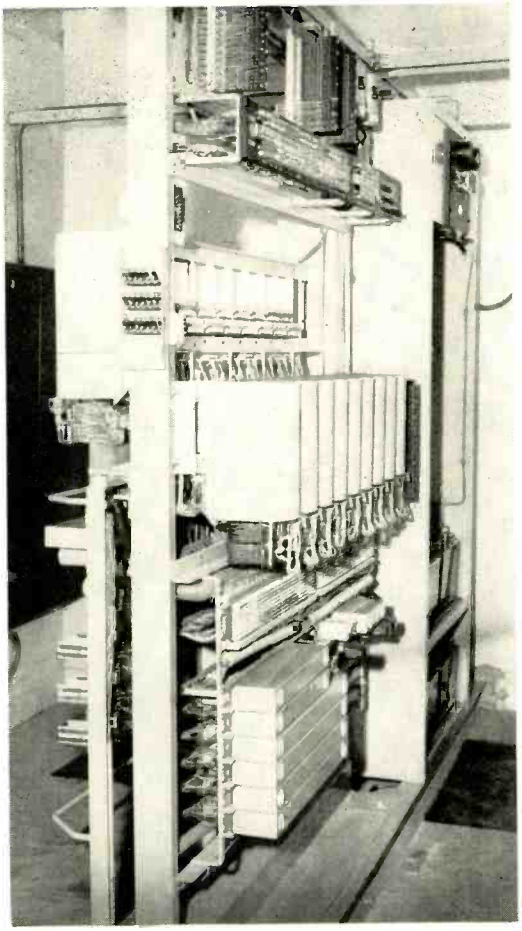


Fig. 2—Circuit arrangement of the 740-E where three-digit numbers are employed.

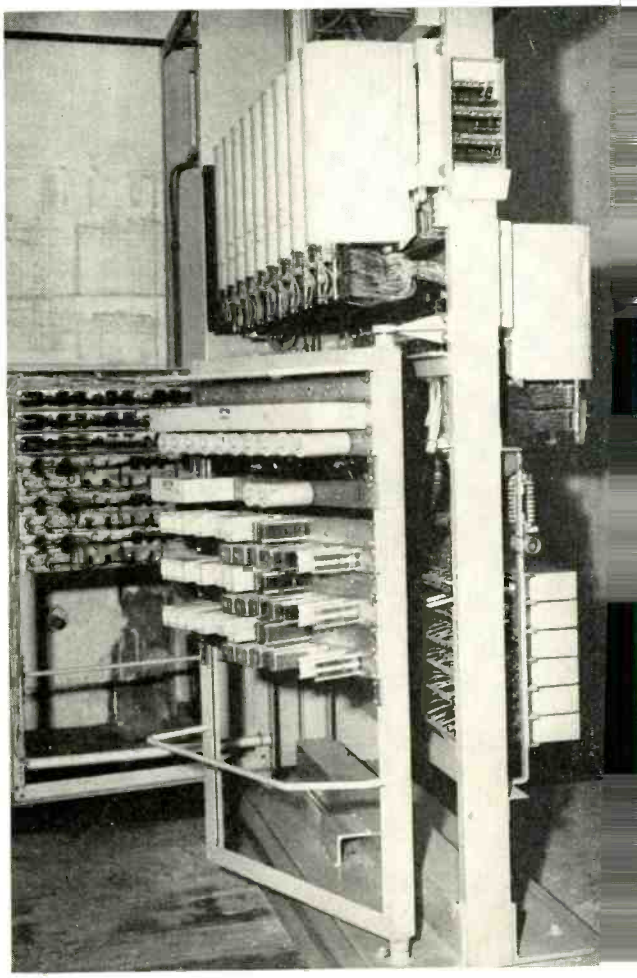


Front view of a line frame and its power supply.

local stations to be dialed directly over tie trunks.

For larger installations, three-digit numbers are employed, and selectors are added between the line finders and the connectors —the selector-connectors under these conditions may be arranged to act as connectors only, or may be replaced by connectors. The circuit arrangement for these conditions is shown in Figure 2. Here the digits 8, 9, and 0 are retained for tie trunks, central-office trunks, and the attendant, respectively, but for all local calls, three digits are used. When arranged for this type of operation, the 740-E has a nominal maximum capacity of 300 lines. One of the great advantages of the 740-E is that an installation may start out using only two-digit numbers and employ the circuit in Figure 1, and then expand to three-digit operation while the equipment is in service merely by adding selectors between the points indicated in Figure 1.

This changing from two-digit to three-digit operation, and the application or removal of the many optional features provided is greatly facilitated by a bank of terminals just below the switches on the switching frames. Most of the options available can be obtained by strapping between these terminals. The connection from line finders to selector-connectors is made between sets of terminals in one of these blocks, and when selectors are added to secure three-digit operation, these jumpers are removed and replaced by cabling to the selector frame. Other changes possible by use of these terminal blocks include making non-assigned lines busy, making a line one of a "hunting"



Rear view of a line frame and its power supply.

group, and arranging a line for restricted service.

The 740-E PBX is arranged in standard "packages" that are wired, equipped, and tested in the shop. Only two types of switching frames are provided: line frames and selector frames. The former include line finders and selector-connectors, or line finders and connectors where three-digit operation is required, while the selector frames include only selectors. Six line frames are available: three with selector-connectors, and three with connectors. Only one selector frame is available. It is equipped with three shelves, but additional switch shelves may be added to the frame when required.

Besides the one or two types of switch frames, a complete 740-E installation includes a distributing frame, a power plant, and a manual switchboard. The power plant is the recently developed 105-C which in most of its features is like the 105-A already described in the RECORD*. For the attendant's position, the 556-A, non-multiple switchboard was developed. This is similar to the 555 type† in structure and general appearance, but has somewhat modified circuits. It will accommodate 180 lines in a single position or 380 lines in two positions.

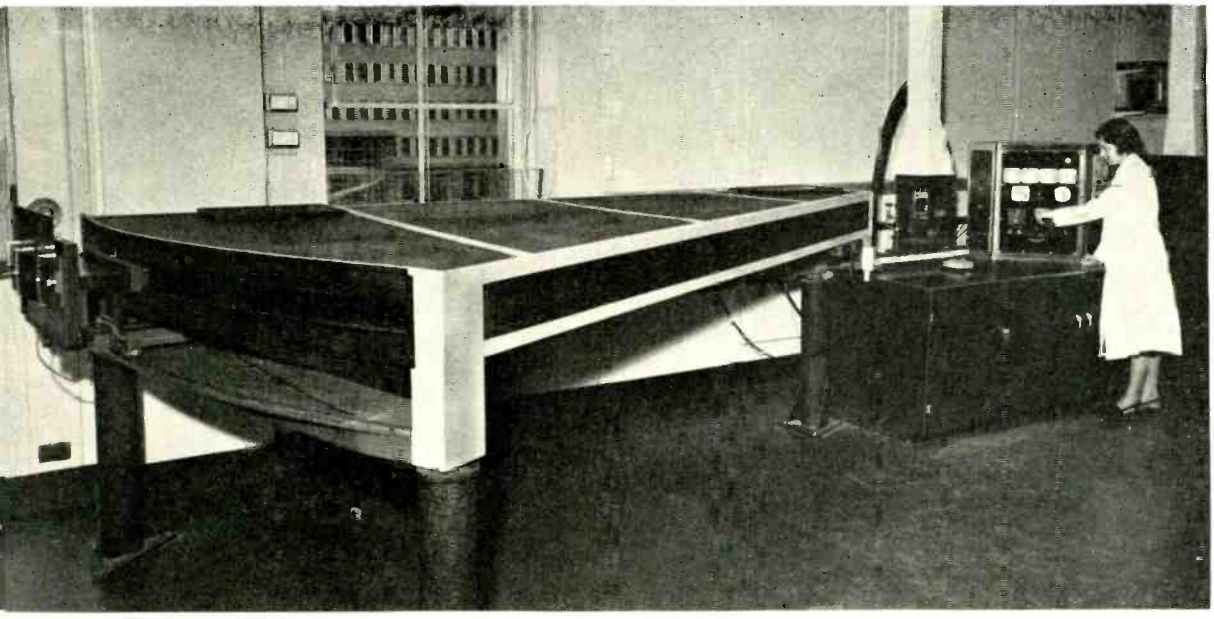
*RECORD, *September*, 1928, *page* 28.
†RECORD, *April*, 1949, *page* 125.

To make the most efficient use of available space on the subscriber's premises, all the switch frames are made double-sided. In addition, swinging gates are provided on all line frames so that trunk and miscellaneous units may be mounted on these frames, and so that there will be adequate maintenance access to the rear of the relay units. Floor plans are available which specify the space required for the initial and ultimate needs of the subscriber.

To take full advantage of the standard "packages" of this new PBX, and to facilitate engineering, a new simplified order form has been devised that permits the various packages in any size PBX to be listed on a single page. Those items that depend on traffic conditions, such as trunks and additional equipment, are listed in a supplementary section of the order form.

The 740-E PBX is now in production, and it is expected that the reduction in the operating companies' engineering effort, the stocking of complete equipment units, and the reduced installation effort on a subscriber's premises, will enable service to be furnished more economically than was previously possible. The addition of the 740E PBX to the dial switching plant should therefore, find wide application among Bell System subscribers.

THE AUTHOR: R. D. WILLIAMS was graduated with a B.S. degree from Case Institute of Technology in 1945, spending three of his years there in the Navy V-12 program. He then entered midshipman's school and in August, 1945, became a radar officer on a destroyer. At the end of 1946, Mr. Williams joined the Laboratories, where he was engaged in trial installation of No. 5 crossbar. In 1947 he was concerned with equipment engineering on dial PBX and small community dial offices. Currently he is engaged in circuit engineering on step-by-step circuits and full selective ringing trial installation on ten party lines in small community dial offices.



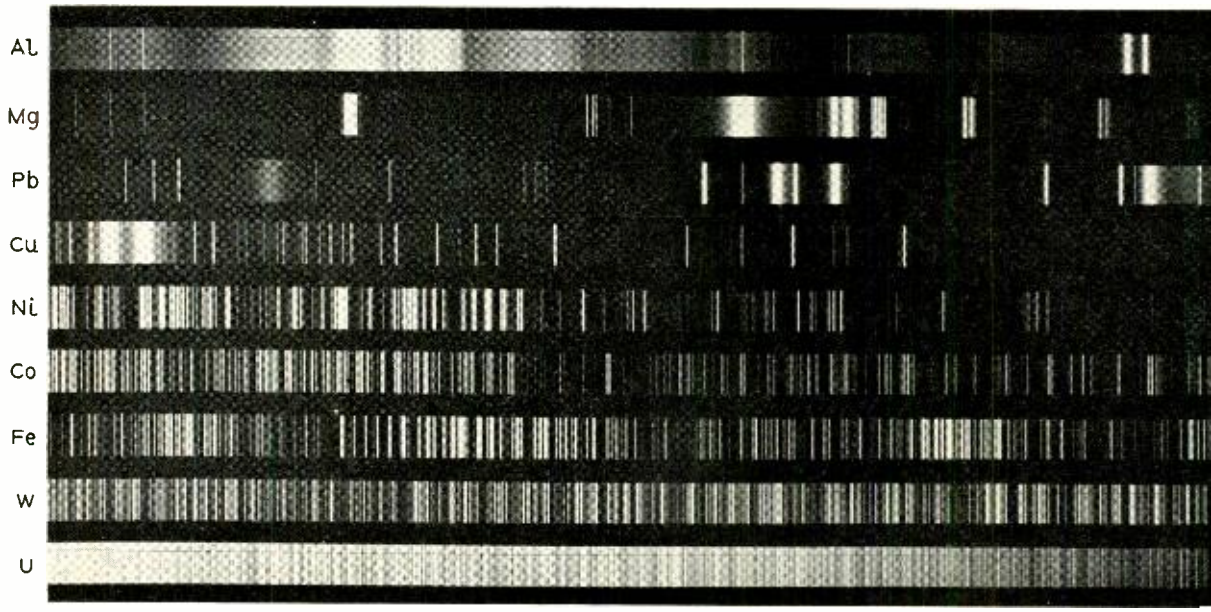
It has an eye for lines

Impurities in minute amounts sometimes make a big difference in how a material behaves. A few thousandths of a per cent of arsenic in lead antimony cable sheath alloy, for example, can render the alloy unusably brittle. Such minute chemical clues to performance are quickly revealed by Murray Hill's emission spectragraph shown above.

Light from an electric arc between two

Betty Prescott mounts an electrode containing a metal under test. Miss Prescott is a graduate in chemistry from Wilson College.

At Hawthorne spectrochemical analysis provides an accurate and rapid technique for the quality control of materials. (Western Electric Photo).



Ultra violet spectra of metals arranged in order of complexity from aluminum (top) to uranium (botton).

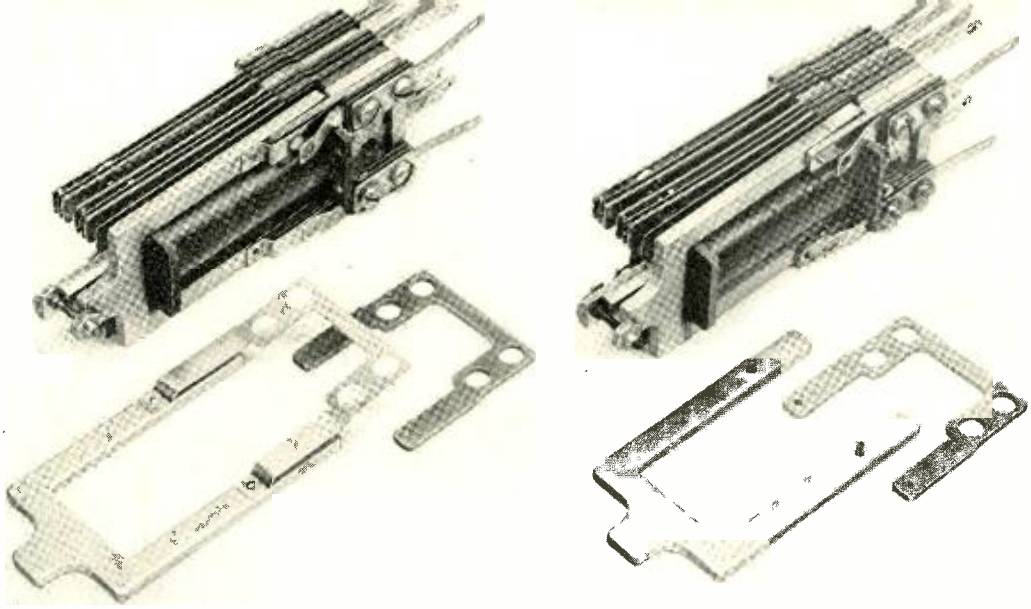
electrodes, one or both of which contain the material under test, is sent into the spectrograph at the left where it is spread in a spectrum 7 feet long. A photographic plate is positioned to record the region of interest. The positions, or wavelengths, of the spectrum lines identify the elements present while their optical density indicates the quantities involved—as little as 0.0001 per cent for many elements. An analysis can be completed in 15 minutes.

