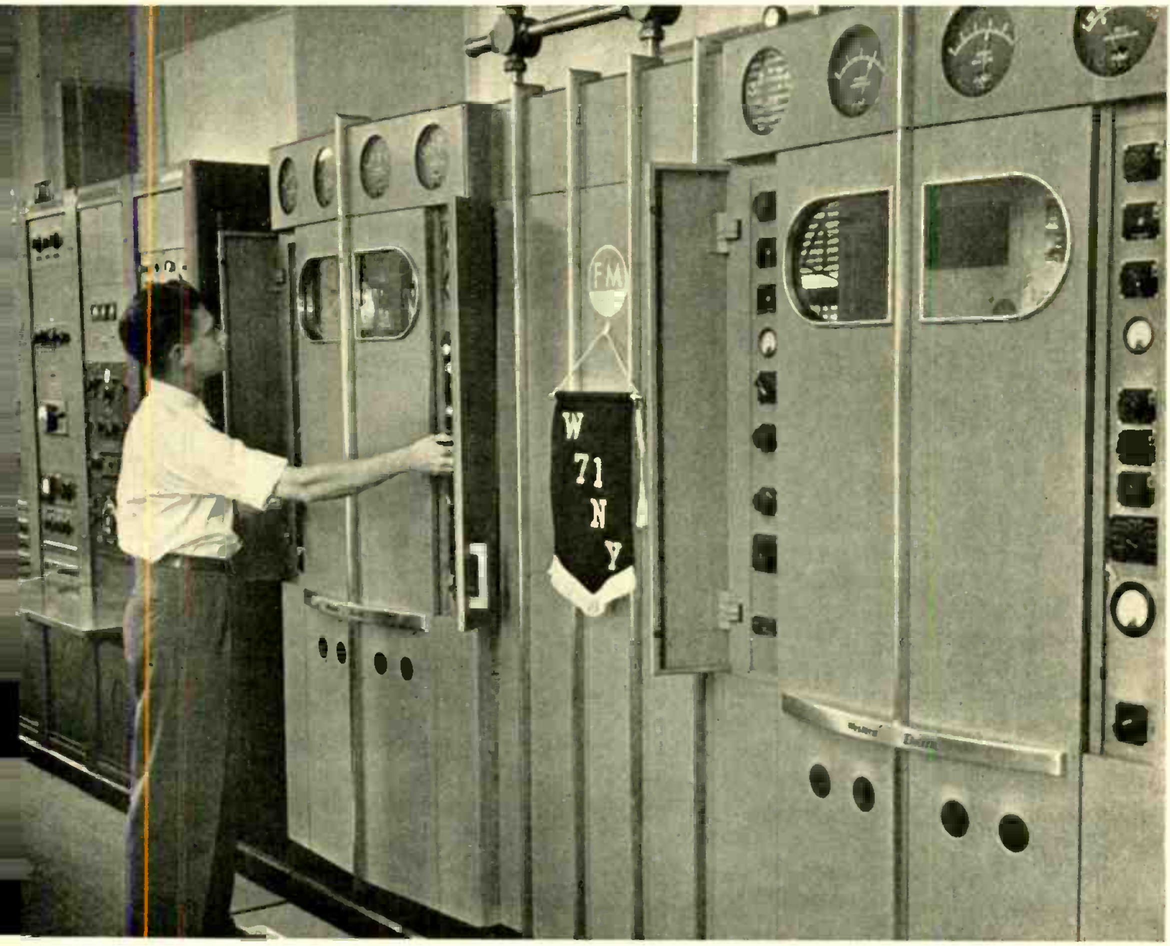
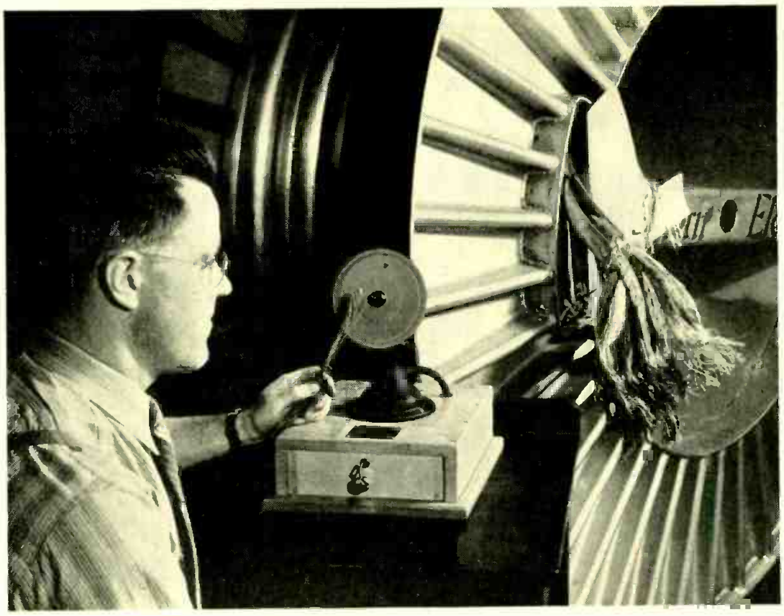
ELL LABORATORIES RECORD



'requency-modulation radio transmitter of Western Electric manufacture as installed for the Bamberger Broadcasting Service, Inc., at 444 Madison Avenue, New York City

ULY 1942 VOLUME XX NUMBER XI



Determining Color in Telephone Cable

By C. T. WYMAN
Cable Engineering

TO ASSIST cable splicers in distinguishing different groups of pairs of wires or the different conductors of a pair, the paper or pulp with which the conductors are insulated is dyed with distinctive colors. The number of colors is not great because the identification by color is of groups of pairs rather than of each pair individually. The arrangement of colors in the 1800-pair cable has already been described in the RECORD.* Red, green, and blue are the common colors used, but the undyed insulation—an off-white or buff—serves as a fourth, and for certain types of cable orange also is employed.

Splices are often made in manholes, where the light is generally poor. Under such conditions it is difficult to distinguish certain shades and colors, and for this reason colors of distinctive hue were selected. After these colors are selected and agreed upon, the amounts of various dyes to obtain them are determined. Unfortunately, however, this does not insure that when the cable is opened for splicing in the manhole, conductors treated with the same dye will all be of the same color. In the first place, differences in fibre structure of various lots of raw material sometimes cause insulation colored with the same dye to take on slightly different hues. Between dyeing and splicing, moreover, several processes and varying storage periods intervene. In the storage periods before the sheath is put on, the insulation may be exposed to light for longer or shorter periods, and also considerable heat may be applied to the insulation both in drying

*February, 1929, p. 221.

and in applying the sheath. Both light and heat tend to fade the colors, and certain of the colors when faded approach the natural insulation color, particularly when seen in dim light.

A certain amount of departure from the original colors is not objectionable, but to insure that the variation in color is not great enough to endanger certain identification, it seemed desirable to provide color standards with which the insulation could be compared, both immediately after the dyeing process and after the lead sheath had been applied. For the first comparison, two standards should be used to insure that the insulation as dyed is within a certain range of color known to be satisfactory. With this assured, the final comparison would need only to make sure that the color had not faded too much from the original. A single reference standard, representing a lower limit of intensity, would furnish all that was needed for this second comparison.

The specifications of color and satisfactory color standards are inherently difficult, but in recent years a system of color notation and a set of color standards developed by A. H. Munsell have gained wide acceptance, being used, for example, by the Bureau of Standards to specify accepted colors for foods and other commercial products.

In this system each color is specified by stating certain values for three parameters called "hue," "value" and "chroma." Hue corresponds most nearly to what we normally call color, and five basic hues are used: red, yellow, green, blue, and purple. Five intermediate colors—yellow-red, green-yellow, blue-green, purple-blue, and red-purple—are also designated, and each of these ten hues is divided decimally to give ten sub-hues. With this arrangement the scale of hues is as shown in Figure 1. Any hue is specified by a letter and a number from one to ten. The letter, such as R, or B-G, represents one of the ten hues, and a number preceding the letter completes the specification of hue. Thus 2R specifies a red approaching the red-purple. Each of the ten nominal hues, since it lies in the center of a group of ten hues, is prefixed by the number 5; thus 5Y indicates the standard yellow hue.

"Value" represents that characteristic most nearly described as lightness or darkness, and is specified by a number from 1 to 10 following the letter or letters representing the hue. Value 0 represents black and value 10 represents white. A color designated 5R2, for example, would thus be a dark red, while a color desig-

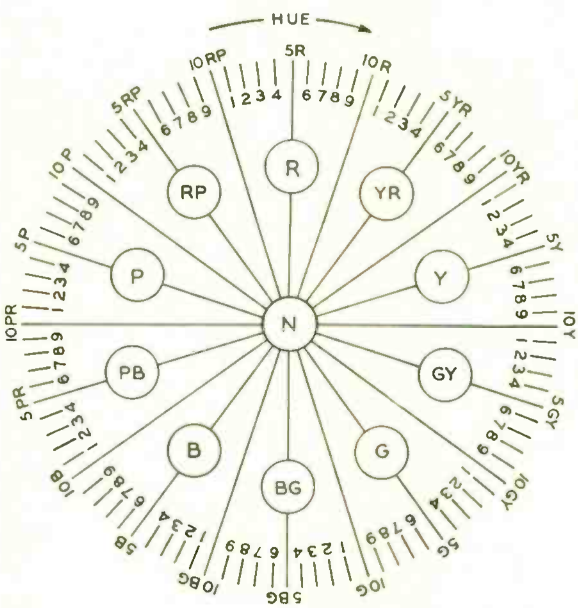


Fig. 1—Hue designations used in the Munsell system for obtaining reference colors

nated 5R8 would be a very light red.

"Chroma" represents the degree of color of any one hue, and is also indicated by a number. It represents the characteristic commonly called weakness or strength, and the number indicating it is written immediately following the "value" number but separated from it by an oblique line. A color of zero chroma would be really a complete absence of color, and would thus be a gray—darker or lighter depending on the "value." A color with a high chroma, on the other hand, would be a very strong color. Any color designation is thus of the form H V/C, where H represents the hue; V, the value; and C, the chroma. A typical pink might be described as 5R8/2, while a royal blue would be 5PB3/12. For neutral shades there is no hue or chroma specification; a slate gray, for example, would be written N2, the N indicating that there is no hue, and the 2 gives the measure of "value."

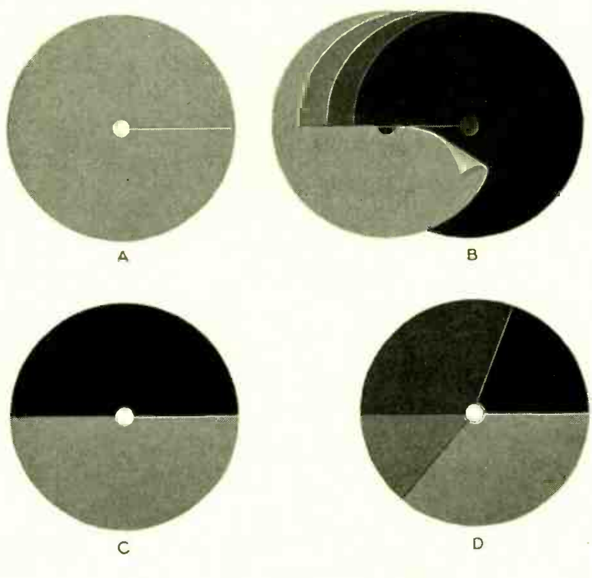


Fig. 2—Method of interleaving Munsell color disks to secure a desired color

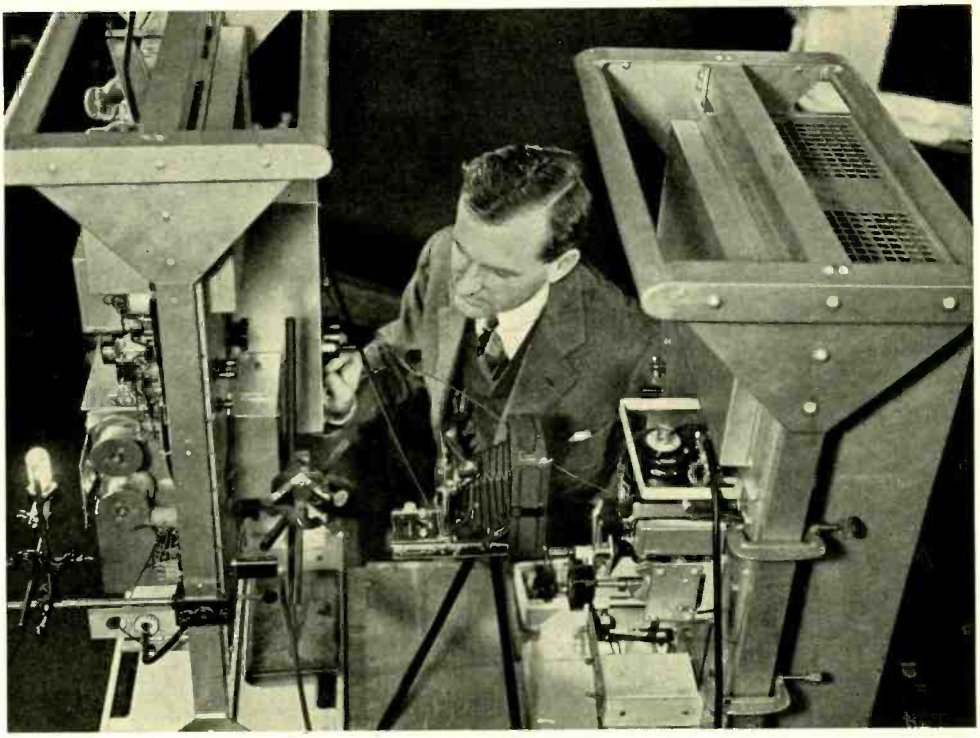
This method of notation provides for the specification of a very large number of colors. It is not necessary to make samples of all possible colors, however, because any color can be secured by mixing certain other colors. A mixture of blue and yellow, for example, gives a green, which may be made darker or lighter by adding black or white. Similar mixing is possible throughout the color range. A simple method of mixing colors for visual inspection, demonstrated by James Clerk Maxwell, is to color different sectors of a disk with different colors and then to rotate the disk. The individual colors then completely disappear, and in their place appears a single color corresponding to the particular combination. In this way, any possible color can be obtained by mixing in the proper proportions two or more of a basic group of colors.

