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Saving Mica by Testing

By K. G. COUTLEE
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FEW insulating materials can claim as many useful characteristics as mica. It is chemically inert, has a low coefficient of expansion, and can withstand very high temperatures without injury. To these desirable characteristics it adds high dielectric strength, high dielectric constant, and low power factor. The ease with which it can be split into thin sheets makes it available in a wide range of thicknesses. Among the many devices using this interesting and unusual material, none places more exacting demands on quality than the capacitors used in large quantities for all types of radio and wire communications circuits. For the better grades of such capacitors, the mica must not only be free from all defects such as cracks or conducting spots, but must have very low dielectric loss, and must be able to undergo wide temperature cycles with only minor changes in characteristics, and these changes must always be the same over repeated cycles. To make sure of obtaining this high quality, only the better ruby muscovite micas* have heretofore been accepted. Mica of this quality and type, however, represents only a small part of the total production, and with the difficulties of wartime transportation, and the enormously increased demand, it early became apparent that a serious shortage would develop.

By employing only the better ruby muscovite micas for condensers, the manufacturers made sure that a satisfactory product would be obtained. There was no evidence, how-

*Record, *October*, 1943, *p.* 60.

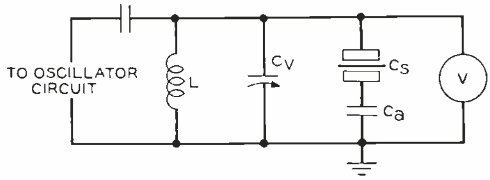

Fig. 1—Simplified circuit indicating the method of testing for power factor

ever, that some and perhaps much of the mica rejected might not also have been equally suitable. Moreover, there was no satisfactory evidence that other types of mica might not also yield appreciable quantities suitable for electrical use. While most of the best ruby muscovite mica came from India, there are large deposits of ruby and other types of muscovite mica in the United States, South America, and Canada, and if these could be made available for mica capacitors, not only would the supply be greatly increased, but the transportation difficulties would be largely avoided.

Because of this situation, the War Production Board appealed to the Laboratories in the fall of 1942 to devise a method of testing and classifying mica that would give more positive results. The tests and classification, in other words, while assuring that no defective mica could be put into finished capacitors, should also insure that no good mica of any type was rejected.

Of the various characteristics that make mica so satisfactory, its dielectric constant shows relatively little variation, since it depends on the basic chemical substance which is essentially the same for all types of muscovite mica. The undesirable micas are inferior either because of physical defects, such as cracks or waviness, or because of foreign inclusions that either increase the losses or lower the dielectric strength. Most of the mechanical defects may be detected visually. What was urgently needed was a quick and easy method of detecting con-

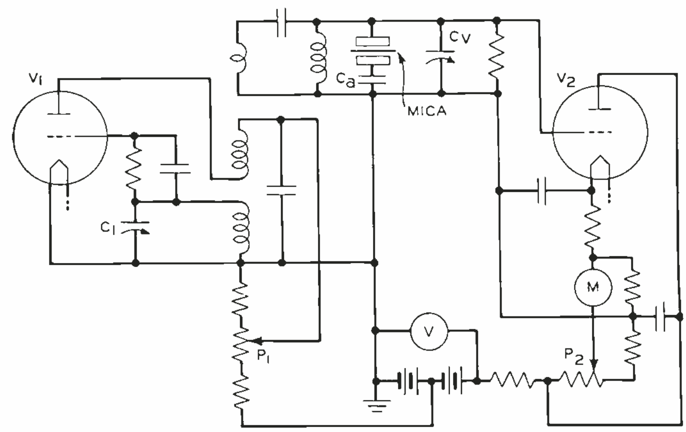

Fig. 2—Circuit schematic of the mica test set with filament supplies and power and voltage switches omitted

ducting regions, and for determining the dielectric loss under the influence of the alternating voltages the mica would encounter in service. To meet these needs, the Laboratories undertook an investigation that culminated in the design of two test sets: one to detect conducting regions, and one to measure the dielectric loss of raw mica in "block" form. This is the term that is used for sheet mica ranging from 7 to 30 mils in thickness.

The test set for determining loss measures the power factor of the current flowing through the mica when high-frequency voltage is applied across it. Since ordinary methods of measuring power factor are too slow for a commercial test of

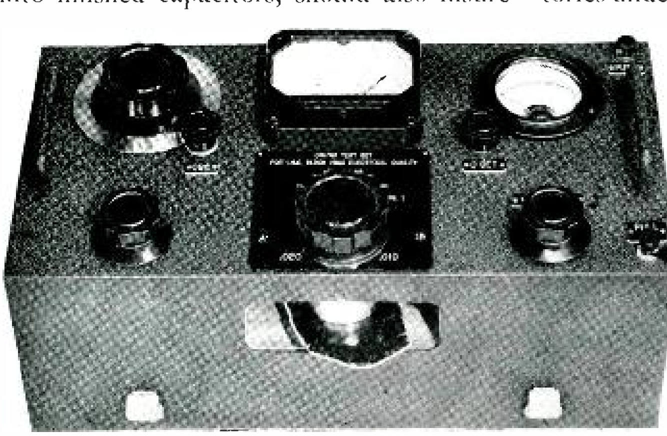

Fig. 3—The mica test set developed by the Laboratories

this type, a circuit was designed that gave a suitable measure of loss as a single reading of a voltmeter. The principle of the circuit employed is illustrated in Figure 1. A high-frequency oscillator, not shown in the illustration, is coupled to a circuit consisting of an inductance L, an adjustable capacitance C_V, and a fixed air condenser C_A of negligible loss. The mica sheet to be tested is placed in series with the air condenser C_A. A voltmeter across the circuit measures the voltage both before and after the mica is in place. Prior to a series of tests, and before any mica has been inserted in series with C_A, the circuit is tuned to the applied frequency, and the input is adjusted to give full scale reading on the voltmeter.

When a sample of block mica is now inserted in series with C_A, it detunes the circuit, which is returned to resonance by adjusting C_V until a maximum reading is obtained on the voltmeter. If there were no loss in the mica, that is, if the power factor were 0, the meter reading would be at full scale as before. Any loss in the mica, however, will appear as a series resistance. Less current will flow as a result, and the voltmeter will indicate less than full scale.

The circuit actually employed is shown in Figure 2 in somewhat simplified form. V_1 is the tube of the oscillator circuit, which is adjusted in frequency and output prior to a series of tests by adjusting C_1 and P_1. V_2 forms part of a vacuum-tube voltmeter. Its reading, taken on the meter M, is used for classifying the mica in terms of power factor. The set includes its own batteries, and V is a voltmeter used chiefly to indicate when they need replacing. All the circuit elements, including the batteries, are housed in the small portable metal case shown in Figure 3. C_1 of Figure 2 is the dial at the upper left, and P_1 is the smaller dial below it. M is at the top center, and V at the top right, with P_2 just below and to the left of it, and C_V at the lower right. At the lower center is a dial used for raising and lowering C_A so that a sheet of mica can be inserted between it and the lower electrode. This dial is also arranged to indicate the thickness of the sample of mica under test. For each test, the sheet of mica is placed between C_A and the lower electrode, and the dial is turned to clamp it in place. C_V is then adjusted to give a maximum reading on the meter.

With an experimental form of such a test set available, a number of samples of muscovite mica of various types were tested, and capacitors were made up by the Western Electric Company under regular manufacturing conditions and subjected to

Fig. 5—The spark test locates conducting regions in block mica, and permits defective material to be rejected before applying the classification test

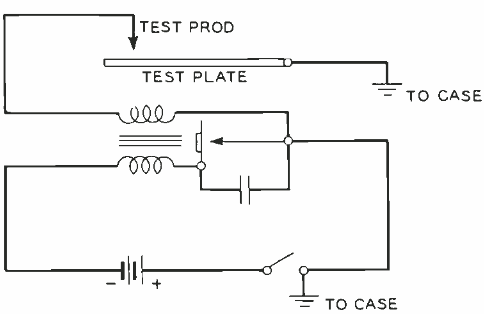

Fig. 4—Circuit schematic of the spark test set

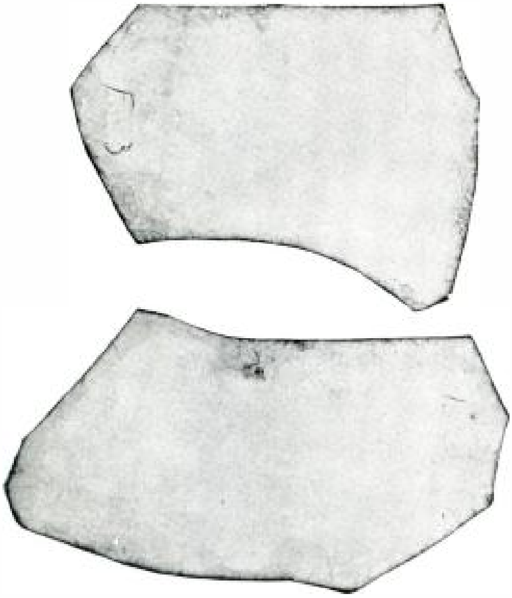

Fig. 6—Both of the above sheets of ruby mica would be accepted by visual inspection, but a reading on the new mica tester would show the sheet at the top to be of electrical quality E3, *while that at the bottom is* E1

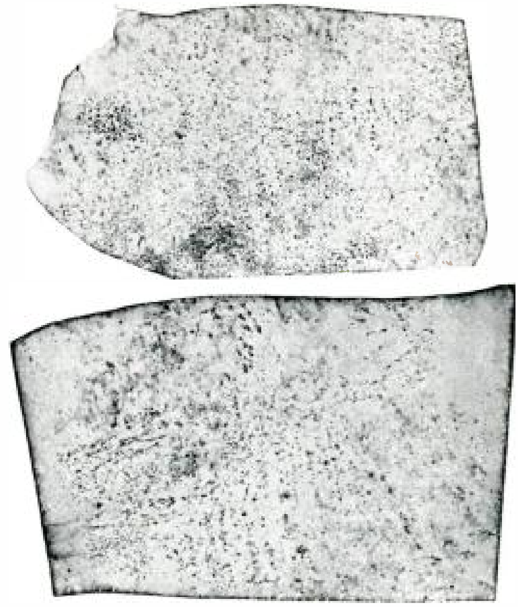

Fig. 7—Both of the above sheets of spotted and stained mica would be rejected by visual inspection, but the mica tester shows the sheet at the top to be of electrical quality E3, *while that at the bottom is* E1

thorough tests. It was found possible to correlate the results obtained from these tests with the power factor indication of the test set. As a result of this correlation, three ranges of power factor were established, each lying between certain pointer readings on the test set. These ranges are called E_1, E_2, and E_3, and the scale of the meter was marked with diagonal lines to indicate them. The reading of the test set also varies with the thickness of the mica as shown by the clamping dial, and the scale of the meter is arranged to permit this factor to be taken into consideration. Since most of the mica capacitors used for war purposes operate at frequencies of the order of a million cycles, the War Production Board requested that this frequency be used for the test. With the new set, it is possible to test as many as fifteen samples of block mica per minute,

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THE AUTHOR: Since 1916, K. G. COUTLEE has been concerned primarily with the electrical characteristics of all types of insulating materials, particularly their dielectric losses under low-potential telephone frequencies and low and high-potential radio frequencies. In the early twenties he was instrumental in designing and developing special laboratory testing equipment used in apparatus and insulating materials studies at radio frequencies. Most of the time since 1928 Mr. Coutlee has been associated with what is now the materials standards group of the Switching Apparatus Development Department where he has dealt with insulating materials problems and the development of testing methods and specifications for raw materials such as waxes, compounds, sheet and molded insulating materials and ceramics used in telephone apparatus.

For the past several years he also has been active in the work of Committee D9 of the A.S.T.M. covering electrical insulating materials and of the War Committee on Radio of the American Standards Committee covering radio insulating materials.

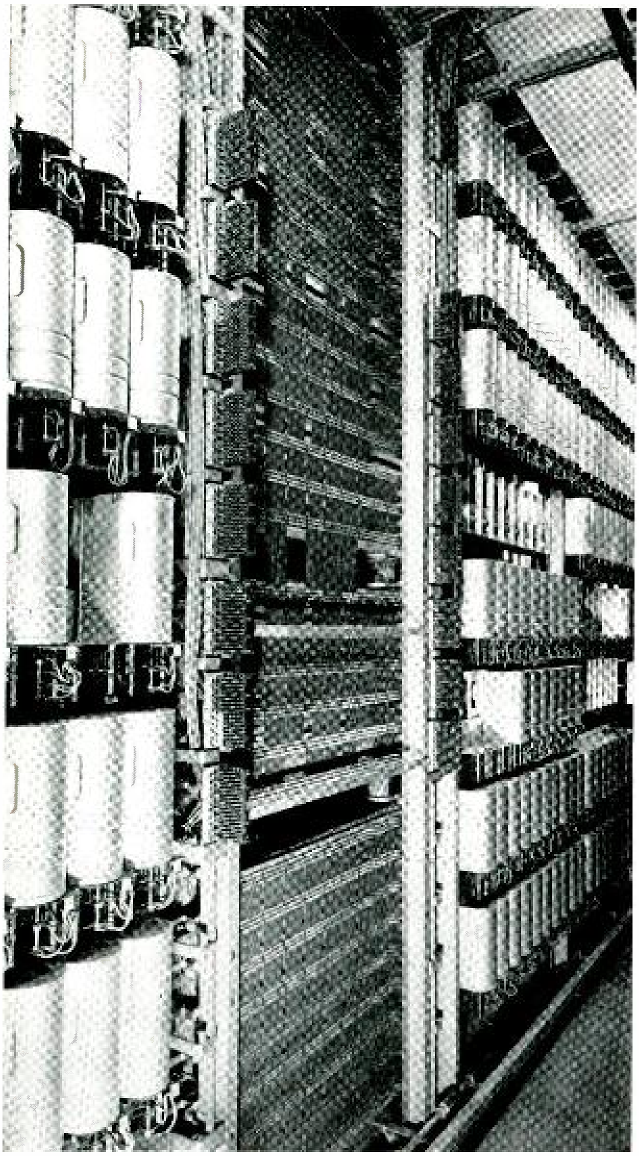
while with the more conventional methods at least fifteen minutes would be required for each test.

To discover conducting regions in stained mica prior to the power factor test, a small test set was designed. This is a battery-operated spark coil arranged as shown in Figure 4. A sheet of mica is placed on the test plate, as shown in Figure 5, and the test point is moved over its surface. Any defective regions will be indicated by sparking at or in the vicinity of the point. Only a few seconds are required for each test.

By the use of these two test sets, a large quantity of block muscovite mica, considered unusable for capacitors by the previous methods, was selected and used in about 40,000 capacitors by several manufacturers. These capacitors fully met thorough performance and life tests made by the manufacturers, and proved the reliability of the test set classification. As a result of this commercial trial, an increase of about 50 per cent in the muscovite mica suitable for use in capacitors has been realized. With investigations that are now in progress, it is hoped that this figure may ultimately be increased to 60 per cent.

Truman Committee Praises Laboratories Development

In a report issued on March 4, 1944, *the Senate Special Committee Investigating the National Defense Program, under the chairmanship of Senator Truman, had this to say of the Laboratories mica testing apparatus described on the previous pages. "During the spring and early summer of this year* (1943), *Bell Telephone Laboratories developed a practical scientific instrument for testing and evaluating the electrical qualities of mica. By the use of this device, it became possible to determine, with a speed that rendered the operation practicable, whether or not spotted and badly stained mica could be used for various purposes in the electrical field. Much of this mica had been rejected by unscientific visual testing. . . . Bell Telephone Laboratories' instrument very favorably impressed the Committee at its hearing."*



Improved Graded Multiple for Step-by-Step Offices

By G. E. DUSTIN
Switching Equipment

IMPROVED graded-multiple trunking arrangements have recently been made available for standard step-by-step offices which result in material economies in selectors and other equipment, and very substantially reduce the cost of making periodic revisions in the number of graded multiple trunks in existing offices.

"Selectors" in step-by-step offices, operating in response to pulses from subscribers' dials, elevate or "step" a set of wipers to any one of ten levels, and then cause the wipers to rotate and attempt to select an idle one of ten bank terminals on each level. Each bank "terminal" comprises three or four bank contacts—T, R, and S, or T, R, S, and C—which serve to extend a three- or four-wire circuit through the bank multiple to a trunk to a succeeding selector or other circuit in the switching train. Thus, each selector has access to ten trunks on each of the ten levels of its bank, and permits a choice to be made from among several groups of trunks in accordance with the number dialed.

The amount of traffic to different selector levels is, in general, not the same. The traffic to a level leading to succeeding selectors in the same office, for example, is almost invariably higher than that to levels leading to selectors in a distant office, where the community of interest among the subscribers is less.

In practice, the selectors are assembled in the factory in groups of ten, called divisions, and the 100 bank terminals of each selector are wired in a common multiple that connects corresponding terminals of all banks together. Two such divisions are mounted on a selector "shelf," and sixteen shelves, or thirty-two divisions, are mounted on the usual central-office selector "frame." The bank multiple of each division of ten selectors is wired to a bay of terminal strips on the selector frame called the "distributing terminal assembly" or the "DTA," at which point as many divisions can be multipled on each level as are required to provide the proper load to the trunks of that level.

