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AS WE enter a new year, I am happy to express to everyone in the Laboratories my appreciation of the fine job that has been done by all of you during 1950, and to extend to you and to your families my wish for a full measure of happiness in the year ahead.

Oliver E Buckley

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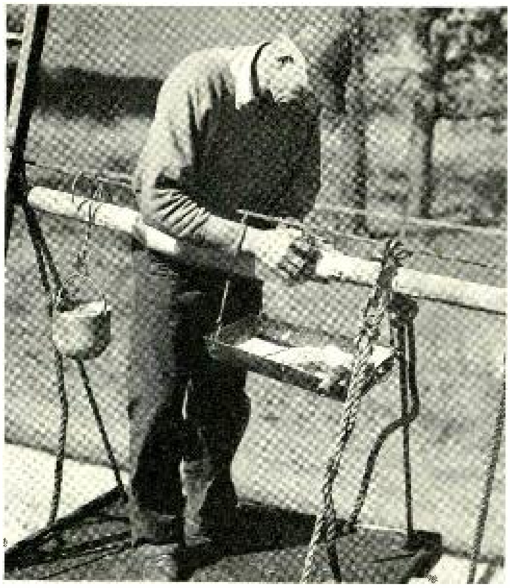


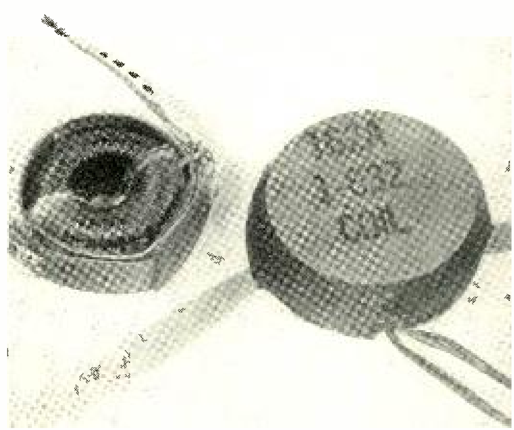
Splice Loading Developments

S. G. HALE
Transmission Apparatus Development

In applying coil loading to voice frequency cables, a variety of methods of housing the coils have been provided. Cases designed for use with submarine cables, buried cables, aerial cables, and cables installed in underground ducts are available to accommodate a wide range of coil complements for use on different sizes of cable. In certain instances it is desirable to load only a few circuits or to replace occasional damaged coils, and in such circumstances, the coils are often incorporated in the splice and housed in the same sleeve. This practice has been expanding as a direct result of the development of smaller and smaller coils. For splice loading, the coils are housed individually in fibre containers provided with muslin tapes so that they may be secured in place. Some coil types, such as those employed in loading circuits for distribution of radio program material, have insulated metal shielding containers instead of fibre. To facilitate installing more than one coil at a particular splice, assemblies have been provided which comprise four, five, or six singly encased coils mounted on a fibre or wooden strip. Similar three-coil phantom type loading units are also available for splice loading of toll cable quads.

An exchange area type loading coil with leads for connection to the cable pairs and cloth tapes for tying the unit in place is shown in Figure 1. A somewhat larger assembly is employed for the individual program-circuit loading coil, and is shown in Figure 2. This assembly includes a metal container for crosstalk shielding purposes, and an outer cloth bag to provide insulation from other conductors. Figure 3 shows an assembly of five encased exchange area coils arranged on a fibre strip for installing in a splicing sleeve. When the installation of larger coil groups was required, several of the five-coil groups could be used, but more frequently one of

Fig. 1—Exchange area coil, partly assembled, and complete.



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the larger lead sleeve* or welded steel† aerial or underground type cases was employed even though the latter are relatively expensive in the small sizes.

More recently, new types of splice loading assemblies have been adopted for exchange area and certain non-phantom toll cable applications. The assembly shown in Figure 4 contains sixteen exchange area type coils of the type shown in Figures 1 and 3. It is only one and a half times the length of the five-coil assembly of Figure 3, and has approximately the same area of cross-section. The cylindrical form, however, since it has no sharp corners, lends itself more readily to inclusion in the splice than does the earlier strip type of assembly. In the assembly shown in Figure 4, the coils are assembled on a wooden dowel, separated by insulating washers and also by steel washers to reduce crosstalk coupling between adjacent coils. The winding conductors of the coils are spliced to textile insulated twisted pair leads laid up in two groups along the assembly of coils and secured with adhesive insulating tape. A protective fibre tube is slipped over the coils, and the entire assembly is vacuum impregnated with an insulating varnish which is cured by baking. The varnish serves to bind the entire assembly solidly together and to provide a protective coating against dirt or moisture

* Record, *April*, 1936, *page* 260.
† Record, *July*, 1931, *page* 517.

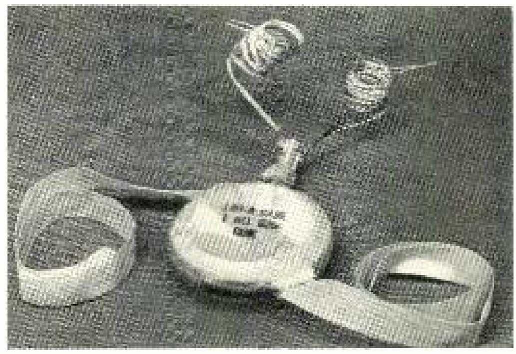


Fig. 2—Program-circuit loading coil.

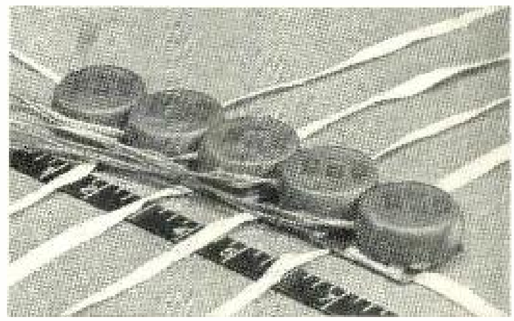


Fig. 3—Strip mounted assembly of coils.

Fig. 4—Assembly of 16 exchange area coils.

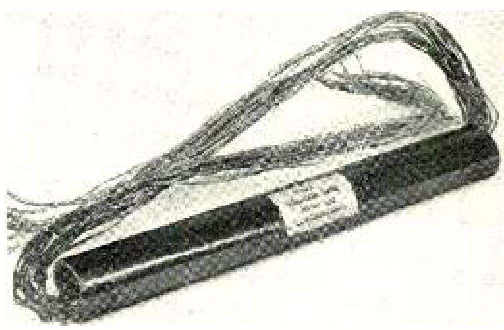
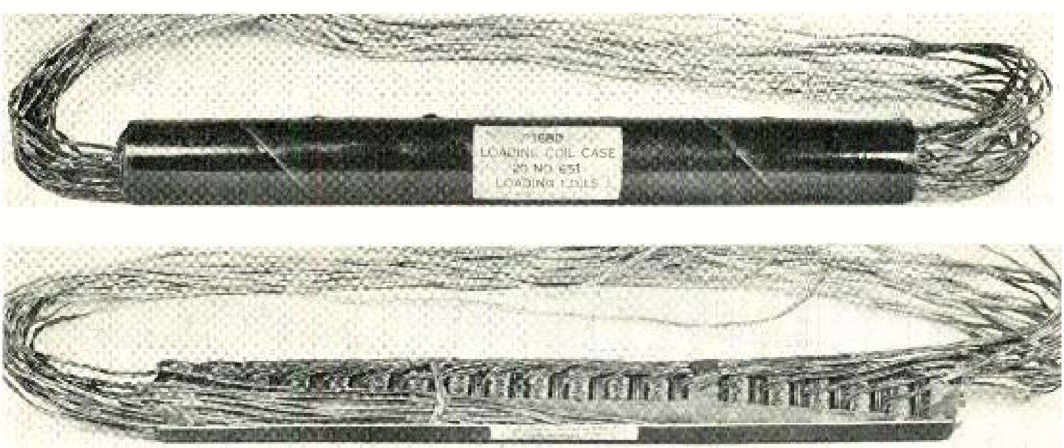


Fig. 5—A twenty-coil assembly employing a new coil for loading long subscriber lines.



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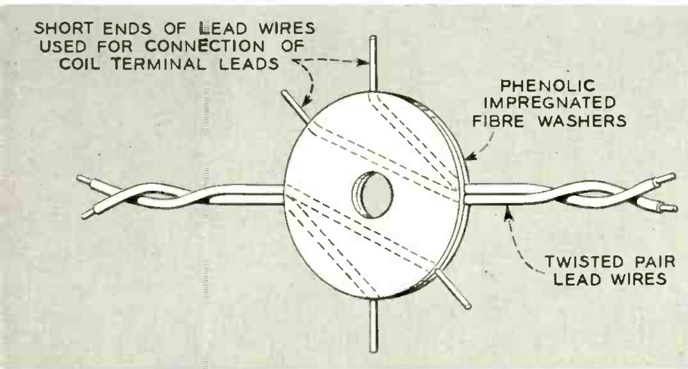
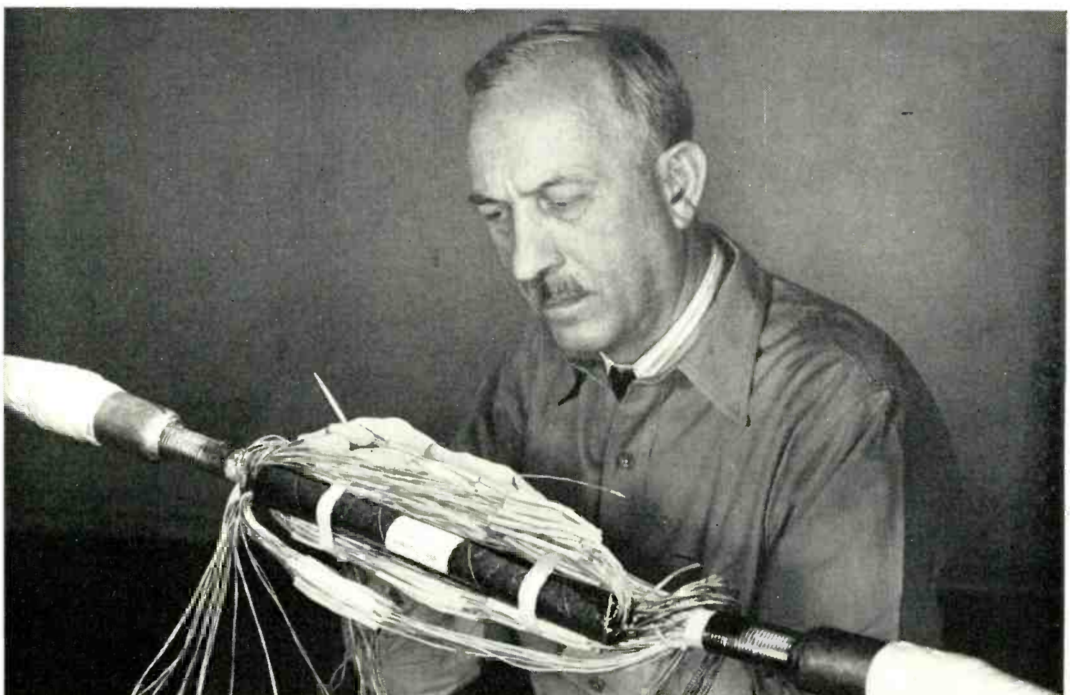


Fig. 6—Method of anchoring the lead-in wires between the washers separating the coils.

during storage and handling. The two groups of leads emerge as shown, one from each end of the fibre tube, for connecting the "In" and "Out" ends of the coils to the cable pairs at the splicing point. In addition to the sixteen-coil assembly shown in Figure 4, two smaller assemblies have been provided containing six and eleven coils, respectively. They are all constructed in the same manner but differ in over-all length according to the number of coils involved.

With a view toward further reducing the size and cost of exchange area loading apparatus, a still smaller coil has been developed. Due to its smaller size, this coil necessarily has a somewhat higher winding resistance than the larger coil, and cannot be substituted for it in all applications. Its principal field of use is in the loading of long subscriber loops. These coils are assembled like the others on wooden dowels, placed within fibre tube casings, and impregnated with a baking varnish. They are available in six, eleven, sixteen, and twenty-coil complements. The twenty-coil assembly is slightly shorter and smaller in diameter than the sixteen-coil assembly of the larger type coil. The complete twenty-coil assembly together with a view having a portion of the fibre tube cut away to reveal the internal construction is shown in Figure 5.

An unusual method is employed in these cylindrical assemblies for anchoring the lead wires and connecting the coil windings to them. The cut-away view shows the lead wires emerging from the edges of thick insulating washers between coils. To accomplish this, the lead wires are laid between two fibre washers, as shown in Figure 6, which have been saturated with an uncured phenolic compound, and



then subjected to heat and pressure. This procedure causes the wires to become embedded in the washers so that a subsequent curing of the phenolic compound provides a solid insulating mass in which the lead wires are tightly anchored. After the washers are assembled on the wooden dowel with the coils, the winding leads are spliced to the projecting short ends of the anchored lead wires. During assembly the splices are all lined up in rows parallel to the axis of the assembly and covered with strips of adhesive insulating tape. A portion of this insulation may be seen in the cut-away view adjacent to the cut edge of the fibre tubing. This provides a simple yet effective method of construction and is employed in the dowel assemblies of both sizes of exchange area coils.

These small cases may be installed within the splice between two lengths of cable or in an auxiliary sheath opening provided for the purpose as shown in Figure 7. The number that can be installed at a given load point is limited to the size of lead sleeving that can be tolerated for covering the completed splice. In general the cable pairs are ballooned outward and the coils are placed within the core of the splice. After completion of the splicing operation, a lead sleeve of appropriate size is installed. The development of these compact cylindrical assemblies of small exchange area coils for splice loading applications has provided a flexible and inexpensive method of installation of comparatively small complements of coils.

THE AUTHOR: After graduating from the University of California in 1928 with the degree of B.S. in electrical engineering, S. G. Hale immediately joined the Pacific Telephone and Telegraph Company and engaged in central-office maintenance work. In 1929 he transferred to the Transmission Engineering Department of the Coast Division. The following year he came to these Laboratories, where as a member of the Technical Staff he undertook loading coil development with the Apparatus Development Department. During World War II he was engaged in developing special magnetic detecting devices. Early in 1949, he was placed in charge of a group responsible for developing loading coils and loading coil cases. Later this group was enlarged to take over also the development of magnetic core detectors.

Difficulties of Diagramming the Ear

Diagrams of the human ear, such as that which appeared on the first page of the Record for November, are important to those doing research on hearing in much the way that circuit diagrams are important to circuit designers. Preparation of such a diagram, however, is not as simple as might be assumed. A diagram that is anatomically correct often fails to give a clear picture of relationship between parts in the aural mechanism. In making such diagrams, therefore, it is the usual practice to sacrifice completeness for clarity.

Most aural diagrams used in the past have been criticized as either too schematic, or so correct anatomically that they fail to show the sound path. Recently F. M. Wiener decided to attempt a better compromise. After a study of drawings and models by various anatomists, and a review of available data on dimensional relationships, he prepared the diagram that appeared in the November Record and earlier *in Physics Today.** It has brought favorable comment from several workers in the hearing field.

* *Vol.* 2, *No.* 12, 1949.

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Traffic distribution in the No. 5 crossbar marker

E. J. FOGARTY
Switching Development

In any automatic telephone switching system, an even distribution of traffic is a desirable objective, and is always sought where other and conflicting objectives are not controlling. In the higher usage circuits, such as senders and registers, for example, relay wear and contact erosion are critical factors in determining the life of the equipment. Hence it is desirable to distribute the traffic evenly over these circuits so that their relays tend to wear at a fairly uniform rate, thus giving the maximum period of service before corrective maintenance is required. For interoffice trunks, a uniform load among the trunks of a group reduces the assignment and balancing effort in both the originating and the terminating offices. Closely related to the equalization of load among switching paths, and accomplished in No. 5 crossbar offices by the same control circuits, is the preferential assignment of the common equipment to various groups of subscriber lines. This serves to prevent undue delays to the higher numbered line groups which may occur in periods of heavy traffic.

The simplest ways of selecting switching paths give far from uniform distribution. If, in choosing an idle trunk in a group, for example, the selection process always started at the same point, the later trunks would carry materially less traffic than the earlier ones even at times of full load, and during hours of light load might carry none at all.

In step-by-step and panel systems, where the selectors hunt over their terminals in this manner, more favorable distribution can be obtained only by such mechanical means as slipped or reversed multiple,* and the improvement that can be gained is limited. Common control systems in which both selection and hunting features are centrally controlled offer better opportunities for obtaining good distribution. In the No. 1 crossbar system, four major types of control circuits are employed: the line link and sender link control circuits, and the originating and terminating marker circuits. To secure adequate control of distribution the necessary features have to be provided in each of these four circuits. In the No. 5 crossbar system, however, all the major selection and hunting features are concentrated in a single type of circuit, the marker. Thus, more complete control of distribution becomes feasible, since more elaborate distributing circuits can be justified economically in a single type of marker.

In the latter system, the trunks of each group and the originating registers are distributed as evenly as possible over all trunk link frames. In placing a call to a trunk or an originating register, the marker remembers the trunk link frame to which it placed the last previous call, and attempts to place the present call to the next higher numbered trunk link frame.

Except the arrangement for selecting a trunk link frame, the largest group from which a selection must be made is the block of twenty trunks on the trunk link frame.* Since this group besides being the largest, presents the most difficult problem, its requirements determine the design of the common preference control circuit, and it may most satisfactorily be used to illustrate the principles involved in many of the selections.

In choosing an idle trunk out of the group, the selecting circuit, in effect, tests the trunks one after the other and seizes the first idle one of the desired route it encounters. Which particular idle trunk will be seized thus depends on two factors: the trunk at which the circuit begins to test, and the order in which the testing proceeds.

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* Record, *September*, 1944, *page* 514.

* Record, *August*, 1950, *page* 357.

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In the actual circuit this testing of the trunks is done simultaneously, but the arrangement of the circuit is such that the same two factors of point of start and order of search determine which trunk is to be selected. To secure uniform use of the trunks, the point at which testing begins should be changed after each operation of the marker to break up any tendency to select some particular trunks more often than others. Where any trunk of the group is equally suitable for use, this rotation of the starting point is sufficient in itself to give uniform distribution over a period of time, bearing in mind that a marker ordinarily does not serve the same route on successive operations. These simple conditions do not apply to the trunk blocks in the trunk link frames however.

These blocks may include a number of groups of trunks, the various groups occupying successive positions of the twenty in the block. To illustrate the inadequacy of a rotation of the starting point, assume, for example, that a particular group of four trunks occupies positions 8 to 11, inclusive. On twenty successive searches for an idle trunk in this group the marker would test the trunk occupying position 8 first in seventeen out of the twenty times, on the average, since it would be tested first when the starting point was anywhere from positions 12 to 19 or from 0 to 8, both inclusive. Each of the other three trunks of the group would be tested first only once. Beside rotating the starting point of test, therefore, it is necessary also to break up the order of test in some situations to avoid conditions of this type.