Taking advantage of these facts, the Munsell Color Company make up a series of color disks, using dyes that are fast to light. The disks have a central hole to fit on the spindle of a motor, and a radial slit from rim to center. A user takes a group of disks of colors that when properly proportioned will give the color he wants, and interleaves them, as indicated in Figure 2, so that the amount of each disk visible is proportioned to the amount of that color required to produce the color wanted. When the motor is run, the individual colors disappear, and the entire disk assumes the desired color.

This method has recently been adopted to secure color standards for cable insulation. A card carrying a scale marked into a hundred divisions around the periphery is mounted on the spindle behind the color disks to provide a ready means of determining the percentage of each that is exposed. After the color disks have been properly arranged, they are pasted together and to this card to hold them.

For the inspection after the cable has been sheathed, where only a single comparison is made for each color, a single set of disks is used as described. For the inspection at the completion of dyeing, however, where two color comparisons are used for each color—one for the lower and one for the upper limit—two sets of color disks are mounted on the same spindle. One set is about twice the diameter of the other, and the smaller set is placed in front of the larger so that the entire disk of smaller area and the outer portion of the larger is visible. Each set of disks is adjusted to give one of the test color limits. This arrangement is shown in Figure 3. When the motor is running there will appear an inner disk of one of the test colors, and an outer annulus of the other. The insulated wires may be held in front of the rotating disks as shown in the photograph at the head of this article, to make sure this color falls between the two test colors. Standards such as these are set up for each color used in the cable. These standards are at present in regular use at the pulp-insulating operation, particularly when a machine is being changed to production of a different color of insulation and for the final inspection of the completed cable to determine whether excessive fading from heat or light has occurred. Fading in the completed cable is usually rather obvious, and does not occur frequently, so that only occasional color tests are required for this purpose. It is planned to introduce similar requirements for strip paper used for insulation. The equipment is not difficult to use since it does not require trained technicians; anyone with normal color vision can make the inspection quickly and with ease.

Fig. 3—Color test disks and drive motor as used at the Kearny plant of the Western Electric Company



Automatic Production of Oscillator Scales

By T. SLONCZEWSKI
Apparatus Development

THE frequency of an oscillator is usually set by turning a few dials until their readings correspond to an entry in a calibration table or chart from which the exact frequency corresponding to the dial indications may be obtained. The relationships between the frequency and dial markings, moreover, are different for every oscillator, so that a separate calibration chart must be prepared for each. To provide a scale and calibration chart of this form is not particularly difficult, but the necessity of referring to a calibration chart for every reading makes the use of the oscillator laborious. Much more satisfactory to the user is to have a dial on which the divisions are carefully marked to correspond to equal frequency intervals. To provide such a scale by the usual methods, however, requires much time and labor when the frequency range of the oscillator is large and the accuracy is high.

The 17B oscillator,* for example, has a frequency range of 150 kc with a precision of 25 cycles. To enable it to be set to this precision over such a wide frequency range, the scale is marked on twenty-five feet of motion-picture film. Scale divisions are 50 cycles apart—three thousand lines

*Record, *May*, 1939, *p*. 291.

being required in all. To make this oscillator direct reading, it would be necessary to draw a line every 500 cycles, and then to draw ten equally spaced intermediate lines. Such a calibration would require about three days to complete, and would thus appreciably affect the overall cost of the oscillator. Since these oscillators will be used in considerable numbers, it seemed worth while to develop an automatic means of calibration.

Although the scales for different oscillators are similar, they are not sufficiently alike to permit the scales for all oscillators to be printed from a single master film. The type of differences that exist, amplified to make them more apparent, are indicated by the two scales of Figure 1, which may be taken to represent those of two oscillators. Dotted lines are drawn from the markings on the B scale to those on the A to make the differences in positions more obvious. If a duplicate of the A scale had been used for the B oscillator, such as would be obtained by direct printing from the A film, there obviously would have been quite appreciable errors at many places along the scale.

Suppose, however, that the A scale were placed over an unexposed film to be used for the B oscillator, and then that it was moved with respect to B at a varying rate such that at each 50-cycle point a line on the A scale would be directly over the position on the B scale where that frequency marking should appear. Suppose further that a method were provided for exposing the section of the B film at the instant it was under the corresponding line on the A film. A printed calibration for the B scale could then be made that was correct for it, and yet was printed a line at a time from the A scale.

Such a method of calibrating films for 17B oscillators was developed jointly by W. J. Means and the author. The arrangement is shown schematically in Figure 2, and as actually set up in the Laboratories in the photograph at the head of this article. Two 17B oscillators are set up facing each other. One of them, at the left in the illustration, serves as the standard oscillator, and has a film scale that has been accurately marked every 500 cycles and then subdivided to give 50-cycle divisions. The other is the oscillator to be calibrated, and it carries on its sprocket an unexposed film that is to be marked line by line from the markings on the film of the standard, although the spacing of the lines will be different from that of the standard.

A standard motion-picture recording lamp is mounted behind the film of the standard, and a condensing lens focuses its rays in a narrow band across the film over the section opposite the hair lines where the scale is read. Between the two oscillators is an inverting prism and a lens which transmit the light passing through a narrow slit onto the film of the oscillator being calibrated. For

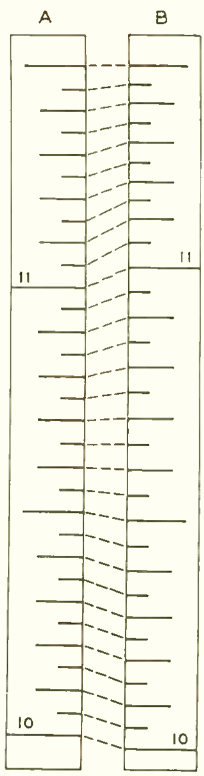


Fig. 1—Film scales for 17B oscillators, although closely linear, are not identical, and cannot therefore be printed from a single master scale

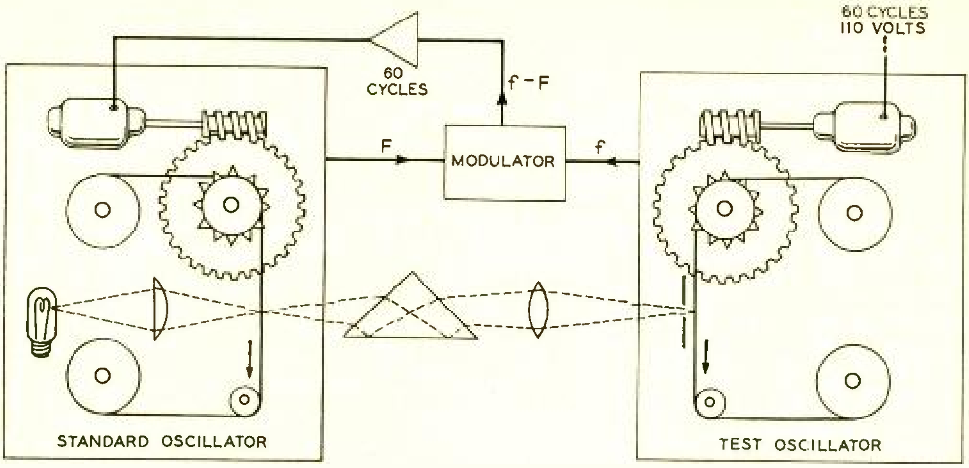


Fig. 2—Diagrammatic sketch of the arrangement for rapid commercial calibration of film scales for 17B *oscillators*

the duration of the calibration, 60-cycle synchronous motors have been attached to the condenser worms of each oscillator. That on the test oscillator is driven from the commercial 60-cycle supply, and runs at constant speed. That on the standard oscillator is driven by the "difference" frequency from the output of a modulator to which the output frequencies of the two oscillators are fed. When the two oscillators are 60 cycles apart in frequency, this latter motor will therefore also have a 60-cycle supply, and the two films will be running at the same speed. As each line on the standard film passes through the band of light, it will be printed on the film of the test oscillator. The purpose of the drive arrangement is to vary the speed of the standard film in such a way as to have the line in the light beam correspond to the frequency of the test oscillator except for the 60-cycle difference between the two outputs. This 60-cycle constant difference

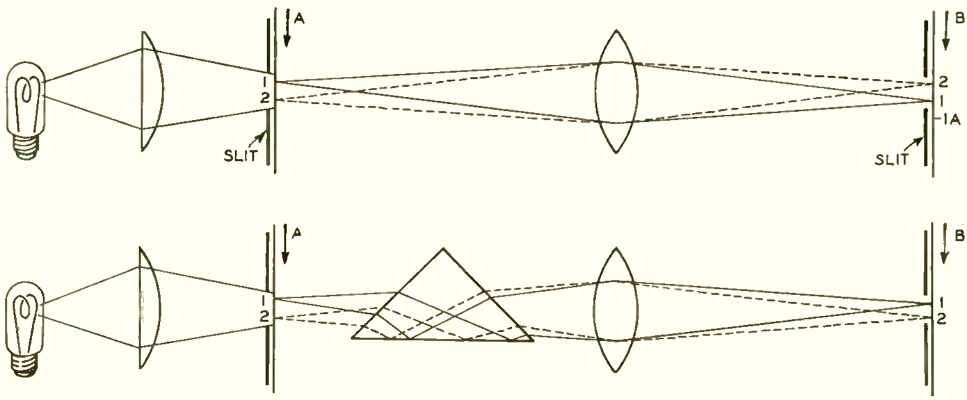


Fig. 3—With an inverted image, top illustration, the direction of travel of the shadow on film B *of a line on film* A *is opposite to the direction of travel of the film. With a rectified image, lower illustration, this direction of travel of the shadow is reversed*

is readily corrected after calibration by the low-frequency adjustment that has been provided for this purpose.

Suppose that at the beginning of a calibration the two motors are started when the frequency of the test oscillator, *f*, is 60 cycles higher than that, F, of the standard oscillator. Thus *f*-F will be 60 cycles, and both motors will be running at the same speed. Suppose now that due to slight differences in the two oscillators, the frequency of the test oscillator becomes more than 60 cycles greater than that of the standard—that when the standard is at 4,990 cycles the test oscillator is at 5,060. To produce a correct calibration at this point the standard should have been speeded up so as to bring the 5,000-cycle line at the calibrating point at this time. This, however, is exactly what has been done. As the frequency of the test oscillator increased more than the desired 60 cycles above the standard, the difference frequency, *f*-F, that operates the driver on the standard, became more than 60 cycles. The motor speeded up as a result, so that when the test oscillator was at 5,060, the increase in speed of the standard had brought the 5,000-cycle line in front of the calibrating slit. Had the frequency of the test oscillator become less than 60 cycles above that of the standard, the reverse action would have taken place; the standard motor would have slowed down so as to have maintained its scale in the proper position to calibrate that of the test oscillator.

Fig. 4—A 17B *oscillator ready for calibration in the calibration dark-room at the Kearny plant of the Western Electric Company*

Since the scales of all the 17B oscillators are very nearly linear, these differences in frequencies occur slowly, and are never great in magnitude. The result is that the standard film slows down or speeds up so as to keep the scale of the unexposed film in correct frequency alignment with the scale of the master oscillator. The slight variations that do occur are only a small fraction of the 25-cycle deviation permitted. The only precaution that must be taken is to make sure that, at starting, the test oscillator is at higher frequency than the standard. If this were not done, the correcting tendency would be in the wrong direction; the standard motor would be speeded up at a time when it should have been slowed down, and vice versa.

The inverting prism plays an important rôle in the calibration procedure. If it were not in the light path, the optical circuit would be as shown in the upper part of Figure 3. As the calibration line on film A reached position 1, just under the top edge of the slit, its shadow would be at position 1 on film B, just above the lower edge of the slit. As the line moved to position 2 on film A, its shadow on film B would move in the opposite direction to position 2. While it is moving to position 2, however, point 1 on film B has moved to point 1A, because of the motion of the film. As a result the shadow of the line on film A would be spread over the entire distance from 1A to 2 on film B.

With the inverting prism this situation is remedied as shown in the lower part of Figure 3. Due to the action of this prism, the shadow of the line at point 1 on film A falls at point 1 on film B—at the same corresponding position of the film. As the line moves to point 2 on film A its shadow moves to point 2 on film B. While it is moving this distance, however, the point of film B that was at point 1 has also moved to point 2 because of the motion of the film. There is thus no relative motion of the film and shadow, and the image appears on film B just as it was on film A. Due to the fact that film A may be moving at a speed slightly different from that of film B, because of the synchronizing action already described, there is a slight spreading, but it is kept negligibly small by making the slits in the path of the light very narrow.

