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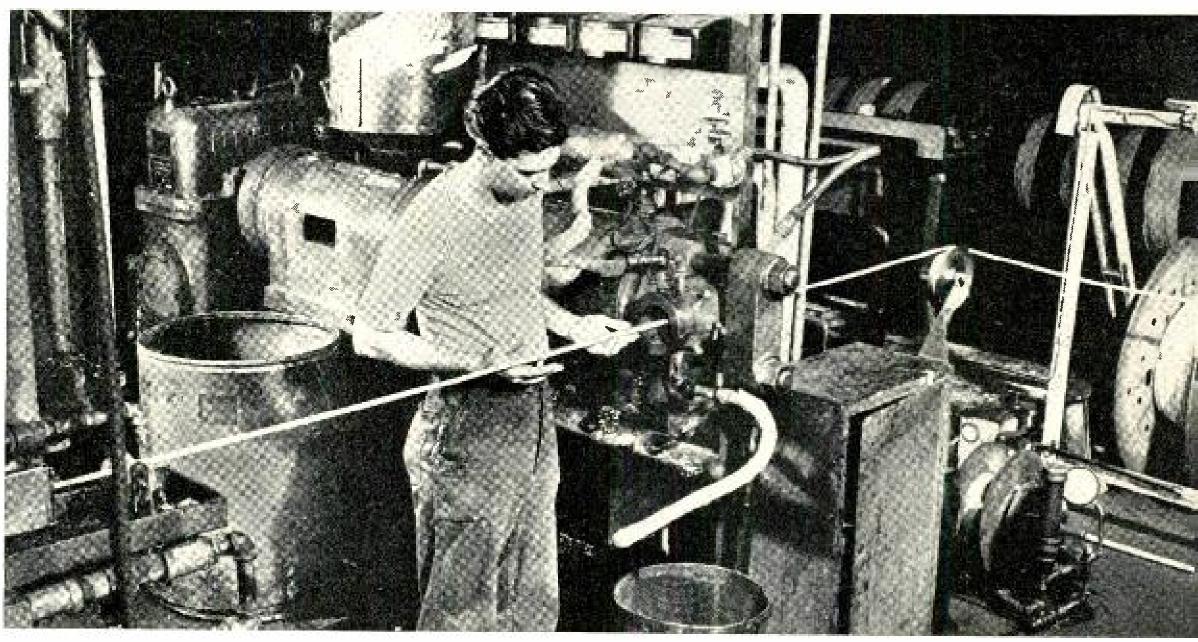
Plastic covers for switchboard cable

D. R. BROBST
Transmission Development

Telephone cables strung along poles or being drawn into manholes for underground installation are a familiar sight. Inside the central office, however, many other cables are used for inter-connecting the telephone circuits and associated apparatus. These are commonly known as switchboard cables and there may be as much as 150,000 feet in a single central office, each cable containing from 6 to 312 conductors.

The switchboard cables differ in appearance from the more familiar outside cables; they are not lead covered and they may be oval or flat, as well as round, depending upon the particular use. For instance, flat cable is used behind the manual switchboard where it must be piled up in step with the equipment on the face of the switchboard. A recent analysis of the production of switchboard cable showed a relation of 69, 29, and 2 per cent, for round, oval, and flat shapes respectively.

Insulation on the individual cable conductors consists of wrappings of cellulose ace-



Extruding the cable cover at the Tonawanda plant of the Western Electric Company at Buffalo.

tate yarn covered by a cotton yarn wrapping. The cotton wrappings are applied in various combinations of colors to facilitate installation and circuit identification. A coating of transparent cellulose acetate lacquer is applied to the cotton wrapping.

Various plastic insulations have been considered for the individual conductors, but have not been entirely satisfactory. Some have had poor aging properties, while others have been unable to withstand accidental contact with a soldering iron. Also, because of the weight of the mass of cables in vertical cable runs, the conductors subject to the greatest pressure may cut through the plastic insulation.

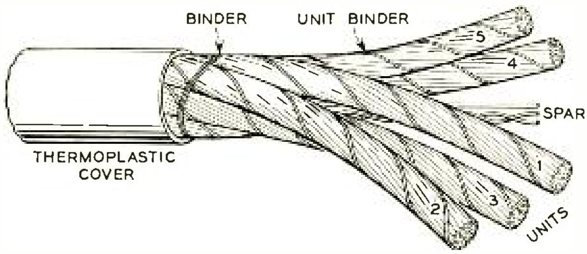


Fig. 1—Typical cable using the new thermoplastic cover.

Although it is not necessary to provide a covering that is completely proof against water or water vapor penetration, some protection is needed, since the dampness sometimes found inside a central office may be sufficient to impair the insulating value of the textile wrapping. This protection has been provided by incorporating into the cable-cover a moisture barrier that slows up the penetration of moisture to such a degree that the electrical characteristics of the cable will be satisfactory through periods of high humidity.

The story of switchboard cable-cover is one of change. As new and better materials have become available, they have been used to provide improved covers; on the other hand, when shortages of the preferred materials have occurred, substitutes have had to be used. For a number of years prior to 1932, developments had resulted in a switchboard cable-cover consisting of successive layers of overlapped wrappings of paper tape, lead alloy tape, paper tape, a closely wound cotton wrapping, and a cotton braiding. The completed cable is painted with gray cable paint. In this construction, the moisture barrier is the lead alloy tape applied spirally with overlapping layers. This method of fabrication permits installing the cable with fairly sharp bends and also provides an adequate moisture barrier of relatively small thickness and low weight.

In 1932 a thinner tape of aluminum replaced the lead alloy tape with a resulting decrease in cable size and manufacturing cost. The aluminum tape was used until 1941, when aluminum became a strategic war metal and a replacement had to be found. A paper tape coated with Pliolite, one of the derivatives of natural rubber, was used as a substitute, but in 1942, with the rubber supply sharply reduced, Pliolite became unavailable. A wax impregnated paper tape was then used until the end of the war, when aluminum again became available.

In the latter part of 1946, however, the aluminum tape was replaced in part by a Vistanex coated crepe paper. Vistanex is a non-vulcanizable, rubber-like synthetic material derived from petroleum. This material had been under study prior to the war, but was not available for general use at that time. It has some advantages over metal tape, since it eliminates the danger of breakdown between the conductors and the metal barrier. It also has a high resistance to moisture penetration and does not harden with age.

Thermoplastic compounds of the polyvinyl chloride type had been investigated as cable covers before the war, but these, too, were not available for general use. Wartime developments produced superior compounds of this type, and after the war these became available in substantial quantities and at satisfactory prices. Accordingly, polyvinyl chloride compounds were introduced in the latter part of 1946 on a small scale and were rapidly extended so that in 1948 this type of covering was being used on over 50 per cent of the cable.

The construction of a typical cable using the new cover is shown in Figure 1; the jacket of polyvinyl chloride compound is applied directly over the group of conductors by an extrusion process. Experience obtained in the manufacture and use of this cover during the trial period led to its adoption as the standard cover on all round switchboard cables.

The new cover has a number of advantages over earlier types. It provides better moisture protection to the textile insulation on the conductors; this tends to smooth out variations of the electrical characteristics due to seasonal changes in humidity. The plastic jacket is tougher and more abrasion resistant. It has no lint, as does the cotton cover; thus the likelihood of lint's causing open contacts on the switching apparatus is decreased. This covering is more easily stripped off at the ends for installation purposes, and it also improves the appearance of the cable.

An extruded cover simplifies manufacture by eliminating the separate taping, braiding, and painting operations. Also, because of the relatively high speed at which the plastic jacket is applied, there is a substantial reduction in the amount of machinery and floor space required in the shop.

At the present time, the thermoplastic cover is being applied to most of the production of round cables, and it is expected that its use will be extended in the near future to all switchboard cables.

THE AUTHOR: Insulation for switchboard wire and cable has occupied most of David R. Brobst's time since he entered the Laboratories in 1922. Besides the development of the plastic covers described in the article appearing on these pages, he has contributed to the development of cellulose acetate lacquer for the textile covering of central office wires, purification of insulating fibres by removal of water soluble salts, and the substitution of cellulose acetate rayon yarn for silk in wire insulation. During the war he was engaged in the design and construction of corona testing equipment and of computer networks for the Armed Forces. Since the war, he has been in charge of a group responsible for central office wire and switchboard cable, magnet wire, and coaxial cable for inside use. Mr. Brobst graduated from Lehigh in 1917 and received his Master's degree from the Polytechnic Institute of Brooklyn in 1937. He spent a year and a half in the Army during World War I as an instructor in various tractor artillery schools.

Insulation by Cataphoresis

H. L. B. GOULD
Magnetic Studies and Applications

Cataphoresis, according to the dictionary, is "the movement of suspended particles through a fluid under the action of an applied electromotive force." The particles, known as suspensoids, carry on their surfaces an electric charge whose reaction with the applied EMF causes the particles to move through the fluid.

Although the phenomenon has been known for a century, its first application by the Laboratories dates back only a few years, when it began to be used to lay down a thin film of insulation on magnetic tape. Because the cores of transformers used in high-frequency carrier systems and radar must handle frequencies up into the millions of cycles, they are made of Permalloy tape ranging from a quarter-mil to two mils thick. The tape is wound into a ring, and between each layer of tape there must be a layer of insulation. Because materials such as enamel, paper and iron oxide will

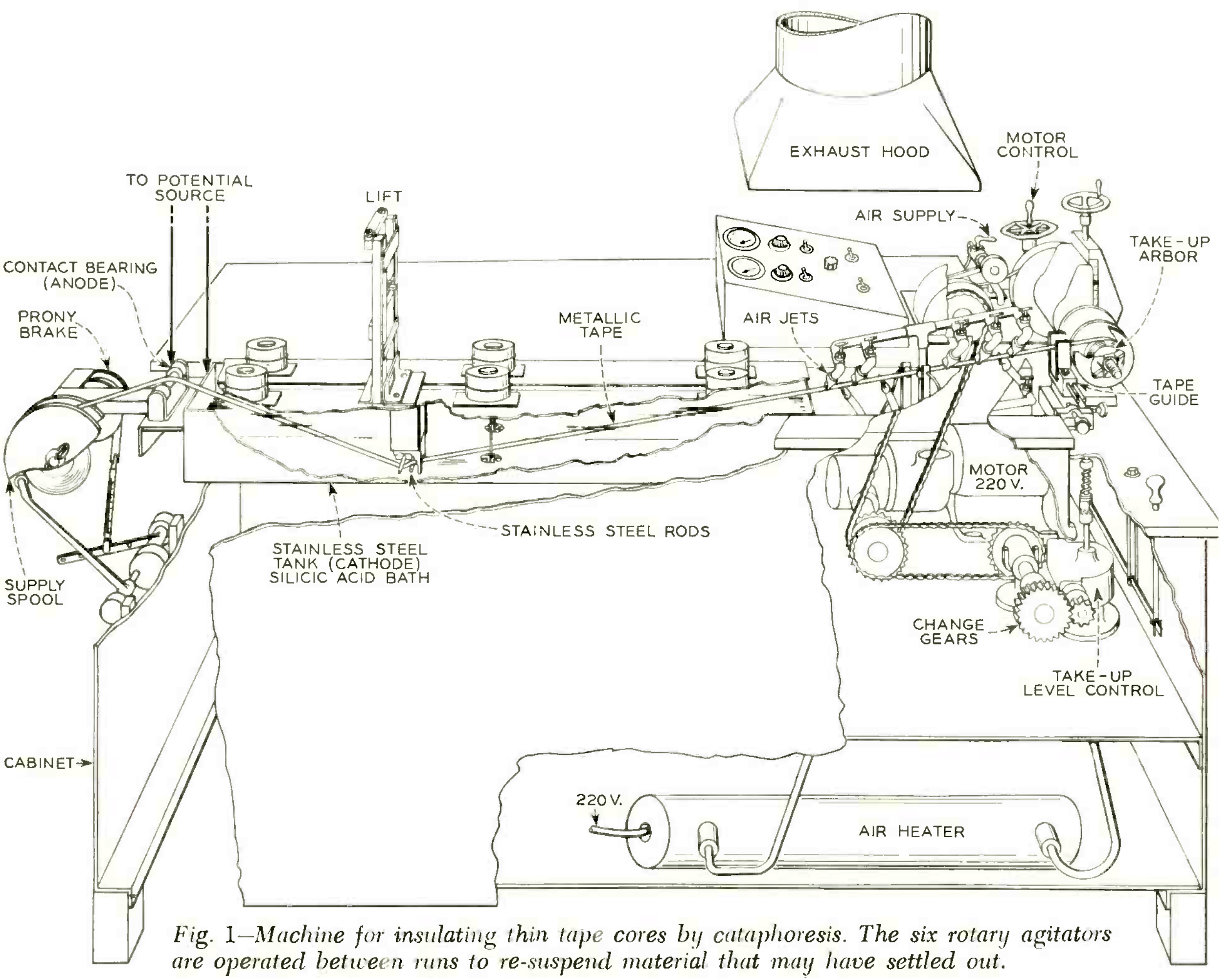


Fig. 1—Machine for insulating thin tape cores by cataphoresis. The six rotary agitators are operated between runs to re-suspend material that may have settled out.

not stand the heat treatment which must follow final forming of the core, they are not applicable.

To solve the problem it was suggested that a thin film of silicic acid might be deposited by cataphoresis. The laboratory apparatus which does this and then winds the tape into a core is shown in Figures 1 and 2. Drawn from a supply-spool at the left, which is braked to hold tension, the tape enters a bath of acetone in which is a suspension of silicic acid particles. The tape and its mechanism are insulated from the tank; a suitable d.c. potential is applied which drives the particles against the tape where they form a layer whose thickness is controlled by the potential and the rate of travel of the tape emerging from the right-hand end of the tank. The tape is dried by jets of hot air and wound on an arbor.

Thin tape cores are heat treated to relieve mechanical strains incurred in processing. This develops the high permeability and also sets the cores in the shapes produced by arbors, clamps or other forming devices. The thickness of insulation desired on each surface of the tape is approximately 0.1 mil. This gives adequate protection against welding during heat treatments up to 1000 degrees C in ordinary atmospheres, such as commercial hydrogen, and also prevents eddy currents in service. During heat treatment the silicic acid gives up its water of crystallization and silicon dioxide remains.

In the laboratory, cores for transformers are made in a diversity of sizes and materials for investigation over a period of time, but only a relatively small number of units of each style are produced; flexibility in the laboratory fabricating technique therefore demands the use of a number of skilled and specialized operations. An operation illustrated in Figure 2 is one in which rectangular cores are clamped into shape before heat treatment. The close tolerances demanded in many applications require a final adjustment in the dimensions of the annealed core. In Figure 3 turns are actually being snipped off to adjust the outside diameter of a core of one-mil tape.

Although high permeability cores of thin tape are extremely sensitive to mechanical distortion, they retain their magnetic quality as long as they are not under stress and their mechanical tightness is maintained. Two adjacent turns of insulated tape in a rigid core may be compared to two pieces of sandpaper that resist sliding past one another but may be easily pulled apart. If care is taken to avoid breaking the brittle bond between turns, the cores will withstand normal handling and require no extra strengthening prior to the coil winding operation. In cases where impregnation is desirable the compactness of the core mini-

Fig. 2—Adele Aboutok clamps rectangular cores prior to their heat treatment. The cataphoresis insulating machine is in the background.

Fig. 3—Close dimensional tolerances require a final adjustment in the core diameter, easily made as shown.

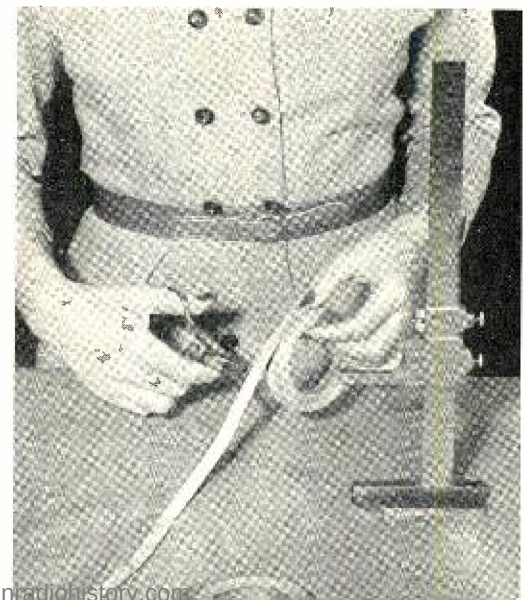
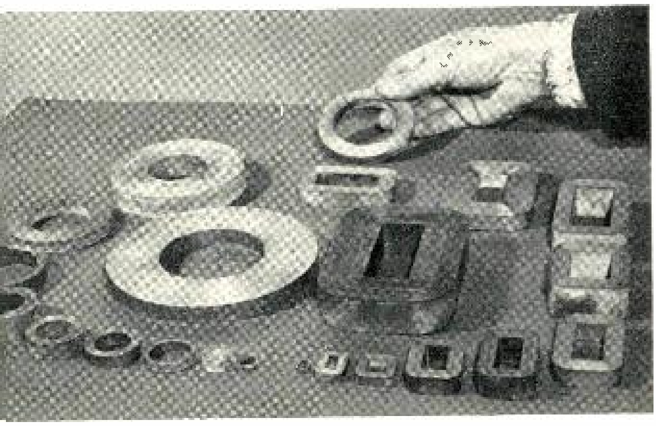


Fig. 4, at right—Using a high frequency Maxwell bridge, the operator checks inductance of the toroidal specimen on the shelf, right of center.

Fig. 5, below—Toroidal and rectangular shapes are usual for thin magnetic tape cores. This is a laboratory variety of finished annealed types.



mizes the straining effects of the impregnating compounds.

To achieve successful insulation by cataphoresis many refinements are necessary in materials and in methods. It was apparent early in the development that the tape must be straight and of uniform width and thickness. Its surfaces must be smooth and free from scale, metal flakes and foreign material. The cross-section should be rectangular, with edges that are free from burrs, nicks and ripples. The strength and ductility also should be uniformly high. Multiple-roll mills with small-diameter rolls will attain these objectives for extremely thin tapes of magnetic materials.

THE AUTHOR: H. L. B. GOULD received his B.S. degree from Acadia University in 1926 and joined the Laboratories shortly thereafter. His work has been concerned primarily with the development and applications of magnetic materials. For many years he was concerned with the development of the molybdenum Permalloy powder core, and made a number of contributions to the art. Since the beginning of World War II he has been actively engaged in problems relative to the use of magnetic materials in thin sheet form.

G. S. PHIPPS
Metals Engineering

Sealing Solder

Most toll and many exchange plant cables in the Bell System are filled with dry gas under pressure to keep out moisture. Excessive leakage of the gas, through a hole in the cable sheath, for example, actuates a pressure sensitive alarm; a crew is then dispatched to make necessary repairs. To insure tightness, it is common practice to test wiped joints* in cable sleeves by applying gas pressure near the joint, immediately after wiping, and then covering the joint surface with a soap solution. If the solder is porous, bubbles appear on the surface at the points of leakage. A sealing method which assures the tightness of such joints has been developed by the Laboratories.

*RECORD, *July*, 1944, *page* 472.