To do this, distribution control in the marker is divided into two processes: one establishes a beginning point that is changed after each operation of the marker, and the other determines the order of search. The first process is represented in the No. 5 crossbar marker by a common sequence circuit that establishes a beginning point for the search in all groups, and changes this point after each seizure of the marker. The other is a preference circuit that establishes the order in which the search is carried out. The sequence circuit changes the beginning point at each marker seizure, while the preference circuit, beginning at a point indicated by the sequence circuit, will test in an order that will give the most uniform distribution.

The major selections requiring distribu-

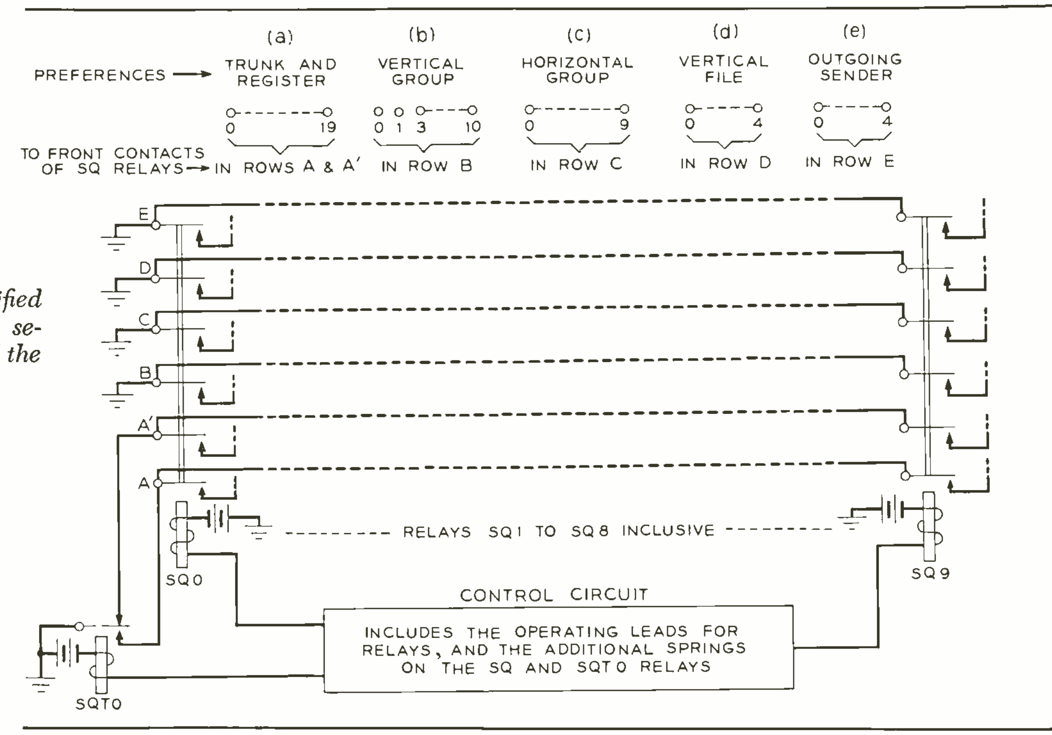

Fig. 1 — Simplified diagram of the sequence circuit of the marker.

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tion control in the No. 5 crossbar marker are (1) vertical-group identification; (2) horizontal-group identification; (3) vertical-file identification; (4) trunk and originating register selection; and (5) outgoing sender selection. The first three of these together identify a calling line on a line link frame. Preference control is needed here to determine which of several simultaneous calls on a line link frame shall be served first. The fourth determines which trunk of the desired route or which originating register of those available in the preferred trunk link frame should be employed. The outgoing sender selection determines which sender of the desired type shall be selected from the preferred subgroup.

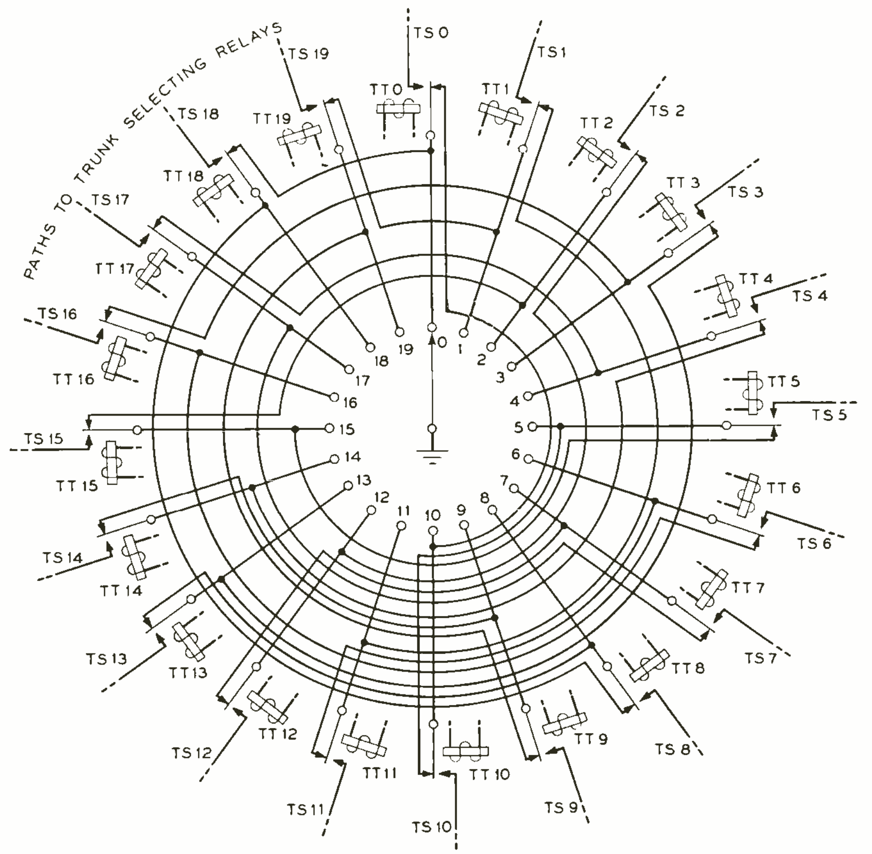

Fig. 2—Diagrammatic representation of the preference circuit for a trunk block of 20 trunks.

The basic sequence circuit of the marker is indicated in simplified form in Figure 1. Ten SQ relays, numbered 0 to 9, are operated one at a time by a group of six control relays in a control circuit. The SQ relays are operated in numerical order on successive marker seizures. Thus if relay SQ0 is operated on the first seizure, SQ1 will be operated on the second, SQ2 on the third and so on. For the eleventh seizure SQ0 will be operated again, and the cycle will repeat. Sets of leads representing the five functions for which a preference selection is required are connected to the front contacts of each relay, and when the relay is operated, ground is placed on these leads as shown in Figure 1. The ten leads used for horizontal group selection, for example, are connected to the front contacts of the C row of springs of the SQ relays, and thus for each seizure of the marker ground will appear on one of these leads. Since the vertical files and outgoing senders are selected in groups of five, each lead is connected to contacts on two SQ relays. The first lead will be connected to the 0 and 5 SQ relays, the NO. 1 lead to the 1 and 6 SQ relays and so on. For ten seizures of the marker, therefore, these groups are run over twice. With respect to vertical group selec-

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tion, lines which should have preference in times of emergency, such as fire, police, and ambulance lines, are assigned in vertical group 2, which is always given first preference regardless of the position of the sequence circuit. Therefore the ten leads from the sequence circuit are connected to vertical groups 0, 1 and 3 through 10, and they become effective only if there is no demand on vertical group 2. Vertical group 11, where used, is given second preference at one step of the sequence circuit.

To provide for the twenty leads for the blocks on the trunk link frames, two contacts on each SQ relay are employed. Leads 0 to 9 are connected to the front contacts of the springs of row A and leads 10 to 19 to contacts on the springs of row A′. Through a front and back contact on the SQTO control relay, ground is placed on the A row of the SQ relay for the first ten seizures of the marker and to the springs of the A′ row for the next ten seizures. In this way ground is applied to the twenty leads of the trunk and register group, one after another, on twenty consecutive seizures of the marker.

The groups of leads at the top of Figure 1 run to the preference circuits for the various selections. Although the basic principle is the same in the design of all preference circuits, the larger size for that of the trunk blocks and its greater complexity make it the best to serve as an illustration. Since the originating registers are associated with one of the trunk blocks of each trunk link frame, and since these, because of their high use, require particular care in equalizing the distribution, the distribution for the registers has been the controlling factor in arranging the preference circuit for the trunk blocks. There may be from four to eight registers on a trunk link frame and their location is such as to group them all at the beginning of one of the trunk blocks. More offices are expected to have five registers per trunk link frame than any other number, and thus this number was assumed in designing the preference circuit. This circuit for the trunk blocks is indicated in Figure 2. The twenty leads from the sequence circuit are connected to the points on the inner circle, where the arm from the central ground, rotating clockwise, represents the advancing action of the sequence circuit. The TT relays, to the springs of which the leads from the sequence circuit connect, are operated for all idle trunks of the desired group, and are released for all busy trunks and for all trunks of groups other than the desired one. The order in which trunks are tested is thus determined by the connections from the back contacts of the TT relays.

By following through these connections, it will be seen that the testing order instead of being 0, 1, 2 to 19 and back to 0 is that given by the middle ring of numbers in Figure 3 reading in the clockwise direction. The inner ring of numbers here corresponds to the numbering of the TT relays and of the leads from the sequence circuit in Figure 2. If the sequence circuit had started at 0, the order of testing would thus be 0, 10, 5 and so forth as shown in the middle ring. Had the point of start been other than 0, say 12, the order of testing would be found by rotating the middle ring until 12 was opposite 12 on the inner ring and the order would then be 12, 7, 17, and so on. The order in which the five registers would be tested for the twenty starting positions is given in the outer ring of Figure 3. In position 0 of the sequence circuit, for example, five registers in positions 0 through 4 of the trunk block

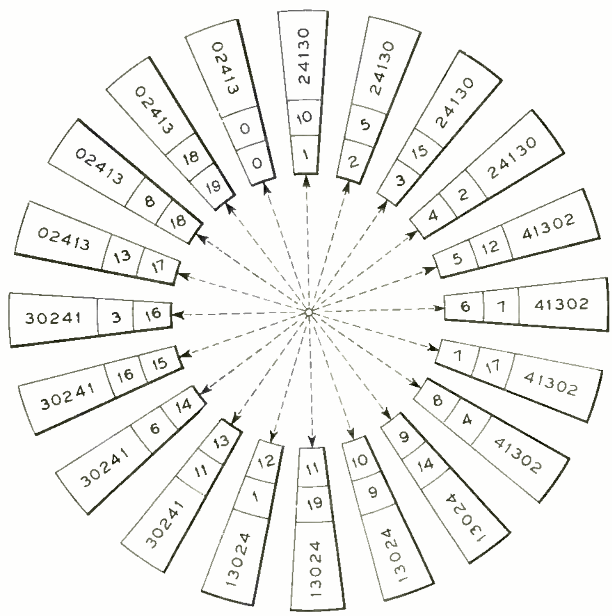

Fig. 3—Diagram representing testing order of trunks and registers.

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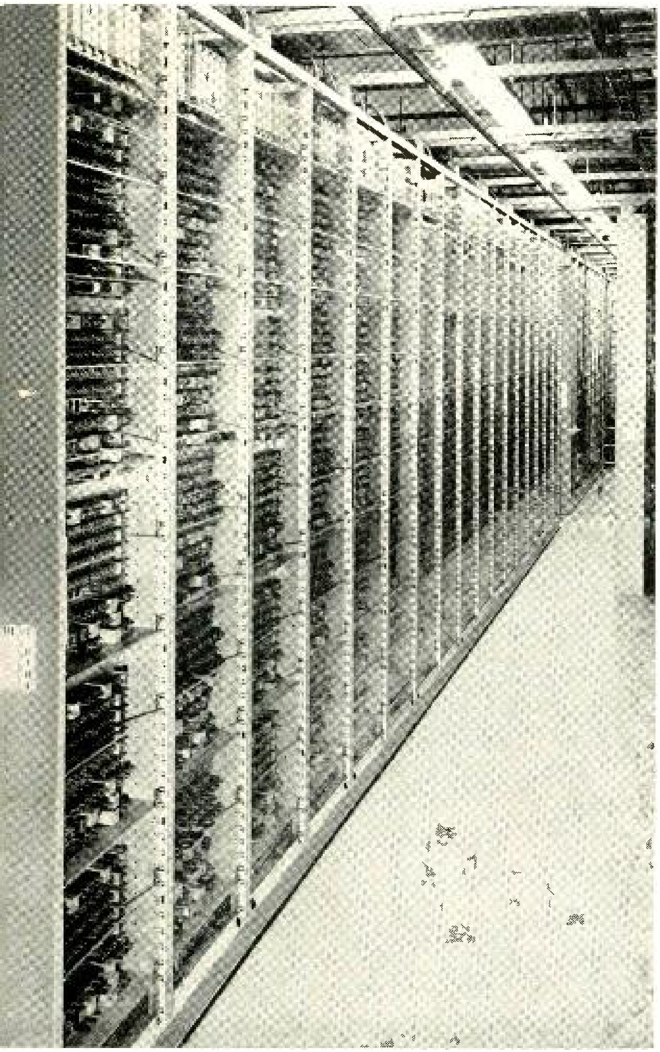

Fig. 4—A line of originating register bays in the Towson office. The distribution of calls to these registers is under control of the circuits in the marker that is described in this article.

are tested in the order 0, 2, 4, 1, 3, as shown in the outer ring. It will be noticed that each of the register appearances is first preference in four positions of the sequence circuit, second preference in four positions, third preference in four positions, fourth preference in four positions and fifth preference in four positions. Since different markers, each with its independent sequence circuit, are placing calls, and since each marker normally places different types of calls and prefers different trunk link frames on successive usages, the over-all effect is to randomize the selection of originating registers. Over a sufficient period of time, the tendency is to load the registers uniformly.

The performance of this feature was observed during two half-hour periods at the Media central office. The observations were made under rather light traffic conditions, which would tend to emphasize any maldistribution of calls among the registers. The results indicate that, with five registers per trunk link frame in service, the least used register carried about twenty per cent less traffic than the average register, and the most used register carried about twenty per cent more traffic than the average register. With higher traffic density, these deviations from average would tend to be reduced. Also, it is probable that observations over a longer period of time would show less deviation from average. Even disregarding these last considerations, the deviations indicated above represent a material improvement over the performance of comparable features in previous switching systems.

In securing optimum distribution for five registers, it is not possible to secure equally good distribution for all other groups of various sizes and positions. The order established gives the best over-all results that could readily be obtained while at the same time securing the optimum distribution for five registers.

A somewhat similar problem occurs in the vertical-group identification function, and in the sender selection function, and they are handled in a similar manner. There may be anywhere from six to twelve vertical groups on each line link frame of an office and thus a staggered preference chain is provided to give equitable service to each vertical group for any number within these limits. Similarly there may be from one to five senders of a type in a sender subgroup, and a staggered chain is used to distribute the calls uniformly among them. There are always two subgroups of each type of sender, with the preference being alternated between the two subgroups by a simple two relay circuit.

Another traffic distribution feature of the marker is that of channel selection. A channel is a path through the line link and trunk link crossbar switches from the subscriber's

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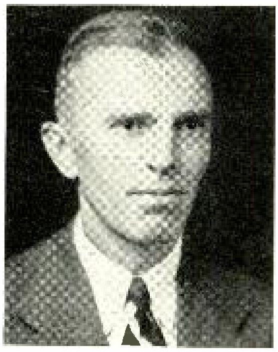
line to the trunk or originating register. The function of channel selection is divided into two parts, junctor group selection and selection of a channel within the junctor group. A junctor is a path from a line link frame to a trunk link frame. Junctors are arranged so that, for any size office, there are at least ten junctors from each line link frame to each trunk link frame. For the smaller sizes of office, there are correspondingly more junctors from each line link frame to each trunk link frame. For selection purposes, the junctors are divided into groups of ten or less, and calls are distributed among the junctor groups by means of a six-step sequence circuit, similar in operation to the multi-purpose sequence circuit described above. After a junctor group has been selected, the individual channel is selected in the same manner as in No 1 crossbar, the lowest numbered idle channel being selected first. This procedure represents an exception to the "even distribution" technique, in attempting to obtain the most efficient use of the channels. Provision is made, by a simple wiring change, for changing the starting point of the channel selection to equalize the wear on the switches during the life of the office.

The marker also provides flexible alternate routing arrangements for outgoing calls, so that, if the direct trunks to the desired destination are all busy, as many as three different alternate routes may be tried. This feature is of particular value in areas having a high volume of interoffice traffic. It allows a relatively efficient use of the small direct trunk groups, since the alternate routes are engineered to carry the calls which fail to find direct trunks.

There are many other subsidiary features which could be included in the discussion of traffic distribution arrangements. However, the major features that have been mentioned in this article illustrate the versatility which is made possible by concentrating the selecting arrangements in one type of common-control circuit.



THE AUTHOR: E. J. FOGARTY received the B.S. degree from Yale University in 1927 and immediately joined the Technical Staff of the Laboratories. Until 1942 he was engaged in analyzing and testing various circuits of the panel and crossbar switching systems. From 1942 through 1945 he participated in the development of flight trainers for the Navy. Since 1945 he has been engaged in the design and test of the marker and its associated circuits for the No. 5 crossbar system.

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Detecting momentary failures in capacitors

L. E. HERBORN
Transmission Apparatus Development

To determine whether a capacitor of the usual foil-paper or foil-mica construction meets its requirement for dielectric strength, it is connected across a test circuit such as indicated by the heavy lines at the left of Figure 1. This circuit consists of an adjustable voltage source, an adjustable resistor to limit the current that would flow should the capacitor break down, and a voltmeter to measure the voltage applied to the capacitor. Should the capacitor break down under this applied voltage, the voltmeter indication would at once drop to some low value, and thus indicate the failure. For certain types of silver coated mica capacitors, however, the breakdown may burn away the silver over a small area and apparently clear the trouble. The duration of the breakdown may be so short that the meter may not give a clear indication of a drop in voltage, and thus the breakdown may go undetected. If, as a result, such a silvered mica capacitor is put in service at its rated d-c voltage, a small migration of silver at the defective area in the mica may result in another breakdown later at this same position which may impair seriously the electrical properties of the capacitor. In this respect, the silvered mica capacitors differ from metallized paper capacitors in that the latter type, which uses much thinner electrodes of zinc or aluminum, can break down many times without any noticeable impairment of dielectric properties.

