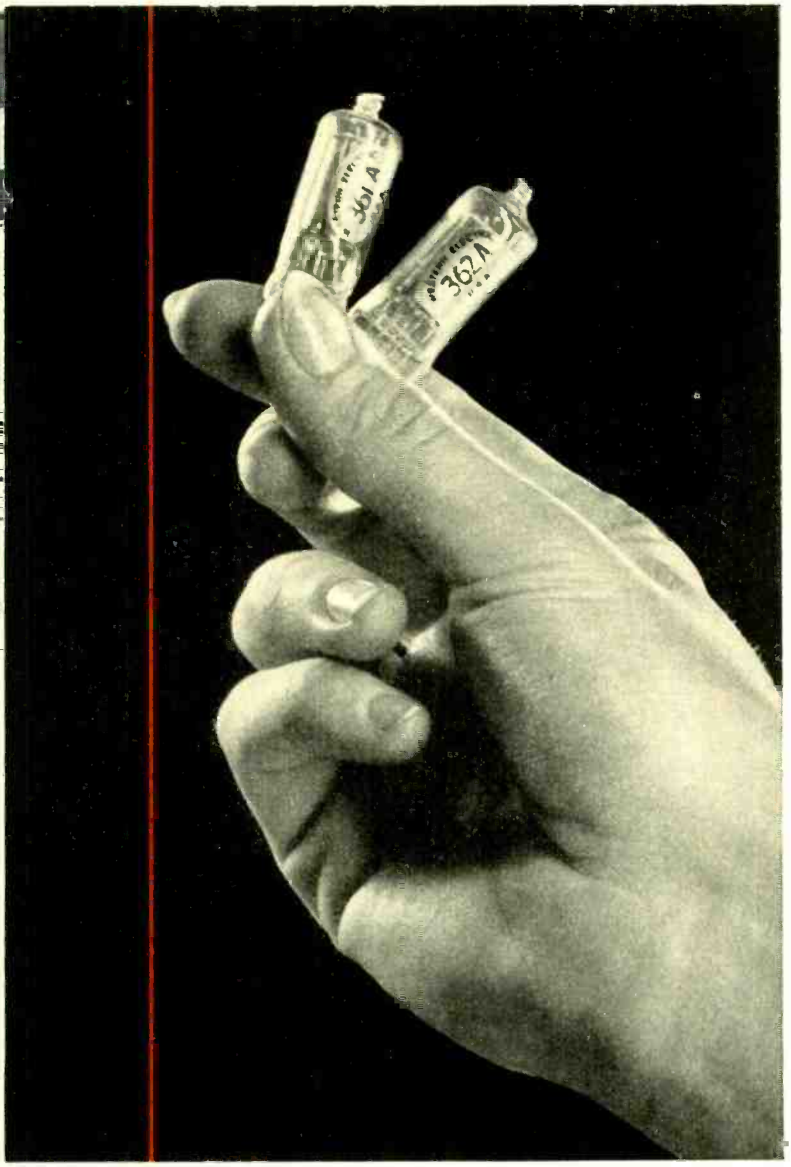
ELL LABORATORIES RECORD



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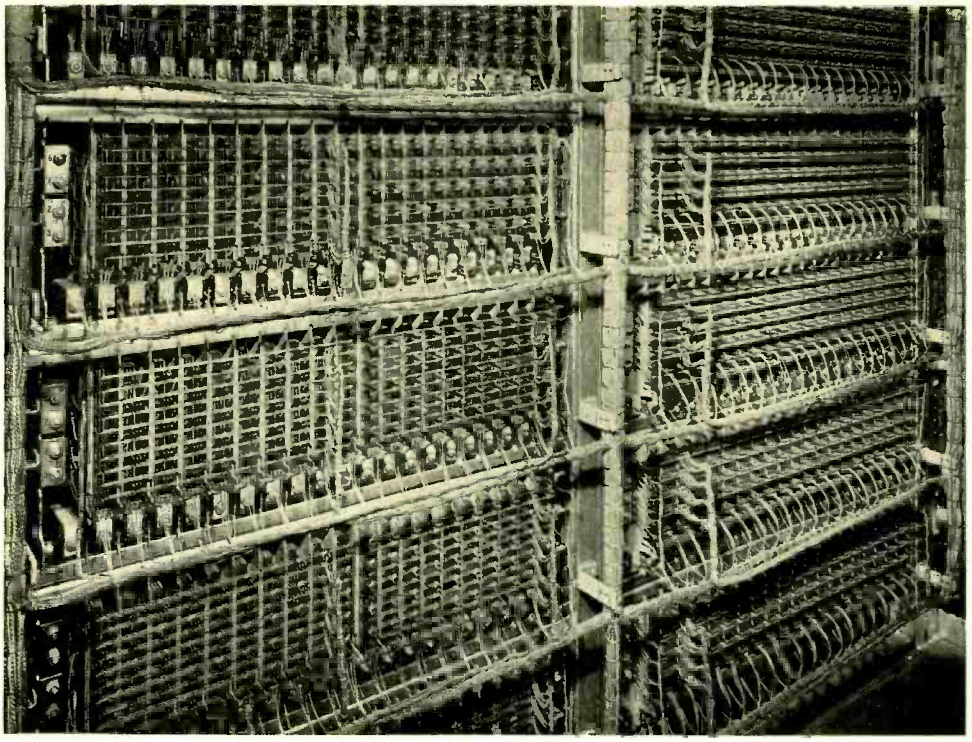
NUMBER V

Miniature vacuum tubes developed by the Laboratories for use in Western Electric audiphones



160-Trunk Incoming Frames

By A. E. K. THEUNER
Switching Development Department

IN THE crossbar system, the incoming-link frame establishes connections between incoming trunks and the line-link frames, which complete the connections to the called subscribers. Its position and function in the switching train has already been described in the RECORD.* Each type of frame has a certain capacity for handling calls, and in general the number of each type employed for any office is determined by the ratio of the traffic reaching that particular switching stage to the frame capacity. This has not been generally true of the incoming frames, however, since their number is determined chiefly by the number of incoming trunks that must be accommodated. The incoming-link frame as originally standardized served a maximum of 100 trunks; and therefore the total number of trunks to be accommodated divided by 100 gave roughly the number of incoming-link frames that are required.

Whether or not 100 trunks will utilize the full traffic capacity of the incoming frame depends on a large number of factors, such as the efficiency of the trunk groups, and coincidence of busy hours on them. Since in most cases they would not, it ap-

*Feb., 1939, p. 173.

peared that the efficiency of the incoming-link frames could be increased and their number reduced if provisions could be made for connecting more than 100 trunks to each frame. Development work with this in view was started some time ago, and an incoming frame is now available that will accommodate a maximum of 160 instead of 100 trunks. A study revealed that with the new arrangement the frames can be loaded to their full call-carrying capacity in practically all cases, and that the use of these new frames will effect substantial economies.

As has already been explained in the RECORD,* the crossbar switch used on most central-office frames includes twenty vertical units such as that illustrated in Figure 1, and such a unit was used on the original incoming frames. It is provided with ten sets of contacts, each set consisting of three pairs of "make" type contact springs. An eleventh spring, evident at the bottom of Figure 1, is used with maintenance plugs for test and make-busy purposes. The interconnections of these springs are as indicated in Figure 2, where for the sake of simplicity only one pair of springs is shown at each crosspoint instead of the three actually used. All three, however, are connected in exactly the same manner. For descriptive reasons one contact spring of each pair will be called the V spring, and the other the H spring, and in the actual vertical unit there are three V and three H springs at each crosspoint. The V springs are formed from a single metal strip, one of which is evident at the front left of Figure 1, and the H springs are extended in soldering strips at the rear of the switch. After the twenty units have been assembled in a frame, the corresponding H terminals of all the units are connected together by horizontal wires. The rear of a complete switch thus appears as illustrated at the left of the headpiece, which

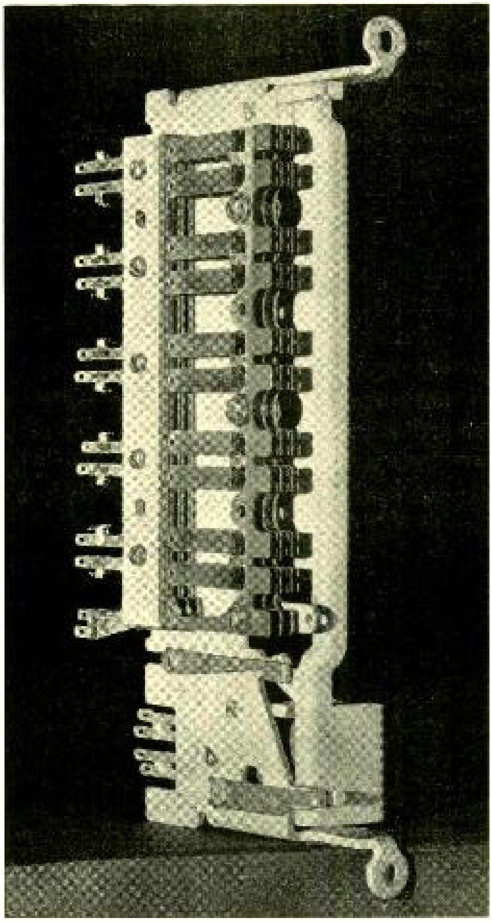


Fig. 1—Twenty elements like the one shown above are mounted side by side on the crossbar switches that are employed for most central-office frames

shows switches mounted one above another on a link frame.

The incoming trunks are connected to the horizontal multipling that connects the H springs together—one trunk for each level. The incoming links are connected to the three V

*July, 1937, p. 338.

strips of each of the twenty vertical units. With this arrangement, any of the ten trunks may be connected to any of the twenty links by closing the contacts at one level of one vertical unit. These contacts are closed by operating one select bar and one holding bar. The operation of the select bar, say that for level 7, places select fingers across the backs of all the sets of contacts in level 7, and when a holding bar is subsequently operated, say that of the 0 vertical unit, the contacts at the crosspoint of the 7 level of the 0 vertical unit are closed. As evident in Figure 2, this would connect trunk 7 to link 0.