Wiped branched joints on large cables are particularly subject to porosity. The cables themselves, sleeves, end plates and lead wedges used in such joints have a large heat capacity. As a result, it takes considerable time for them to cool from the wiping temperature to the temperature at which the lowest melting liquid fraction of the wiping solder solidifies. As a wiping solder cools from the liquid state, the primary lead solidifies first, and is surrounded by a liquid which precipitates lead-rich crystals as the temperature decreases. With slow cooling, some of this liquid ultimately drains to the bottom of the joint and drips away, thus leaving the fissures of Figure 1. These cracks are further enlarged by the contraction of

Method of applying sealing solder to a branched joint.

solidifying liquid remaining within the joint.

Most small joints, and large single cable joints that cool rapidly, are relatively free from porosity. This is demonstrated in part by a simple experiment. The top sample in Figure 2 is a wiping solder that had been solidified rapidly by casting into a cold metallic open mold, and then bent over a mandrel. The entire surface is ductile and free from cracks. The bottom sample is the same solder cast in a mold made of insulating material, to slow solidification. The casting was then bent similarly over the mandrel. In the latter case the primary lead solidified in a loose packing at the surface while the remaining liquid portion of the alloy contracted to leave potential cracks in the surface. They opened readily when the sample was bent.

Studies indicated that the possibility of completely eliminating porosity by varying the solder composition itself was not promising. Where evidence of porosity existed, the practice had been to rewipe the joint repeatedly until it was gas-tight. An improved method, it has been found, is to apply a supplementary layer of a lower melting solder over the surface of the wiped joint. This layer can be applied easily by using the residual heat in the joint, immediately after wiping, to melt the supplementary solder, without remelting or reheating the original joint. The solder having the lowest melting point (eutectic) of any alloy containing bismuth, lead and tin was tested for this application and found to be signally successful.

This sealing solder alloy contains 52.5 per cent bismuth, 32 per cent lead and 15.5 per cent tin. It melts completely at 95 degrees C. At temperatures between 95 and 184 degrees C—the latter being the final solidification temperature of the widely employed *E Wiping Solder* (34.5 per cent tin, 1.25 per

Fig. 1—A porous area in a wiped joint as it appears unetched and enlarged 400 times. As the solder cools, the primary lead solidifies first, and is surrounded by a liquid which precipitates lead-rich crystals. Some of this drains off, leaving the fissures shown.

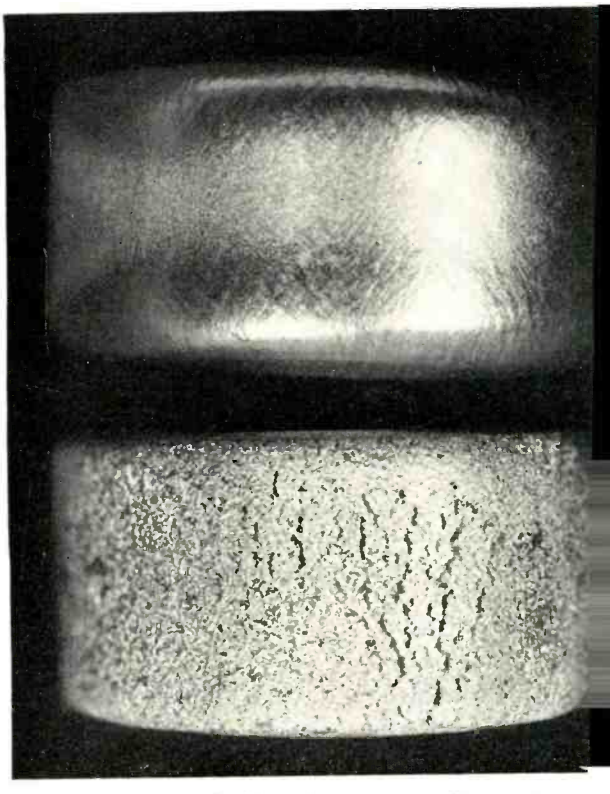


Fig. 2—Bent cast strips illustrate the effect on structure of variations in freezing rate of wiping solders. Top strip was chill cast and shows a sound ductile structure. Bottom strip was slowly cooled and, upon bending, fissures between crystallites were exposed.

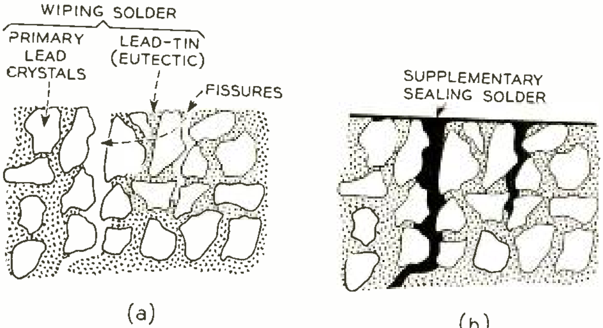


Fig. 3—Sketch of probable sealing action of solder: (a) A wiped joint containing fissures extending from the surface toward the center of the joint and (b) these fissures filled with sealing solder.

cent antimony, 0.11 per cent arsenic, balance lead)—it combines readily with the wiping solder to effect a good seal. Apparently it is drawn into the capillary-like fissures in the wiped joint. The new supplementary solder, known as *B Sealing Solder*, blends with the wiping solder so completely that microscopic identification in sectioned samples is exceedingly difficult. The probable sealing action of the supplementary solder layer is sketched in Figure 3.

In field operations the sealing solder, in the form of the thin stick shown on the first page of this article, is touched to the wiped joint as soon as the latter has solidified. The sealing alloy melts readily and is wiped around the joint with the finishing cloth. After all areas are covered, the joint is allowed to cool and is pressure tested. The same sealing solder technique can be used to repair old joints, provided the joint is well cleaned and then heated to from 150 to 170 degrees C. In nearly all cases, gas-tight joints have resulted from the use of this method, thus eliminating the need for a complete rewiping of older joints.

This new sealing solder is now being used extensively in the Bell System, not only for large complex splices, but routinely on all wiped joints as added protection against the need for rewiping.

THE AUTHOR: G. S. Phipps joined the Laboratories in 1930 after receiving a B.S. in Electrochemical Engineering from Pennsylvania State College. He later received an M.S. in Metallurgy from Columbia. Mr. Phipps has been chiefly engaged in metallurgical research on low melting alloys, solders and related materials. He has been responsible for the selection or development of many of the general or special solders now used in the Bell System.

This Month's Cover

One of the many services performed by Bell Telephone Laboratories is the design and development of the coin collecting apparatus used in public telephone installations. Such apparatus must be designed to withstand constant use over long periods; after several hundred thousand coins have gone through the mechanism, it must, though worn, still function properly. In recent years Bell Laboratories engineers, through the use of special coatings for the metal parts, have extended the service life of coin chutes so that they now last ten times longer than they once did. The photograph on the cover of this issue shows a life-test of a coin collector chute.

Number group frame for No. 5 crossbar

O. J. MORZENTI
Switching Equipment

As in the No. 1 crossbar system, there is no permanent or prearranged association of directory numbers with switch positions on the line link frames of a No. 5 crossbar office. A marker upon receiving the number for a terminating call must therefore ascertain which one of the many switch verticals in the office is associated with that particular directory number so that a connection may be established. The marker obtains this information from the number group frame. This frame, in a manner of speaking, is a large central file, kept up to date with the latest directory number assignments, to which each marker in turn applies for the necessary information, asking, in effect, on which line link frame and where on that line link frame will the line corresponding to this directory number be found. While getting this information, the marker must also be told the type of ringing required for this number—or the ringing combination as it is called. After this information is received, the marker disconnects itself from the number group, and proceeds to establish connection to the called line.

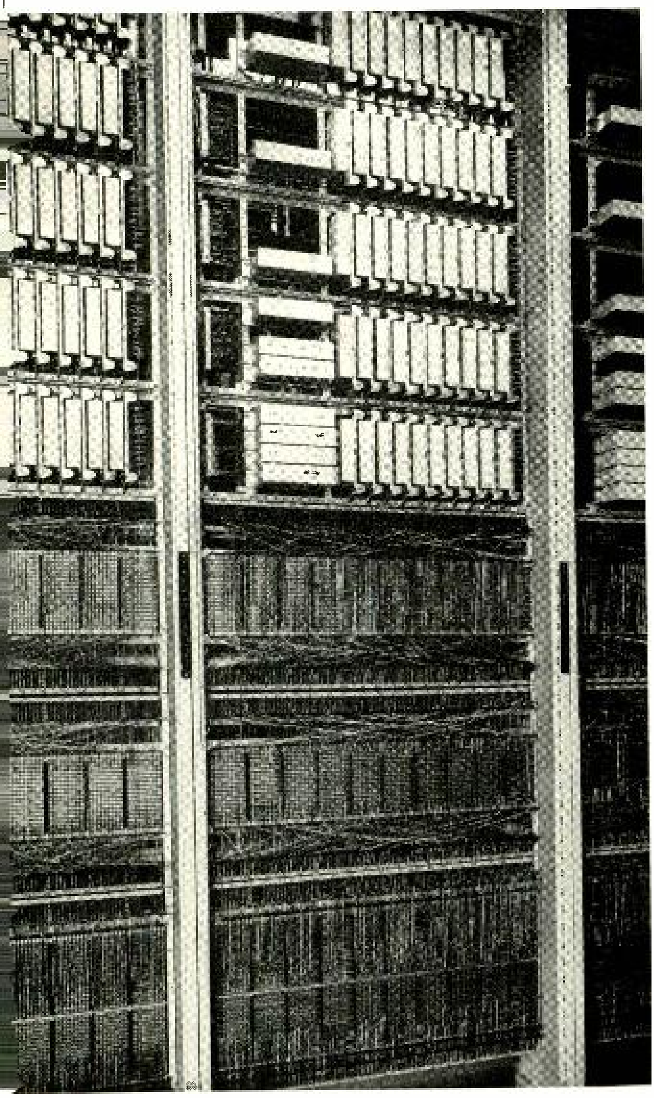


Fig. 1—A number group frame of the No. 5 system.

The position of a particular number on a line link frame is identified by giving the line link frame number, the horizontal group, the vertical group, and the vertical file, while the type of ringing is given as one of fifteen possible ringing combinations. A horizontal group represents the lines associated with all the crossbar switches in the same level of a line link frame, and there are ten such horizontal groups on each frame. A vertical group represents five verticals in the same vertical column on all ten switches of a frame. Any particular frame may have from six to fourteen vertical groups: six when no supplementary bays are used, and fourteen when the full complement of supplementary bays is used. A vertical file represents a single column of verticals, and there are thus five vertical files in each vertical group.

A number group frame, as pictured in Figure 1, is arranged to serve 1000 consecutive directory numbers. Thus, a 10,000-number office would have ten such frames, the first serving numbers 0000 to 0999, the second 1000-1999, etc., up to the last for numbers 9000-9999. The upper part of the frame is filled with relays which receive the directory number from the marker. They in turn extend leads from the marker to three cross-connecting fields occupying the lower half of the frame, where the actual translation from directory number information into equipment location is made. The bottom field serves to identify the line link frame number and is known as the "LL" field. The middle, or "RF," field, identifies the ringing combination and vertical file. The top, or "VHG" field, identifies the vertical and horizontal groups.

Each of these cross-connecting fields consists of an array of terminals in numerical sequence representing directory numbers, and an array of terminals representing specific equipment locations or ringing combinations. A translation is accomplished by means of a jumper wire which connects a particular directory number terminal to the terminal associated with its equipment location or ringing-combination terminal. Figure 2 shows the simplest form such a translating scheme may take, wherein these cross-connections are shown for directory number 2435 to LL 25 (line link frame 25), RF 024 (ringing combination 02, vertical file 4) and VHG 078 (vertical group 7, horizontal group 8). The marker, through paths WL, WF, and WG "wets" or places a potential on the proper directory number terminals, those of number 2435 in this example, whence the jumpers extend this potential to the equipment location terminals. The marker receives this potential back over leads FU, FT (frame units, frame tens), RC, VF (ring combination, vertical file), and HG, VG (horizontal group, vertical group) and thereby recognizes the translation.

A marker gains access to the proper number group frame, in competition with other markers, through its associated number group connector. The choice of number group frame is dictated by the thousands digit of the called directory number. Thus, the number 2435 would be found in number group frame 2; the marker summons that particular number group and is then concerned only with number 435 within that group. For transmitting this number to the number group frame, three sets of ten leads are employed: an HB set to indicate the hundreds digit; a TB set to indicate the tens digit; and a U set to indicate the units digit. As a result of a potential placed on one lead in each of these sets in the marker, relays in the number group connect three other leads from the marker, designated WL, WF, and WG, respectively, to the terminals in the three directory-number arrays representing the particular number wanted. Thus, if the marker has placed a potential on the NO. 4 hundreds lead, the NO. 3 tens lead, and the

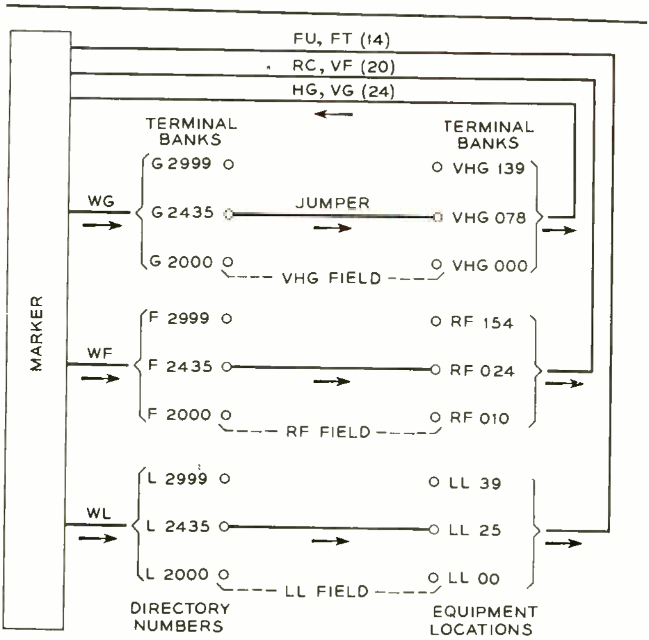


Fig. 2—Simplified diagram of the method of translating from directory numbers to the information the marker needs in locating a line.

NO. 5 units lead, the WL, WF, and WG leads will be connected to terminal NO. 435 of each of the three directory-number arrays. The WL lead will be connected to the array associated with the LL field; the WF lead to the array associated with the RF field; and the WG lead to the array associated with the VHG field.

How this is accomplished is indicated in Figure 3. There are ten hundreds block relays, and each of the ten leads over which the marker transmits the hundreds digit will

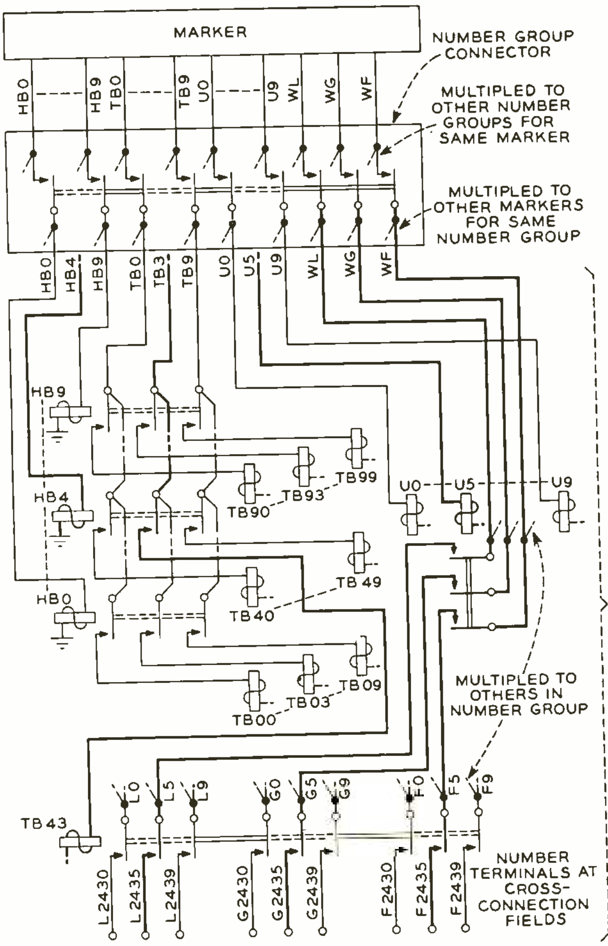


Fig. 3—Simplified schematic of relay circuit in number group that extends battery on WL, WG and WF leads from marker to called directory number terminations of cross-connecting field.

be connected to the winding of one of them. Each of the hundreds block relays has ten springs, and the ten leads over which the marker transmits the tens digit are connected in multiple to the springs of all the hundreds-block relays. The ten front contacts of each hundreds-block relay are connected to the windings of ten tens-block relays. In all there are 100 tens-block relays —ten for each of the hundreds block relays. Each tens block relay thus represents ten consecutive directory numbers. The NO. 43 tens-block relay, for example, represents directory numbers from 430 to 439, inclusive, since it is operated only when the NO. 4 hundreds lead and the NO. 3 tens lead have potential on them. Each tens-block relay has thirty springs, or three sets of ten, and each set is connected to one of the three arrays of directory number terminals already mentioned.

Multicontact relays are used for the tens-block relays. Each of such relays has sixty contacts and two operating magnets, but by controlling the magnets independently, each multicontact relay becomes the equivalent of two thirty-contact relays. Fifty multicontact relays are thus required to furnish the 100 tens-block relays, and they are mounted in five rows of ten each on the upper part of the number-group frame as may be seen at the upper right of Figure 1.

Besides the hundreds-block and tens-block relays, designated HB and TB for convenience, there is a group of ten units relays, and the winding of each is connected to one of the ten units leads from the marker. Each of the units relays has three springs, and the WL, WF, and WG leads from the marker are connected in multiple to the three springs of each relay. From the front contacts of the ten units relays there are thus a total of thirty leads, three from each—and these thirty leads are connected in multiple to the thirty springs of each tens-block relay. When a units relay is operated, therefore, the WL, WF, and WG leads will be extended to all the tens-block relays, and through the particular tens-block relay operated will be extended to the three arrays of directory number terminals. In the example taken, only the NO. 43 tens-block relay is operated, and if the NO. 5 units relay is operated, the WL, WF, and WG leads will be extended through the NO. 43 tens-block relay to the terminals of the three directory number arrays that represent NO. 435. Of the 1000 terminals in each of the three arrays, therefore, only terminals numbered 435 will be connected to the WL, WF, and WG leads and will thus have potential on them. Three jumpers then extend this potential to the terminals representing the equipment location and ringing combination and thence back to the marker.