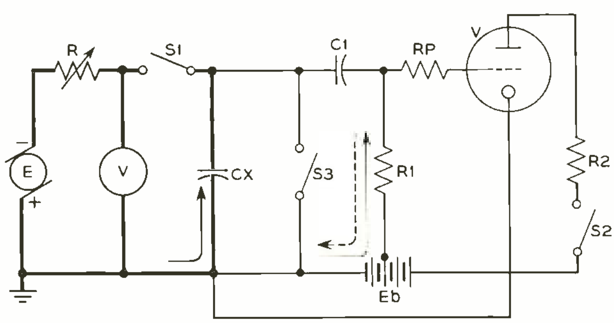

Fig. 1—Test circuit for capacitor failure.

Although in the Western Electric plants, the operators are trained to reject a capacitor if the meter indicates any voltage fluctuation during the test period, the failure may be so brief that no fluctuation of the meter pointer is detectable. It was felt desirable, therefore, to devise some means of detecting these very brief failures in a positive manner so as to eliminate the human factor and permit machine inspection. As a result, the circuit shown in light lines at the right of Figure 1 was designed to be applied to the existing dielectric strength test circuit.

It consists of a cold cathode trigger tube* with a suitable main anode voltage supply and a voltage on the control anode that is just a little below that necessary to cause ionization. With these voltages on the main and control anodes, the tube will not ionize and thus will not pass current. An auxiliary capacitor C1 with its associated resistor R1 is connected into the circuit in such a way that charging current to this capacitor will lower the voltage on the control anode, while a discharge current from it will raise the voltage on the control anode sufficiently to ionize the tube and cause it to glow. Once the tube has been ionized and has started to pass current, it will continue to do so until its main anode circuit is opened.

Switch S3 is used only to discharge the

* RECORD, *December*, 1936, *page* 114.

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capacitors at the end of a test and remains open during the testing period. Switch s2, on the other hand, is closed before the start of the test, and remains closed until after a breakdown has ionized the cathode tube. It is then opened to restore the tube to normal conditions. When switch s1 is closed to initiate a test; both capacitor c1 and the test capacitor cx begin to charge. The voltage drop across the resistor R1 due to the charging current to capacitor c1 reduces the bias on the control anode, and thus the tube does not ionize. If, however, at any instant during or after the charging period, the dielectric of the test capacitor cx ruptures, a low-resistance discharge path is formed for capacitor c1, which will immediately discharge through it. The discharge current through resistor R1 will result in a sufficient increase in voltage on the control anode to ionize the tube and cause it to pass current. In other words breakdown of the test capacitor cx, so short as to be undetectable on the voltmeter, will cause the tube to pass current, and once current is started it will continue to flow until switch s2 is opened. In this way momentary breakdowns of the test capacitor cx, even of a few milliseconds duration, will cause the cold cathode tube to glow and remain in a glowing condition until switch s2 is opened.

By adding this very simple circuit to the existing dielectric test circuits, therefore, it is possible to detect even the most brief ruptures of the capacitor under test. The Western Electric Company is planning to incorporate this feature in their new testing machine which is now under construction.

THE AUTHOR: L. E. Herborn joined the Technical Staff of the Laboratories in 1923, and until 1928 was associated with the Research Department on the development of terminal equipment for high-speed submarine cables. At the completion of this work he transferred to the Apparatus Development Department, where he engaged in the development of precision impedance measuring equipment. During the war he collaborated in development of circuits for military equipment. Mr. Herborn has the degree of B.S. in E.E. from Cooper Union.

THE EDISON MEDAL for 1950 has been awarded by the American Institute of Electrical Engineers to Otto B. Blackwell, formerly Vice-president of the Laboratories, "for his pioneer contributions to the art of telephone transmission." Presentation of the medal will be made on January 24 during the Institute's winter convention.

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Amplification at 6-millimeter wavelength

J. B. LITTLE
Electron Dynamics Research

It has been said that almost any vacuum tube can be made to oscillate, and this is perhaps true. However, the job of making a tube which will oscillate at a desired frequency is not an easy one as that frequency gets higher and higher. Correspondingly more difficult is the problem of making a tube that will *amplify* at increasingly higher frequencies. Until very recently no vacuum tubes had been built that gave a net gain at frequencies greater than 24,000 megacycles, or in wavelength, 1.25 centimeters. The tube described in this article was designed to give net gain at 48,000 megacycles or 6.25 millimeters wavelength.

J. R. Pierce, in his book,* has published the theory and design of the traveling-wave helix-type amplifier tubes which are now finding application in the 4000-mc communication bands. This theory is applicable to higher frequencies, and prior to the present work had been used successfully by L. M. Field at Stanford University to design a tube for 1.25 centimeter waves. Theory indicates that, up to some practical limit, amplifiers for high frequencies may be designed by scaling down the linear dimensions of a lower frequency amplifier. At 4000 mc, the conventional helix is about a quarter inch in diameter and 18 inches long. These dimensions scaled by a factor of 12 for a 48,000 mc tube will be only about 20 mils and 1.5 inches respectively.

At this point it will be profitable to look briefly at the physical structure of the 4000-mc tube in order to see what mechanical changes are necessary to make the scaling more practicable. Figure 1 shows the conventional tube with the helix supported by ceramic rods which space it from the walls of a closely dimensioned glass tube. Electrons from the gun at one end of the tube move inside the helix and parallel to its axis, those electrons which are close to the turns of the helix being the more effective. The tube fits through holes in two waveguides; the input waveguide is lined up and matched to the end of the helix near the gun and the output waveguide is similarly matched to the far end of the helix.

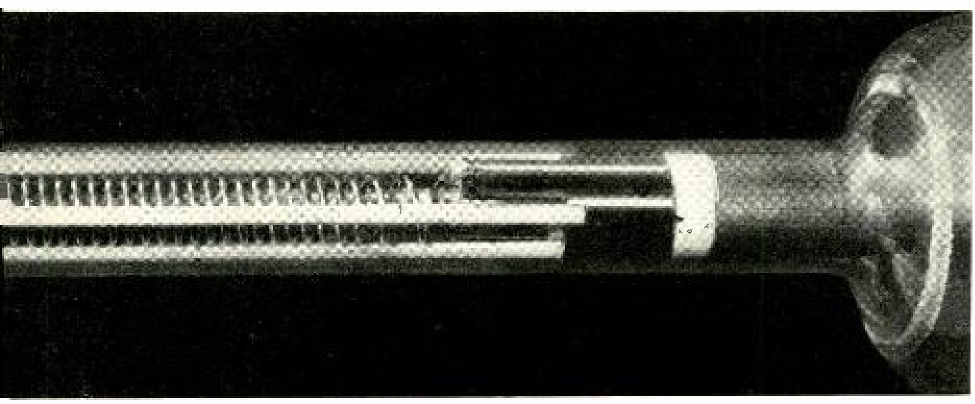

Fig. 1 — In this enlarged view of one end of a traveling wave tube for 4000-mc, ceramic rods and the central helix can be clearly seen.

One of the first changes made was in the helix support structure. The axial ceramic spacer rods were eliminated and instead the helix was supported at its ends only. This was done by stretching a closely wound

Traveling—Wave Tubes, D. Van Nostrand Company, Inc., 1950.

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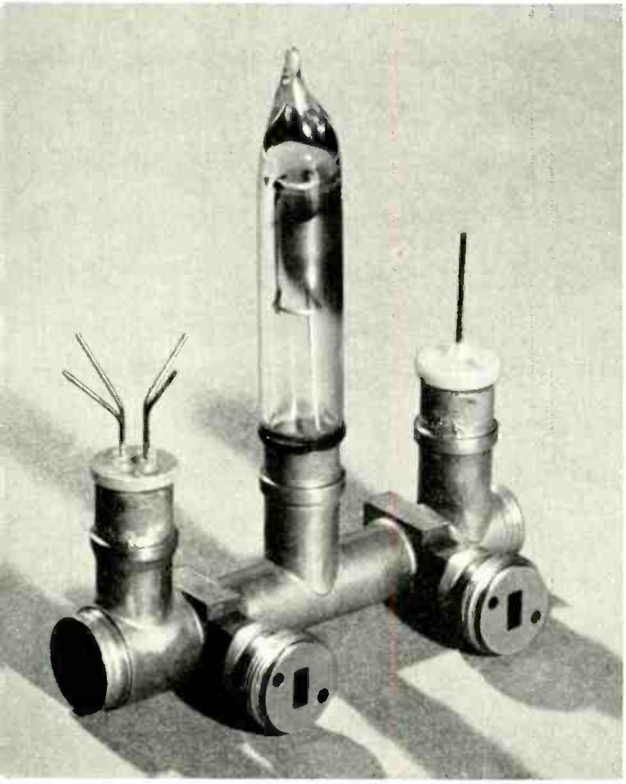

Fig. 2—The completed tube.

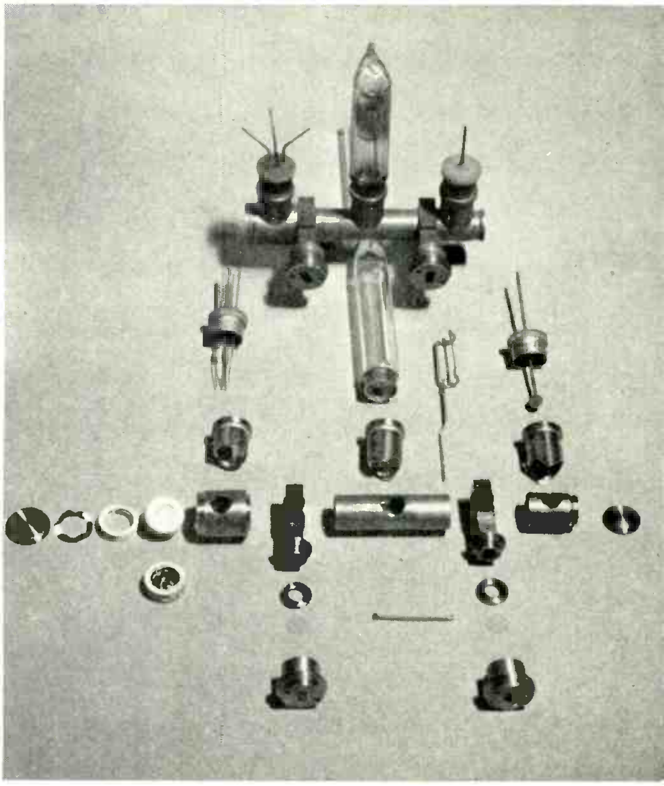

Fig. 3—Parts of the tube, and the tube itself.

helix to the correct pitch and supporting each end by three tiny radial fins. This design permits electrons to flow both inside and outside the helix with consequent improvement in the possible electronic gain. At the same time it simplifies the construction of the helix. Tension in the helix prevents too much sagging. The same method was not applicable to the larger helices because the sag along the length would be too great.

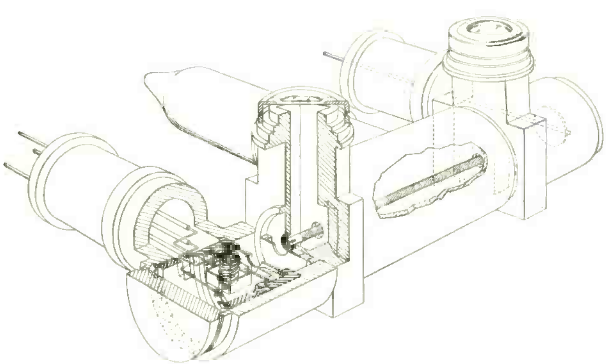

Fig. 4—An experimental tube for 48,000 mc. Principal parts, left to right, are the electron gun, the input waveguide, the helix, the output waveguide, and the electron-collector. The signal input comes down the input waveguide; its amplified counterpart goes up the output waveguide.

A second change was to make the input and output waveguides an integral part of the tube envelope. This eliminates the necessity for the small diameter glass or quartz tubing which would otherwise be required to pass through holes in the 6-mm waveguides. By this design change the tube envelope can be made of rugged metal details. All metallic materials, however, must be non-magnetic; otherwise they will distort the magnetic field which is necessary to keep the electron beam parallel to the axis of the helix.

A third modification was in the matching method used to couple the helix to the input and output waveguides. This matching was done on the assumption that any complicated change of the pitch or diameter of

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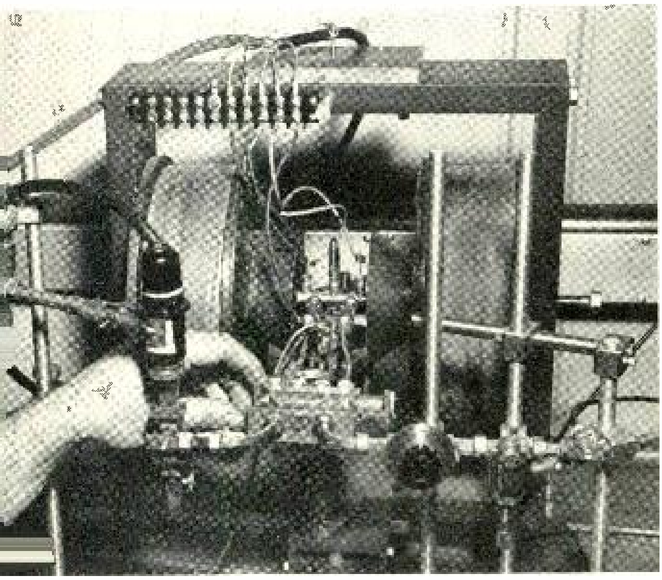

Fig. 5—Laboratory test set-up for the new tube; the engineer's fingers are touching the waveguide switch.

the helix near its ends would be impractical; and, that the match should be made between the guide and the helix as simply as possible, even at the expense of some band width. By experiments on a scaled up model it was found possible to effect a satisfactory match by terminating the helix in a cylinder formed by brazing the end turns of the helix together and properly orienting this helix-to-cylinder junction in the waveguide structure.

One other compromise was made in the interest of simpler construction. That was to make the helix somewhat larger in diameter than it would have been by direct scaling from its 4000-mc prototype. A helix wound of 0.003 in. wire on a 0.030 in. mandrel and stretched to 0.0065 in. pitch was designed. The tube should be operated with 1000 volts plate potential and it was expected to give several decibels net gain at the 6-mm wavelength with a one milliampere beam current.

Figure 4 is a tube design incorporating the features previously discussed. The electron gun floods the end of the helix with electrons so that both those inside and outside the helix contribute to the gain of the tube. The helix is held in place by its own tension, the ends being supported by small fins resting on ledges in the waveguide structure. The waveguides form part of the tube envelope. Over-all length of the tube is held to a minimum to reduce the magnetic field requirements.

In building the tube as shown in Figure 2, various obstacles were encountered. For instance, the 0.003-in. diameter tungsten wire used for winding the helices was found to be twisted enough, as it came off its spool, to cause slight irregularities in the pitch of the finished helices. It was necessary to anneal the wire between the spool and the guide on the winding machine to eliminate this difficulty. Then, fastening the 0.001-in. fins to the outside of the helix was another difficult job which was finally accomplished by first tack-welding the fins in the proper position, and then copper-brazing them in place by induction heating. During this operation a tiny shim had to be placed between the region of the helix where turns were brazed together, and that region where the turns were to remain free.

THE AUTHOR: After he had graduated from Harvard (1936) in physics, J. B. LITTLE decided he was a mechanical engineer at heart, so he took a year's graduate work in that subject. In the Laboratories, which he entered in 1937, he had four years on the mechanical design of electron tubes, then went to Physical Research on various military projects. In the latter part of the war he worked on mechanical problems of the K-band magnetron. Since 1947 he had been in electron dynamics, having charge of the assembly group and doing research on waveguide tubes such as he has described. On October 1, Mr. Little joined the research staff of International Business Machines at Poughkeepsie where he is working on electronic problems.

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At Holmdel, R. S. Ohl had meanwhile perfected a harmonic generator, in which a silicon detector is used as the non-linear element. It was invaluable to this project, since at the outset, no reliable source of 6 mm energy was available. Others at Holmdel had collected various items of waveguide plumbing and a few early designs of attenuators, wavemeters and crystal mounts were also available.

First tests on the new traveling wave tube were crude but soon refinements in technique were evolved. Because a strong magnetic field of great uniformity was needed, a large electromagnet was required. To orient it with respect to the tube, the magnet was mounted on a spherical joint whose center was located midway between the pole faces. With micrometer controls, the field was then lined up precisely with respect to the axis of the tube. A one-degree change of angle would make the difference between gain and no gain in the output of the tube.

It was desirable during tests to reduce the power which had to be dissipated by the helix, so the plate voltage instead of being continuous was pulsed at approximately 1000 cycles.

Because insertion gain is the difference in power output with the tube out of the circuit and in, it was desirable to switch the tube in and out quickly. A switch was developed, in which a sliding element changes short sections of waveguide so as to accomplish the shifting of paths.

In the test equipment more or less conventional supplies are used for the voltages on the tube proper, but the radio-frequency supply is more noteworthy. It consists of a 1.25-cm reflex oscillator feeding a crystal harmonic generator. The appropriate harmonic is taken off in a 6.25-mm guide with proper matching and padding, and fed to the waveguide switch. The signal can then be passed through the tube to the detecting and measuring circuits, or can by-pass the tube and go directly to these circuits. Following the switch are another pad, a wavemeter, a calibrated variable attenuator and a crystal detector. Since the 1.25-cm reflex oscillator is modulated by a square wave at audio frequency, the crystal output current is modulated so that an audio preamplifier can be used for presenting the signal on an oscilloscope. The signal levels with and without the tube under test can be compared and made equal heights on the screen by adjusting the attenuator.

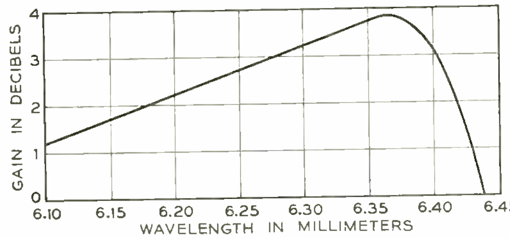

Fig. 6—Gain of the new tube as a function of wavelength.

Gain measurements have been made on several tubes, and a representative gain versus wavelength curve is shown in Fig. 6. It is apparent that the gain varies considerably with the wavelength. On the other hand, attention should be drawn to the fact that the frequency band width corresponding to the region between 6.3 and 6.4-mm wavelength is approximately 750 megacycles.