To accommodate 160 trunks per frame, it was necessary to provide a new vertical unit for the primary switch of the frame. This new unit is

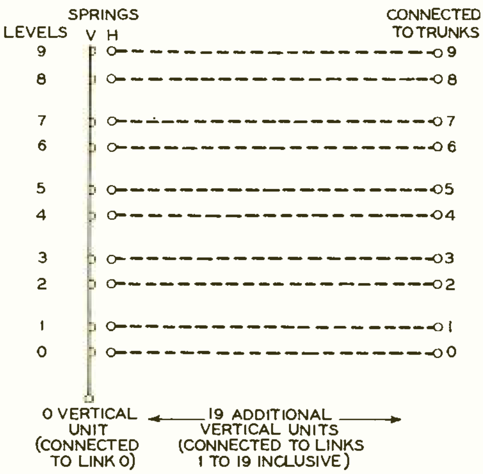


Fig. 2—Simplified circuit schematic of a crossbar switch, where each small circle represents three contacts—all wired alike

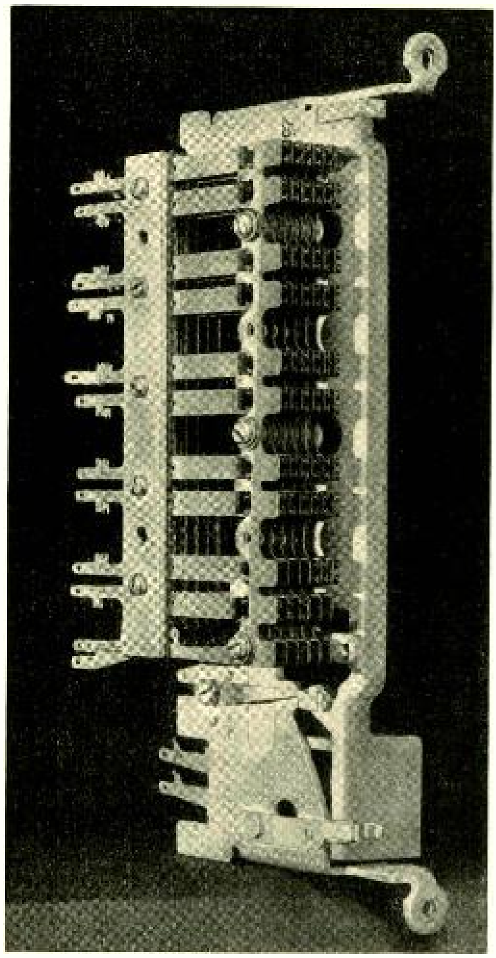


Fig. 3—A sixty-contact crossbar unit such as is used for the 160-trunk incoming frames

shown in Figure 3. It differs from the former unit primarily in having six V strips instead of three. Six sets of H springs are provided for the upper eight levels, but the lower two levels have only three sets of H springs—the three for level 1 being associated with the three V strips on the right, and the three for level 0, with the three V strips on the left. A diagram for this new switch—corresponding to Figure 2 for the old—is shown in Figure 4. With this arrangement, each of the upper eight levels will accommodate two trunks, so that a switch provides for connection to sixteen trunks altogether. There are thus two trunks associated with each crosspoint, and when a select and a hold bar are operated, one trunk will be connected to the three left V strips, and one to the three right V strips of the vertical unit (each set of three v strips is represented by a single line in Figure 4).

To select the particular trunk wanted of the two that have been connected to the v strips, the two lower sets of crosspoints are used. The incoming links, instead of being

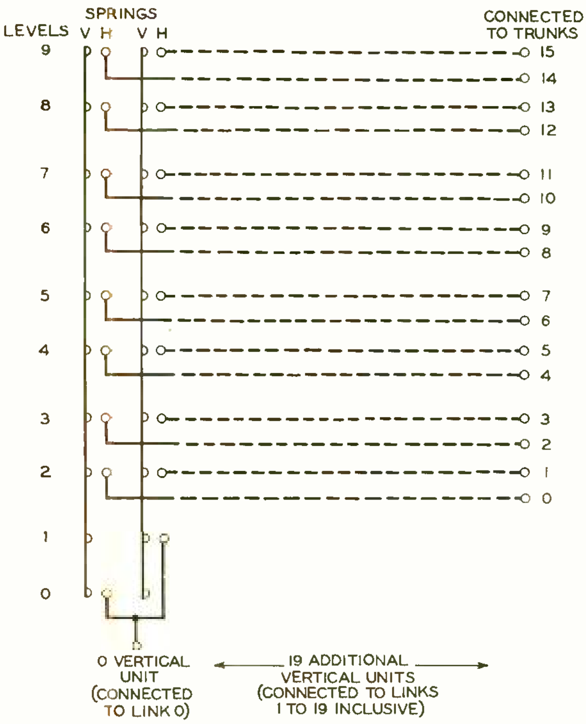


Fig. 4—Simplified circuit schematic of a crossbar switch used for the 160-trunk incomings. Here each small circle represents three contacts

connected to the v terminals as they are on the 100-trunk link frame, are connected to the H terminals of the two lower levels. Since there is no horizontal multipling between verticals on these two lower levels, each of the twenty vertical units represents a different link. With the select bar for level 7 operated, for example, trunks 10 and 11 will both be connected to v strips when the holding bar is operated. If the 1 select bar has also been operated, however, the operation of the holding bar will connect trunk 11 to link 0, while if select bar 0 had been operated instead of 1, trunk 10 would have been connected to link 0. In this way the two lower crosspoints permit a choice to be made of the two trunks associated with any one level.

The 0 level crosspoints are used for even-numbered trunks, and the 1 level crosspoints for odd-numbered trunks. The operating circuit of the 0 level select magnet is thus multipled to the control circuits of all even-numbered trunks of the switch, and the 1 level select magnet to the control circuits of all odd-numbered trunks. The control circuit of each trunk thus operates two select magnets: one for the level with which the trunk is associated, and the other for either the 0 or 1 level depending on whether the trunk is even or odd.

Besides this novel arrangement of the trunks and links on the switches, the 160-trunk incoming-link frame includes another feature that is very helpful. The terminating markers,* which control the completion of a connection through the incoming and line-link frames, require certain information regarding the type of trunk calling. With the 100-trunk incoming frames, this information was transmitted by means of a multi-contact relay, one of which was provided for each of the ten primary switches on a frame, and thus since the operation of one of these relays indicated only one type of trunk, only trunks of the same type could be connected to any one switch.

**July*, 1939, *p.* 356, and *August*, 1939, *p.* 373.

With sixteen trunks per switch, this method would produce undesirable inflexibility because all trunks would have to be arranged in groups of sixteen of similar type. A new method was therefore developed to permit the trunks to be arranged in smaller groups. It requires that only the two trunks of each level of the switch be of the same type. The circuit that makes this possible is indicated in Figure 5. In the terminating marker, one of a set of three relays must be operated to indicate the class of trunk and one of another set of three to indicate the office restrictions. One side of the windings of all three relays of one set is connected to battery, and one side of the windings of the other set is connected to ground as indicated. The six leads from the other side of the windings of all six relays are carried through the marker connector, and multipled to the contacts of ten LC relays on each frame. To operate one of each of the two sets of relays in the marker, it is obviously necessary only to close a path from one of the three leads of one set to one of the three of the other set.

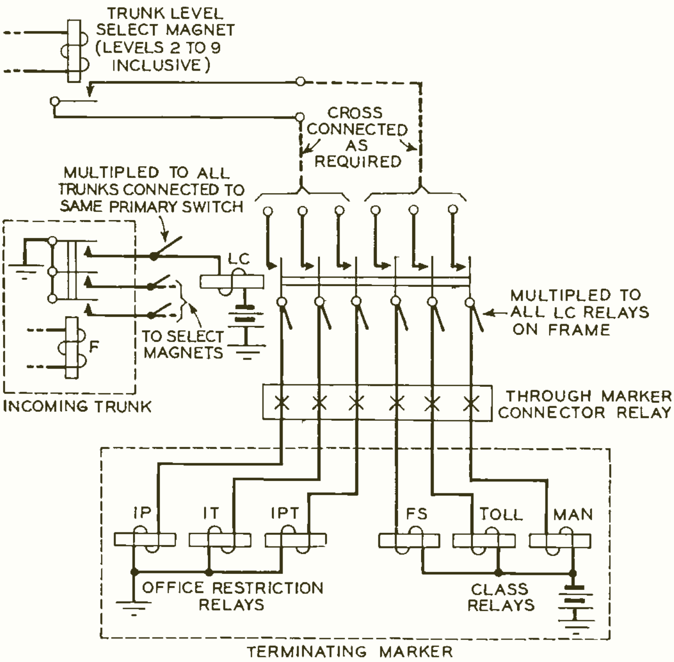


Fig. 5—Method of indicating type of trunk with the 160-trunk incoming frames

Each select magnet of the eight trunk levels on the switch closes a pair of contacts when it operates, and the two leads from these contacts are brought to terminals that may be cross-connected as desired to one of each set of three terminals on the LC relay. When a select magnet operates, therefore, a connection will be made that will operate two relays in the marker to give the proper class and restriction indications. With this arrangement, therefore, only the two trunks of each level need be of the same type, and the restrictions that are imposed on connecting trunks to switches are greatly reduced.

These six-wire crossbar switches are required only for the primary bays of the incoming frame; the secondary bays employ the three-wire switches as heretofore. Since the six-wire switches are slightly wider than the three-wire switches, the 160-trunk frame is somewhat wider than the 100-trunk incoming-link frame, but the increase in width is only about four inches. This 160-trunk incoming-link frame can be provided on additions to installations equipped with the existing 100-trunk frames.

Loading Coils With Cores of Molybdenum Permalloy

By R. M. C. GREENIDGE
Telephone Apparatus Development

IN THESE days of strenuous effort to reduce ordinary consumption of the metals vitally needed for defense uses, the development of loading coils with cores of molybdenum permalloy is of particular interest. It is also an illustration of how the introduction of a new element, even though used in small quantities, may result in a decided gain in many ways. The use of a comparatively small amount of molybdenum makes it possible to manufacture loading coils with considerably less nickel than would have been needed otherwise.

Although the invention of permalloy revolutionized the design of loading coils and resulted in much smaller and better units,* it did not mark the end of progress in this field. The permalloy that has been largely used for loading coils contains about 81 per cent nickel and 19 per cent iron, and is known as 81 permalloy. More recently a modified permalloy has been developed that reduces the iron content to some 17 per cent and contains 2 per cent of molybdenum. This new alloy is called 2-81 molybdenum permalloy. Like the earlier permalloy, it is used in compressed powder form for the cores of loading coils, but it represents a considerable

*Record, *Sept.*, 1927, *p.* 1.