The frame number is indicated to the marker over two sets of leads: a set of four FT leads to indicate the tens digit of the frame number, and a set of ten FU leads to indicate the units digit. This implies that for

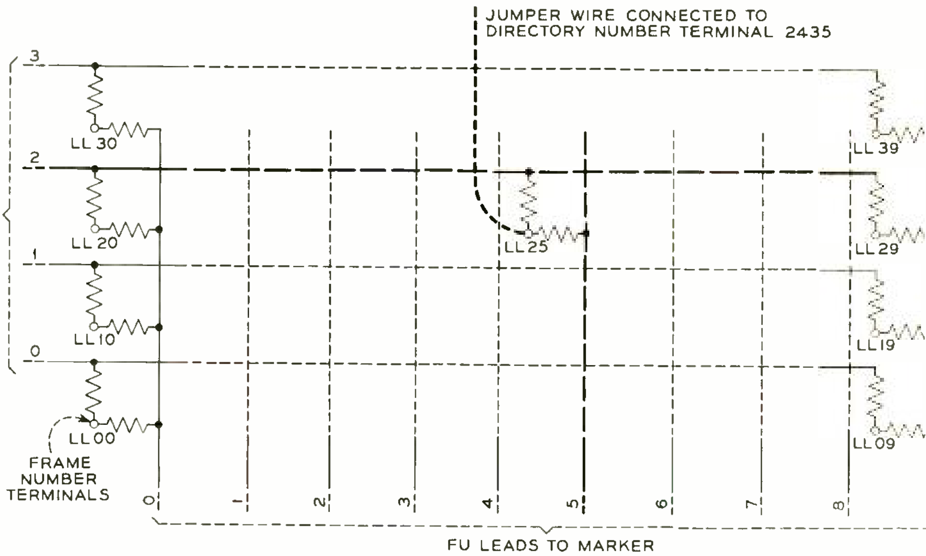


Fig. 4—Arrangement of resistance networks that permits two pieces of information to be translated by one jumper.

a line link frame number, it is necessary to convey two pieces of information—the frame tens and the frame units numbers. At first glance it would seem that two cross-connections would be required, one for each piece of data, instead of only the single cross-connection shown in Figure 2. By use of a resistance network as shown in Figure 4, however, it is possible to couple these two pieces of data with only one jumper connection. Here each of the line link frame number terminations, to which the directory numbers are cross-connected, is associated with the frame tens and units leads to the marker through a pair of resistances. Thus when a potential is applied through the relay tree, through the jumper wire associated with 2435, and thence to line link frame terminal 25, a current will flow through the FT2 resistance to the FT2 lead into the marker, where it is recognized as a frame in the twenties, and current will also flow through FU5 resistance to the FU5 lead into the marker, where it is recognized as a frame with a five units digit. These two facts inform the marker that it is frame 25.

An arrangement similar to that of Figure 4 is used for combining the vertical and horizontal group information. The possible 140 combinations can be accommodated by ten HG leads for the horizontal groups and fourteen VG leads for the vertical groups. Similarly for vertical file and ringing combination information, the 75 possibilities are cared for by twenty leads, five VF leads for vertical files, and fifteen RC leads for ringing.

There is still another function that the number group must perform for the marker. Some of the lines of any number group may be PBX trunks. The directory number given the marker will ordinarily be that of the first of the terminal hunting group, and this particular trunk and perhaps several adjacent ones may be busy while others in the group are idle. If the number group gave the location of the first trunk to the marker, the marker—after disconnecting from the number group—might find the trunk busy and would have to reconnect to the number

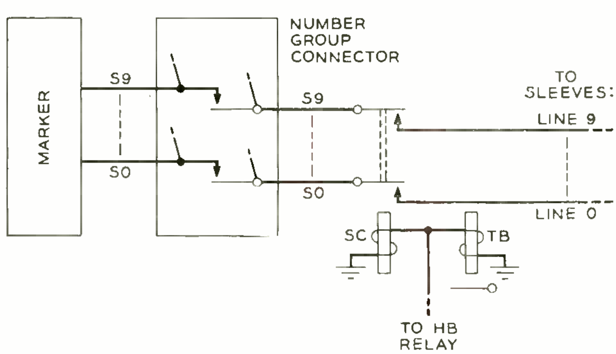


Fig. 5—Simplified circuit indicating method by which marker tests for idle PBX trunks.

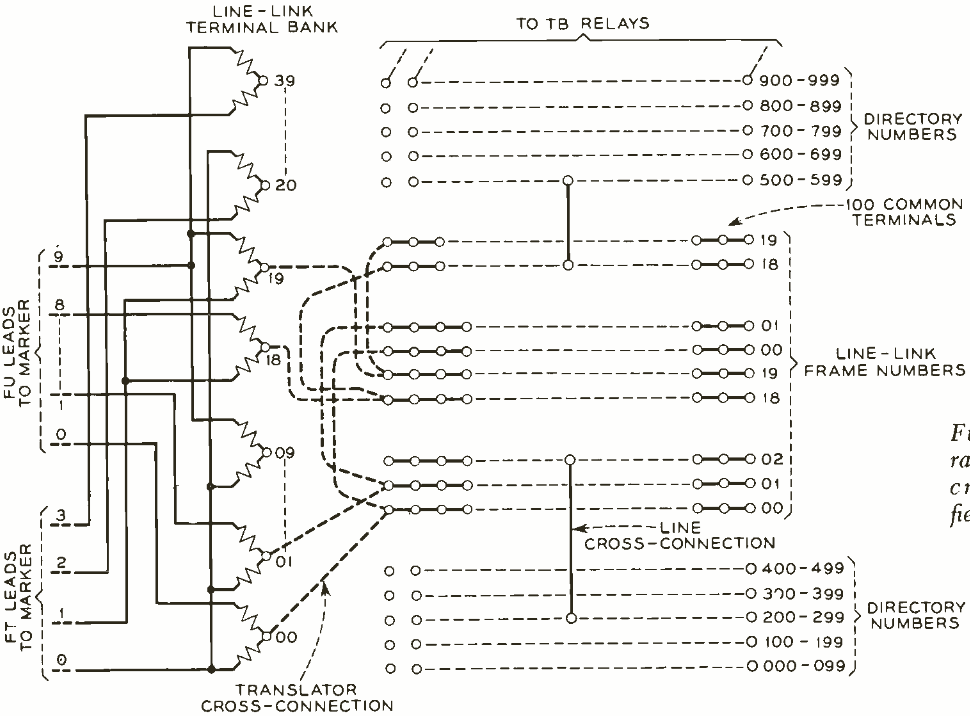


Fig. 6 — Typical arrangement of the LL cross-connecting field.

group to get the location of another trunk of the group. To avoid this loss of time, facilities are provided in the number group to permit the marker to test for an idle trunk before leaving the number group, and then to determine the location of only the first idle trunk found.

This is accomplished by extending the sleeve leads of all PBX trunks to the number group, and providing ten additional leads between the number group and the marker over which these sleeves may be tested. As shown in Figure 5, an SC (sleeve connect) relay is paralleled with each TB relay that has PBX trunks associated with it, and thus the SC relay is operated at the same time as the TB relay. There are ten springs on each SC relay, and the sleeve leads from the PBX trunks are connected to their front contacts, or to as many of them as may be required. The springs of the SC relays are connected through the number group connector, back to the marker.

All terminal hunting groups have ringing combination NO. 10, and when the marker gets this code from the number group, it

THE AUTHOR: O. J. MORZENTI joined the Systems Development Department of the Laboratories upon receiving his B.E.E. degree from the University of Minnesota in 1937. He engaged in trial installations and current engineering work until the war, when he became associated with radar and radar test set equipment design. Since the war he has been occupied with No. 5 crossbar switching equipment development. Four years of his Laboratories' service have been in the plants of the Western Electric Company at Hawthorne, Point Breeze and Duluth.

tests the ten sleeve leads, and then transmits a units code for the first idle trunk found. Where there are more than ten trunks in a PBX group, SC relays will be associated with all the TB relays that have trunks of that group, and provision is made for advancing from one to another if all trunks associated with one TB relay are busy.

The principal objective in the equipment design of the number group frame was to arrive at a flexible grouping of the LL, RF, and VHG terminal arrays so that they may be varied in size as the demand for terminals requires. Figure 6 shows a typical arrangement of the LL cross-connecting field, arranged for 20 line link frames. As with the RF and VHG fields, the 1000 directory number terminals are arranged in ten rows of 100 each, five rows above and five below the equipment location terminals. The LL field has 4000 terminals in forty rows of 100 each. Each row consists of ten groups of ten common terminals, multiplied together so that the 100 terminals of the row are common. In the illustration, since only 20 line link frames are involved, two such rows may be multipled to represent one line link frame. Had forty frames been involved, each row would have represented a single frame. Similarly, had there been ten frames, four rows could be multipled to represent a frame, keeping in mind, however, the pattern required for future expansion. These rows, or multiples of rows, are then connected to the translator resistor networks, which are mounted on the rear of the frame in groups of 20. Figure 7 shows these connections and resistors, with the multipling of terminals for the RF field. These facilities are provided on the rear of the frame where they do not interfere with running jumpers on the front of the frame to associate line with directory number assignments. The RF and VHG fields have 2000 terminals in 20 rows, arranged for variable multipling in similar fashion to the LL field.

These arrangements make possible a fairly standardized design for economical manufacture, and yet provide the needed flexibility to meet the many job variations peculiar to No. 5 crossbar application.

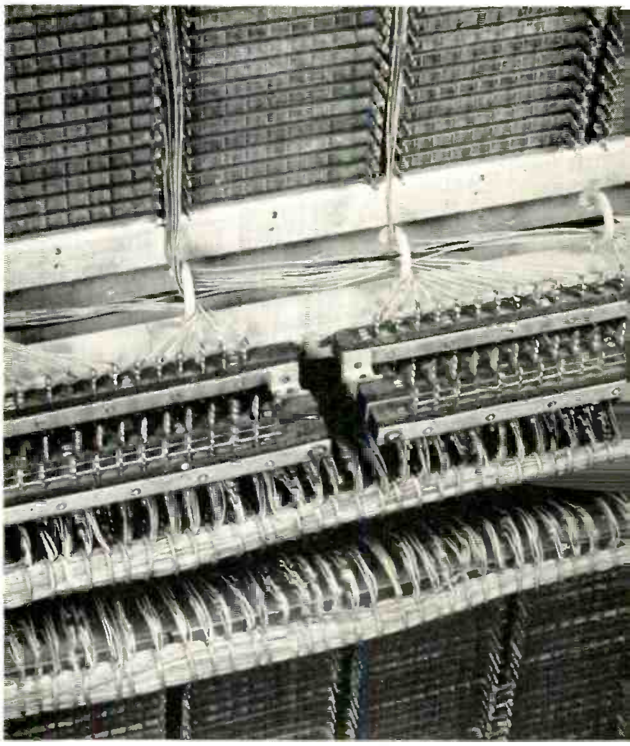
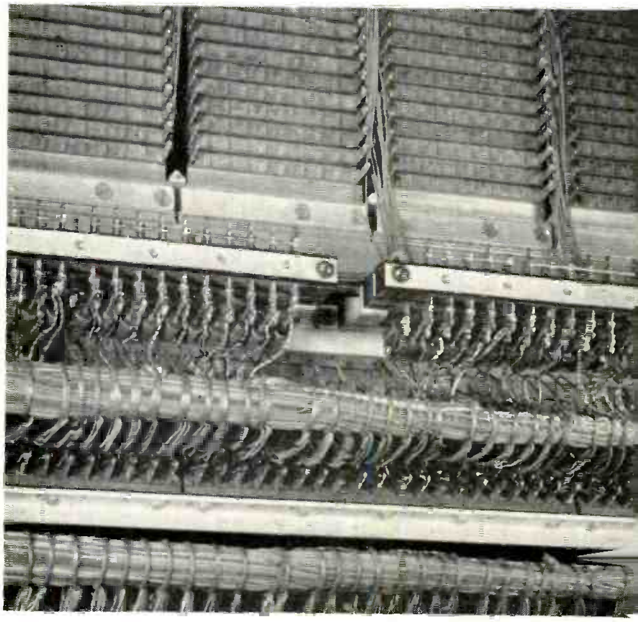


Fig. 7—Rear of number-group frame. Above, looking down on the terminal strips; below, looking at terminal strips from beneath. The resistors are just below the strips and are barely visible in the lower illustration.



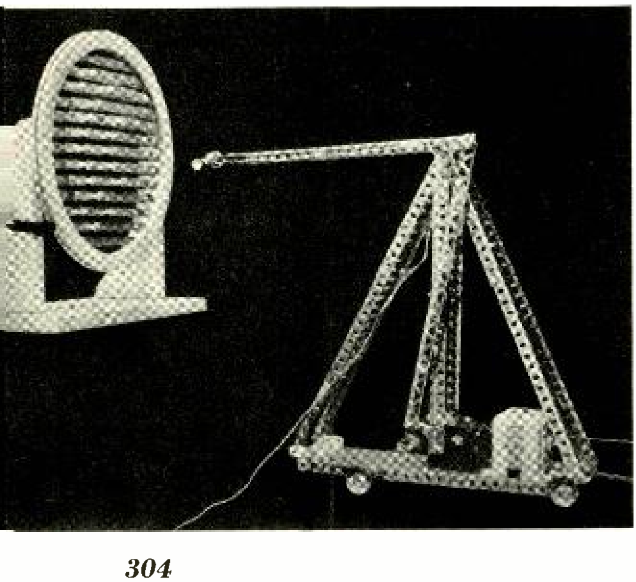
Photographing sound waves

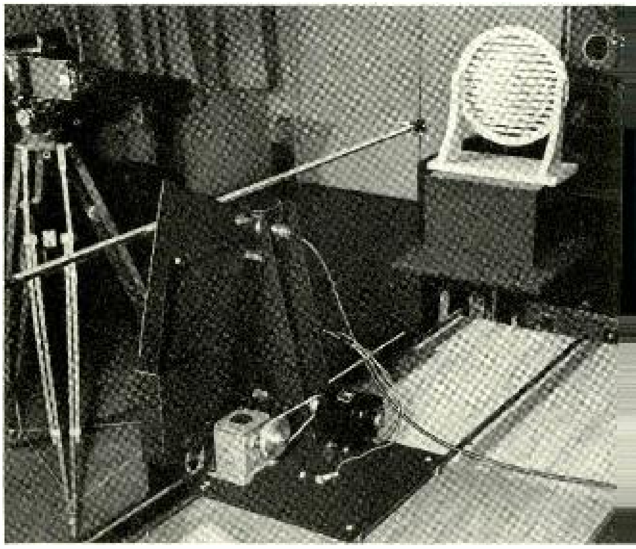
In analyzing the performance of a sound wave radiator such as a telephone receiver it is important to know the way in which the sound waves proceed as they emerge from the sound source. After studying various possible methods of capturing the compressions and rarefactions in sound waves, W. E. Kock and F. K. Harvey decided upon one that has proved to be very useful for investigating the space patterns of both acoustic and microwave radiators. This scheme involves a simple photographic technique wherein waves are portrayed by a small lamp moved up and down as it progresses in one plane across the sound field. Intensity of the light is varied automatically in accordance with the sound level determined by a small probe microphone attached to the lamp. The photography is carried on in a darkened room and the camera is arranged to record all the traces of the lamp so that a picture of the sound radiation is built up by scanning somewhat in the way television images are formed.

At the start, a toy construction set belonging to one of the smaller members of the Kock family was raided over a week end and on the following Monday morning a motor-driven scanning device of the walking-beam variety appeared on a laboratory bench ready for a trial run. The microphone and lamp were attached to one end of the swinging arm and connected to an amplifier. A small loud speaker radiating a high frequency was directed at one side of an acoustic lens and on the other side the scanner set was energized. For about ten minutes thereafter the excursions of the lamp were photographed with a Land camera, the scanner meanwhile pulling itself several feet through the sound field as an anchored thread wound itself up around an axle in the motor gearing. A minute later a developed picture was withdrawn from the camera. It showed promise.

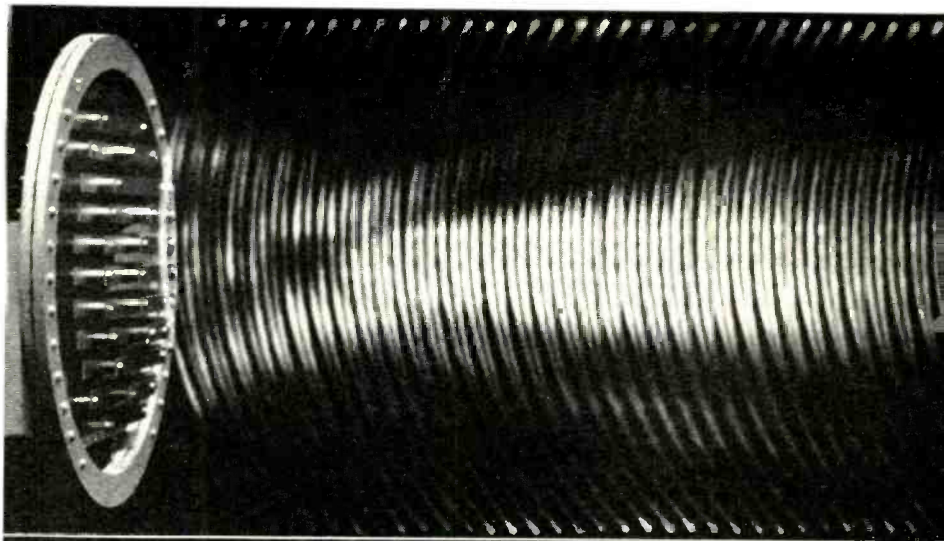
After several days of alternately adjusting amplifier circuits and film exposures, some crude but intriguing pictures were obtained of sound waves emerging from various lenses. The technique was further improved and additional pictures made on the bend-

First model of scanning device.

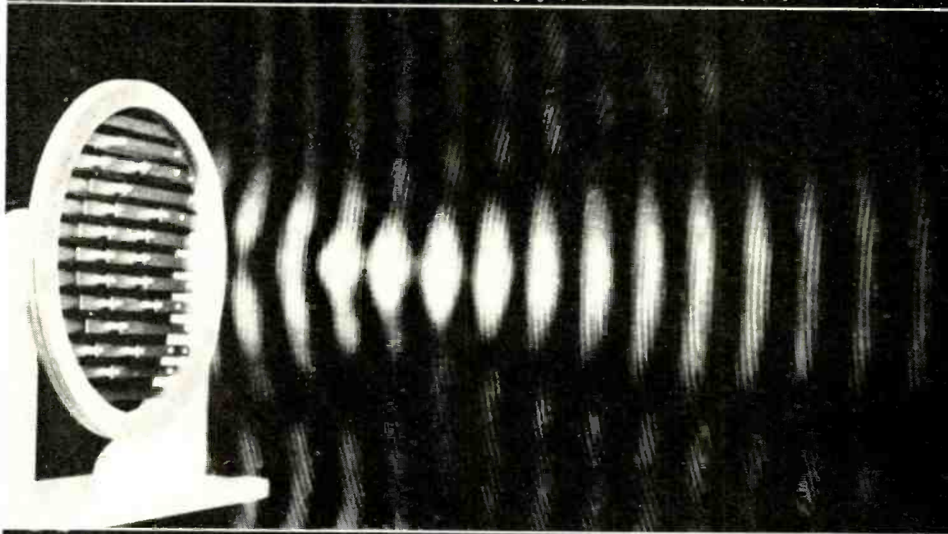




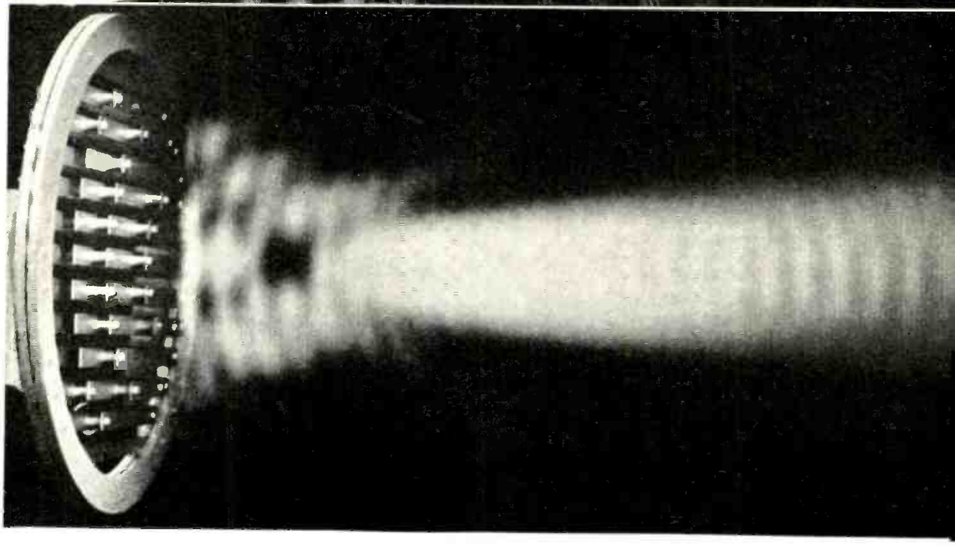
Improved model of scanner.