Spectrograms reveal chemical factors responsible for defective parts returned from the field and they guide the setting up of specifications standards for materials. At Hawthorne, too, spectrography provides an accurate and rapid techinque for checking the quality of purchased materials or of materials in process like plating solutions and die-casting alloys which may be analyzed and controlled for composition while still in the melt.

Bell of Canada to Provide TV Network

The Canadian Broadcasting Corporation has announced that the Bell Telephone Company of Canada has been awarded a five-year contract for the provision of television network service in Canada. The network will include Montreal and Toronto and will be tied into the United States television network at Buffalo. Buffalo now receives network service via coaxial cable from Cleveland.

TD-2 Radio will be used to provide a one-way channel from Buffalo to Toronto and a two-way channel from Toronto to Montreal. A total of fifteen repeater sections will be required. Two channels will be installed in one forty-one mile section across the Western end of Lake Ontario in order to provide frequency diversity. This arrangement will minimize outages due to fading to be expected over such a long over water path. An additional two-way channel between Montreal and Toronto is being provided for telephone service. It is expected that the Buffalo-Toronto section will be in service in March, 1952, and the remainder early in 1953.



Improved U, UA, and Y type relays

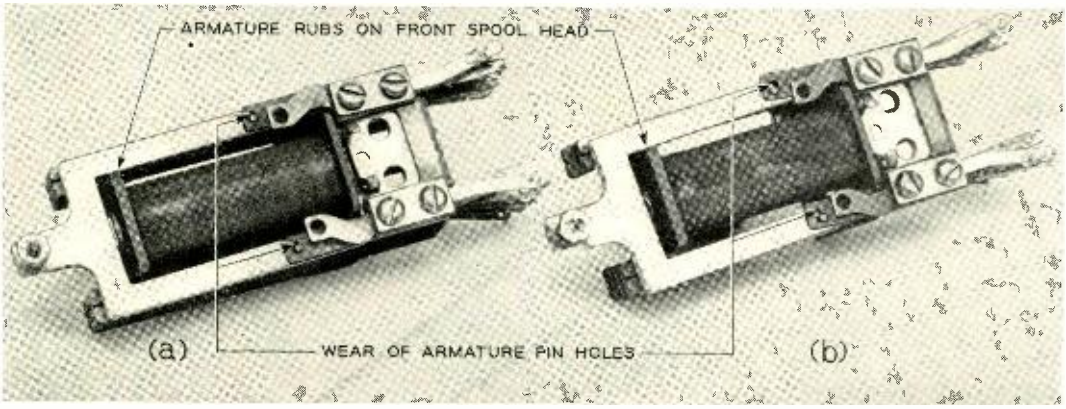
W. C. SLAUSON
Switching Apparatus Development

As telephone traffic increases and costs of providing service increase, concentrated efforts are being made to hold down operating costs without impairing the quality of the service. One area of attention has been that of U, UA, and Y type relays, where recent circuit needs have imposed more difficult requirements on these relays.

The new No. 5 crossbar system, automatic message accounting, and greater use of unattended offices have produced a demand for higher operating speeds, longer life, and greater adjustment stability of these relays. Prior to, and during World War II, the relays used in the No. 1 crossbar system were not required to have operate times of less than

Fig. 1 (*at top of page*)*—The reed type hinge on the left now replaces the pin type hinge, right.*

Fig. 2 (*a*)*—After* 100 *million operations, wear of the armature pins has allowed the armature to drop and rub on the front spoolhead.* (*b*) *After bending the armature pin bracket, the relay was good for another* 100 *million operations.*



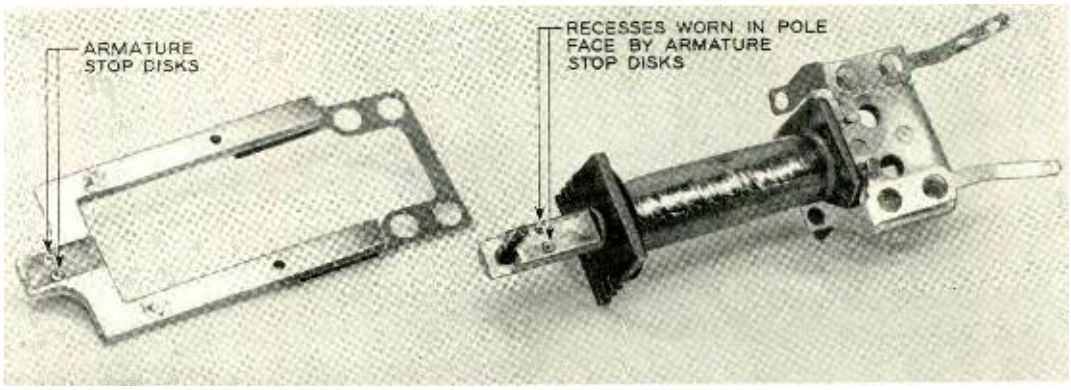


Fig. 3—Wear of the stop pins and core pole-face after 50 million operations.

ten or fifteen milliseconds and did not have to operate in any case more than two or three hundred million operations during their life —in most cases, only about one-tenth as many. In the No. 5 system, however, the useful life of some of the relays must be as many as one billion operations over a period of 40 years, and with speeds as fast as five milliseconds.

To attain the increased life, faster speeds, and greater numbers of operations, several changes have been made in design. One of these was the development of a reed type hinge suspension for the armature to replace the older pin type, as shown in Figure 1. While the pin type armature hinge is fully satisfactory when the U relay is used in the original No. 1 crossbar circuits, in the new circuits, the much larger number of operations and the higher speeds of operation made it necessary to use the reed type hinge. With the pin type hinge, the rubbing action of the pins wore grooves in the holes of the hinge bracket, causing the front end of the armature to drop until eventually the top inner surface of the armature rubbed on the top surface of the front spoolhead, resulting in faulty operation of the relay. This is shown in Figure 2(a), on a U relay after approximately one hundred million operations. The associated relay, Figure 2(b), is one that had failed at about the same number of operations, but was made serviceable by bending the hinge bracket so that the front end of the armature was restored to its normal position. Then, after operating the relay another 100 million times, the additional wear of the hinge bracket holes allowed the armature to drop and touch the front spoolhead again. By this time, the useful life of the relay had ended.

Similar relays provided with the new reed hinge have been operated over a billion times under the same conditions, without showing fatigue of the reed hinge and with no dropping of the armature. This hinge is now in regular production on U, UA, and Y relays.

Another effect of the increased number of relay operations and higher speeds de-

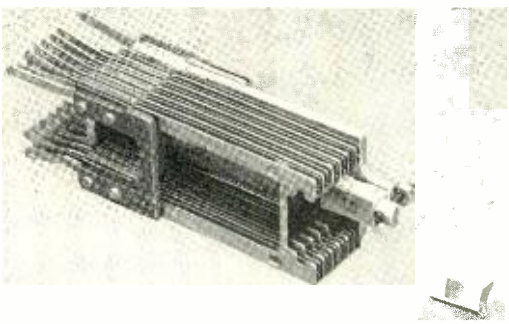


Fig. 4—Improved relay life is obtained with a Teflon separator.

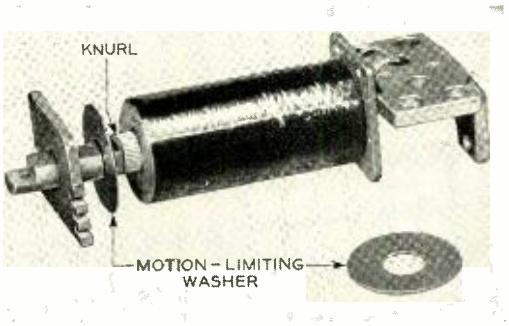


Fig. 5—Motion limiting washer for relay coils fits snugly over the core.

manded by new circuits, lies in the wear at the pole faces of the armature and core. Most relays are provided with small, non-magnetic discs welded to the armature pole-face, used to provide a space between the armature and core when the relay is operated. These "stop discs" serve two purposes—to reduce the effect of residual magnetism that tends to hold the relay operated when power is removed from the winding, and to provide a desired release time of the relay. On relays equipped with low resistance windings and having large armature travels, the armature strikes the core at a relatively high velocity, with the result that the stop discs not only show wear themselves, but also pound into the core pole-faces. Under the most severe operating conditions, the air gap may be entirely gone on some of the relays after 50 million operations and the armature pole-face then strikes the core pole-face—a condition that increases the effect of residual magnetism in slowing the release of the relay, or even causing failure to release. Figure 3 illustrates such a relay, showing the impressions in the core pole-face made by the stop discs and also indications of actual contact between armature and core pole-faces. The latter may be seen as bright spots at the tips of the pole-faces in the photograph.

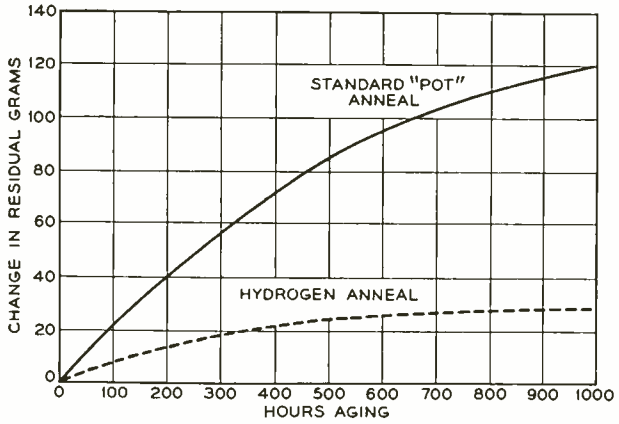


Fig. 6—Comparison of standard "pot" anneal and hydrogen anneal.

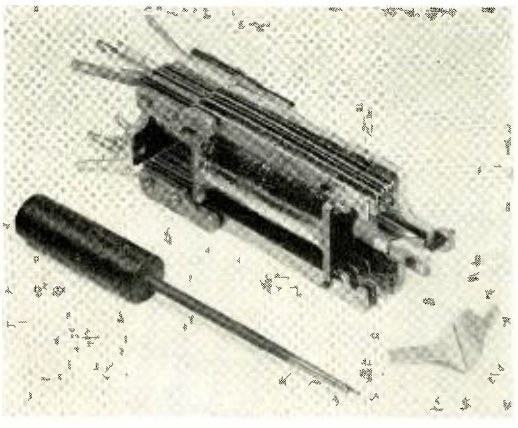
To overcome this source of trouble, a wear pad made of a new plastic called "Teflon" has been developed. This pad or separator is designed so that it can be applied to the relay either during its assembly in the factory or on the relay in the central office. Figure 4 shows a relay with the separator installed, and a separator alone. The slot is provided to clear the stop discs already in place on the armature.

Laboratory tests have shown that the relay may be operated more than 500 million times before any appreciable wear of the separator occurs. When the wear reaches an amount that might affect the release time of the relay, it is a simple matter to remove the old separator and install a new one.

Besides the new separator, improved life of the stop discs has been achieved by changing the metal of which they are made. Previously, the stop discs were of nickel silver, but tests have shown that the use of an alloy of gold, silver, and platinum—previously used only for electrical contacts—doubled the useful life of the stop discs. For some relays, this change in stop disc material enabled the relay to meet the new life requirements without adding the Teflon separator.

The spring studs used to operate the relay springs are also subject to wear. This causes loss of contact "follow," reducing the force between contacts that close on relay operation, and making the separation less between contacts that open when the relay operates. If this continues far enough, the relay will fail in its circuit function. The studs were made originally of hard natural rubber, but studies have shown that a synthetic rubber containing a graphite mixture has wearing characteristics two or three times better than

Fig. 7—The magnetic separator is fastened to the pole-face by using a special wrapping tool.



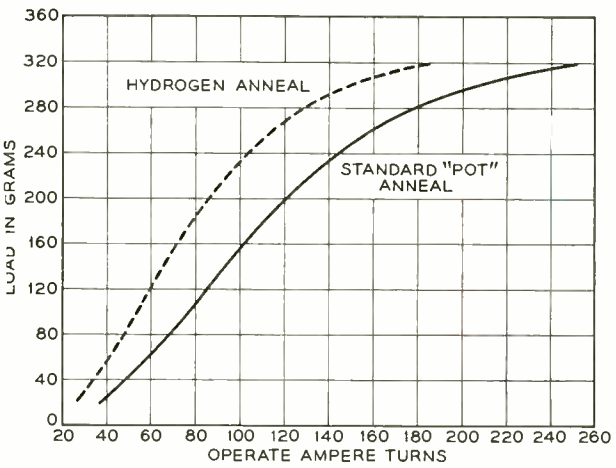


Fig. 8—Increase in pull of a typical UA relay due to annealing the magnetic parts in hydrogen.

those of the natural hard rubber. The graphited synthetic rubber is now being used for all new relays.