This method of calibration has proved very convenient as well as economical. In a comparatively short time, oscillators can be calibrated to well within the required precision without requiring the painstaking effort demanded by the individual calibration method. The calibration set-up employed at the Kearny plant of the Western Electric Company is shown in Figure 4. Here the lens may be seen on a stand between the two oscillators, and the inverting prism is only partly visible at the right of the standard oscillator.

The Morris Liebmann Memorial Prize

has been awarded by the Institute of Radio Engineers to Dr. S. A. Schelkunoff of the Mathematical Research Department "for his contributions to the theory of electromagnetic fields in wave transmission and radiations."

NEWS AND PICTURES

Official Photograph U. S. Army Air Corps

HEADQUARTERS SIXTH CORPS AREA, MAY 21, 1942

THE EMPLOYEES OF WESTERN ELECTRIC, CHICAGO, ILL.

NOW IT CAN BE TOLD OFFICIALLY. RADIOS YOU HELPED TO BUILD AIDED US TO BOMB TOKYO AND HALF A DOZEN OTHER JAPANESE CITIES. THROUGH THOSE RADIOS WE ISSUED COMMANDS BETWEEN SHIPS THAT SENT OUR BOMBERS ON THEIR MARKS; THROUGH THOSE RADIOS WE CHEERED EACH OTHER ON AS OUR BOMBS CRASHED INTO VITAL JAPANESE NAVAL AND MILITARY INSTALLATIONS. AND, PERHAPS BEST OF ALL, THROUGH THOSE RADIOS, WE HEARD THE HYSTERICAL JAPANESE BROADCASTERS, TOO EXCITED TO LIE, SCREAMING ABOUT THE DAMAGE WE HAD DONE. WE WHO MADE THE FLIGHT DEEPLY APPRECIATE THE ASSISTANCE GIVEN BY YOU WHO MADE THE RADIOS.

JAMES H. DOOLITTLE
BRIGADIER GENERAL U.S. ARMY AIR CORPS

[*The picture shows microphones, designed by the Laboratories and made by Western Electric, in use in a U. S. Army bomber*]

News of the Month

Trial Air Raid Alert

On May 19 a trial all-out air raid alert was held involving approximately 3800 members of the Laboratories at the West Street buildings. The time consumed for members of the various emergency groups to get to their posts was four minutes after the standby alarm was sounded and the time to complete the evacuation after the all-out alarm was sounded was five minutes.

At the invitation of C. J. Glinane, Lieut. Edward A. Au, Warden Commander for the Sixth Precinct of the New York City Police Department, was present at the trial. Lieut. Au, with G. F. Fowler, Emergency Protection Coördinator, and W. A. Tracy, Zone Warden, made an inspection throughout the building.

In a letter to Dr. Buckley written the day after the trial, Lieut. Au said:

"I feel it obligatory to express my admiration for the steps taken by your organization in developing air raid precautions within the West Street buildings. It was indeed an inspiring and solacing experience to witness the demonstration executed on Tuesday, May 19, 1942, by the protective services of the Bell Telephone Laboratories. I would particularly commend to your attention the two men who planned and consummated the details of the Drill—Mr. William Tracy, Zone Warden of the Sixth Precinct Air Warden Service, and Mr. George Fowler, Emergency Protection Coördinator for the Bell Labs. I count myself fortunate that these two men, so competent and enthusiastic, are associated with me in Air Warden Activities.

"It was amazing that a first trial drill could be effected so successfully. In my in-

Air Raid Fire and Rescue Squads in Control Room spection tour of the plant during the drill, I visited numerous points without observing a single situation that did not measure up to the most exacting standards of safety and efficiency. All standard practices were rigorously observed, and in some instances adapted ingeniously to the needs of your particular problems.

"The solicitude of your management for the welfare of your employees is admirable. I found it an auspicious augury of the prosecution of the war effort that so important a plant as the Bell Labs is so completely prepared for all eventualities.

"The coöperation extended by all involved in the drill was complete. This eagerness of the employees, and their knowledge of precisely what to do, reflects a fine morale. I can certify that the Drill was by far the most comprehensive executed within this City to date.

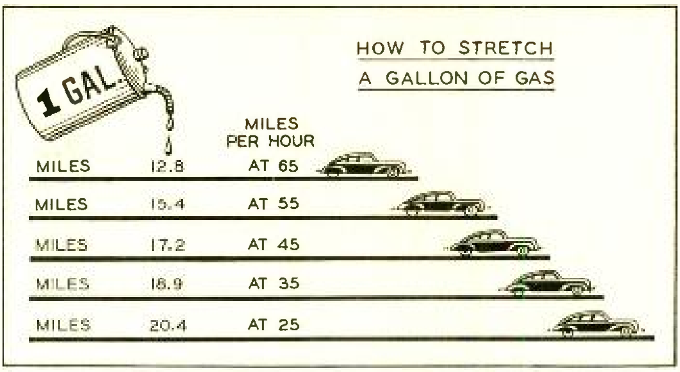
"The variety of services organized to provide against air raid incidents, e.g.—Decontamination Truck, Morale Squad, American Legion guards, etc., is testimony to the organizing genius of Mr. Tracy and Mr. Fowler.

"You have my heartiest felicitations on the status of the Air Warden organization of Bell Telephone Laboratories."

Tires, Gasoline and Speed

Every member of the Laboratories who drives a car is finding it both a virtue and a necessity to extract every possible mile from his tires and his gasoline. His is an engineering problem, in which all his motoring friends are interested. Here are some figures compiled by The Travelers Insurance Company of Hartford.

As compared with 25 miles per hour, tires wear out almost twice as fast at 45, and nearly four times as fast at 65. That is why speeds over 40 are unpatriotic, if not also illegal. What happens to miles-per-gallon is shown in the diagram. Oil and maintenance costs, too, go up, so that your total costs are about 50 per cent higher at 45 than at 25 miles per hour.



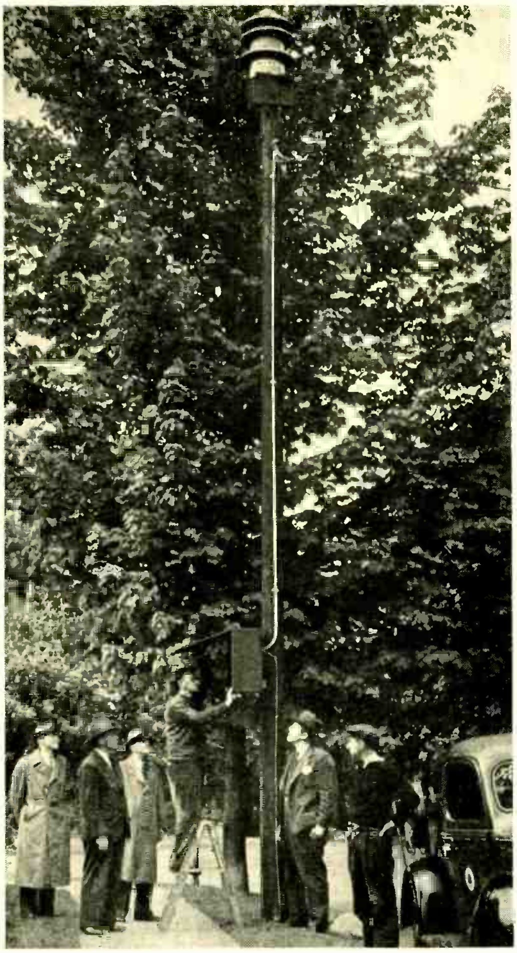
Of course, those are average figures, based on more than 300 vehicles of various weights and makes. Another study showed, however, that at higher speeds the light car owner's pocketbook took a worse beating proportionally than the heavy car owner's.

To conserve tires and gasoline in running your car—keep tires properly inflated; accelerate slowly; use first and second gears as little as possible; and shift into high at 15 miles an hour; if your clutch slips, get it adjusted; and every 5,000 miles or oftener have the distributor points cleaned and adjusted and the tires transposed.

Air Raid Warning by Remote Control

Air raid alarm systems that enable a single control point to operate a number of sirens simultaneously have recently been put into service in New Rochelle and Yonkers. The circuits were developed by the Laboratories and were installed and are being maintained by the New York Telephone Company.

At the control point of the system, which is at Fire Department Headquarters in New Rochelle, and at Police Headquarters in Yonkers, is a three-position key. This is shown in an illustration on page v. When the key is moved to the up, or red, position, all the sirens sound intermittently to give an air raid alarm. When it is moved to the down, or white, position, they sound continuously to give the all clear signal. A station ringer is enclosed in the box in which the key is mounted, and rings in step with the sirens if the circuit has functioned properly and power has been connected to the sirens. If there is any failure, the bell will ring for only a brief period, and will then stop.



Inspecting the power relay at a siren post in a New Rochelle residential district

The control point is connected over three cable pairs to the nearest central office. Here, in enclosed cabinets, is the major part of the control equipment, including indicating lamps and a telephone set for communicating with the control point. In the bottom cabinet is a horizontal row of equipment for each siren circuit, and as many as twenty of these circuits may be installed in a single cabinet. Common equipment and alarms are housed in the upper cabinet. From these cabinets, a single cable pair runs to each alarm location, where the relays that connect a-c power to the sirens are located. In the illustration above, the siren is shown at the top of the pole, and the control equipment is in the box placed about eight feet off the ground. Power for operating the siren is taken from the local commercial supply.

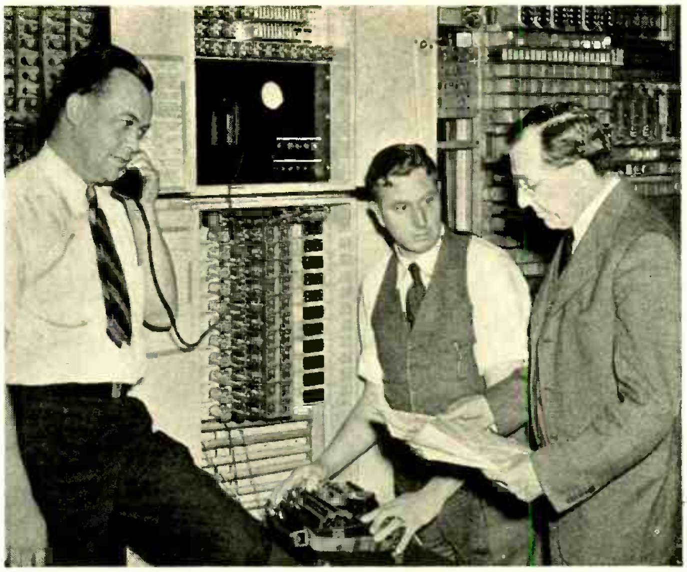
All conductors of the control network are under continuous automatic supervision. Any irregularity, such as an open circuit or crossed or grounded wires, at once sounds an alarm at the central office, and will not cause a false operation of any of the sirens. Ten sirens are controlled by the system in New Rochelle; and at Yonkers, it is expected that seventeen sirens will ultimately be used, although only eleven were included in the initial installation.

Substitutions for Critical Materials

Electrical Engineering, in its June issue, reports on a conference held during the recent A.I.E.E. Northeastern District meeting in Schenectady in which the general topic *Conservation of Critical Materials by the Use of Substitutes* was discussed. With reference to J. R. Townsend's talk during this conference on *Use of Substitute Materials in the Telephone Field* it said:

"Shortly after the outbreak of the war in Europe in 1939, the Bell Telephone Laboratories intensified its long-standing normal project of collecting data on raw materials and conducting studies of comparative suitability of different materials for specific applications in telephone equipment. According to Mr. Townsend's report, this general program of studies had for some years been concerned with the possible use of plastics in replacing rubber and metal, and the possibility of using copper-silicon alloys to replace nickel-silver which is used for contact springs. Results of these studies have permitted quick substitutions to be made under emergency conditions as they arose, and have enabled impressive amounts of critical materials to be saved or conserved for direct war uses.

"Since 1939, the need for some of this work could be anticipated; for example, substitutes for nickel, aluminum, and zinc. Soon, however, substitutes had to be found for substitutes, as the war spread to the Far East to affect such normal supplies as jute from India, tin from Malay, felt from Australia, rubber from the Dutch East Indies, and Manila hemp from the Philippines. Since about the first of 1942, production curtailment has been necessitated by a lack of certain available materials and now the problem no longer is primarily one of using less-scarce materials, but of limiting the use of all materials to those essential to civilian economy and war necessity. Mr. Townsend pointed out that substitute materials must be abundant, easy to work, and not require special machinery or take engineering talent from more essential war duties. He also pointed out that engineering ingenuity coupled with such necessities as those currently faced frequently resulted in the development of new and sometimes less expensive products. Some permanent benefits will naturally result.