Results of first scanning attempt. The waves are there!



Adding a constant reference signal to the probe pickup causes interference which brings out the individual wave crests.



Fine-grain scanning with the improved instrument gives a smoother intensity-pattern.

Pattern of sound waves from a telephone handset.

ing of waves by prisms, diffraction around objects, diffusion by divergent lenses, radiation from loud speakers and so on. A movie also was attempted, by repeating a set of four frames each one a quarter-wave different in phase position—the result being a presentation of waves moving outward from a lens, converging to a focus, and then diverging again.

Although this rough apparatus succeeded in proving the ideas of the engineers it was, of course, only a stop-gap device. It had the temperament usually associated with improvised mechanisms and, having to be returned to its young owner, it yielded shortly to a smoother working model-shop product of closer tolerances and more rugged design. Both the experimental scanner and its successor are shown in the illustrations as well as typical sound-wave portrayals obtained with it.

Machine for winding helices on ceramics

Types of vacuum tubes now under development require the winding of helices on tiny ceramic rods which need to be supported at the point of application of the winding as the turns are applied. To do this, F. H. Best of Electron Dynamics Research has developed a novel winding machine. On a heavy bedplate are mounted six bearing-pedestals. First four in the picture carry the ceramic support for the helix; it is drawn along by a lead screw supported by the fifth and sixth bearings. As the support emerges through a guide, the wire is wound on. A wire of 0.6 mil diameter has been wound on one of 5 mils. Pitch of the winding can be tapered by a cam-and-lever arrangement in the transparent box. Pictured is Herminia Dominguez of Electron Dynamics.

D. A. ALSBERG
Transmission Development

Phase measurements for L carrier components

Television and broad-band carrier facilities, as, for example, the New York-Midwest coaxial cable link, employ vast numbers of transmission networks such as filters, equalizers, and repeaters. Adjustments of these networks during both development and manufacture require a large number of precise phase and transmission measurements.

Earlier measuring equipment did not provide the speed, facility, and accuracy considered necessary for the components to be tested. For example, a typical equalizer for L1 carrier requires measurements of phase and transmission at 60 points. To make these measurements required at least five hours and included applying calibration corrections and computing results. Errors in measurement might go undetected until the results were computed; besides, there was a possibility of errors in calculations.

A new phase and transmission measuring system, covering a frequency range from 50 to 3600 kilocycles has been developed and it is now possible to measure these quantities with greater accuracy and in considerably less time, with no need for corrections or computations. For example, the time required to measure the equalizer at the 60 points previously mentioned has been reduced from 5 hours to about 45 minutes, and the accuracy is greatly increased.

The new device compares, with respect to phase and amplitude, the outputs of two transmission channels energized from the measurement frequency source; one channel serves as the reference standard, while the other channel includes the apparatus under test. This is illustrated by the block diagram of Figure 1. The measuring circuit is based upon the heterodyne principle whereby the phase and transmission of the unknown are translated from the variable frequency to a constant intermediate frequency at which the phase and transmission standards operate.

Accurate phase shifters and variable attenuators having negligible phase shift are difficult to design for broad band operation. They may readily be designed, however, for fixed frequency operation. To operate the phase shifter standard and attenuator standard at a fixed frequency requires frequency conversion, thus introducing problems of modulator design and automatic frequency control; but these problems are less severe than those encountered in designing for broad band operation.

Referring to Figure 1, the desired measurement frequency F from the master oscillator is applied to both the standard "s" and the unknown "x" channels through the splitting pad I. Because of the transmission differential between the two channels, caused by the apparatus under test, the voltages at "s" and "x" modulator inputs, points A and B respectively, differ with respect to phase and amplitude. These voltages are applied to the "s" and "x" modulators where the original frequency F is converted to a constant intermediate frequency of 31 kc. The output voltages at points C and D from these modulators still differ in phase and amplitude, but are now at constant frequency, 31 kc.

To make this frequency conversion, a slave oscillator, shown to the right of the master oscillator in Figure 1, is used. By means of a synchronized oscillator and modulator, the output frequency of the slave oscillator is maintained constantly at 31 kc higher than that of the master oscillator. The frequency of 31 kc was chosen primarily on the basis of filtering requirements of the modulators; margin is provided between the lowest signal frequency, 50 kc, and the cut-off frequency of the filters so as to provide about 55 db loss at 50 kc. The output of the slave oscillator is applied to the "s" and "x" modulators at points G and H through splitting pad II.

Output of the "s" modulator passes through the range attenuator II and the measuring phase shifter into the detector

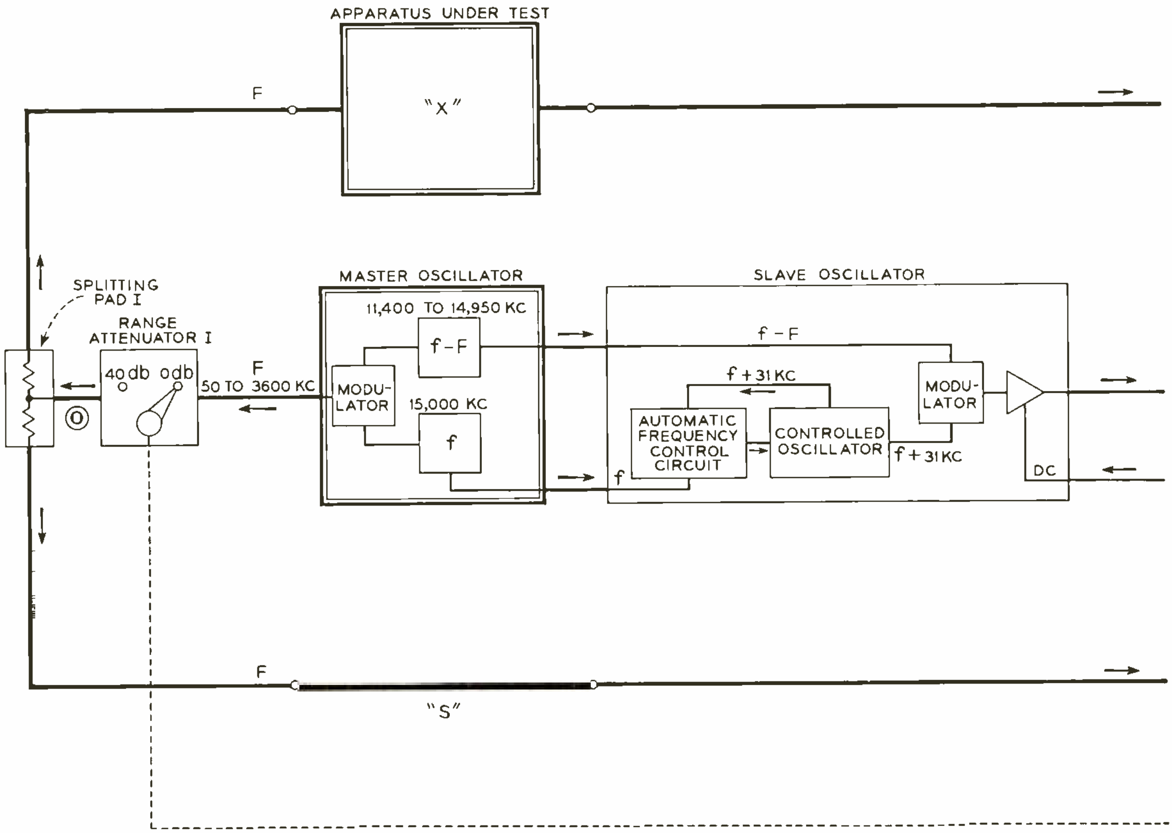
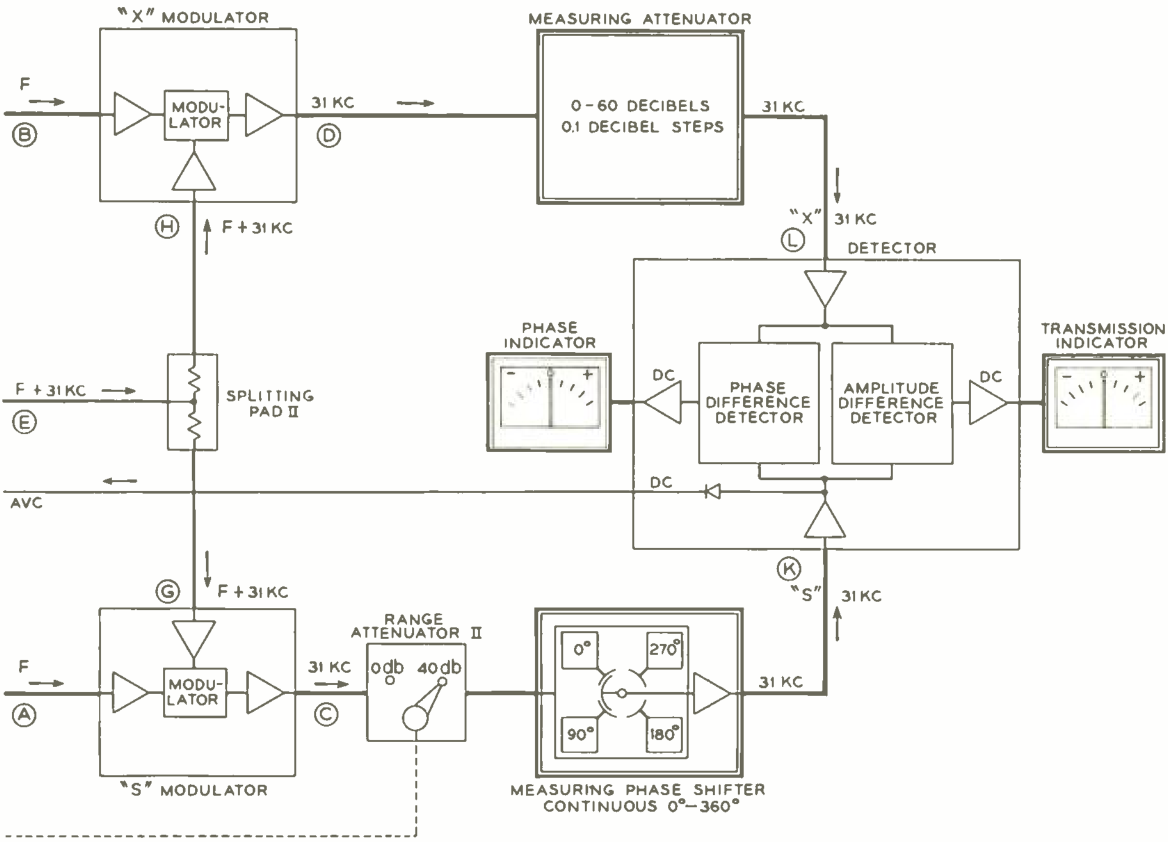


Fig. 1—Block diagram of phase and transmission measuring set.

at point K, while the output of the "x" modulator passes through the measuring attenuator into the detector at point L. The detector compares the voltages of the "x" and "s" channels as to magnitude and phase, indicating their differences on the scales of the indicator meters.

Adjustment of the measuring set prior to making measurements is accomplished by inserting a zero loss strap, electrically equivalent to the "s" strap, in place of the apparatus under test indicated in Figure 1, and adjusting for null readings on the phase and transmission difference indicating meters. The measuring phase shifter has, by design, 20 db loss; hence, with the measuring attenuator set at 60 db loss and the range attenuator set at 40 db loss, the "s" and "x" channels are nominally in balance, except for small residual phase and transmission differentials which are "zeroed" out by initial adjustments of the phase shifter and of the amplifiers within the detector. The phase shifter and attenuator dials are adjusted to read zero when this balance has been made.

Measurements of either loss or gain of the apparatus under test can be made on this device. When measuring loss, the range attenuator I is set to 0 db and the loss in the measuring attenuator reduced by the amount introduced by the apparatus under test. In measuring gain, the attenuation through the measuring attenuator must be increased by the amount of the apparatus gain. To insure that the "s" and "x" channel modulators are not overloaded by excessive input, range attenuator I is set to 40 db loss at the start of gain measurements. Since this attenuator is common to both "s" and "x" channels, no phase differential is introduced. By means of a mechanical linkage between range attenuators I and II, the latter is oper-



ated at the same time to remove 40 db loss from the 31 kc standard channel, keeping the net level at the detector input (point K) constant.

In addition to null-balance method of measurement, it is also possible to use the direct reading scales of the phase and transmission difference indicating meters. An automatic volume control circuit regulates the output voltage of the slave oscillator to maintain constant the amplitude of the "s" channel input to the difference detectors. It thus assures invariance of the indicator scale factors with either the modulator frequency-transmission characteristic, or input voltage variation at the "s" modulator caused by reflections from the apparatus under test. As the control action simultaneously affects both the "s" and "x" modulators equally, the system zero is undisturbed.

As indicated in Figure 1, the master oscillator, a modification of the 25A oscillator to be described in a forthcoming issue, is of the heterodyne type, employing a 15,000 kc fixed oscillator and a variable oscillator having a frequency variation of 11,400 kc to 14,950 kc. The scale for this master oscillator is of the motion picture type*, 300 inches long, calibrated every 10 kc and further subdivided every 2 kc. It covers the entire range of 50 kc to 3600 kc. A 0-10 kc vernier dial with 100 cycle divisions, operating on the fixed 15,000 kc oscillator frequency, is used to interpolate between adjacent 2 kc graduations on the main film scale. It is possible, by comparing the output oscillographically with a 10 kc standard of frequency, to set the oscillator within 50 cycles of any desired frequency in its band.

Due to unavoidable manufacturing varia-

*Record, *July*, 1942, *page* 270.

Fig. 2—Measuring attenuator with computing dials.

tions in the tuned circuits of the 31 kc fixed frequency section of the measuring circuit, there will be slight variations in the "Q" of these circuits. Small changes in frequency from the 31 kc value, therefore, will not produce exactly the same amount of phase shift between the "x" and "s" channels; consequently it is imperative that this frequency be held to a very close tolerance. Also, the calibration of the phase shifter is dependent upon close frequency control.

Briefly, the method of keeping this close control consists of applying the fixed local oscillator frequency f of the master oscillator, to an automatic frequency control circuit shown in the slave oscillator of Figure 1, which causes the controlled oscillator to have an output frequency f + 31 kc. This is modulated with the variable local oscillator frequency f – F, of the master oscillator, resulting in an output frequency F + 31 kc.

In the automatic control circuit of Figure 1, frequency f is compared with that of the synchronizing oscillator by detecting their differences in a modulator. The nature of the control is such that any deviation of this difference from 31 kc causes the frequency of the controlled oscillator to change in the direction to eliminate the deviation, with the result that the frequency is held to 31,000 ± 1 cycle. A description of this system will be given in a forthcoming issue.

When measuring gain, the measuring attenuator dials are arranged to increase in one direction, and when measuring loss, the indications increase in the opposite di-

Fig. 3—Optical cam of phase shifter.

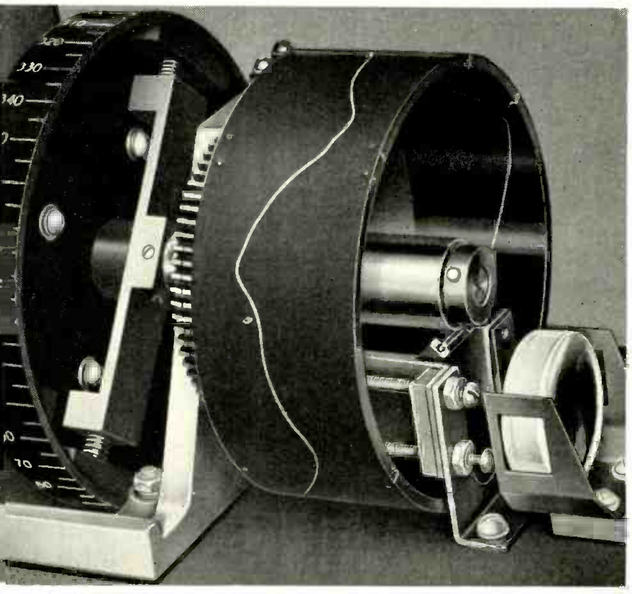
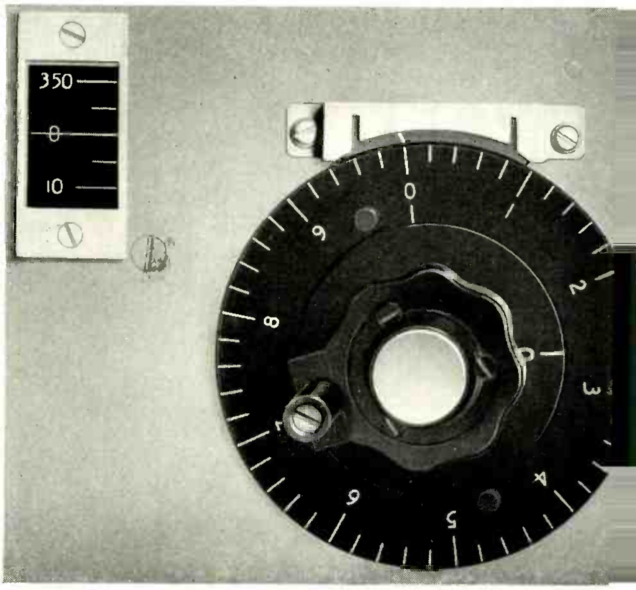


Fig. 4—Phase shifter scales and projected index.



rection. A switching arrangement automatically controls the dial lighting circuit so that the proper scales are illuminated at the number adjacent to the index. As shown in Figure 2, additional lights on the attenuator panel indicate when gain or loss are being measured. Thus, gain or loss is read directly without any need for computation.

The phase shifter uses a four-quadrant variable sine capacitor similar to those used in radar ranging units, and is provided with two linearly subdivided scales—coarse 0-360 degrees on a cylinder, and fine 0-10 degrees on a dial. To make this capacitor continuously variable over 360 degrees introduced a problem of linear correspondence of electrical phase shift with mechanical displacement of the rotor shaft. To overcome this problem, an arrangement shown in Figure 3 was used. The shaft of the sine capacitor is equipped with a transparent lucite drum, having a line that acts as a movable index associated with the fine dial which is geared to the sine capacitor shaft. This line is projected optically to appear adjacent to the fine dial, as shown in Figure 4 by means of a light projected through the lucite drum of Figure 3.