With the increased speed of operation of the relays, the coils are subject to much greater vibration than heretofore, and this has introduced the possibility of lead breakage. Such breakage is due principally to fatigue, when there is some looseness of the coil on the relay core, and the impact of the armature against the core pole-face produces lateral displacement of the coil at the front or non-terminal spoolhead. This movement has a tendency to bend the leads sufficiently to cause them eventually to break as a result of fatigue. To eliminate this movement, a motion limiting washer has been provided to fit snugly over the core and which is bonded to the end of the coil. Figure 5 illustrates the washer and the way it is used. In assembly, the washer and front spoolhead are pushed over the knurl on the core and the washer is bonded to the front end of the coil. The tight fit of the washer on the knurl is the feature that prevents lateral movement of the coil. There is always some slight shrinkage of the cellulose acetate in the longitudinal direction of the coil, but the washer can move with the coil, although eliminating lateral movement. Use of this washer has practically eliminated lead breakage from fatigue.

The Y type relay was designed to provide time delay on release. Over a period of years, it was found that the release characteristics of some of these relays had changed—in some cases, the relays would fail to release at all. Investigations showed that over a period of time, the coercive force of the magnetic iron increases, and with the relatively closely coupled magnetic circuit of this relay, the residual magnetism increased to a value in excess of the spring tension restoring force.

This aging effect can be practically eliminated on new relays by heat treating the magnetic parts in an atmosphere of hydrogen, and this is being done on UA and Y type relays. Figure 6 compares the effects of aging on residual magnetic force of the

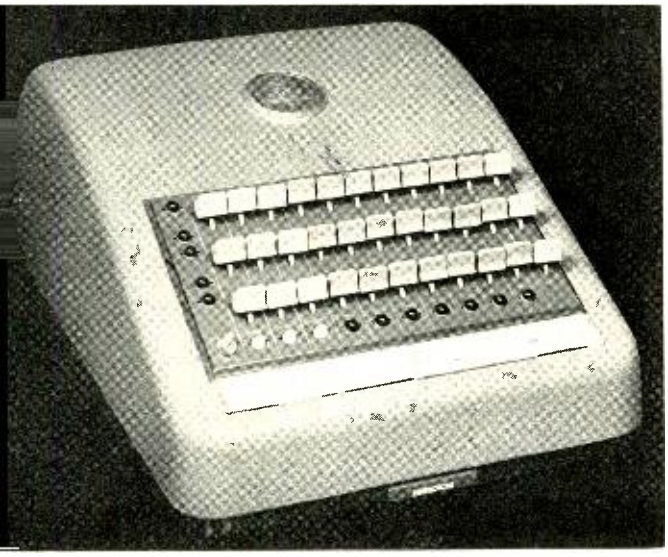
THE AUTHOR: Majoring in Mathematics, Physics, and Chemistry, W. C. SLAUSON received an A.B. degree from Hamilton College in 1927. He came directly to the Laboratories, where his first work consisted of design and development of polarized relays and signals. Later, he became concerned with U and Y type relays, making the fundamental capability studies, and establishing the original requirements for U relays. During World War II, he was in charge of specifications and drawings for permanent magnets for magnetron tubes, and designed special solenoids for electrically controlled torpedoes and radar scanning devices. He also developed water tight sealed relays for submarine detection apparatus. Both during and since the war, he took part in hydrogen annealing developments for stabilizing the magnetic characteristics of relays. Most of his work since the war has been concerned with U, UA, UB, and Y type relay problems.

standard "pot" anneal with the newer hydrogen anneal. For Y relays already in service, however, and therefore subject to aging effects, a magnetic separator has been developed that will reduce the residual force sufficiently to enable the relays to meet their adjustment requirements. This is a small nickel detail as shown in Figure 7, that can be wrapped around the core pole-face, using the special tool illustrated.

Besides greatly reducing the effect of aging, hydrogen annealing increases the permeability of the magnetic iron by a large amount. This is shown by the typical curves of Figure 8, where the pull of a UA relay has been increased as much as 50 percent. This gain is of particular importance on the UA relay, since this relay, having a larger pole-face area than that of U and Y type relays, and consequently having a lower reluctance magnetic circuit, is more susceptible to variations in permeability of the iron. The importance of aging or of poor quality iron is thus reduced by means of hydrogen annealing.

Telephone central office switching apparatus is unique in many respects. Designs are based upon requirements in existence, or anticipated, at the time the designs are prepared, but very often, advances in technical developments introduce unforeseen difficulties. Besides, increased telephone traffic may demand speeds of operation not previously considered, and problems of life and wear of the apparatus appear. The several improvements described in this article, therefore, indicate only a few of the objectives that engineers are constantly working toward to maintain and to improve telephone service.

A New PBX For Small Business Offices



A new PBX, known as the 507, is beginning to make its appearance in small business offices. It is available in two sizes. The larger one, designated the 507-B, serves as many as five central office trunks and twelve extensions, while the smaller, the 507-A, shown at the left, is not so wide and serves three central office trunks and seven extensions.

This new PBX is a modernized and improved design of the 505 or its slightly modified successor the 506 PBX. These also were available in the same two sizes, but they used "drops" as supervisory signals, the more usual form of key handles, and were housed in a rectangular wooden cabinet. Taking advantage of improved manufacturing methods, the 507 has a magnesium die-cast housing, lamps for supervisory signals, and key handles specially shaped for pleasing appearance and for ease of operation. A more complete description of this new PBX will appear in a forthcoming issue of the RECORD.

New ringer for 500-type telephone set

H. A. BREDEHOFT
Station Apparatus Development

Throughout the centuries of civilization, bells have been the conveyors of information affecting the gamut of human emotions. In the telephone, too, the ringing of a bell continues to be the most practical way of announcing the arrival of messages. But comparison of the new C-type ringer with its predecessors, reveals many physical differences.

Just to run through the course of ringer history, there was the Watson ringer of 1878 (Figure 1), followed by the No. 8 type of Figure 2. This continued to be the basic design° until the advent of the combined telephone set in 1937. When that set was being designed, a flatter structure† was required by the limited space available. Like previous ringers, the B-type used in combined set has two coils with the armature pivoted in the center so as to vibrate outside the pole pieces. By contrast, the new C-type ringer (Figure 3) has a single coil, a short cylindrical permanent magnet and the armature vibrates between the pole pieces.

In laying down the design objectives for the C-type ringer, consideration was given to the functional characteristic of interest to subscribers as well as to the Bell System. It will be convenient to describe the features of interest to each of these categories of viewpoint: the subscribers', the Operating Companies' and Western Electric's.

One design objective, the reduction of maintenance visits to adjust the loudness of the bell, has proved an important item of subscriber convenience. He need no longer bury his telephone set under a pillow, stuff paper in the gongs or call in the telephone man. Available through a slot in the base of the 500-type telephone set is the edge of a plate, rotation of which will give control of the sound output. Mechanically, this accomplishes a variation in the energy input to the gongs by means of simultaneous changes in gong spacing and allowable clapper-ball motion. This plate, the heart of the sound control mechanism, is cast with a serrated surface at the lower edge for finger control and, as shown on Figure 4, rotates on a shaft that extends through the ringer frame. The end of the shaft is attached to a spring catch that engages slots in the ringer frame to position the plate for four steps of sound volume. Gong spacing varies with rotation since the gong mounted on the plate is eccentrically located with respect to the shaft. The

° RECORD, *July* 1932, *page* 385.
† RECORD, *May* 1942, *page* 222.

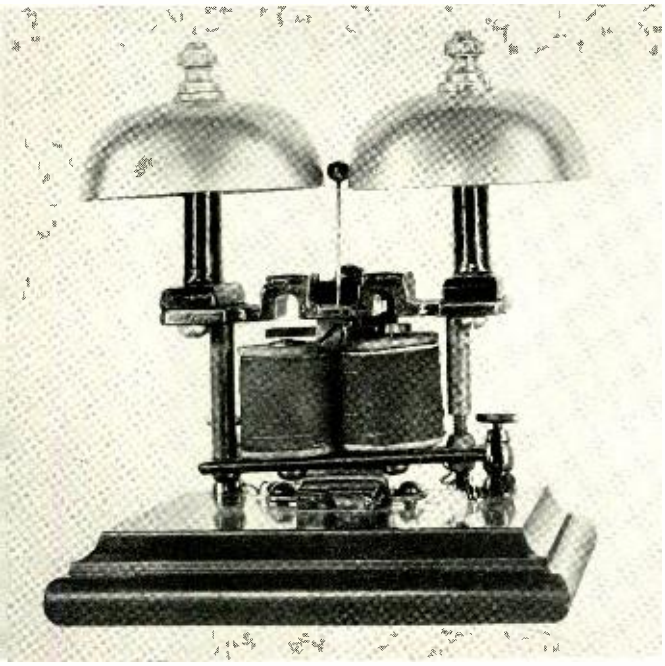


Fig. 1—This specimen of Watson's 1879 ringer is in the Bell System Historical Museum.

edge of the plate adjacent to the stop rod is a cam surface having discrete steps of rise. These sections of the cam surface are the contact points of the stop rod, and limit armature and clapper ball motion in accordance with the gong spacing at a particular sound control position.

The highest sound level is about 2 db above that of the combined telephone sets in current use and equal to it at the next lower position. Successive decreases of 5 db are obtained at the remaining two positions. Mechanical damping is avoided by maintaining proper clearance between the gongs and the clapper in the static positions. This contributes to clearness of ring and with harmonic spacing of the fundamental tones makes the sound more agreeable. The fundamentals of the gongs are spaced at a musical interval of a major third and resonated by air chambers under the gongs, which raise the output of the fundamentals above that of the overtones, pleasantly emphasizing the harmonic relationship. These resonators cause more than a 15 db gain in the fundamental gong frequencies, thereby effectively increasing the attention attracting quality of the gongs considerably more than is indicated by over-all sound output comparisons. This large low frequency gain helps those having some hearing loss in the higher frequency range as in the case of many older people.

System requirements for the C-type ringer include the possible addition of an extra extension telephone bringing the total permissible to five on a line. Consequently, the impedances of the new ringer at ringing and voice frequencies have been designed to meet this requirement. Normally, the ringer is installed with maximum bias-

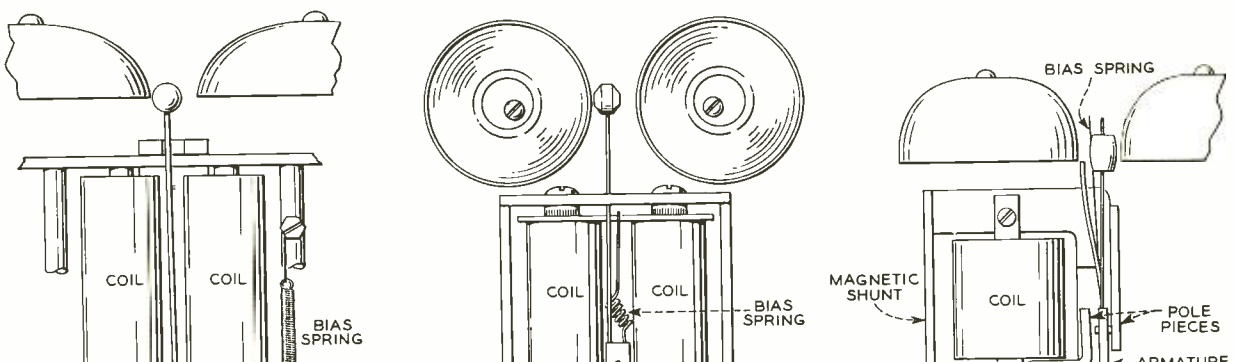


Fig. 2—The 8-type ringer is shown on the left, the B-type in the center, and the C-type on the right.

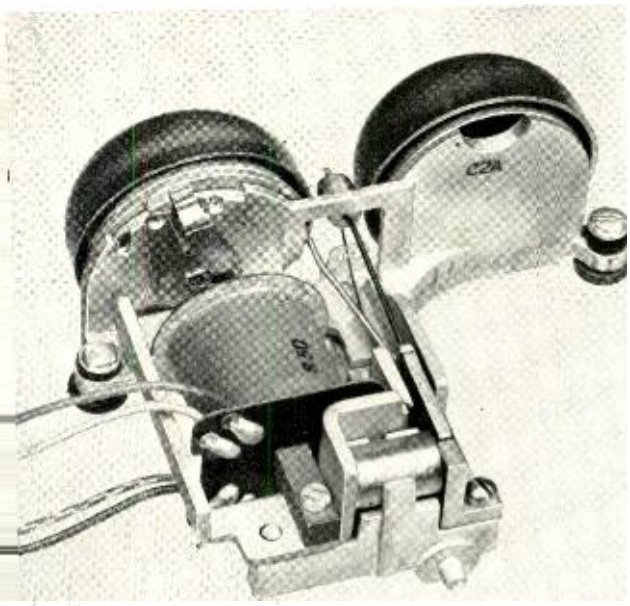


Fig. 3—The C2A ringer.

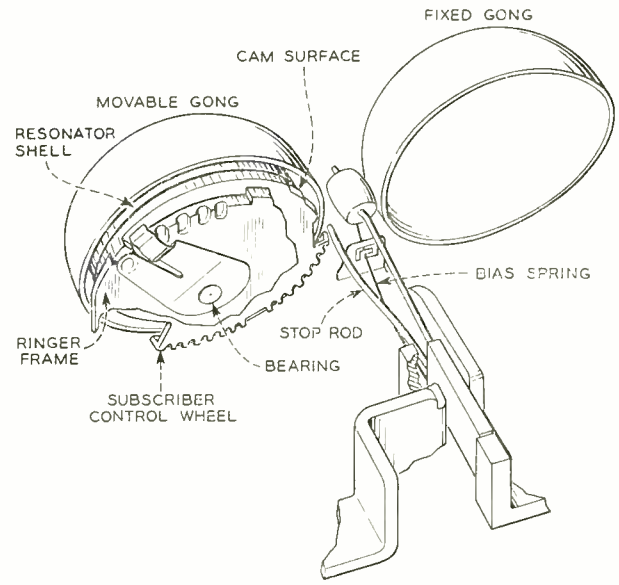


Fig. 4—Mechanism for sound level control.

ing load on the armature, however, in case of a line having the maximum number of extensions, a long loop and other adverse circuit conditions, the installer can use a lower biasing spring tension, as two notches are provided in the biasing spring bracket. This will provide increased ringer sensitivity that will be sufficient to meet limiting field conditions.