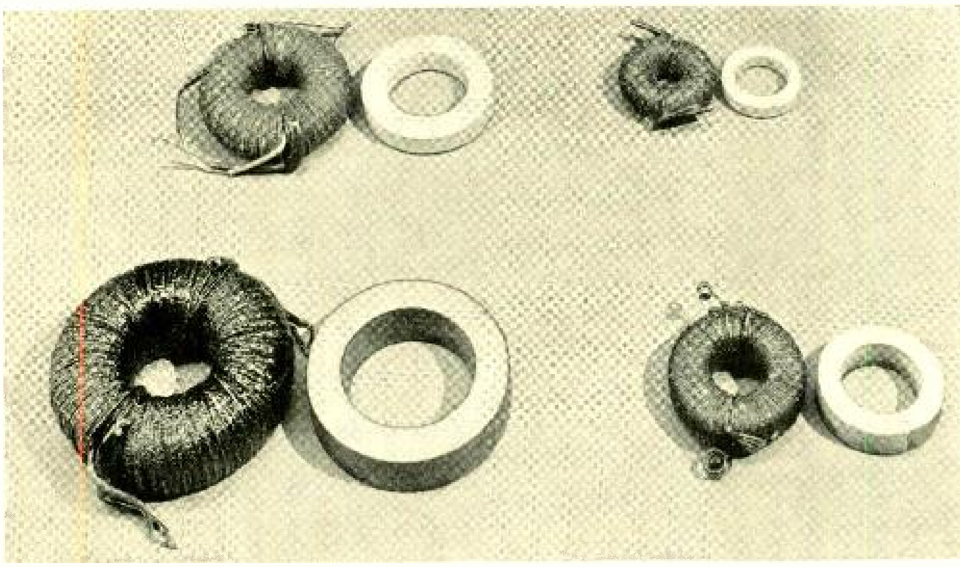


Fig. 1—Molybdenum-permalloy coils and cores above, and permalloy coils and cores below. The reduction in size is approximately fifty per cent

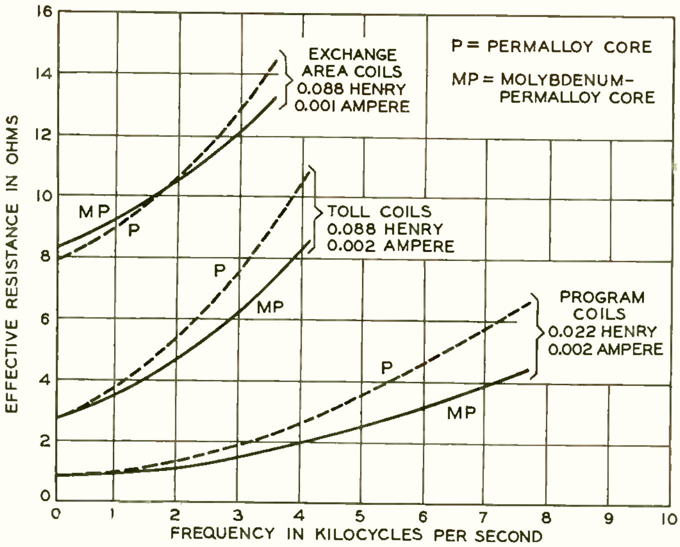


Fig. 2—Effective resistance of various types of coils for both permalloy and molybdenum-permalloy cores

improvement in having 70 per cent higher permeability and markedly lower hysteresis and eddy-current losses. In general, such improvements can be made to give better coils of the same size, or coils of approximately the same characteristics but of smaller size. Since the previous permalloy coils satisfactorily met all the requirements, it was decided to take advantage of the improvements possible with molybdenum permalloy to secure smaller size. The reduction obtained, about 50 per cent, is indicated in Figure 1.

One of the important factors that must be considered in designing a loading coil is its d-c resistance, and the higher permeability of molybdenum permalloy makes it easier to secure the desired value. For two coils of the same size and inductance, a core of high permeability will require a smaller number of turns than one of low permeability, and since with fewer turns larger wire can be used, the d-c resistance will be lower. If, on the other hand, the d-c resistance and inductance are to be kept the same, a smaller coil can be derived by using a core which utilizes a material of higher permeability.

Another factor that must be considered in the design of loading coils is the core-loss resistance R_m. This resistance has three components known as the hysteresis, residual, and eddy-current losses. In the expression below these components are given from left to right in the above order:

$$R_m = 16{,}000\ aIf\sqrt{\frac{\mu^3 L^3}{V}} + c\mu f L + e\mu f^2 L$$

Each of them consists of certain circuit or material factors such as frequency "f" and permeability "μ" but, in addition each has a coefficient—a, c, and e respectively—that depends on the material and construction of the core. While the higher perme-

TABLE I

Core	Permeability	Loss Coefficient: Hysteresis $a \times 10^6$	Loss Coefficient: Residual $c \times 10^6$	Eddy Current $e \times 10^9$
2-81 molybdenum permalloy	125	1.6	30	19
81 permalloy	75	5.5	37	51

ability of the new material would tend to make all of the component losses greater, and the smaller volume also would tend to make the hysteresis larger, the loss coefficients are enough smaller for the new material to offset the effect of higher permeability and smaller volume.

These loss coefficients are determined by test methods already described in the RECORD.* Their values

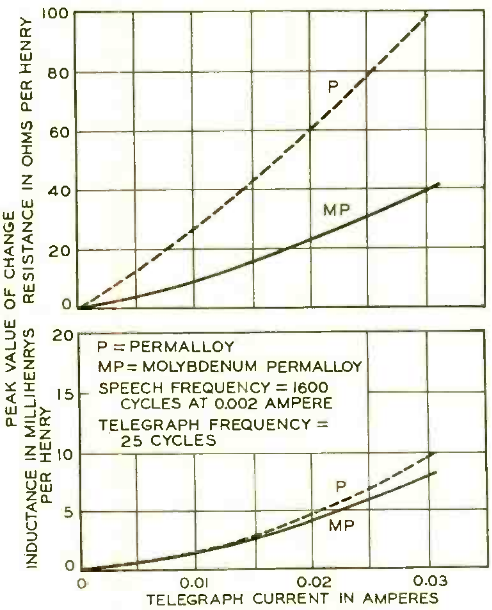


Fig. 3—Flutter depends on changes in resistance and inductance due to telegraph currents. The molybdenum-permalloy cores show distinct improvement in this respect

for both molybdenum permalloy and 81-permalloy are given in Table I. It will be noticed that the hysteresis and eddy-current coefficients are much lower for the new material. The "residual" coefficient is only slightly lower, but this coefficient plays only a minor rôle in determining the core-loss resistance. At voice frequencies the sum of the component loss resistance is appreciably lower for the

*RECORD, *Dec.*, 1940, *p.* 117.

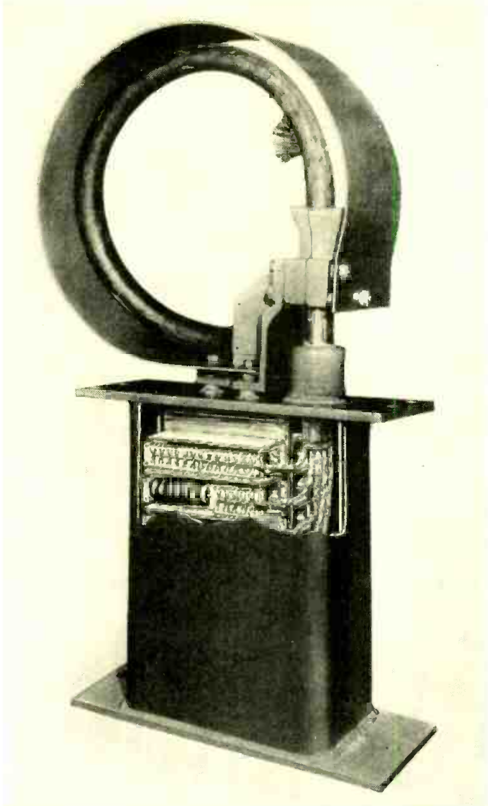


Fig. 4—Case designed for exchange area coils of the molybdenum-permalloy type

new than for the old coils. The overall electrical characteristics of the new and old coils are shown in Figures 2 and 3. The former shows the effective resistance, which comprises both the d-c resistance and the core loss, and the latter shows the "flutter" effect.

"Flutter" is due to the superposition of low-frequency telegraph currents on the voice-frequency currents. The result of this combination of signals in a coil is to cause periodic variations in its inductance and resistance, thereby affecting the transmission of voice currents. In designing a toll loading coil through which telegraph currents must also flow, the flutter must be kept to a low value to secure good telephone transmission. Still another factor entering the design of loading coils is the "modulation" effect, which arises from the simultaneous transmission of multi-channel voice-frequency telegraph currents. Both of these effects are kept to tolerable levels if the hysteresis resistance is below a certain value. Of course, other properties of cores affecting the permanence of permeability under service conditions need critical examination also, since in general materials with higher permeability tend to show greater susceptibility to superposed steady-state magnetic forces. Fortunately the new material, while somewhat poorer in this respect, yields suitable results.

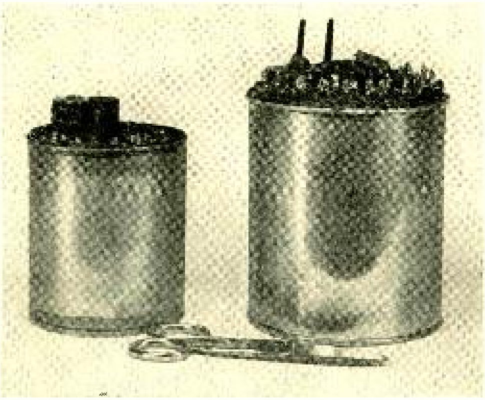
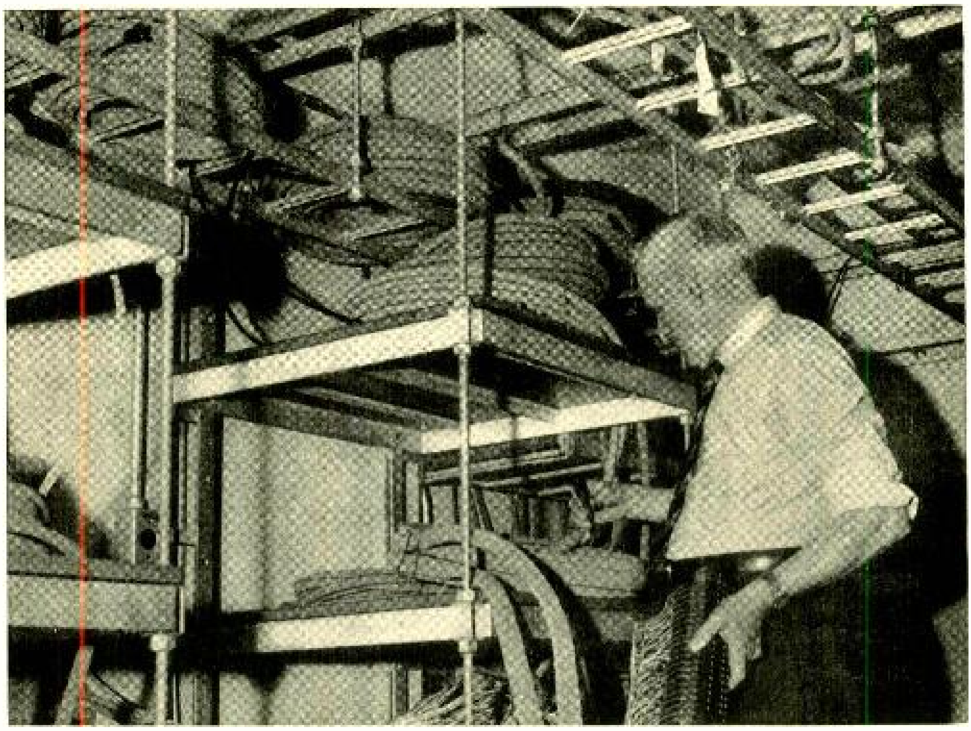


Fig. 5—Loading units comprising one phantom and two side-circuit coils with molybdenum-permalloy cores at left and permalloy cores at right

Because of the reduced size of the new coils, and hence the smaller diameter of the hole in the torus of the completed coil, new winding machinery had to be developed to permit the most economically proportioned coil to be employed. The development of these new machines was carried out by the Western Electric Company.