To calibrate the phase shifter, a cellulose acetate sheet was fastened to the lucite drum and calibration points every 5 degrees were marked on the sheet. The latter was then removed and the points connected by a smooth line. This line was transferred to a photographic negative that is fastened to the lucite drum, thus giving a transparent line through which the light passes to appear adjacent to the fine dial. Slip clutches permit setting the phase shifter dials to zero when the measuring set is initially "zeroed." Phase shift can therefore be read directly from the dial without need for computation.

No shift of the reference zero of the system occurs as the measuring frequency is changed. To achieve this, the difference in phase shift and transmission between the "x" and "s" channels is held to less than 0.1 degree in phase and 0.02 db in transmission over the entire band of 50 to 3600 kc. The problem may be illustrated by the fact that at 3600 kc, coaxial cable of the type used for television transmission in central offices contributes a phase shift of 0.2 degree per inch of length. This also illustrates the importance of the manner in which the network under test is connected into the system—it becomes necessary to define exactly the physical points on a network between which phase shall be measured. To obtain the full advantage of the independence of the "zero" from frequency changes, the patching cable in the "s" branch of the circuit is equal in electrical length to the cable and clip leads used to connect to the apparatus under test.

Measurement of phase and transmission differentials between the "x" and "s" channels is done in the detector where, through an equal arm resistance bridge, the vectorial sum and difference of the "x" and "s" voltages are compared in magnitude in a differential detector whose output then is a measure of the phase differential between the "x" and "s" voltages. This output is reasonably independent of the level differences between the "x" and "s" voltages. A second differential detector measures the transmission differential.

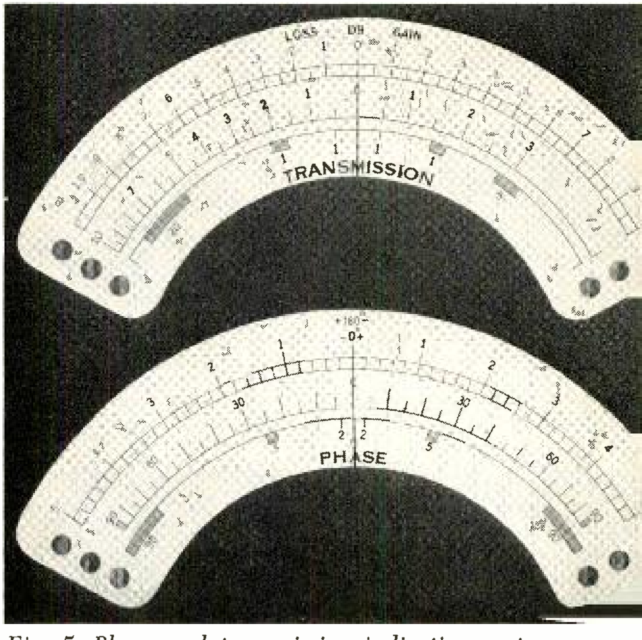


Fig. 5—Phase and transmission indicating meters.

Indicating meters display the phase and transmission differentials on calibrated scales. Three scales are provided on each meter, as shown in Figure 5. The fine scales permit close examination of phase to 0.1 degree and transmission to 0.02 db; the coarse scales permit rapid appraisal of network per-

Fig. 6—Operating the phase and transmission measuring set designed for video frequencies.

formance to the order of 2 degrees and 0.5 db by observing the meters while sweeping the master oscillator through the frequency band being used. The third is a null scale particularly for null balance measurements. These scales on both instruments have the same sensitivity as the fine scales near zero deflection, but since they are provided with varistor shunts across the indicators, the sensitivity is greatly reduced for large deviations from the balanced condition. Consequently, no matter how much phase and transmission are out of balance, the indicators always remain on scale. As an aid to the operator, colored pilot lights adjacent to each scale indicate the one in use.

Components of this measuring set are mounted in a specially designed console, shown in Figure 6. This console will be described in a forthcoming issue of the RECORD. Although the measuring set is a very complex instrument, the complexity is justified by the ease of measurement and the accuracy of the results obtained. To measure an apparatus component, the operator merely inserts it into the measuring circuit, sets the oscillator to the frequency desired and reads the meters or dial settings of the phase shifter and attenuator. The skill required of the operator has been reduced to a minimum, despite the high order of accuracy of measurement. A more detailed discussion of this measuring set will be found in the *Bell System Technical Journal* for April, 1949, pages 221 to 238, under the title *A Precise Direct Reading Phase and Transmission Measuring System for Video Frequencies* by D. A. Alsberg and D. Leed.

THE AUTHOR: D. A. ALSBERG obtained his undergraduate training in Stuttgart, Germany, completing the work in 1938. Coming to this country, he engaged in graduate study at Case School of Applied Science (now Case Institute of Technology) in 1939-40. Following three years as development engineer with several companies in Ohio, he entered the U. S. Army, serving at Aberdeen Proving Ground and in the European Theatre. In 1945, he came to Bell Laboratories, where he is concerned with phase and transmission measurement problems.

Maintenance facilities for the No. 5 crossbar system

O. H. WILLIFORD
Switching Engineering

In a No. 5 central office, new maintenance devices and techniques are employed, and the use of automatic trouble detecting facilities is increased. Also there is a greater degree of automatic coverage of the outside plant than in previous systems. Practically all the controls for maintenance equipment are concentrated in one location, called the maintenance center; the one at the Media office in Pennsylvania is shown in Figure 1. The equipment includes primarily a trouble recorder, an automatic monitor, a master test circuit, and a jack bay for outgoing trunks. Here also are means for extending the alarms* to a distant office during unattended periods.

The trouble recorder† functions automatically to keep a punched-card record of troubles that occur on service calls, both for the major part of the central office equipment and for the associated outside cable plant as well. The automatic monitor checks on a sampling basis the performances of the pulse-receiving equipment of all register circuits, and the pulse-sending equipment of all senders, and causes the trouble recorder to make records of irregularities disclosed. The master test circuit provides for simulating service calls under controlled conditions. This aids the maintenance personnel in the final diagnosis of an indicated trouble condition, and also permits insurance tests to be made of those parts of the central office equipment that do not have access to the trouble recorder. It also permits tests to be made of subscribers' line and outgoing trunk conductors, and associated incoming trunk circuits in distant offices. This includes a rapid test for continuity and polarity of outgoing trunks. The alarm extension facilities can keep an attendant at a remote central point informed of the occurrence of each trouble, and indicate to him its classification as to urgency of corrective action.

Automatic recording of trouble is aided by the nature of the No. 5 system wherein markers become associated with all major circuits in the process of establishing connections. Self-checking features, which are basic elements of markers, also check the associated circuits, and where faults are detected, they are recorded. Markers become associated with line circuits for originating and terminating calls, when checks for continuity and the absence of false ground are made, and through associated senders on outgoing calls they receive indications of open outgoing trunks. Such failures are recorded on the trouble recorder when encountered. Under key control, the trouble recorder may also record the identity of lines on which permanent signals occur.

The automatic monitor is provided to disclose irregularities in the pulsing features of registers and senders. This is one of the new devices in crossbar switching, and its performance is being followed with interest. Its circuit consists essentially of pulse-receiving equipment and two sets of digit recording relays. It associates itself automatically with registers on service calls and records on one set of recording relays the digits pulsed into the register by the subscriber, and on the other set, the digits passed from the register to the marker. It similarly associates itself with senders, and on one set of recording relays records the digits sent to the sender by the marker, and on the other set, the digits pulsed out by the sender. With both senders and registers, after pulsing is completed, the two sets of monitor recording relays are compared, and if mismatch occurs, the trouble recorder is caused to make a record of the details of the call. This record includes the identity of the as-

*Record, *August*, 1949, *page* 294; *September*, 1949, *page* 322.
†Record, *May*, 1950, *page* 214.

Fig. 1—Maintenance center of the Media No. 5 office.

sociated line or trunk, since some types of failure might be due to faulty line or trunk conditions. One monitor circuit cannot, of course, monitor all calls, but it works continuously, and over a period checks a substantial percentage of the calls each register or sender handles.

The No. 5 system is designed to permit a degree of unattended operation and therefore it is expected that there will be scheduled periods when an office is attended and others when it is not. Since the trouble recorder is automatic, it will record troubles which occur while the office is unattended as well as while it is attended. Also, during the unattended periods, alarms will be transferred to an attended office, and the seventy codes available permit the nature and seriousness of the trouble to be readily appraised. A repair man would at once be dispatched to the unattended office should any serious trouble arise, but normally the troubles will not be of a nature to require immediate attention.

When the maintenance force returns to the office at the next maintenance period, the punched cards stored in the trouble recorder give details on the troubles that have arisen, and thus they can readily be located and remedied. For this purpose the master test circuit is available. Its control panels carry keys and push buttons to permit the markers, registers, senders, and trunks to be selected as desired for a test call, and lamps on the control panel indicate the progress of the call. The automatic monitor can also function as a test circuit, and will be called in by the master test circuit in testing registers and senders. Troubles occurring in the major circuits while under test will be registered on the trouble recorder. The trouble recorder may also be controlled to give a record of the establishment of test calls which complete satisfactorily, to supplement lamp signals. Start and release control of this master test circuit can be extended to any point in the office where a maintenance man may wish to observe the performance of the equipment under these conditions.

While the office is attended, the master test frame is the observation and control point for the office. Here progress lamps display continuously the flow of traffic through the office, and an experienced man can often tell by the pattern of these lamp flashes in space and time whether or not all is well in the office. Audible and visual alarms will indicate the occurrence of irregular conditions in either the inside or outside plant under operating conditions. Individual circuit make-busy jacks are also concentrated here so that circuits with indicated troubles can be quickly isolated from service. Access by the master test circuit to circuits plugged busy is not prevented.

Both the trouble recorder and master test circuit are designed for use with automatic message accounting equipment where this is provided. It is necessary only to add a small relay unit to the master test circuit to adapt a master test frame for automatic message accounting maintenance. The trouble recorder was also designed in anticipation

THE AUTHOR: O. H. WILLIFORD joined the Laboratories in 1920, to take a technical training course for high school graduates. After completing this course, he took supplementary work at Brooklyn Polytechnic Institute and New York University. He then engaged successively in laboratory and field testing of step-by-step, panel, and manual systems, including the No. 3 centralized information desk system and the No. 4 order turret for receiving telegrams by telephone. During the development of No. 1 Crossbar, he conducted an out-of-hour course on this system and also rewrote the text material. During World War II he engaged in the development of secrecy communications systems and in the design and field testing of firing and control circuits for rocket launchers and flame throwers. With the development of No. 5 Crossbar he has been occupied principally in designing the maintenance facilities, and was one of the group who represented the Laboratories during the installation and cutover period of the initial installation in Media. As a member of the Switching Engineering Department, he is at present engaged in writing a series of engineering information descriptions of the No. 5 system, intended primarily to acquaint Telephone Company's engineers with features and arrangements available, together with their field of application, so as to aid in the engineering of central offices employing this type of equipment.

of the future automatic testing of subscriber lines for low insulation resistance. When this is provided, subscribers' lines can be tested automatically when desired, and the trouble recorder will record the identity of lines found to have less than an established minimum insulation resistance.

The possibility of unattended operation for extended periods of time lies in no small measure in the many operating safeguards that have been built into this system. The extensive use of second-trial and alternative-choice features prevents localized troubles from interfering with the completion of calls through the office, and circuits have been designed to prevent the pyramiding of trouble that has sometimes occurred under overloads in previous offices. These designs include a more liberal provision of timing intervals in the markers. This permits timing the switching functions in smaller increments, thus providing less circuit delay when failure is encountered, and advance by timeout is required. Every precaution has been taken to localize trouble when it does occur. The more extensive use of double contacts, the elimination of relay types and contact combinations that have required abnormal maintenance in previous experience, as well as a more liberal use of contact protection, greatly contribute to the freedom from trouble in the No. 5 office.

Dodge Awarded Shewhart Medal

Harold F. Dodge, Quality Results Engineer, was presented the American Society for Quality Control's 1949 Shewhart Medal at the Society's annual convention in Milwaukee recently. The citation accompanying the award recognized Mr. Dodge's "many original contributions to the art of statistical quality control, his pioneer achievements in scientific sampling inspection, and his leadership in the development of quality control standards for industry. These contributions," the citation states, "have exerted a deep and stimulating influence on the founding and growth of quality control as a new engineering profession."

The Shewhart Medal was established in 1947 as a tribute to Walter Shewhart of the Laboratories, first honorary member of the Society, whose development of statistical methods for control of manufacturing processes led to the foundation of quality control as a profession.

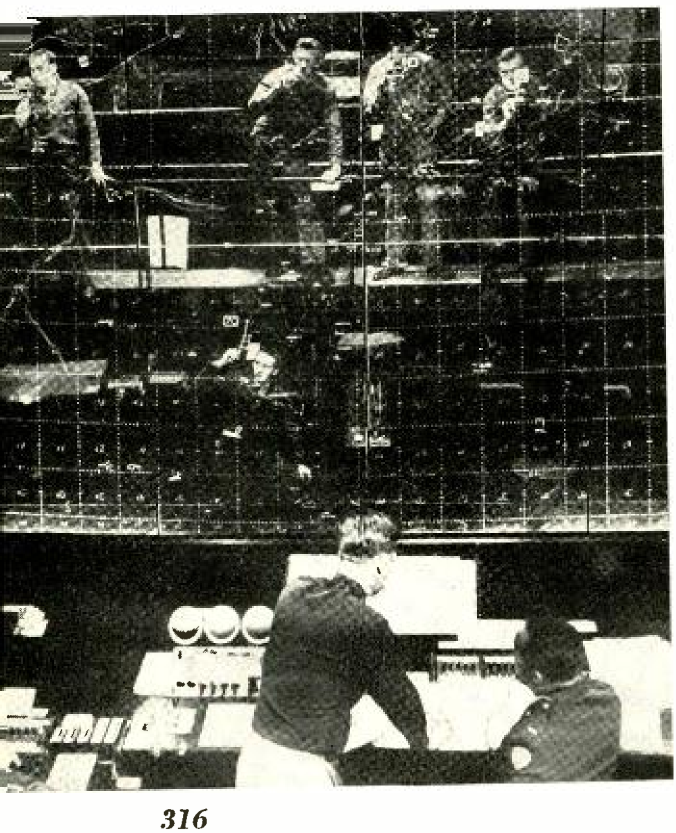
Bell System Important to Air Defense

The Air Force has given the go-ahead signal to Bell System and independent telephone companies for a job of the utmost importance—providing communication facilities for a permanent air defense and air raid warning system which will be able to alert the entire United States quickly should an emergency arise.

The Continental Air Command, Lt. Gen. E. C. Whitehead commanding, headquarters Mitchel Air Force Base, N. Y., already is operating radar outposts in New York and in other parts of the country and more will be set up. And by the end of the summer it hopes to have 160,000 civilian ground observers recruited and trained as lookouts.

The program means a man-sized task for all telephone people. Operating groups—installers, operators and others—will set up equipment and handle vital calls. Non-operating people may volunteer their services as ground observers and plotters and for many other jobs.

Air defense control center operating near New York area has this Lucite wall map of northeast states and other areas. From scopes at radar stations and other sources of information, plotters wearing headsets track aircraft in the area, writing backward on the map with luminous pencils so controllers can read the data easily.



Briefly, here's the way the Ground Observers' Corps fits into the picture. At a giant chain of 8,500 civilian observation posts, the spotters, using existing commercial telephone lines, will swiftly report any planes to filter centers.

The Bell System has issued instructions for the rapid passing of the aircraft flash call from the ground observer's telephone to the proper filter center and to the proper portion of the plotting board at that center. Operators trained in the handling of air raid warning calls will periodically receive "refresher" training.

At the filter centers the telephoned reports are plotted, filtered and passed on to the proper radar identification center. At this point radar and ground observer information is correlated, evaluated, and relayed to another point, an air defense control center. Filter and control centers are well supplied with 1A key telephone systems, many of them modified by Bell Telephone Laboratories.

There a control officer, from the information thus accumulated, takes appropriate measures to meet the situation presented; perhaps calls into action anti-aircraft batteries and orders air raid warnings to key point areas likely to be endangered. These are geographical sections embracing concentrations of strategic industry or population.

In issuing these warnings, at each air defense control center, an air raid warning officer is in charge of a communication warning system made up of a modified 551-type PBX switchboard of from two to three positions and a "memory" board, designed by the Laboratories, which is equipped with colored lamps to indicate the degrees of the alert.

This board, installed for the Air Force by the telephone company, is a map showing the key point areas. Circuits designed by Station Systems Development connect it electrically with the switchboard so that when a warning is given to any particular area the color of the warning is indicated by a corresponding light on the memory board.

This permits the air raid warning officer to concentrate on other areas to be warned, yet keep informed of the status of warning in each area.

Each of the air raid warning switchboards has lines to the nearest long distance toll board. The entire system operates by using normal toll telephone connections over which the warning calls are flashed, under priority handling, to each key point warning center, where the telephone company has installed a telephone modified by Station Systems Development to have a red handset and four illuminated buttons. Each of the buttons is connected to a separate one-way line from the local toll board. Complete instructions are attached to the front of each instrument.

When a key point receives an alert from the air defense control center, the telephone rings

n New York City's Police Headquarters, an installer uts in a new key telephone. The four illuminated buttons of this red set indicate degrees of alert.

and a flashing colored button indicates the degree of warning. A person at the key point warning center depresses the button and answers with the name of his center and the color of the lighted button. This answer, if correct, is acknowledged by the Air Force operator verifying the signal.

The key point then proceeds to spread this warning to other communities in the warning area which in turn notify vital units such as hospitals and fire departments.

The ground observer system closely parallels the air defense which was brought to high efficiency during World War II. And now, as then, every operation, from reports of airplanes detected by radar or by civilian observers, to the ordering of fighters into the air, relies on telephone facilities and services.

A big part of the job is supplying private line telephone and teletypewriter circuits required for the use of the Air Force exclusively, designing unusual telephone arrangements using standard equipment, and installing the all-important communication systems for radar identification, filter and air defense control centers.

Except for scheduled training exercises—like "Operation Lookout" successfully completed last September in ten northeastern states—and emergencies, the ground observer posts and filter centers will be maintained on a "stand-by" status.

Located strategically in the Continental Air Command, the New York Telephone Company, through its liaison representative, Herbert J. Schroll, assistant vice president, has the responsibility of coordinating defense communications planning and requirements for other Bell System companies and the United States Independent Telephone Association. Each of these companies has appointed its own representative who serves as coordinator for the company's territory.

Also co-operating are the A T & T and Long Lines, the Western Electric Company and Bell Telephone Laboratories.

Vail Medal Awards

Three telephone men who braved a blizzard, and an operator who remained at her post during a disastrous fire to help others in distress last year, have been named to receive silver Vail medals and $500 in cash each for "courage and devotion to duty," it was announced June 1.

The Vail awards are made from a fund established in 1920 as a memorial to Theodore N. Vail, former A T & T president, to perpetuate the Bell System ideals of public service.

The Bell System National Committee of Award recognized the outstanding spirit of service of three plant department men of The Mountain States Telephone and Telegraph Company. They were William B. Edmunds, cable splicer; Keith F. Hough, combinationman; and William L. Payne, combinationman, all from Cheyenne, Wyoming. It also granted an award to Mrs. Helen Doris Turner, Hyndman, Pa., an operating agent of the United Telephone Company of Pennsylvania, a non-Bell company.