Another feature of interest from a system standpoint is that, unlike other ringers, the C-type up to the point of the winding being burnt out will not suffer demagnetization in service from surges on the line due to lightning or accidental contact with power lines. The magnetic paths of the electromagnet are so proportioned that saturation occurs long before the field strength becomes great enough to appreciably affect the permanent magnet. Also of interest to the field is the fact that the new ringer has eliminated the need of coding and handling several special combined telephone sets. The coil has a divided winding so that the sets can be used not only in individual and two-party but also in two-party message rate service. Only four-party full selective service requires a different code of ringer. Some extension stations are arranged so that the subscriber, on occasion, can cut off the ringer electrically by a switch. This type of special set is no longer

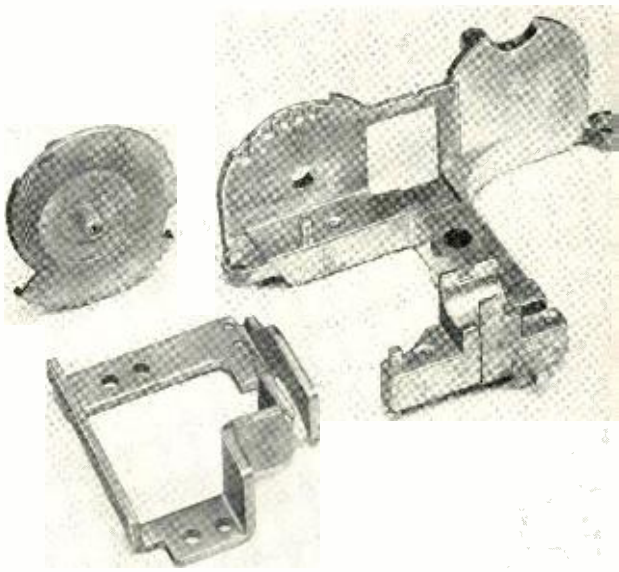


Fig. 5—Lower left, the punched and formed pole piece for the C-type ringer; upper right, the die cast frame; upper left, the finger wheel for sound level control.

required since the installer, by bending a tab on the spring catch can provide the subscriber with an additional step on the volume control where the ringer is completely silent.

Special features so far described, along with available space in the 500 type set, have primarily influenced the structural design of the C-type ringer. However, considerable thought has gone into producing a piece of apparatus that would be adaptable to modern manufacturing techniques pertaining to accurate, high rate production. From this standpoint, we have as usual worked closely with Western Electric engineers, incorporating into the design their ideas to facilitate production and reduce costs. The ringer structure is built around a single coil providing obvious manufacturing economies in materials and fabrication. As the inductances of the coil have to be boosted to approach that of two coils, a magnetic shunt is placed across the ends of the core of the coil. Mechanically, this joins the two pole pieces thereby forming a single unit of what would otherwise consist of three details (Figure 5). This simplification not only reduces the handling of extra piece parts but forms a more rigid structure requiring fewer fastening points. Incidentally, the armature is punched out of the scrap from the center of the pole piece blank. Assurance of a rigid, accurate mounting for the sound control features is secured by the use of a die cast frame. This type of design reduces to a minimum the number of fixtures and jigs that would otherwise be required for manufacture of a ringer composed solely of punched and formed parts.

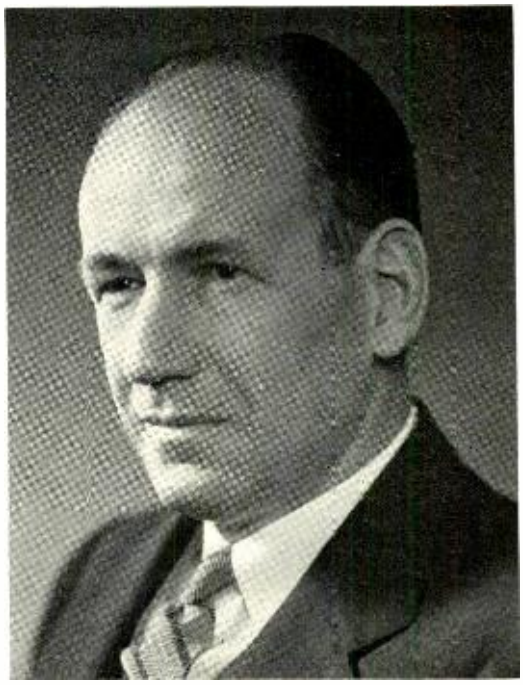
Part of the manufacturing process involves adjustment of the ringer by an automatic machine that will be described in a subsequent article. Machine adjustment of the permanent magnet flux and the biasing spring tensions for suitable operating characteristics eliminates the need of a manual trial and error procedure during ringer manufacture. Experience to date indicates that automatic adjustment aids greatly in producing ringers with uniform operating characteristics.

THE AUTHOR: H. A. Bredehoft joined the Laboratories in 1927, after graduating that year from Kansas State with a B.S. E.E. degree. From then until 1942 he was a member of the Apparatus Development Department, engaged in the development of station signals. During World War II, he worked on a military project, and in 1945 returned to Station Apparatus Development where until recently he was in charge of a group developing station signals. He is now a member of the Station Systems Development Department.

New Laboratories Director

C. W. Phalen, vice president of the American Telephone and Telegraph Company in charge of personnel, has been elected a director of the Laboratories to fill the vacancy created by the resignation of W. C. Bolenius.

Mr. Phalen started with the New York Telephone Company, joining the company as a lineman at Syracuse in 1928 after his graduation from Yale University. He became a plant chief in 1929 and after holding a series of supervisory positions in the upstate plant department, was named assistant vice president, personnel, in 1943. He was elected vice president, personnel, a year later and moved to the public relations department in a similar capacity in 1945. He came to the A T & T as vice president in 1948 and since then has been successively in charge of public relations, revenue requirement, and personnel.



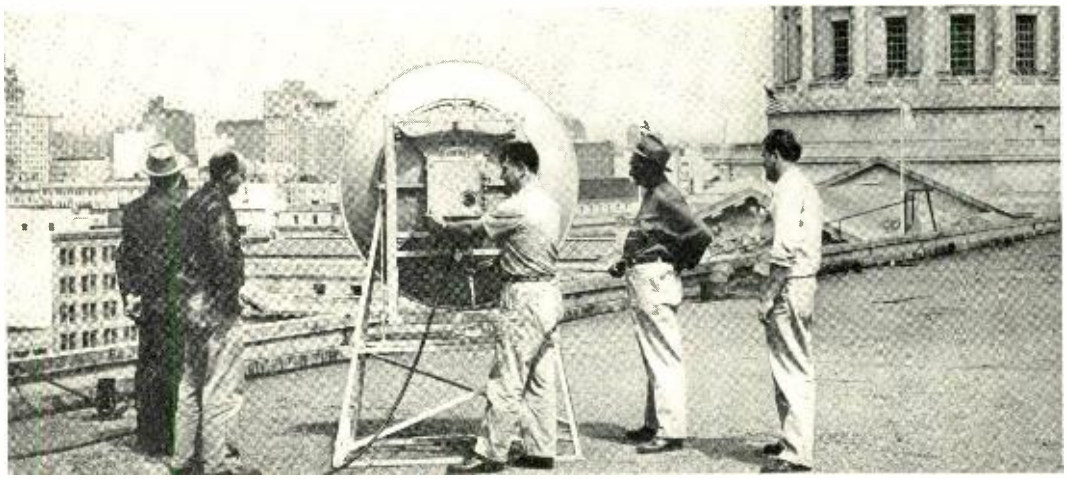
C. W. PHALEN

First Coast-to-Coast Telecast Covers Peace Treaty

The largest single television audience in history—estimated at upward of 30,000,000 people—heard and saw President Harry S. Truman open the Japanese Peace Treaty Conference in San Francisco on September 4, marking the nation's first coast-to-coast telecast. The transcontinental hookup was made possible when Long Lines met a U. S. State Department request to advance the TV opening of the new cross-country radio relay system. The new route was opened for telephone use on August 17.

The "historic first" program went off without a hitch. Newspapers in cities along the relay route commented favorably on the quality of transmission. The *New York Times* reported that "the image reproduced on screens in the New York area, nearly 3,000 miles from the scene, had excellent clarity and compared favorably with programs of local origin. The contrast was of first-rate quality and there was no distortion."

Ninety-four of the country's 107 TV stations were reported to have carried the President's address opening the Conference.



Pacific Company engineers install the antenna which was used to beam television signals from the roof of the Opera House into the transcontinental radio relay system.

Left—On a bright Fall morning, Mrs. Sturzenegger makes toast for Bill's breakfast. Right—This promises to be a breezy day, and the open wires will be swinging. So Bill threads a new chart in the recorder which will note hits between the wires.

Bill and Wayne Parks check pole stubs having special preservative treatment.

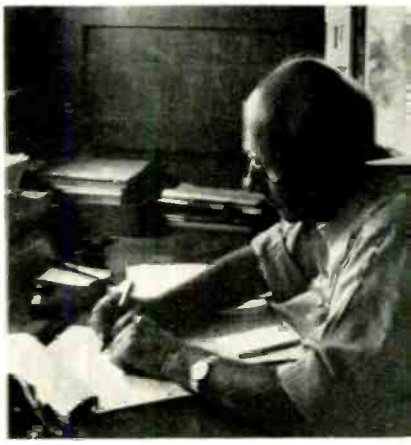
A DAY AT CHESTER FIELD LABORATORY

At Chester, in the New Jersey hills, is a hundred-acre outdoor laboratory of the Outside Plant Development Department for all sorts of studies on poles, wires, cables, conduits, and in fact anything that is to be used in the open. There is a wind-swept ridge for studies of what wind does to wires and cables; there is a birch thicket for abrasion studies of drop wire; there is a pond for immersion tests. Engineers come and go, as their work requires, but a half dozen men or so are there all the time to keep the place in order, plant poles, set up tests and read meters. They are headed by W. C. Sturzenegger, a life-long local resident, who still lives in the house where he was born. In these pictures the RECORD follows Bill Sturzenegger through a typical day's work.

Left—Secret of the test plot's neat looks is the mower, piloted by Wayne Parks. Right—Bill oils up a machine which keeps bare wires swinging to test a new type of tie.

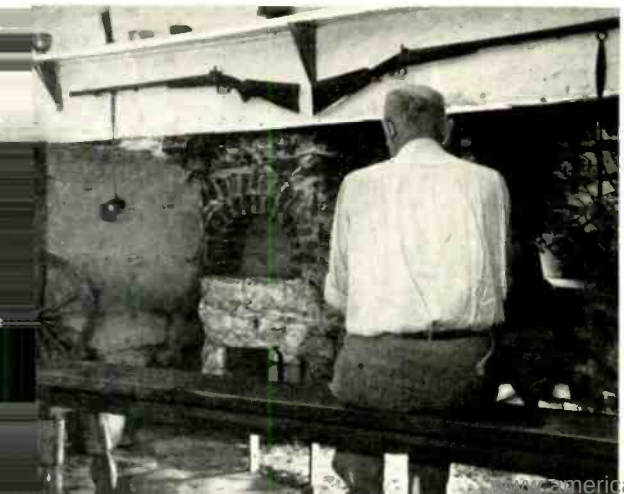
Left—Living near the test plot, Bill lunches at home. Having ten minutes of his lunch hour to spare, he gets out the lawn mower and begins the season's final trimming. Right—Back on the job, he finds the Rolph brothers, Tom and Wandell, puzzled over a level winding winch that refuses to wind level.

At a high-voltage test of buried cables, Bill reads the voltmeter and sees that all is in order.



In the late afternoon Bill sits down to make up time reports.

Left—It turns chilly at the end of a Fall day in the Jersey hills so Bill is grateful for a little fire when he gets home. This room was the kitchen of the 200-year old house, once an inn on the road between Easton and New York. Old records refer to its "ballroom". Right—watching television of an evening, Bill has his flintlock handy to pot the villain if the hero misses.



Chemists from the World Conclave of the American Chemical Society visited Murray Hill on September 12. There were 125 visitors representing 18 foreign countries in the group. Their host was R. M. Burns, who is shown in the center above, as he addressed the chemists in the Arnold Auditorium.

New York Company to Spend $180,000,000 in 1952

The New York Telephone Company has announced that its construction program for 1952 will total 180 million dollars—a 20 million dollar increase over 1951. About 130 million dollars are earmarked for New York City and its metropolitan area in southern Westchester and in Nassau County. The program is being undertaken on the assumption that the company's earnings will be sufficient to attract the new money necessary.

In the New York metropolitan telephone area the company's 1952 plans provide for 31 new central offices and major additions to 43 others. The program includes seven new buildings and sizable extensions on nine more. A million and a quarter miles of wire in cable will be added to the intricate maze which, among other things, enables most New Yorkers and many suburbanites to dial directly 3,750,000 telephones in New York City, south-

ern part of Westchester and in Nassau County.

Considerable amounts of new equipment will augment New York City's vital long distance facilities. Two new tandem central offices will be added, for example, and will provide a faster, more reliable service on calls not only to nearby points but on calls between New York City and many towns and cities in distant parts of the country. The company's program of dispersing long distance equipment more widely and making alternate calling routes available to safeguard service in case of war emergencies will be pushed ahead.