Conventional loading coil cases of the welded steel and lead sheath types have been employed for potting the new coils and units. Because of the large reduction in size of coils, however, the new cases are considerably smaller and lighter than those for potting equal complements of the old coils. A new type of internal case assembly has been adopted for the small exchange-area coils which is better adapted to their size. The cutaway view in Figure 4 shows an assembly of these coils. The coils are arranged in units of thirteen on short horizontal dowels, and have their leads carried to a terminal strip to which the cable stub wires are also connected. In previous designs of cases for exchange-area coils, the coils have been assembled in large quantities on long vertical dowels hung from the case cover, and the coil terminal wires have been spliced directly to the stub wires. The smaller size of the new coils is also reflected in the size of the new phantom loading units, each comprising one phantom and two side-circuit coils. The new and old units are shown side by side in Figure 5.

This development was completed in time to have commercial designs of the small coils and cases for all voice-frequency loading applications available for the large plant expansion accompanying the National Defense Program. The 1941 demand is over a million loading coils.



Cellulose Acetate Yarn Replaces Silk for Wire Insulation

By D. R. BROBST
Switchboard Cable Engineering

FOR years silk has been one of the most desirable textile materials for insulating wires for electrical purposes. It has been particularly satisfactory for telephone central-office wires because of its stability in electrical characteristics under varying atmospheric conditions, and its good aging properties.

The types of wires most widely used for interconnecting apparatus in central offices include three classifications: switchboard wire, which is used in hand-formed local cables to connect closely associated apparatus; switchboard cable wire, which is used in grouped units with a common covering to connect equipment more or less widely separated within the central office; and distributing-frame wire, which is supported loosely on metal frames and used for equipment connections which may be changed at frequent intervals.

For many years after the beginning of the telephone industry, silk was used in all of these wires, usually in double layers and covered with cotton. However, supplies of silk were often uncertain and the cost high, particularly during periods of unsettled world conditions. For these reasons, it was found desirable, in recent years, to employ two grades of insulation in switchboard wires and cables. The lower grade insulation was used in local circuits and was composed of two wrappings of cotton and a cellulose acetate lacquer coating. The higher grade insulation was used in toll circuits and consisted of two wrappings of silk, one of cotton, and a cellulose acetate lacquer coating.

Distributing-frame wire has an enamel coating on the conductor, two wrappings of silk, a wrapping of cotton and a lacquer coating. The addition of enamel to the insulation in this wire is designed to provide for the more severe handling to which this wire is subjected in service.

The type of silk which was used in these wires is known as spun tussah. It is made from the cocoons of wild silk worms and utilizes the short lengths of fibers discarded after the continuous filaments from the cocoons are used for higher grade textiles. It is a product of China and its importation has been practically stopped by the Sino-Japanese War. It was therefore necessary to obtain a satisfactory material to substitute for the silk.

Ever since the introduction of synthetic fibers in the textile industry, consideration has been given to the possible use of these materials for electrical insulating purposes. The desirability of obtaining a rayon or similar material for use in place of silk is indicated by the substantial cost saving, and by the advantage to be obtained by having an assured

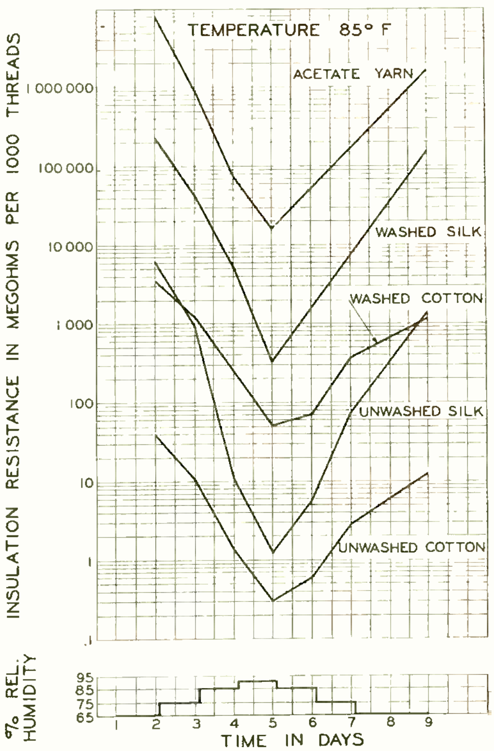


Fig. 1—Insulation resistances of textile, when threads are stretched between electrodes

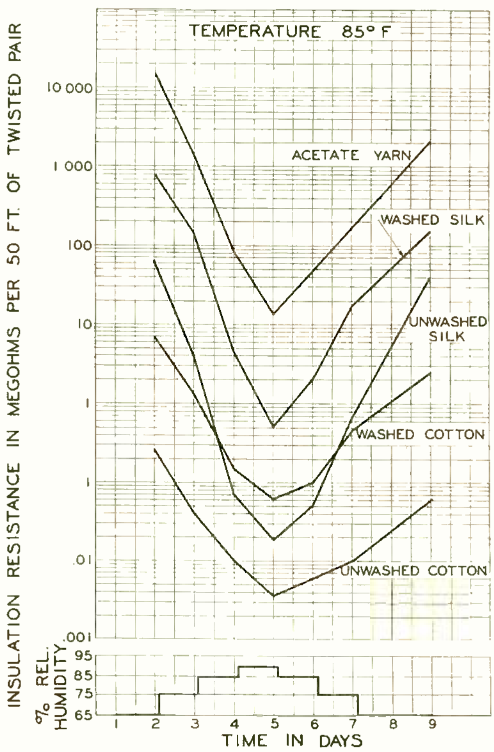


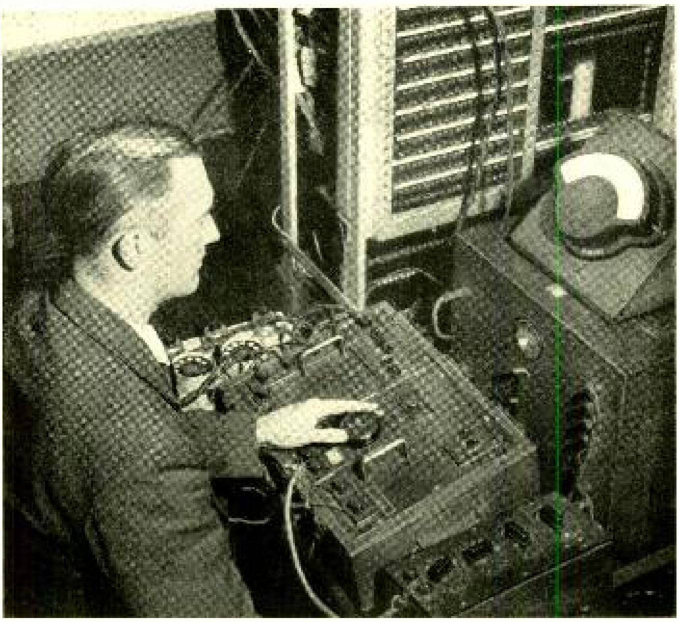
Fig. 2—Insulation resistances between two wires of a twisted pair

source of supply within this country.

About twenty years ago a preliminary investigation was made on samples of imported cellulose acetate yarn, which indicated that its electrical properties were superior to those of silk. It was, however, a new material with no assured source of supply and no experience was available as to its aging properties. At that time it was only a promising possibility for future use.

By 1925 the trend toward the use of acetate yarn in the textile industry was accompanied by the establishment of several plants in this country to produce this yarn. With assured sources of supply available, trial installations of the wire using acetate yarn were made in several telephone central offices. These installations were made primarily to determine the handling characteristics of the material during manufacture and installation, and to obtain data on the aging properties under service conditions. At that time, mechanical difficulties experienced in handling the wire offset the price differential between the silk and the acetate yarn so that no economic advantage could be obtained by its adoption.

With further expansion in the use of acetate yarn in the textile industry and the resulting reduction in price, it appeared desirable in 1938 to make further studies of the possibility of introducing the change. In the meantime, methods of handling the acetate yarn had been developed so that it could be used in the regular manufacturing processes without difficulty. Tests made on yarns manufactured at that time confirmed the results of previous tests regarding the superior electrical characteristics of this material as compared to silk; and tests on cables removed from the trial installations after fourteen years of service showed the aging properties to be satisfactory. About that time the importations of the spun tussah silk were diminishing rapidly. Consequently, the spun tussah silk was replaced by acetate yarn in all switchboard wire, switchboard cable wire and distributing-frame wire.



J. F. Barry measuring electrical characteristics of wire samples which are in an adjoining humidity room

The advantages to be gained by the use of the acetate yarn from the standpoint of electrical characteristics and price not only warranted the substitution of this material for silk in the silk- and cotton-insulated wires, but amply justified the use of a wire with double wrappings of acetate yarn, a single wrapping of cotton and a lacquer coating in place of the wire which had heretofore been made with a double wrapping of cotton and cellulose acetate lacquer coating. This provided a single type of wire for both switchboard wire and switchboard cable which could be used without any distinction as regards type of service. By eliminating one type of wire it has reduced the number of colored wires to be manufactured and stocked by approximately three hundred. It also improved the electrical characteristics of both local and toll circuits. The annual production of these wires totals several billion feet.

361A and 362A Vacuum Tubes

Although not larger than your little finger and about half as long, the small vacuum tubes shown on page 113 excel some much larger ones in performance. They were developed primarily for the new Western Electric Orthotronic audiphone. A unique feature is their extremely fine filaments which permit operation on a single small dry cell. The tubes are pentodes. Five leads pass through the press; in the audiphone they are connected by binding posts to avoid the increased length which a socket would require. The 361A is used in a resistance-coupled amplifier with a gain of 37 db; and the 362A is a power tube whose normal output is 9 milliwatts. Both tubes operate without bias. Although intended primarily for audiphones, they are suitable for other applications, particularly where space is at a premium.

NEWS AND PICTURES

Frank Schlarb, Northwestern Bell

Cable-lashing machine which automatically binds the cable to the messenger strand

News of the Month

New Board Member

M. R. Sullivan, vice president of the American Telephone and Telegraph Company, has been elected a member of the board of directors of Bell Telephone Laboratories to fill a vacancy created by the resignation of W. H. Harrison who is now on leave with the OPM in Washington. Mr. Sullivan was vice president in charge of operations for The Pacific Telephone and Telegraph Company from 1939 until called to A T & T on December 1 of this year.

A native of Oakland, California, Mr. Sullivan began his telephone career in 1912 as a clerk in the office of the division traffic engineer in San Francisco. From that beginning he progressed step by step up the ladder of the Pacific Company organization. In 1913 he became a traffic inspector, and in 1917 chief clerk for the division superintendent of traffic. Continuing in the same department, he held, among other posts, those of division traffic supervisor, general toll supervisor and general traffic supervisor. In 1928 he was made general traffic manager of the Northern California and Nevada area, and in 1934 vice president and general manager for that area.

Four years later Mr. Sullivan's duties as vice president were made company-wide, when he became chief of staff of the operating vice president's organization; and in 1939 he was elected vice president in charge of operations.