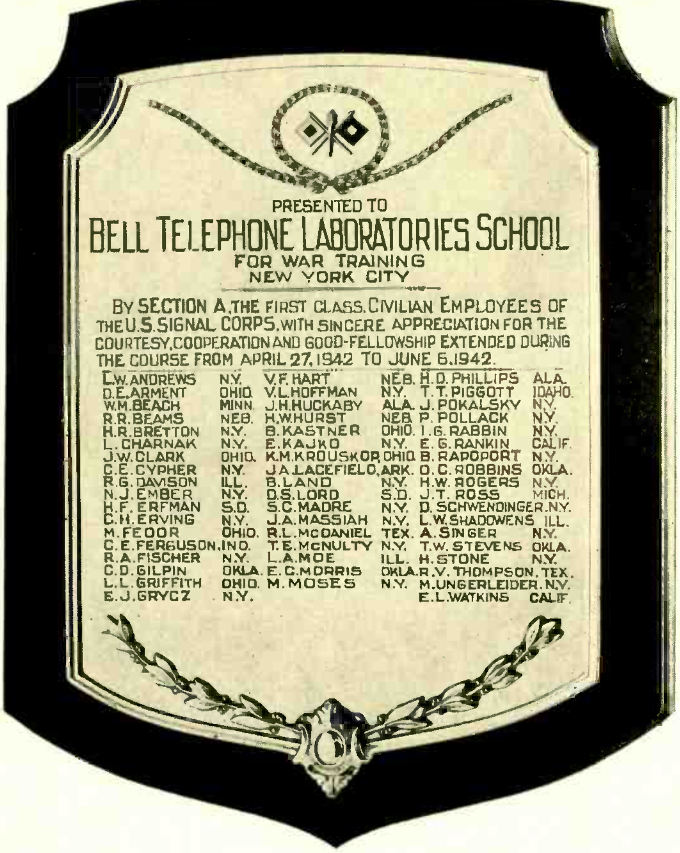
Making a routine test of the siren-sounding control and checking equipment at the New Rochelle central office

"The use of materials in wartime is based upon three groupings: those essential for the conduct of the war, those essential for necessary civilian uses, and those available as substitutes for relatively scarce materials. Respectively, aluminum, tin, and wood, are examples of these three classifications. The Bell System program for 1942 will save for war purposes 100,000,000 pounds of copper, zinc, lead, magnesium, nickel, aluminum, alloy steel, tin, chromium, crude rubber, phenol fiber, jute burlap, and silk. This is typical of the communications industry in general. Rubber, widely used in telephone practice for insulation, has been reduced by about 85 per cent. Silk fabric and yarn, long favorites and vital materials for insulation, have been reduced by 95 per cent and are rapidly on their way toward total and permanent replacement by such substitutes as acetate fabrics, nylon, spun glass and other materials."

Mayor Stanley Church of New Rochelle points to the key used to sound the sirens. District Manager J. N. Bennett of the New York Telephone Company is at the right

Military and Naval Items

Members of the Laboratories who have been granted leaves of absence, since the last issue of the Record, to enter military service are Hugh J. Glynn, Foster A. Hinshaw, Frank J. Howe, John F. McCarthy, Ernest F. Neubert, Capt. Dexter T. Osgood, Frank J. Osolinik, Lt. LeRoy G. Rainhart, Alex J. Sandor, Wilson Taylor, Francis E. Tucker and Anthony A. Waraske; for N.D.R.C. serv-



Plaque presented to the Laboratories by the first class in the School for War Training to record their presence in class and completion of course on June 6. Men whose names appear on the plaque are all civilian employees of the Signal Corps

ice, John E. Tweeddale; and to enter naval service, Ensign Halsey A. Frederick, Jr., Jesse M. Jackson and Ensign Charles C. Rock. Ensign Rock had previously been granted a personal leave of absence to engage in N.D.R.C. work but this was changed to a naval leave on June 18.

Malcolm A. Specht was recently advanced to the rank of Major. He is now teaching an advanced course in gunnery in the Field Officers Course at the Field Artillery School at Fort Sill, Okla.

Major Harvey N. Misenheimer, who has been a member of the Signal Corps Board at Fort Monmouth for the past thirteen months, has been transferred to the Office of the Coördinator of Information at Washington.

Lieut. Harold B. Guerci writes from Fort Totten, N. Y.:

"Since coming on active duty on January 7, I have been Assistant Communications Officer at the Staff Headquarters of the Anti-aircraft Artillery Command, where, because of relative familiarity with the Telephone Company and its functions, I have been assigned the procurement of its teletype and long lines full-period facilities. In addition, our work covers other communication, intelligence and signal devices."

* * *

Dr. Buckley was appointed chairman of the committee on the John J. Carty Fund of the National Academy of Sciences, succeeding the late Bancroft Gherardi. He has also been elected a member of the Engineering College Council of Cornell University for a term of three years.

The honorary degree of Doctor of Science was conferred on R. R. Williams by Columbia University on June 2 and by Yale University on June 9.

At the war production conference held in Newark on May 29, W. H. Harrison, Director of Production of the WPB, discussed *More War Production Today and Tomorrow.* H. F. Dodge was among the discussion leaders for the Panel on *Ordnance Inspection.*

H. M. Spicer discussed small motors at the Spencer Thermostat Company in Attleboro, Mass., and at the General Electric Company in Schenectady.

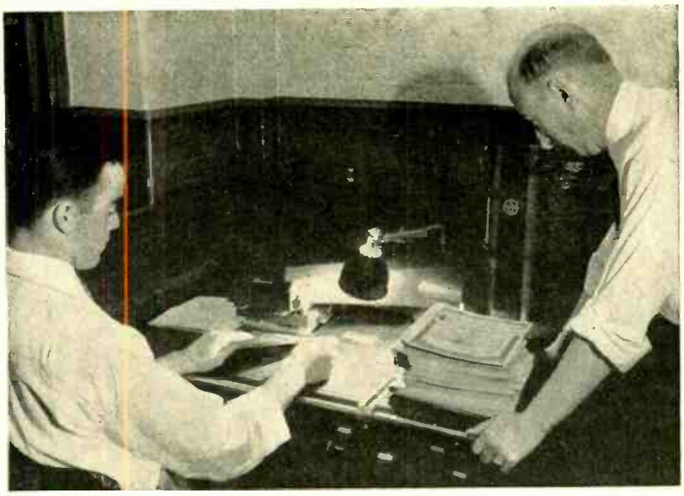
F. G. Colbath made a trip to Arlington, Virginia, to inspect a new private-branch exchange.

R. L. Jones, on May 14, spoke on *Man and Minerals* before a large group composed of members of the Research and Apparatus Development Departments at Murray Hill. In giving this talk, Mr. Jones had the honor of being the first speaker in the auditorium of the Acoustics Building at Murray Hill.

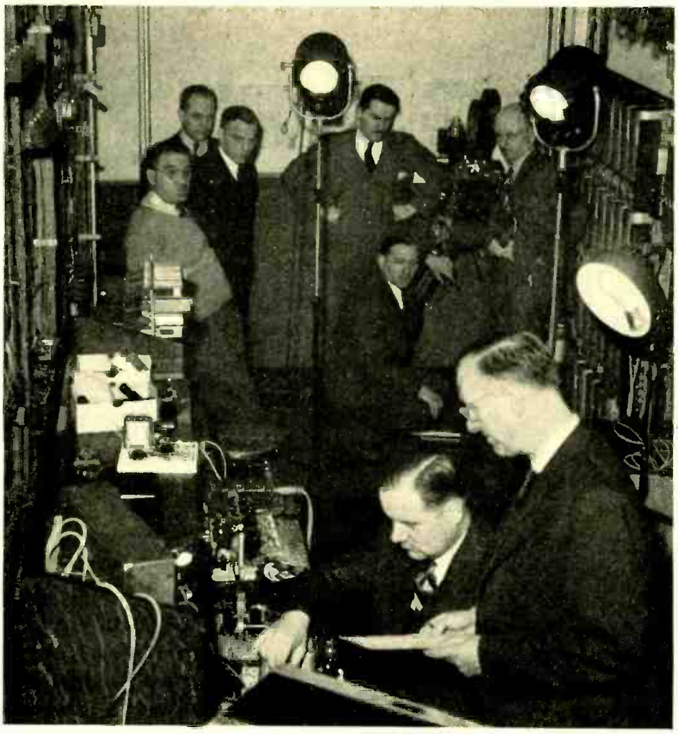
To THE *American Standard Definitions of Electrical Terms*, which has just been published by the A.I.E.E., a number of members of the Laboratories have contributed. W. J. SHACKELTON was a member of the sub-committee on General Terms, with particular responsibility for the sections on Kinetics and Magnetics. R. G. MCCURDY was a member of the sub-committee on Generation Transmission and Distribution; and W. H. MARTIN and W. WILSON were chairmen of the sub-committees on Wire Communication and Electronics, respectively. HARVEY FLETCHER represented the National Academy of Sciences on the General Committee.

The campaign for increased purchases of bonds has meant busy days and some nights for the bond group in Payroll Accounting. The Misses Elsie Burger (foreground) and Regina Hawkins set up the deductions from payroll while W. J. Darlington brings the card records up to date. At right are W. C. Kirkman and P. H. Dowe of the tax group

THE REGULAR STAFF OF THE Laboratories has been augmented in carrying its extra load of war effort by "loans" of personnel from other companies in the Bell System. Engineers and draftsmen have been taken on for the duration from the American Telephone and Telegraph Company, The Bell Telephone Company of Pennsylvania, Illinois Bell Telephone Company, New Jersey Bell Telephone Company, New York Telephone Company, New England Telephone and Telegraph Company, and the Western Electric Company. Negotiations are also under way with other Associated Companies. This is an example of the general interchangeability of personnel in the Bell System where the shift in effort has enabled the Laboratories to better meet the demands created by the war effort. In future issues of the RECORD the assignment of these men will be discussed.



A new addressograph is a great time saver in printing "holders'" names on the bonds. In May, J. R. Walsh (left) ran 3199 *bonds through the machine. C. E. Flaig (right) is supervisor of the group*



Included in the Western Electric picture MINES ABOVE GROUND *are several views taken at the laboratory. In the photograph above, taken in the Toll Switching Laboratory, R. V. Crawford and E. R. Smith are shown in the foreground and, at the rear, left to right: Arthur Burns, Springer Pictures; Fred Luther and C. L. Stong, Western Electric; H. C. Gipson, John Clemens and Harold McCracken, Springer Pictures*

Teaching of Ferromagnetism was the subject of an article by R. M. BOZORTH published in the April issue of the *American Journal of Physics*.

Demagnetizing Factors of Rods, by DR. BOZORTH and D. M. CHAPIN, appeared in the May issue of the *Journal of Applied Physics*.

R. CLARK JONES spoke on *A Siren of High Efficiency and Large Output* and J. B. KELLY on *Transmission of Sound Signals in Congested City Areas*, before a meeting of the Acoustical Society of America held at Ann Arbor, Michigan, on May 15.

PART OF WESTERN ELECTRIC'S overall information program, the motion picture *Mines Above Ground*, deals with the Western Electric-Bell System threefold program of metals conservation—through industrial research. This involves the use of alternate materials and the reclamation of scarce materials by the Nassau Smelting and Refining Company's operations. It is a story of industrial thrift practices established in peacetime which have become doubly valuable in time of war. Several views taken in the Laboratories are included in this two-reel film.

The picture was shown at a press preview on June 8 which was attended by P. B. FINDLEY, E. R. SMITH, R. V. CRAWFORD, J. W. BEYER and D. B. PENICK, several of whom were shown in the shots taken at the Laboratories. The film is available for showings before important groups of salvage experts, to Bell System groups and to clubs and engineering societies.

UP TO DATE more communications equipment has been made by the Western Electric Company for our armed forces since the beginning of the present conflict than was turned out during the entire period of World War I. Such production calls for vast amounts of raw metal, far more than is available from conventional mines below the ground, hence every ounce that can be salvaged from outworn parts and other scrap must be conserved for re-use. The picture referred to above shows how such conservation can most effectively be accomplished.

J. H. HEISS, JR., of the Chemical Laboratories, received a degree of Bachelor of Science and Engineering from the Newark College of Engineering.

A. R. KEMP and W. J. CLARKE were at Hawthorne to discuss enameled wire development. Mr. Kemp visited the Mellon Institute at Pittsburgh upon his return.

J. H. INGMANSON and V. T. WALLDER visited Point Breeze in connection with impregnating materials for switchboard cords.

E. E. SCHUMACHER attended a conference

held at the Bureau of Ships in Washington.

R. M. BURNS and K. G. COMPTON, at Point Breeze, discussed finishes; Mr. Compton also visited Hawthorne in connection with the same subject.

B. L. CLARKE and H. W. HERMANCE visited the Davison Chemical Company, at Baltimore, to discuss dehumidification.

D. A. MCLEAN, at the Hawthorne plant, carried out experimental work on the production of high-voltage paper condensers for special equipment.

W. E. CAMPBELL conferred with members of the General Electric Company at Schenectady on special problems of wear and lubrication.

AT PRINCETON, before faculty members and graduate students, C. S. FULLER spoke on *Structure of Synthetic Polymers* and W. O. BAKER on *Relationships Between Properties and Structures in Polyamides.*

JOHN MILLS received an "Alumni citation" from the University of Chicago.

A. R. THOMPSON has been reëlected president of the American Institute of Graphic Arts for 1942-43.

AT PURDUE UNIVERSITY, as part of the ceremonies dedicating the new physics laboratory, J. A. BECKER spoke on *Electron Microscopes and Their Uses.*

THE TELEPHONE HOUR

MONDAYS AT 9 P.M. — WEAF

July	
6	HELEN TRAUBEL, *soprano*
13	BARTLETT AND ROBERTSON, *piano*
20	GRACE MOORE, *soprano*
27	LAWRENCE TIBBETT, *baritone*

R. M. RYDER is the author of an article entitled *The Electrical Oscillations of a Perfectly Conducting Prolate Spheroid* published in the May issue of the *Journal of Applied Physics.* This article is condensed from a dissertation presented at Yale University in connection with his Ph.D. degree.

ALFRED DECINO, a member of the Radio Research Department, received the M.S. degree from Stevens Institute of Technology on June 4.

J. H. BOWER visited the Bureau of Standards in connection with matters pertaining to dry batteries.

A. W. ZIEGLER has returned from Hawthorne where he spent three months in connection with the manufacture of quartz crystal units.