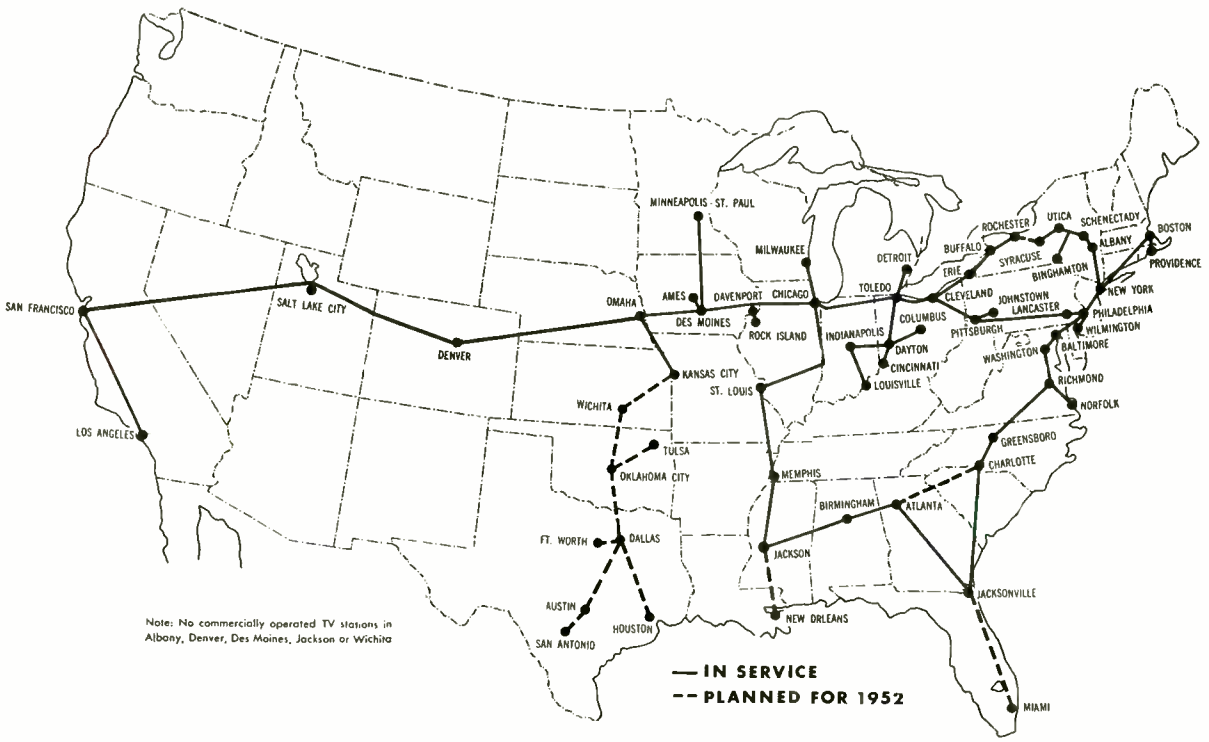
Telephone Link to Cyprus

An overseas telephone link to Cyprus Island, in the eastern Mediterranean Sea, was opened on September 1 by Long Lines. Calls between any point in the United States and Cyprus will be routed via London. In the last 24 years, expansion of the overseas services of the Bell System has made it possible for Cyprus and almost 90 other countries and territories to reach the 44,000,000 telephones in the United States.

Two-Way Coast-to-Coast TV Opened

Television facilities for coast-to-coast network service on a regular basis began on September 28. The cross-country service provides initially, one program channel in each direction. Speeding up the installation of facilities to televise the Japanese Peace Treaty Conference made it possible to advance the start of regular coast-to-coast service in both directions to the September 28 date, which is sooner than had been contemplated.

The Bell System, in six years, has made available a network of more than 23,500 miles of intercity television channels connecting cities in the East, South, Middle West and now the West Coast. Including the coast-to-coast link there are approximately 14,500 miles of radio-relay channels and 9,000 miles of coaxial cable channels serving the nation's television audience. Additional thousands of miles of channels are expected to be available in late 1952 which will permit adding Miami, New Orleans, Tulsa, Oklahoma City, Ft. Worth, Dallas, San Antonio and Houston to the rapidly expanding nationwide network.



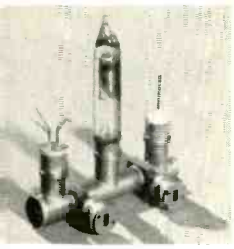
BELL SYSTEM TELEVISION NETWORKS ROUTES

Can You Title These Pictures?

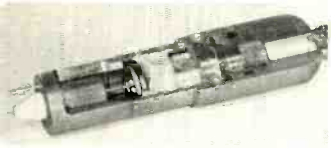
All except one appeared in the RECORD since June, 1950. Can you detect the picture which has not appeared? Answers on page 487.

1. This man is operating
   A. An analog computer
   B. A voice simulator
   C. An impedance bridge
   D. An improved announcing system for telephone offices

2. The object being worked on is
   A. A new type of microwave antenna
   B. A housing for plane-borne equipment
   C. A float for sound transmission studies over water
   D. A new kind of speed-boat developed by a Laboratories hobbyist

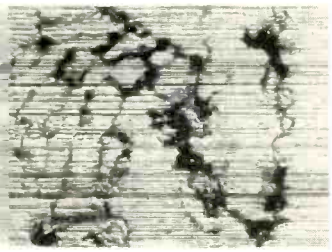


3. This device is a
   A. Photo cell unit
   B. Microwave amplifier
   C. Gas micro-analyzer
   D. Electronic water pressure meter

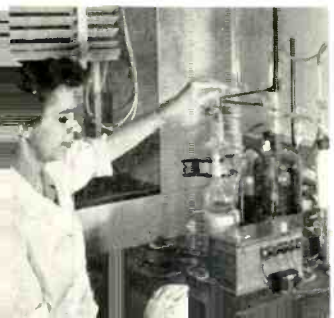


4. Cross-section of a
   A. Microwave converter tube
   B. Submarine repeater seal
   C. New coaxial splice
   D. High pressure crucible for production of quartz

5. This picture portrays
   A. A mysterious growth produced by a metal
   B. Relay contact wear
   C. The beginning of an arc discharge
   D. Ionic bombardment of a filament



6. This picture reveals
   A. Metal about to break under strain
   B. Action of chemicals on insulation
   C. Fissures in wiped solder
   D. Termite destruction in wood

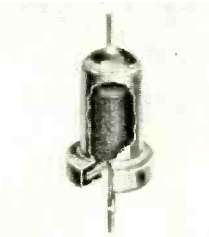


7. This girl is testing for
   A. Electrical conductivity
   B. Moisture content
   C. Chlorides
   D. Impurities in germanium

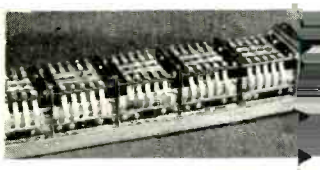
8. This machine punches out cards which record
   A. Distribution of trunk activity in busy hour
   B. Billing data for calls
   C. Circuit interruptions in a crossbar system
   D. Calls handled by office while unattended

9. These men are engaged in assembling a new
   A. Coaxial cable
   B. Telephone repeater
   C. Wave guide
   D. Machine for extruding plastics

10. This is
    A. A tantalum rectifier
    B. A sample of radio active isotopes
    C. Coaxial alarm unit
    D. An electrolytic capacitor

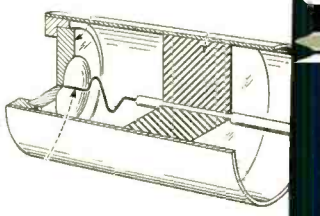


11. This is a
    A. Line selector for a dial system
    B. Tuned reeds for selective ringing
    C. Bandswitch for an amplifier
    D. Part of a relay computer



12. These people are
    A. Air raid wardens plotting the flight of enemy planes
    B. Operating a new calculator for 4-digit numbers
    C. Testing their speeds in setting up announced numbers
    D. Playing a new kind of musical instrument

13. This is a section of a
    A. Phototransistor
    B. Silicon rectifier
    C. Transistor
    D. Temperature control element for N-1 carrier



14. This man is being tested for
    A. Brain waves
    B. Sound pressure in ear canal
    C. Temperature difference between ears
    D. Effect of vision on hearing

C. C. Taylor Goes to Switzerland

C. C. Taylor of the Laboratories and E. W. Bemis of O and E were advisors to the United States Delegation to the Sixth Plenary Assembly of the International Radio Consultative Committee of the International Telecommunication Union held at Geneva, Switzerland, June 5 to July 6. About forty countries were represented at this meeting, where radio problems of world wide importance were discussed. Thirteen study groups considered technical questions relating to radio communication—questions such as the establishment of a standard frequency and time signal service, ideal frequency bandwidth and channel separation for radio telephone and telegraph, radio propagation, and transmitter, receiver and over-all system problems.

The U. S. Delegation at Geneva, Switzerland, C. C. Taylor is fifth from the right and E. W. Bemis, A T & T is second from the left.

G. H. Wannier's Trip Abroad

Gregory H. Wannier recently spent three months in Switzerland, accompanied by his wife and his boys, Tony, 6 and Peter 4. The occasion of the visit was an invitation by the University of Geneva to act as guest Professor during the summer semester 1951. This was Mr. Wannier's first visit to his land of birth since 1938, and the first visit altogether for the rest of the family. He did little traveling outside that country.

Mr. Wannier spent several months roaming in Geneva, with frequent visits to Basel and other parts of the country. In addition to his regular duties he gave lectures covering the Laboratories' work on gaseous electronics and ferromagnetics. Some of these lectures were also given at the Polytechnicum (E.T.H.) in Zurich.

The Wannier family used its weekends for excursions round the country, on foot, by car, train, boat and cable car. Among these, the visits to the city and canton of Bern were outstanding successes because cable cars are always a delight for the small fry. The final weeks in July were spent in the high Alps in the village of Saas-Fee.

Theatre TV Aided by Bell System

Long Lines facilities played a major role recently in enabling theatres in several Eastern and Midwestern cities to feature live television programs originating in New York City. Three boxing matches were televised—the Louis-Savold fight June 15, at Madison Square Garden, was carried to nine theatres in six cities; the La Motta-Murphy bout June 27 at Yankee Stadium, and the Layne-Marciano match at Madison Square Garden July 12 were delivered to eleven movie houses in eight cities.

Telecasts traveled from ringside over New York Company facilities to the control center at Long Lines headquarters, and then over Long Lines video channels to the cities on

Considerable interest has been shown by Telephone Company people in the warning system. One group which visited the Laboratories recently to see and discuss the system consisted of James Poole, A. A. James and E. P. Hurley, all of The Southern New England Company.

the theatre network. There Associated Company facilities carried the telecasts to the theatres where they were projected by special equipment on the large movie screens.

Heretofore, the Bell System's video network facilities have generally been used to interconnect broadcasting stations to bring live programs to widely scattered home audiences.

Women Pioneers Plan a Busy Season

Activities Committee of the Women Pioneers of the Frank B. Jewett Chapter of the Telephone Pioneers of America have launched an ambitious program for the 1951-52 season. Tentatively included in their plans are a bazaar at which they will sell their handicraft; sewing classes under Marie Simone; and sale of Christmas cards, candies and perfumes to finance their charities at Christmas. A course is also contemplated in which they will make toys, magazine racks and book ends and similar items with "easy-build" patterns under guidance of a qualified instructor. A social evening of Canasta is underway and instructions are being given to beginners. The Women Pioneers plan to edit their own magazine which will include pertinent articles for women nearing retirement; news activities of the group; book reviews; and occasional outstanding recipes and household hints.

Laboratories Develops Air Warning System

As part of the nation's preparation against air attack, the Laboratories has developed a system to spread warning quickly from civil defense centers. It will be installed by the telephone companies on orders from the various defense authorities.

Briefly the system consists of a telephone dial marked WHITE, RED, BLUE, YELLOW and OFF, instead of the familiar letters and numbers. When a finger is inserted in one of these holes and the dial pulled around and released, a series of dial pulses into a transmitting set are sent out as dc telegraph impulses over a network into as many distributing centers as needed. Each of these will be in a central office, and individual lines will radiate to the warning posts specified by civil defense authorities. The pulses will be counted by a relay chain and converted into pulses of ringing current sent out over all the lines. This current will be characterized by polarity to ground, etc., just as in four-party selective ringing. Suitable circuitry at the terminals will cause the ringing current to light one of

This battery of telephones in the Air Force command post deep in the Pentagon provides direct communications with the nation's air warning network, fighter and bomber bases and Air Force headquarters. Into this room will come the first alert should enemy bombers start moving over Arctic or coastal radar stations toward us.—Associated Press Wirephoto.

four lamps, and a bell will ring in accordance with a code corresponding with the character of the alert. This will continue until an "OFF" signal is sent out by the dial.

Requirements for the system were set up by engineers of A T & T in conference with W. O. Arnold of Switching Engineering. Circuits and equipment were developed by engineers under R. W. Harper and F. W. Treptow.

Central Safety Committee

The Bell System is proud of its unusually fine safety record. Over the years the Laboratories has given much thought to the elimination of accidents to its employees in the discharge of their duties and has attempted to provide equipment safeguards and work procedures that should make possible the performance of our work without accidents. A new central safety committee, with D. W. Eitner as chairman, has been appointed by M. J. Kelly to coordinate the safety and accident prevention efforts at the various locations. One of the best preventatives of accidents is the alertness of each employee in eliminating hazards and unsafe actions. The aim of the Central Safety Committee is to create a safety awareness in Laboratories members in order that the excellent Bell System safety record may be equalled or bettered at the Laboratories.

These are the Central Safety Committee and the departments they represent: J. B. Johnson, Department 100; A. A. Oswald, Department 200; C. G. Miller, Department 300; P. A. Jeanne, Department 350; E. L. Alford Departments 400 and 500 (N. J.); R. C. Koernig, Departments 400 and 500 (N. Y.); A. K. Bohren, Departments 850 and 7800; I. W. Whiteside, Department 7300; L. S. Hulin, Department 7500; and J. W. Tengstrom, Departments 7100, 7200, 7400, 7600, 7700 and 7900. L. E. Coon is secretary and also represents Departments 6000, 6500, 8000 and 9500.

GUARDIANS OF THE SKIES

The Telephone Hour, September 10

As you sit in your home tonight the skies above our nation's borders are being searched for any intruders. Incredibly fast jet planes and all-weather night fighters are on the runways at interceptor fields. Pilots are waiting in the ready rooms. A telephone call could send these planes into the air on a moment's notice.