The new member of our Board is married and has a married daughter. He has recently served as a director and vice president of the San Francisco Chamber of Commerce, and as a director of the San Francisco chapter of the American Red Cross. He doesn't get out on the golf course very often—he's too busy—but when he does he's good at that too.

M. R. Sullivan, vice president of the A T & T, has been elected a director of Bell Telephone Laboratories

Colloquium

Lloyd Espenschied, at the November meeting of the Colloquium, spoke on the subject of *Inventing*. He discussed inventing as the integral part that it is of the creative process in general and of our research and development work in particular; of what constitutes invention, the mental process, and effort involved; something about the patent system and steps that it is necessary we take to insure our right to use.

At the November 27 meeting Dr. Frederick Seitz of the University of Pennsylvania, one of the active contributors to the study of the solid state, discussed the *Theory of the Plastic Properties of Metals*. There is at the present time excellent evidence to support the view that the inherent changes that take place during the cold working of metals, as well as other crystalline media, can be described in terms of a particular type of atomic disarrangement, known as a dislocation. Dr. Seitz reviewed the experimental evidence leading to this conclusion and then the basic principles involved in the formation of dislocations and their subsequent motion were treated in a descriptive manner. In this connection, the application of the theory to such phenomena as work-hardening, creep, internal friction (of plastic origin) and residual resistance were presented.

First Aid Conference

The Third Annual First Aid Conference was held in the West Street auditorium on November 26. During the past few years fifty-three members of the Laboratories have been specially trained to render First Aid care in cases of accident or emergency sickness arising at locations other than West Street and ten of these are qualified to instruct groups of their associates at their respective locations. These persons are graduates of the joint First Aid courses of the Laboratories and the American Red Cross and are now rendering all First Aid care required by members of the Laboratories at these locations.

The conference was devoted to the discussion, demonstration and working out of group problems involving First Aid care and transportation of persons having wounds, burns, fractures, shock and stoppage of breathing. In addition to these problems the revised procedures for applying fixed traction splints to fractured arms and legs, the method of performing artificial respiration on asphyxiated persons caught in the débris of a collapsed building and the method of transporting persons with fractured spines were discussed and practiced.

Dr. John L. Mulherin, Field Representative of the American Red Cross, Eastern Area, instructed the members of the con-

Special First Aid Group of the Laboratories Being Instructed in Artificial Respiration by New Large-Group Method

Standing, left to right—Dr. John L. Mulherin, American Red Cross; C. R. Kendall, Supervisor of Safety Methods and First Aid Training, New York Telephone Company; Dr. M. H. Manson, Medical Director of the Laboratories; Dr. L. D. Bristol, Health Director, A T & T; and L. E. Coon and J. S. Edwards of the Laboratories. Miss T. E. Boden, Supervisor of Health Education of the A T & T, is shown kneeling in the front row, second from right ference in the new method of training large groups to render artificial respiration. Dr. Mulherin and G. B. THOMAS addressed the group at luncheon, both stressing the value of First Aid training in the conservation of man power for National Defense through the reduction of accidents, in relieving the suffering and in guarding against further damage to those injured and in the decreasing of accident expenses. The day's program was concluded by DR. M. H. MANSON, Medical Director, who, in a short talk, placed special emphasis upon the care of fractures and the importance of proper transportation of the injured.

Visitors present at the conference to observe the Laboratories' methods of training were Dr. L. D. Bristol, Health Director, Miss T. E. Boden, Supervisor of Health Education, and Earl S. Miner, Safety Engineer, all of the American Telephone and Telegraph Company; and C. R. Kendall, Supervisor of Safety Methods and First Aid Training, New York Telephone Company.

The program was arranged and directed by L. E. COON of the Employees' Service Department under the supervision of J. S. EDWARDS. Mr. Coon was assisted by L. J. BARKER, KATHERINE DORING, JOHN LEUTRITZ, JOHN DUNHAM, L. R. LOWRY, C. ERWIN NELSON, ROBERT POPE, MARTHA SCHMITT, H. P. SMITH and L. C. WESCOAT, First Aid instructors.

OPEN HOUSE AT MURRAY HILL

MEMBERS of the Outside Plant Development Department and their families spent Saturday afternoon, December 6, at the Murray Hill laboratory. After inspection of the quarters of the Outside Plant Development Department, guests assembled in the lounge and restaurant where tea was served. Groups were then formed for inspection of the other parts of the buildings, including the power plant and acoustics auditorium. Guides for the occasion were L. S. O'ROARK, C. D. HANSCOM and F. L. HUNT from the Bureau of Publication and E. L. ALFORD, B. A. MERRICK, G. Q. LUMSDEN, W. T. JERVEY and J. T. LOWE of the Outside Plant Development Department.

Similar arrangements are planned for other departments shortly after they have been moved to Murray Hill.

PERSONS RENDERING FIRST AID AT LOCATIONS OTHER THAN WEST STREET AND THOSE AT WEST STREET PARTICIPATING IN CONFERENCE

Building "R"

C. J. Calbick
H. W. Ericsson
A. C. Holetz
E. D. Morris
F. W. Stubner

Graybar-Varick Building

C. A. Dahlbom
O. E. DeLange
P. J. Doorly
J. R. Erickson
H. F. Gartner
O. D. Grismore
R. C. Hersh
J. W. Hoek
P. Kuhn
G. G. Lavery
E. J. McCarthy
J. J. McMahon
A. E. Melhose
E. G. O'Donovan
J. J. Pauer
A. F. Pomeroy
G. A. Smith
W. F. Smith*
J. E. Tarr
Elena Tighe
H. R. Vail
M. L. Weber
H. F. Winter
G. R. Yenzer

Summit

John Leutritz*

Whippany

J. V. Kelly
L. W. Lott
A. A. Skene

Davis Building

T. M. Bensler
D. W. Bodle
C. W. Christ
Elizabeth Culbert
J. M. Dunham*
R. Haard
L. S. Inskip*
R. Pope*
Margaret Remmelman
H. Sagefka*
G. J. Wismar

Murray Hill

O. B. Cook
T. J. Crowe
J. J. Harley
P. Venneman*

Holmdel

L. J. Barker*
L. R. Lowry*

Deal

J. P. Schafer*

West Street

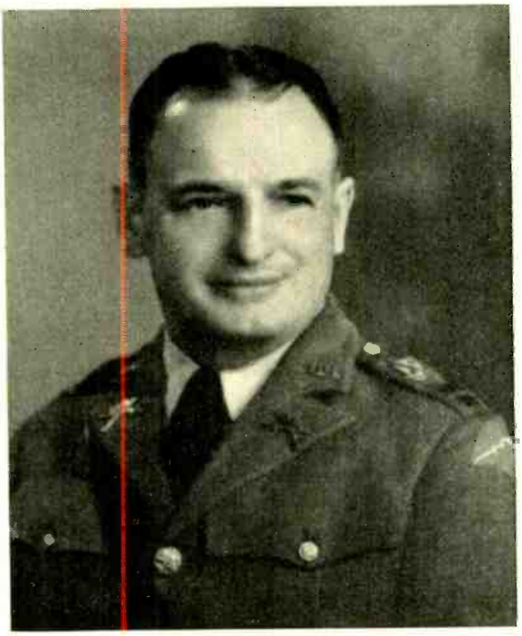
C. N. Anderson*
C. F. Benner*
L. E. Coon*
Katherine Doring*
J. S. Edwards*
C. H. Greenall*
Dr. M. H. Manson
C. Erwin Nelson*
Dr. C. A. O'Malley
Margaret Portelroy
Ruth Robinson
Martha Schmitt*
W. W. Schormann*
H. P. Smith*
W. C. Somers*
E. B. Stallman
G. B. Thomas
W. A. Tracy
L. C. Wescoat*

*First Aid Instructors.

FRANK B. JEWETT has been appointed to the Advisory Board of the recently formed Coördination and Equipment Division of the Operations Branch of the Signal Corps. This Board is composed of officers from the various arms and services of the Army and a group of civilian leaders in the communication engineering and electrical fields.

On December 3, Dr. Jewett spoke on *Science in the Defense Program* at the annual convention of the American Society of Mechanical Engineers in New York City.

R. M. BURNS spoke on *Corrosion of Metals* before a meeting of the American Society for Metals which was held in Indianapolis on December 15.



Captain Albert G. Kobylarz is now in the Office of the Chief Signal Officer in Washington

B. L. CLARKE and C. L. LUKE attended the fall meeting of the American Society for Testing Materials held at the Bureau of Standards in Washington. This meeting was devoted to the chemical analysis of metals.

C. C. HIPKINS, as a member of the Advisory Committee on Protective Coating of OPM, attended the monthly meeting in Washington. Mr. Hipkins also addressed a gathering of technical employees of the Maas and Waldstein Company on the subject of *Finish Testing*.

T. Pariseau, Troop A, 102nd Cavalry, at Fort Jackson, South Carolina

CAPTAIN ALBERT G. KOBYLARZ writes from Washington:

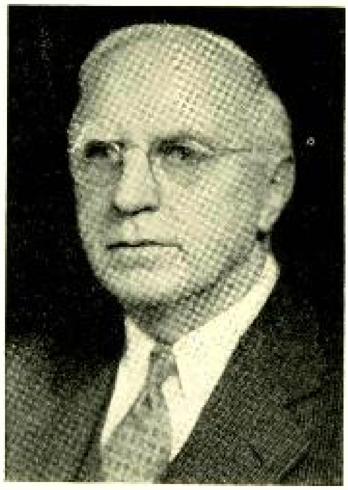
Since my assignment here on November 1 to the Office of the Chief Signal Officer, I have assisted in formulating new Signal Corps equipment channels of maintenance which are being revised to meet new conditions. My particular job is Liaison Officer between Air Corps and Signal Corps as pertains to Signal Corps equipment assigned to the Air Corps, a job giving me a chance to visit Air Depots at various points.

T. PARISEAU, Troop A, 102nd Cavalry (Horse-Mechanized), writes from Fort Jackson, South Carolina:

The accompanying photograph was taken as we returned from a three-day bivouac. The equipment you see draped about me is packed on a saddle and the saddle in turn placed on the horse. During maneuvers, which are now in progress, the men ride with a fully packed saddle at all times as many nights are spent far from the base camp. I could go on to great lengths describing my experiences—spills and thrills—in the cavalry, but time is limited as one's work is never done where horses are concerned.

B. M. Bouman

J. N. Walters



G. W. Elmen

RETIREMENTS

THE THIRTY-FIRST of December brought to a close the active service of three members of the Laboratories—G. W. ELMEN, Research Physicist, J. N. WALTERS of the Switching Engineering Department and B. M. BOUMAN of the Equipment Development Department.

At a time when scientists and engineers alike were completely convinced that the maximum attainable magnetic permeability was to be found in pure iron, Mr. Elmen demonstrated conclusively that higher permeability, and more favorable values of other characteristics as well, could be obtained by alloys of iron with proper heat treatment. His invention was valuable not only for itself but for the stimulus which it gave to magnetic research throughout the world and thereby to the production of other unique alloys. His development of the permalloys—iron-nickel alloys, properly heat treated and containing between 35 and 85 per cent nickel—produced material of very high permeability to low magnetizing forces and amost negligible hysteresis loss. His permalloys permitted the development of long deep-sea submarine cables with telegraphic capacities approximately five times that of previous cables. Substantially all of the long deep-sea cables laid in the last two decades have utilized his invention.