MEMBERS OF THE LABORATORIES TO WHOM PATENTS WERE ISSUED DURING THE MONTHS OF APRIL AND MAY

H. W. Augustadt
R. H. Badgley
C. I. Baker
H. M. Bascom
C. A. Bieling
B. G. Bjornson
H. S. Black
A. R. Bonorden
L. J. Bowne
J. W. Brubaker
E. Bruce (2)
C. J. Callbick
F. S. Corso
E. F. Dearborn
P. G. Edwards (2)
G. B. Engelhardt
O. A. Friend
D. K. Gannett (2)
J. J. Gillich
F. Gray
E. I. Green (2)
O. E. Greenwood
J. A. Hall
N. I. Hall
C. A. Hedberg
I. H. Henry
C. N. Hickman
R. K. Honaman
A. L. Hopper
A. W. Horton, Jr.
F. A. Hoyt
R. G. Humphrey
J. B. Johnson
R. M. Kalb
J. A. Kater
A. P. King (2)
F. S. Kinkead
F. A. Korn
J. A. Krecek
J. G. Kreer, Jr.
H. K. Krist
E. Lakatos (3)
F. B. Llewellyn
A. A. Lundstrom
J. M. Manley (2)
W. P. Mason (3)
E. C. Matthews
J. O. McNally
J. W. McRae
A. E. Melhose (2)
D. Mitchell
M. E. Mohr (2)
N. Monk
P. B. Murphy
R. S. Ohl
J. T. O'Leary
B. M. Oliver
G. L. Pearson (2)
E. Peterson
F. A. Polkinghorn
N. Y. Priessman
G. A. Pullis
H. T. Reeve
F. W. Reynolds
C. D. Richard
A. L. Samuel (2)
O. A. Shann
T. Slonczewski
K. D. Smith
P. H. Smith
F. R. Stansel
E. M. Staples
H. F. Stover
W. B. Strickler (2)
E. R. Taylor (2)
C. C. Towne
W. W. Tuthill (2)
E. L. Vibbard
A. Weaver
H. W. Weinhart
J. W. West (2)
L. R. Wrathall (2)

Some Members of the Laboratories

Biographies of members of the Laboratories chosen by lot from those who have been with us more than six months and less than twenty-one years follow.

* * * * *

Jeannette Warnetzka wears this blouse not only because she looks well in it but because it typifies the domestic art of her family homeland—the Ukraine. To carry the tradition further she made it herself. Still in the tradition she loves Ukrainian dances and chorals and quite often takes part in both.

Jeannette lives with her family in Maplewood, where she was educated in the public schools. Graduating from High School in 1939, she entered the Laboratories in 1940 as a messenger. Some time later she was transferred to Central Files, and with a section of that organization was transferred to Murray Hill in March of this year.

In addition to her singing and dancing, Jeannette does a bit of archery and occasionally rides horseback. Her relatives in the Ukraine have not been heard from, but since there was no fighting in their region, she hopes for the best.

Jeannette Warnetzka

* * * * *

Bill Conner likes to run—his distance was the quarter mile—but a football term will better describe his work in the Local Service Department. That term is "running interference," for Bill's job is to fend off from the Research men the foot-clogging jobs of procurement. Does an engineer want a pillow-block or a board, or a glass-

William J. Conner

blowing job, Bill will see that he gets it while meanwhile the engineer is using his capabilities on other things.

On the way to an N. Y. U. degree himself, Bill can't remember when he first wanted to be a chemical engineer. Between work and study he hasn't much leisure; his favorite novels have economic problems as a basis. He lives in Dumont with his parents, a brother, and a sister.

* * * * *

A NATIVE of England, JOHN HUNTLEY, JR., came to the United States to grow up. After graduation from Boonton High School he attended Newark College of Engineering for two years, then entered the Laboratories early in 1940. A member of the piezo-

JOHN HUNTLEY, JR.

electric research group under R. A. HEISING, he runs a sort of "crystal clinic" where he measures the quartz crystals received by the Laboratories and furnishes to the users a statement of their orientation with respect to the crystalline axes. The properties of quartz, particularly as to the effect of temperature on vibration, vary with the angle at which the crystal plate is cut from the original piece, and knowledge of the angle is basic to further work on the plate.

John's studies did not stop when he joined us; he is taking electrical engineering at night at N. Y. U. The mathematics in his course, especially the calculus, he finds particularly useful in interpreting his daily

As forecast in the February issue, Alta Boch has withdrawn from Current Engineering to become the bride of Kermit S. Dunlap (Acoustical Research, Murray Hill)

work. Before the war he had an amateur radio station, but now photography has advanced to his prime recreation. A carefree bachelor, he goes fishing in Maine on vacations.

* * * * *

THERE ARE TWO LEWIS J. STEINBACHS in the Laboratories, father and son—and also a daughter in Transcription. This story is about "the old man," who incidentally is far from old, being still in his forties. Lew and the Bell System joined forces in 1921 in the Philadelphia Instrument Shop, predecessor of the huge Specialty Products Shop. Broadcast transmitters were being made there, and Lew worked on them for a time, then returned to the Frankford Arsenal where he had earlier served his apprenticeship as a toolmaker. There he was assigned to a development job under H. B. ELY. In this work the relationship between engineer and instrument maker was so close that when Col. Ely came to the Laboratories some time later, he arranged to bring Mr. Steinbach with him. Their first joint project in their new environment was the design of new loud speakers, based on measurements made in the Lyric Theatre at Hoboken.

Among other projects which have profited from Lew's craftsmanship are the small

Lewis J. Steinbach

message register and the ringer for the combined telephone set. Through his ability and coöperation he has won for himself the highest rating in his line of work, that of "technician."

Lew lives in Rutherford, where he enjoys raising flowers. He also likes to build and repair radio sets, but that hobby has been laid aside "for the duration."

* * * * *

V. E. Legg was in Chicago and St. Louis from May 11 to May 15 on loading coil development problems.

A Secondary Frequency Standard Using Regenerative Frequency-Dividing Circuits, an article by F. R. Stansel, was in the April issue of the *Proceedings of the I.R.E.*

F. Hardy and G. H. Downes were in New Haven and Atlantic City on matters pertaining to the lubrication of switches.

G. A. Ritchie and E. Graf went to Hawthorne to discuss switching devices.

G. B. Baker visited the Leeds & Northrup Company in Philadelphia. He also went to Washington on the design of special relays.

H. B. Brown was at Hawthorne and at the Leeds & Northrup Company on special 200-type selectors.

Fullerton S. Kinkead, a member of the Telegraph Development Department, died suddenly on the ninth of June. Mr. Kinkead was graduated by Ohio State University in 1926 with the degree of B.E.E. During a summer vacation while attending college, he worked for the Installation Department of the Western Electric Company and upon graduation immediately joined the Laboratories. Since then he had been successively associated with three groups in the Telegraph Development Department—carrier, direct current, and, since 1929, switching.

In connection with these activities Mr. Kinkead showed exceptional ingenuity and contributed many novel and practical suggestions—about fifty patents having been issued in his behalf. Mr. Kinkead's major contributions were made in the switching group where he was responsible to a large degree for the successful circuit development of all the manual switchboards and automatic teletypewriter concentrating units used in the nationwide TWX service and of the telegraph service board which is replacing the telegraph test boards in the larger cities. More recently, Mr. Kinkead had made important contributions to the development of circuits for the full automatic teletypewriter switching system now being used in the extensive private line networks of the General Electric Company and the Republic Steel Corporation.

F. S. Kinkead, 1905-1942

Before the Century of Progress opened in 1933, he spent several months in Chicago adjusting and testing the teletypewriter switchboard which demonstrated—with the aid of two teletypewriters in another section of the Bell Telephone Exhibit—the procedure taking place in TWX central offices for rendering this service. He also adjusted and tested the multi-channel telegraph exhibit in which carrier-current transmission at voice frequencies was demonstrated. While in Chicago he aided in the training of the personnel required to demonstrate and to maintain these two exhibits.

During the past year most of his time was spent in the development of war projects where again he demonstrated his exceptional versatility and engineering ability.

Mr. Kinkead's chief hobby was photography, particularly stereoscopic. He was the proud owner of a stereoscopic projector and also of a camera adapter for taking such pictures, both of which were his own design and construction.

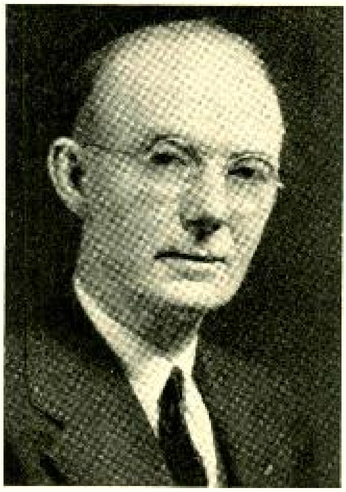
* * *

P. T. Higgins made a trip to Hawthorne for the quarterly survey on step-by-step apparatus. He also went to New Haven to investigate a field trial of the lubrication of step-by-step switches.

W. G. Laskey visited the Triplett Electrical Instrument Company, Bluffton, Ohio, the Hickok Meter Manufacturing Company, Cleveland, and the General Electric Company, West Lynn, in connection with the development of meters.

A. R. Bonorden has been elected a member of the Plainfield City Council.

* * *



M. V. Hickey

M. V. Hickey Retires

Michael V. Hickey retired under the Retirement Age Rule on June 30 after completing twenty-four years of service with the Engineering Department of the Western Electric Company and the Laboratories. Mr. Hickey worked for twenty-one years as a carpenter for Robert E. Kelly, contractor, before coming to West Street. Here he started as a carpenter, advanced to assistant foreman in 1925 and then became foreman a few years later. At the time of his retirement he was a group supervisor in the Building Shop. His responsibilities were supervising all carpentry work in the Plant Department. This work covered repairing doors, windows, and floors; building shop and laboratory benches and certain special apparatus not covered by the cabinet group; laying floors and floor coverings; constructing concrete forms and scaffolding; and handling other house carpentry work.

H. L. Messerschmidt of the Switching Apparatus Development Department received a degree of B.S. in Electrical Engineering from Rutgers University.

R. L. Lunsford, A. C. Gilmore and T. J. Grieser were in Hawthorne in connection with communication equipment. Mr. Lunsford also visited Washington and Fort Monmouth.

H. E. Marting and R. L. Young recently made a trip to Washington in connection with the expansion of telephone equipment there.

G. Q. Lumsden and J. Leutritz, Jr., made an inspection of the timber test plot at Gulfport, Miss. Mr. Lumsden then made an inspection of experimental lines of salt-treated southern pine poles in Alabama. He also stopped at Spartanburg, South Carolina, to discuss commercial salt treatments and accelerated pole-drying experiments.

Mr. Lumsden and C. H. Amadon inspected treated poles at Brewster, N. Y.

Members of the Laboratories who completed twenty years of service in the Bell System during June were:

Research Department

A. E. Harper — E. L. Norton
A. G. Jensen — H. L. J. Siedentop

Apparatus Development Department

W. J. Abbenseth — Norman Insley
L. H. Campbell — P. E. Mills
J. S. Elliott, Jr. — P. S. Olmstead
D. O. H. Weston

Systems Development Department

W. C. Babcock — J. M. Eglin
E. C. Blessing — E. W. Flint
P. G. Edwards — A. A. Heberlein

Personnel Department

M. L. Wilson

General Service Department

E. G. Conover — Helen Keiningham
Kathryn O'Connor

Plant Department

W. E. Cantwell — R. L. Hastings
M. J. Walker

STEPHEN GASPARICK
of the General Service Department completed thirty years of service in the Bell System on June 13

CHESTER S. GORDON
of the Outside Plant Development Department completed thirty years of service in the Bell System on June 18

JAMES T. LOWE
of the Outside Plant Development Department completed thirty years of service in the Bell System on June 17

R. H. COLLEY, with C. H. AMADON and G. Q. LUMSDEN, made an inspection of zinc meta-arsenite treated poles and experimental ground line treatments on Staten Island.

H. T. LANGABEER discussed power problems with engineers in Washington.

F. T. FORSTER observed battery tests under way in Pittsburgh.

C. W. VAN DUYNE was at the Electrolux factory in Old Greenwich, Conn., on matters pertaining to machine design.

J. H. SHEPARD attended a conference on protection at Attleboro, Mass.

J. H. SOLE is at Fort Wayne on machine design development.

L. J. STACY, with C. B. Campbell of the A T & T, was at Albany and Springfield to study step-by-step system dialing.

H. J. MICHAEL and L. M. ALLEN, at Baltimore, made observations on the performance of the a-c key-pulsing equipment.

M. A. WEAVER has been in Tulsa, Okla., in connection with crosstalk tests on type-K carrier cables.

H. C. FRANKE visited Washington and Charlotte for studies of the transmission performance of type-K carrier systems.

B. DYSART spent several days at Minneapolis studying a new method of automatically switching coaxial-cable circuits.

D. A. QUARLES has been elected a member of the Executive Committee of the Yale Engineering Association.

C. A. WEBBER and W. J. KING were at Hawthorne to discuss cable design problems. Later in the month W. FONDILLER and H. H. GLENN were there to confer on enameled wire.

R. T. STAPLES was at Point Breeze to confer on cord development problems.

E. H. GILSON, in company with K. J. Plucknett of the Rural Electrification Administration, visited Manassas, Va., in connection with an investigation of the characteristics of power distribution circuit faults.

DURING MAY, J. W. SCHMIED and R. MARINO were at the Patent Office in Richmond; and W. J. HILL was in Washington and Richmond relative to patent matters.

MEMBERS OF THE LABORATORIES BRIDGE CLUB were quite successful in the special tournaments conducted by the Metropolitan Commercial Bridge League. The team-of-four championship was won by MISS EDNA

Walls, doors and guards are useless, if YOU talk!