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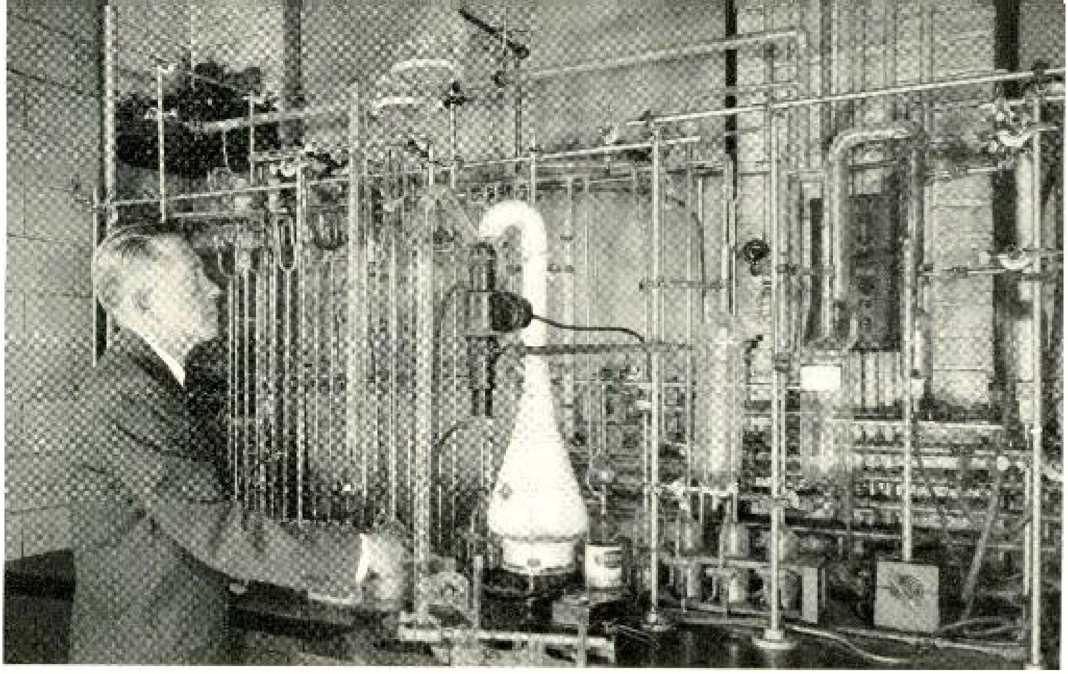

An improved vacuum fusion furnace

W. G. GULDNER
Chemical Laboratories

The presence of gases in combination or in solution even in minute quantities, may greatly affect the physical properties of metals. For example, in the nickel used for vacuum tube cathodes, oxygen in the order of 0.008 to 0.02 per cent has been found. In specific cases this amount of oxygen can seriously impair electron emission of the tube.

To determine the amount and kind of gases in a metal, it has been customary to use a vacuum fusion furnace in which a specimen of the metal is melted in a graphite crucible, using a high-frequency induction coil. The oxides are reduced by combination of the oxygen with the carbon and the resulting CO, along with the other liberated gases, are pumped off for analysis and measurement. This process depends to a great extent on the design of the furnace. Although many investigators both in the United States and abroad have studied the presence of gases in metals, the vacuum furnaces used have been lacking in precision and reliability when only small samples, of the order of 1 gram, were available for investigation. In order to minimize the effect of the comparatively large amount of gas evolved from the material of which the conventional design of furnace is made, samples up to 30 grams were required.

In the vacuum furnace developed in the Laboratories, radical changes in design have been made to obtain the desired precision and reliability. Details of this furnace are shown in Figure 1. A clear quartz tube, 2 inches outside diameter and 6½ inches long, is suspended from two glass hooks by means of platinum wires, inside a 3-inch Pyrex glass envelope. This suspension minimizes the volume of material to be heated to high temperatures, a feature that aids in keeping the gas evolved by the furnace itself to a low amount. Inside the quartz tube is a graphite crucible supported in the vertical position by graphite powder, loosely packed to aid in retaining the heat generated in the crucible and to permit the free flow

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of gases to be pumped out. This crucible is ¾ inch outside diameter and 3 inches long and is provided with a graphite funnel that has been split lengthwise to avoid eddy currents which might otherwise be generated in it.

An opening at the bottom of the 3-inch Pyrex glass envelope provides access for inserting and removing the quartz tube and associated parts. This opening is fitted with a glass plug B and the joint is made vacuum tight by sealing wax. It is of interest to note that the temperatures at this point are low enough that sealing wax may be used effectively in this way. This assembly provides a simple yet effective high-vacuum chamber easy to construct, assemble, dismantle, and clean. A glass disc attached to the plug acts as a heat shield and provides additional protection in case of spattering molten metal that might result from any unanticipated rapid evolution of gas.

Samples of the metal to be studied are admitted to the crucible without interfering with the vacuum. A branch tube leading off at right angles to the vertical tube, as indicated in Figure 1, connects with a group of closed tubes, called a "tree," in which as many as 10 or 12 samples may be stored. A small magnet held in the operator's hand is used to move ferrous samples from the storage tubes to the crucible; non-ferrous samples are placed in "cups" which are of magnetic material. These cups are purposely made too large to pass into the vertical tube leading to the crucible, but can be made to discharge their loads into the crucible by manipulating the magnet.

This arrangement makes it possible to study several samples of a metal without breaking the vacuum seal. After one sample is melted and the gas pumped off, another sample can be moved into the crucible on top of the first and the analysis repeated. After completion of the investigation, the vacuum is broken and the crucible with the specimens removed through the bottom opening.

To measure the temperature of the melt, an optical pyrometer is focused on the specimen through an optical flat or window at the top of the furnace tube. To protect the inner surface of this glass window from being coated with metal vaporized from the crucible, a glass tube is inserted in a side-arm. It contains an iron slug that makes it possible to move the glass tube back and forth at will by using a magnet.

The furnace is cooled with a high velocity air stream directed uniformly about the walls of the furnace by means of a glass funnel located as shown at the bottom of Figure 1. Elimination of water cooling simplifies the construction and reduces the size of the furnace, thus permitting the use of a smaller induction coil with consequent more efficient heating. High-frequency power for heating is supplied by a 5-kw oscillator operating at a frequency of 525 kilocycles.

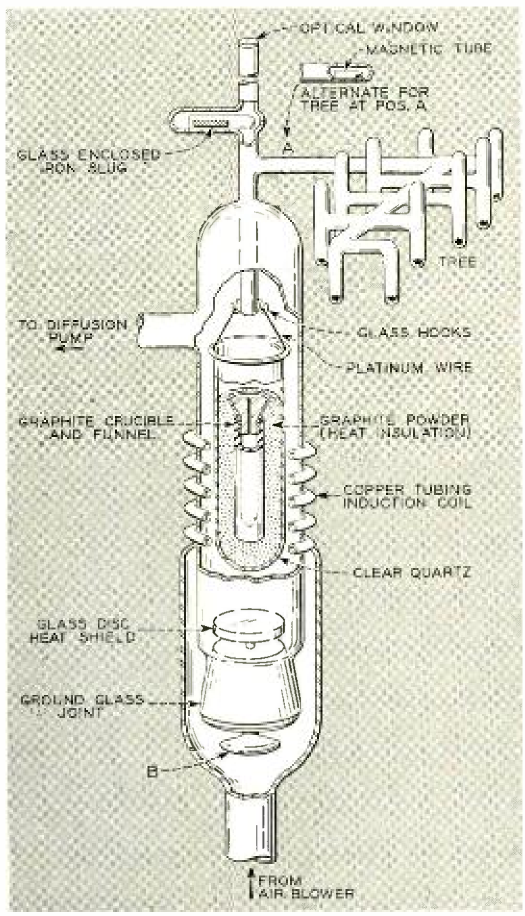

Fig. 1—Cut-away view of vacuum fusion furnace developed by the Laboratories.

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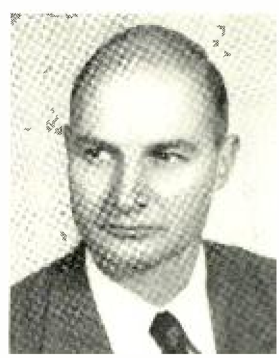
To operate the furnace, the crucible is first "out-gased" by applying the high-frequency power and heating the empty crucible to 2400 degrees C for a period of two hours. Removal of the gases is accomplished with a two-stage mercury diffusion pump coupled to a high-speed mechanical pump. This almost entirely frees the furnace structure and crucible of gas. Using a much higher temperature for out-gassing than the 1650 degrees C usually employed for melting the metals, improves the accuracy of the gas determination. For example, it has been found that the amount of oxygen evolved in 30 minutes as CO from the furnace assembly before introducing the specimen, is equivalent to less than 0.0002 per cent oxygen by weight based on a one gram sample.

This furnace has been in constant use for about two years and many determinations have been made on iron, molybdenum iron alloys, copper, germanium, microphone carbon, and nickel. It has been possible to obtain accurate measurements on relatively small samples, some as small as 0.1 gram, although 1-gram or 2-gram pieces are generally used. Some materials have been heated as high as 2650 degrees C and the furnace has been operated continuously for periods as long as 6 hours at 2400 degrees C. The design of the all-glass furnace providing a high vacuum envelope with full vision, together with the suspension of the quartz tube assembly in vacuum, results in the elimination of massive metal details, quartz to metal or quartz to glass joints, rubber or lead gaskets, the use of cements for attaching dissimilar materials, and also provision for radiation shields, ceramic supports and water cooling.

THE AUTHOR: Before joining the Laboratories in 1930, W. G. Guldner spent two and one half years in plant biological research at the Boyce-Thompson Institute in his home town of Yonkers, New York. His first work at the Laboratories was in the chemical department, where he made chemical analyses, and later on, was concerned with electrochemical methods. During this time, he attended New York University, graduating in 1935 with a B.S. degree in chemistry and physics. From 1935 to the present, he as been engaged in high-vacuum and low-pressure analytical procedures; during World War II, this was particularly related to chemical studies of problems connected with electron tube development. Since then he has been in charge of low-pressure analytical work on a wide variety of problems throughout the Laboratories.



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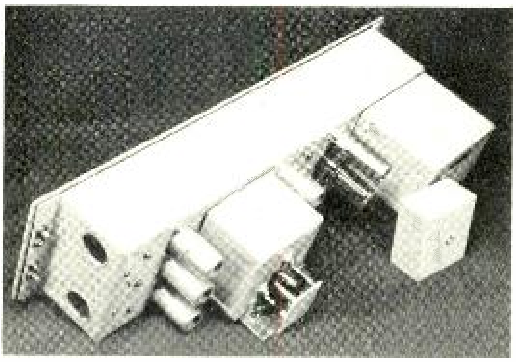

The LD-B1 branching amplifier

E. J. HOWARD
Transmission Systems Development

At the overseas radio receiving stations of the American Telephone and Telegraph Company at Netcong and Manahawkin, New Jersey, Point Reyes, California, and Fort Lauderdale, Florida, the incoming radio signals are picked up on antennas which are mostly of the rhombic type.* An antenna coupling transformer is connected between each rhombic antenna and a coaxial transmission line that conducts the signal to the station building where the transmission lines terminate in an antenna patching panel. Although it was the practice initially to use a rhombic antenna for each receiver, the patching panel was necessary to permit rapid substitution of a spare antenna or receiver and for local tests.

The early receivers were all of the double sideband type and only one voice-frequency channel was obtained from each antenna and receiver. Since the antenna and coupling transformer were efficient over the entire overseas frequency range from 4 to 23 mc. however, it was evident that it should be possible to parallel a number of receivers on one antenna at the antenna patching panel.

There would be no particular difficulty in doing this, if, when a number of receivers operating on different frequencies were paralleled on one antenna, each receiver input presented a high pure resistance at every frequency other than its own operating frequency. To obtain optimum signal-to-noise ratio and selectivity, however, the input circuit of an overseas receiver is a sharply tuned circuit; its input impedance may drop to very low

* Record, *April*, 1932. *page* 291.

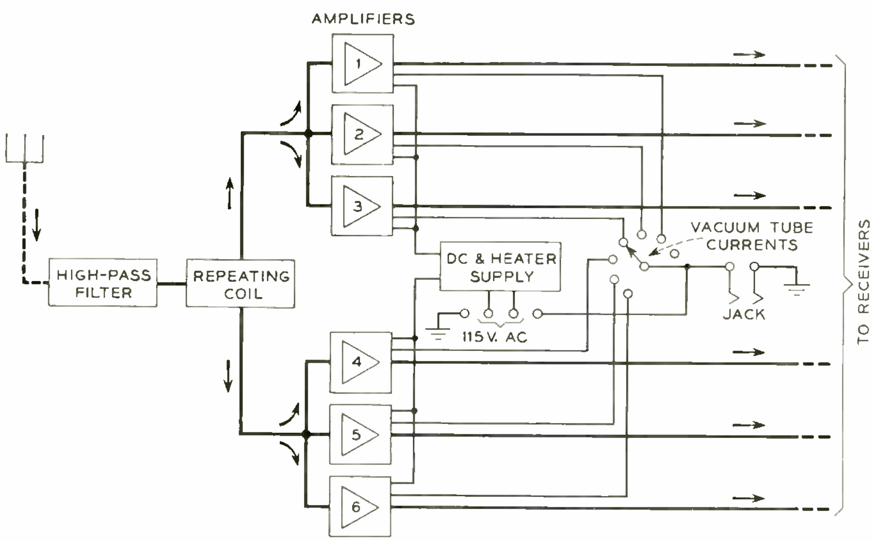

Fig. 1—Block schematic of the branching amplifier and its association with the antenna.

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values off resonance, thus introducing large loss to other paralleled receivers tuned to other frequencies. The reactive component of the impedance also makes it difficult to tune a receiver with others bridged across its input. The problem is further complicated by the fact that the lengths of transmission lines necessary to interconnect two or more receivers are appreciable fractions of an electrical wavelength at the operating frequencies. Due to the impedance transforming characteristics of fractional wavelength lines, the impedance variations presented by bridged receivers are greatly increased.

Nevertheless, this same impedance transformation characteristic of transmission lines has been employed to accomplish a limited amount of receiver paralleling. A number of lengths of line each terminated in coaxial jacks were provided at the patching panel. When a receiver was bridged across another, if the second gave too much loss, additional transmission line could be inserted so that a higher bridging impedance could be obtained. This method of paralleling was cumbersome and inefficient from the operating standpoint.

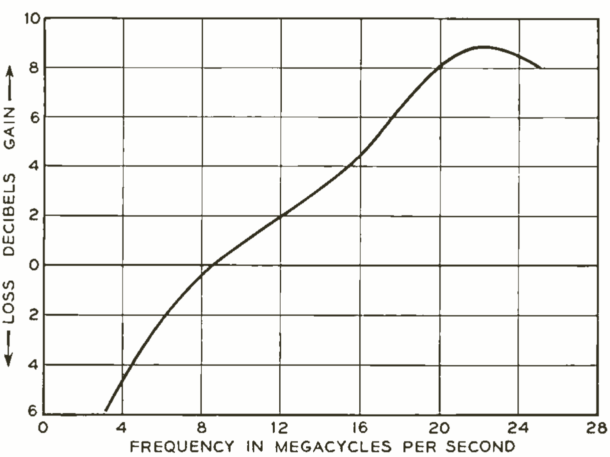

Fig. 2—Gain characteristic of the branching amplifier.

In the late 1930's as a result of the use of single sideband transmission and other improvements, two voice-frequency channels—and later three—per receiver were obtained, thus giving a more economical use of the antennas. In recent years, however, new channels have been added to existing routes, and service has been established to many new countries. In some cases the great circle paths to two or more countries differ so little that fairly good performance is obtained by using one antenna to receive from the different countries. The need for a method of efficiently paralleling receivers thus became urgent, because some receiving sites were filled with antennas.

Since vacuum tubes having sufficiently high transconductance and low interelectrode capacitances to provide reasonable gain over fairly wide frequency bands had become available, an experimental isolating or branching amplifier was constructed in 1947 in the Laboratories. After a satisfactory field trial of this amplifier, the American Telephone and Telegraph Company requested a commercial design, which culminated in the LD-B1 branching amplifier.

A block schematic of this branching amplifier is shown in Figure 1. The line from the antenna first passes through a simple high-pass filter, which attenuates frequencies below 2.5 mc, the attenuation rising to approximately 25 db in the 500-1600 kc broadcast band. Strong signals from local broadcast stations, if not attenuated, would produce serious cross-modulation. From the filter, the circuit passes to a broadband repeating coil, which was an existing design used in the antenna coupling transformer. The unbalanced low side of the repeating coil connects to the input coaxial line. Since the high side of the transformer is balanced, the grids of three triode amplifiers are paralleled on each side. Each amplifier is a 2C51 twin triode,* the first section being directly coupled to the second section, which is used as a grounded-grid triode.

The output circuit is a simple, single, fixed-tuned circuit employing capacitive coupling for connection to the output coaxial line. A resistor across the inductor serves to broaden the tuning while a second resistor across the coupling capacitor limits the output impedance when no load circuit is connected. The design of the out-

* Record, *September*, 1947, *page* 325.

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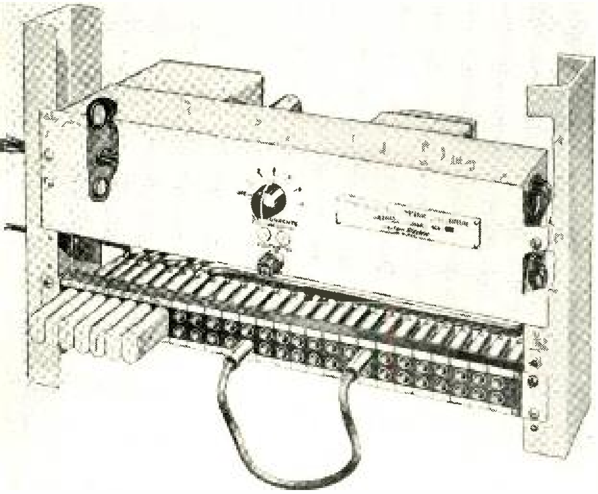

Fig. 3—The branching amplifier with its self-contained power supply is mounted on a 3¼-in. panel which fastens to a 19-in. relay rack. Connections between input and output of the amplifier, and of others that may be mounted above it, are made at the jack strip shown beneath the amplifier.

put circuit determines the gain-frequency characteristic, and with the simple circuit proposed, it would not be possible to obtain the same gain over the entire frequency range from 3 to 25 mc. Maximum gain could be obtained only over a restricted band. It was necessary, therefore, to select the position of maximum gain in such a way that the signal-to-noise ratio at the output of the receiver would be as high as possible over the entire band. To accomplish this, the gain characteristics that are shown in Figure 2 were provided; the gain is highest between 20 and 25 mc and becomes a small loss below 10 mc.