In fact, the Air Defense Command's whole plan for meeting enemy aircraft depends largely upon the Long Distance telephone. Volunteer observers report by telephone to Filter Centers where the path of any unidentified plane is charted on a map and a report made to the interceptor command.

Not long ago, the Eastern Air Defense Command engaged in maneuvers. Our own planes impersonated a theoretical enemy. In just one day, ground observer teams, reporting to nineteen filter centers, made more than twenty-six thousand telephone calls

Think of it! More than twenty-six thousand telephone calls in one day's test—vivid proof of the importance of the telephone to national security. There you have one more example of the tremendous demand for telephone service created by our country's defense program. In the last five years the Bell System has spent five and one-half billion dollars to improve and expand the telephone service to the public, the armed forces, civil defense organizations and defense industries.

And more needs to be done. The money to build an improved and expanded telephone system comes from people who put their savings in the telephone business. They will continue to do so only so long as they believe their investment is safe and will pay them a good return.

More than a million of them have put their savings into the telephone business. We must depend on them—now and in the future. Only a financially strong telephone system can maintain the good service so vital to America today, and build the telephone service our country will need tomorrow.

Protecting Your Mortgage

LLOYD H. BUNTING, *Insurance Counselor*

It is the common desire of most married couples to acquire a home of their own where they can raise their family under the best conditions. Anyone who has ever sat on his own porch on a warm afternoon and surveyed his estate, or watched the children at play in the yard, or planted his own garden knows the comforts and satisfactions which go with such a possession. To be able to "monkey around," to sandpaper and paint the screens, to build your own fence, to fix up a sand box for the kids, to be able to do most anything you want on your own property—that is the American way of life.

The mortgage is a very useful financial device enabling millions of people to purchase homes which they would not otherwise have been able to have. However, it is not something to keep permanently. Most people gradually reduce their mortgage and thereby increase their equity, until the home finally becomes fully owned. This is a day to celebrate for it represents the completion of a long and steady program of saving with a worthy result. The relatively new, amortizing mortgage, makes this possible.

The mortgagee, the other party to the home purchase agreement, is usually a bank, insurance company or a building loan organization. Anyhow it is a "business-wise" organization and as such looks after its own interests by requiring you, the mortgagor, to furnish it with the following instruments for its protection: The mortgage contract, a bond signed by you and your wife, a fire insurance policy of sufficient size to at least cover its investment, a title policy. There is also the little matter of payments from your earnings. The mortgagee doesn't even lose if the purchaser should die before completing his contract because the mortgage is a conditional conveyance of the property to the mortgagee as security for the full payment. But suppose something happens to you? The Government, through its experience with the Home Owners Loan Corporation, shows that for every loss of a home by fire there are 16½ deaths among home owners resulting in most cases in foreclosure and the loss of the home to the wife and children. No one would think of owning a home and not having it covered by fire insurance, but as you can see life insurance is more important.

Just as the lender protects its interests, so is it good business for the home owner to protect his family's interests by purchasing the proper life insurance contract. The cost is not too great for the benefits derived, as the following will demonstrate: To cover a $10,000 mortgage for a man, age 30, with a 20-year amortization period still to run, the initial monthly premium is $10.92 or for an owner age 35 it is $13.00. If this plan is followed these premiums can be deducted from your salary. If the dividends are used to reduce the outlay the average premium at age 30 will be $8.36 or for the owner age 35 it will prove to be $10.14 monthly. This gives an average outlay of from 1 to 1¼ per cent of the amount of the total mortgage. These premium figures include a disability provision so that if the owner should become incapacitated during the 20-year amortization period the insurance policy would become paid up and no further payments would be required during the continuance of the disability.

Should the owner die during this period his wife would then receive an amount at least equal to the outstanding mortgage so that she could pay it off in full and possess the home free and clear. In the later years of the plan she would receive an additional sum which would be a great help to her in many ways.

When the required amortization payments have been completed and the mortgage is paid off then of course the home is free and clear under the terms of the mortgage contract. At such time the owner, who was age 30 when he started, would then have a life insurance policy for $4,000 which he could surrender

for $1,304 to help him celebrate the occasion, or it could be continued in force at a reduced premium. The same is true for the owner who started at 35 except that in his case the celebration value will be $1,468. If the policy values were taken into consideration by subtracting them from the total premiums paid, the net cost for the life insurance protection would have been $35.12 per year for the man who was 30, or $45.28 for the owner who was 35. This is approximately a net yearly cost of from ⅓ to ½ per cent of the total amount of the mortgage. Not too high, it seems, for the comfort and satisfaction and assurance received.

New TV Links Installed

A southbound television channel from Detroit to Toledo was placed in service on September 5 by Long Lines. Prior to the opening of this channel, Detroit was served by three northbound TV channels from Toledo by means of radio-relay facilities, the first two of which have been in service since September 20, 1948. The third northbound channel was added on May 1, 1949.

A second intercity television circuit for Birmingham, Ala., and Atlanta, Ga. was made available on September 12 to permit reception of a special Red Cross program. Regular use of the circuit began September 17.

This additional service was provided by adding television equipment to an existing coaxial cable from Memphis, Tenn., to the two cities. The TV signals will travel over one of the coaxial tubes in the cable not now being used to carry telephone calls.

The new circuit will enable television stations in Birmingham and Atlanta to broadcast two different network programs at the same time. Under present arrangements the two local stations in each city share the use of a single coaxial circuit.

Other plans for extension of television service in the south include the connection of Miami and New Orleans to the network in late 1952. The Miami connection will be made by equipping an existing coaxial running south from Jacksonville, and New Orleans will be served by a coaxial cable now under construction south from Jackson, Miss.

National Electronics Conference

Bell Laboratories engineers will have an active part in the Seventh Annual National Electronics Conference and Exhibition in Chicago, October 22, 23, and 24. This conference, which will be held at the Edgewater Beach Hotel, is sponsored by the A.I.E.E., I.R.E., Illinois Institute of Technology, Northwestern University, and University of Illinois, with the University of Wisconsin and the Society of Motion Picture and Television Engineers participating.

A session on high-frequency measurements, prepared in cooperation with the Joint A.I.E.E.-

Joyce Thompson and Eleanor Ringel with the twelve girls who have just completed an intensive training course in stenography. These girls are now taking regular dictation calls from Central Transcription. Seated—Miss Thompson, Olga Nagy, Marion Buckley and Eleanor Heil. Standing—Yvonne Wolf, Miss Ringel, Anne Sethmann, Elizabeth Witte, Sarah O'Brien, Lucille Columbia, Helen Farrell, Lucia Celentano, Mary Incampo and Sarita Stillman.

I.R.E. Committee on High Frequency Measurements, and scheduled October 22, includes papers by three Laboratories people. E. D. Reed will present *A Sweep Frequency Method of Q Measurement for Single Ended Resonators;* J. P. Schafer and L. E. Hunt, *Measurement of the Relationship between Baseband and Radio Frequency Amplitude in FM Systems;* and P. H. Smith will describe his *Chart for Coaxial-Line Probe Measurements.*

At the Tuesday afternoon session on Computers, M. D. Fagen will speak on *Performance of Ultrasonic Fused-Silica Delay Lines.*

Turkish Telephone Engineers Train with Michigan Bell

The second half of a program designed to help Turkey reorganize its telephone system got under way in August with the arrival in New York of ten young Turkish communications engineers who will receive technical training with Michigan Bell. A team of seven Bell System men has been in Turkey since last spring surveying facilities there and developing plans for expansion. Two former Michigan Bell engineers are among this group.

Both strategic and economic considerations make it vital that Turkey's telephone system be overhauled. One of the most strongly anti-communist countries in the Middle-East, Turkey is a next-door neighbor of Russia and at present has no telephone communication with the outside world. Efficient operation of the telephone system within the country is essential to the industries and the general economy of Turkey, and to the government itself.

The engineers training with Michigan Bell were selected by the Turkish Ministry of Communications as the best qualified with respect to general education and knowledge of English. Michigan Bell was selected for the project because its training program could readily be adapted to that planned for the visitors.

Sponsored by the Economic Cooperation

C. C. BARBER
35 Years

J. W. FARRELL
40 Years

W. A. BOYD
40 Years

E. J. JOHNSON
40 Years

S. B. KENT
40 Years

SERVICE ANNIVERSARIES

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

40 Years

W. A. Boyd.....30th
J. W. Farrell.....11th
E. J. Johnson.....3rd
S. B. Kent.....3rd

35 Years

C. C. Barber.....2nd
Oceana Johnson...7th

30 Years

M. L. Almquist...20th
Louise Ellin.....10th
M. E. Esternaux..11th
A. H. Falk.....8th
L. E. Gaige.....14th
H. A. Hay.....13th
C. Kreisher.....11th
B. A. Nelsen.....3rd
N. Scribner.....23rd
E. M. Staples....19th

25 Years

H. J. Camp.....4th
R. R. Cordell....15th
L. R. Cox.....5th
C. C. Fleming....25th
F. W. Horn.....2nd
L. S. Inskip.....13th
W. T. Jervey.....4th
D. G. Neumann..11th
A. Roces.....1st
Edna Ruckner....25th
C. W. Schramm..12th
W. C. Toole.....4th

15 Years

S. Bodnovich.....1st
R. W. Bruckmann 14th
W. S. Irvine.....26th
P. Ronan.....30th
D. L. Viemeister..26th

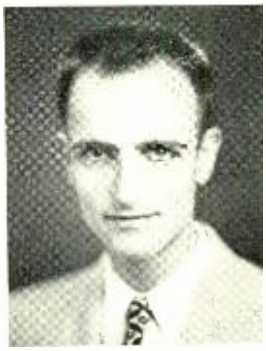
10 Years

D. Keir.....27th
A. D. Klein.....27th
F. F. Moller.....27th
F. J. Morin.....27th
Agatha Tellefsen..14th
W. A. Von Glahn.18th
R. E. Azud.....23rd
B. D. Carniglia....1st
Dorothy Delaney..3rd
G. W. De Sato....20th
R. H. Fox.....1st
J. M. Hinkle.....6th

Called to Active Duty

R. R. REPPY

Two members of the Laboratories have recently received military leaves of absence. They are Raymond R. Reppy, who was a technical assistant at Whippany, and Sutton Monro, a Member of the Technical Staff in Quality Assurance. Mr. Reppy was a reservist in the Air Force, Mr. Monro, a naval reservist.



SUTTON MONRO

Administration, the reorganization project is the result of a request by the Turkish Ministry of Communications for American technical assistance. The Ministry also operates the country's telephone and telegraph systems.

Laboratories Pilot Has Close Call

Lieutenant Robert Norton, a Fifth Air Force bomber pilot on military leave of absence from the Laboratories, has recently completed his forty-fifth combat mission in Korea. Assigned to the night flying 3rd Bomb Wing, the 28-year-old veteran of World War II says his 32nd mission was his closest call.

"We were attacking a twelve-vehicle convoy near Suan when Communist small arms fire started hitting us all over," he said in a recent interview. "We destroyed or damaged six of the supply trucks and then headed for an advance air strip for an emergency landing."

Lieutenant Norton landed the badly damaged B36 "wheels up" . . . and no one was hurt. He had a similar close call over Germany on his fifth mission with the maurauder bombers. On that occasion he made an emergency landing at a friendly airbase in France.

Air Force Association Honors Shockley

At its annual convention in Los Angeles the Air Force Association presented a Citation of Honor to William Shockley for the Transistor as a contribution to the defense and security of the United States.

The citation, presented to Dr. Shockley by Lieutenant-General James H. Doolittle, air hero of World War II, reads in part:

"A new invention—the Transistor—promises to revolutionize electronics and, in so doing, materially advance our air capability.

"Dr. William Shockley of the Bell Telephone Laboratories is chiefly responsible for the development of the Transistor . . .

"Its effect on tomorrow's Air Force promises to be significant and far-reaching.

"In recognition of his contribution to the defense and security of the United States, the Air Force Association awards its Citation of Honor for outstanding public service."

In accepting the reward Dr. Shockley emphasized that the development of the Transistor was the result of the activity of a number of people at Bell Telephone Laboratories, and he accepted the award in their names as well as in his own. The Transistor, and the way which they worked on it, said Dr. Shockley, is built upon a basis of general physical science, developed by scientists throughout this country and other countries as well.

News Notes

S. B. COUSINS participated in a Traffic Conference of the Michigan Bell Telephone Company at Macatawa, Michigan, on September 11 and 12. During the conference Mr. Cousins spoke on the *Business Side of the Laboratories.*

WILLIAM SHARPLESS received his professional engineers degree in Electrical Engineering from the University of Minnesota. It was awarded for having completed not less than eight years of professional engineering and for having submitted a thesis.

THE WEST STREET CHORUS, under the direction of R. P. YEATON, will take part in the program to be presented at the Life Member Club luncheon of the Frank B. Jewett Chapter of the Telephone Pioneers on October 18 in the West Street Auditorium. GRACE WAGNER will be the accompanist.

Answers to the picture quiz on page 480 of this issue: 1B; 2A; 3B; 4B; 5A; 6C; 7B; 8C; 9B; 10D; 11C; 12D; 13A; 14B. Picture No. 7 has not previously appeared in the RECORD.

RETIREMENTS

Recent retirements from the Laboratories include H. A. Larlee with 46 years of service; A. L. Matte, 33 years; R. C. Ennis, 28 years; and Dumitru D. Gologan, 8 years.

Herman A. Larlee

Around the turn of the century, when a New Brunswick lad wanted to savor the gaieties of the States, he got himself a job as escort to a few carloads of potatoes across Maine and down to Boston. That was how Herman Larlee made his entry in 1904; at stops he stoked the fires that kept the potatoes from freezing; en route he rode the caboose. Next spring found him inspecting transmission instruments in Section 9-D at West Street. At that time all transmitters, receivers and "induction coils" were owned by the American Bell Telephone Company and leased to the Operating Companies. In 1907

One of the groups at the dinner tended to H. A. Larlee: in the foreground are W. H. Martin, M. J. Kelly, R. L. Wegel and Mr. Larlee.

he became a Western Electric shop inspector and in 1910 was moved to the Transmission Laboratory to help in development on carbon and transmitters. He had a great deal to do with the centrally-damped transmitter and the 144-type receiver, the last to be developed for desk stand use.