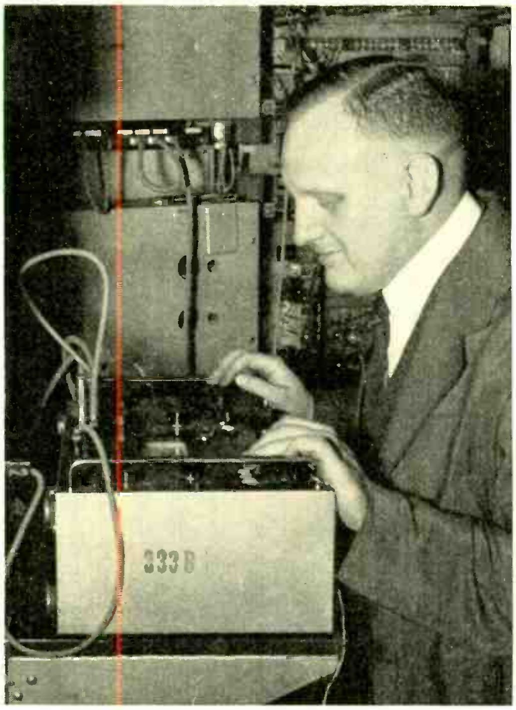
Modifications which he made in these alloys by the inclusion of small percentages of other metals, such as molybdenum or chromium, have permitted large reductions in the size of loading coils used on telephone cables with consequent reductions in the size of manhole space required, the cost of coil cases, and an increase in the number of possible telephone circuits without excessive costs. His alloys of iron, nickel and cobalt have unique and advantageous properties and are widely used in radio transmitters and receivers, in speech recording and reproducing apparatus, in telephone receivers and transmitters and for other purposes.

In 1927 he was awarded the John Scott Medal by the City of Philadelphia and the Elliott Cresson Medal by The Franklin Institute in 1928. In 1932 the honorary degree of Doctor of Engineering was conferred upon him by the University of Nebraska.

Born near Stockholm in 1876, Mr. Elmen came to this country in 1893. He graduated from Luther Academy at Wahoo, Nebraska, in 1898 and then entered the University of Nebraska where he received his B.S. degree in 1902 and M.A. in 1904. He immediately joined the staff of the General Electric Company which he left in 1906 to join the Engineering Department of the Western Electric Company and since then has been continuously engaged in magnetic research.

* * * * *

MR. WALTERS' service in the Bell System started in 1902 when he joined the Plant Department of the Central Union Telephone Company. For a year he worked in Vincennes and Washington, Indiana. For the next two and a half years he was with the Kellogg Switchboard and Supply Company installing switchboards throughout the Middle West, and then was wire chief of the New Home Telephone Company at Linton, Indiana. From 1905 to 1909 he worked for the Bell Telephone Company of Buffalo, first in the Engineering Department and then as exchange cable maintenance foreman at Rochester. When this company was consolidated with the New York Telephone Company in 1909 he became district inspector of the Rochester district in charge of central office and outside plant maintenance. In 1913, in New York, he transferred to the Engineering Department of what was then the New York and New Jersey Telephone



J. Maurushat making transmission measurements on cable-carrier program equipment

Company, working on fundamental design plans for central offices. When the field trials of the semi-mechanical system started, he was one of the group of engineers assigned to this work and became the first chief switchman of the Waverly exchange.

In 1916, Mr. Walters joined the Engineering Department of the American Telephone and Telegraph Company and in 1919 the equipment division of the newly formed Department of Development and Research. Since 1934 he has been in what is now the Switching Engineering Department of the Laboratories. During this time he has been intimately associated with the maintenance development program covering the panel, step-by-step and crossbar systems. In this work, in addition to aiding in formulating the broad requirements for all kinds of testing equipment, he has been concerned in the design of new apparatus and systems from the standpoint of maintenance.

William Ruhe, an electrician in the Building Shops, repairing a watchman's magneto

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Mr. Bouman graduated from the University of Minnesota in 1904. After two and a half years with the Stromberg-Carlson Telephone Manufacturing Company he became a member of the Equipment Engineering Department of the Western Electric Company in New York. A year later he went to Hawthorne where he had charge of the Western Electric Company's equipment-engineering work for the New York Telephone Company. He later specialized on equipment standardization work.

In 1913 he was detailed to the American

Telephone and Telegraph Company in New York where, for the next three years, he took an important part in the joint program of the A T & T, Western Electric Company and the Operating Companies in the standardization of central-office equipment, particularly the No. 1 central office. He then returned to Hawthorne where he made many contributions in the application of these standards to manufacturing methods.

Since his transfer to West Street in 1919 he has continued his activities in standardization work and has applied himself to the initiating and development of new central-office equipment. Mr. Bouman's most recent activities have been concerned with the development of and improvements in the Nos. 11 and 12 switchboards and their operating accessories, particularly metal chairs for telephone operators.

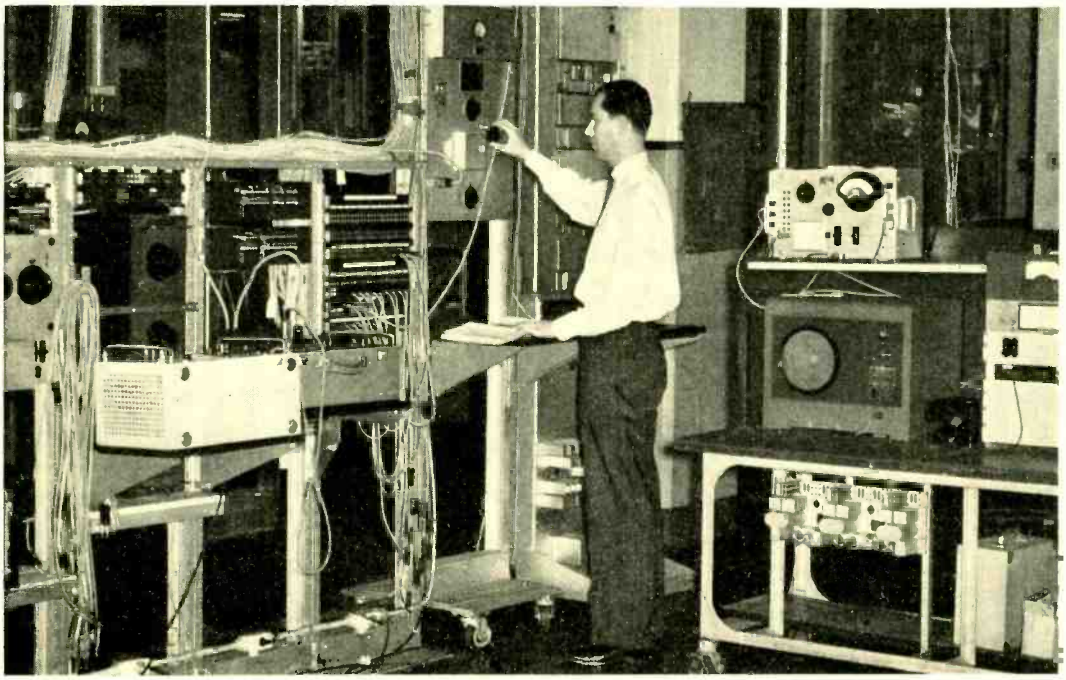
* * * * *

C. S. Fuller, on November 17, presented a talk entitled *Properties of Some Newer Plastics* before a joint meeting of the Pittsburgh Section of the A.I.E.E. and the Engineers Society of Western Pennsylvania at the Mellon Institute in Pittsburgh. He also spoke on *Crystalline Behavior of High Polymeric Substances* before a technical group of the Hercules Powder Company at Wilmington, Del., on December 4 and before the New Haven section of the American Chemical Society on December 11.

K. K. Darrow discussed *Transmutation* at meetings of the Michigan State College section and the Toledo chapter of the American Chemical Society; and *Physical and Chemical Forces* at meetings of the Midland (Michigan), Ann Arbor and Detroit sections of that society, and before the Physics Colloquium of Columbia University.

L. A. MacColl, at the Symposium on Non-Linear Circuit Theory of the A.I.E.E. Basic Science Group held in New York City, spoke on *Power Series Solutions of Dynamical Problems.*

Microchemistry was the subject of B. L. Clarke's paper presented before the West-



The field trial of the K2 carrier telephone system between New York and Pittsburgh required an extensive testing set-up at each terminal. The Laboratories' testing position at Pittsburgh is pictured above with E. H. Perkins of Transmission Development Department. In this trial Mirrophones, one of which is shown on the table at the right, were used as substitutes for the human voice when talking tests were made

John A. Hall
of the Patent Department completed thirty-five years of service in the Bell System on the first of December

Guy M. Campbell
of the Patent Department completed thirty-five years of service in the Bell System on the eleventh of December

Josiah F. Lewis
of the Commercial Relations Department completed thirty-five years of service in the Bell System on November 15

ern Connecticut section of the American Chemical Society. The meeting was held in Stamford on December 15.

F. F. Lucas, on December 11, presented a paper entitled *High-Power Metallography* before the Canton-Massillon Chapter of the American Society for Metals.

Some Studies of Chemical Reactions in Vacuum was discussed by L. A. Wooten on December 4 before the Emporium (Pa.) section of the Institute of Radio Engineers.

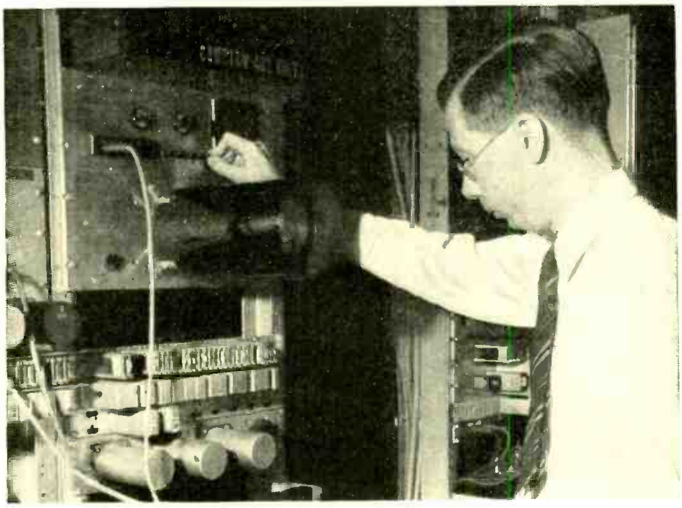
An article entitled *Improved Ceramic Dielectric Materials*, by M. D. Rigterink, was published in the November issue of *The Review of Scientific Instruments.*

A. J. Christopher and J. A. Kater were at Kearny in connection with air condensers for use on J and K systems.

W. Fondiller and R. W. DeMonte were at the Hawthorne plant of the Western Electric Company where they discussed transformer problems. Mr. DeMonte also visited Wright Field, Dayton, in connection with transformer testing methods.