Assume, for example, that there are 2,000 first selectors in a large central office, and that 40 are required to provide the proper load on the second level to ten second selectors. The banks of the first selectors would then be multipled together on the second level into 2,000÷40, or 50 "subgroups" of forty selectors (four divisions) on ten trunks to second selectors. These would be called non-graded subgroups of forty selectors on ten trunks. The total number of second selectors that could be reached from the second level of the first selectors would, of course, be 50×10 or 500.

Figure 1 illustrates a non-graded subgroup of twenty selectors on ten trunks, where the two divisions of ten banks are multipled together at the DTA terminal strips at the right for connection to ten trunks to succeeding circuits. Each line and each terminal represents a three or four-wire circuit through the bank multiple and bank terminal strips.

However, it will be noticed that there is a "reversal" in the multipling of terminals 1 to 9 between divisions, whereas the tenth terminals are multipled "straight." This reversal, which connects trunk 1 of one division to trunk 9 of the other, trunk 2 to trunk 8, etc., is applied in practice to reduce the selector hunting time and to equalize wear on the switches, since it causes half the selectors to hunt over the trunks in the opposite order from the other half. The No. 10 terminals are multipled "straight" to enable last-trunk-busy registrations to be obtained whenever this trunk, which is last choice to all the selectors, is reached. Where a subgroup is made up of more than two divisions of selectors on ten trunks, the reversal is made as near the middle of the subgroup as possible.

There are several disadvantages to this apparently simple method of subgrouping selectors and trunks, but the principal one is that it does not provide the greatest possible efficiency in the use of the trunks, and consequently, in the use of the succeeding circuits to which the trunks connect. Probability theory shows that the efficiency of trunk groups in terms of the amount of traffic that each trunk can carry increases as the size of trunk group increases. If the 2,000 selectors mentioned above, for example, each had access to more than ten terminals on each level, the number of second selectors required would have been less than 500.

Telephone traffic is measured in terms of hundreds of call-seconds, abbreviated ccs. One ccs may be represented by one call of 100 seconds' duration, two calls of 50 seconds, one-half call of 200 seconds, and so on, and if a trunk were used continuously it would carry 36 ccs in an hour. This efficiency cannot be attained in practice, however, since the number of calls lost from encountering all-trunks-busy conditions would become too high. Such lost calls during the busy hour are allowed in varying amounts from 1 in 50 to 1 in 1000 at different stages

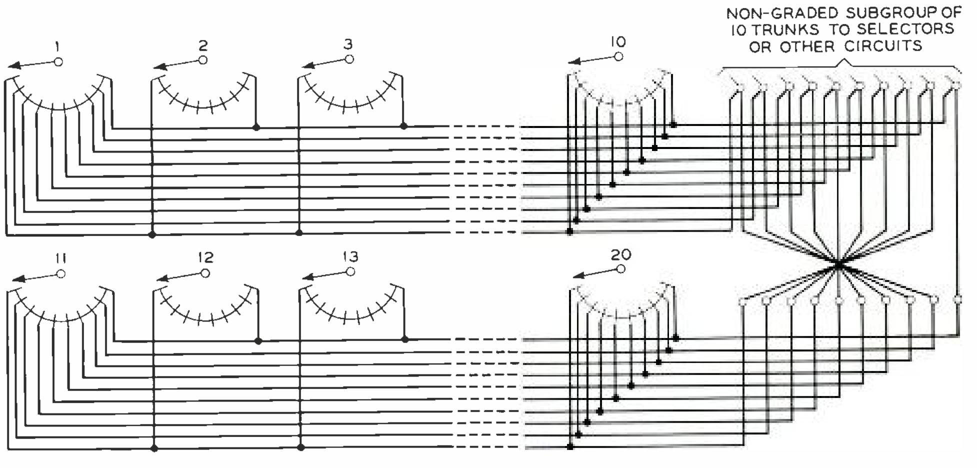


Fig. 1—With a non-graded subgroup of twenty selectors on ten trunks, all the selectors have access to all the trunks, as indicated by the cross-connections at the right

of the switching train, but in the usual trunk groups from selectors, 1 in 100 (1/100) lost calls are allowed, and this grade of service is assumed in the following discussion. Figure 2 indicates the capacity in CCS per trunk for various size trunk sub-

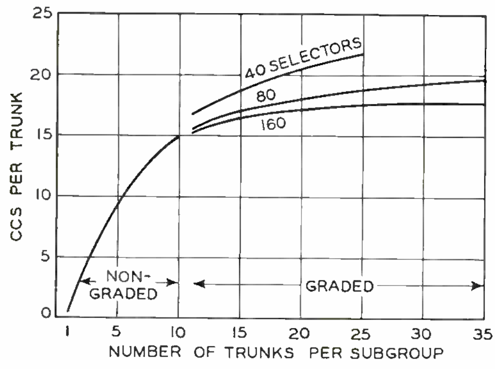


Fig. 2—The capacity in CCS per trunk for non-graded trunk subgroups from one to ten and graded subgroups of eleven to thirty-five trunks based on 1/100 *lost calls*

groups from 1 to 35, based on a probability of 1/100 lost calls. The curve up to ten trunks illustrates the efficiency obtained with non-graded subgroups of 1 to 10 trunks. The curves beyond ten trunks, which are based on the new graded-multiple arrangements, illustrate how this efficiency can be increased by graded multiple, although while doing this the number of terminals to which each selector has access on each level is maintained at ten.

Graded multiple increases the number of trunks per subgroup by the method indicated in Figure 3. Here the selector banks are omitted for the sake of simplicity, and only the connections at the bank terminal strips are shown. Each row of terminals at the right may be thought of as representing the multiple of one or several selector divisions at the DTA. A graded multiple subgroup of thirteen trunks is here obtained by multipling the first three terminals separately through each half of the divisions and connecting them to six trunks, and multipling the remaining seven terminals through all of the divisions and connecting them to seven more trunks. The trunks in the sets of three are called "individual" trunks, and those in the set of seven are called "common" trunks. A "reversal" in the multipling of the common trunks except the last is employed to reduce the selector hunting time, and as with 10-trunk subgroups, this reversal is placed between two divisions at the middle of the subgroup. Graded multiple efficiency depends upon the individual trunks being early-choice trunks and the excess traffic from all of these trunks overflowing into the common trunks.

Three other graded multiple arrangements, of 11, 19, and 12 trunks, which have been used extensively in the past, before the improved present standard graded arrangements were introduced, are shown in Figure 4. In these diagrams only the DTA terminals are represented, which is the method of picturing graded multiple arrangements in the standard Bell System information.

Until the new improved graded arrangements were put into effect, the maximum number of trunks employed in step-by-step selector graded multiple subgroups was nineteen, and the number of selectors before which these graded subgroups were multipled varied from 20 to 100 selectors. At the time the original arrangements were adopted very little test data were available to confirm the probability theory of the gain obtained. It was thus not definitely known just how much advantage there would be in larger subgroups. On the other hand, there were

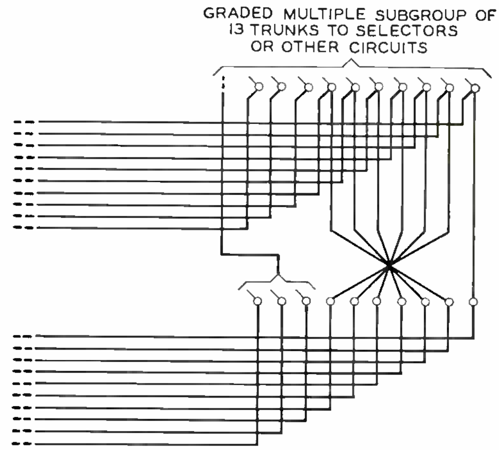


Fig. 3—With graded multiple some of the trunks are accessible to only part of the selectors. The arrangement shown forms a subgroup of thirteen trunks of which seven are accessible to all selectors

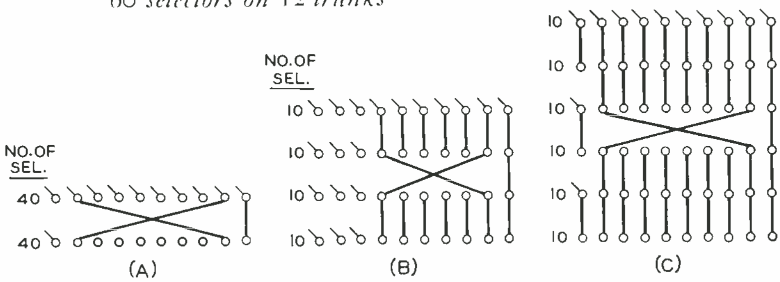


Fig. 4—Three graded multiple subgroups that were used before the new arrangements went into effect had: at A, 80 selectors on 11 trunks; at B, 40 selectors on 19 trunks; and at C, 60 selectors on 12 trunks

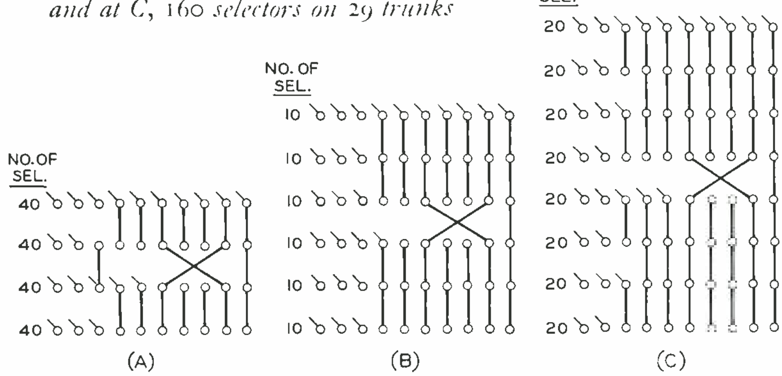


Fig. 5—Three of the graded multiple arrangements that would now be used in place of those shown in Figure 4 provide: at A, 160 selectors on 20 trunks; at B, 60 selectors on 27 trunks; and at C, 160 selectors on 29 trunks

two objections to carrying grading too far. The larger subgroups increase to some extent the average hunting time for the selectors, and with very fast dialing, the danger of the next digit being dialed before an idle trunk had been found would thus be increased. This would result in part or all of the pulses for this digit being lost, causing a partially dialed number, or, in some cases, a wrong number. Moreover, the more traffic the trunks are made to handle, the greater likelihood there is that two calls might seize the same trunk during the short unguarded interval between the seizing of the trunk and its being made busy. It seemed wiser at that time, therefore, to restrict the graded arrangements within the limits mentioned. Since then, however, tests and experience have substantiated the graded multiple theory, and circuit and adjustment changes in the selectors have been devised which will reduce the above difficulties to a materially greater extent than they would be increased by the larger subgroups. As a result, the graded arrangements have now been extended to include a maximum of 35 trunks and from 20 to 320 selectors in a subgroup. The present standard forms provide for 20 selectors on from 11 to 19 trunks, 40 selectors on from 11 to 20 trunks and on odd numbers of trunks from 21 to 25, and for 60, 120, 240, 80, 160, or 320 selectors on from 11 to 20 trunks and on odd numbers of trunks from 21 to 35.

Figure 5 shows three of the present standard graded forms which are used in practice in place of the three forms shown in Figure 4. It will be observed that the form at (A) for 160 selectors on 20 trunks, which is used in place of 80 selectors on 11 trunks, saves two out of 22 trunks, or 9.1 per cent. Similarly, the forms at (B) and (C), for 60 selectors on 27 trunks and 160 selectors on 29 trunks, result in savings of 5.3 and 9.4 per cent, respectively.

The increased efficiency of larger subgroups is illustrated to some extent by the

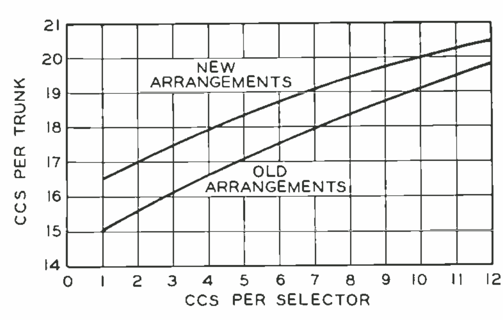


Fig. 6—Capacity per trunk for various selector loads with the old and new arrangements

curves in Figure 2. The curves above 10 trunk represent the capacity per trunk of three series of the new graded arrangements, namely 40, 80, and 160 selectors on the indicated numbers of trunks. The higher capacity in ccs per trunk with fewer numbers of selectors is due to another probability factor called the "limited source effect" which reveals that as the number of selectors becomes more nearly that of the number of trunks, the capacity per trunk becomes higher. Equivalent arrangements with higher numbers of trunks are actually more efficient, however. Eighty selectors on 15 trunks, for example, will permit 16.9 ccs per trunk whereas 160 selectors on 29 and 31 trunks will permit 17.6 and 17.7 ccs per trunk respectively; similarly, 40 selectors on 16 trunks will permit 18.9 ccs per trunk, and 80 selectors on 31 and 33 trunks, 19.4 and 19.6, respectively.

The curves in Figure 6, however, give a better picture of the actual increases obtained in practice. These curves show the approximate average capacity of the old and new graded arrangements in ccs per trunk plotted against ccs per selector delivered to the subgroups. It is this latter figure that is used in practice in determining the particular grades to use, and the curves, therefore, indicate approximately the increased efficiency in the range from 1 to 12 ccs per selector. On the basis of an annual production of 450,000 lines, it has been estimated that with the new graded arrangements, some 8,000 fewer selectors would be required. With the associated shelves and banks, this would represent a saving in installed cost of about $400,000.

The wider range of graded subgroups is also of importance in handling periodic rearrangements of trunks to care for changes in load to the various selector levels. If the traffic to a particular level increases, for example, it is necessary to provide more trunks. With the previous graded arrangements, it was frequently necessary, because of the limited number of standard forms available, to rearrange the multipling at the DTA to provide fewer selector divisions for each subgroup, and then to install additional subgroups of selectors and trunks. With the new arrangements, there is a greatly increased number of standard forms, and thus it will nearly always be possible to keep the same number of selectors per subgroup, and merely change the number of trunks to provide for changes in traffic.

Furthermore, improved cross-connection plans are now employed for the cross-connection of the graded multiple subgroups of

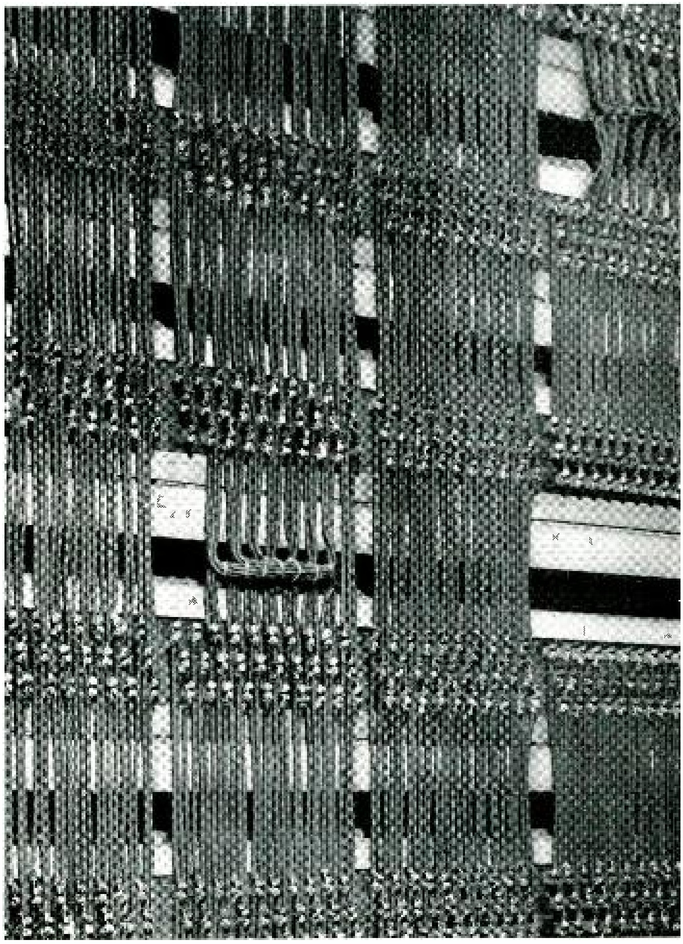


Fig. 7—Close-up of DTA frame showing a twelve-trunk graded group near the center

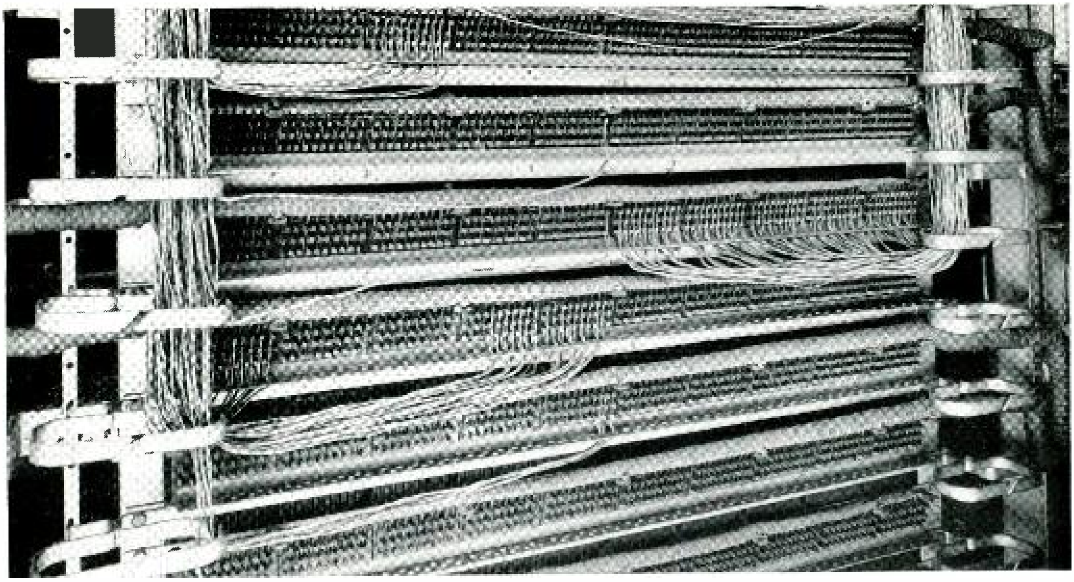


Fig. 8—Rear view of DTA frame showing cable forms coming from the selector banks and the jumper cross-connections going to the terminal strips for the trunks to succeeding circuits

trunks to the succeeding selectors in the train, and these result in far greater similarity in the order of cross-connecting the trunks of different sized subgroups. The amount of recross-connecting required in changing the number of trunks per subgroup is thus greatly reduced. Trunking rearrangements that previously required changing from 50 to 80 per cent of the cross-connections, and sometimes extensive strapping changes as well, can now be made by changing only from 5 to 40 per cent of the cross-connections and with very few strapping changes.