In a receiving system the optimum signal-to-noise ratio is obtained when the predominant noise is the thermal agitation noise from the input or antenna circuit. In other words the noise in the succeeding circuit should be small compared to the input noise multiplied by the gain of the first amplifier. Although the first amplifier gain increases the signal and input noise in the same ratio, if the gain is sufficiently high the amplifier noise adds only a small amount to the amplified input noise measured at the amplifier output and thus decreases the signal-to-noise ratio very little at this point. When atmospheric noise (static) is present and is large compared to the input circuit noise and the amplifier noise, the gain of the first amplifier has a very much smaller effect on the signal-to-noise ratio at the output of the amplifier. Since the atmospheric noise is usually fairly high compared to the noise in the receiving equipment at frequencies below 10 megacycles, it was possible to sacrifice gain in the branching amplifier at the low frequencies with very little penalty in signal-to-noise ratio. The output circuit was therefore designed to peak near the high-frequency end of the working range to obtain gain in the branching amplifier above 10 megacycles where static levels are usually low.

When a receiver capable of producing a good signal-to-noise ratio, like those used for overseas telephony, is connected to the branching amplifier, the amplifier

THE AUTHOR: In 1920, E. J. Howard joined the Research Department of these Laboratories as a technical assistant, and worked on carrier telegraph, telephone, and picture transmission. From 1923 to 1927 he studied at Columbia University and received the A.B. degree. In this latter year he re-joined the Research Department and engaged in research and development on transoceanic and ultra-high frequency radio. During the war he worked on radar and microwave radio relay systems. After the war he transferred to the Systems Department, where he has been engaged in developing transoceanic radio equipment.

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may reduce the signal-to-noise ratio of the receiving system very little at 20 mc. At 5 mc it may reduce the signal-to-noise ratio of the receiving system by 4.5 db in the absence of atmospheric noise, and a negligible amount in the presence of atmospheric noise of usual intensity.

Because the input tube of the branching amplifier is a small one with low bias, unwanted signal input voltages should not exceed 3 millivolts to avoid cross-modulation with the desired signal. For input signal levels in excess of 3 millivolts, attenuation pads may be plugged in ahead of the branching amplifier.

Since the amplifier circuit has a fair amount of d-c feedback, it is not sensitive to voltage changes, and a simple supply circuit using a condenser-resistor filter and gas regulator tube is adequate for good gain stability for line variations of 105 to 125 volts.

A typical method of mounting the branching amplifier on a nineteen inch rack together with a patching panel is shown in Figure 3. It requires five and a quarter inches of mounting space including the self-contained power supply, and has no operating controls. The pin jacks and switch are for measuring vacuum tube currents. The input of the branching amplifier is normally patched to the antenna jack through the double coaxial plug on the left end. The other six double plugs patch the six branch output circuits to six receivers. The receivers may be tuned to any frequency in the range 3 to 25 mc without reacting on each other. Flexible patch cords are employed for other than normal connections between antennas, branching amplifiers, and receivers. If more than six outputs are required, one branching amplifier output may be patched to the input of a second to give eleven branch output circuits.

Approximately sixty of these amplifiers are in service at the four American Telephone and Telegraph Company stations mentioned in the opening paragraph. Their simplicity and flexibility contribute considerably to operating efficiency. The cost of a branching amplifier is about one-twentieth of the cost of a rhombic antenna and transmission line, and the maintenance costs are comparable to those for an antenna.

Electrons and Holes in Semiconductors

Dr. W. Shockley's new book, *Electrons and Holes in Semiconductors,** another in the Bell Laboratories series, is the first comprehensive treatment on the new Transistor electronics. The book develops the concept of the positive hole and its negative counterpart, the excess electron and leads to the development of the theory of semiconductors in a form useful to workers engaged in research and development of Transistors and their applications.

The book is divided into three parts. Part I, entitled "Introduction to Transistor Electronics," reviews the bulk properties of semiconductors, the Transistor as a circuit element, quantitative studies of the hole injection, and the physical theory of Transistors. In Chapter 2, a number of problems and answers furnished by circuit and development groups of the Laboratories are included to show the orders of magnitude involved in calculations of power gain in various circuits and for signal-to-noise ratios.

Part II, "Descriptive Theory of Semiconductors," discusses the physics of semiconductors, including analogies with circuit theory and applications to Transistor electronics. Part III, "Quantum Mechanical Foundations," continues a discussion of elementary quantum mechanics with circuit theory analogues that aid those readers not having extensive training in theoretical physics. An introduction to statistical mechanics for semiconductors and other topics applicable to the theory of electronic conduction in crystals are also included.

* D. Van Nostrand Co., New York, 592 pages, $9.75.

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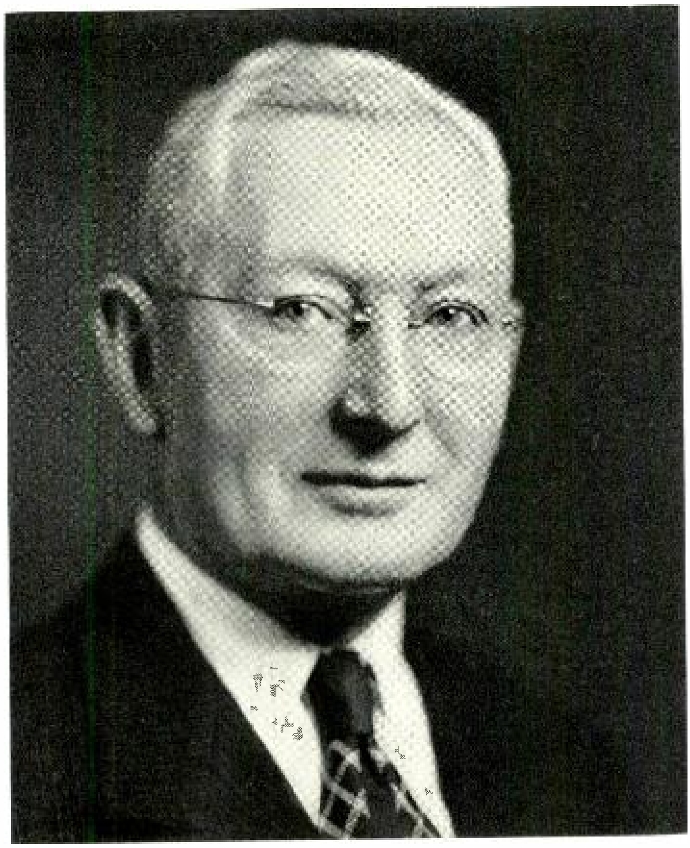

William Fondiller Retires

During his 41 years in the Laboratories, Mr. Fondiller has seen the Bell System's horizon extended from a thousand miles to the span of the globe; has seen the wide spreading of loading, the electron tube, dial systems, the combined telephone set. To all of these he has contributed by leadership and to many of them by invention.

After graduation from City College (B.S. 1903) Mr. Fondiller did graduate work at Columbia, (E.E. 1909; M.A. 1913). Entering the Laboratories in 1909, he was assigned to the Physical Laboratory. The extension of the development of loading coils begun in 1900 was one of his first jobs and he was a joint inventor of the high-stability loading which in 1914 was an essential element of the first Transcontinental Line. In 1916 he brought to a successful conclusion the development of a radically new type of magnetic material, the compressed powdered iron core. This has since had wide application in audio, carrier and radio frequency apparatus. In 1917 he became a supervisor in the Apparatus Design Department, taking charge of the development of transmission apparatus, electro-magnets, resistances, central office wiring. Six years later he became head of the General Development Laboratory (formerly the Physical Laboratory) where he instituted the systematic investigation of properties of materials.

In 1928 Mr. Fondiller became Assistant Director of Apparatus Development. At various times he was in charge of the design of dial switching apparatus, station apparatus, and transmission apparatus, including electrical filters, transformers, varistors, and testing equipment. He also had charge of apparatus drafting and specifications engineering. During this period occurred the development of the Bell System's first combined telephone set. His engineering contributions are evidenced by the various technical papers he has presented; he also has 18 patents with three more pending.

Appointed in 1943 Assistant Vice President in charge of the Laboratories' General Staff, Mr. Fondiller assumed responsibility for accounting, treasury, commercial relations, plant operation

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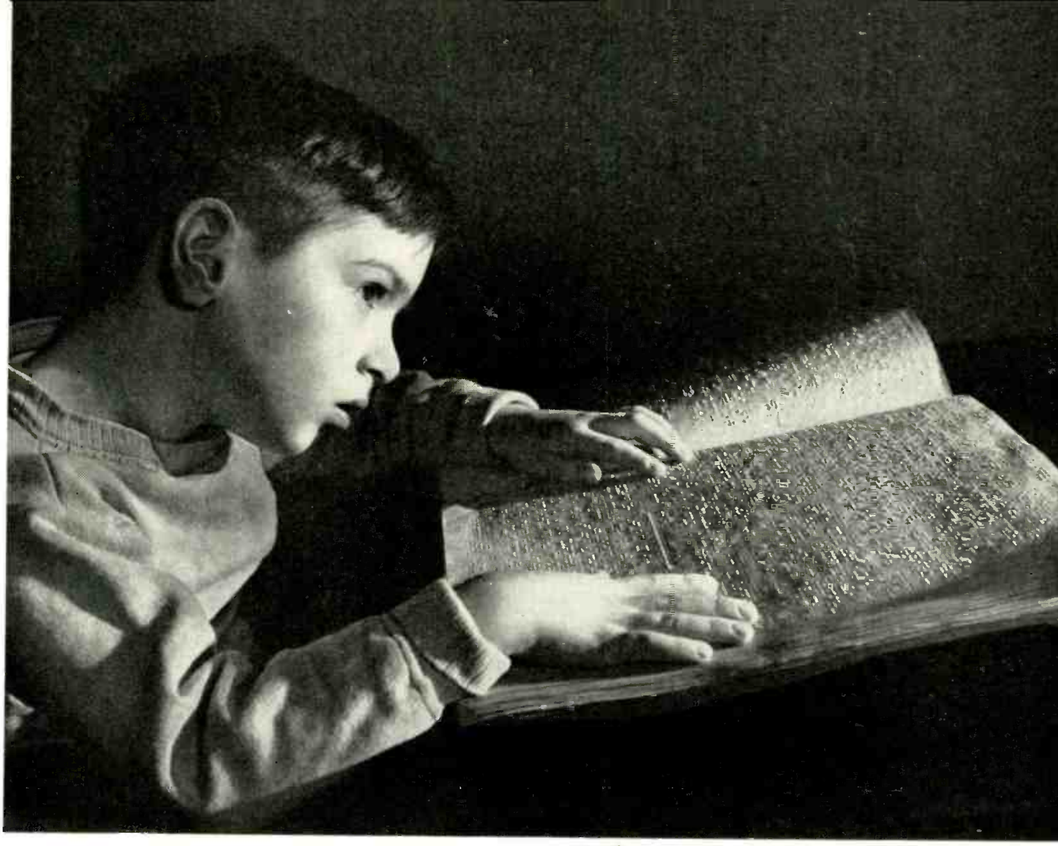

and engineering and shops, as well as a variety of general services. During World War II, when it was necessary to deliver "pre-production" models to the military at the earliest possible moment, Mr. Fondiller set up within the framework of his department an expanded Development Shop which in its peak year turned out $24,000,000 worth of electronic weapons, employed 875 people and marshaled the services of over 300 subcontractors. After the war he developed and installed Area Management, a plan which set up local managers for all of the non-technical operations at the principal Laboratories locations in New York and New Jersey.

Mr. Fondiller is a Fellow of A.I.E.E. and of A.A.A.S.; and a member of Sigma Xi and of Tau Beta Pi. He has long been active in the American Technion Society, which promotes technical education in Israel. During a visit to the Haifa Institute of Technology in 1949 he received the honorary degree of Doctor of Science. He is also the recipient of the Townsend-Harris Medal of City College and the Columbia University Medal. He has also been a Research Associate at Columbia.

During his long residence in Yonkers, Mr. Fondiller was active in community affairs and was for five years chairman of the city's Electrical Commission. He and his wife now live in Manhattan; they have two sons and one daughter, all of them married.

Picture Wins Grand Prize

A $2,000 U. S. Savings Bond was the grand prize won by W. S. Suydam of Apparatus Drafting at Murray Hill in the black-and-white division of *Popular Photography's* contest announced in the December issue of the magazine. A total of 53,558 entries to the contest came from every state and territory of the United States and from 38 foreign countries. The contest opened in January, 1950, and closed July 15, 1950.

Mr. Suydam's prize-winning entry depicts a small boy avidly reading a book in Braille with sensitive fingertips. Its title is "My World Is Growing."

W. S. Suydam

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Bachrach
George L. Best


Bachrach
Bartlett T. Miller


Conway
L. Thurston Pendleton


Bachrach
Clifton W. Phalen

Organization Changes Made by A T & T Company

In a series of A T & T organization changes effective November 3, Vice President Clifton W. Phalen has been named to head the Administration-R Department and is responsible for rate and revenue matters. Mr. Phalen, formerly vice president, information, has been succeeded in that post by Bartlett T. Miller, staff vice president. Mr. Miller continues to be responsible for matters involving general relations with Federal Government departments and agencies, other than the Federal Communications Commission.

Vice President George L. Best, who heads the business research department, will also be responsible for advising and assisting the operating companies on relations with other utilities and Government departments and for matters pertaining to purchase and sales of operating properties. These functions will be performed by the Administration-B Department. L. Thurston Pendleton, formerly assistant vice president for revenues under C. F. Craig, has been appointed assistant to the president and is responsible for advising and assisting the operating companies on matters pertaining to federal and state regulatory bodies.

A graduate of Yale University, Mr. Phalen began his Bell System career in 1928 in the plant department of the New York Telephone Company at Syracuse. He became a plant chief in 1929, after serving as a lineman, cable splicer, installer and repairman. Named assistant vice president of the New York Company in 1943, he was elected to the post of vice president, personnel, the following year. He became head of the public relations department of that company in 1945 and accepted a similar position with the A T & T in 1948.

Mr. Miller entered the telephone business in 1910 as a traffic student with the Colorado Telephone Company at Denver. After holding various supervisory posts in the traffic department there, he transferred to the New England Telephone and Telegraph Company in 1923. He was elected vice president, public relations, of the New England Company in 1944, and three months later became vice president, personnel and public relations. In 1945 he assumed the duties of vice president and general manager. He joined the A T & T in 1946 as assistant vice president in the O & E Department and in the following year was named vice president in charge of the Long Lines Department. In 1949 he was elected vice president in charge of relations with the Federal Government and other communications companies.

Mr. Best began his telephone career in 1922 in the commercial department of the New York Telephone Company. Named general commercial manager of the Long Island area in 1929, he transferred to A T & T in 1937 and in 1940 was placed in charge of its commercial division. He became an assistant vice president in 1942 and four years later was elected vice president of the Western Electric Company. He returned to the American Company as vice president early in 1950.

Mr. Pendleton started his Bell System career with the O & E department of the A T & T in 1923. He was named commercial staff engineer in 1942 and later held successively the posts of sales and servicing engineer and rate engineer. He was appointed staff engineer in the Administration-W Department in 1944 and became assistant vice president for revenues in the Administration-C Department in 1946.

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Dolls and Toys

The Doll and Toy Committee of Bell Laboratories Club at all locations of the Laboratories has completed a banner year with more dolls and toys donated, and more institutions supplied than ever before in its history. In New York under the chairmanship of Mary Cross Frank there were 3500 Christmas presents and 450 dressed dolls.

The display at West Street, which seems more impressive each year, drew hundreds of visitors as well as members of Laboratories families who had dressed dolls. Forty-five institutions benefited from West Street's generosity. This year Whippany, under the chairmanship of "Pat" Gertrude Rooney, built a church to house their display, and made it complete even to the pipe organ for an organist doll, and the marriage ritual typed into a tiny book in the hands of a doll minister. There were 134 dolls in the wedding party and congregation, beautifully dressed for wards of the State Board of Child Welfare, for a neighboring hospital and two local settlement houses. Marion Merck designed the display.

Murray Hill's display, under the direction of Marie Kummer, second vice president of the Club, was far more extensive than in former years. With new members increasing the staff at that location, there were 350 dolls dressed and over a thousand toys and cuddly animals for local sanitariums, nurseries and social service bureaus in Summit, Elizabeth, Plainfield and Westfield. The dolls were set in an impressive toboggan, driven by Santa, and placed on a snowy hillside, with the additional toys among the evergreens.

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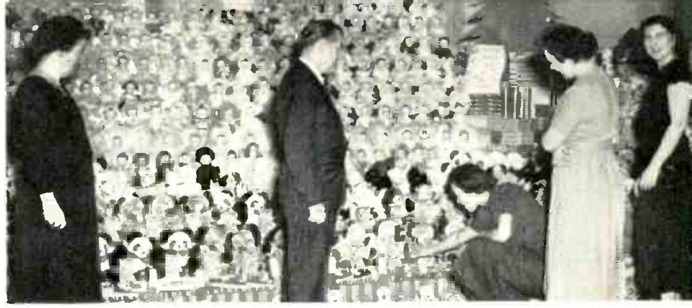

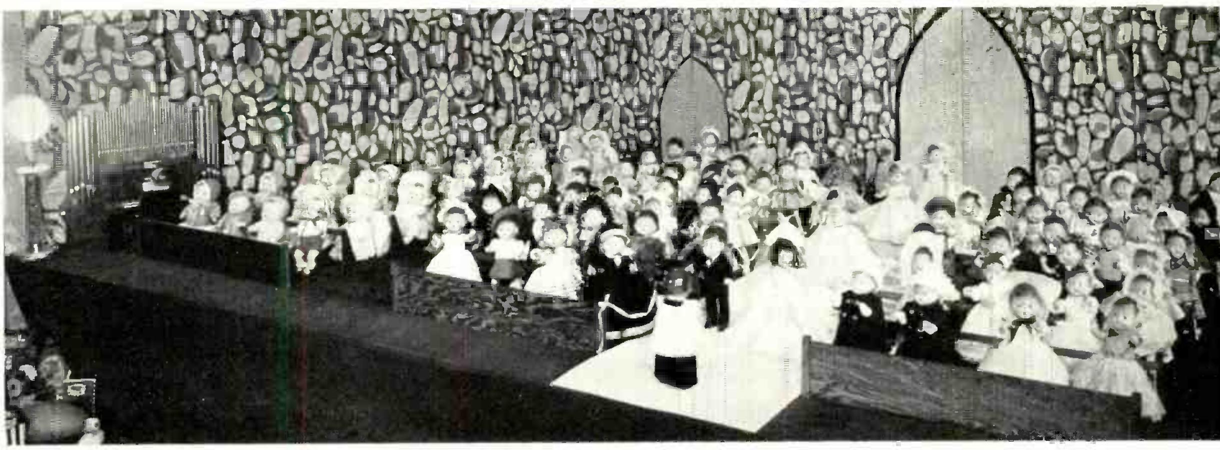

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Sandia Group Visits Murray Hill

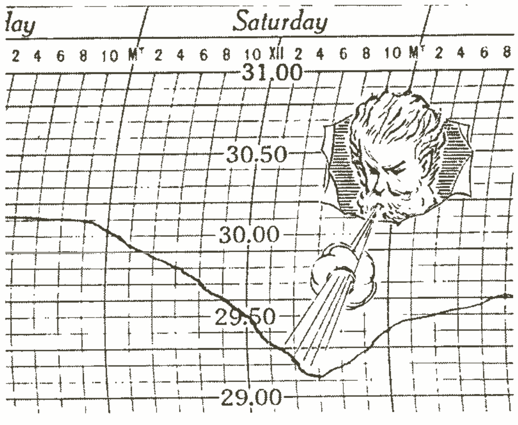
A group of technical leaders of the Sandia Corporation's laboratories visited West Street and Murray Hill on November 13, 14 and 15. Left to right, J. B. Fisk, G. E. Hansche, E. F. Cox, H. W. Bode, R. P. Petersen, R. E. Poole, M. J. Kelly, W. A. MacNair, D. A. Quarles, Ralph Bown, and K. W. Erickson. Mr. Poole, a member of the Laboratories on leave of absence, is Director of Development and Research at Sandia; Dr. Petersen is Director of Research and Messrs. Cox, Erickson and Hansche are members of his staff. Effective methods of research administration were discussed, including problems of recruitment, space, relation to development work, and management control of current projects.