Work on a handset telephone was under way, and in 1912 Mr. Larlee shifted to it. Briefly diverted to war activities in 1917-18, he worked on transmitters for gas masks and for airplanes. In 1926, when the handset was going into production, Mr. Larlee was put in charge of a team of engineers and scientists who went to Hawthorne to help Western Electric get started. On his return he took up current engineering on the handset, including an extensive program of tests on the carbon and on the completed instruments and sets. In 1937 he became Station Maintenance Engineer, in order to collaborate with the Operating Companies on their problems.

H. A. Larlee

A. L. Matte

During World War II Mr. Larlee was loaned to the Army with the title of Consultant to the Secretary of War. He kept up a continuing survey of the Signal Corps' repair shops, advising them as to suitable techniques. After the war he took up his previously assigned duties as Station Quality Engineer in Quality Assurance.

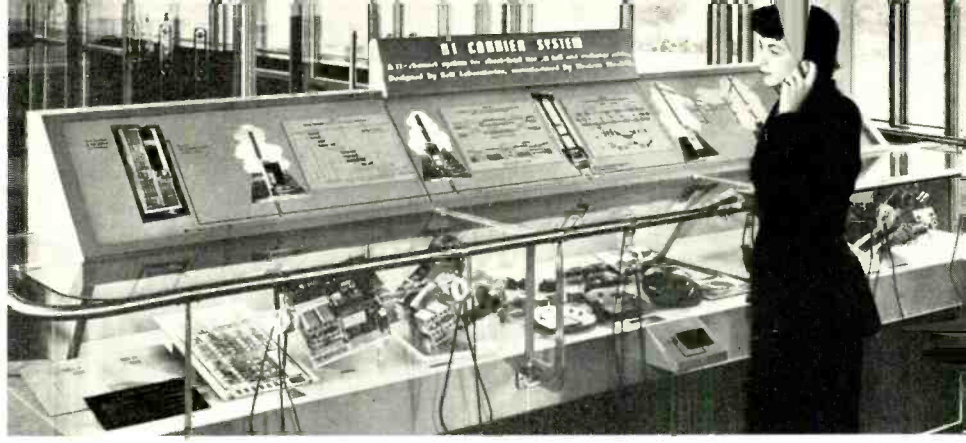
Mr. and Mrs. Larlee have lived in Mountain Lakes for many years. They have two boys and one girl; a third boy, then an engineer with Bell of Pennsylvania, was killed in World War II. Mr. Larlee has been active in many civic affairs as volunteer policeman, director of the savings and loan association, and master of his Masonic lodge.

Roy C. Ennis

To few who work at West Street does it occur that a building has a life of its own, much like a tree. Things keep happening to it all the time, due to the use that is made of it; stair treads wear smooth, linoleum curls up. Other things happen from vibration, from the elements, from corrosion. Even since he came to work here in 1923, Roy Ennis has been looking for these things, and seeing

D. D. Gologan

R. C. Ennis



Anita Sperco of Murray Hill Transcription listening to the narration that describes the N1 carrier telephone system display on the Concourse at that location.

that they are set to right. When you see a repair crew at work, or a gang of masons or painters, you can be pretty sure that Mr. Ennis has been at the bottom of it. The repair of West Street structural steel, involving removal and replacement of the brick-work, was a big job on which he was project supervisor.

Long interested in gardening, Mr. Ennis has moved to Wyckoff, the increased area of which will give him plenty of scope for his hobby.

Andrew L. Matte

A. L. Matte graduated from M.I.T. with the B.S. degree in 1909 and returned in 1912 to take graduate work. In 1918, after five years with the Detroit United Railways, he joined A T & T transferring to the Laboratories with the Department of Development and Research in 1934. His life work has been concerned with carrier telegraph systems, in connection with which he holds nineteen patents. A recognized authority in the field, he has been called into consultation by the government and various railroads. He has written a number of professional papers, for one of which he and his co-author received an A.I.E.E. first prize for "best paper in the field of engineering practice." Frequency shift telegraph,° the subject of that paper, was widely used by the Armed Forces during the war for radio trunk circuits, and this development was credited with making radio teletype practicable.

Mrs. Matte was formerly a secretary in D & R. The couple will continue to live in Summit; Mr. Matte has become an associate professor of electrical engineering at Polytechnic Institute of Brooklyn.

Dumitru D. Gologan

Mr. Gologan was born in Roumania 65 years ago and took trade school courses there. Coming to the United States in 1906, he worked for many different firms in Newark and in New York and at one time operated his own jobbing shop. He joined the Laboratories at Murray Hill in 1942 as an Instrument Maker in the Development Shops and one of his first assignments was to a special shop set up in the Acoustics Building to handle an important military project. With the end of wartime activities, he worked for a time with the magnetics group and at the completion of this assignment returned to the Central Shop. He completes his career with the Laboratories while serving the Physical Research Department as a member of the Local Branch Shop. A bachelor, Mr. Gologan lives with his uncle's family in Union.

° Bell System Monograph B-1620.

W. A. Weikert, the Laboratories "birdsmith," is shown with his exhibit of whittled birds. His birds are made from a single block of sugar pine, usually scaled to size and hand painted. Shown in the exhibit are some of his favorites including a nuthatch, Baltimore oriole, a blue jay and a woodpecker.

DOLL AND TOY CAMPAIGN COMMITTEES

Early September saw the beginning of unusual activities on the part of the Doll and Toy Committees at various Laboratories locations. Under the leadership of Eugenia Wyckoff, second vice-president of Bell Laboratories Club and head of the committee, a program is under way to coordinate the buying of Christmas toys and dolls. The plan will spread the money donated by Laboratories members to provide more toys and dolls for needy and sick children in over 100 institutions and hospitals, and to save the time of members of the committee. At Murray Hill, Eileen Gilburn, and at Whippany, Alice Charlton, have added the names of the Sister Kenny Foundation and of the children cancer patients in the Jersey City Medical Center to the institutions to which they will contribute.

In addition, simple circular-skirt patterns to glamorize the dolls and save hours of sewing time will be made available through the Doll and Toy Committee members. The pattern was designed by Eileen Clifford of Central Files.

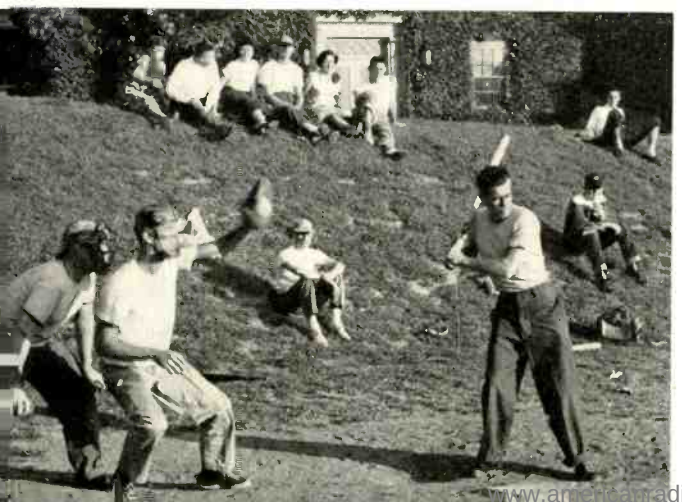
In New York Miss Wyckoff will be assisted by Catherine Lennon, treasurer; Catherine Durnan, assistant treasurer; Mary Kitchell Stokes, secretary; and Margaret Sheehan, assistant secretary. At Murray Hill Miss Gilburn's committee will be comprised of Thelma Gradwell, assistant chairman; Shirley Lawton, treasurer; Marian Harold, assistant treasurer; Jean Wilson, secretary; and Eloise Giles, assistant secretary. At Whippany Miss Charlton's committee will be Marion Merck, secretary; and Loretta McBride, treasurer.

Helen Conklin is the Holmdel chairman and Helen Johnson the chairman at Deal. Harry A. Doll, who will represent the Laboratories at Winston-Salem and Burlington, will use his donations at the Carolina Polio Hospital.

A special group of larger dolls will be purchased by donations from West Street veterans and dressed by veterans' families. The dolls will be given to the wounded at Kingsbridge Hospital for their little girls. Eleanor Burden is in charge of this project.

Committee members and their departmental representatives will be calling on Laboratories members or their families in early October to dress dolls or buy a doll.

Baseball at Stevens Field, Hoboken. Members of the Laboratories and their families watch the Messenger and Plant teams play their final game for West Street's championship. George Schiehser is up, with Edward Clifford, catcher, and Joseph Hurley, umpire. The winners were the Messenger team, left to right, first row, *Richard Crowell, Ronald Messinger, and Frank Pesce;* second row, *Charles May, Fred Castle, Edward Clifford, Robert Cinelli and James Carroll;* third row, *Howard Weilbacher, Benjamin Clark and John Burke; and* fourth row, *Umpires Joseph Hurley and William Seeger.*



News Notes

DR. DENNIS GABOR of the Imperial College of Science and Technology in London visited the Murray Hill Laboratories on August 31. At a conference in the Arnold Auditorium he spoke on *Light and Information*. He dealt generally with the communication theory in two dimensions and points of view on the information theory applied to the theory of light. Dr. Gabor is known for his pioneering work in the theory of communication, speech compression and other fields.

B. S. BIGGS assumed the chairmanship of the North Jersey Section of the American Chemical Society on July 1, having served a year as chairman-elect. The North Jersey Section with over 4000 members is the second largest local section of the American Chemical Society.

A. W. TREPTOW ran scratch-resistance and abrasion-resistance tests on porcelain enamel linings at the Bureau of Standards in Washington. At Winston-Salem with A. W. ZIEGLER he reviewed the process for making metallized ceramic terminals for hermetically sealed transformers and networks. Mr. Treptow also visited Indianapolis to discuss the effect of cobalt shortage on black printing ink for dial number plates and to inspect new facilities for making dial number plates. On a trip to Hawthorne satisfactory procedures for sealing deposited carbon resistors in metallized ceramic housings were established.

"Doll Gets Doll From Dolls" might be the caption of this feature which shows Harry Doll, member of the Laboratories group at Burlington, accepting a gift of dolls for polio patients presented by the Alamance County Nurses' Association.

DISTRIBUTION TERMINALS until recently have not been gas tight. Consequently, when an exchange cable system is placed under pressure it becomes necessary to plug all terminal stubs. J. A. RATTA and D. C. SMITH were recently in Nantucket to initiate a field trial of a new method of plugging.

Preparing technical material for distribution to various parts of the Bell System, Edith Nielson knows the importance of her work and its relation to the associated development of telephone and military projects. The Laboratories offer opportunity for young women in many interesting clerical and technical fields. If you know any young women who might be interested, please refer them to Hazel Mayhew at West Street or Phyllis Taylor at Murray Hill.

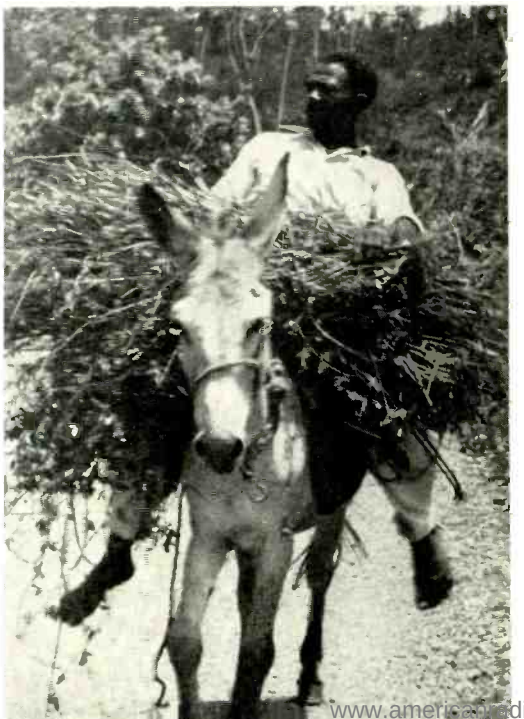
F. HARDY has been elected a director of the New York Section of the American Society of Lubrication Engineers.

THE FABRICATION of components is now under way for a field trial of the new L3 coaxial system. Ceramic housings for the line amplifier transformers were discussed by A. D. HASLEY during a visit to the American Lava Company at Chattanooga, while production facilities for the transformers themselves were inspected by W. L. BRUNE at Haverhill. Also at Haverhill, J. R. BARDSLEY discussed design improvements in the system's new variable power loading coils.

Terry Rillo, formerly of the General Service Department at Murray Hill who was an accordion soloist with the Murray Hill Popular Orchestra, recently arrived in Japan, her first stop on a 60,000-mile USO tour on which she will give 60 shows.

R. P. Wells at Jamaica

From time to time Laboratories' personnel are called to various parts of the world on company business which takes them to strange places. R. P. Wells has recently returned from a three-month survey of the islands and waters in the British West Indies for the submarine cable group. Always interested in finding scenes other than those of measuring equipment, Transistors and schematic diagrams in the RECORD, he submitted these photographs which were taken on the trip depicting life on the island of Jamaica. The photograph above, taken on the main street of the island capital city, shows women about to enter a bus. (It was not determined whether the baskets were taken from the head before entering.) The other photograph was taken fifteen miles north of the capital city (Kingston). Charge for taking picture—two American cigarettes.



News Notes

R. S. DUNCAN and H. A. STONE visited Haverhill to help speed the manufacture of adjustable inductors for the group and channel filters of the new Type-O carries system for short-haul open-wire lines. Feature of these precisely-adjustable inductors is their high Q at carrier frequencies secured through the use of ferrite cores.