A part of a selector frame of 320 selectors, with its distributing terminal assembly bay in the center, is shown in the photograph at the head of this article. The horizontal rows of terminals are the bank terminal strips on which the bank multiples of 100 terminals from each of the 32 selector divisions are terminated. Two of the selector divisions are unequipped, resulting in the blank spaces seen in the DTA. Figure 7 shows a close-up of the front of the bank terminal strips and the vertical strap wiring used to multiple the divisions together on each level. The reversal forms between some of the divisions are clearly visible. Each section of the terminal strips, consisting of ten sets of three terminals, represents the ten bank terminals of one level from each division. Each complete terminal strip has ten such sections—one for each of the ten levels. The three terminals T, R, and S of each circuit are staggered so that vertical strapping connects like terminals of adjacent divisions

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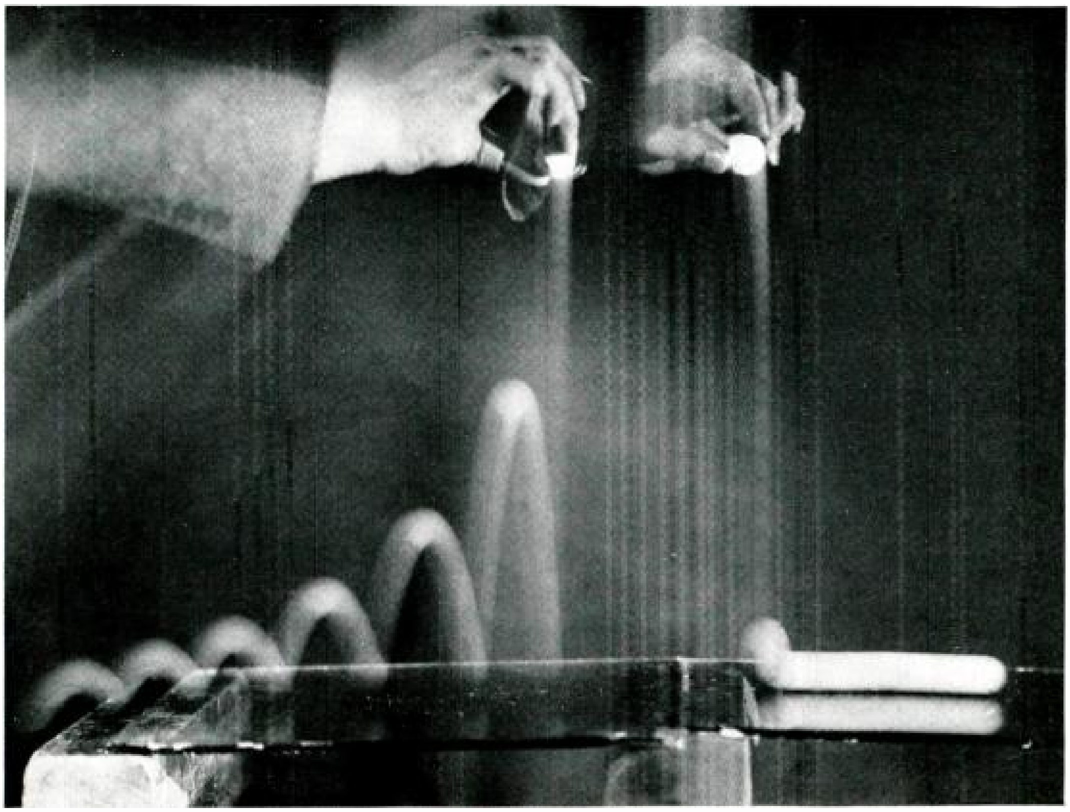
THE AUTHOR: G. E. DUSTIN graduated from Iowa State College in 1918 with the degree of B.S. in E.E. After a year of service in World War I, he joined the American Telephone and Telegraph Company, and shortly thereafter set up and operated in a number of cities the original service-observing equipment for step-by-step dial offices. Subsequently, he was associated with the development of step-by-step circuits and equipment in the Department of Development and Research. He continued this work after the D & R was transferred to the Laboratories. Since then, his work has included the study of trunking problems for crossbar as well as step-by-step systems.

together. At the center of the picture may be seen a graded multiple subgroup of twelve trunks consisting of four individual first and second choice trunks, seven common trunks multipled with a reversal, and the tenth choice common trunk multiple straight.

Figure 8 pictures the rear of the DTA showing the jumper cross-connections that connect the trunks at the bank terminal strips with outgoing terminal strips—shown at the sides of the DTA in the photograph at the head of this article—to which cables to the succeeding selectors are terminated. The taped forms coming in from the banks and then fanning out to the bank terminal strips are also clearly visible.



BUTYL RUBBER AS AN ABSORBER OF VIBRATION

When a rubber ball is dropped on something hard, it bounces. True or false? True, if it is natural rubber, or Buna-S; false, as the right-hand picture shows, if it is of butyl rubber. There is very little rebound when the atomic groups within the molecules convert most of the kinetic energy of the falling ball into heat. If this kinetic energy is stored temporarily as potential energy by the atoms when the ball deforms on striking the table, it is reconverted into energy of motion on the rebound. The unusual property of butyl rubber, demonstrated here, makes this synthetic effective as an absorber of vibration.

J. W. Mullen, II, adjusts the current of an electromagnet that operates the plunger of this automatic stirrer

Automatic Stirrer for Viscous Liquids

An automatic stirrer developed by the Laboratories for the preparation of solutions of highly viscous organic compounds is being used in the study of synthetic rubber. The material to be stirred—sample and solvent—is sealed into a glass test tube, thus avoiding evaporation and contact with the air. In the tube is a cylindrical steel plunger. The tube is raised and lowered by a motor-driven crank while the steel plunger is held in a fixed position by an electromagnetic field. The viscous mixture is therefore forced back and forth past the plunger. The tube passes through the center of the electromagnet as shown in the accompanying picture. One of the test tubes with its plunger is to be seen lying on the laboratory bench. The current of the magnet comes from the rectifier on the left.

New High-Speed Teletype Service Offered on Experimental Basis

High-speed private line teletypewriter service has been offered by the Long Lines Department of the A T & T on an experimental basis. The new system will be capable of handling 100 words a minute rather than the previous top speed of 75 words a minute. This service will be furnished between two points only, and not on a network basis.

It is expected that this development, which makes possible the transmission of information more than 30 per cent faster than before, will prove especially useful to industrial concerns occupied with war work. Only companies which can justify their need of this high-speed service to the War Production Board will be provided with the necessary equipment at this time.

While the service was being tested lately between New York and Atlanta, several unusual maintenance problems were encountered. Because of the excessive speed of transmission, it was necessary to devise new lubricating and ventilating systems so that the equipment would not heat up. In addition, the Laboratories and the Teletype Corp. made some modifications in the standard teletypewriter to enable it to operate at the higher rate of speed. Under the new arrangement, it is hoped that in many cases one teletypewriter machine of the faster type can ultimately do the work that two of the slower speed machines have been doing.

The minimum contract with customers will be for one month, with service six or seven days a week, eight hours per day. The new equipment includes page teletypewriters, automatic sending and receiving, keyboard sending and receiving, and machines that receive only. Also available is equipment for automatic transmission—automatic transmitters, typing reperforators and typing reperforators with keyboards.

Those in the Laboratories who contributed importantly to this project were E. F. Watson, S. L. Eppel, B. S. Swezey and M. N. Smalley, all of Telegraph Development.

Retirements

Four members of the Laboratories have recently retired from active service: C. W. Keckler, J. F. Johlfs and Bartholomew Lynch at their own request with Class A pensions and E. J. Sause under the Retirement Age Rule with a Class A pension.

* * * * *

Before coming to the Bell System, Mr. Keckler was with the Dean Electric Com-

C. W. Keckler

E. J. Sause

pany of Elyria, Ohio, for six years, engaged in circuit engineering and the installation of telephone equipment. In 1911 he joined the equipment engineering group of the Engineering Department of the Western Electric Company at Hawthorne and six months later transferred to the Northern Electric Company at Montreal on the same type of work. Since 1914 he has been in the Systems Development Department at West Street in charge of a group concerned with the design of circuits for manual and dial systems.

Mr. Keckler contributed much to the development of the panel-sender tandem, the first installation of which was made at East Thirteenth Street in New York and now used in several of the larger cities. As part of this development, the call announcer system was first put into commercial use. He was also responsible for the development of the timing and zoning features in the panel-dial

J. F. Johlfs

Bartholomew Lynch

system whereby the subscriber is charged automatically in accordance with the area called and the length of time consumed.

* * * * *

From 1894-1918 Mr. Sause was with the firm of W. H. Deghuee, Export Lumber, and then for a year was with the Owen-Magnetic Automotive Company. He joined the Engineering Department of the Western Electric Company in 1918 and, after four years with the order analysis group of the old Model Shop, transferred to the Commercial Relations Department. His first work in this department was on cost analysis and later he was with the estimating group. For the last ten years he has been responsible for cost appraisal of all Laboratory plant equipment. During the war he has been concerned with cost estimates on newly developed vacuum tubes and with many of the largest development and model production projects.

* * * * *

Mr. Johlfs joined the Engineering Department of the Western Electric Company in 1918. Previous to this he had worked in oil refineries from 1894 to 1902, in coastwise and foreign shipping from 1902 to 1911, and in miscellaneous work from 1911 to 1918. At West Street, Mr. Johlfs spent the first four years maintaining and servicing storage batteries and later became engaged in laboratory and other service work in the Research Department. Subsequently, he was put in charge of the third floor chemical stockroom which was shifted to the General Service Department in 1939. When this stockroom was moved to Murray Hill, Mr. Johlfs was transferred to that location. He remained in charge of the chemical stockroom until he retired in order to move his residence to Florida.

* * * * *

Mr. Lynch came to the Engineering Department of the Western Electric Company in 1919 as a watchman and later became a storekeeper in the Development Shop. In 1930 he transferred to the power operating group where he was assigned to control access to the high-voltage vacuum tube laboratory at the time this was located in Section G of the West Street building. Mr. Lynch's interest in the operation of high-voltage vacuum tube testing apparatus soon led to the position of power service operator and he was assigned to operate and maintain the high voltage equipment. When this laboratory was relocated and expanded in Building "T," Mr. Lynch was assigned there as one of our most experienced power service operators. For the year preceding his retirement, Mr. Lynch has been absent due to sickness.

Bell Telephone Laboratories

TECHNICAL EMPLOYMENT DEPARTMENT

April 23rd, 1942 — July 31st, 1944

Because of his efficient and friendly contributions in the procurement of technical manpower for development and research on war projects, his many friends in the Laboratories welcome this opportunity to join in wishing

O.W. PRASUHN

continued success in his new responsibilities in personnel work with

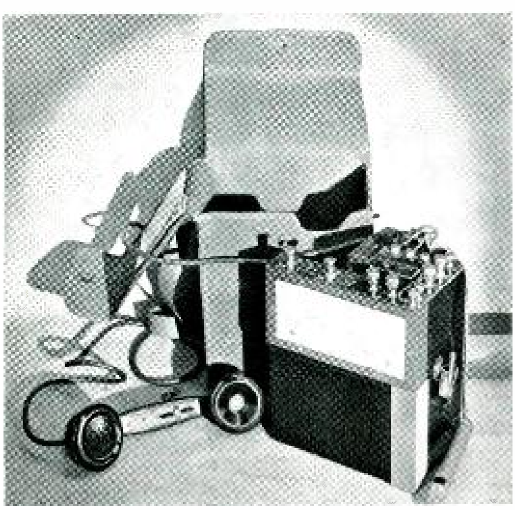
THE OHIO BELL TELEPHONE COMPANY

for which he has been recalled by them.

When O. W. Prasuhn returned to Ohio Bell, from which he had been temporarily transferred to the Laboratories, his associates in Personnel presented him this certificate

EE-105 Telephone

To permit a telephone lineman to talk from any point along a line to an adjacent terminal or repeater station without interfering with carrier channels, the EE-105 telephone was designed. It permits him also to listen for an idle circuit on wires equipped with telephone repeaters without upsetting the repeater balance. This new telephone set is an adaptation of the EE-8 telephone set in general use by the Signal Corps. A filter has been added that passes the voice frequencies to the telephone set and shuts out the carrier frequencies. Keys have also been added to permit the bridged impedance to be adjusted to its optimum value, and to provide other adjustments.



Telephone Center Dedicated at Halloran

The new telephone center at Halloran Hospital in Staten Island has recently been dedicated. The center has facilities for reading, writing, and a comfortable lounge where the men can relax while awaiting completion of their calls. With twenty telephones in booths, sixteen served by the five-position attended switchboard, and four equipped as coin-telephones for local calls, the best possible service is provided for the wounded Army men there.

T. J. Arkinson, 1893-1944

Thomas J. Arkinson, a member of the Technical Staff in the Equipment Development Department, died suddenly on August 2. Mr. Arkinson attended Ohio University for three years and then worked for three years for the Interborough Rapid Transit Company. In 1920 he joined the Engineering Department of the New York Telephone Company and during the next twenty-two years he was concerned with power engineering and maintenance procedures, first in Manhattan, then in the Bronx-Westchester area and finally in the Long Island area. In 1942 Mr. Arkinson transferred to the Laboratories where, as a member of the power group, he had since been engaged in the development of fractional horsepower motors for radio and radar equipment.

Telephone Service During the Circus Fire

Hartford's step-by-step dial system experienced unprecedented loads at the time of the circus fire but it met the test and no emergency measures for control of traffic became necessary. A little more than an hour after the first fingers of fire had reached up the side of the big tent, the central office battery discharge, normally 650, was 1150. Emergency Diesel engines, on test that afternoon, were continued in service to augment the regular power.

Installers were dispatched to the city's hospitals to add lines, and traffic's PBX instructors and commercial people aided the regular operators at these boards to handle the tremendous traffic. PBX repairmen were stationed at these boards as well as at police headquarters and at emergency installations to guard against any breakdown in the equipment. Back in the central office plant men watched for alarms and call blocks in the dial equipment. Two traffic overflow desks were wired and held for relief of any PBX unequal to its load.

At the state armory, selected by the authorities as a temporary morgue, a battery of 15 telephones was hastily installed to serve as an information bureau. Manned by girls from the telephone business office, an estimated 10,000 calls were handled in 12 hours. Additional trunks were installed at two locations for the Red Cross and at a public school where the hundreds of lost children were held until called for.

In all, a total of 47 emergency local circuits were installed. As news of the fire spread, incoming toll traffic reached new peaks. Southern New England and Long Lines engineers established additional emergency toll circuits to New Haven, New York, Boston and other centers, a total of 30 finally being pressed into service. Because of the thousands of people involved there was little let-up in telephone traffic all night. Not until almost noon the next day did the volume of traffic assume any semblance of normality. Traffic was the greatest ever handled by The Southern New England Telephone Company's biggest office — greater even than any 24-hour load during the disastrous flood of 1936 or the hurricane.

Explosion-proof telephone used in the communications system of a TNT plant

In Our Nation's Service

Awarded the Purple Heart

ANDREW F. BARTINELLI and RAYMOND P. CHAPMAN both have received the award of the Purple Heart as a result of wounds suffered in action in Italy. According to word received from their families, they are convalescing and expect to rejoin their outfits.

Receives Air Medal

LIEUT. HERMAN E. MANKE, for meritorious service in the New Guinea area, has been awarded the Air Medal and has been promoted to the rank of First Lieutenant.

Major William J. Flavin

Corona Flier Leads Unit in Fight in France is the title of an article on Major William J. Flavin in the August 1 edition of the *Long Island Star-Journal.* "Flying dawn-to-dusk missions in his P-47 Thunderbolt fighter in support of the Allied ground assault troops advancing in occupied France is Major William J. Flavin of Corona, squadron leader of a 9th Air Force fighter group. 'Our troops are doing a great job and we are giving them every assistance possible,' grins this 25-year-old son of John B. Flavin of Corona.