The Mountain States men comprised a "snow buggy" team which in January, 1949, rescued many people stranded in the state's worst blizzard on record in which thirteen lives were lost. As cases were reported to them by the Wyoming Highway Patrol and the American Red Cross, the men set out at great personal risk to aid people in distress. The three worked throughout the three-day storm, under almost unendurable conditions.

Mrs. Turner stuck by her switchboard during the disastrous fire which on Christmas of last year gutted the heart of Hyndman, killing two and injuring several. Operating her switchboard by flashlight, and later by the glow of approach-

New York Times Photo

A reproduction of the first telephone used to transmit news was presented by the Laboratories to The New York Times, *and put on display in the newspaper's Museum of the Recorded Word. The instrument was presented to Arthur Hays Sulzberger, left, president and publisher of* The Times, *by J. T. Lowe, curator of the Historical Museum.*

ing flames, Mrs. Turner remained at her post despite fire fighters' warnings of danger. She summoned fire departments, ambulances, the Red Cross and doctors from nearby communities.

In making its selections, the National Committee considered 24 noteworthy acts performed by telephone people in 1949 and early 1950. The deeds involved 38 individual employees and one group to whom bronze Vail medals had previously been awarded by committees within the various Bell System companies. Each bronze medal awarded to an individual, not selected for a higher award, is accompanied by $100 in cash.

Jewett Fellow Publishes Chemistry Text

First book to be announced from a Frank B. Jewett Fellow is *Principles of Ionic Organic Reactions,* by Elliot R. Alexander, published by John Wiley & Sons. To an acknowledgment, in his preface, of Fellowship aid, Dr. Alexander added in a letter to the Committee, "Without the Jewett Fellowships this book would not be in existence."

Dr. Alexander was one of the first five scientists to receive a Fellowship. Since completing his work at Harvard and the University of California, he has been in the Chemistry Department at the University of Illinois, first as Instructor and now as an Assistant Professor.

Frederick Johnson Elected President of Pioneers

Frederick Johnson of Montreal has been elected president of the Telephone Pioneers of America for the one-year term beginning July 1, 1950. Mr. Johnson, who is president of the Bell Telephone Company of Canada, served as senior vice president of the Pioneer Association last year. He is succeeded in that post by Hal S. Dumas of Atlanta.

1950 Greater New York Fund Drive

Volunteer solicitors for the 1950 campaign of the Greater New York Fund collected $4466.80 from 1721 members of the Laboratories in New York. The funds will be used by 423 social agencies, hospitals and asylums for the care of the sick and poor in New York. J. C. Kennelty was chairman of the drive this year.

The Murray Hill Symphony Orchestra

The Murray Hill Symphony, conducted by P. B. Oncley, presented its second noon-hour program of the season on May 25 in the Arnold Auditorium to two capacity audiences. U. A. Matson, as piano soloist, played the first movement of the Beethoven Concerto No. 1, accompanied by the orchestra. Music by Abert, Dittersdorf and Luigini made up the orchestral part of the program.

A party on June 13 for members of the Symphony and their families closed the season. Officers for the 1949-50 season were R. H. Nichols, Jr., chairman; F. L. Crutchfield, vice-chairman; R. N. Larsen, treasurer; and Priscilla Pecon, secretary. E. E. Mott served as librarian. J. B. Hays, Jr., was chairman of the Music Committee, assisted by H. F. Dienel and J. V. Domaleski.

Musicians who have recently moved to Murray Hill are cordially invited to join the Symphony when rehearsals resume in the Fall.

News Notes

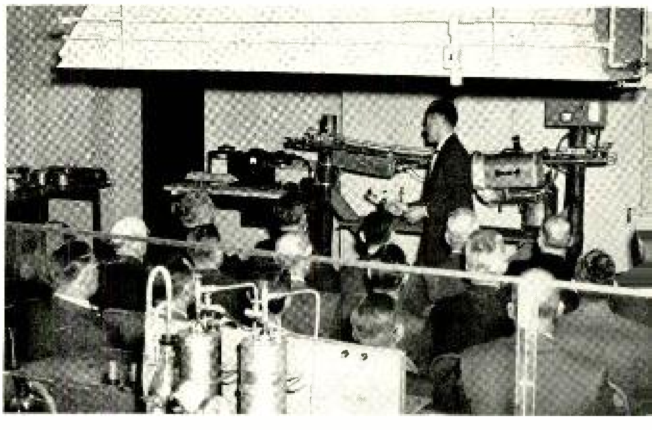
R. Bown, on a trip to the Pacific Coast and the Sandia Corporation at Albuquerque, New Mexico, during May and early June, addressed joint meetings of the A.I.E.E. and the I.R.E., at Seattle, Portland and San Francisco, and a meeting of the Electric Club in San Francisco. At each of these three cities and in Los Angeles he addressed groups of telephone employees.

In the March, 1950, issue of the *Journal of Speech and Hearing Disorders,* the Council of the American Speech and Hearing Association presented the Honors of the Association, "for distinguished contribution to the field of speech and hearing," to Dr. Harvey Fletcher. Dr. Fletcher's portrait and a summary of achievements for which the award was granted appear in the *Journal.* Since his retirement last fall from the Laboratories, Dr. Fletcher has been teaching at Columbia University.

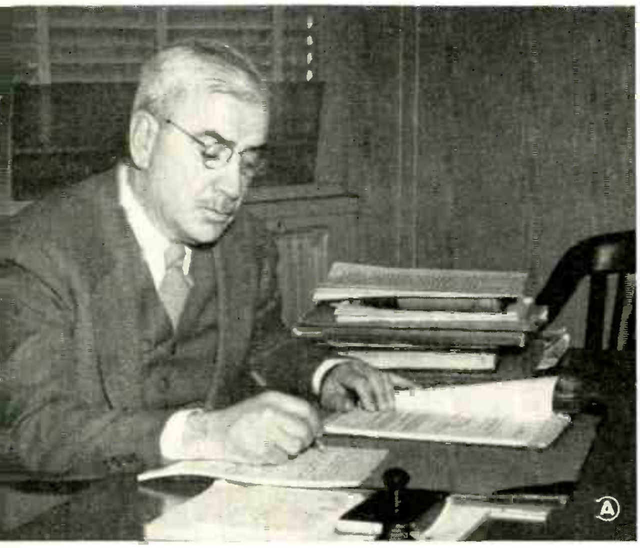
W. H. Doherty, Director of Electronic and Television Research, received an honorary degree of doctor of science from the Catholic University of America on June 7 at the sixty-first annual commencement exercises.

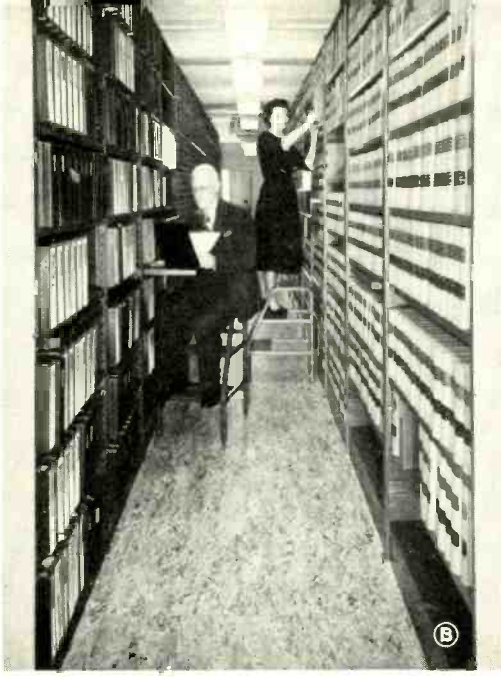
J. M. West, as Military Research Engineer, now reports directly to W. C. Tinus, Acting Director of Military Electronics Development. Mr. West's various groups will be headed by S. C. Hight, R. C. Newhouse, H. T. Budenbom, J. H. Cook, M. J. Burger and E. L. Norton. Now reporting to R. A. Cushman is V. M. Cousins, who formerly reported to Mr. West.

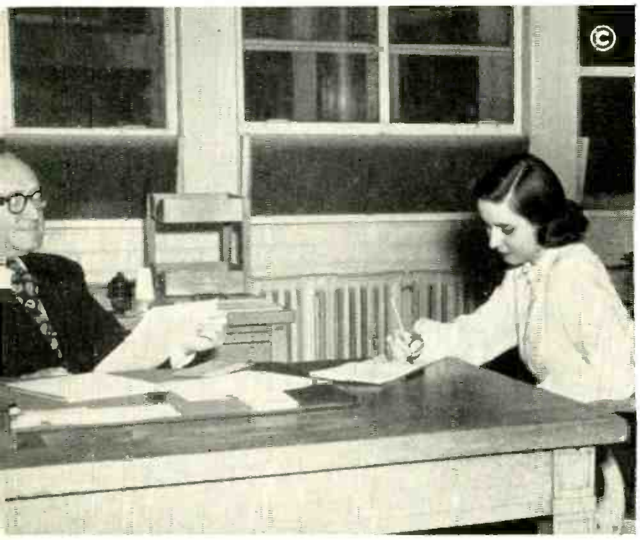
M. H. Cook and J. R. Townsend have received honorary certificates of the American Standards Association in recognition of their work in the development of industrial standards.



On May 11 over 350 executives and supervisors of New Jersey Bell visited the Murray Hill laboratories. In the morning one half the group listened to lecture-demonstrations in Arnold Auditorium while the other half toured the buildings. In the afternoon the groups reversed. The upper photograph shows E. Hartman discussing sound reference measurements and the lower one, M. W. Bowker, cable development.







THE NEW YORK QUARTERS

Administrative offices and some of the staff of the Patent Department are now quartered on the sixth and seventh floors at West Street. There are four divisions, headed by Division Attorneys J. W. Schmied, H. A. Burgess, G. H. Heydt and B. H. Jackson; thirty-five attorneys report to them. Service groups at West Street and Murray Hill are headed by H. P. Franz.

General views of the West Street quarters include G. H. Heydt, one of the Division Attorneys, shown at his desk (A) and attorney P. J. Roche searching a patent in one of the files where Rose Kovac is working (B). Chief clerk of the Patent Department is C. A. Conrad (C) dictating a memorandum to Helen Kubu. H. P. Franz (D) is Patent Service Manager. Photograph (E) shows the girls who are responsible for

OF THE PATENT DEPARTMENT

the patent, general and correspondence files of the department. May G. Reilly, patent librarian, is shown on the extreme right of the group. Secretaries to the division attorneys (F) occupy the front of the transcription room.

In the next photograph (G) showing a part of the library is V. P. Triolo making use of reading room facilities and Elizabeth Culbert, checking an item in the current magazines on the rack. Dorothy Patchell standing (H) is in charge of the group working on controls and reports. Mabel Weidler, rear of (I) is responsible for patent transcription. At the lower right (J) H. F. Beck, standing, patent drafting supervisor, discusses a drawing with one of the draftsmen, E. A. Lichtenberger.

News Notes

E. T. MOTTRAM has been appointed a Transmission Systems Development Engineer, reporting to H. A. Affel, Director of Transmission Systems Development. In this capacity Mr. Mottram will have charge of groups concerned with broad-band terminals, transmission testing systems, equipment, drawings and laboratory maintenance. In addition, the submarine cable group under J. J. Gilbert, which formerly was a part of G. N. Thayer's organization, now is in Mr. Mottram's.

E. H. BEDELL, formerly Assistant Superintendent, Manufacturing Engineering, Western Electric Company, Burlington, North Carolina, has accepted a position with the Laboratories as of June 1. Mr. Bedell is in charge of the activities of the Military Electronics Department in the Burlington and Winston-Salem Radio Shops reporting to W. C. TINUS, Acting Director of Military Electronics Development at the Whippany laboratory.

The first of a series of displays of the Laboratories' work has been constructed for the Concourse at Murray Hill. This display is devoted to work on electron tubes. Those to follow will cover telephone instruments, outside plant developments, crystals, semi-conductors, and other areas of Laboratories work. The displays are being built by the Macmullen Associates of New York, under the direction of H. J. Kostkos (at the left) of the Publication Department.

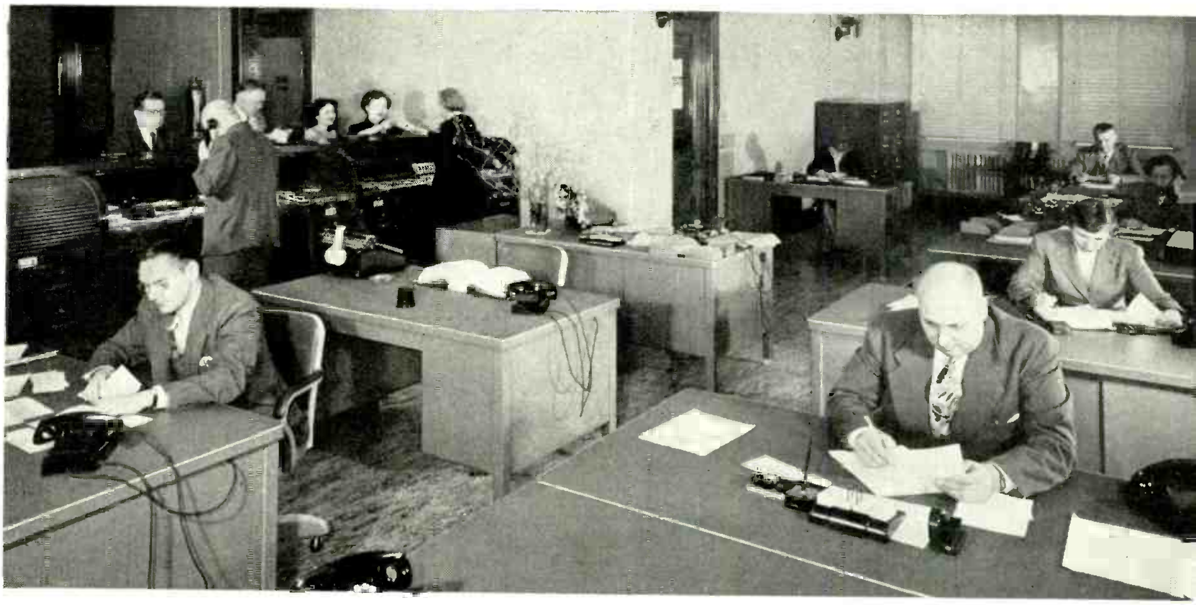
LAST MONTH, in the story *Submarine Cable Links Key West-Havana*, it was stated that "construction of the detail parts (of the repeaters) was supervised by L. F. WILLEY and B. SLADE." It should have been "by M. C. WOOLEY and B. SLADE."

R. J. NOSSAMAN attended the Plant Operation Conference of the Northeastern area of the Ohio Bell Telephone Company at Catawba Cliffs Beach Club, Catawba Island, Ohio, from June 7 to June 9. On June 8, he told the conference about new developments in outside plant, among them pre-lashed cable, polyethylene insulation on cable conductors, and a new central office protector. He also discussed results to date in coordinated maintenance studies of exchange plant.

R. K. POTTER attended a conference on speech communication under the joint auspices of the Acoustical Society of America, the Carnegie Project for Scientific Aids to Learning at the Massachusetts Institute of Technology and the Psycho-Acoustic Laboratory at Harvard University. The conference was held four days, May 31-June 3, at Massachusetts Institute of Technology. Others who attended were J. C. Steinberg, H. K. Dunn, N. R. French, W. E. Kock, E. Peterson, H. W. Dudley, L. C. Peterson and O. O. Gruenz. Papers were presented by Mr. Steinberg, *Vocal Cord Vibrations;* Mr. Dunn, *Demonstration of Electrical Vocal Tract;* Mr. French, *Questions Regarding the Auditory Systems;* and Dr. Kock, *Binaural Localization and Masking.*

F. J. GIVEN served as chairman and gave the welcoming address of the *Symposium on Improved Quality Electronic Components* which was held in Washington May 9-11. It was sponsored jointly by the A.I.E.E., the I.R.E., and the Radio Manufacturers Association, with the cooperation of the Department of National Defense and the National Bureau of Standards. E. I. GREEN, P. S. DARNELL and R. M. C. GREENIDGE delivered papers at the meetings.

J. Z. MENARD went to Cleveland to discuss the operation of transcribed message facilities in the 3A weather system.



The Treasury Department at West Street has returned to its former quarters, now completely renovated. A general view of the room with its specially designed bookkeepers' and tellers' desks is above. Members of the Department are J. F. Murphy and Bessie O'Donnell standing at the counter, left; and seated H. S. Hopkins and Marie Tighe, first row; and R. A. D'Elia, Anne Cooper, Anne Sweeney and E. W. O'Hara, second row.

At the annual luncheon of the Bell Laboratories Club, officers for the 1950-1951 season were installed. Seated, left to right, around the table are J. J. Harley, Marie Kummer, Second Vice-President of the Club for 1950-51; F. D. Leamer; Christine Smith, Assistant Secretary of the Club; D. D. Haggerty, Executive Secretary; G. H. Reuble; O. E. Buckley; J. A. St. Clair; F. E. DeMotte; R. H. Wilson, President of the Club; Fay Hoffman; D. A. Quarles; A. J. Daly and Muriel Walter. Standing, left to right, are H. Z. Hardaway, first Vice-President of the Club; D. J. Brangaccio; A. J. Kuczma; H. H. Abbott; E. A. Perpall; W. J. Seeger; R. A. Deller, N. W. Bryant; S. D. White; E. K. Eberhart; J. G. Whytock; and W. C. Toole.

RETIREMENTS

Among those retiring from the Laboratories are F. S. Malm with 44 years of service; W. H. Long, 41 years; C. S. Demarest, 40 years; S. C. Cawthon, 39 years; and C. H. Amadon and R. A. Shetzline, 32 years.

Charles S. Demarest

Things weren't too easy for Charlie Demarest back in the nineteen-hundreds. It was still the custom, for a boy who wanted an education to go out and work for it; and because his father, formerly a minister, was dead, Charlie started to work early. In the summer of 1903 he started to work for Western Union in Chicago, soon became an operator, and continued in this work intermittently for various companies until he was through college. It was his experience in telegraphy that brought him into the Bell System in 1906. The Northwestern Company

C. S. Demarest F. S. Malm

had a heavily loaded circuit which they wanted to operate by the "dispatch" method; i.e., the name of the called party was passed by telegraph and the distant operator made sure he and his line were available when the toll line was ready. Mr. Demarest was hired to take charge of the telegraph part of this operation. During the summer vacation following, he worked as a Long Lines testboard man in Minneapolis.

With the degree of Electrical Engineer from the University of Minnesota safely tucked away, Mr. Demarest came to A T & T Engineering in New York in June 1911. His first job was design and testing of long distance telephone circuits; in 1918 he was put in charge of a group. During this period the No. 4 Toll Testboard was developed and Mr. Demarest had part in the work.

From 1919 to 1922 Mr. Demarest and his group were working on equipment designs for toll circuits; he also made an extensive study of the economic value of the Laboratories' efforts in toll circuit equipment. An important contribution to this art was the mounting of these new systems on plates which in turn could be mounted on standard relay racks, on a uniform dimensional basis. Over the next twelve years his work included equipment for carrier, radio and signalling systems. For radio systems he developed a simple method for signalling. He was also much concerned with the successful development of the type-D carrier, the forerunner of short-haul carrier telephone systems. Because of its simplicity this system was widely popular with the Telephone Companies. This type of work continued until 1934, with problems in carrier, radio interconnection circuits, and power plants. Sixty-five patents record his contributions to the telephone art.