Aamodt, E. A. Thurber, T. V. Curley and G. C. Lord with C. L. Deelwater substituting for Mr. Thurber on the last night; the pair championship, by Mr. Curley and Mr. Lord; and in the individual tournament, Mr. Deelwater was runner-up. In the team-of-twelve tournament held during the year, the Laboratories Club finished in second place.

Twenty-Five-Year Service Anniversaries

Immediately after R. E. Collis received his M.S. degree from Iowa State College in 1917 he joined the Engineering Department of the Western Electric Company. His first work was in connection with the design and testing of printing telegraph systems including secret coding arrangements for the U. S. Signal Corps. Following this he was in charge of the printing telegraph laboratory, associated with the design of both multiplex and simplex systems.

In 1922 Mr. Collis transferred to what is now the Switching Development Department. Here he was first concerned with the testing and trial installations of the link-type panel circuits. From 1924 to 1932, in the fundamental development group, he was engaged in the development of decoder circuits for the panel system; of means to improve and extend the signaling capability and range of interoffice trunks; and of fundamental circuits for automatic charging of telephone calls on a timed and zoned basis. Since 1932 Mr. Collis has been supervising the development of senders, decoders and markers for both the panel and crossbar systems. Last fall he was also given charge of the group handling all routine test circuits for these systems.

Mr. and Mrs. Collis live in Summit, New Jersey, with their two children, a boy and girl, ages 13 and 9. Mr. Collis is active in a local civic association and represents this association on the Summit Defense Council. His main recreation is golf and he is a Telephone Pioneer.

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After graduation from Cornell University in 1917, Lester H. Germer was employed for about three months by the Research Department of the Western Electric Company before enlistment in the Army. He served as a Second Lieutenant in the Air Service and was cited by General Pershing "for exceptionally meritorious and conspicuous service."

Returning to the Laboratories in 1919 he was associated with Dr. C. J. Davisson in researches on thermionics and electron scattering. He received the degree of A.M. from Columbia University in 1922, and the degree of Ph.D. in 1927. He was awarded the Elliott Cresson Medal of The Franklin Institute in 1931.

In recent years Mr. Germer has been concerned in pioneering work in the development of electron diffraction and the application of this technique to problems in surface chemistry and the crystalline struc-

Raymond E. Collis

Lester H. Germer

James W. Schmied

ture of matter. These researches have to do with such diverse matters as rates of corrosion of metal surfaces, the ways in which single layers of atoms and of molecules arrange themselves under various circumstances, discovery and identification of protective surface layers, the structure of carbon surfaces, and order in alloy systems.

The Germers live in Millburn, New Jersey. A daughter, who is a graduate of Cornell University, is employed by the International Business Machines Corporation, and a son will be a junior at the Massachusetts Institute of Technology in September. Dr. Germer is active in outdoor sports and is a member of the Telephone Pioneers of America.

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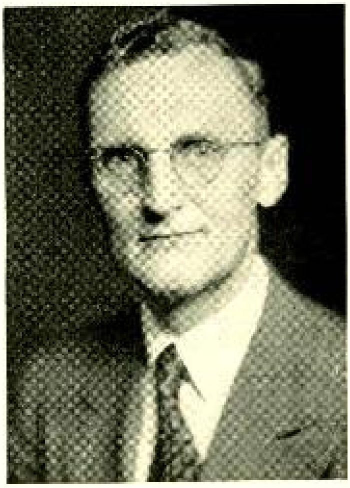
J. W. Schmied, Patent Attorney, immediately joined the Civil Service Commission in Washington after receiving his B.S. degree from Ohio Northern University in 1910. A year and a half later he entered the Patent Office as an assistant examiner where he ultimately became an assistant to the Examiner of Interferences. During this time he studied law at George Washington University, receiving his LL.B. degree in 1915. He was admitted to the bar of the District of Columbia in 1915, of New York State in 1921 and to practice before the Supreme Court of the United States in 1933.

Mr. Schmied joined the Patent Department of the Western Electric Company in 1917 and until 1926 was concerned with patent work relating to radio and carrier systems. Since 1926, except for the summer of 1929 when he was in England aiding in clearing up an accumulation of patent work caused by sound-picture litigation, Mr. Schmied has been head of the department which now handles d-c telegraphy, telegraph switching, magnetic materials, submarine cables and telephone cable structures. Since 1930 his department has dealt with the patent work relative to the TWX teletypewriter system and more recently has been concerned largely with private-wire telegraph systems of the self-directing message type.

Mr. and Mrs. Schmied live in Madison, New Jersey. A musical family, all five of their children—three daughters and two sons—play the piano. The oldest girl, now in college, and the youngest, now in high school, also play the violin and were chosen for the New Jersey All-State High School Orchestra. The other daughter, now also in college, plays the 'cello as well. The older son is now in the United States Field Artillery. The Schmieds have a place in New Hampshire where they usually spend their vacations. Bee-keeping and the propagation of choice varieties of bearded iris are chief among Mr. Schmied's hobbies.

Ray H. Kreider
of the Equipment Development Department completed thirty years of service in the Bell System on June 24



Gilbert T. Ford
of the Equipment Development Department completed thirty years of service in the Bell System on June 24

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H. W. Goff joined the Engineering Department of the Western Electric Company immediately after he received his degree of B.S. in Electrical Engineering from the University of Wisconsin in 1917. His first work was in the machine switching laboratory. A year later he joined the Navy where he be-

HAROLD W. GOFF

MARY CROSS FRANK

LESLIE A. LEATHERMAN

came an Ensign Engineer on transport duty. On his return to West Street he joined the machine-switching design group primarily on the mechanical phases of the design work. During this time he was concerned with the development of the coordinate system, the forerunner of the present crossbar system.

Since 1927, in what is now the dial apparatus group of the Switching Apparatus Development Department, Mr. Goff has been associated with the development of dials for subscribers' telephones. In this connection he was responsible for the invention and development of the Western Electric repertory dial. Since last September he has spent all of his time on war projects. During his service with the Laboratories over forty patents have been issued in his name, indicating his many contributions to the telephone art.

The Goffs live in Flower Hill at Manhasset, Long Island, and have a daughter and a son, both in High School. Mr. Goff has been actively identified with local civic affairs. For a number of years his principal pastime has been shooting, and he has been active in the Port Washington Rifle and Revolver Club.

* * * * *

FOR THE FIRST seventeen years of MARY CROSS FRANK's service with the Laboratories she operated the printing telegraph between West Street and the Hawthorne plant of the Western Electric Company. In 1934 she transferred to the Mailing Department where she was with the outgoing mail group. Since 1936 she has been a service clerk in the photograph, photostat and blueprint group of the General Service Department, first as service clerk for the blueprint group in the Davis building and then at West Street. More recently she has had charge of the order service for the two new blueprint machines recently installed in Section 2A.

Mrs. Frank, who married Charles Frank, a tinsmith in the Building Shop, in October, 1940, lives in the Village. For a number of years she has been active in the Women's Auxiliary of the Father Duffy Chapter of the Rainbow Division Veterans and is now its president. Her main diversion is reading. Both Mrs. Frank and her husband belong to the Edward J. Hall Chapter of The Telephone Pioneers of America.

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L. A. LEATHERMAN spent the summer of 1916 in the Western Electric student course at the old Clinton Street shops in Chicago. After graduation from Purdue the following spring with a B.S. degree in E.E. he immediately went to the Hawthorne plant. He enlisted as a private in the U. S. Army that October and spent eighteen months in France with a telephone squad of a light railway engineering regiment which ran trains between the standard gauge railroad and the trenches. After the Armistice Mr. Leatherman took a four-months' course in liberal arts at the University of Toulone in southern France.

Mr. Leatherman returned to the equipment engineering group at Hawthorne late in 1919. He was sent to New York for the summer of 1921 as a resident engineer during the first panel installations. He transferred permanently to West Street in 1923 and for the next two years was concerned with panel and manual equipment design in the Equipment Development Department. From 1925 to 1929 he was associated with the drafting and clerical methods group of the same department and since then has been in the power group where he has been responsible for the preparation of specifications and Bell System practices covering the installation and maintenance of central-office and private-branch exchange power equipment.

The Leathermans, who live in Madison, New Jersey, have three children, the oldest having just started his first year in chemical engineering at Ohio State University.

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After H. F. Dodge received his S.B. degree from the Massachusetts Institute of Technology in 1916 he remained there a year as an instructor in electrical engineering. Joining the Engineering Department of the Western Electric Company in 1917, Mr. Dodge continued his education on a part-time basis at Columbia from which he received his A.M. degree in 1922. Throughout World War I he was associated with the development of submarine detection devices for the Navy and did experimental work at Port Washington, Sea Gate, Fort Wright and Nahant. In this connection he became an expert on binaural listening. Following the war he was associated with the Research Department in the development of telephone instruments and allied products. This work included handset and broadcast transmitters, electrical stethoscopes and articulation test methods. Several patents were issued to him on electrical stethoscopes and transmitters including paper-ring mountings used in the latter.

In 1924 Mr. Dodge joined the Quality Assurance Department, then known as the Inspection Engineering Department, and is now Quality Results Engineer. He is responsible for the quality control inspection and rating plan used for major classes of apparatus and equipment made by the Western Electric Company; for the development of sampling inspection techniques and tables used widely in the plants of the Western Electric Company for process and final inspections, with consequent substantial savings and improvement in control of quality; and for Inspection Practices (specifications) which are the basis for continuing inspection results furnished to the Laboratories for quality assurance purposes. Recently he has been associated with inspection problems relating to the procurement of war supplies.

An allied field in which Mr. Dodge has contributed substantially is in the standardization, through the A.S.T.M., A.S.M.E and A.S.A., of graphical presentation of data and quality control of products. He is chairman of the A.S.T.M. Technical Committee of the Interpretation and Presenta-

Your Skin in Summer

Keep It Clean

After swimming in a pool, take a warm shower with soap and dry yourself thoroughly with a towel. Dry your feet last and do not use that towel again. Dry thoroughly between your toes.

Learn what poison ivy looks like, and keep away from it, especially on a warm day. If you have been exposed, particularly by handling it, wash well with strong laundry soap. A thick paste of soap is a good emergency relief.

Keep It Cool

In hot weather, avoid overexertion. In any weather be careful to acquire your tan on the installment plan. If you do get sunburned apply an ointment or baking soda solution on a compress. Drink plenty of water, cool but not ice cold.

Harold F. Dodge

Danforth K. Gannett

Alfred L. Johnsrud

tion of Data; chairman of A.S.M.E. subcommittee on Standards for Graphical Presentation which has published standards on *Engineering and Scientific Charst for Lantern Slides*. In addition to these, Mr. Dodge is also chairman of the A.S.A. War Emergency Committee on Quality Control, formed in 1941 at the request of the War Department, which has produced standards on *Guide for Quality Control*, *Control Chart Method of Analyzing Data*, and *Control Chart Method of Controlling Quality During Production*.

Mr. and Mrs. Dodge live in Mountain Lakes, New Jersey, with their three children, one son and two daughters. The two older children are in High School and the other is in Grade School. Mr. Dodge has taken an active part in the civic affairs of his community, prepared the measurement plan for real estate appraisal used for tax assessments there and has been a member of the Planning Board since its creation in 1930, its chairman for seven years, and currently its vice-chairman. He was vice-president of the Bell Laboratories Club for one year. His recreations are badminton and amateur movies and he is a Telephone Pioneer.

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Throughout his twenty-five years of service in the Bell System, D. K. Gannett has been associated with transmission problems, for the most part on problems of toll-telephone transmission. Mr. Gannett attended the University of Minnesota, from which he received the degree of B.S. in Engineering in 1916 and an E.E. degree in 1917. He immediately joined the Engineering Department of the A T & T, was a member of the D & R, and is now Toll Transmission Engineer in the Transmission Engineering Department.

During World War I Mr. Gannett was engaged in developing means for speeding up telegraphic communication with Europe by the application of amplifiers employing the then new vacuum tube to submarine cables. Since then he has been engaged principally in toll transmission problems in such fields as toll-line signaling systems; facsimile and television transmission over wires; the distribution over Bell System wire lines of very accurate frequencies to control the frequencies of power stations and radio broadcast stations; program networks for interconnecting broadcast studios and radio transmitters; and the special problems involved in securing the best performance from vacuum tubes in the telephone plant. Recently, most of his time has been spent on war projects.

Mr. Gannett's work has often been in the nature of pioneering on new developments. For example, he designed and supervised the construction and testing of the first models of the voice-frequency ringer of the general type now in use throughout the Bell System. He took part in the demonstration for the newspapers of picture transmission by wire at the time of the political conventions of 1924, and was in immediate charge of the 1925 demonstration when pictures of President Coolidge's inauguration were sent by wire to newspapers in New York, Chicago and San Francisco. He was also associated with the television demonstration in 1927 when Herbert Hoover's voice and image were transmitted by wire to an audience in New York. About thirty patents have been issued to him and he is the author of several technical papers.

Residents of Mountain Lakes, New Jersey, the Gannetts have two sons, the older of whom has just completed his freshman year at the University of Michigan. Mr. Gannett has been active in the Laboratories Golf Club and has played in most of its tournaments. He is interested in bridge and photography and is a Pioneer.