"Major Flavin has more than 60 missions to his credit and flies with a crack P-47 Thunderbolt dive-bombing group, 'Morgan's Maulers.' This group was one of the first to carry 1,000-pound wing bombs and engage in blasting marshalling yards, airfields and other objectives in occupied France, Belgium and Holland.

"Taking off from a rain-soaked field before dawn on the second day of the invasion, Major Flavin and his squadron of eager 9th Air Force pilots escorted troop-carrying C-47 transports towing gliders full of paratroopers onto the Cherbourg peninsula. 'It was a thrilling sight to see gliders circling and landing. There were men rushing into action with tommy guns in the face of big German guns,' Major Flavin explained. 'I'll never forget that sight of the beachheads lined with landing boats unloading tanks and trucks. Behind them in the channel, warships shelled German fortifications and hundreds of fighter planes flew overhead providing top cover.'

"On April 14 Major Flavin's group completed the longest dive-bombing mission into France. They surprised 50 German aircraft on the ground, destroying at least 20 and wrecked the airfield without loss to themselves. Major Flavin's group established another record later by attacking the municipal airport at Bremen, to complete the longest dive-bombing mission ever flown from Great Britain. The following day Lieutenant General Spaatz, commanding officer of the United States Strategic Air Forces, sent a congratulatory message to the 9th Air Force personnel on the execution of their longest mission."

MAJOR WILLIAM J. FLAVIN

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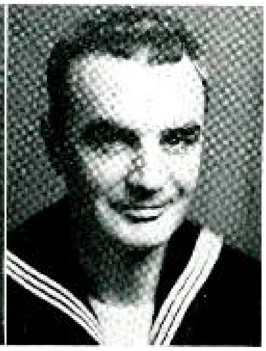


J. D. Cuyler
Tucson, Arizona

W. J. Gallagher
Ames, Iowa

George W. Galbavy

"The article on *Field-Laboratory Tests of Alloy Cable Sheath* by F. B. Livingston in the June issue of the Record was greatly appreciated. Most of the cable installations in New Guinea going out of the central office are of the aerial type. The trouble that is encountered is a research worker's paradise! We have even arrived at the conclusion that these pesky Gremlins are doing their bit in creating trouble."

Lieut. John H. Pennstrom

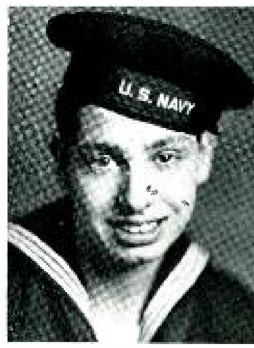
"It's going on years since I last walked through the halls of 463, but I can't very well forget those halls as long as the Record keeps coming in. I've recently transferred to an Army Airways Communications Systems Group. We are the fellows who set up and operate all the radio equipment throughout the many Pacific Islands en route to Tokyo. I'm still flying, and there isn't an island nor atoll now in American hands that we haven't landed on and put in our installations while the fighting was still hot."

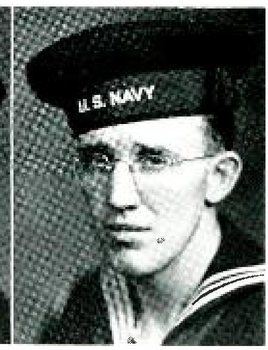
Lt. C. H. Will
Brooklyn Navy Yard

Ens. J. P. Manning
Deland, Fla.

John J. Turley

"Things are not bad here now as everything is beginning to settle down. Of course, every once in a while it looks like a gigantic Fourth of July celebration but what else can one expect. However, I sure hope it won't be long before this is over as I can hardly wait to see good old New York again. From the stories told by men in the last war I thought the French were all glamour gals. Boy, was I surprised! I'll take the States every time."





Arnold Wander
Navy Yard, S. C.

M. F. Coffey
Key West, Fla.

Leaves of Absence

As of July 31, there had been 879 military leaves of absence granted to members of the Laboratories. Of these, 34 leaves have been completed. The 845 active leaves were divided as follows:

Army 497 Navy 257 Marines 29

Women's Services 62

There were also 16 members on merchant marine leaves and 29 members on personal leaves for war work.

Recent Leaves

United States Army

Carl W. Bachmann	Ernest T. Lundgren
Margaret M. Devlin	John J. Mosko

United States Navy

Ensign Carl G. Braun	Ens. C. A. McJohnston
Michael F. Devlin	Jean R. Nally
Virginie A. Doulberry	Edmund H. Parsons, Jr.
Charles A. Liscum	Ens. R. L. Valentine*

Gottfried O. Voigt

*Formerly in Merchant Marine

Warren Wheeler

Warren Wheeler writes from North Africa: "Quite to my surprise I found conditions here not unbearable. The beds could be more comfortable, and food more varied, but who's to complain? The Red Cross conducts tea dances, bringing in French girls to dance with. A soldier preparing for the occasion removes all pens, pencils, rings, identification bracelets, for these are all rich prizes to the French girls. I have heard many a G.I. sigh for just one American girl—almost any one!"

Military News

Personal leaves of absence have been granted to E. J. May to enter the Army Specialized Training Program and to J. H. Mulligan, Jr., to work for the Naval Research Laboratories in a civilian capacity.

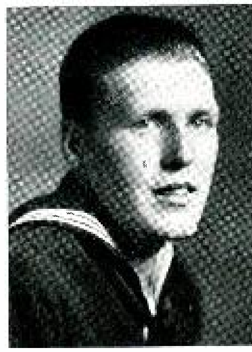
William J. Thoele writes: "Since I last wrote I have added another country to my rapidly increasing number. I am now somewhere in France. The weather has been exceptionally good over here which makes life a little more pleasant. Please give my best regards to all my friends at the Labs."

Lt. G. E. Davis
Foster Field, Texas

Lt. R. L. Norton
Coffeeville, Kansas

Charles W. Muccio, with an Infantry company, writes: "Am now somewhere in France and in good health. Have had an opportunity to taste good old French cider which tastes almost like wine. Have also picked up a little of the French language which I get a kick out of using. Keep up the good work back there because the boys over here won't let you down."

Lieut. Charles H. Will of the Navy completed his indoctrination course at Princeton and is now stationed at the Brooklyn Navy Yard for special training.



G. C. Barry
Newport, R. I.

J. F. Picard
So. Portland, Me.

Jack Picard spent most of his eighteen months out of the States off the coast of Newfoundland on Coast Guard Patrol.

James D. Cuyler is in training at the Davis-Monthan Field, in Tucson, Arizona, with a bomb and gunnery squadron.

Robert Burns visited the Laboratories recently while on furlough from the Deridder Army Air Base in Louisiana, where he is attached to a Communications Squadron.

Major Allen L. Whitman, after three months at USASOS HQ in Australia, is back in New Guinea. "My work has to do with Signal Supply and leads into many and varied aspects of the game. I unexpectedly found Wallace C. Babcock in an Australian office and got late news of friends at the Labs. Tent life on the beach, with a swim right at the door and cool ocean breezes, seems very luxurious for the field."

"I am working on submarines once more and expect to go back to sea again on one

J. P. Mahoney
Fort Belvoir, Va.

W. C. Rouse
New York, N. Y.

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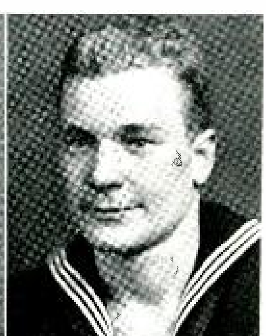
Charles J. Kuhn, Jr., with some of his "Fiji Island Buddies"

soon," writes Robert W. Tomb from a San Francisco Post Office address.

Warren Goldstein is working in the machine shop at a U. S. Naval Torpedo Testing Range in Montauk, L. I.

Leon Goldfelder writes: "I am now stationed at Lincoln, Nebraska, where I am studying the latest instrument flying aids and techniques, and how to teach them to pilots. Before entering the ASTP, I was an instrument trainer instructor at the Pocatello Army Air Base in Idaho. There my duties were to teach pilots instrument flying on the Link Trainer, and my next assignment will be along the same lines."

G. J. McArdle
Camp Rucker, Ala.



H. J. Rohr
Detroit, Mich.

Joseph Mazzi was here recently while on furlough after completing his "boot training" at the U. S. Naval Training Station at Sampson, N. Y.

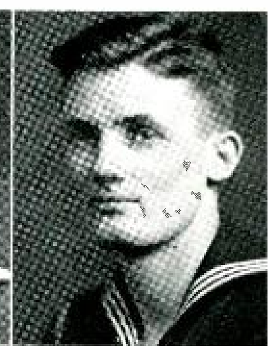
Joseph J. Rosato has been transferred to Camp Swift, Texas. "I have been getting the Record regularly and so have kept in touch with the boys in the service. I'm looking forward to that day when I can again take an active part in the work of the Laboratories."

Daniel Brady is with an Infantry company somewhere in France.

Aviation Cadet James M. Hoagland is taking pre-flight training at Maxwell Field, Alabama, in preparation for further training in air navigation.

Carmen D'Amico is now stationed at Oceanside, California; Honora Ferris is taking a course in Aviation Machinist Mate School at Norman, Oklahoma; Robert L. Pritchard of the Navy is studying electrical engineering at Brown University; A. F. Schweizer is taking primary flight training at Thunderbird Field in Arizona; Eugene J. Breiding and Clifford E. Underhill are both stationed at the Great Lakes Naval Training Center.

J. C. Stuhlman
Atlantic



W. J. Nicholl
Rochester, N. Y.

John M. Reuter writes: "It is a pleasure to get a first-hand view of the Navy's smooth steamrollering of the Pacific. Naturally communications plays a large part in this, and I can say with pride that BTL developed material holds a high percentage in the equipment I've seen."

Harold Raimert is in officers' training at Cornell University; Thomas E. Bailey is in the V-12 Unit at Yale University.

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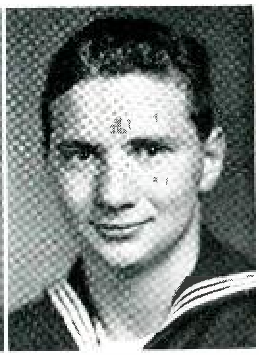
Sgt. Harry Verges visited the Laboratories while on a recent furlough from Camp Ellis, Illinois.

Edward W. Karpen is stationed at Camp Davis, North Carolina, where he expects to be assigned to a Signal * * * Maintenance Unit. While at Camp Murphy he met



C. J. D'Arcy
Sampson, N. Y.

Joseph Mazzi
Sampson, N. Y.

Gustav Backman, Hans Menzel, and William Brossok, all of the Laboratories.

Cornelius D'Arcy visited the Laboratories on a recent leave from Sampson, N. Y. He expects to go to Hospital School for training as a Medical Corpsman.

Walter Farnham, while attending gunnery school on the Hawaiian Islands, finds time to enjoy the sights of the island, and especially the swimming at Waikiki Beach.

Ensign Frank W. Lindberg is on duty in the Pacific; John W. Hoell is stationed at Corpus Christi, Texas, where "the towns are smaller, the buildings lower, and the Texans taller than anywhere else"; William Brander is in the Instrument Repair School at Aberdeen, Maryland; and Vincent Decker is at Sampson, New York.

Robert W. Blaschke, who had been stationed in North Ireland and England, now finds his new job as Electrician's Mate on a minesweeper interesting as well as nerve-wracking.

Victor Silzer is * * * Instructor, teaching Airborne Equipment at Boca Ratan Field, Florida.

Gordon B. Taylor, in the U. S. Submarine Service, has been promoted to the rank of EM 2/c. He has been on active duty in the Pacific for over a year.

Domenick Maccia of the Navy, stationed

H. H. Hoffman
Robins Field, Ga.

F. J. Osolinik
Robins Field, Ga.

at Bainbridge, Maryland, expects to be sent to Aviation Radio School to take radio, gunnery, and preliminary flight training.

Joseph Hill has completed boot training at the Great Lakes Naval Training Station and is now attending the Naval Pre-Radio School in Chicago.

Monroe W. Dring and Edward A. Hake are both stationed at the Great Lakes Naval Training Center.

Fred H. Engelman is stationed at Napier Field in Alabama awaiting assignment to pre-flight training.

Sgt. Morgan F. Hickey is with the Air Force in England. "We had a big day here at our bomber base in May when we had our Hundredth Mission Festival"

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J. A. Lasco
Aberdeen, Md.

C. G. Petersen
Camp Reynolds, Pa.

Sgt. John A. Lasco, with the Ordnance Department of the Army, was back at West Street to visit recently after completing ten months of temporary overseas duty. New Caledonia, Guadalcanal and Tulagi are among the places where he was sent. The group he was with was responsible for taking special equipment, including the M-9 Electrical Gun Director developed by the Laboratories, to these places and instructing Army personnel in its installation, operation, and maintenance. His duty there completed, he is now stationed at the Aberdeen Proving Ground, Maryland.

Capt. LeRoy G. Rainhart, who is stationed at Camp Carson, Colo., where he is in charge of an Engineer Maintenance Company, visited the Laboratories recently.

Upon completion of a three-month liaison mission in England, Lieut. Col. Malcolm A. Specht visited the Laboratories during a leave. He is now with the Field Artillery at Camp Hood, Texas.


C. J. Keyser
Ft. Monmouth, N. J.

Irving Bernstein
Camp Gruber, Okla.


Capt. L. G. Rainhart
Camp Carson, Colo.

Lt. Col. M. A. Specht
Camp Hood, Texas

Walter Burkart is a Radioman in the Navy, stationed at Jacksonville, Florida, where he has been for the past six months.

William F. Blazure has been in the U. S. Naval Hospital at Bainbridge, Maryland.

Ensign John F. Martin has received his commission in the Naval Air Corps and is now at an operational base flying F6F's.

Robert Komuves is stationed at Fort Monmouth; Thomas J. Walsh is taking boot training at Sampson, N. Y.


R. S. Troeller
Ft. Meade, Md.

Maj. F. A. Minks
Ft. Monmouth, N. J.

Howard W. Creuziger sends "Greetings from the Spam-happy E.T.O.! I've been in Scotland and England. I've seen castles and some very interesting landscape. But, after several months over here, I'm still not used to powdered eggs and milk."

Major L. W. Stammerjohn with the Air Force overseas says: "I see a lot of Western equipment of many types. It is really good to read those name plates. That equipment is tops and plenty of important things are being done with it. We manage to keep very busy here, and all of it is most interesting and gratifying work."

Aviation Cadet Harold Jaffe is in an advanced flying school at Eagle Pass, Texas; George E. Linehan has been assigned to work in the Pentagon Building in Washington.

Lieut. Alfred O. Schmitz visited the Laboratories during his first leave in fifteen months. He had just received his Air Corps "wings" and was awaiting further orders.

J. F. Schneider, who has been with the Quartermaster Corps since last October, recently visited friends at Murray Hill and West Street. He now expects to report to Camp Reynolds in Pennsylvania.

J. F. Schneider
Camp Reynolds, Pa.

Lt. A. O. Schmitz
Maxwell Field, Ala.

Lieut. Frank R. Hully visited the Laboratories recently after receiving his commission in the Air Force at Selman Field, Louisiana. He expects to be stationed in Lincoln, Nebraska.

Lieut. Richard J. Comer stopped at West Street during his leave. He won his "wings" June 27 at the Army Air Base in Blytheville, Arkansas, where he will return to await further assignment.

Lt. R. J. Comer
Blytheville, Ark.

Capt. J. E. Zendt
Bradley Beach, N. J.

Captain James E. Zendt stopped at West Street recently while en route from Camp Murphy, Florida, to Bradley Beach, New Jersey. On his new assignment he will be engaged in personnel work in the Signal Corps Ground Signal Agency. At Camp Murphy he was Assistant Director of the Personnel Division.

Ensign Russel Valentine of the Navy is temporarily stationed in New York awaiting assignment. Ensign Valentine had been in the Merchant Marine. While in that service he made several trips to England, Italy and Africa, and in March, 1943, his ship was torpedoed off Casablanca.

Lieut. Walter E. Gilson of the Merchant Marine visited West Street after having just returned from England. He left that country the day before "D Day," and hopes next time he'll be going on to France.

Ens. A. L. Vabulas
Daytona Beach, Fla.

Lt. F. R. Hully
Lincoln, Nebr.

Ens. R. L. Valentine
Atlantic

Lt. W. E. Gilson
Atlantic

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J. A. Joyce
Cochran Field, Ga.

D. J. Spicciati
Navy Seabees

Edward L. Fischer writes: "I am working in a Signal Center in one of Australia's large cities. Life here is similar to that in the States with a few minor changes. The Red Cross here takes the place of the U.S.O. and Service Clubs, and it is doing a wonderful job. Best of luck to Bob Lynch, wherever he may be."

Robert F. Flinn is now overseas, in the Pacific theater. Peder M. Ness is at Fire Control School in Newport, Rhode Island.

James M. Cullen is "still in New Guinea but at another base. There is a great deal of Jap radio equipment around, but all tubes are broken—can't seem to get enough parts for a whole set."

D. J. Spicciati, who is a Chief Petty Officer in the U. S. Navy Seabees, was a recent visitor of the Laboratories.

Lieut. William Wiegmann, a recent visitor at West Street, has received his commission in the Air Forces and has been transferred to a Replacement Training Unit in Lincoln, Nebraska.