It Happened in November

The "big blow" that occurred on Saturday, November 25, 1950, and caused widespread damage in New York and New Jersey, also left its mark on the recording barometer at Murray Hill. A portion of the record chart is shown here, indicating that, although the drop in pressure was not so rapid as in other storms, it was over a rather lengthy period in comparison. Most of the damage seems to have been due to the high velocity gusts that sometimes struck at just the right moment to knock over a tree—a kind of resonant blow.

Damage to the Laboratories' property was unusually light at West Street; the only effect of the storm was the loss of most of the roof on a small metal penthouse on the roof over section C. Murray Hill survived without any damage, while at Whippany, shingles were blown off and two trees were uprooted. At Holmdel, one end of a barn was pushed in slightly, but the contents of the barn were not harmed. A few shingles were blown off the roof of the main building, and some trees were blown down, but these did not damage the property. Both Holmdel and Deal were without power for awhile; Holmdel for two days and Deal for a few hours. Deal survived the storm with only the temporary power failure.

Thus it appears that the Laboratories' Plant Departments were very well prepared when the storm came. Elsewhere in the Eastern area storm damage to Bell System installations resulted in over 600,000 telephones and 4,000 long distance circuits being put out of service. Even before the winds had subsided, however, repair crews were tackling the job of restoring service—telephone men and women working long hours and using all available resources to keep essential calls going through. Many of the circuits were restored to service within 24 hours,



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and about half were working again in 60 hours. Within less than a week following the height of the storm, service was very nearly normal in all areas. No small part of this feat was due to sizable stocks in Western Electric warehouses, and special shifts at Point Breeze to keep up drop-wire production.

Telephone people once again did a fine job, having the advantage of being ready when the trouble came and knowing what to do when it arrived. It is estimated that it cost the Bell System nearly $7,000,000 to restore all service to normal—another demonstration of the importance of keeping the Bell System in a financially healthy condition to meet whatever emergencies that may arise.

Telephones Help Speed Wreck Rescues

The following paragraphs have been excerpted from the New York Telephone Company's magazine, "The Telephone Review."

"Philip Sheehan is a repairman in the Long Island area. Thanksgiving Eve he arrived home after a full day's work, turned on the radio and sat down to supper. Over the radio came the first announcement of the crash.

"He rose from the table, hopped into his car and, knowing that the wreck area was under the jurisdiction of the 102nd Police Precinct, he sped to their headquarters. There he learned of the seriousness of the situation. . . .

"After checking with the police lieutenant, he sped to the nearest Company garage, obtained a Company car, loaded additional sets and wire into it and called his foreman's home. . . . He was told to proceed to the wreck and help in any way possible and more men and equipment would arrive. He raced to the wreck.

"He knew the police needed a phone on the south side of the tracks, so he ran a wire to a terminal on a pole in the rear of an adjacent house. Having no time to wait for special central office facilities, he requested permission from the customer to bridge an emergency telephone on her line.

"Within minutes, service was established and the authorities had a telephone to use in requesting and directing the vital help necessary. Meanwhile, other Company men arrived with loads of equipment and set up many lines that were immediately marked at the central office switchboard and given special service. In addition, six mobile radio telephones had sped to the scene and were playing their part.

"Philip Sheehan didn't leave once he had set up that first emergency line. He stayed on to help and he stayed until 9 o'clock the next morning. Then, seeing he could be of no further assistance, he quietly went home.

"One comment made at the scene best describes Sheehan's contribution. An unidentified official said, 'Here we were figuratively out in a wilderness, needing a phone right there with us more than anything else—and by God, there it was just as though it dropped from nowhere.'

"The first indication of the disaster was noticed in both Virginia 7, and Virginia 9 central offices at 6:29 p.m. by calls to the police. Immediately, our operators alerted nurses, doctors and hospitals in the vicinity.

Reporters telephoning stories of Long Island wreck from two emergency handsets.

"Handling the mounting traffic volume in the central offices near the wreck area was made possible by employees eager to help by staying beyond the normal hours of duty and by those off duty who were called and came willingly.

"By 7:30 p.m. 124 operators were on duty in the two exchanges Virginia 7 and 9. Normally there are fifty. In these two offices the operators usually handle 48,000 calls between 6 p.m. and 11 p.m. During these hours on the night of the disaster, 82,000 calls were made."

E. C. Edwards of the Laboratories was a passenger in the fourth car of the following train. He was badly shaken up.

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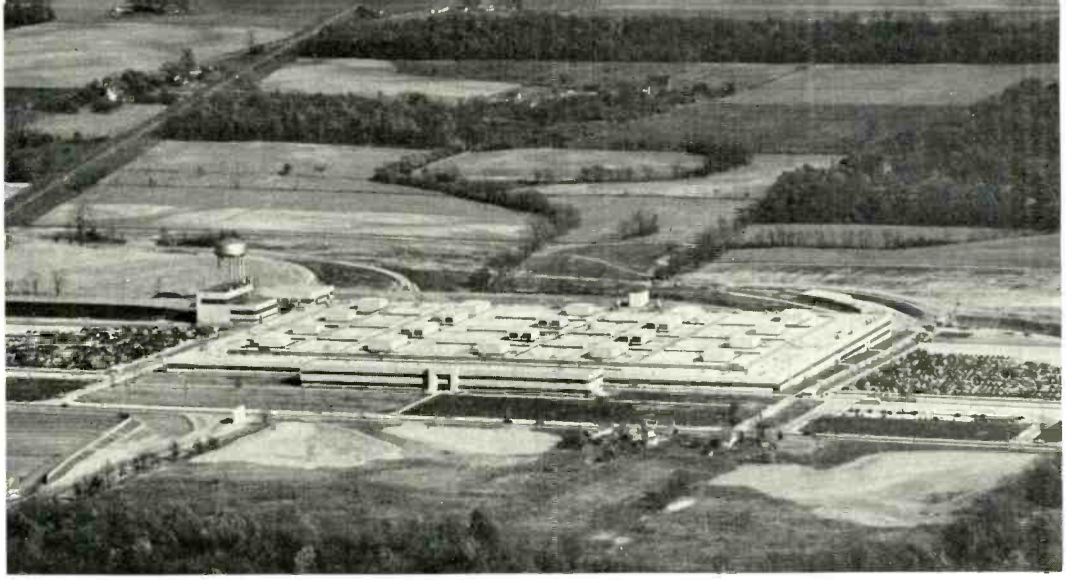

Indianapolis Plant —

Western Electric's New Home of the Telephone Instrument

Engineers of Station Apparatus Development who used to take a train to Chicago and then a cab to the Archer Avenue plant of Western Electric are learning a new route. Now they go to Indianapolis, then six and one half miles northeast on Highway 100 to a brand new plant on Shadeland Avenue. This is where the telephone instrument is going to be made from now on.

Located on a 133-acre tract, the new plant was constructed under the supervision of Western Electric engineers. It was designed especially for the single purpose of telephone instrument manufacture, just as the Allentown plant was designed especially for electron tube manufacture. Over 5,000 people are employed in producing some 8,000 telephones each working day. These include more than eighteen different types of telephone sets, one of which is the new 500 type set designed by the Laboratories and now undergoing field tests.

Actually, the Shadeland Avenue plant is the culmination of a transfer in manufacturing location for telephone sets begun a few years ago, when leased space near the Indianapolis Speedway was acquired and assembly of the combined set started there. This was in anticipation of the new plant replacing the Archer Avenue factory.

Four principal structures with auxiliaries, including a 500,000 gallon water tank comprised this new addition to Western Electric's chain of manufacturing plants. The main manufacturing building consists of a main floor and a partial lower level, containing over thirty acres of floor area. The building houses several thousand machines beneath the more than 2½ miles of overhead conveyor carrying apparatus and parts to and from assembly operations. Surrounding the manufacturing area on the main floor is an 80-foot wide periphery partitioned off for special process rooms, treatment rooms, shop offices, cafeterias, rest rooms, and first aid stations.

The office building, consisting of two stories, is about 500 feet long and 76 feet wide. Besides the offices, it contains a hospital completely

This drilling and tapping machine performs seven different group operations simultaneously on the frames of telephone dials, turning them out at the rate of 750 an hour.

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equipped for first aid work and examinations.

In addition to housing the boilers, the boiler house is equipped with pumps, an electrical substation, and five rotary air compressors.

A special process water cooling system has been provided to furnish cooled circulating water to air compressors, refrigerators, die-casting and molding machines, etc. By this method, 97 percent of the water passing through the cooling system is reused, thus reducing the demand for new water to only about 1250 gallons per minute. The controls and pumps for this process are housed in a one story brick pump house. City water is piped directly to the plant from the Fall Creek Reservoir six miles away, but as added protection, the 500,000 gallon elevated water tank was constructed as a reservoir.

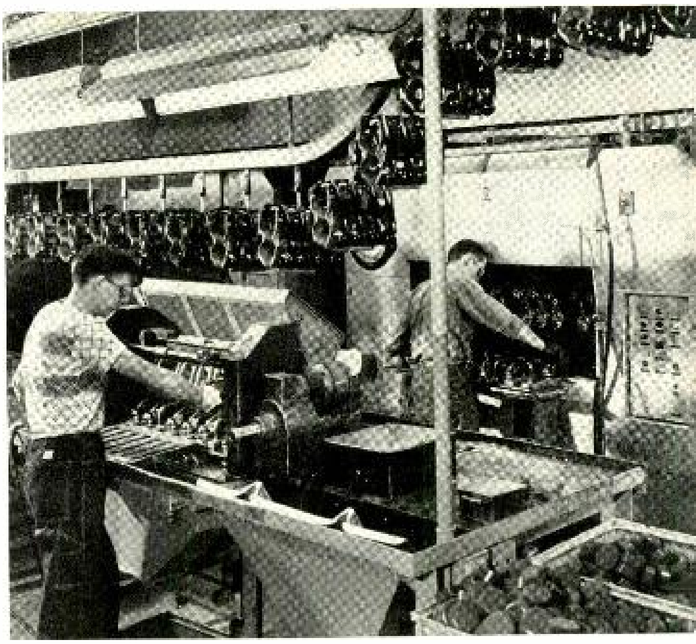
The new plant is completely self-sufficient. Every step from raw material to finished product takes place in its shops or on the main assembly lines themselves. Its own control laboratories continuously check the quality of raw materials and finished products. There is even an oil refinery that salvages oil used in manufacturing operations and makes it suitable for reuse. By means of a special pneumatic system, plastic molding powders are forced through pipes from outside storage tanks directly to the plant's molding rooms. Throughout all the operations, there is scarcely a lost motion. Each assembly step is the last word in efficiency.

Dust control, so essential in the manufacture of precision telephone sets, is accomplished by introducing filtered fresh air into the building and maintaining the inside atmospheric pressure slightly higher than the outside. The ventilating system is so adjusted that the higher the temperature outside, the greater the volume of fresh air pulled through the plant—on a hot day, the big fans can move two and one-half million cubic feet of air per minute through three and one-quarter miles of ducts.

Since a great quantity of metal plating is done in the plant, special attention is given to the treatment of its wastes before it enters the city sewer, to make it harmless to human life and to sewer lines, and to prevent it from interfering with the city's sewage treatment process. Acid and alkaline water is passed through six tanks and treated with caustic solutions to assure that it is not acid. Cyanide wastes are retained in tanks long enough to oxidize them with chlorine before releasing them into the sewage systems.

Besides including the most modern equipment and methods of manufacture, the plant has been designed as a "human" place too—liked both by the people who work there and by the community of which it is a part. It is a place of glistening tile walls, dust free fresh air, abundant light. It has three attractive cafeterias, its own kitchen, bake shop, and, as previously mentioned, a modern hospital. Adequate space for employees' cars is available in parking fields capable of accommodating 2450 cars. A 470-foot square athletic field is being constructed which will be equipped with two soft ball diamonds, badminton, volley ball, and basketball courts; at other locations horseshoe pitching areas and shuffle board courts are provided. The new plant represents the best in modern factory engineering.

From these discs of molding powder resembling hockey pucks which you see in the right foreground, telephone handset handles will be made. First the discs are electronically preheated in a machine at the far right that raises them from room temperature to 260 degrees F in 27 seconds. Then the preheated discs are put into dies which in turn go into molding presses such as the one seen in the center background. In three minutes, the new handset handles emerge.



Colloquium Meetings at Deal and Holmdel

W. D. Lewis talked on *Light Route Radio Systems* on November 3 at Holmdel. Mr. Lewis pointed out the need for such light route systems and described one approach to the problem. Some of the components which have been developed and some still under development

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Graduate Drafting Assistants and Junior Mechanics, class of 1950. Standing, left to right, E. M. Woodruff, W. Burkart, J. Stamas, W. J. Weber and F. C. Wanits. Seated, J. D. Olesko, G. B. Clark, Jr., and A. O. Schmitz.

were mentioned. The goals in these developments are simplicity of construction and maintenance and low cost of production. At the next meeting, held on December 8 at Deal, T. J. Grieser described the TD 2 radio relay system. Some comparison with TDX were made and some equipment and installations were shown in slides. The present and hoped for performance of the system were examined.

P. G. Edwards Lectures on N1 Carrier

The first in the 1950-51 series of lectures was given at West Street November 27 and at Murray Hill November 30, by P. G. Edwards. His topic was the *N1 Carrier System*.

This system has been designed especially for short haul traffic circuits on existing cables. It is capable of handling twelve telephone conversations simultaneously on two pairs of wires and thus adds greatly to the carrying capacity of the cables. Filter costs, and therefore terminal costs have been reduced by using miniaturized components, unit construction, double sideband transmission, and a new type of built-in compandor. This has made possible economical application of carrier to short haul circuits—in the range of about 15 to 200 miles.

Mr. Edwards outlined the need for the new system, describing the several basically new approaches to the development and the resulting advantages. He discussed the design of the system and testing equipment, showing slides of the several components, assemblies, and transmission characteristics.

Graduates of Training Courses

F. D. Leamer presented certificates to graduates of the Drafting Assistant and Junior Mechanic Training Courses, following a luncheon on November 29 in the West Street conference dining room. In view of the temporary suspension of training activity in these courses, this is the last of the trainee groups to graduate under the training program which was resumed in 1946.

F. C. Wanits receives his certificate from F. D. Leamer for having successfully completed the Junior Mechanic training course.

Stamp Club News

Members of the Stamp Club attended the Associated Stamp Dealers Exhibit at the 31st Regiment Armory following a surprise retirement dinner at "The Captain's Table" in honor of Julian Blanchard, a prominent member of the Club. The Club presented Dr. Blanchard with a philatelic briefcase, and an album containing the artistic endeavors which members had written to express their good wishes upon his retirement.

Dr. Perrine of A T & T Describes Carrier Systems

Presenting a demonstration lecture entitled *More Waves, More Words, Less Wires*, J. O. Perrine, Assistant Vice President of the A T & T, described some of the Laboratories' developments in carrier transmission at a joint A.I.E.E.-New York Electrical Society meeting.

Presiding at the meeting was J. D. Tebo, Chairman of the New York Section of the A.I.E.E., who introduced the President of the New York Electrical Society, G. T. Minasian

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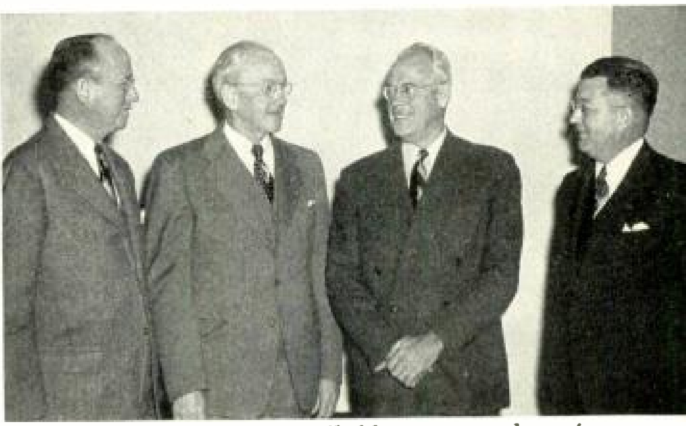
of the Consolidated Edison Company. Mr. Minasian then introduced Dr. Perrine.

On December 7, Dr. Perrine gave the same lecture to the A.I.E.E. Student Branches in the metropolitan area, who were guests of the New York Section. Mr. Tebo introduced Dr. Perrine at this meeting.

Educators at Murray Hill

Some ninety members of the New Jersey Council of Education were guests of the Laboratories at Murray Hill on November 17. The group, composed of principals and superintendents of schools, and representatives of normal schools, Rutgers University and the State Department of Education – were welcomed by R. K. Honaman in the absence of Dr. Buckley. In the Auditorium they heard demonstration talks by W. H. Doherty, W. E. Kock, and A. F. Bennett. After lunch, they were shown the workings of the Transistor, outside plant, crystal growing and metallurgical laboratories, the analogue computer and the free-space room.



S. B. Cousins; Dr. C. H. Threlkeld, superintendent of schools, South Orange and Maplewood; Dr. Harold A. Ferguson, principal of Montclair High School; R. K. Honaman.

International Group Hears About Latin America

Sensitivity of our Latin neighbors to the manners of U. S. tourists was emphasized by Dr. Frederick Ingvoldstad in a talk before some 200 members of the International Relations Group in the Arnold Auditorium on December 1. Dr. Ingvoldstad is director of travel forums conducted by Columbia University.