* * * * *

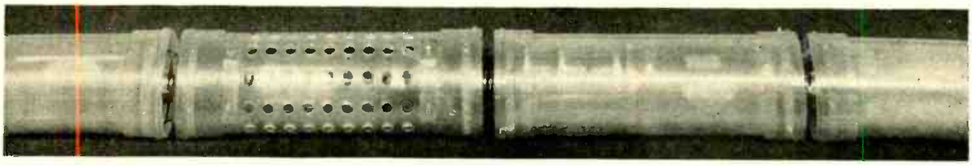
After A. L. Johnsrud graduated from the University of Minnesota in 1916 with the degree of B.A. in Physics, he remained there a year for graduate work and as a research assistant. His first work with the Engineering Department of the Western Electric Company was on the development of air-damped transmitters and sensitive detection devices for aircraft and submarine location purposes. In this connection he spent some time at Ellington Field, Texas, and at the submarine base at New London. After the war he engaged in fundamental research on carbon to develop higher sensitivity in transmitters. From 1921 to 1926 he made fundamental photoelectric studies leading to the development of the tubes used in picture transmission and television. He then actively engaged in the development of television equipment, making use of these sensitive photoelectric cells, and participated in the one-way demonstration from Washington to New York.

Mr. Johnsrud then assisted in the development of television in color, outdoor television and two-way television. As Television Demonstration Engineer he displayed this art to more than 12,000 people. In 1933 he became Equipment Engineer for the Research Staff Department, developing rectifiers to replace storage batteries in many of the laboratories, instituting the use of photographic methods in research, and laying down the principles of safety practices in research engineering. More recently, in the Electron Optics Department, he has been concerned with fundamental research in connection with secondary electron emission, the reflection of electrons and their application to electronic devices.

The Johnsruds, who live in Mountain Lakes, New Jersey, have one daughter who has just completed her freshman year at the New Jersey State College for Women and a son who is in High School. Mr. Johnsrud is an instructor in First Aid and, in his home community, serves as director of First Aid training under the Red Cross, and as administrator of the First Aid, Ambulance and Medical Services under the local Defense Council. His recreations are golf and badminton and he is a Pioneer.

MR. & MRS. LESSON IN WAR ECONOMICS — *By Arthur Folwell and Ellison Hoover*

[This is a contribution to Victory by Arthur Folwell and Ellison Hoover—Courtesy New York Herald Tribune Syndicate]

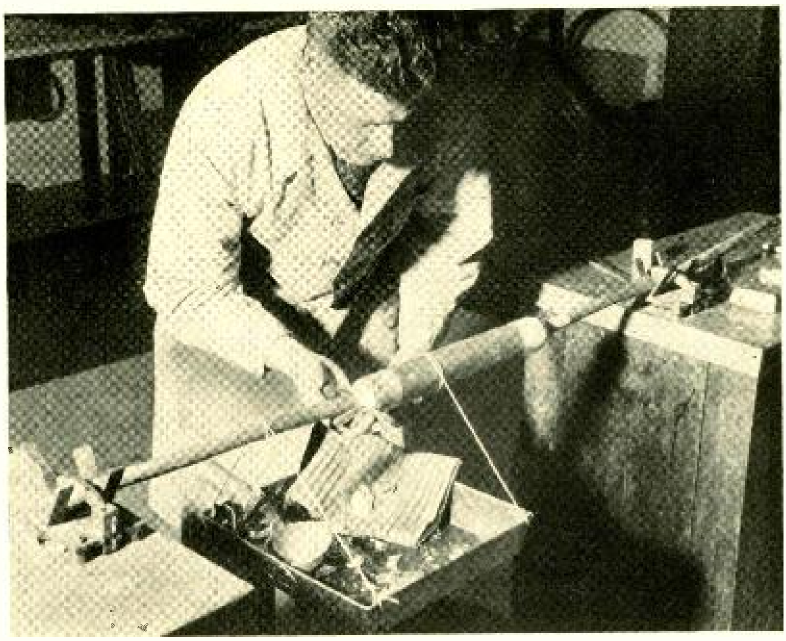


Repeater for Submarine Telephone Cable

At the top of this page is a portion of the repeater for the transatlantic telephone cable described by Dr. Buckley in the Record for June. Inside the perforated cylinder is a vacuum tube; the others contain coupling networks. Each of the cylinders is about six inches long. Over them is an assembly of the steel rings shown at the bottom of the page; over these rings, in turn, is a copper tube with a watertight seal at both ends.

The repeater housing, which is about seven feet long, was designed so that it can be incorporated within the cable structure and treated as a part of the cable while the latter is being laid or picked up. This treatment includes bending around a drum, six feet or more in diameter, which controls the movement of the cable. In addition, the housing must resist the crushing effect of the hydrostatic pressure at the ocean bottom. In order to avoid the expense and difficulties of replacements, the objective is a life of 20 years for the repeater, including vacuum tubes.

Engineering of the project has been carried out by the submarine cable group headed by J. J. Gilbert. W. M. Bishop, assisted by W. Gronros, Q. E. Greenwood, W. P. Frawley, E. M. Boardman, and H. Alfke, was responsible for the mechanical design of the repeater. O. B. Jacobs supervised the electrical design of the repeater and the investigation of system problems with the assistance of D. E. Thomas, I. E. Wood, D. M. Osterholz, and H. B. Brehm. Engineers of the electronics group under the leadership of J. R. Wilson, H. A. Pidgeon and V. L. Ronci developed the long-life vacuum tube.



Using Less Tin in Cable Joining

By J. T. LOWE
Outside Plant Development

ASK a cable splicer in what part of his work he takes the most pride and he will nearly always say "wiping joints." This means joining cables by soldering the ends of lead sleeves to the cable sheath. He enjoys this work because making joints that are gas-tight and present a finished appearance is a skilled operation performed with considerable artistry. It is an operation which in recent years has consumed in the Bell System from a million to two and a half million pounds of lead-tin alloy annually.

Suddenly, due to the war in the Pacific, it became essential that large amounts of tin be saved. Would it be possible to meet the essential requirements for a wiped joint with far less solder, without introducing an entirely new wiping technique?

A new tight wipe or fillet joint recently investigated by the Labora-

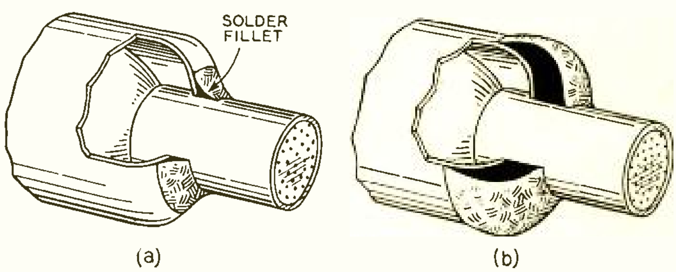


Fig. 1—New cable joint (a) which saves a large portion of the solder previously used, as illustrated at (b)

tories does this. It is shown in Figure 1A compared with the former joint in 1B. In the making of Y-joints, not so large a proportion of the solder can be saved because of the difficulty of removing the excess material from the spaces between the cables. Even there, however, considerable savings can be realized.

The idea of wiping joints with a reduced amount of solder is not new. An approach to this was made by one of the Associated Companies some time ago with satisfactory results. Recent work by the Laboratories has carried the curtailment of solder much further, and to a point which appears to be about as far as is practicable.

Essentially, the new method consists of a careful beat-in of the sleeve ends to the proper shape to facilitate formation of a satisfactory fillet of solder and to obviate rounding out the sleeve ends with solder.

Tests of strength, resistance to fatigue, and gas-tightness show the new joints to be fully as good as the old. The wiping technique is somewhat simpler, and it is well liked by the splicing forces. The adoption of the new joint reduces the amount of tin the Bell System would ordinarily need for wiping solders by more than sixty per cent.

Fig. 2—Beating-in the ends of a cable sleeve in preparation for the new cable joint

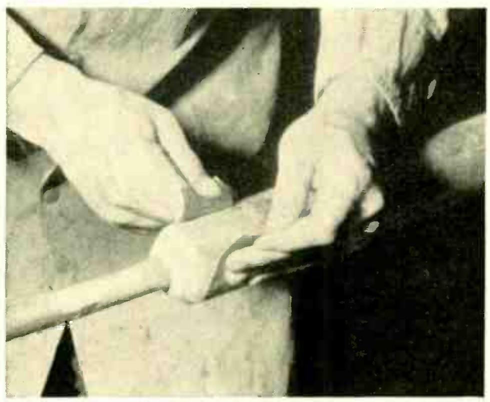


Fig. 3—Cable and sleeve are taped with paper to prevent the solder from spreading

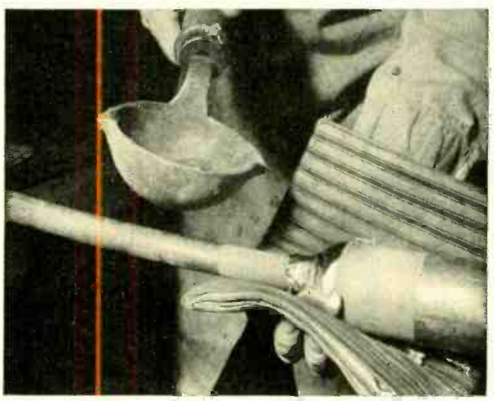


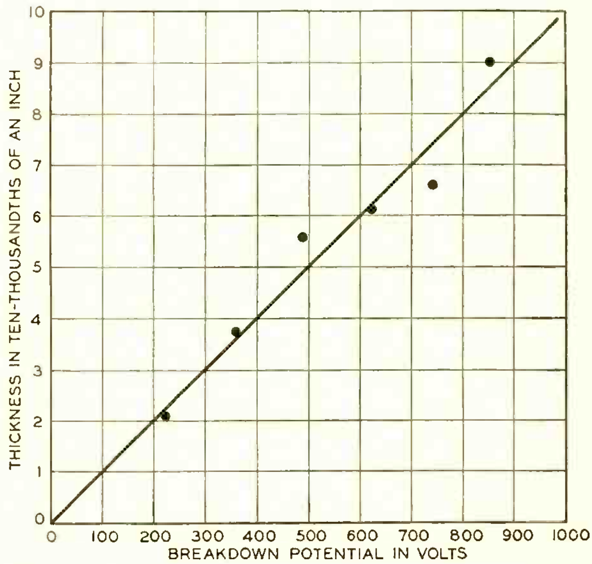
Fig. 4—Pouring the solder

Fig. 5—Final wiping of the joint

Thickness of Aluminum Oxide Coatings

ALUMINUM surfaces in telephone apparatus are sometimes protected by a layer of oxide which is deposited electrochemically. In manufacture it is important to control the thickness of these deposits and several methods have been tried. A majority of them, such as scratching the surface, stripping off the deposit to weigh it, and measuring the thickness of a cross-sectional cut under the microscope, involve destruction of the sample. A quick and reliable method of checking these coatings, which is not subject to this limitation, has been devised recently by the Laboratories. It measures the voltage required to break down the oxide coating and punctures the specimen with so small a hole that it is not marred appreciably.

A chromium plated steel sphere about an eighth of an inch in diameter is pressed against a thin plate of oxide coated aluminum by adjusting the screw collar above it until the force, as indicated by a calibrated spring, is from one to two kilograms. Increasing voltages up to 1500 are then applied and that at which breakdown occurs is noted. Resistors limit the current and a safety switch protects the operator. This method has been used in the Laboratories to study the relation between film thickness and the time required to make the deposits electrochemically. The thickness obtained by averaging several readings is generally within ten per cent of the value found by direct measurement with a microscope.



Relation between the thickness of an experimental aluminum oxide coating and its breakdown voltage

A Grounded-Plate Amplifier for the F-M Transmitter

By A. A. SKENE
Radio Broadcast Development

WITH the increasing interest in frequency-modulation broadcasting, it has been necessary to provide transmitters of greater power. Since the Western Electric Company already have available a 1-kw transmitter,* it seemed desirable to use this as a driving unit, and to design only an amplifier to secure greater output. A new 10-kw amplifier unit has thus been developed to be used in conjunction with the smaller unit. The design of high-power transmitters for F-M service has difficulties, however, that are not serious in transmitters operating at the frequencies of the regular broadcast band. F-M has been assigned the band from 42 to 50 megacycles, and at these higher frequencies, simplification in design and reduction in size are of particular importance because of lead reactances and stray capacitances to ground which increase with frequency and with size, and may become serious obstacles in large transmitters operating at high frequencies.

*Record, *September*, 1940, *p.* 21.

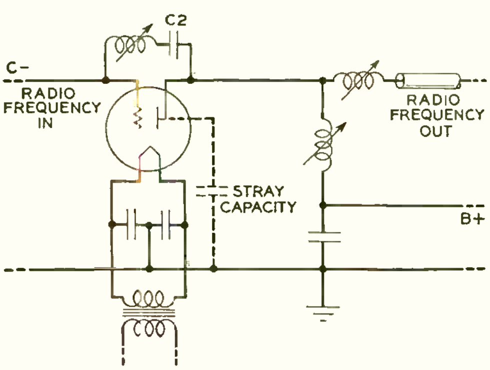


Fig. 1—The usual form of radio amplifier has a grounded filament and a plate at the radio-frequency potential

These difficulties have been successfully overcome in the 10-kw transmitter recently developed by the Laboratories—the 506A-1 RTE—by the use of the new Western Electric 389AA air-cooled vacuum tube and by a novel circuit arrangement suggested by W. H. Doherty. To simplify the operation and maintenance of the transmitter, it was desirable to use air-cooled tubes, thus avoiding a water-cooling system, but air-cooled tubes have larger plate structures than water-cooled tubes, and for a 10-kw transmitter, two tubes of the previously existing type would be required. The large capacity-to-ground of such a combination would seriously hamper a satisfactory design. Only a single tube of the new type is needed, and thus the capacity-to-ground of the plate structure could be appreciably reduced.