D. W. Graham
Ft. Monmouth, N. J.

Lt. Wm. Wiegmann
Lincoln, Nebr.

Lieut. Colonel A. J. Engelberg has been named the new chief of the San Bernardino (California) Air Service Command signal section.

L. Munch of the Navy is on active duty somewhere in the Pacific. R. J. Nielson stopped at West Street while on furlough from Fort Benning, Georgia.

Warrant Officer Joseph F. Daly, returned from the South Pacific, recently visited the Laboratories. He will be stationed in Atlantic City for two weeks where he will await further assignment; Richard E. Strebel visited West Street while on a recent leave. He expects to be sent to Chicago for Radio Technician training.


Lt. Col. Engelberg
San Bernardino, Calif.

L. D. Munch
Pacific

Donald E. Blesse is in an aviation electrician's mate school in Jacksonville, Florida, attending technical classes and working on naval aircraft; Ensign Harry A. Bennett is stationed in Yorktown, Virginia, where he has come in contact with some of the * * * equipment he worked on at the Laboratories before entering the Navy.

James H. Riley is going to school at Hoffman Island, N. Y., and upon completing his course there he expects to become a Radio Officer aboard a merchant ship.

Ensign Harold C. Bell transferred from Pensacola to the Naval Air Station at Banana River, Florida. Thomas Slattery is now somewhere in France.

Other members who have written:

J. D. Ontka, Henry Algarin, C. W. Peterson, W. V. Hoshowsky, R. E. Henneberg, Elena R. Tighe, W. J. Schneider, P. M. Crouch, C. T. Bolger, W. J. Boo, Grace M. Connor, Arthur Henricks, Margaret Kenny, A. B. Watrous, M. E. Poulsen, B. E. Brown.

News Notes

The Western Electric Company recently leased the Lane Bryant Building, 529 West 42nd Street, New York City, for the manufacture of electronic equipment for the Armed Forces. It is estimated that approximately 2,000 people will be employed when full production is reached in the late fall or the first part of 1945. The new plant, six-storied and built of brick and reinforced concrete, is situated between Tenth and Eleventh Avenues and extends through to 43rd Street. The total floor space amounts to about 196,000 square feet.

M. D. Rigterink visited the Stupokoff Ceramic Manufacturing Company in Latrobe, Pa., to discuss the production of special ceramics.

W. L. Bond was at the Clifton plant of the Western Electric Company in connection with crystal processing.

T. G. Kinsley and H. J. McSkimin visited Hawthorne on matters pertaining to their work on crystal test sets.

C. J. Frosch, at Dayton, discussed development of adhesives and, at the Virginia Lincoln Corporation, plastics problems.

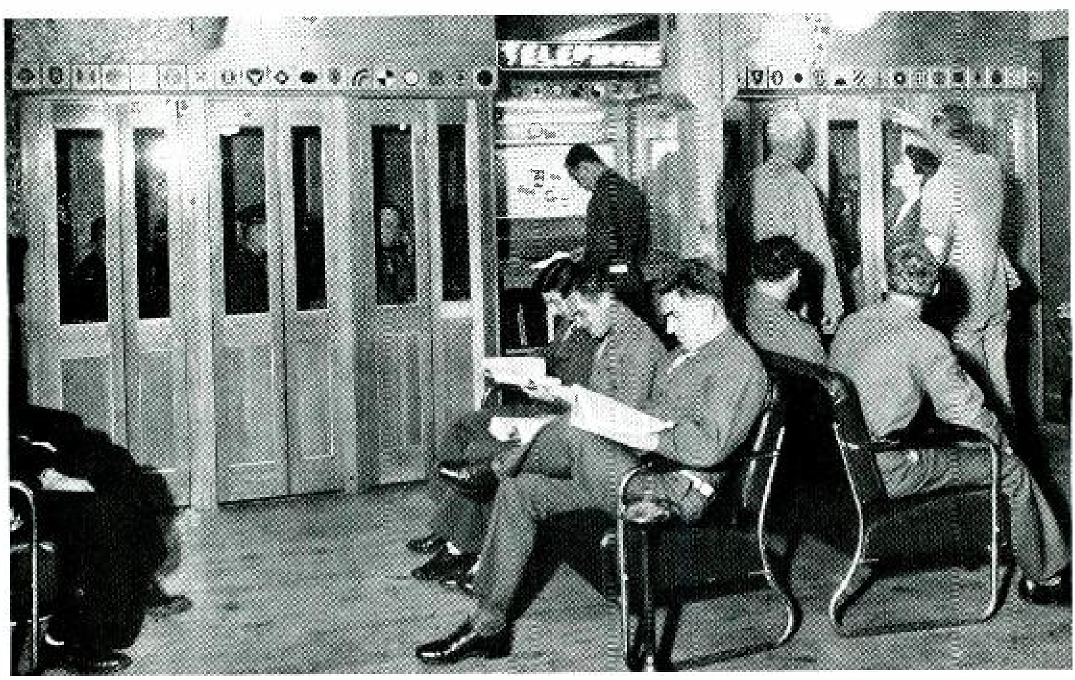
R. W. Walker went to several synthetic rubber plants in Akron to discuss special methods of tests.

Noise Figures of Radio Receivers, an article by H. T. Friis, was published in the July issue of the *Proceedings of the I.R.E.*

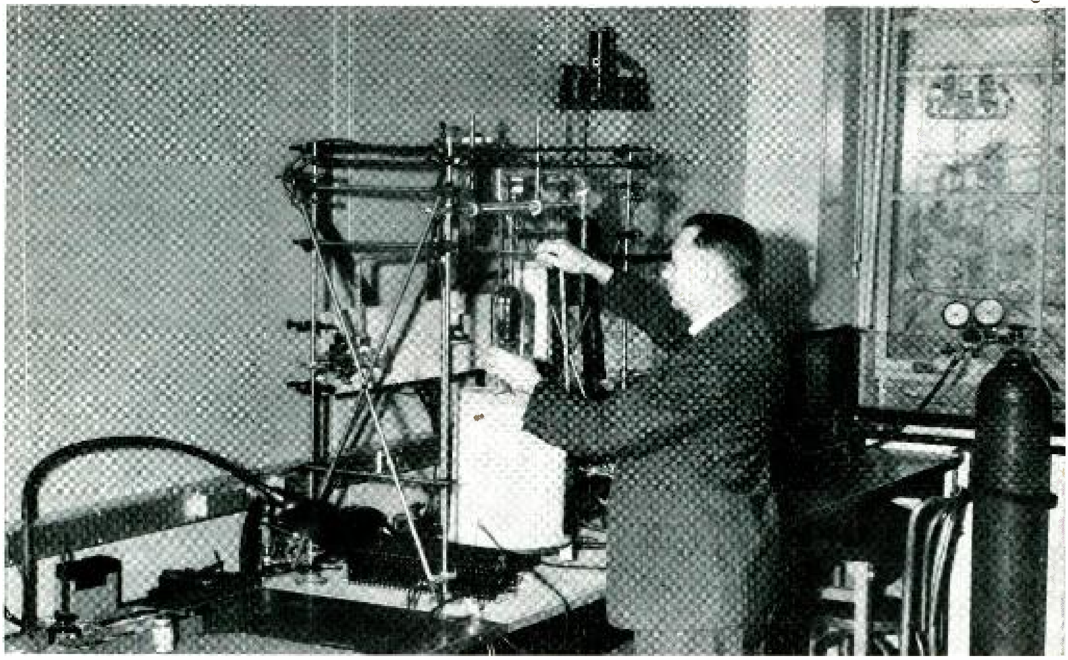
A. E. Johanson of the Radio Research Department has received the B.E.E. degree from New York University.

J. H. Bower, at Cleveland on battery problems, visited the Willard Storage Battery Company and the National Carbon Company there.

H. H. Glenn and H. H. Staebner discussed cord development problems with engineers of the Western Electric Company at Point Breeze.



Soldiers at Fort Story, Virginia, enjoy using the unattended public telephones in their Service Club. The decorations—Army insignia in colors—have stimulated much favorable comment



Pumping apparatus used in studying the physical properties of thin films. H. G. Wehe is carrying on the investigation

W. J. King has recently returned from the Hawthorne plant of the Western Electric Company where he spent some time in connection with high-voltage cables and connectors.

C. A. Webber discussed high-voltage cables with engineers of the American Steel and Wire Company, Worcester, and of the Simplex Wire and Cable Company in Boston. On another trip, he went to Hawthorne on general wire and cable problems.

W. R. Lundry, at Minneapolis, Eau Claire and Stevens Point, installed and tested equalizers on the coaxial cable system.

R. T. Staples discussed various cable problems at the Boston Insulated Wire and Cable Company and at the Nehring Electric Company, Chicago.

August Service Anniversaries of Members of the Laboratories

10 Years

G. F. Clement
E. A. Floystad
J. M. Fraser
C. M. Gaston
W. W. Halbrook
J. H. Hammond
William Keister
W. J. King
H. O. Kramer
Oscar Kummer
W. F. Miller
Margaret Molloy
Ellen Staehler
P. A. Stevens

15 Years

F. J. Bednarek
L. W. Bellevue
Kathryn Black
W. G. Bowie
W. H. Brattain
H. B. Briggs
W. J. Brown
C. J. Christensen
K. G. Compton
F. R. Dennis
E. H. Eveland
H. C. Franke
R. O. Fraser
T. H. Guettich
L. E. Hunt
J. F. Jensen
A. E. Johanson
K. L. King
L. Y. Lacy
P. M. Mackoff
C. R. Martin
J. F. Morrison
J. F. Nuner
G. T. Papineau
J. J. Pauer
L. E. Peterson
Anna Povey
J. J. Reif
W. W. Rindlaub
P. J. Roche
Martin Salzer
T. J. Schmidt
R. L. Shepherd
A. C. Stark
Alice Storey
J. O. Sullivan
C. H. Swannack
T. L. Tanner
A. C. Velie
J. H. Waddell
Ethel Walker
K. B. Walker

20 Years

Edmond Bruce
H. C. Curl
H. B. Fischer
Walter Fontana
L. A. Gardner
E. A. Nesbitt
H. B. Noyes
Charlotte Papillon
R. C. Pfarrer
Molly Radtke
W. H. Sellew
George Thurston

25 Years

Ralph Bown
R. A. Chegwidden
A. M. De Rose
L. W. Drenkard
C. H. G. Gray
Mildred Lammers
F. A. Lindeberg

30 Years

C. R. Englund
L. W. Kelsay
E. F. Watson

35 Years

K. S. Johnson
R. G. Ramsdell
A. R. Swoboda
Charles White

45 Years

J. A. McIntyre

"The Telephone Hour"

(NBC, Monday Nights, 9:00 P.M., Eastern War Time)

SEPTEMBER 4, 1944

The Last Song — *Tosti*
Deh vieni alla finestra from "Don Giovanni" — *Mozart*
Ezio Pinza

Serenade — *Drigo*
Orchestra

Fiocca la Neve — *Cimara*
Ezio Pinza

Symphony No. V in E Minor (from the "New World")—Finale — *Dvorák*
Orchestra

The Lament of Ian the Proud — *Griffes*
Ezio Pinza

SEPTEMBER 11, 1944

À la Kreutzer — *Arranged*
Orchestra

Serenade — *Schubert*
Marian Anderson

Three O'Clock in the Morning — *Robeldo*
Orchestra

By the Waters of Minnetonka — *Lieurance*
Keep Your Hand on the Plow — *Spiritual-arr. Hall Johnson*
Marian Anderson

March from "Le Coq d'Or" — *Rimsky-Korsakoff*
Orchestra

Divinités du Styx from "Alceste" — *Glück*
Marian Anderson

SEPTEMBER 18, 1944

Poupée Valsante — *Poldini*
Orchestra

Clair de Lune — *Debussy*
Perpetual Motion — *Poulenc*
Malagueña — *Lecuona*
Oscar Levant

Cavatina — *Raff*
Orchestra

Concerto in A Minor —First Movement — *Grieg*
Oscar Levant and Orchestra

SEPTEMBER 25, 1944

Lily Pons will be the guest artist

Bell Laboratories Club has no more tickets for these programs because its limited supply has already been distributed to applicants.

W. C. Schmidt tested equipment for data-smoothing networks on a recent trip to Chicago.

J. R. Weeks visited the Tobe Deutschmann Works at Canton, Mass., with representatives of the Western Electric Company to discuss molded condenser problems.

A. D. Hasley was at the M.I.T. Radiation Laboratories at Cambridge on transformer problems.

H. E. Vaiden and F. Berger recently visited the Universal Winding Company, Providence, to discuss automatic coil winding machines.

R. C. Jones was at Point Breeze for several days in connection with the manufacture of coaxial cable.

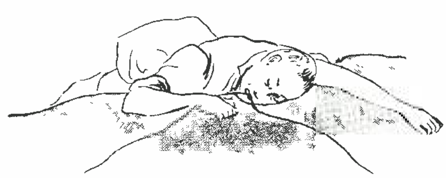
C. H. Amadon observed the treatment of lodgepole pine and western cedar poles in Colorado, Washington and Wyoming.

R. H. Colley attended a meeting of the Executive Committee of the American Wood-Preservers' Association at Cincinnati.

C. Q. Lumsden continued the study of seasoning of creosoted and salt treated southern pine at Forrestville, Conn.

J. V. Elliott of the Apparatus Staff Department recently received his B.M.E. degree from New York University.

K. L. Maurer has been made a member of the Long Island Suburban Alumnus Chapter of Tau Beta Pi, honorary engineering fraternity, "in recognition of distinguished public service." At the time of his initiation on July 12, the following citation was read: "Highly connected with an organization already devoted to war work, you offered your few leisure hours to the



"In one instance during the fighting on Attu, a dead Japanese soldier was found, his body stiff, both hands clutching our wire—with a section of wire still gritted between his teeth. He had stripped off six or more inches of insulation cleanly, shorting out the circuit."

The Enemy Hangs On To The Death. Will YOU Hang Onto Your Bonds?

Your Copy of the RECORD

Please put your RECORD in the "Correspondence-Out" box when you are through with it so that it can be sent to a Serviceman's family.

General Staff, Air Raid Protection, Nassau County War Council. You were assigned to work on the development of a plan for the distribution of air raid warnings and the communication arrangements for report and control centers. You swiftly qualified as Communications Director, and the plans developed and applied under your guidance were simple, completely efficient and inexpensive."

TEST EQUIPMENT for use in the maintenance and operation of radar systems in the field was displayed at an exhibit in the Graybar-Varick building on July 6. While this exhibit was primarily for representatives of the Army and Navy, it was also open to certain of the Laboratories' staff and the Western Electric Company who have an interest in this type of equipment.

B. J. KINSBURG, accompanied by various members of the Long Lines Department, visited the Minneapolis-Stevens Point coaxial system to observe the trial of a manual gain control unit.

L. G. ABRAHAM, accompanied by members of the O & E and Long Lines Departments, visited various terminal and repeater points on the Minneapolis-Stevens Point system in connection with the trial of new equalizers.

J. E. CASSIDY was at the Patent Office in Richmond relative to patent matters.

B. H. JACKSON was in Washington during July relative to interference proceedings.

E. E. SCHUMACHER and D. H. WENNY visited the laboratories of the General Electric Company at Schenectady on July 4 to discuss metallurgical problems. On July 13 Mr. Schumacher inspected the Allegheny Ludlum's Steel Corporation's plant at Brackenridge, Pa., and its strip mill at West Leechburg, Pa.

G. E. BAILEY was in Hawthorne in connection with manufacturing problems on the wood type operators' chairs.

A. F. PETRIE and J. M. DUGUID attended the A.I.E.E. convention in St. Louis.

Transcription Department at Murray Hill. Miss E. Munk, who sits at her desk at the extreme left in the rear, is in charge

Distaff

"Symbolically, the work or activities of women, or woman's authority or domain"—Webster

OUR battles of 1944 are fought far from our door-yards, and by specialized troops. Requiring as much brains as theirs, if less brawn, are the jobs our modern Molly Pitchers do. They are making weapons, not manning them. In their smocks or coveralls, they are drawing or reading blueprints, operating machines, assembling apparatus, and wiring it into complete tools of war. When the thermometer climbed to 95 last month they said, "My Joe can take it, and so will I, to bring him home the sooner."

These four girls at Graybar-Varick—Nellie Smith, Florence Dengler, Eleanor Cherep, and Gilda Minicieli—are wearing safety caps which can be adjusted to cover their hair completely when there is a hazard connected with operating machines

Jean L. Brumm

Jean L. Brumm came to Murray Hill as a messenger in 1943 after graduating from North Plainfield High School and Drake College. She soon became a mimeograph operator, then typist and now she is a stenographer. Jean is the oldest of three sisters. They spend their summer vacations at Lavallette, New Jersey, where Jean enjoys one of her favorite sports, swimming. She has acquired the now convenient habit of bicycle riding and at home she likes to sew.

* * *

When Ruth Varvaro's fiancé, S/Sgt. Leonard W. Olsen, joined the Marines, she decided to leave her position as fashion artist in the children's department at De Pinna's and take a war job. To her preoccupation with fashion seemed to have little reality or necessity in a world of guns and ships and planes.

After taking the Laboratories six-week full-time drafting course Ruth was assigned to the Research Drafting Department. Thereafter she continued her drafting school studies on a part-time program and recently has completed her course.