C. A. Webber and R. T. Staples visited Point Breeze on cord development problems.

On November 17, A. R. D'heedene spoke on *Crystal Elements in Wave Filters* and on November 24, A. J. Grossman on *Attenuation and Phase Equalizers* before the Wave Filter and Network Lecture Course sponsored by the Communication Group of the A.I.E.E. New York section.



J. R. Davey making a measurement at the laboratory model of a cathode-ray distortion-measuring set in the telegraph laboratory in the Graybar-Varick building

Walter V. Thompson
of the Transmission Apparatus Development Department completed thirty-five years of service on Nov. 11

Fred Haese
of the General Service Department completed thirty years of service in the Bell System on December 4

At Hawthorne, J. D. Tebo discussed crossbar apparatus and V. F. Bohman, step-by-step apparatus.

E. W. Gent and R. E. Ottman visited The Bell Telephone Company of Pennsylvania, Philadelphia, to discuss problems related to the pneumatic ticket-distributing system.

O. S. Mesch, at the Electric Controller and Manufacturing Company, Cleveland, investigated portable electric welders.

E. St. John visited the Haydon Manufacturing Company, Forestville, Conn., for the purpose of discussing timers, interrupters, clocks, synchronous motors, gearing and other apparatus.

At the Weston Electrical Instrument Company in Newark, C. F. Swasey, A. W. Daschke and W. H. Sellew discussed meters.

E. D. Mead attended the Quality Survey on Crossbar Switches at Hawthorne and also discussed other items on the crossbar switch, multicontact relay and timers.

The November issue of *Industrial Standardization* carries an article by W. W. Werring on *Engineering Problems in Dimensions and Tolerances*. This is a five-page abstract of a similar article published in the *Bell System Technical Journal*.

C. H. Wheeler and N. J. Eich visited the Forest Hills central office of the New York Telephone Company for the purpose of investigating line relays.

J. R. Townsend spoke on *An Engineer Looks at Plastics* before the Society of the Plastic Industry at a meeting which was held in Hartford on December 2.

As part of an educational course being given in New York City by the American Society for Metals, W. W. Werring discussed *Impact Testing*.

H. E. Marting, at the Western Electric Company, Hawthorne, discussed general equipment problems.

R. C. Platow, at a meeting of the Mathematical Society of New York University on November 26, gave a talk on *High-Speed Motion Picture Photography*.

George J. Seltzer
of the Plant Department completed thirty years of service in the Bell System on the eighth of December

Edward F. Hill
of the Transmission Apparatus Development Department completed forty years of service on December 6

Twenty-Five-Year Service Anniversaries

J. B. Shiel

A. H. Heitmann

A short time after John B. Shiel joined the Engineering Department of the Western Electric Company he transferred to the circuit design laboratories of what is now the Systems Development Department. Here he took part in several of the toll development projects, particularly those relating to signaling systems. During this time he attended Cooper Union Institute from which he received his B.S. degree in 1922 and his E.E. degree in 1928. When a laboratory testing group was formed in 1923 he was placed in charge of it and for the next six years worked on this phase of toll work.

Since 1929, in what is now the Switching Development Department, Mr. Shiel has been responsible for the development of trunks involved in toll connections. Among the specific projects with which he has been connected are the type-A cords for the No. 1 toll positions, positional coin control for toll switchboards, number-checking circuits, and operator-office trunks for completing community dial office calls.

Mr. and Mrs. Shiel live in Glen Head, Long Island, and they have one daughter who is now in elementary school. Mr. Shiel's most interesting hobby is the collection of books on Long Island—he has over 200 books and papers covering its history. His recreations are tennis and swimming.

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Most of Albert H. Heitmann's service with the Bell System has been devoted to the theory, development and application of loading coils. In this work he has participated in fundamental investigations on phantom circuit problems, and has played an important part in the reduction of cross-talk contributed by loading apparatus and repeating coils that are used in phantom group circuits.

After Mr. Heitmann received his M.E. in E.E. degree from Ohio State in 1909 he spent a year in the research laboratory of the Westinghouse Electric and Manufacturing Company. He then returned to Ohio State where he spent one year as a laboratory assistant and another as an instructor in Electrical Engineering. In 1912 he joined the Engineering Department of the A T & T and was concerned with telephone interference problems and transpositions for open-wire lines. From 1916 to 1920 he was with the Kellogg Switchboard and Supply Company in Chicago where he was in charge of a laboratory for experimental work on the insulation of automobile ignition products and on various telephone devices. Since 1920, with the Department of Development and Research of the A T & T and with the Transmission Engineering Department of the Laboratories, he has been concerned with transformers and loading coils for telephone circuits.

The Heitmanns live in East Rockaway, Long Island. They have one daughter who is now in her second year at the American University in Washington, D. C. Mr. Heitmann is a Telephone Pioneer.

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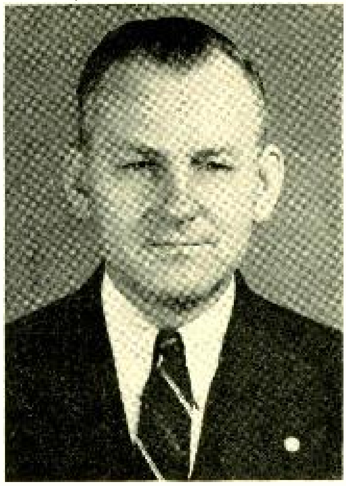
The fifth of December saw Albert C. Goebel's completion of twenty-five years of service with the Engineering Department of the Western Electric Company and the Laboratories. Previous to 1916 Mr. Goebel had spent about six years as a helper and then a wireman with Blackman and Gutt-

A. C. Goebel

Miss Matilda Goertz



M. O. Kastner

man, electrical contractors, and as a wireman for the Interboro Rapid Transit Company. His first work at West Street was in a similar capacity in the Building Shops. During the First World War he served with the Research and Inspection Division of the Signal Corps for about two years and was stationed in France for most of this time.

On his return he again took up his work in the Building Shops. In 1925 he transferred to the Power Plant where he has since been responsible for the operation of its electrical systems and for the various power rooms at 463 West Street and in the Graybar-Varick building.

The Goebels live in the Bronx where their seventeen-year-old son is in high school. Mr. Goebel is an ardent sports fan and attends all the baseball, football and hockey games that he is able to. He is a member of the Edward J. Hall chapter of the Telephone Pioneers of America.

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Miss Matilda Goertz, a member of the Technical Staff, graduated from Normal College (now Hunter) with the A.B. degree in 1912, and received the degree of M.A. for work in mathematics from Columbia in 1915. After graduating from Normal, she taught mathematics and languages in New York City high schools. She joined the Laboratories in 1916 and did statistical work and mathematical typewriting for several months. The following year she transferred to the Physical Laboratory where she engaged in various kinds of laboratory work.

In 1918 Miss Goertz joined the magnetics group of what is now the Physical Research Department where most of her time has since been spent on original research work in connection with the development of new magnetic materials. She has been associated with much of the development and use of magnetic materials such as the permalloys, the perminvars, the permendurs and other magnetic alloys. Due to her long association with the magnetic group she is one of the useful sources of information in its work.

A resident of Jackson Heights, Miss Goertz is active in sororal organizations and has for many years been allied with social welfare work. She is a member of the Edward J. Hall chapter of the Telephone Pioneers of America.

* * * * *

Martin O. Kastner, who completed twenty-five years of service on the nineteenth of December, was with Fuch and Lang Manufacturing Company of East Rutherford, New Jersey, as a lathe and milling machine operator for four years before he joined the Model Shop of the Western Electric Company in 1916, now the Development Shop of the Laboratories. Since then, as a lathe and milling machine operator, he has been associated with many important projects such as telegraph printers, picture transmission and sound pictures. More recently he has been engaged in making molds and dies for the formation of plastic materials into handsets, wall sets, testing equipment and other apparatus and in making special anodes for vacuum tubes.

Mr. and Mrs. Kastner, who live in Carlstadt, New Jersey, have one son who, after graduating from high school in 1939 and taking a year's business course, now works in New York City. Mr. Kastner's main recreation is bowling, particularly with a Carlstadt club and occasionally as a substitute in the Bell Laboratories Club. He is also a fresh-water fishing enthusiast.

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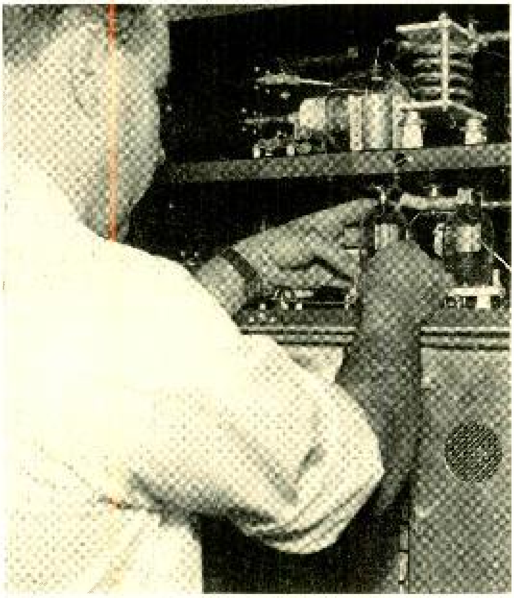
R. G. Koontz and W. E. Grutzner visited Boston in connection with proposed additions to the Lynn, Mass., crossbar office.

F. A. Korn, A. A. Hansen, and D. L. Moody reviewed a-c key-pulsing problems with the Operating Company at Baltimore.



E. D. Prescott demonstrating the ease with which a vacuum tube can be installed in the 1-kilowatt FM transmitter

J. G. Ferguson at Baltimore and W. L. Roth at Baltimore and Washington reviewed airport communication problems.

U. S. Ford was in Wilmington, Delaware, in connection with the trial installation of trunk-usage measuring equipment that is in use in the Wilmington step-by-step office.

O. J. Morzenti and A. M. Zillian have been associated with the K2 trial between New York and Pittsburgh.

V. T. Callahan visited Glen Rio, Texas, on maintenance problems of gasoline engine sets furnishing primary power to carrier stations. He also visited the D. W. Onan & Sons' factory at Minneapolis, Minn.

H. E. Pearsall punching holes for mounting vacuum tube sockets on a metal chassis in the Transmission Development Laboratory Shop

J. M. Duguid attended a Quality Survey conference on small ringing units at the Lorain Products Corporation, Lorain, Ohio.

H. T. Langabeer visited the General Electric Company at Schenectady in connection with regulators for use with gasoline engine-driven generators.

L. J. Purgett spent several days at Cleveland observing the installation of capacitors for power-factor correction.

C. S. Knowlton was in Allentown, Pa., in connection with reserve power for the K2 system. He also visited Schenectady regarding various power items.