With the transfer of D & R to the Laboratories, Mr. Demarest came to West Street where his work shifted over to studies of local transmission such as a proposed repeater, contacts, and the combined telephone set then under development. In 1940 he became Economic Studies Engineer in Station Apparatus Development. During the war, he prepared a number of instruction manuals for military developments, and afterward he made a study of the invention aspects of war contracts in the Patent Department. Recently, as Apparatus Consultant, he has worked on some important special assignments. From 1941 until retirement, he was telephone representative on an A. S. A. committee on letter symbols and abbreviations.

Mr. and Mrs. Demarest will live on their farm in Lyme, New Hampshire; no Florida for this still-hardy Minnesotan. A little farming, with local civic activities, will probably occupy most of his time.

Frank S. Malm

By a quirk of fortune, Frank Malm became a rubber chemist because he was a good wireman. While he was in Western Electric's student course, he had won commendation for the way he wired up some tricky new trunk circuits. That brought him to the attention of Western's first Engineer of Manufacture, who was looking for someone to study processes of making hard rubber. The year was 1908 and Mr. Malm changed his night courses at Armour Institute to cover chemistry instead of electricity. In his new assignment Mr. Malm developed the rubber formulas that came into use in the Western Electric Company and over the next 10 to 15 years became thoroughly informed on rubber chemistry and processing and on factory practices. During this period he came in contact with many representatives of the rubber industry and today can claim as personal friends many of the leaders in the rubber world.

When the Bell System decided to connect

Catalina Island with the California coast by cable, the work of making the two thirty-mile cables was to be done at Hawthorne and Mr. Malm was sent east to work with R. R. Williams of the Laboratories. A few years later, the Laboratories had developed the new material paragutta (a mixture of deproteinized rubber, gutta percha and wax) to the point of putting it into use. Mr. Malm transferred (in 1929) to the Laboratories and went to Germany with J. J. Gilbert and others to supervise the manufacture of a cable to be laid between Key West and Havana.* Because paragutta required more heat than gutta percha to soften it, joints in cables could not be made with bare hands which was the custom of that time. Mr. Malm helped develop the first machine to do the job.†

Returning to New York, Mr. Malm worked on rubber and synthetic plastics of all kinds. One big job early in the war was to test many different formulas for insulating materials using rubber substitutes. Later when lead became a critical material he took part in the development of Alpeth cable sheath as a substitute for lead. When the recent Key West-Havana cables were being planned, he was again called on for advice.

Eleven papers, chapters in several technical books, and a number of patents record his major contributions to the rubbert art.

During his career Mr. Malm has been honored by his associates in the rubber industry in many ways. He has served on the Board of Directors of the Rubber Division of the American Chemical Society, he is a Fellow of the Institute of the Rubber Industry (British), and during the last war he served as a consultant to the Rubber Directors Office on wire and cable problems and also on hard rubber. He is a member of the New York Chemists Club.

It appears that Mr. Malm will be even more active in retirement than he has been during his Bell System career. He has been sought as a consultant by several industrial concerns. In one such project he will represent a British submarine cable company at the International Trade Fair in Chicago during August of this year. Another connection will be with the Propeller Division of the Curtiss-Wright Corporation where he will be interested in vibration damping problems related to hollow propellers.

Mr. and Mrs. Malm will continue to live in Millburn. They have one son with General Motors and another who is attending William and Mary College.

*A two-way, four-channel cable, it is still in service as are the Catalina cables.

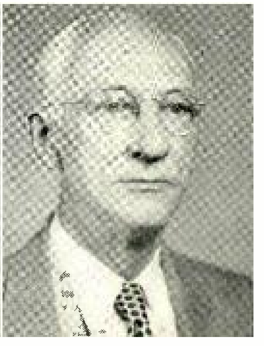
†Record, *July*, 1934, *page* 327.

Roy A. Shetzline

When he put on his hat and walked out of Graybar-Varick on June 3, Roy Shetzline started on an adventure that will exercise thirty-two and a half years of telephone talents. For he was on his way to Tokyo, to become Chief Research Engineer on the staff of the Chief Signal Officer of the Military Government. This organization is rehabilitating the Japanese communication system, and Mr. Shetzline will have charge of a large group on engineering and development problems. He succeeds F. A. Polkinghorn, who is returning to the Laboratories after two years' leave of absence.

Like the good Philadelphian that he was, Mr. Shetzline went to the University of Pennsylvania. On graduation (B.S. 1915; B.S. in E.E. 1917) he joined A T & T's engineering department and began making coordination studies between electrified railways, power transmission lines and telephone systems. From 1924 to 1929 he was in charge, for the Bell System, of a cooperative field study with the N.E.L.A., of the coordination of exchange telephone circuits and power distribution lines. Results have been of the utmost value in securing coordination of telephone and power distribution systems at reasonable cost.

R. A. Shetzline



C. H. Amadon

From 1929, Mr. Shetzline was in the transmission engineering group in charge of studies to determine the requirements of telephone apparatus design to minimize noise and crosstalk, to evaluate the effects of noise and crosstalk on telephone service and to establish suitable noise and crosstalk standards. In 1934 with the D&R group, he transferred to the Laboratories.

During the war, Mr. Shetzline wrote, and supervised a group of writers of, instruction books for radar and other Laboratories developments. Since then, he has been a member of Transmission Development, working on line problems of the L-1 coaxial system. Recently he prepared and taught a course in Communications Development Training on telephone transmission systems.

In a few months his wife and one of his sons will follow Mr. Shetzline to Tokyo, where the latter will continue his school work. After his two-year commitment, Mr. Shetzline expects to return and take up teaching, an activity for which his teaching of a graduate course at New York University has stimulated his interest.

Clarence H. Amadon

Clarence Amadon, a graduate of Biltmore Forest School, became the first full-time forester of the Western Electric Company's Engineering Department in 1917, after some years of timber cruising in Quebec, Nova Scotia, Maine, West Virginia, and Florida. His first job was inspector of timber products; later, and through his whole period of service, he has had a good deal to do with the development of specifications for timber and for timber preservation. In his earliest assignments he helped in stabilizing inspection techniques with a view to better correlation between supplier practices and Western Electric inspection methods. He was transferred to the Laboratories' Outside Plant Development Department in 1927.

W. H. Long

S. C. Cawthon

Beginning about 1930, Mr. Amadon took an active part in the development of practical inspection procedures for poles in line. He became in effect a teacher—on the spot—of methods for recognizing defective timber, at the same time preventing unnecessary removal of still serviceable poles and crossarms. He was among the first to establish the relation between the depth of preservative penetration and the incidence of decay. He established and kept the records of "test lines" of pedigreed poles of various types in different sections of the country to obtain service test data for comparison with laboratory and test plot experience.

For nearly three years during 1945-1949 Mr. Amadon was headquartered at Denver in order to facilitate timber production and use in the territories of the Mountain States and the Pacific Companies.

During his thirty-two years in Bell System, Mr. Amadon has built up an unusually wide acquaintance among men in the timber and wood-preserving industry, as well as in the communication and power fraternities. He may accept consulting work in these fields. Immediately, Mr. and Mrs. Amadon will live in Gloversville, New York; later, they may do a bit of traveling.

William H. Long

Just after World War I the Laboratories were busy finishing up the development of the panel system, and they called on the Operating Companies for manpower. Bill Long was one of five who came over from Bell of Pennsylvania in 1919; he had entered it ten years earlier as an installer and rose to be wire chief at Media. His first job at West Street was on circuit descriptions and apparatus adjusting information; and three years later he was put in charge of one of the groups. In 1926 this work was transferred to the circuit designers, and Mr. Long went over to making up key sheets. From 1928 to 1935 he was concerned with toll circuits—analyzing orders, seeing that special circuits were designed and checking them.

A second heavy work-load—this time due to World War II—brought Mr. Long into Apparatus Specifications from 1942 to 1946. Then he returned to Circuit Development, where he checked drawings to see that designers had followed accepted practices as far as possible. Early last year he became supervisor of a drawing standards group who check schematics and equipment cross-connections.

Mr. and Mrs. Long will spend their summers between their home and a South Shore beach club; in the winter they expect to travel in warmer climates.

Samuel C. Cawthon

Samuel C. Cawthon joined the Western Electric Company at Hawthorne in August, 1911, upon graduation from Mississippi A & M College. After approximately a year in the student engineering course, which included installation work in Minneapolis, he was assigned to development work on lead covered cables at Hawthorne, this organization later becoming part of the Outside Plant Department of the Laboratories. In this early work he was principally concerned with problems relating to mechanical equipment and to machine construction. In particular, if a device was required in order to perform an experimental manufacturing operation or set up a test procedure, Mr. Cawthon was delegated to produce the device and see that it worked. This aptitude has kept him occupied through most of his career in the mechanics of cable development work rather than the electrical or transmission aspects.

Mr. Cawthon was transferred to the cable group at Kearny in 1928 and for the next several years was principally occupied with the development of protective coverings for telephone cables buried in the ground. This work resulted in the widely used tape armored and jute protected cables. In recent years he has been part of the group responsible for the development of Alpeth and Stalpeth composite cable sheath.

Mr. Cawthon has been much interested in photography for a number of years and is in demand by his friends for wedding pictures. He has thoughts of turning this hobby to commercial account as one means of occupying his retirement days. He has a daughter in Illinois and a son in Colorado and is expecting to make Colorado his future home.

"Telephone Hour"

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

July 3	*John Charles Thomas**
July 10	*Lucile Cummings*
July 17	*Oscar Levant*
July 24	*Barbara Gibson*
July 31	*Gladys Swarthout*
August 7	*Michael Rabin*
August 14	*Nelson Eddy**
August 21	*Ezio Pinza**
August 28	*Leonard Pennario*

* From Hollywood

News Notes

J. B. Fisk was elected to the Governing Board of the American Institute of Physics at the annual meeting.

K. K. Darrow spoke on the subject *Electricity in Metals and Semi-Conductors* at the Squier Signal Laboratories, Fort Monmouth. At a meeting of the Long Island Subsection of the I.R.E., he gave a talk on *Electrons in Metals.* He also spoke on *Rectification at Junctions between Metals and Semi-conductors* before a colloquium at Aberdeen Proving Ground.

W. T. Read attended the *Conference on Plasticity of Crystalline Solids* in Pittsburgh at which he presented the paper *Dislocation of Models of Grain Boundaries.*

A conference to discuss the work of the Physical Electronics Research Group at Murray Hill on May 24 included a talk on *Bombardment-enhanced Thermionic Emission* by J. B. Johnson and on *The Distribution of the Velocities of Gaseous Ions in an Applied Field* by G. H. Wannier.

L. A. MacColl presented a talk on *Effects of Non-linearities in Servomechanisms* before a meeting of the A.I.E.E. in New York City.

C. Herring spoke to the Physics Colloquium at Princeton University on *Pulsations of the Gas Bubble Produced by an Underwater Explosion.*

W. Babington visited Frankford Arsenal, Philadelphia, to discuss testing of die castings.

F. Haese, left, is interested in the exhibit of G. B. Joslin, who, though retired from the Laboratories, has retained a lively interest in the Stamp Club. Walter Kuhn's exhibit, rated the "Best in Show," attracts two visitors at the Stamp Exhibit which was held May 9-11 in the West Street game room.

Arts and Crafts Club

Artists and craftsmen of the Laboratories displayed their work at the fifth annual exhibition of Bell Laboratories Arts and Crafts Club, May 24-26, in the Game Room at West Street. Sculpture, ceramics, oil paintings, water colors, pastels and monochromatic art were judged by art critics, while handicrafts were awarded prizes by popular vote. Winners in the exhibition were: *Watercolors* – M. K. Zinn, first prize; Helen Cruger, second; Mary Buebe, third. *Sculpture* –Hazel Mayhew, first prize; Ruth Lundvall, second; J. A. Hole, third; and Bruce Bleecker and Hazel Mayhew, honorable mentions. *Oils*– K. A. Williams, first prize; Betsy Bates, second; C. B. Feldman, third; and John Neill, honorable mention. *Handicrafts*–V. L. Lundahl, first prize; L. L. Sweet, second and fourth, Marilyn Winters, third; Betty Engstrom, fifth; and Ethel Rispin, sixth.

Quality Assurance Get-Together

The fifteenth annual bowling and dinner of the Quality Assurance Department was held on May 11 in New York. Sixty-five members of the department, including field engineers from Boston, Cleveland, New York, and Philadelphia, participated in a bowling tournament at the National Bowling Alleys and in a dinner at the Georgian Room of the Cornish Arms Hotel. The photographs below give a glimpse of the party.

News Notes

W. Shockley gave a talk on *Recent Results on Ferromagnetic Domains* at the International Business Machines seminar at Poughkeepsie. He repeated his talk as the Williams Lecture to the Metallurgical Department Colloquium at Massachusetts Institute of Technology.

B. McMillan spoke on *Information Theory* at a meeting of the Naval Research Reserve Unit 3-1 at Columbia University on May 11.

A class studying the physics of gaseous discharges in the Graduate School at New York University heard J. A. Hornbeck speak on *The Townsend Discharge.*

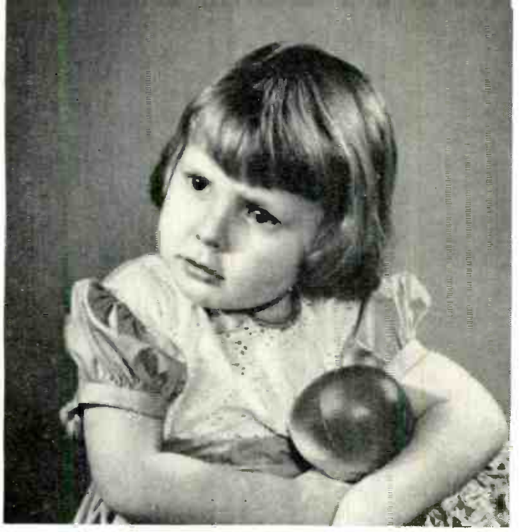
U. B. Thomas attended the Fourth Annual Signal Corps Battery Conference at Asbury Park, New Jersey. He and W. W. Bradley visited the Electric Storage Battery Company in Philadelphia for a discussion of battery problems.

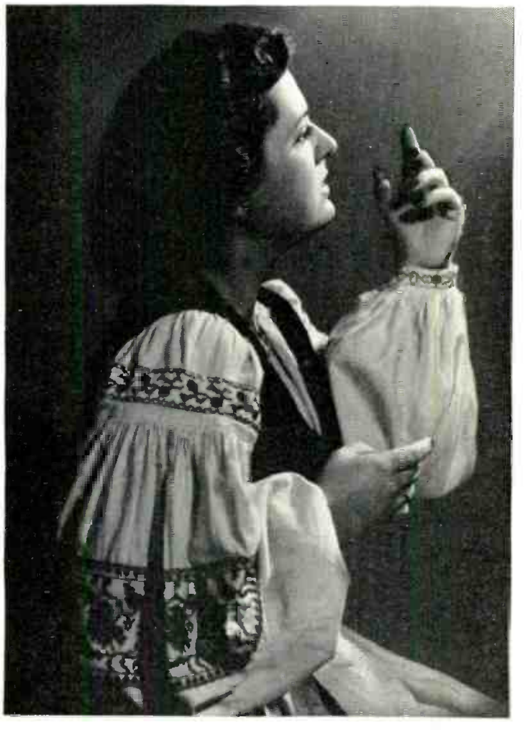
C. KITTEL presented a paper on *Recent Progress in Ferromagnetism* at a meeting of the Annual Congress of The Canadian Association of Physicists, McMaster University, Hamilton, Ontario.

S. M. ARNOLD and A. MENDIZZA set up a new corrosion site and inspected telephone field equipment at Steubenville, Ohio.

W. J. KIERNAN conferred on finishes for electrolytic condensers at the Sprague Electric Company in North Adams, Massachusetts.

J. R. FISHER, W. F. JANSSEN, M. D. RIGTERINK, L. EGERTON and A. W. TREPTOW attended the annual convention of the American Ceramic Society in New York City.





Photographic Salon Firsts

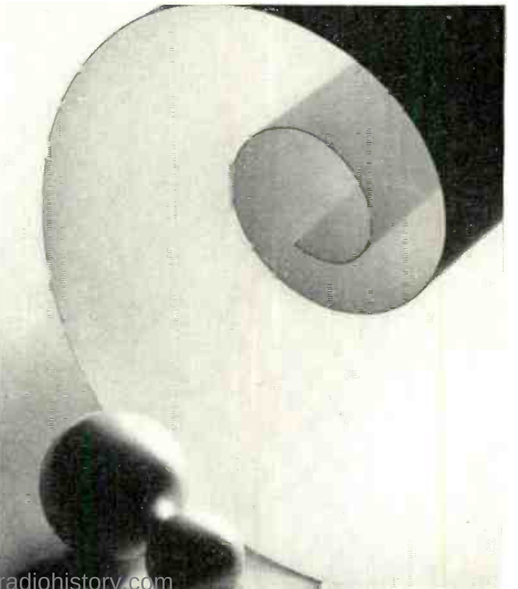
Above—Restricted Class. "Vieux Montmartre." R. P. Jutson.

Right, top—Children and Pets. "No." J. F. Neill.

Right, center — Portraits. "Augustana." W. J. Rutter.

Right, bottom—Still Life. "Dynamic Symmetry." R. S. Kennedy.

(Prize winners in the "Landscape" and "Miscellaneous" classes will be in the next issue.)



Send the Record to Europe

It has been suggested that the RECORD would be of interest to European relatives or friends. If, after you have finished with your copy, you wish to send it to a friend or relative, place it in an envelope (E-1547) and attach 7 cents in postage. The envelope should be conspicuously marked "General License GTD."

R. D. HEIDENREICH took part in a symposium at the Naval Research Laboratory in Washington where he presented a talk entitled *Electron Diffraction and Electron Microscopy in Metallurgy.*

G. H. WILLIAMS and R. BURNS visited the du Pont manufacturing plant at Parkersburg, West Virginia, in connection with engineering requirements covering nylon molding compound.

H. W. HERMANCE and C. W. MATTSON conducted sequence switch trials in Chicago central offices.

G. N. VACCA discussed insulations and jackets for rubber covered wire at Point Breeze.

M. W. BALDWIN was the June speaker at the Deal-Holmdel Colloquium on June 2 at Holmdel. His topic was *Television Picture Fidelity.*

M. D. FAGEN, J. A. BECKER and A. W. ZIEGLER took a trip to the Naval Air Development Center at Johnsville, Pennsylvania, to discuss a military project.

W. J. KIERNAN and C. R. STEINER conferred at the Sprague Electric Company on techniques of applying a new polyprene insulating finish for electrolytic capacitor cans.

A. B. HAINES, L. W. KIRKWOOD and T. H. CHEGWIDDEN visited Winston-Salem in connection with military transformers. Mr. Haines attended A.I.E.E. sessions that were devoted to magnetic amplifiers in Pittsburgh.