She was married July 9 when her fiancé returned after two years in the South Pacific. He has received the Presidential Unit Citation for service in the Guadalcanal-Tulagi campaign. Mrs. Olsen lives in Laurelton, Long Island. She is a graduate of Pratt Institute where she studied Textile Design.

* * * * *

A graduate with distinction in Mathematics at Cornell University in 1943 and a member of the Mortar Board, National Women's Honor Society, Mrs. K. R. Randall is making her contribution to the war effort as Technical Assistant at Murray Hill while her husband serves as Lieutenant in the Quartermaster Corps of the Army. Mrs. Randall also excels in athletics. She ranked fifth among the Junior Girls of the Eastern Lawn Tennis Association in 1939. Sewing is another of her interests and she turns this to practical account in the present emergency by making some of her own clothes. Mrs. Randall is the daughter of T. C. Rogers, who was a member of the Laboratories staff at the time of his death last year. She has a brother in the Army.

H. M. Yates discusses a research project with draftsman Ruth Varvaro Olsen

Engagements

*Ens. Frank Lindberg, U. S. Navy—*Effie Ross
*Fred J. Herr—*Ann McGrath
Ralph Rullo, U. S. Army—*Elizabeth Angelo
*Lt. L. G. Fitzsimmons, U. S. Navy—Jane Smith

Weddings

*George Schiehser, U. S. Army—*Margaret Glander
Harry Wrubel—*Anne Schiffman
Leonard W. Olsen, U.S.M.C.—*Ruth Varvaro
Charles McCauley, Jr.—*Evelyn Lencki

*Members of the Laboratories. Notices of engagements and weddings should be given to Miss Mary Ellen Wertz, Room 1103. Extension 296.

HELEN KALINOVSKA

HELEN KALINOVSKA, who is a native New Yorker, took an academic course at Parsons College in Fairfield, Iowa. At the end of her sophomore year she entered the records group of the Personnel Department at West Street where her work for the most part is with the Men's Employment Department. Her duties include stenography and typing, preparing Inventors' Contracts for signature and maintaining records in connection with them, the recording of Bell System service credit information prepared by the Benefit Department, preparing for the Accounting Department rate cards of new members of the Laboratories, and a multitude of other details in the work of the records group.

Despite her heavy working schedule Miss Kalinovska finds time to teach a Sunday School class of Junior boys, write articles and type notes for the church servicemen's newspaper, sing with the choir, and to play volley ball and swim.

* * * * *

MRS. K. R. RANDALL

BEFORE JOINING the Laboratories last September, BETTY ROGERS MORSE had received degrees from Smith and from Mt. Holyoke Colleges and had worked for one year at Harvard toward her Ph.D. in crystallography. Mrs. Morse had also been the crystallographer in a sound laboratory where she set up the orienting department for the manufacture of quartz oscillators and after that trained people to use and calibrate the equipment. Now a member of the Commercial Products Development Department, she is located at the Graybar-Varick building where she has been helping to do research to improve the method of making quartz plates.

In college she had studied composition and voice, and music is today her favorite diversion, as in-

Betty Rogers Morse

dicated by her large collection of symphonic and Gilbert and Sullivan recordings. Reading and Spanish are her other interests.

* * * * *

For two and one-half years Mrs. Eleanor Gaal has been receptionist at the Graybar-Varick building. As her title implies, she receives visitors, secures passes for them, and provides a messenger to escort them to the person they wish to see.

During her high school days she spent much of her spare time doing tap and ballet

Eleanor Gaal

dancing professionally. Besides her job, Eleanor loves sewing, cooking, dancing, and her Indian jewelry which she collected while visiting Mexico this summer. Her husband is a radio operator in the United States Coast Guard somewhere overseas.

Do You Eat an Adequate Breakfast?

Though nutritionists say that breakfast should provide from one-fourth to one-third of daily nutritional requirements, few of 800 wives questioned in a recent survey conducted for the Office of War Information sent their husbands to work with enough food of the right kinds.

According to the Bureau of Human Nutrition, Department of Agriculture, the first meal of the day, which follows the longest interval between meals and which fuels the body for the morning, should consist of fruit or fruit juice, whole grain or restored cereal, eggs, meat or fish, bread, butter or fortified margarine, and a beverage. Most of the 800 women interviewed failed to serve at least one of the elements, generally the fruit or cereal.

The survey showed considerable variation in the foods served for breakfast, and no one combination was reported by more than 9 per cent of the women interviewed. The combination most often reported was meat, eggs, toast and coffee. Such a menu, nutritionists point out, consists largely of protein and lacks Vitamin C supplied by fruit and calcium provided by the milk used on cereal.

Spotted in the News

An Army officer in Newport News, Virginia, vouches for this one: He says he placed a long distance call. The operator said "Thank you, just a minute please." After waiting a moment, the officer was startled to hear a plaintive little voice ask, "Won't you please say 'you're welcome'? All day long I say 'thank you' and no one ever says 'you're welcome!' " He did. . . . Here's what one GI wants to hear if and when he gets a chance to telephone home from the South Pacific: The squeak of the fourth step on the front stairs; the dry crackle of ice cubes coming loose from the tray; the rustle of Betty's taffeta gown and the knock of Pop's pipe against the china closet.

Navy Production Program

Ralph A. Bard, Under Secretary of the Navy, in a letter to the Laboratories dated July 21, sent through the New York Office of Inspector of Naval Material, said: "I feel you are entitled to a frank statement from the Navy as to what your future prospects and obligations are. To put it in one word—it is work, and more work.

"The Navy's production program is still increasing. The last six months of 1944 will show an increase in production of about 10 per cent over the first six months of 1944, and the program for the first six months of 1945 will be about 3 per cent greater than the first six months of 1944. We expect this production program will be carried out, *and it is not expected that the ending of the war in Europe during this period will affect this program.* Our battle of production will end only with the defeat of Japan.

"We therefore call upon all employees, regardless of peace talk and developments in Europe, to stick on their jobs, back up the Navy, and prepare it to pour on the Japanese the cumulative power of our fleet and our production lines so that the fleet will be effective and our soldiers and sailors will have the necessary arms and ammunition to take an instant advantage of the opportunities which will be presented to shorten this war.

"While our overall demand will show little if any material decrease, there will of course be some terminations and, here and there, cutbacks because of the changing war conditions. Based upon the program for the year ahead as we now see it, there should be just as many workers employed on the Navy Production Program a year from now as there are at the present time."

Transit Strike Brings Telephone Problems

Some of the problems which a Bell System operating company must meet came up during the recent suspension of the transportation system in Philadelphia. Plans for its transportation of operators and office workers, made as a part of the telephone company's wartime preparations, functioned smoothly. Telephone trucks and cars were brought in from the surrounding territory, and from as far as New York and Washington. Employees reported at the nearest central office, and were taken to one of three distributing points, whence they were taken to their working place. Several hundred girls on evening duty were housed in nearby hotels; the company bought nightgowns, toothbrushes and powder for those who could not get their own. In one central office, where the chance of rioting kept the girls indoors, motion pictures were brought in by the company's public relations men.

Telephone loads were well in excess of normal and appeals were broadcast by radio to refrain from all but essential calling. The dial system functioned smoothly. Increased long distance traffic was handled promptly, thanks to excellent attendance of operators and the No. 4 toll switching system, currently being described in the RECORD.

HELP! HELP!

for the final push that puts the fall crops of fruit and vegetables into storage and cannery for our winter tables.

MEN are vitally needed for the Hudson Valley apple crop.

WOMEN are vitally needed in Central New York and on Long Island for vegetable crops.

If you haven't taken *your vacation,* call Mrs. C. A. Smith, Ext. 1449, West Street, for full information.

"A Couple of Wires and Some Field Phones"—the Vital Link

With the Yanks on the Western Front in Europe, "communication is the thread upon which hangs success or failure. . . ."

To our advance patrols on an island in the Pacific, the sound of friendly voices coming in over a wire line or radio "means you've got your artillery, the air support or most anything you need, right in there behind you ready to pitch. . . ."

From our fighting men on opposite sides of the globe come letters bearing this eye-

Army-Navy "E" Flag with its third star signifying the fourth award to the Laboratories just before it was raised at West Street by Paul Kashtelian, left. J. F. Hurley is at the right

witness testimony on what dependable communications equipment means to them. Reading them makes it easier, somehow, to "take with a grin" whatever limitations in telephone service may be necessary to provide our armies with all the equipment required to hasten the day of victory.

One such letter is from Lieut. Roger G. Sherman of the Indiana Bell Telephone Company, in the Pacific.

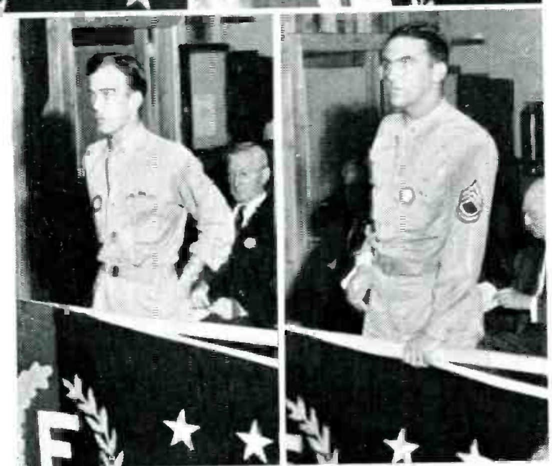
"Telephone service is the big thing," writes Lieutenant Sherman. "Radio nets are good to fall back upon, but the entire show hinges on the telephone. Although patrols use the very excellent field radios, when it comes to an operation of any consequence (no matter how far into the bush) miles and miles of wire go in with the push.

"It's wonderful to have the perfect communications afforded by wire lines. I'm constantly amazed by the simple fact that a couple of wires and some field 'phones can link you up so satisfactorily. Our radios, too, are amazing. When you are 'way out in the blue, beyond previous patrol activity, and talk with 'home' like it was next door—it's a great feeling. You can't imagine how reassuring it is to have the verbal link. All the difference in the world between being completely alone, or tied up nicely with the unit back in the beachhead. I've had many of these experiences and I never fail to be affected. The sound of their voices, coming in over a wire or radio, means you've got your artillery, the air support or most anything you need, right in there behind you.

"If you ever saw the faces of a group around a field radio or 'phone light up when the contact comes in clear and strong you'd know what I mean. It's especially apparent if you've been out of contact for a while."

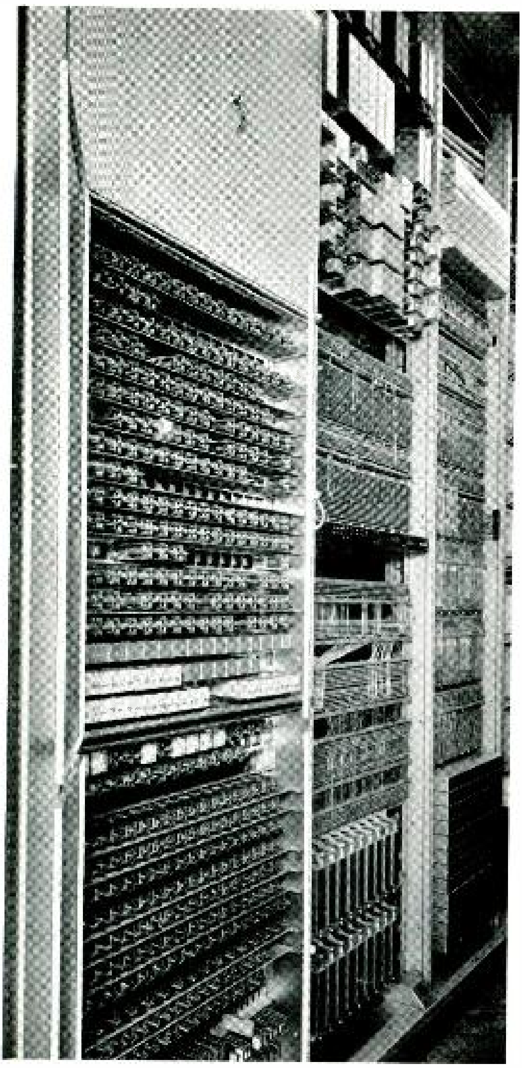
Another, from Private Belote, writing of the Normandy campaign, said:

"Here communication is the thread upon which hangs success or failure, life or death; and as in the telephone company back home, the call does get through. A decisive moment hangs in the balance, men begin to sweat, curse and coöperate. The messages gets through no matter what the difficulties may be. In countless cases we think of and thank those of you back home who designed and built our telephones, radios and telegraphs. I know the feeling of hearing all types of communications functioning faithfully, becoming a part of the history being made here."



"E" PIN PRESENTATION CEREMONIES

As the Preproduction Shop at Chambers Street has been organized since the December 31 Army-Navy award, a special noontime ceremony was held at which time "E" pins were presented to over a hundred people. William Fondiller (above, left) acted as master of ceremonies and short talks were given by Dr. Buckley (center) and David Anderson (right), President of B.T.L.E.A., and by T/Sgt. James Sweeney (right) and Pvt. Albert Hanson from Halloran Hospital, both of whom had served in the African and European areas



Multi-Frequency Frame Identification in Crossbar Toll

By O. MYERS
Switching Development

To ENABLE a marker to find and close an idle path between the incoming and outgoing trunks, it must know the frames to which these trunks are connected. Once these are known, the marker can seize the connectors associated with them and proceed to locate an idle path. Although marker action in the crossbar toll system is similar to that in the local system, the method of identifying the frames to which the incoming and outgoing trunks are connected is different.

In the local system a sender link and controller is associated with each district frame, and the controller passes the number of its associated frame to the sender by grounding two of twelve leads, and the latter passes this number to the marker. Outgoing trunks associated with one route relay of the local system are always connected to a pair of office frames, which are seized as a unit by the marker, and the frame identification is given by a cross-connection that is made at the route relay.

Neither of these conditions is true of the crossbar toll system. A sender link and controller is used in common by a group of frames, and thus does not know the number of the frame with which it is momentarily associated. Similarly, the outgoing trunks forming a group to one location are not all connected to one frame but are assigned to as many frames as possible. Facilities are provided, moreover, so that trunks can be readily patched or cross-connected from one frame and group to another, and thus even their originally assigned positions may not be held continuously. This patching or cross-connecting is done not only to provide for the normal variation in the load on various trunk groups, and to take care of temporary loads, such as those caused by sporting events, conventions, or catastrophes, but to even the load on the frames, since the call-carrying capacity of the office is greater when all frames are equally loaded.

Because of this situation, frame identification for both incoming and outgoing trunks must come from the trunks themselves. It was to meet this situation that the multi-frequency frame identification system was developed. It provides an identification for each frame by transmitting a group of three frequencies over a single lead to the marker.

The arrangement of the circuit is indicated in Figure 1. A group of oscillators is employed to generate eight frequencies spaced 170 cycles apart from 425 to 1615 cycles. These particular frequencies were selected because they are the ones that have proved satisfactory for the voice-frequency telegraph system, and suitable filters and other associated apparatus were available. For each frame, three of the eight frequencies are selected as an identification. With eight frequencies there are 56 possible combinations of three, and forty of them are used for frame identification. A sufficient number of combinations could have been obtained from six frequencies if the combinations were allowed to include one, two, or three frequencies, but by always using three, the circuit may be made self-checking, since a missing or additional frequency is readily detected.

For each frame, the three frequencies employed are combined through a resistance network, and then are passed in series through the primary coils of ten transformers. The secondary winding of each transformer connects to 30 of the 300 select magnets of a frame. The primary windings are shunted with a resistance so that an open circuit in any one winding will not interrupt the entire supply for that frame, and the select magnets are similarly shunted in order to reduce their high impedance to these particular frequencies.

Leads from the select magnets are brought to the marker during the handling of a call. The lead from the incoming select magnet is carried through the sender link and sender to the marker when the call comes in, and the lead from the outgoing select magnet is one of those connected to the marker through the block relay when the group of trunks is tested. After an idle trunk is selected, the lead from the select magnet associated with that trunk remains connected to the marker.

In the marker, the frame identification signals pass through an amplifier to increase the level of the received signals, and thence to a group of nine filters, one for each of the eight frequencies, A to H, inclusive, and one marked GU, which is used as a guard as described later. These are shown at the top of the middle marker bay in the photograph at the head of this article. Following the filters are rectifiers which convert the signal to direct current to operate relays in the translating circuit that closes a single lead to operate a relay that identifies the frame.