F. F. FARNSWORTH and G. Q. LUMSDEN have just returned from a visit to the Pacific and Mountain States areas where discussions were held with interested telephone engineers and

Taken at the Palo Alto, California, pole yard, F. F. Farnsworth describes why this lot of poles is clean. From left to right, are T. L. Oliver, Bell Laboratories Field Engineer at San Francisco; W. M. McClelland, engineer with the Pacific Company; Mr. Farnsworth; and E. M. Calderwood, Outside Plant Engineer, San Francisco.

pole treaters relating to the introduction of pentachlorophenol-petroleum preservative for Northwest pole species such as lodge-pole pine, Douglas fir and larch. Conditioning methods, prior to treatment, affecting penetration of preservative, and the minimizing of injurious checks were also discussed. This survey was made because of continuing unfavorable bleeding experiences with these thinner sapwood species when treated with creosote.

Bell Laboratories Record

RECENT DEATHS

HARRY R. CLARKE
December 16, 1892 – August 12, 1951

After several years of general technical experience, Mr. Clarke joined the Laboratories in 1917. He was assigned to a radio group at West Street responsible for the development of wind-driven generators for aircraft. Shortly after World War I he was transferred to the newly formed specifications department to cover all types of telephone apparatus.

From 1922 on, in what is now the Station Apparatus Development Department, Mr. Clarke had been intimately concerned with the development of station apparatus, including transmitters, receivers, headsets, mountings, headbands, and testing equipment on which he had been granted twelve patents.

He was associated with the original design of the telephone handset handle and was granted a patent on a hollow handle of thermoplastic. Other contributions include the mechanical design of the lineman's rubber handset and the adjustable headband for the operator's headset. During World War II he was engaged in the development of special headsets for military use and designed the rubber face harness of the lip microphone.

At the close of the war, Mr. Clarke was assigned to the dial development group where he contributed to the design of the 7-type dial for use in the new 500-type telephone set and a similarly improved dial to replace the 5-type dial. For the past year he had been assigned to the development of a signaling device for a Signal Corps field telephone set. He is survived by his wife and a sister.

H. R. CLARKE

N. A. HALL

A. S. BERTELS

NELSON A. HALL
September 6, 1888–September 1, 1951

N. A. Hall's service with the Bell System dates back to 1905 when he entered the American Bell Company at 463 West Street to handle work on telephone receivers and transmitters, which at that time were returned here for repair. Two years later when that company became part of Western Electric, Mr. Hall transferred to the service group and advanced until he became head of the service staff in the Transmission Department.

In 1923 he resigned to join the Penn Mutual Insurance Company where he remained for nearly 20 years. At the outbreak of World War II he decided to do war work and was reemployed at the Laboratories. During that period he became an outstanding project expediter in the field of underwater sound. At the end of the war he remained, first in the Purchasing Department and later as Commercial Relations representative at Whippany.

At the time of his death he was a Member of the Laboratories Staff under Area Management at that location where he followed orders on outside suppliers associated with production of military equipment. Mr. Hall is survived by his wife and five children.

ARNOLD S. BERTELS
January 15, 1871 – September 8, 1951

At the time of his retirement in 1932, Mr. Bertels had completed 44 years of service. In his 19 years of retirement he had enjoyed good health and was active until his death.

His Bell System career began in 1888 as a night operator at Wilkes-Barre for the Central Pennsylvania Telephone and Supply Company. In 1891 he became a telephone inspector and later a wire chief and chief operator. After two years he transferred to what is now the New York Telephone Company as telephone inspector, later becoming an inside central-office repair man, and in time an inspector. In 1910 he began to study the semi-mechanical circuit at 463 West Street where a year later he began working on the testing of circuits for the new system. From

1913 to 1918 he was engaged in New York and New Jersey locations on routine tests for the dial system. At the end of that period he became Equipment Engineer at West Street and in 1919 he transferred to the Circuit Engineering Department. His last years at West Street were spent in Systems Development where his accumulated experience contributed to the development of routine tests.

His son and daughter-in-law, Mr. and Mrs. A. R. Bertels, are members of the Laboratories. Two other sons also survive.

News Notes

BIBLE of the telephone man is the *Bell System Practice,* a handbook whose numerous sections tell him the best way to do almost every job in the Plant Department's repertoire. In fact, it is the standardization based on the "BSP" that makes it possible for a crew from Indiana to restore telephone service in Massachusetts. Practices telling how to test and maintain telephone systems are written by engineers who were active in the development and usually the system and the test facilities are available in the Laboratories for a direct check on the BSP. Recently, however, A. G. MATHIS spent several days at Harrisburg running through the tests specified in a new BSP on an actual No. 23 operating room desk to be sure that his directions to the telephone plant people were all satisfactory. Because this desk is of a recent type and has several brand-new features, the installation is of great interest to engineers in the Laboratories and in A T & T. It is planned to make some fairly extensive tests of its traffic handling capabilities, and H. E. NOVACK went out to arrange for them and to discuss acceptance tests. While in Harrisburg, he lent a hand to Mr. MATHIS.

FOR SEVERAL YEARS work has been under way to standardize manufacturing specifications for large-production components on a national basis. In emergencies there is a big advantage in having such components readily producible by more than one company. D. R. BROBST and R. W. BOGUMIL visited Western Electric's Tonawanda plant to discuss the conformity of Laboratories' requirements for enamel wire and switchboard cables to NEMA specifications.

NEWTON MONK has written on *Experimental Radio-Telephone Service for Train Passengers;* F. B. ANDERSON on *Seven-League Oscillator;* and C. C. BUTLER on *The Calculation of Traveling-Wave-Tube Gain* in the August issue of *I.R.E. Proceedings.*

DURING A VISIT to the Simplex Wire and Cable Company, Cambridge, Massachusetts, L. G. RAINHART and V. T. WALLDER witnessed the extrusion of polyethylene on a special cable design. H. PETERS also visited this company in connection with submarine cable splicing. Mr. Wallder was at Point Breeze where he discussed low temperature testing of plastics with Western Electric engineers.

FOLLOWING A. G. BELL'S advice, E. A. THURBER took a "dive into the woods" of Cape Breton Island where he had the pleasure of meeting a few of Bell's oldest and closest friends, climaxed by a conducted tour of the entire Bell-Grosvenor estate at Beinn Breagh.

THE LABORATORIES were represented in interference proceedings at the Patent Office in Washington during August by W. F. SIMPSON and J. W. FALK before the Board of Interference Examiners. G. F. HEUERMAN appeared before the Board of Appeals at the Patent Office in Washington relative to an application for patent.

Engagements

Shirley Dixon—Frank C. Norton °
Virginia Van Winkle—Herbert E. Randall, Jr.°
Rosalie Girgenti °—Michael Gulya
Meredith McKone °—Walter F. Krieger
Ruth A. Vieweger °—Roger R. Victora °

Weddings

Eileen George °—Thomas Loughlin
Kathleen Muccione °—Raymond Greenfield
Marylin Dowling °—Robert J. Moran

Births

Cathy Darlynn on August 2 to Mr. and Mrs. John H. Hershey. Mr. Hershey is a member of Military Electronics at Whippany.

James Hugh on August 17 to Mr. and Mrs. James Meehan. Mr. Meehan is a member of Murray Hill Area Management.

Nancy Deborah, September 8, to Mr. and Mrs. William P. Slichter. Mr. Slichter is a member of the Chemical Laboratories.

Brian Paul on July 7 to Mr. and Mrs. Richard L. Dougherty. Mr. Dougherty is a member of the Switching Systems Development Department.

John Bellman on September 4 to Mr. and Mrs. William J. Grubbs, Jr. Mr. Grubbs is a member of the Military Electronics at Whippany.

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

W. KEISTER gave a demonstration lecture on *The Magic of Relays* before the Northern New Jersey Subsection of the I.R.E. in the Arnold Auditorium at Murray Hill, September 12. He described and illustrated the manner in which relays can be made to perform the logical actions required in computers and automatic switching arrangments, showing the wide use of computer techniques in large telephone switching systems.

THE LONGEST Type-N carrier systems to date are the Bangor-Limestone (Maine) systems covering a distance of 184 miles. ESTHER RENTROP, A. J. AIKENS, J. L. DONCOURT and J. MALLETT spent a month measuring the noise and crosstalk performance of the cable facilities.

IN CONTINUANCE of corona threshold tests of coaxial cables being made for the L3 development program, J. M. DUNHAM and J. H. HARDING have completed tests on several repeater sections of the recently installed Dallas-Houston coaxial cable.

ALTHOUGH TELEVISION SERVICE has been provided over TD-2 radio circuits since September, 1950, the first telephone message circuits to use TD-2 facilities were placed in service on the Omaha-Denver segment of the Chicago-Oakland system on July 9. Chicago-Omaha service followed on July 24, and Denver-Oakland service was instituted on August 17. Special delay equalization was required for message service, and various members of the Laboratories participated with the Long Lines department in pre-service tests to determine the efficacy of the equalization and to make observations of telephone transmission. The Omaha-Denver section was tested by H. W. EVANS, H. E. HESKETT and A. C. PETERSON at Omaha, and J. G. CHAFFEE, T. R. D. COLLINS and W. C. WARMAN at Denver. Tests on the Chicago-Omaha section were made by B. C. BELLOWS, C. E. CLUTTS and J. M. MACMASTER at Chicago; R. L. ROBBINS at Omaha; H. E. CURTIS and G. W. WHEELER at Denver; and J. B. MAGGIO, A. C. PETERSON and R. L. ROBBINS at Oakland participated in tests of the Denver-Oakland section.

A METHOD has recently been devised to run the pneumatic ticketing tubes inside the housing of the 3CL toll switchboard. Buffalo was selected for the first commercial trial of this new arrangement, and W. W. BROWN went there from the Laboratories to inspect the finished installation. From Buffalo, he went to Cleveland for a conference on a new operator's chair.

"Relax, everybody, it's for me."

R. O. RIPPERE recently went to Peoria, Illinois, to discuss the changes required to permit lines equipped with step-by-step switches to handle coin boxes equipped for the new ten cent initial charge. He later went to Chicago to discuss with the Illinois Bell Telephone Company problems connected with extending the line ranges of step-by-step offices.

R. D. MINDLIN, W. P. MASON, T. F. OSMER and H. DERESIEWICZ prepared a paper on *Relative Slip of Contact Surfaces of Elastic Spheres Caused by Tangential Forces*. It was presented by Dr. Mindlin at the U. S. National Congress of Applied Mechanics held at the Illinois Institute of Technology in Chicago.

A TELEPHONE SYSTEM is never static, but changes as operating experience suggests improvements. Our engineers are constantly revising the circuits, but the revisions must be put into effect in an orderly manner. So as to cause the least interference with production and the fewest reissues of drawings, a committee which meets bi-monthly to coordinate the revisions on No. 5 crossbar consists of four Western Electric engineers, and K. M. FETZER, W. E. GRUTZNER and L. J. SCOTT of the Laboratories. Their August meeting was held at Hawthorne; it was attended also by R. E. HERSEY and H. D. CAHILL.

AFTER MATERIALS ENGINEERING has endorsed the use of a new material, the supplier must do considerable experimenting before production flows smoothly. During this period, engineers from Western Electric and the Laboratories are likely to visit the supplier's plant and offer suggestions. One such visit was that of J. B. HAYS and J. W. KITTNER to a plastics molding plant, to review the production of a test set case and try to discover causes of difficulties.

"The Telephone Hour"

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

October 8	Ferruccio Tagliavini, *tenor*
October 15	Lucile Cummings, *contralto*
October 22	Michael Rabin, *violist*
October 29	Ezio Pinza, *basso*
November 5	Marian Anderson, *contralto*
November 12	Nelson Eddy, *baritone*
November 19	Jascha Heifetz, *violinist*
November 26	Oscar Levant, *pianist*

C. A. LOVELL, R. C. NEWHOUSE, and S. H. WASHBURN recently visited the McDonnell Aircraft Corporation in St. Louis and later the Minneapolis-Honeywell Regulator Company in Minneapolis to discuss with them certain war jobs with which they are connected.

FOR SOME TIME now a trial has been under way in the automatic message accounting center in Philadelphia for pressurized relay cabinets. Small individual blowers maintain clean air at slightly above atmospheric pressure in the cabinets so that no dirt can get in. H. A. BURGESS, A. J. ENGLEBERG, N. V. MANSUETTO, N. H. THORN and J. B. WORTH recently visited the Philadelphia office to discuss with members of the Western Electric's Installation Department, and with the Bell Telephone Company of Pa., modified arrangements to secure more complete and accurate records of the results of the trial.

IN SWITCHING ENGINEERING O. H. WILLIFORD, with J. P. Ringland and T. A. McDermott of O&E, visited the Michigan Bell Telephone Company in Detroit to discuss a number of unusual problems encountered in their Centerline No. 5 crossbar office. These are due primarily to very large and rapid industrial growth, stimulated by the national defense preparations. R. F. MASSONNEAU and R. A. MILLER, with W. D. Mitchell and R. T. King of A T & T, inspected the management announcement system which Westinghouse Electric Corporation have set up in their East Pittsburgh plant.

DESPITE THE GENERAL RISE in costs, engineers have managed to keep down the cost of loading coil cases through the use of thinner steel and more efficient manufacturing methods. Samples of these economical designs were inspected recently by J. E. RANGES during a visit to Hawthorne.

WITH THE MANUFACTURE of porous tantalum electrolytic capacitors now in full swing for Type N carrier and other uses, M. WHITEHEAD joined Western Electric engineers in discussion with the Fansteel Metallurgical Corporation, in Chicago where some of these capacitors are being produced. A feature of these capacitors is the large electrode area secured by sintering the tantalum to produce a porous structure.

J. B. HARLEY, J. G. NORDAHL, N. MONK, A. E. RUPPEL and A. C. PETERSON visited the Motorola Company in Chicago on July 24 and 25 to discuss field information and arrangements for handling modifications in mobile radio equipments which the Western Electric Company purchases from Motorola for Bell System use.

A. P. JAHN, with engineers from U. S. Steel Corporation, Armco Steel Corporation and Westinghouse Electric, visited Pennsylvania State College, July 20, to examine specimens of iron and steel exposed in the corrosion test plot which has been maintained there for several years by Committee A-5 of the American Society for Testing Materials.