W. Kalin, Dr. Frederick Ingvoldstad, Ruth Kendall and W. H. Edwards at Murray Hill. Dr. Ingvoldstad spoke before the International Relations Group.

Latin-American cultures differ widely from each other, from the Guatemalan which is strongly aboriginal to the Argentine which is much like our own. The people are alike, however, in being awed and a bit dismayed by the overwhelming power of their big neighbor to the north, and in being quick to resent patronage by tourists. Genuine friendliness is understood and appreciated, but Latin-Americans are suspicious of our rapid-fire good-will methods.

Following the talk, Dr. Ingvoldstad was a luncheon guest of the group leaders.

Organization Changes

Switching Development

C. G. Miller, Systems Practices Engineer, has transferred from the Systems Engineering Department to the Switching Systems Development Department, reporting to A. J. Busch, Director of Switching Systems Development. Mr. Miller's department has transferred with him, except for the group reporting to J. Abbott, Jr., and now engaged in the preparation of apparatus maintenance material. This group transferred from the Systems Engineering Department to the Standards and Drafting Department, becoming a part of the Switching Apparatus Specifications Department.

Military Electronics

A. A. Currie, formerly a member of Mr. West's group, is now a supervisor in Mr. Higgins' group, reporting to R. R. Hough. M. J. Burger of Mr. West's group has been advanced to a higher level of supervision. R. W. Benfer of Mr. Higgins' group has also advanced, and now reports directly to Mr. Higgins. B. McKim of Switching Engineering, New York, has been assigned temporarily to Mr. West's group at Whippany.

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W. B. Groth of Switching Systems Development demonstrates the code translator and printer for which the U. S. Patent Office recently issued one of the longest patents on record. Watching the demonstration are the Patent Staff members who worked on it. Left to right, H. F. Beck, drafting supervisor, Frances Novick who typed the patent, equivalent to a 366-page book, and C. F. Campagna who drew the equivalent of 136 sheets of drawings.

News Notes

POWER CONVERSION apparatus in telephone central offices must not only provide filtered dc power for charging and floating the emergency storage battery, but also must accomplish this without creating a disturbing audible noise in the power room. D. H. SMITH attended the Boston meeting of the Acoustical Society of America to hear lectures on means of reducing such audible noise. At Boston, F. W. ANDERSON studied the electrical noise produced by line voltage regulators in the TE-2 system. At Bristol, Conn., Mr. Anderson conferred with a manufacturer of regulators that are used on TD-2 spur routes.

R. J. NOSSAMAN, on November 28, talked to a group of about 400 Northern Electric and Bell Telephone Company of Canada people at Montreal on the subject of *Recent Activities in Outside Plant Development.* A similar talk was given on November 30 in Toronto to a group of about 200 people, predominantly from the Canadian Bell Plant and Engineering Departments in the Western Area of that company. Mr. Nossaman also visited the Shearer Street and Lachine Works of the Northern Electric Company in Montreal and took part in a field trip in Toronto to review a number of Outside Plant installations in and near that city.

WITH HERMETICALLY sealed apparatus in increasing demand, R. A. SYKES, B. S. WOODMANSEE and A. W. ZIEGLER discussed sealed terminals at Winston-Salem. Messrs. Woodmansee and Ziegler continued on to consult with terminal manufacturers at Cincinnati, Ohio, and Elkhart, Indiana. Mr. Woodmansee also took the opportunity to discuss ultrasonic delay lines with a manufacturer in Erie.

R. M. C. GREENIDGE reviewed the possibilities of evaporated metal resistors with a manufacturer in Brooklyn. Resistor problems were also the main topic when B. SLADE and E. M. BOARDMAN visited Allentown. With E. C. HAGEMANN and A. H. SCHAFER, Mr. Boardman inspected a Collingdale, Pa., plant which is manufacturing resistors for Western Electric.

Peder M. Ness of Electron Dynamics, whose dexterity and patience in assembling the 6-mm travelling-wave tube, described on page 14 of this issue, contributed much to its success.

ALLEVIATION OF THE dust problem in crossbar offices by means of a new type of baffle was discussed by F. A. JOHNSON with representatives of the New Jersey Bell in whose territory the idea is to be tried out. The baffle consists of a shield inserted between mounting plates to cut down the circulation of dust-laden air.

WHEN CONSTRUCTING open-wire and cable lines, some means of communication is needed between the workmen stationed at various points along the line. Hand signals have been used for the purpose. In an improved system now under development the men will be provided with "inductive talking sets," each consisting of a transmitter, receiver, and loop antenna, and will be able to converse with each other by telephone but without the necessity

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of metallic connection, in much the same manner as is employed with "walkie-talkie" radio sets. The winch line pulling in a cable or any approximately paralleling power or telephone line guides the signals. During November 1950, J. W. Kittner observed trials of models of these sets during aerial cable and open-wire installation work near Bangor, Maine.

J. H. Gray visited Atlanta to observe field use of unglazed vitrified clay conduit for underground cables. Service trials are confirming laboratory tests showing that the omission of glaze in no way affects the serviceability of the conduit while manufacture is facilitated considerably by elimination of glazing and scarifying operation.

The Pennsylvania Railroad is saving a considerable amount of time in the operation of switching locomotives in their York, Pa., yard. Each locomotive and the yard master's office are equipped with two-way radio telephone units that enable the yard master to communicate with the locomotives and the locomotive engineers to talk with each other. This installation is being made by the Bell Telephone Company of Pennsylvania. On November 15, Newton Monk and F. D. Coombs, in company with G. M. Smith of the A T & T, visited York to inspect the new installation.

As long as 20 years ago, samples of telephone cables and insulated wires were buried in a test plot at Lawrenceville, New Jersey. Recently, F. W. Horn, A. Mendizza, and V. J. Albano visited the spot to examine these samples. Various types of cables and wires such as underground distribution wire having different types of protective coverings, are buried in a variety of soils throughout the country–locations such as wet and dry areas in New Jersey, alkali soils in California, and salty marshes near New Orleans. This is a continuation of the constant study of materials and fabrication processes directed toward improvements in construction of cable and wire coverings to protect against corrosion.

Making sure that a system operates satisfactorily after it is installed is second in importance only to the original design. R. F. Massonneau, H. E. Noweck, S. P. Shackleton, and D. H. Pennoyer visited the Bell Telephone Company of Pennsylvania in Philadelphia to discuss methods for keeping track of the behavior of the AMA system recently installed in that city.

January Service Anniversaries of Members of the Laboratories

40 years

R. P. Ashbaugh

35 years

J. M. Maxey
H. A. Richardson

30 years

C. F. Campagna
J. H. Gray
P. C. Ryder

25 years

H. P. Cummings
H. E. Ericson
J. Landers
J. Leonard
J. Marshall
P. J. Nolan
L. C. Peterson
J. Rerecich
L. A. Rich
J. M. Rogie
R. E. Wirsching

20 years

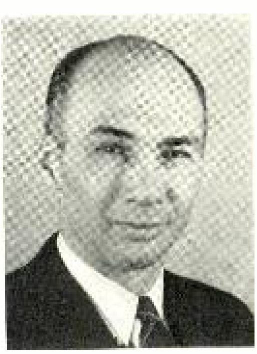
W. T. Cunningham
J. N. McTighe
H. Schwarz

15 years

H. L. Bond
H. L. Brunjes
J. Fagan
E. B. Kopetz
R. J. Latsch

10 years

K. M. Brown
Lois Burford
R. J. Collins
G. N. Eltz
J. F. Frock
C. L. Hagetter
J. M. Marko
G. N. Paravati
C. D. Parker
N. A. Popp
H. G. Reimels
A. B. Van Liew
E. J. Zillian



H. A. Richardson

R. P. Ashbaugh

J. M. Maxey

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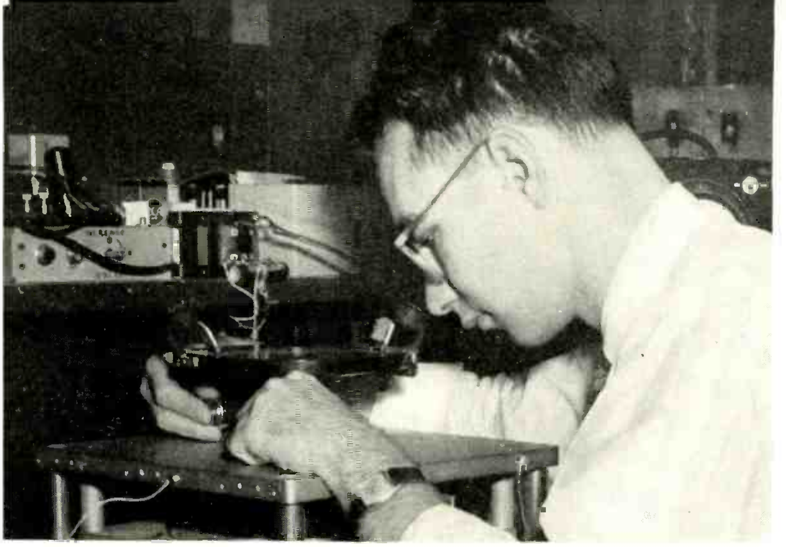
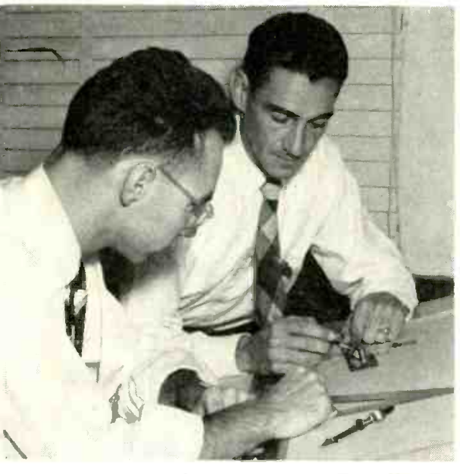


L. C. Brown in his laboratory at Whippany measures the shaft position of a small remote control motor. Measurements are made in a shielded cage because accuracy required is such that electrical noise must not be present.

INTRODUCING CHARLIE BROWN
Technical Assistant at Whippany



Over a drawing board, Charlie discusses changes in the mechanical mounting of a motor.

L. C. Brown of Military Electronics typifies the Technical Assistant who joined the Laboratories before the war. Starting at Graybar he advanced by studying nights at Brooklyn Polytech and later Newark College of Engineering. The war came. Mr. Brown spent three years in service, half the time overseas as a radar observer and technician with the 12th AAF. He saw action in a C-47 in the invasion of southern France, Balkan air combat, the Po Valley campaign among others, and returned unscathed. Shortly after his return to Graybar, he transferred with his department to Whippany radio laboratory.

During military training in Florida, he met and married the daughter of a St. Louis minister. They now own their home in Rockaway, New Jersey, and, needless to say, are active church members, particularly in the young married set. They are also members of a theater group. Their son, Gary, was only a day old when pictures of his dad were taken at Whippany. He was barely two weeks old when he posed for the RECORD.

Here he gives Rose Arkie a data sheet to type.

From Central Instrument Bureau, he borrows equipment to use in his breadboard test. P. K. Prothero is charging it out.

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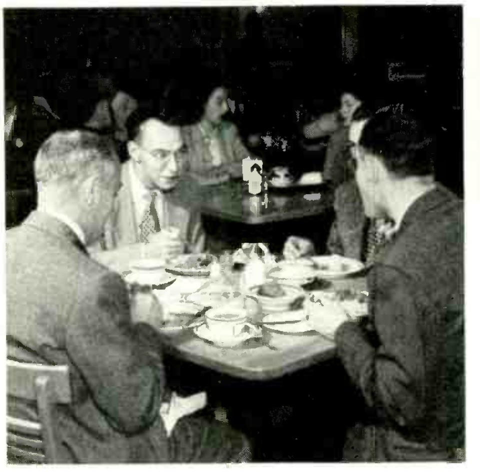
Deskwork includes the computing of power needed for a military electronic device. Mr. Brown forward, H. A. White, rear.

Charlie is measuring voltages on the breadboard model of a pulse forming device that he built.

With his supervisor, R. F. Lane, he looks over one of his memoranda ready for typing. The interesting globe is used in connection with their work.



Young fathers at lunch in the Cafeteria. Left to right are J. J. Scanlon, L. C. Brown, H. A. White and J. G. Matthews.

The L. C. Browns of Rockaway, New Jersey. Saturday work and evening classes leave little time for baby, Gary, an obliging model though only two weeks old.

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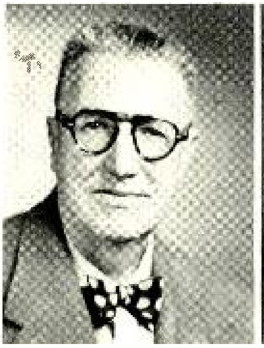
RETIREMENTS



JOHN HALL A. H. SCHIRMER J. F. DAHL

Among those retiring from the Laboratories are John Hall with 44 years of service; J. F. Dahl, 42 years; William Fondiller, 41 years (see page 25); A. H. Schirmer, 39 years; Stephen Gasparick, 38 years; and L. J. Barker, 27 years.

JOHN HALL

John Hall joined the Laboratories in 1914, but before that he had had quite a career in engineering. He had been with an electric railroad, had worked up during four years with the C&P Company to be wire chief of one of its biggest exchanges and had put himself through Union College (B.S. 1914) by part time work for New York Telephone. After two years on relay design, he transferred to Patent, working on switching circuits. By 1928 he was a member of the New York Bar, and had charge of a group concerned with manual circuits. From 1931 to 1937 he was European patent attorney for E.R.P.I. and was stationed in London to look after that company's patent interests in sound pictures and in deep sea cables. Returning, he worked on teletypewriter switching circuits. When the war came, he specialized in computers; and later on A.M.A. One of his big patent cases was pictured in the RECORD recently.* Fifteen patents record his own contributions to the art.

Preparing patent applications is what Mr. Hall really enjoys more than anything else, so he expects to continue in private practice. With that and his hobbies—woodworking, photography and stamps—he expects his time to be well occupied. He is married, has one son, and lives in Summit.

JACK F. DAHL

While Jack Dahl was getting some all-around Plant experience with Illinois Bell in Chicago (he joined in 1907), he did some circuit designing. So in 1919, when the Laboratories needed engineers to cope with the post-war load, it was natural that Mr. Dahl should be transferred to New York. After a year on PBX circuits, he was directed to develop a trunk circuit that could be quickly changed from "call circuit" to "call indicator" operation when the originating office was cut over from manual to dial. He then developed a circuit which would display automatically the number called over a call-indicator trunk as soon as the "B" operator became available.

As the years went by, Mr. Dahl designed the call-distributing No. 3 information board, the No. 3 order turret for large telephone users, the centralized "B" board for manual-to-panel calls. In the crossbar program, he developed the call distributing sender to complete calls from a manual board. He also developed the No. 1 crossbar incoming trunks from a toll office arranged to give reverse battery supervision to the originating end. Along with these major projects, he has designed a good many trunk circuits; this activity, in the form of current engineering in connection with Western Electric orders has been his principal one in recent years. Fifteen patents record his personal contribution to our art.

Mr. Dahl and his wife will soon leave their Morristown home for Florida. When summer comes, they plan to make an extended tour of the United States.

AUGUST H. SCHIRMER

Upon entering the Engineering Department of the New York Telephone Company in 1911 after graduation from Case School of Applied Science, "Gus" Schirmer undertook a series of assignments on the electrical protection problems of the plant. Included in these was a study which led to the adoption of the porcelain-type protector blocks used in station, cable, and central office protection. Nine years later Mr.

*November 1950, page 515.

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Schirmer joined the transmission development group of D & R as a specialist on protection matters. Since that time he has been responsible for the development of protection systems and equipment and the evolution of protection theory. His work has involved extensive studies of the nature of lightning and of the effects of lightning and power potentials on telephone lines and equipment.

In related fields, Mr. Schirmer has also devoted a great deal of attention to investigations of cases of electric and acoustic shock and has been responsible for the work on electrolysis of telephone plant and electrolysis mitigation measures. He has achieved a well earned national reputation in the field of his specialization and has frequently served as an expert witness or consultant in cases involving the effects of lightning or foreign potentials. For a number of years he was active in the work of the Joint Subcommittee of the Edison Electric Institute and Bell System, particularly in connection with problems involving electrical protection and the joint use of poles by power and telephone companies. He also is chairman of the Grounding and Lightning Arrester Committee and a member of the Correlating Committee of the National Electrical Code.

When D & R was consolidated with the Laboratories, Mr. Schirmer came to West Street as Protection Standards Engineer of the Protection Development Department. He has continued in that work and has served as a consultant to Laboratories, A T & T and Operating Company people having problems of electrical protection and electrolysis. In 1948, Mr. Schirmer transferred with his group to the Outside Plant Development Department where his activities and responsibilities have continued to be of the same nature as previously.

Parents of nine and grandparents of four, most of whom live nearby, the Schirmers have no incentive to move away from Hillside, N. J.

Stephen Gasparick

At thirteen, a boy is old enough to go to work in Hungary, so when he reached that age, Steve Gasparick was apprenticed to an electrical manufacturer. When he became a journeyman he moved over to a subsidiary of International Western Electric, which then did a considerable business in various foreign lands. Deciding after two years that his future was not in Austro-Hungary, he came to the United States in 1905 and in 1912 joined Western Electric in New York as an instrument maker. Soon he was transferred to Development Shop work on the first telephone dials to be made by Western Electric. He continued in the Shop on all kinds of craftsmanship until 1934, when he joined a development group to work on quartz crystals as frequency standards. In 1936 he joined the Research service group and became in 1937 one of the first mechanics to work in Summit, in the rented building on Broad Street. In recent years he has done a great deal on ceramics and tools to extrude and to grind them.

Mr. and Mrs. Gasparick live in Lyndhurst, N. J. One of their sons is a C.P.A., the other an electrical engineer who is teaching in a high school. A true craftsman, Mr. Gasparick looks back to the exhibition pieces he made while an apprentice and forward to the tool and die work he hopes to do in retirement.

Lionel J. Barker

After graduation from a naval apprentice training school in England Mr. Barker became a marine engineer in the merchant service. He came to the United States in 1910 and became an inspector in a marine engine plant. During World War I he served in the Inland Water Transport, which operated on canals in France.

Stephen Gasparick L. J. Barker

On joining the Laboratories in 1923 he was first a millwright but soon became an instrument maker. For a time in 1926-7 he was a watch foreman in the Plant Department; in that period he wrote an article for the Record* on Plant's service to the rest of us. Then for six years he was an instructor in the Instrument Makers' Apprentice school. In 1933 he moved to Holmdel where he was a laboratory mechanic and later an instrument and toolmaker. During the following years he worked on components for the MUSA, on the directional wave guide coupler extensively used in radar and other microwave systems, and on many parts for an important fire control radar.†

Beyond enjoying his new leisure, Mr. Barker has no particular plans for his future.