There are two sets of frame identifying relays, one for the incoming and one for the outgoing frames, and the same set of filters, amplifiers and translating circuit is employed for both. Between the translating circuit and the identifying relays there is a steering circuit that switches the signal from one to the other of the identifying circuits as required. When the marker starts to handle a call, the steering relays are in condition to pass the multi-frequency signal to the incoming-frame identifying relays. After one of them has operated and locked, the steering relays transfer the leads from the translating circuit to the identifying relays for the outgoing frame. As soon as an idle outgoing

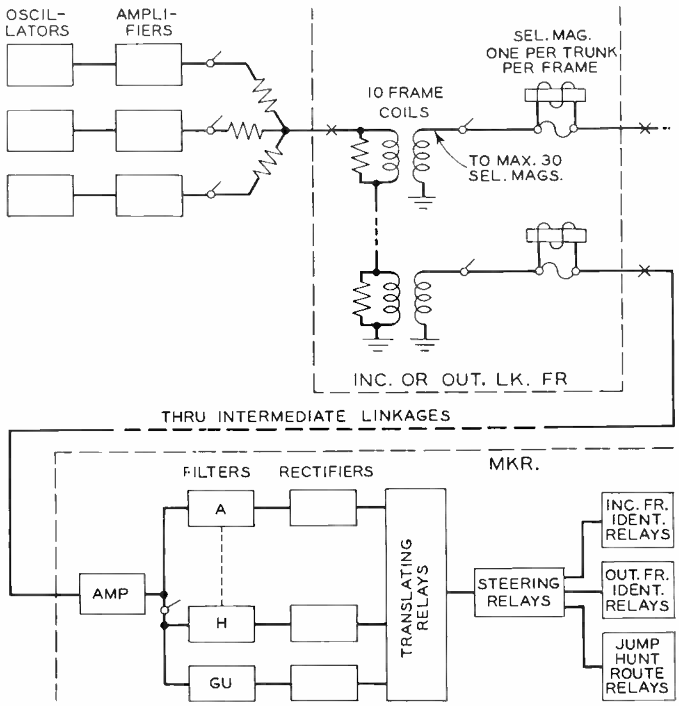


Fig. 1—Block schematic of circuit used for multi-frequency frame identification

trunk has been selected, a signal from the outgoing frame will operate one of the identifying relays for the outgoing frame. Under normal operating conditions, the steering relays merely switch the leads from the translating circuit back and forth between the incoming and outgoing frame identifying relays as successive calls are handled. At times, however, the trunks provided in a particular group are not adequate to handle the traffic. Provisions are therefore made for adding another group of trunks to the same point, and the box at the lower right of Figure 1, marked "jump-hunt route relays," is used when this is done.

Intertoll trunk groups are subject to large variations of load. Most trunk groups have spare terminals in the trunk block connector, and these are connected to jacks at the trunk assignment patching-jack frame. When not plugged up, these jacks ground the associated sleeve leads to the marker, making them test busy. When only a moderate overload exists, trunks may be borrowed from some point whose route is through the overloaded office, or they may be built up by cross-connecting or patching to reach this point. Then by patching to the spare assignment patching jacks these trunks are temporarily made part of the overloaded group. When a severe overload occurs, however, the spare trunk-block terminals and patching jacks are insufficient to provide relief, and jump hunting is used.

The marker is provided with a group of jump-hunt route relays cross-connected for various classes of outgoing trunks. Each is arranged to select as many as 40 spare terminals in a trunk-block connector. When an overload occurs which is too great to handle with the spare terminals in the overloaded group, trunks that can be made available at the desired point are borrowed from lighter loaded groups, and these are patched into the jump-hunt group whose route relay cross-connections fit. A spare terminal in the original group, if available, is patched to a jump-hunt control circuit. If there is no spare, a working terminal is used, and the associated trunk is patched into the jump-hunt group. This terminal tests busy to the marker as long as any trunk in the original group is idle or all trunks in the jump-hunt group are busy. When it becomes idle, the marker selects it, but on testing the select magnet lead for an outgoing frame identification signal, the marker receives instead the forty-first frequency combination, which tells it that a jump-hunt route relay must be operated. The marker then applies low resistance battery to the select magnet lead to operate a relay in the jump-hunt control circuit, and also rearranges the steering relays to transfer the translating relays to the "jump-hunt route relays." The operation of the relay in the jump-hunt control circuit removes the jump-hunt signal, and substitutes a new combination that tells the

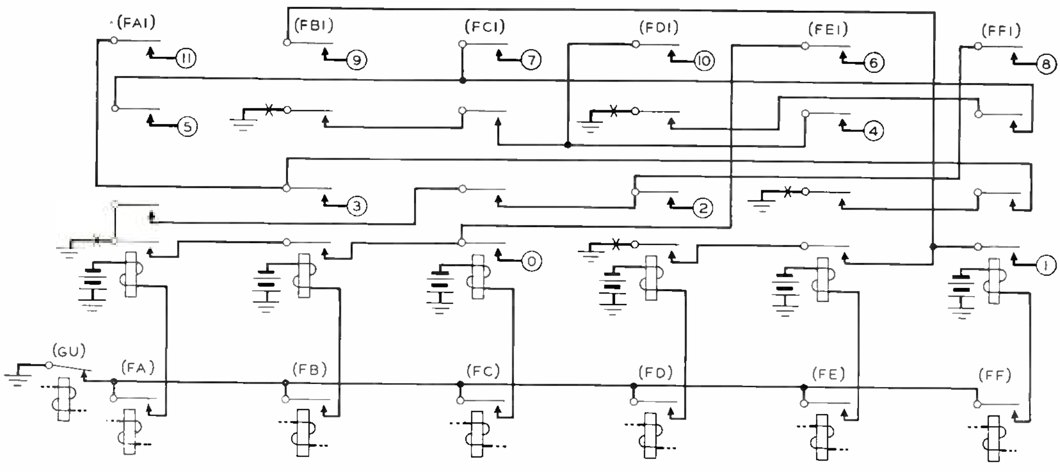


Fig. 2—Translating circuit that converts ground on three leads of a group of two to ground on one lead of a group of forty

Table I—Frequencies Employed for Frame Identification

Designation	*Frequency*
A	425 cycles
B	595 cycles
C	765 cycles
D	935 cycles
E	1105 cycles
F	1275 cycles
G	1445 cycles
H	1615 cycles
Guard	255 cycles

marker which jump-hunt route relay to operate. On receiving this information the marker operates the route relay corresponding to the jump-hunt group, and then returns the steering relays to the outgoing-frame identifying relays. When an idle trunk of this group is found, the frame identification signal is received in the usual way.

To translate the combination of three grounded leads of a total of eight to a ground on one single lead out of 40 that will designate one particular number is the function of the translating circuit. Its general arrangement is indicated in Figure 2. The numbered leads in the upper part of the diagram are those to the frame identifying and jump-hunt route relays, and indicate the number of a particular frame or route relay. Ground is carried through contacts of three of the relays in the lower row—one of which will be operated for each of the three frequencies received—and each of these three relays operates the relay shown immediately above it. These latter relays carry a large number of springs, and 41 chain circuits are carried through the contacts of these relays in such a way that for any of the 41 combinations of three operated relays, one and only one circuit will be closed through to ground. Relays for only six of the eight frequencies are shown in Figure 2, and some of their contact springs are omitted, but the general method employed can be seen from the relays shown. The relays and springs shown serve for decoding numbers from zero to eleven.

The eight frequencies employed for frame identification and their letter designations are given in Table I, and the 41 combinations employed, with the frame numbers they indicate, in Table II. After a jump-hunt signal has been received, and the translating circuit has been steered to the jump-hunt route relay circuit, 25 of the codes are used to designate the particular route relay wanted. The decoded numbers are shown in the right-hand column of Table II. For the most part they are the same as the frame identification numbers, but certain circuit economies were obtained by departing from this correspondence for a few of the higher numbers.

How the translating circuit works can readily be seen by following through the action of one of the codes. Suppose, for example, that the three frequencies received were those marked A, B, and C in Table I. After rectification, these three frequencies would operate the A, B , and C relays in the lower row of Figure 2, since the GU relay is normally operated. These three relays in turn would operate the three relays immediately above them, and as a result a circuit would be closed from ground on the lower spring of the FA1 relay, through the lower contacts on the FB1 and FC1 relays to lead number zero. Had the frequencies been AEF, which represents number eleven, a cir-

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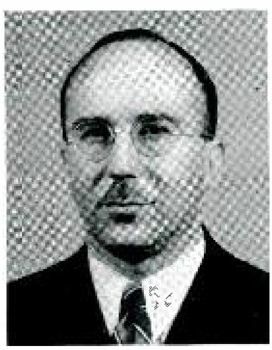


The Author: After receiving a degree of B. Chem. from Cornell University in 1921, O. Myers joined the Installation Department of the Western Electric Company where he installed and tested panel central offices until 1924, when he joined the Technical Staff of the Laboratories. At first he was with the circuit laboratory, where he tested various circuits, including the decoder sender, and the toll key-pulsing system. In 1929 he transferred to the sender design group where he worked on senders, decoders, and test circuits. In 1932 he took part in the fundamental design work of the crossbar system. Since that time he has been engaged in the development and design of the crossbar system, mostly in connection with marker circuits that are used for both local and crossbar toll systems.

cuit would have been closed from ground on the second spring of FE1, through the second spring of FF1, and the fourth spring of FA1 to lead No. 11.

The select-magnet leads over which the three-frequency signals are passed often may carry disturbing voltages either induced in them or applied in the operation of other select magnets on the same frame. These would cause false signals if preventive means were not taken. The GU filter and rectifier in Figure 1, and the GU relay in Figure 2, avoid false operation by opening the operating circuit of the relays in Figure 2 whenever induced voltages are present. These induced voltages have component frequencies over a very wide range, but the greatest amount of energy is at the low frequencies. If the translating circuit is rendered inoperative while frequencies below 425 cycles are encountered, therefore, the disturbing effects of induced currents can be avoided. This is accomplished by adding a ninth filter, marked GU in Figure 1, and allowing the output from this filter to release relay GU in Figure 2. When GU is released, the ground connection for all the translator relays is opened, and thus the transmission of codes is blocked while the induced currents are present. Any frequency below 425 cycles could have been used for this guard circuit, but 255 cycles was selected as a suitable filter for this particular frequency as it was already available.

Two sets of oscillators are provided for each office to insure a source of the eight frequencies at all times. These are arranged so that one set is substituted automatically for the other in case of trouble. Under normal conditions each set carries the load for eighty-eight minutes and then the other set is automatically substituted for it. This insures that each set is in working order at all times. Besides this regular transfer at eighty-eight-minute intervals, the marker is arranged to make the transfer if on a second trial a frequency is missing from one of the codes. When such a transfer is made, an alarm is also given so that the trouble can be found and corrected.

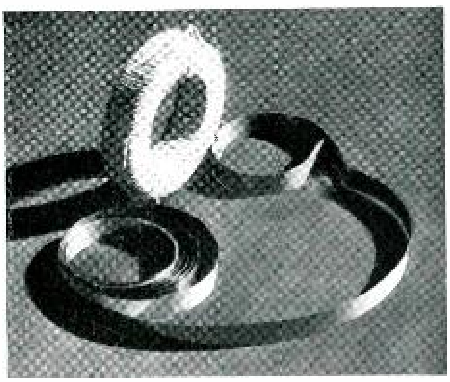
TABLE II—FREQUENCY COMBINATIONS WITH THEIR FRAME AND ROUTE RELAY NUMBERS

Frequency Combinations	*Incoming or Outgoing Frame Number*	*Jump-Hunt Route Relay Number*	*Frequency Combinations*	*Incoming or Outgoing Frame Number*	*Jump-Hunt Route Relay Number*
ABC	0	0	ABG	20	20
DEF	1	1	EHC	21	..
ACD	2	2	ACG	22	21
EFB	3	3	EHB	23	..
BCE	4	4	CGD	24	22
DFA	5	5	EHA	25	..
ABE	6	6	BCG	26	23
DFC	7	7	FHA	27	..
ACF	8	8	BGE	28	24
DEB	9	9	DFH	29	..
BCD	10	10	BGF	30	..
EFA	11	11	DEH	31	..
ABF	12	12	BGD	32	..
DEC	13	13	EFH	33	..
ACE	14	14	ABH	34	..
DFB	15	15	DEG	35	..
BCF	16	16	ACH	36	..
DEA	17	17	DFG	37	..
ABD	18	18	BCH	38	..
FHC	19	..	EFG	39	..
			EFC	Jump Hunt	19

Historic Firsts

ELECTRO-MAGNETIC HARMONIC GENERATORS

IN carrier telephone systems, each voice band interacts in a modulator with a single high frequency called the carrier to produce a group of high frequencies for transmission. At the receiving end, a carrier of the same frequency restores these high frequencies to the voice range by an inverse modulation. Until ten or twelve years ago, the carriers had been generated by vacuum-tube circuits. For some systems, a separate oscillator was used for each carrier, while for one system the output of a single oscillator was fed to a vacuum-tube harmonic generator, and some of the harmonics produced were separately amplified and used as carriers.



Up to that time none of the carrier telephone systems provided more than four channels, and there was no overall advantage in using a common supply for the carrier currents. In 1934, however, when the development of broad-band carrier systems was undertaken, the situation changed because many more channels were required by each system. Separate oscillators for each carrier were undesirable not only because of the cost, but because of the difficulty in maintaining a large number of oscillators at their correct frequencies. Some form of harmonic producer seemed preferable, but it was desirable, if possible, to avoid using vacuum-tube harmonic generators because of their cost, the instability of their higher harmonics, and their need of separate amplifiers for each carrier.

In other fields, harmonics had been obtained by taking advantage of the non-linear characteristics of iron-core coils. Although a wide range of harmonics had been obtained, their amplitudes fell off rapidly with frequency. For the new carrier systems, on the other hand, it was very desirable to have all the carriers at approximately the same amplitude. The use of magnetic generators seemed promising, however, and an investigation of their possibilities was therefore undertaken by E. Peterson, J. M. Manley, and L. R. Wrathall.

As a result of their work, a broadband harmonic generator was devised that was efficient and stable. This generator — described on page 357 of the RECORD for July, 1937—produces its harmonics by discharging a condenser through a coil with a saturated permalloy core. With the circuit provided, the discharge takes the form of a high-amplitude pulse of current that gives rise to a broad band of harmonics of substantially uniform amplitude. Since the sharp pulse occurs when the core is saturated, there is no change of flux with time, and thus the eddy-current losses are small, and the efficiency of generation is consequently high. In one application, twelve of the generated carriers are selected for use—the 16th to the 27th harmonics of 4 kc. These are equal in amplitude to within a few tenths of a db, and are at a level sufficient to supply 240 modulators and an equal number of demodulators without amplification. Generators of this type were first used in the coaxial cable system installed between New York and Philadelphia in 1936. At the present time, they are used in all the broadband carrier circuits of the Bell System, where they are proving highly satisfactory.

Electrical Test for Moisture in Telephone Poles

By J. G. SEGELKEN
Outside Plant Development

SOME preservative treatments for poles—impregnation with water-soluble salts and with creosote in reduced amount—depend for success on having the poles dried to the right extent. Hence, an estimate of the moisture content is important. There are several ways of making this, but no single method is best for all circumstances. Two quick means, based on experience, are the appearance or the weight of the poles. Another method is to determine the density of the poles from disks cut from their bottom and top ends.

If the problem is that of finding the average moisture content of a lot of poles laid out on skids so that they are all accessible, probably the easiest method is to take borings from a representative number of poles, combine all the borings into one composite sample and determine its moisture content by extraction. When a lot of seasoned poles have to be characterized one at a time, an electrical method will be applicable under suitable weather conditions. If the task is that of periodically judging the condition of a lot of poles in a stack, an electrical method may be used if it is feasible to drive nails for electrodes into certain test poles at the time of stacking and to separate such test poles from adjacent ones by inserting insulating strips.

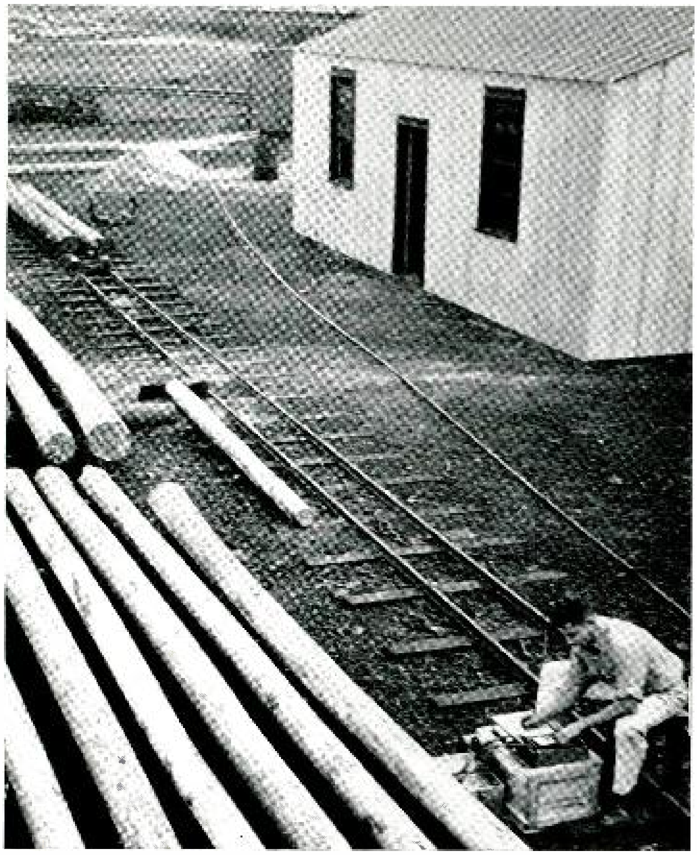


Fig. 1—Measuring the resistance of untreated southern pine telephone poles with the Laboratories' electrical apparatus for determining the moisture content of timber. A. H. Hearn is shown making tests at a creosoting plant in South Carolina

An electrical method involving the use of four electrodes has been developed by the Laboratories. It measures the moisture in terms of the resistance between two nails driven deep into the sapwood. Since the object of the test is to arrive at an estimate of the moisture content of round timber as a whole, electrodes are used which will penetrate most of the sapwood. Measuring the electrical resistance between the nails also includes the effect of any substances that are in solution in the water.