July Service Anniversaries of Members of the Laboratories

45 years

C. A. Grant

35 years

C. H. Achenbach
John Jessich
Fred Mezger
G. F. Shulze
W. B. Strickler

30 years

H. C. Baarens
J. A. Carr
C. W. Carson
A. F. Conk
H. J. Elschner
G. L. Gottron
C. M. Hebbert
R. W. Hoffmann
L. M. Ilgenfritz
J. W. Kennard
J. M. Labaugh
A. G. Lang
D. W. Mathison
Thomas McLaughlin
O. R. Miller
R. A. Miller
Mary Mulhern
K. O. Olson
W. A. Phelps
Robert Pope
George Puller
E. W. Rahn
A. R. Rienstra
G. A. Waters
Arthur Westenberger
O. H. Williford
J. R. Wilson
E. B. Wood

25 years

W. R. Bennett
Nelson Botsford
J. W. Brubaker
Wilma Cadmus
C. W. Christ
C. A. Collins
B. H. Cornell
C. H. Dagnall
J. C. Davenport, Jr.
H. K. Dunn
J. W. Emling
C. A. Fischer
A. J. Gaborc
Clarence Gerbig
W. E. Grutzner
G. B. Gucker
Albert Hartmann
D. B. Herrmann
C. C. Hipkins
L. S. Hulin
A. P. Jahn
G. D. Johnson
W. J. Kiernan
Paul Kuhn
J. F. Martin
R. K. McAlpine
T. A. McCann, 3rd
M. B. McDavitt
Ella Munk
Ernst Nelsen
N. C. Norman
A. C. Norwine
Mary O'Brien
John Pasanen
Helen Quinn
S. R. Russell
Clinton Shafer, Jr.
E. G. Shower
J. M. Vesely
H. T. Wilhelm

20 years

H. W. Allison
A. B. Anderson
R. R. Andres
W. M. Bacon
J. H. Beiner
R. R. Blair
Charles Breen
H. B. Brehm
W. J. Carroll
H. T. Carter
D. F. Ciccolella
J. E. Corbin
S. A. Darby
J. J. DeBuske
L. B. Dixon
Adrian Doornheim
F. E. Drake
R. C. Edson
R. H. Erickson
J. F. Ferko
R. J. Ficken
J. C. Fletcher
E. S. Greiner
A. B. Haines
K. E. Hammer
A. D. Hasley
Edward Hughes
G. D. Ipsen
J. D. Kleinkauf
G. G. Lavery
L. W. Mackey
J. M. Manley
C. W. Mattson
C. B. McKennie
R. A. Molitor
W. W. Mumford
J. J. Oestreicher
A. C. Pfister
G. S. Phipps
John Raptoulis
A. K. Schenck
Walter Sennett
G. V. Smith
A. G. Souden
V. G. Sprague
K. H. Storks
E. C. Torkelson
Mary Torrey
A. H. White
E. G. White

15 years

R. I. Forrest
Virginia Kahse
K. J. Kraft
J. A. Lehans
J. M. Niedzwiecki
W. H. Seckler
F. J. Shiel
E. C. Thompson

10 years

C. L. Beckham
C. T. Bolger
M. W. Bowker
D. E. Brenneman
R. L. Carbrey
T. B. Couper, Jr.
S. C. Day
C. T. Goddard
A. E. Joel, Jr.
Florence Lutgen
Kathleen McGovern
Jane Melroy
F. R. Merritt
M. C. Nielson
O. C. Olsen
J. W. Rieke
William Robertson
R. M. Ryder
G. H. Schatz
G. L. Schaudel
H. E. Seaman
C. L. Semmelman
O. L. Sickles
F. W. Starzer
K. H. Stern
E. G. Strubing
G. B. Thomas, Jr.
R. K. Thompson, Jr.

AT THE PIONEER PICNIC IN NEW JERSEY

Over 1500 strong, pioneers, their families and guests, enjoyed an old-fashioned picnic at Farcher's Grove in Union on Saturday, June 10. Activities included softball, horseshoe pitching, a golf-chipping contest, exhibitions of archery and table tennis, dancing, both straight and square, and—for the children—pony rides, foot races and games of all kinds.











RECENT DEATHS

ROY W. CHESNUT, June 4

The death of Mr. Chesnut removes one of the foundation stones upon which the Laboratories carrier systems development work has been constructed. Before his association with the Laboratories, his early activities included a B.A. degree, summa cum laude, from Harvard University after three years of college work, and a period of service as first lieutenant in the Signal Corps in World War I. His work in the latter capacity with early methods of aircraft detection won high commendation.

At the Laboratories Mr. Chesnut's first work in 1920 was in the publication field, preparing technical bulletins and monographs which publicized the work of others. The practice of publicizing and giving credit to others' work, while minimizing his own contribution, was characteristic of the man.

R. W. CHESNUT
1892-1950

J. C. BAIN
1901-1950

A year or two later he transferred to technical development work, with direct supervision of groups which developed successively the terminals and other portions of types B, C, J, K, and L carrier systems as well as many special carrier projects. His continuous activity in this field, from the beginning of the use of carrier systems to the present time when carrier is king of the toll routes, made him an invaluable consultant and adviser. During World War II Mr. Chesnut's activities were again directed toward airplane detection, with tools very different from those available to him thirty years earlier.

Handicapped by asthma for many years, he was nonetheless considered a tower of strength by those closely associated with him. As a technical advisor, group leader, and personal counselor, his time and energies were available without stint to all. He was also active in Boy Scout work and in the Montclair Engineers Society, particularly in its early years.

HAROLD G. BANDFIELD, May 10

Upon graduation from the University of Michigan with a B.S. degree in 1905, Mr. Bandfield entered the Western Electric Company in the Clinton Street Shop in Chicago. He transferred to New York in 1907 and worked on the development of protection apparatus, coin collectors, and ringing systems.

In 1916 Mr. Bandfield transferred to the Patent Department. His initial assignment was to a group concerned with the fields of protection and miscellaneous telephone and telegraph apparatus. A few years later he was assigned to the fields of submarine cable systems. Subsequently, he was in charge of patent work relating to chemistry. Prior to his retirement in 1947 he had specialized on cords, capacitors and the field with which his career began, the development of protection apparatus.

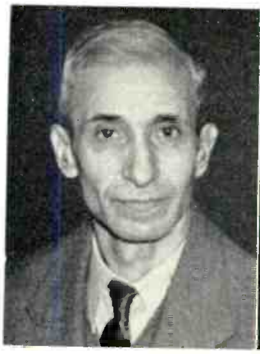
JOHN C. BAIN, May 12

Before Mr. Bain joined the Laboratories he had been associated with radio for many years. In 1917 he entered the employ of Marconi's Wireless Telegraph Company in London. Five years later he resigned to join the radio department of the Cunard Steamship Company, and served as a radio operator on transatlantic liners, particularly the *Berengaria,* until he came to the Laboratories in 1929.

H. G. BANDFIELD
1882-1950

H. E. CROSBY
1887-1950

Mr. Bain's early work here had to do with the preparation of information covering the installation of broadcasting and police radio systems. His next assignment was the mechanical design of radio equipment for aircraft as well as for mobile applications. Early in World War II he was assigned to Fort Hancock where he engaged in the design and development of Signal Corps radar SCR 268. Following that he worked at Whippany on the design of Signal Corps and Navy fire control radars. More recently he has been associated with the design and development work in conection with government projects. A native of Halkirk, Scotland, Mr. Bain was educated at the Edinburgh Radio Institute. After coming to this country, he also studied at Pratt Institute.



Andrew Bartinelli
1887-1950

Jacob Weber
1883-1950

Halsey E. Crosby, May 28

At the time of his retirement in 1948 Mr. Crosby had completed twenty-nine years of Bell System service. He first joined Western Electric in 1907 leaving after a short time. He returned in 1919. For the next five years he held various positions in the Building Department engineering office. In 1924 he transferred to Research as Supervisor of the Hudson Street Tube Shop. Reassigned to the Plant Department in 1931, Mr. Crosby was engaged in engineering problems of Building Construction and Operation for the rest of his service.

He was closely associated with safety problems in the Laboratories, was Chairman of the Laboratories Safety Committee for fifteen years and was an active member of several committees of the New York Safety Council. During the war he maintained contacts with the Plant Security Organization of the Army concerning plant protection matters both in New York and New Jersey locations.

Andrew Bartinelli, June 8

In 1917 Mr. Bartinelli entered the Traffic Department of the General Service Department of West Street. For eighteen years he was engaged in the Receiving Department and was responsible for all Western Electric receivals at West Street. During those years he was a member of the Baseball Club of Bell Laboratories Club and also a semi-pro ballplayer in the New York League.

After retiring in 1935 because of arthritis, Mr. Bartinelli learned clock repairing and for a number of years spent a part of each day repairing clocks, including many from the Laboratories. His son Andrew F. Bartinelli is a member of the Murray Hill Area Staff.

Jacob Weber, May 16

Mr. Weber joined the Western Electric Company in 1902 in New York and for eleven years worked in the General Service Department polishing and buffing telephone apparatus. In 1913 he transferred to Hawthorne where he did similar work until 1918 when he transferred to the store room for desk stand parts. Returning

Margarita G. O'Brien, who celebrated her golden jubilee in May, is shown with some of the "boys" who have worked with her in the Record Room. She has kept in contact with them and their families through the years. Left to right, with her are Andrew Burke, Federal Telephone and Telegraph; W. F. Sefcek, Switching Development; A. Johnson, Cost Accounting; E. G. Olsen, Electronics Apparatus; Harold Schmitt, New York Area General Service Manager; Fred Keller, Engineering, Western Electric; R. F. Haug, Plant Accounting; R. D. Long, Cost Accounting; Clyde Gallon; W. D. Elliott, Methods and Standards; Elmore Krauth, U. S. Post Office; and Joseph Doyle and Vincent Batti, Miss O'Brien's present "boys."

"Darling, I think this 534A would be perfect with your black and white."

to West Street in 1920 he was assigned to the Receiving Department as a receiving clerk. From 1928 until his retirement in 1948, he was responsible for deliveries of material throughout West Street.

News Notes

W. T. Wintringham attended a symposium on Color and Color Photography at the Eastman Kodak Company in Rochester.

L. G. Bostwick and G. E. Perreault visited Winston-Salem to discuss selectors.

W. G. Hensel and W. C. Babcock examined models of parabolic antennas for microwave circuits at Needham, Massachusetts.

C. L. Beckham took traffic measurements at the No. 5 office at Towson, Maryland.

"They let me have it to go with the 'Flapper Look'."

R. F. Massonneau visited the Audichron Company in Atlanta with R. A. Miller, H. W. Augustadt and C. A. Nickerson.

B. McKim and H. H. Abbott observed the cutover of the second installation of A4A toll crossbar equipment at the Indiana Bell Telephone Company in Indianapolis.

R. B. Curtis and R. C. Pfarrer took traffic measurements at the cutover of the A4A system at Albany and at Indianapolis.

L. A. Yost visited the New England Company at Boston in connection with the engineering of a No. 5 crossbar job.

H. H. Abbott and A. Burkett were at Atlanta from May 22 to May 24 to discuss community dial offices and rural area problems.

P. V. Welch visited the C & P Company at Charleston, West Virginia, to discuss PBX problems.

A. A. Hansen and N. A. Newell visited the Milwaukee and Madison, Wisconsin, offices in connection with signaling tests on the N1 carrier system. Mr. Hansen, on a visit to the Indianapolis A4A toll office, observed single frequency signaling performance. At the Westlake, Ohio, No. 5 crossbar office he observed the trial of simplified maintenance facilities which was being initiated.

In Chicago, E. D. Mead and W. G. Laskey discussed message register development; J. S. Garvin and O. Mohr, design changes in connection with relays; P. B. Drake, U and Y type relays; F. W. Clayden, on various types of relays used on trial trunk circuits; R. R. Stevens and C. E. Mitchell, production of granular carbon; and W. R. Neisser and J. L. Garrison, design and manufacturing problems in connection with the 425A network used in the new telephone set.

V. B. Pike and Robert Pope spent some time in various cities in the Southern Bell territory, cooperating in cable sheath corrosion studies.

H. D. MacPherson and D. F. Johnston observed the performance of the A4A toll office in Indianapolis.

E. G. Andrews spoke on *Computers* before the Pittsburgh section of the A.I.E.E.

M. Salzer attended a Quality Survey at the Teletype Corporation in Chicago.

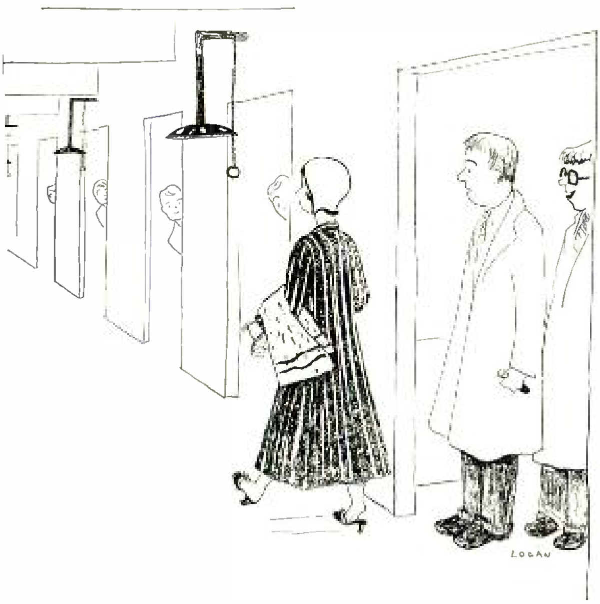
E. St. John was at the R. W. Cramer Company in Centerbrook, Connecticut, to discuss timing devices.

E. R. Casey was at the Patent Office in Washington during May relative to patent matters.

E. M. Smith, P. W. Sheatsley and G. F. Sohnle visited the Sunset-Hilltop office of The Bell Telephone Company of Pennsylvania in the Philadelphia area in connection with automatic message accounting equipment.

L. H. Allen and P. B. Fairlamb inspected an installation of a recently developed key equipment at the Municipal Airport, Burlington, Vermont, for the Civil Aeronautics Administration.

J. R. Erickson visited the CAA Control Center at Cleveland to discuss communication problems connected with Air Traffic Control. Mr.



"During New York's water shortage she got into the habit of coming over here every Thursday."

Erickson observed Air Traffic Control procedures at the CAA Control Center in Atlanta during "Operation Swarmer." He also conferred with members of the Southern Bell Telephone Company and 2nd Regional Headquarters of the Civil Aeronautics Administration on Communication requirements. Later he visited Control Centers and INSAC Stations in Florida with members of the CAA.

At Allentown, M. B. McDavitt, A. C. Keller, A. J. Busch, W. W. Werring and O. M. Hovgaard discussed glass enclosed switches; and A. D. Knowlton, R. A. Miller, W. J. Brown, L. B. Cooke, and W. R. Goehner discussed Phototransistors.

L. R. Snoke and O. A. Hanna inspected an experimental brush control project on cable right-of-way over the mountains near Hamburg, Pennsylvania.

P. P. Koliss was at Indianapolis in connection with the manufacture of models of a new central office protector.

G. Q. Lumsden, L. R. Snoke and J. Leutritz, Jr. made an inspection of the pole and small test specimens undergoing outdoor exposure at the Gulfport, Mississippi, plot.

A. H. Schirmer, L. S. Inskip and D. W. Bodle participated in a cable protection conference in the Western Division of the New England Telephone and Telegraph Company.

D. W. Bodle investigated lightning damage to a mobile radio transmitter at Long Green, Maryland. He also visited Station WFIL-TV in Philadelphia in connection with a protection problem.

C. F. Wiebusch was a member of a panel discussing *Training in Mechanics for Engineering Students* at a meeting, on May 13, of the American Society for Engineering Education at Lehigh University.

J. K. Mills and W. V. Flushing made ringing drain tests on the 805B ringing power plant at the Stratford office of the Southern New England Telephone Company in Bridgeport.

J. M. Duguid and L. D. Fry, at the Detroit plant of the General Motors Corporation, observed cold weather starting tests of diesel engine alternator sets.

J. A. Potter observed operation of the 12 volt power plant at the TD-2 radio relay station in Angola, Indiana.

W. L. Betts and E. F. Helbing attended a quality survey conference on charging and ringing generator sets at the Fort Wayne plant of the General Electric Company.

At Haverhill, H. E. Vaiden discussed new transformers; B. E. Stevens, power apparatus; and A. C. Ekvall, coils and transformers. Mr. Vaiden, with D. W. Grant, visited the New York Transformer Company at Alpha, New Jersey, concerning transformers.

H. M. Spicer conferred with engineers of the Superior Electric Company at Bristol, Connecticut, on the design of motor driven autotransformers for the L-3 carrier system.

R. H. Ross discussed designs of small motors, for use on the T-33 system, with the A. W. Haydon Company at Waterbury, Connecticut.

N. H. Thorn discussed with The Southern New England Telephone Company in Bridgeport, Connecticut, arrangements for the installation of signalling equipment in the step-by-step office there.

John Curley, usher at the 55 Bethune Street door, buys a poppy from Virginia Groth during the American Legion Poppy Drive at West Street. Veterans and girl volunteers sold 768 poppies made by veterans in VA hospitals. Proceeds of the sales will be used by the Bell Telephone Post 497 welfare committee for disstressed post members and for disabled hospitalized veterans.

R. H. Miller attended the cutover of A4A toll switching equipment at Indianapolis, and discussed with representatives of several Telephone Companies problems relating to installations of A4A equipment in their territories. He also was in Albany regarding the A4A installation.

N. V. Mansuetto made a survey of the equipment in Milwaukee, Madison, Hartland and Watertown, Wisconsin, preparatory to the trial installation of N1 carrier order wire and alarm equipment.

J. Meszar gave a lecture on *The Automatic Message Accounting System from the Layman's Point of View* in the Arnold Auditorium

W. B. Sage made preparations in Buffalo and Lancaster, N. Y., for the trial of simplified register and sender test equipment to be installed in the No. 5 crossbar office at Lancaster.

R. A. Miller, H. W. Augustadt and C. A. Nickerson conferred with the Audichron Company at Atlanta on prototype models of announcing machines.

R. A. Miller and L. B. Cooke attended a meeting of Committee TR-10, Audio Facilities, of the Radio Manufacturers Association that was held in New York City.

W. L. Casper addressed groups of Manufacturing Department Engineers at Kearny, Hawthorne, Point Breeze, Haverhill, Winston-Salem and Burlington on the problems and program of the Joint Western Electric-Bell Laboratories Committee on Economy of Design and Production of which Mr. Casper was the Laboratories' chairman.

The Laboratories were represented in interference proceedings at the Patent Office by E. B. Cave before the Board of Interference Examiners.

G. W. Meszaros made tests at Key West on the power equipment to be used to supply power to the repeatered submarine cable between that point and Havana.

J. C. Bayles attended a conference on May 3 in the Pentagon Building, Washington.

J. F. Wentz, J. F. Morrison, M. N. Yarborough, R. O. Wise and H. Z. Hardaway attended the I.R.E. Convention at Dayton on airborne communications and electronics. They also reviewed work being done by the Laboratories for the Air Force on airborne equipments.

This Month's Ad ⟶

F. G. Foster appears in the facing advertisement. Metallurgy and biology share common problems in the field of research microscopy. In this work, he is assisted by Clarice Lovell, a graduate of the University of Pennsylvania in bacteriology. Out of hours, Mr. Foster cultivates microscopy in the study and photography of plant and marine life.

F. M. Thayer produced this striking Bulletin Board poster which was used throughout the Laboratories to publicize the annual concert of the Murray Hill Chorus. Another poster, which was displayed in stores and public buildings in Summit, was produced by J. H. Cave.