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* *December*, 1926, *p.* 120. † *March*, 1950, *p.* 103.

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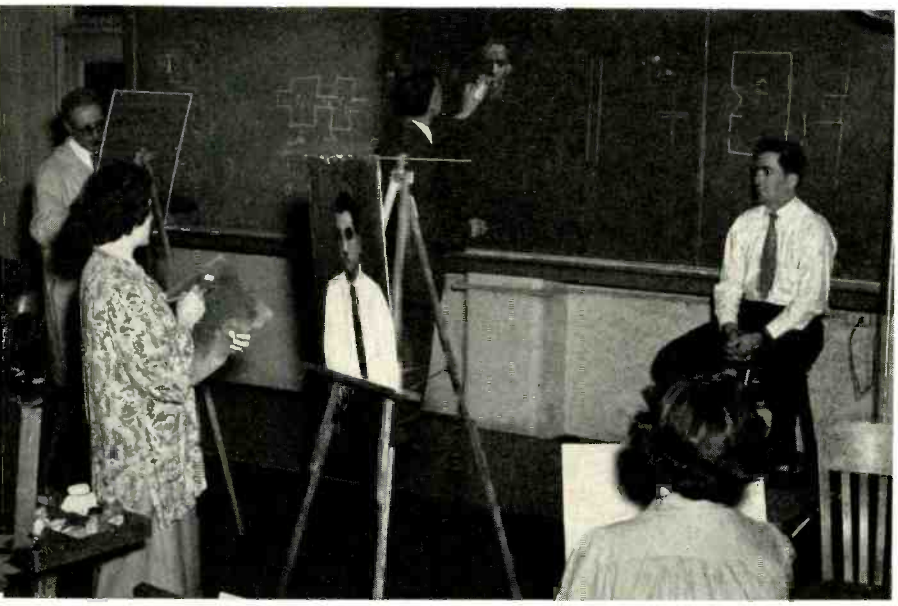
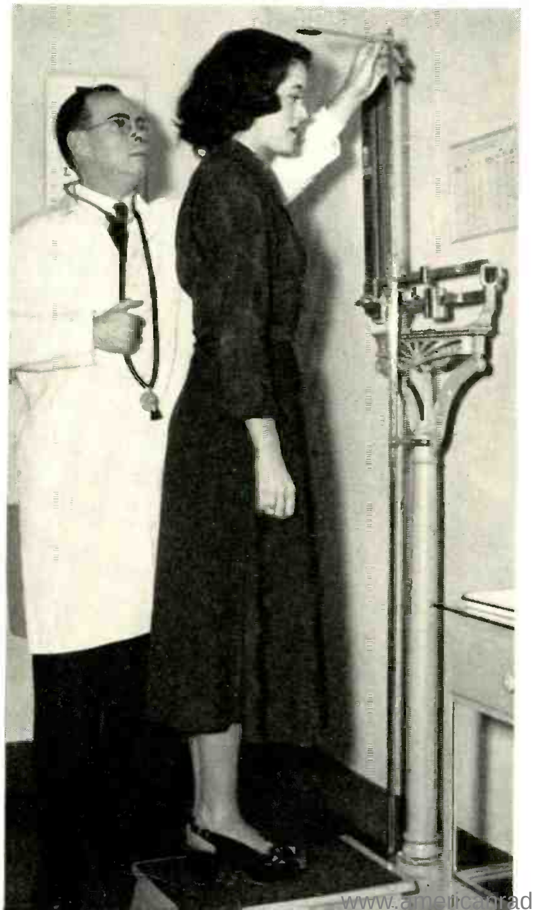


Your New Year's Projects

Members of this group are studying art for a second year under E. Stanley Turnbull.

Margaret Monahan's height and weight are under scrutiny by Dr. M. J. Hanley who is responsible for physical examinations at West Street.



Fifty clowns with baggy breeches, high pointed hats and pompons, and grinning faces were made by Mrs. H. S. James, Sr., mother of a Burlington Laboratories engineer, for H. A. Doll's friends in polio wards of the Central Carolina Convalescent Hospital. The rag doll clowns are made of multicolored print and are anchored with beans: thus the polio patient gets both a doll and a bean bag. Janie Murdock is shown with Mr. Doll who is with the Laboratories group at Burlington.

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Projects you can carry out at the Laboratories are shown on these pages:

1. To enroll in one of the Laboratories' creative project groups.

2. To join an active recreation group.

3. To make an appointment now for your annual physical examination.

4. To be friendly to newcomers.

5. To join a First Aid course now.

6. To help the less fortunate, the sick.

Members of the ceramics class, molding vases and working on a potter's wheel.

Women Pioneers hard at work on one of their latest projects, the making of scrap books from greeting cards for children in hospitals and for chronic veterans in government hospitals. Left, Nora Larkin and Mae West.

Members of the First Aid Course at Whippany demonstrate the proper method of transporting a patient on a stretcher.

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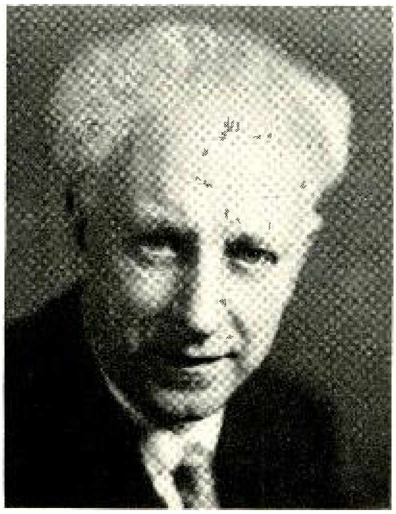
H. Z. HARDAWAY
First Vice-President



R. H. WILSON, *President*

MARIE KUMMER
Second Vice-President

OFFICERS OF BELL LABORATORIES CLUB

R. H. Wilson, President of Bell Laboratories Club, is well known at West Street as former Research Staff Engineer and later General Service Manager. Mr. Wilson is now Area Manager at Murray Hill.

A graduate of Victoria University, Manchester, England, with B.Sc. and M.Sc. degrees, he came to the Laboratories from the University of Toronto, Canada, to develop radio receiving equipment. He was intimately associated with the experimental work which culminated in radio transmission between Arlington, Virginia, and Paris, France, in 1915.

First vice-president of the Club, H. Z. Hardaway transferred to Whippany in 1942 from the Southern Bell Telephone Company where he had spent two years in Outside Plant Maintenance. In the war years he designed and developed airborne submarine and Navy Ordnance equipment. Following that he spent two years in Winston-Salem as Laboratories manufacturing relations engineer. Now back at Whippany he is again engaged in the development of airborne equipment.

Mr. Hardaway, a Kentuckian, is a graduate of the University of Iowa. He has been a softball and bowling enthusiast at both Whippany and Winston-Salem. During his stay in North Carolina, he was also active in the Junior Chamber of Commerce and in the American Society of Mechanical Engineers.

Marie Kummer, second vice-president of the Club, set out on an engineering career when she was a messenger at West Street. She studied six years at Brooklyn Evening College until overtime for warwork interrupted. In 1945 she resumed her studies and three years later received her B.A. degree in mathematics. A member of the Transmission Systems Development Department at Murray Hill, Miss Kummer is engaged in equalization problems in connection with the L3 carrier system.

News Notes

K. G. COUTLEE, G. DEEG, I. L. HOPKINS and E. E. WRIGHT attended the Cincinnati meeting of the A.S.T.M. Mr. Hopkins is Secretary of a Subcommittee on plastic research and Mr. Coutlee was appointed Chairman of a Subcommittee on compounds and waxes. At the National Research Council Conference on insulation at Mt. Pocono, Mr. Coutlee gave a paper on *The Electrical Properties of Mica* and D. A. McLEAN conducted a round-table discussion on *Ionic Losses in Dielectrics.*

R. M. BURNS attended the dedication of the new marine corrosion testing station at Harbor Island, North Carolina. This station, maintained by the International Nickel Company, will continue the extensive program of studies on the action of sea water organisms on materials, initiated some years ago at Kure Beach. He participated in a meeting in Washington of the Division of Chemistry and Chemical Technology of the National Research Council. Dr. Burns represents the Electrochemical Society in that body. He has also been re-elected Councilor for a three-year term of the New York Sec-

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tion of the American Chemical Society from which he retired recently as Chairman. Mr. Burns spoke on *Chemists in the Electrical Industry* before the New Jersey Chapter of the American Institute of Chemists at the Esso Research Center, Linden, New Jersey. He also discussed corrosion of metals before a faculty seminar at Washington Square College of New York University.

THE HISTORY of television, including early color demonstrations, was reviewed by A. G. JENSEN at Vail Hall in the New Jersey Bell Telephone Building in Newark on November 15. Mr. Jensen also discussed late television developments, with emphasis on color video at a meeting of the Monmouth subsection, I.R.E., Ft. Monmouth.

A. C. KELLER was a guest speaker at the New York Telephone Company Chief Engineers Conference at the Engineers Club on December 11. Other speakers included New York Telephone Operating Vice President O. M. Taylor, Vice President and General Manager W. Powell, Assistant Vice President F. E. Brooks, and D. P. Fullerton, Chief Engineer. The subjects of Mr. Keller's talk were *European Telephone Practices* and *A New Translator for Toll Systems*.

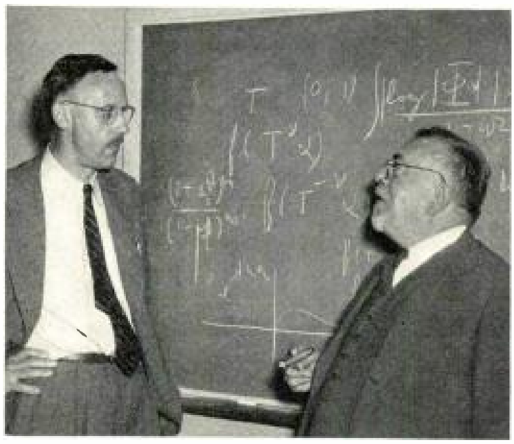
SIMPLIFIED maintenance facilities for the registers and senders of the AMA type No. 5 crossbar office at Coraopolis, Pennsylvania, were placed in trial operation by C. W. HAAS and A. A. HANSEN. At Ambridge, Pennsylvania, the No. 5 crossbar office was also visited in connection with maintenance studies.

To say good-bye to Fred Cunningham, a hundred and thirty of his friends in the Bell System assembled at dinner on November 20. Master of Ceremonies was W. H. Doherty; speakers were M. H. Cook, H. J. Delchamps, W. C. Tinus and E. F. Nelson of the Laboratories; F. M. Ryan of A T & T, J. R. Poppele of Station WOR; and J. W. LaMarque of Graybar. R. E. Coram presented a token of his associates' affection and esteem. William Stumpf was chairman of the committee.

M.I.T. Professor Visits Murray Hill

Dr. Norbert Wiener, professor of mathematics at Massachusetts Institute of Technology, visited Murray Hill recently. His day was a busy one, occupied chiefly in conferences with several groups in transmission and mathematical research fields. He spoke in the late afternoon before a larger group in the Arnold Auditorium on *Multiple Prediction and Cross Talk* in which he discussed a statistical theory of the transmission of electrical signals in communication circuits.

Much interest was evidenced during the visit whenever opportunity was presented for individuals to discuss phases of Dr. Wiener's books with him. His earlier *Cybernetics or Control and Communication in the Animal and the Machine*, and the recent *The Human Use of Human Beings: Cybernetics and Society* were occasional topical subjects for the day.



H. W. Bode (left) and Dr. Norbert Wiener during a discussion held by the mathematics group at Murray Hill.

News Notes

J. R. TOWNSEND was reappointed Vice Chairman of Standards Council, American Standards Association, at the annual meeting.

A. C. WALKER's talk on *Crystals* was one of the 1950 John E. Sweet courses of lectures given before the Technology Club of Syracuse and Affiliated Societies on November 13 at the Museum of Fine Arts in Syracuse. In his illustrated talk Dr. Walker described the basic principles that are involved in the growing of large single crystals.

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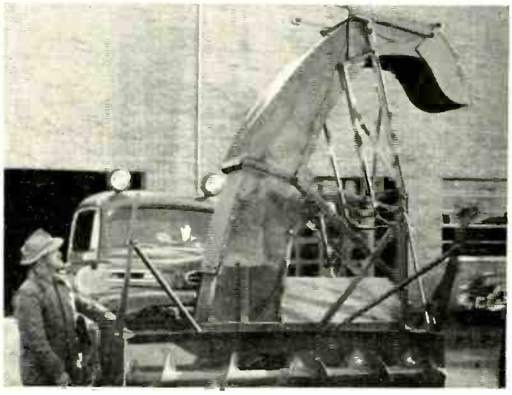
WHEN WINTER COMES

Cold weather means that more heat is required from the boilers. J. J. Moore fires boiler No. 8 while W. T. Quinn brings in coal.

Sidewalks around the West Street building are kept free of snow by the snow plow being readied for service by W. E. Lichte.

Guards John Moeller (center) and Jim Barton (right) have their winter uniforms inspected by Patrick McLaughlin, their supervisor.



The "Snow-Go" machine at Murray Hill is made ready for use by Pat Duffy. Joseph Pigno is shown in the driver's seat.

Joe Pigno and Tom Corcoran of the Murray Hill Grounds Maintenance Group placing road clearance snow stakes.

←
James Lawrie (left) and Daniel Mahony putting anti-freeze in the Laboratories' automobiles at Murray Hill.

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News Notes

R. B. Curtis and R. C. Pfarrer visited the A4A toll switching system cutover at Kansas City to discuss maintenance problems and to make traffic observations on the senders. Mr. Curtis also discussed toll switching system maintenance problems with the maintenance personnel at Indianapolis.

At Wright-Patterson Air Base, Dayton, Ohio, C. S. Fuller was chairman of a meeting sponsored by the Research and Development Board to review progress in synthetic rubber research. W. O. Baker read a paper on the dynamics of individual rubber molecules.

B. S. Biggs, J. B. De Coste, V. T. Wallder and C. C. Lawson conferred at Point Breeze on ways to improve the outdoor durability of polyvinyl chloride plastics for wire and cable. Mr. Wallder also discussed the properties of polyethylene as insulation for power cables with an A.I.E.E. committee in New York.

During November the varied activities of the Switching Systems Development Department required its engineers to visit cities as widely separated as Naugatuck, Connecticut, and Kansas City: W. W. Brown visited Naugatuck in connection with the design of operators' chairs, and H. D. MacPherson visited Kansas City for the cutover of an A4A toll office. Work in connection with A4A also called M. F. Fitzpatrick, R. S. Skinner, A. G. Runnels and A. B. Van Liew to Albany, where an A4A office was recently put into service. Work on No. 5 crossbar called H. J. Keefer, and T. F. Egan to Norristown, Pennsylvania, and H. I. Miller, and A. P. Goetze to Media, Pennsylvania, while S. J. Brymer visited Hawthorne in connection with the No. 1 crossbar. PBX's also called some of the Systems engineers to outside points: A. C. Gilmore, C. R. Gray, H. A. Miloche, P. L. Wright, to Philadelphia, and F. W. Treptow to Batavia, Ohio. On other work D. Ritchie, Jr. went to Philadelphia, C. W. Haas to Pittsburgh, and A. C. Gilmore, and R. W. Westberg to Galion, Ohio. Besides these various outside activities, J. Meszar went to Pittsburgh to talk before the A.I.E.E. Section Meeting, and W. Keister to Chicago to talk before the A.I.E.E. Communications Group.

"Looks like Jim's wife doesn't want him to go to that party."

"Oh, Boy! Credit the Telephone Company with another rescue."

Methods of testing the purity of compressed gases—oxygen, nitrogen and hydrogen—which are used in large quantities at Murray Hill were discussed by F. J. Biondi at the Research Laboratory of the Linde Air Products Company, Tonawanda, New York.

N. Monk presented a paper, *Experimental Radio Telephone Service for Train Passengers,* at the National Meeting of I.R.E. Professional Group on Vehicular Communications, held at Detroit in November. In his talk, Mr. Monk described the development of telephone service

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"Telephone Hour"

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

January 1	Lucille Cummings, *contralto**
January 8	Jussi Bjoerling, *tenor*
January 15	Lily Pons, *soprano*
January 22	Jascha Heifetz, *violinist*
January 29	Ezio Pinza, *basso*
February 5	Marian Anderson, *contralto*
February 12	Robert Casadesus, *pianist*
February19	Ferruccio Tagliavini, *tenor*
February 26	Bido Sayao, *soprano*, and GiuseppeValdengo, *baritone*

* From Carnegie Hall

between moving railroad trains and land stations. Because the present train telephone stations place a burden on the railroads in furnishing attendants, experiments have been initiated utilizing coin box telephones. These experiments are giving promising results.

About sixty copies of the Record go to Australia and occasional letters to the Editor show that the magazine is valued. Recently a letter from an engineer in the Postmaster General's Department disclosed a new interest: "I am prompted to write to you, not on any technical matter, but to convey my appreciation of a picture—the picture of the two young women which heads the list of Engagements and Weddings. Some months ago, I saw a larger version of this same picture, probably in the Bell Record, and each time I see the little picture afresh, its charm is renewed. It is the most charming and striking photographic portrait study I think I have ever seen, not to mention the aptness of its application in your Publication; nor to mention the lovely subjects. I would like to have this picture for the wall at home, and I would appreciate it greatly if you could send me a photographic print of it." The picture is one taken by W. E. Thacker, who won a prize with it in the Camera Club's contest in 1949. Mr. Thacker is now on leave of absence.

Engagements

*Dorothy Delaney—Arthur C. Mann
*Justina Hawansky—Robert Masters
Elizabeth Pollard—John A. Brankner*
*Marianne Mesler—William Gee
Anne Prete—*Alfred Stiller
*Dolores Stanganelli—George Esau
Ruth Volz—Frederick A. Kling*
*Rita Zoch—*William A. Buchwald

Weddings

*Sylvia Anderson—Raymond B. Dahl
Lois Baker—*Charles H. Dykeman
Millie Glaser—*Maurice E. Fine
*Cornelia Hasbrouck—Ernest McGill
*Elizabeth Sprissler—Alex L. Tullo
*Margaret Steiger—Samuel H. Edwards
*Adamae West—Lawrence Scherer

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

The 1951 Telephone Almanac features the telephone's value to the American community. A limited number of copies are available for distribution—call Extension 565 at West Street.

A. C. Kane, A. W. Dring and O. B. Cook visited Point Breeze to discuss the manufacture of the new NC distribution cable terminal. Its body of molded plastic forms a gas tight joint with the cable sheath. Carbon block protectors are a feature of the new terminal.

Appearing in the facing advertisement is R. K. McAlpine who works on the development of circuits for No. 5 crossbar which is served by the trouble recorder. →

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