The apparatus is essentially an ohmmeter with a potentiometer to adjust the zero reading and a switch which may be connected to any one of five external circuits and a test position. Potential for the testing apparatus is supplied by three 45-volt batteries which are connected in series.

Four 20-penny nails are driven three and a half inches into the pole and connected to the binding posts of the apparatus. The distance between nails driven at B and C, Figure 2, is from fifteen to twenty-five feet depending on the pole's length. A nail is driven at A about two feet from B, and at D the same distance from C. The measurements give the resistance of the test section between the electrodes B and C. The nails at A and D are used in calculating the contact resistances between B and C and the wood.

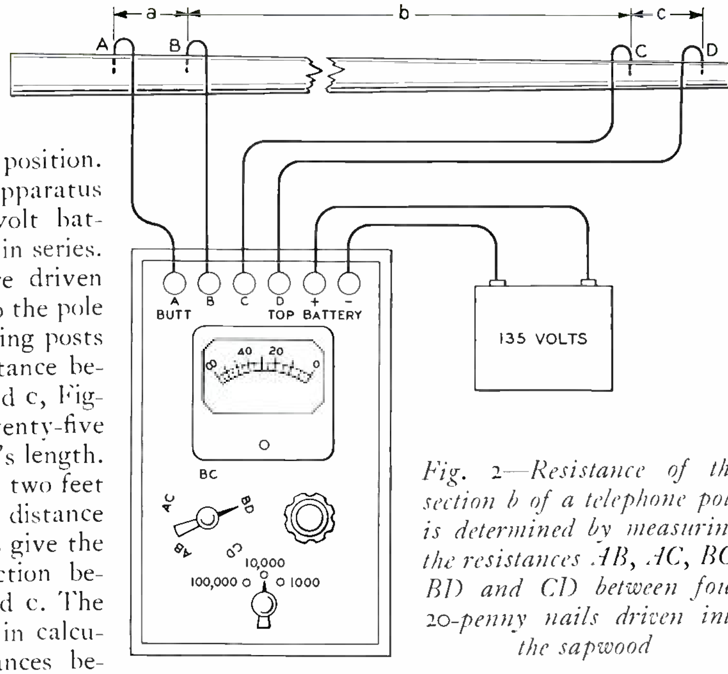


Fig. 2—Resistance of the section b of a telephone pole is determined by measuring the resistances AB, AC, BC, BD and CD between four 20-penny nails driven into the sapwood

The timber is insulated at one end from the ground with a piece of bakelite, glass or other nonconductor. Then the circuit switch is set successively to measure the resistance between AB, AC, BC, BD and CD. From these values the contact resistance at nails B and C can be calculated and the resistance between them is one-half the resistance of (AC+BD)−(AB+CD). Since the distance between electrodes B and C varies with the length of the pole, the calculated resistance has to be divided by the length b, Figure 2. The quotient is recorded as the average resistance in megohms per foot of the test section.

To correlate the resistance measurements with the moisture content of the poles, a disk approximately one inch thick was cut from both ends of several experimental poles. After soaking in water to swell the disks to as near normal green volume as practicable, their volume was determined by water displacement. Then the disks were dried and weighed and the density of each one, top and butt, was determined. The average of these values was taken as the density of each pole as a whole. The dry weight of the poles was then calculated from their densities. Poles were weighed periodically. The per cent of moisture content is 100 times the quotient of the difference between the actual weight and the calculated dry weight divided by the dry weight.

Disks approximately one inch thick were also taken from the immediate vicinity of the B and C electrodes. Sectors were cut from them and the moisture content of the pieces from the center out was determined by the oven drying method. This gave for each sector the moisture gradient from inside to outside and provided a basis for calculating the moisture content of the disks as a whole.

To determine the temperature of the poles in these experiments a hole for a thermometer was bored in them four inches deep at a point six feet from the B electrode. Temperature readings were taken when the electrical measurements were made but further work will have to be done before the effects of temperature in round timbers like poles can be definitely determined.

When the nail electrodes are new, their contact resistance is approximately proportional to the total resistance between the electrodes B and C but deviations are introduced if the nails are allowed to remain in the test piece and become rusted during the period of seasoning or storage. The four-electrode method, which eliminates contact resistance, is therefore essential for studying

Fig. 3—The apparatus is a direct-current ohmmeter. A switch connects any one of five circuits through different parts of the pole under test. Power is supplied by three forty-five-volt dry batteries in series

seasoning rates in different types of stacks. For the rapid selection of dry poles and with freshly driven nails the resistance between the nails at B and C can be calculated, with reasonable accuracy, by multiplying the BC reading by 0.9, but this simplification is only recommended for reasonably dry poles, that is, for poles in which the moisture content is at fiber saturation or less.

This method has been used during air-seasoning and kiln-drying of southern pine round-timber under the varying weather and temperature conditions encountered at the seasoning yards in southern states. The tests were made from the time the poles were cut until they were ready for creosoting. The method, however, has not been refined sufficiently nor tried out enough to define fully its field of usefulness; but the work just reported is a step in that direction.

THE AUTHOR: J. G. SEGELKEN received from the University of Cincinnati the degree of A.B. in 1927, M.A. in 1928 and Ph.D. in 1929. In his graduate work he specialized in botany and physical chemistry. Dr. Segelken joined the Outside Plant Development Department of the Laboratories in 1929 to engage in the development of processes for the preservation of timber products. This work continued until 1941 when he was diverted to war projects which now occupy practically all of his time.

Micro-Motion Pictures of Rubber Latex

By FRANCIS F. LUCAS
Chemical Laboratories

UNDER a powerful microscope, a dilute suspension of the milky latex tapped from rubber trees appears as minute globules of different sizes. Most of the particles in fresh latex are spherical and the smaller ones gyrate about the larger ones in motions which appear to be caused principally by electrical forces between the particles rather than by the molecular action of the liquid. As the particles age the smaller ones may coalesce with the larger to form pear-shaped and larger spherical units. This process of agglutination is one of the first steps in the production of rubber.

Studies of this action, with the aid of motion pictures, show that a particle in suspension may have one or more satellites; and about a satellite there may gyrate a still smaller particle. Small particles move faster than large and are not necessarily held bound by larger particles. Generally, they rotate about a large particle only momentarily and then pass rapidly to another where the motions are repeated. When one small particle encounters another they may gyrate momentarily and then separate.

Because of their relatively slower motion, the larger particles can be photographed clearly at high magnifications with an automatic time exposure of one-quarter second and this was the procedure followed in the time studies of merging particles. Otherwise, at lower magnifications normal exposure of 16 frames per second was used.

The pictures were taken with an electrically operated 16-mm camera. It was mounted on a steel bridge of substantial construction which was insulated from the microscope. The image was kept under constant observation. There were two sources of light, an automatic arc lamp for photography and an incandescent lamp for visual examination.

To follow the motion of the particles they were illuminated with colored light and projected against a field of the complimentary

Fig. 1—Balata latex, enlarged from one frame of a motion picture of the particles. The small particles rotate around the larger ones

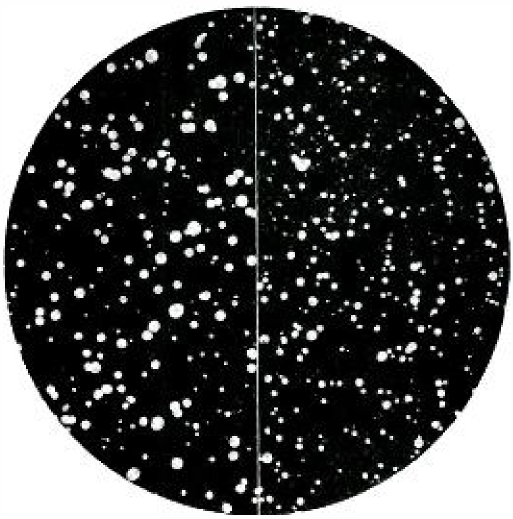


Fig. 2—Comparison of balata and Hevea latices. Hevea particles are smaller in size and move slightly faster than balata particles

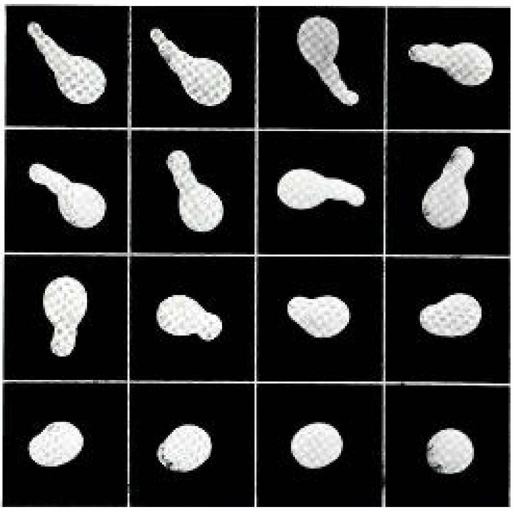


Fig. 3—Progressive stages in the merging of Hevea particles. Two or more small particles become attached to a large spherical one. They are slowly absorbed and form a larger sphere

color; or three colors were used, for example: one side of the object was illuminated with red light, the opposite side with green and the field with blue. The same sides of all the particles were then red, the opposite sides green and these red-green particles were seen against a blue field. When a satellite gyrated about a primary particle this symmetrical coloring caused red to be superimposed on green as the particles crossed, making it possible to tell whether the satellite passed over or under the primary particle.

Balata latex was diluted with ammonia solution and illuminated by this color method to study its group and chain formations. Under a magnification of from 25 to 50 times at the film, chains could be observed forming, breaking up, and reforming. The particles arrange themselves in ever-changing patterns and the dispersion has numerous areas which are almost devoid of particles. These vacant areas change slowly in location, shape and size. Very dilute dispersions of both balata and Hevea latices were filmed to study the motions of individual particle and also inter-particle motions. A single, freely suspended particle moves very little and seems to be in a state of colloidal equilibrium. An isolated doublet moves about as much as a single particle. The satellite slowly approaches and recedes from the primary particle and gyrates about it. Individual components of isolated triplets and quads also move or sway slowly but they retain approximately their positions relative to one another.

As the concentration of latex increases, particle motions increase. When there are few particles in the field these motions are barely perceptible but when many are present the activity greatly increases. A typical photograph of balata latex, much enlarged from the film, is shown in Figure 1.

Two latices may be compared by exposing the two halves of the film separately. With one side of the frame masked, balata latex was filmed on the other side. Then the film was rewound, the half mask was removed and the opposite half mask inserted to cover the exposed film. Hevea latex was then filmed on the unexposed side. When projected, the two latices are seen side by side as shown in Figure 2. The distinguishing differences are the smaller particle size and the slightly faster motion of the Hevea latex. When this latex and a synthetic latex are filmed together the synthetic latex appears more uniform in size, and its motion is much more rapid.

Progressive stages in a time study of merging Hevea particles are shown in Figure 3 which is reproduced, much enlarged, from the motion picture film. In the sequence of events two or more particles become attached to form a tapering chain. The smaller particles are then pulled into the larger one and the spherical outline of the smaller particles disappears, forming a pear-shaped

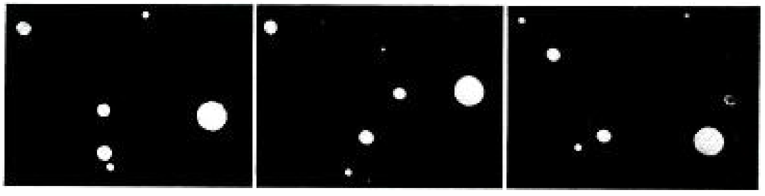


Fig. 4—Three successive positions of a balata constellation moving as a unit in an electric field. The largest particle has three satellites, each of which has a smaller particle rotating about it

unit. Then the neck is pulled into the bulb. The particle becomes egg-shaped and finally spherical. Twenty-six hours were required to complete these changes but continued observation for thirty days more showed no further change.

Application of electrical potential does not materially alter the interrelations of the dispersed particles. A doublet travels as a unit with the satellite gyrating about the primary particle. Triplets and also quads travel as units. Migration to the anode is at a uniform rate regardless of particle size. Sometimes a satellite in its gyrations about a primary particle moves against the direction of migration, sometimes across the current, and sometimes with it.

Hevea latex is composed of particles ranging in diameter from about 0.10 to 2.0 microns. About 75 per cent of the particles are smaller than 0.30 microns but the 25 per cent of those which are larger comprise the greater mass. The larger particles are the primary ones and the smaller are the satellites. That portion of the particles represented in the chart, Figure 5, by the range from about 0.30 to 1.85 microns are the particles which, according to the motion pictures, have strong interparticle relationships. The particles represented by the peak of the curve are those of weaker relationships. Since the larger particles form by the merging of two or more smaller ones, it appears likely that Hevea latex in its early state may be predominately of the size represented by the peak of the curve. No opportunity has been afforded to examine a latex as it emerges from the tree but observations show that a single large particle can develop in a few seconds, or it may take hours or days.

Neoprene and Buna s latices have been studied in a preliminary survey and they show great similarities in colloidal structure. In both latices the particles are transparent to ultraviolet light but could be stained sufficiently with Methylene Blue to be photographed with the ultraviolet microscope. These synthetic latex particles are much smaller and more uniform in size than those of Hevea, and Buna s particles appear definitely smaller than those of neoprene. The particles form chains and groups with dark interspaces in the same manner as balata and Hevea latices, but the pattern changes with greater rapidity. The small particles appear to have the same inter-

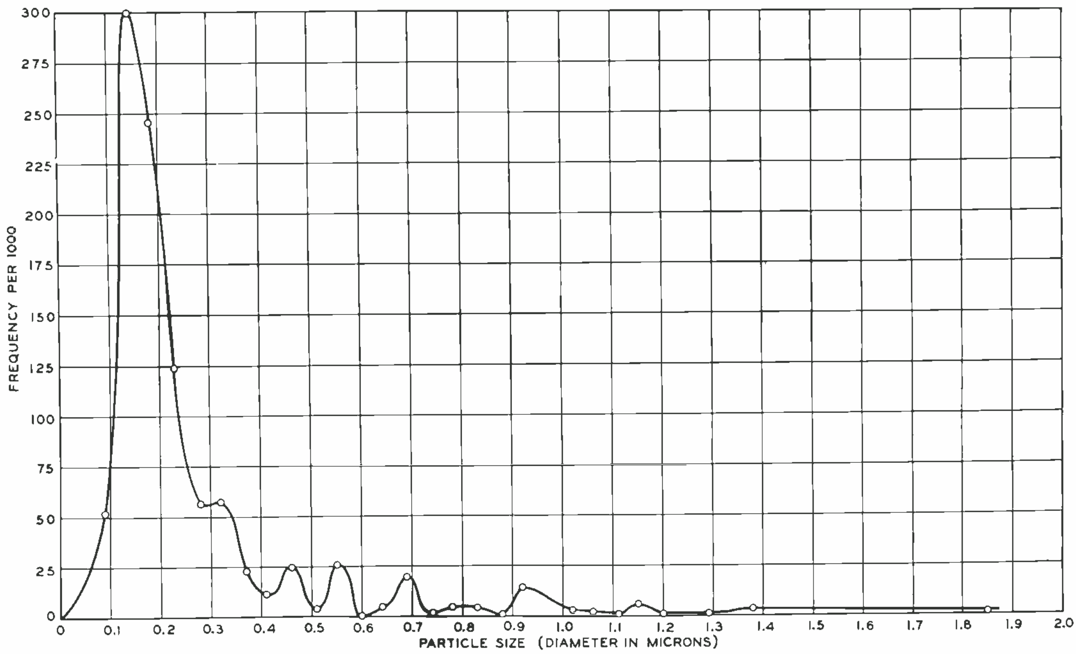


Fig. 5—Most of the particles of Hevea latex are less than 0.30 microns in diameter but those which are larger contribute most to the total mass

Fig. 6—Electron micrographs of colloidal gold also show doublet and triplet formations which indicates that this is a general property of colloidal suspension. (Photo—courtesy of the American Cyanamid Company)

particle relations as are found among the smaller particles of Hevea. Structurally the synthetic latices are similar to Hevea latex with the larger particles screened out.

That the doublet formation is a fundamental element of colloidal structure and independent of the nature of the dispersion seems to be established by the electron micrograph of Figure 6 which shows that there are doublets and triplets in colloidal gold dispersions. The colloidal gold particle is about 125 A° in diameter.

These experiments indicate that the motion of the particles in a dispersion of Hevea or balata latex is controlled by forces that result from charges on the particles. These charges keep the particles separated and under normal conditions there is no evidence that they collide as they approach and recede. Particles of different size tend to form a group or constellation whose motions center about the largest particle. If the charges are nullified, agglomeration occurs and forms the elastic mass from which rubber is made.

The Author: F. F. Lucas has been associated with the Bell System since 1902 and has been the Laboratories' specialist in microscopy for nearly thirty years. He received the honorary degree of Sc.D. from Lehigh University in 1931. Dr. Lucas has been awarded several medals and diplomas for outstanding contributions to high-power metallography and ultra-violet microscopy. He has served as delegate to several international congresses on metallography and has published many papers in this field. His contributions in the field of cytology and bacteriology are also noteworthy. In 1940 the United States Public Health Service sought Dr. Lucas' coöperation in a study of the life cycle of the syphilis spirochete. Some of the motion pictures taken in that study have been used in Army and Navy service films.