Even with this new tube, however, it was found there would be sufficient stray capacitance from plate to ground to result in a rather large loss in the plate tuning coil, and—of even greater importance—the tuning would be undesirably sharp. With F-M transmission, the program at the output of the transmitter requires a total band width of over 150 kc, and unless the tuning is very broad there is distortion because of the increasing attenuation and phase shift of the signals towards the sides of the frequency band.

Both of these obstacles were overcome by the use of a grounded-plate amplifier and a number of novel features used with it in the new transmitter. The usual amplifier circuit, in which the filament rather than the plate is grounded, is shown in Figure 1. The large stray capacitance between plate and ground results not only in large tuning-coil losses, but in sharpening the tuning, and thus introduces distortion. With the new grounded-plate circuit, indicated in simplified form in Figure 2, the stray plate capacitance to ground is in parallel with the grounding condenser (C-1), which is used to block the d-c path to ground of the plate supply, and thus has no effect on the operation of the circuit. Only the capacitance of the filament to ground need be considered with this arrangement, and this capacitance is much smaller than that between the plate and ground.

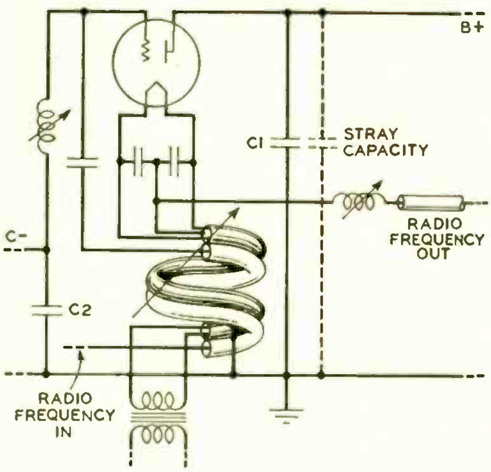


Fig. 2—With a grounded-plate amplifier, the stray plate-to-ground capacitance is in parallel with the grounding condenser, and is thus of no importance

The filament of the tube is at high radio-frequency potential, and it is very essential to supply filament current without the necessity of operating the filament transformer at this high potential above ground. It is also necessary to supply radio-frequency driving potential between the grid and filament from the driver unit, one side of which is grounded. A method of attaining these two objectives is shown schematically on Figure 2. The plate tuning coil of Figure 1 is replaced in this new circuit by a coil between filament and ground. If this

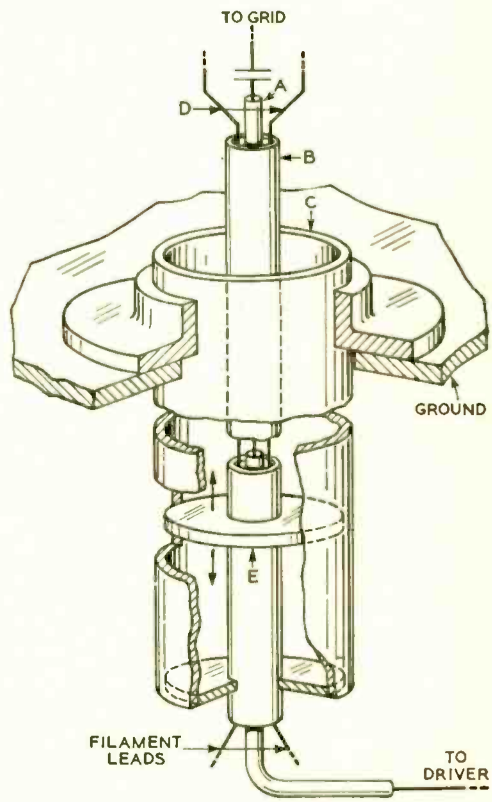


Fig. 3—Concentric structure used for tuning, and grid and filament lead-in

coil be formed by a pair of copper tubes in parallel as indicated in the illustration, the filament leads may be threaded through the bore of one of the tubes, and the grid-driving potential supplied through an inner conductor of the other. At the filament end of this coil, the copper tubes are connected to the filament through condensers as shown, and the other end of the coil is grounded. Thus the filament current and grid-driving voltage are delivered at the required circuit locations with the sources (driver and filament transformers) maintained at ground potential.

The necessity of being able to adjust the reactance of this inductance introduces numerous mechanical difficulties if an attempt is made to employ a coil as shown schematically on Figure 2. These difficulties are avoided by the use of a coaxial transmission line less than a quarter-wave in length, and short-circuited by an adjustable bridging connector at the far end. Such a section of line has a positive (inductive) reactance, which may be varied by the proper adjustment of position of the adjustable bridging connection.

The arrangement of such a structure to replace the tubing coil of Figure 2, consisting essentially of two concentric systems, is indicated in Figure 3. The innermost conductor carries the RF driving potential, and its upper end is connected to the grid through a blocking condenser. The tube surrounding this lead, marked A in the sketch and corresponding to the unshaded tube of Figure 2, is connected electrically at both ends to a tube of larger diameter marked B. At their upper ends, these two tubes connect to the filament through the two by-pass condensers. The annular space between these two tubes thus corresponds to the shaded tube in Figure 2 and serves as a duct through which the filament leads are carried. Tube B is surrounded by a still larger tube, C, which is grounded at its upper end.

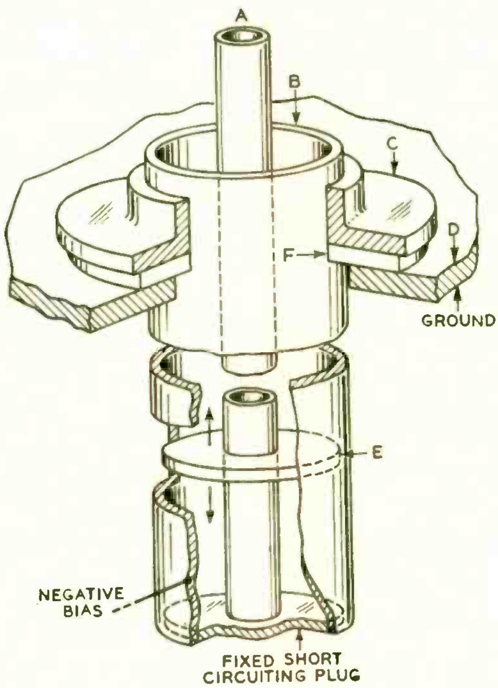


Fig. 4—Coaxial structure used for neutralizing inductance

Near the lower end is a sliding diaphragm E that connects B and C together. This latter pair is thus a short-circuited coaxial structure of less than a quarter-wave in length, and serves as the output tuning unit. Tuning is controlled by moving the diaphragm E up or down the tube as required.

A short-circuited coaxial structure is also used for the neutralizing inductance, shown in Figure 1, connected between grid and plate in series with a blocking condenser. This coil carries a large current and must be continuously variable and adequately shielded. To meet these conditions with a grounded plate is fairly simple, since only an inductance to ground is required, with a blocking condenser to isolate the d-c grid bias potential as in Figure 2. For this neutralizing inductance a short-circuited coaxial structure is also used, with a diaphragm to vary the inductance by changing the effective length of the tube. The arrangement is shown in Figure 4. The ground plate shown here is the same as that of Figure 3. The outer shell B of the coaxial structure, however, instead of being connected directly to the ground plate, is connected to the flange C, which is separated from the ground plate by the insulating plate F. Plates C, F and D thus form a condenser, and in function correspond to C2 of Figure 2, and serve to block the d-c grid bias from ground. The inner conductor A is connected directly to the grid and the inductance of this coaxial structure is controlled by varying the position of the diaphragm E. Negative grid bias is connected to the outer shell at the lower end, where there is a fixed short-circuiting plug. From here it flows directly to the grid, but is blocked from ground by the insulating plate F.

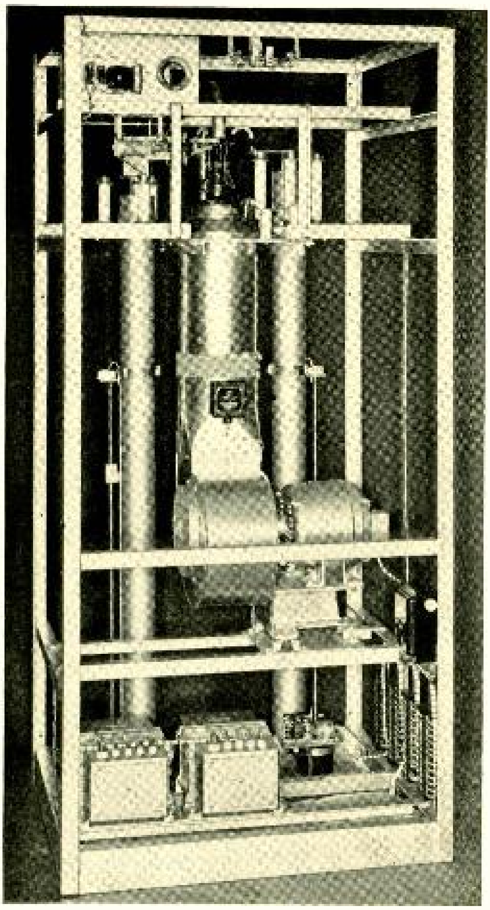


Fig. 5—The 10-kw amplifier with enclosing cabinet removed

With an air-cooled tube, the plate structure has metal fins over and around which air is circulated to secure the required cooling. A blower to supply the air is mounted in the lower part of the transmitter, and the air from it passes through a tube that surrounds the cooling fins. In the new transmitter the functions of plate by-pass condenser, C1 of Figure 2, and air duct are combined. The duct is made of a dielectric material and plated with silver inside and out to form the two plates of a cylindrical condenser. The outer surface is grounded and the inner surface is connected to the cooling fins of the plate. Such an assembly is easy to construct, and this form of condenser gives a uniform current distribution over the conducting surfaces.

These three tubular structures are prominent in the appearance of the amplifier as shown in Figure 5, where the central tube is the air-duct and plate blocking condenser, and the tubes on each side of it are the two coaxial structures. The common ground plate lies transversely across the amplifier, and besides serving as a common ground is used also as a supporting member. The output of the transmitter passes from the filament to the transmission line through an adjustable inductance used to adjust the impedance of the output circuit. Since both ends of this coil are at RF potential, a short-circuited coaxial structure is not the most convenient device, and so for this inductance a coil with an adjustable copper slug to vary the reactance is used.

With these novel features, both electrical and mechanical, the new transmitter is unusual in appearance as well as in design. All tuning and amplifier controls are motor operated to eliminate long or intricate mechanical linkages, and all contactors are controlled by direct current to insure quiet operation. By means of interlocks and time delays, all potentials are applied in the proper sequence at starting, and a complete complement of safety devices provides full protection for the operating personnel. The complete 10-kw transmitter includes the driving unit already referred to, the 10-kw amplifier unit, and a power-supply circuit arranged in a cabinet of similar appearance. This assembly is completely self-contained, and requires a minimum of floor space. Since in the F-M field the transmitters are often installed on an upper floor of an office building, the compactness of this design is a distinct advantage.

Contributors to this Issue

T. SLONCZEWSKI has been a member of the Technical Staff of the Laboratories since he received the degree of B.S. in E.E. from the Cooper Union Institute in 1926. He was at first engaged in the development of alternating-current bridges but has for some years devoted his attention to the study of oscillator and other electronic circuits. He has been responsible for the design of a number of oscillators that have been used for testing purposes by various departments of the Laboratories, by the manufacturing organization of the Western Electric Company, and in the field. For the last year Mr. Slonczewski has been engaged in war projects. He holds a number of patents covering various phases of his work in the measurement field.


T. Slonczewski

J. T. LOWE received the B.M.E. degree from the University of Kentucky in 1912 and the E.E. degree there in 1930. Following graduation in 1912 he joined the student course of the Western Electric Company at Hawthorne and then entered the Hawthorne division of the Apparatus Development Department. In 1914, Mr. Lowe transferred to the same department in New York to develop apparatus for manual telephone systems. In 1920 he entered the General Telephone Sales Department of the Western Electric Company. Four years later Mr. Lowe joined the Department of Development and Research of the American Telephone and Telegraph Company where his work consisted mainly in the study of gases encountered in underground systems, detection of carbon monoxide in manholes, spacing of open-wire pairs, insulators and miscellaneous outside plant materials. When the Department of Development and Research was consoli-

J. T. Lowe

C. T. Wyman

A. A. Skene

dated with the Laboratories in 1934, Mr. Lowe returned to West Street to engage in outside plant development work. More recently his work has been directed toward the development of materials and methods for conserving tin and rubber.

C. T. Wyman graduated from the Northwest Missouri State College in 1927 with the B.S. degree. He held a graduate assistantship in Physics at Missouri University the following two years, and obtained the M.S. degree in 1929. In 1929 he joined the Laboratories and until recently was associated with general engineering problems of lead-covered cable designs. At first he was stationed at Hawthorne but transferred to Kearny in 1931. He transferred to the Transmission Apparatus Development Department in May of this year and since then has been engaged in the design and testing of retardation coils.

Following service in the U. S. Army during 1918 and 1919, A. A. Skene received the degree of B.S. in Electrical Engineering from Pennsylvania State College in 1920. He at once joined the Engineering Department of the Western Electric Company, where he was engaged in apparatus design and radio development until 1923. He then spent some six years with the Union Switch and Signal Company, concerned with the engineering of railway signaling and automatic train control systems and equipment. In 1930 he joined the Technical Staff of the Laboratories, where he has been occupied in the design and development of radio broadcasting transmitters and associated apparatus.