C. J. Davisson attended a dinner of previous Nobel prize winners held at the Roosevelt Hotel in New York City on December

Over 3200 dolls and toys were distributed to fifty-three institutions and welfare agencies by the Laboratories Christmas committee. This generous response was an increase of 600 over last year. The photographs shown on this page were taken at the time the dolls and toys were being packed preparatory to distribution.

The Doll and Toy Committee consisted of Margaret McEntee, chairman; Margaret Ahrens, Mary Ellen Bagley, Charlotte Bortzfield, Grace Clifford, Olga Gramm, Margaret Gray, May Hale, Nora Holohan, Marguerite Johnston, Martha Keller, Eleanor Lloyd, Doris Mayer, Helen Mockler, Louise Muller, Louise Van Bergen, Ada Van Riper, Loretta Vogel, Anita Warwick and Ida Wiberg

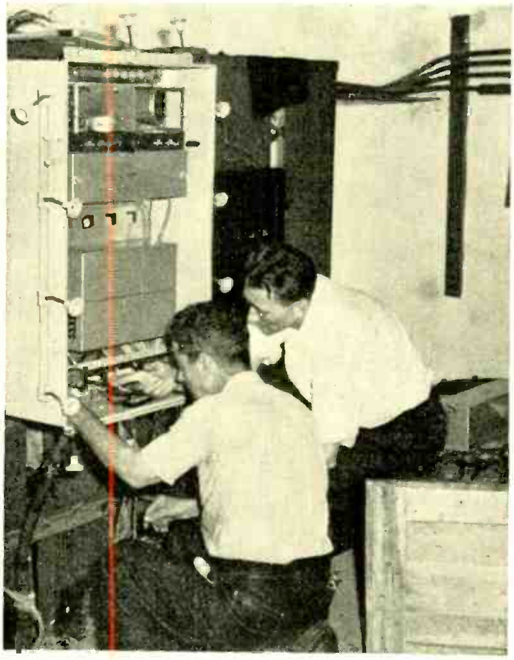
10. The dinner was sponsored by the newly organized Scandinavian Center.

F. R. DICKINSON has just returned from Key West and Havana where he supervised the installation of a new seven-channel carrier telephone system in one of the submarine cables between the mainland and Cuba. C. A. W. GRIERSON and G. W. COWLEY remained at Havana and W. P. FRAWLEY and R. L. TAMBLING at Key West.

J. H. SOLE was in Fort Wayne in connection with machine design problems.

T. R. CURTIS and J. P. WEAVER of Hawthorne spent some time at the Laboratories discussing the production of K carrier equipment. With A. J. WIER and R. D. EHRBAR they visited the carrier stations at New Brunswick and Princeton.

R. O. RIPPERE was in Chicago in connection with the installation of the No. 6 order turret at the Montgomery-Ward Company.



At the Havana end, F. R. Dickinson (right) shows a Cuba Telephone splicer where the cable is to be connected

L. J. STACY and W. BUHLER made several trips to New Haven to conduct a study of subscribers' dialing in step-by-step offices.

W. RUPP and B. MCWHAN were in Baltimore to discuss the installation of a-c keypulsing circuits operating from a No. 1 toll switchboard to a local crossbar office.

ON NOVEMBER 1 the Stevens Point-Minneapolis cable was returned to commercial service after one month of laboratory testing. On the day it was returned to service, one of the worst storms of the year caused considerable damage on open-wire and other circuits, which necessitated routing many circuits over the coaxial.

In the Key West cable hut, C. A. W. Grierson (center) watches the submarine cable being strapped in place. Also pictured are representatives of the A T & T and Southern Bell, and the local mascot

R. E. MERRIFIELD has been appointed Service Manager for the Murray Hill laboratory. E. G. CONOVER has been appointed Merchandise Manager of the General Service Department and E. J. REILLY, Local Service Manager.

W. Y. LANG visited in Schenectady to install ventilating equipment for trial in apparatus cabinets of the 81A1 teletypewriter switching unit that is being used by the General Electric Company.

Some Members of the Laboratories

For many years the Record has published the biographies of its contributors, and of those who have recently passed a 25-year service anniversary. With this issue begins a novel feature: biographies of members of the Laboratories chosen by lot from those with more than six months and less than twenty-one years of service.

* * * * *

Richard S. Leonard, "Dick," when someone calls him to his telephone, is now well along with his Second World War. The first one interrupted his schooling with a trip to France, where he had charge of a front-line radio post. But he returned, to graduate from Worcester Poly in 1921 and enter the Laboratories. After some years on circuit analyzation he transferred to the Telegraph Laboratory, where his latest project has been to set up, test and study the No. 1 Telegraph Service Board. (The picture shows him checking circuits at the I.D.F.)

Richard S. Leonard

Then came a field trial at Dayton, and circuit changes to be tried out in the Laboratory.

As befits a married man and the father of a Junior in Millburn High School, Mr. Leonard is fighting the current war as a Civilian Defense volunteer. Back of that lies ten years as a Scouter; he likes to tramp and camp with the boys. The radio and current magazines occupy his evenings at home.

Jack A. Morton

With a research fellowship and several industrial offers to choose among, Jack A. Morton selected industry because he felt he would get farther as a member of a team; and the Laboratories in particular because of its reputation. That was in 1936, and experience has not changed his opinion. His work here has been in development of tubes and circuits for ultra-high frequencies, as a member of the Circuit Research Department.

Mr. Morton holds degrees from Wayne University and University of Michigan, and is now studying for his Ph.D. at Columbia

MISS MARY TORKAS

on the part-time plan, specializing in mathematical physics. In addition, he has taken a number of Out-of-Hour courses and has taught a two-term course in differential equations. His recreation is small-boat sailing and he was one of the founders of the Sailing Club. Married some three years ago, he and Mrs. Morton live on the mountain-slope above Plainfield.

* * * * *

FROM A SOLID AMERICAN HOME in Jackson Heights comes MARY TORKAS to her work in Stenotype Telephone Dictation. Miss Torkas is one of those rarities, a native New Yorker; she was born in Manhattan and graduated from the Commercial course at Washington Irving High School. Entering the Laboratories as a typist, she learned stenotyping, and now takes dictation on that machine. Occasionally she and the machine go to engineers' desks—but usually they stay in Section 2D at West Street and receive dictation by telephone.

Miss Torkas likes dancing and walking; she reads a good deal and enjoys the movies. On summer Sundays she goes to Jones Beach with her parents and her brother; she vacations at Lake Ronkonkoma.

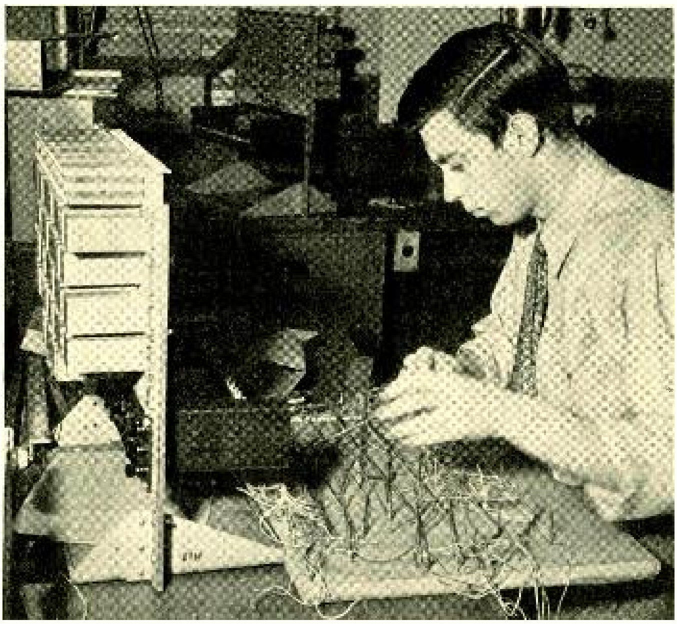
* * *

WHEN HE ISN'T BUILDING THINGS for the Laboratories he is building things for himself, is HARRY ELHOME, a sheet metal worker in the Building Shop. Picture shows him fitting a guard around the belting of a precision drill press; not pictured, because it is too far away, is his country home at Lake Secor in Putnam County, which he built with his own hands. Mr. Elhome joined us in 1930; two years later he was married. Every week the Elhomes and two other couples dine together and play pinochle. Once upon a time he played soccer and went in for track sports, but lately he has been playing horseshoes back of Section R. Also he skates; and this winter he intends to ski.

* * * * *

A NEWCOMER TO THE Telegraph Development Laboratory is BILL FLEISCHER—Carl William to the Payroll people. Born upstate, he moved to Long Island several years ago, and graduated from the high school at Bellmore last June. His first love was chemistry, but electricity has now displaced

HARRY ELHOME



Carl William Fleischer

it. Bill was a wrestler in school; now he plays tennis and soft ball, but his real avocation is music. He plays the French horn in our Club Orchestra, and is looking forward to his first symphony concert.

In the picture, Bill is wiring one of a pair of artificial cables for laboratory use; he also measured a large number of commercial condensers in order to select those whose capacitance fitted the rather exacting requirements of the circuit.

* * * * *

C. W. Halligan and L. E. Van Damme have been at San Francisco in connection with communication equipment for defense purposes.

D. K. Gannett and W. L. Black, at Rochester on November 10 and 11, attended a meeting of the RMA Committee on Standard Broadcast Transmitters and Speech Input Equipment.

H. B. Noyes went to San Francisco for tests of crosstalk at type-K frequencies in the 22-gauge toll cables crossing San Francisco Bay to Oakland. He was assisted by representatives of The Pacific Telephone and Telegraph Company.

During November, R. J. Fluskey was at the Patent Office in Washington relative to routine patent matters.

D. F. Hoth was at Morristown and Closter, New Jersey, and Flushing, Long Island, on experimental work concerned with noise reduction on program loops.

E. B. Mechling and R. J. Symonds coöperated in tests of crosstalk that were made in the Kingsbridge central office in New York City.

V. J. Hawks, A. W. Lebert and H. S. Winbigler spent several weeks in Florida in connection with tests on type-J carrier telephone systems.

The carrier transmission group played its part in furnishing telephone service to meet the sudden demand which followed the Japanese attack on Sunday, December 7. Field trials of two of the new K2 carrier systems between New York and Pittsburgh were near completion when Long Lines Traffic asked if the circuits could be made available. Within an hour final tests were made and in another fifteen minutes all twelve channels of one system were in use. By midnight the other system was in service, thus adding 24 circuits between New York and Pittsburgh. Engineers on duty at Pittsburgh at the time were E. H. Perkins and P. V. Koos; at Altoona, A. C. Velia; at Harrisburg, H. C. Fleming; at Allentown, F. B. Anderson; and at New York, F. A. Brooks, L. C. Roberts, J. T. O'Leary, G. P. Wennemer, J. G. Kreer and H. S. Black.

The field trial of the K2 system has required observations and tests at each of the terminals and at 22 repeater stations. Other engineers who participated in this work during November were T. F. Gleichmann, H. K. Krist, O. H. Loynes, J. Maurushat, Jr., and E. K. Van Tassel.

B. H. Jackson and N. S. Ewing appeared before the Board of Appeals at the Patent Office relative to applications for patent.

M. R. McKenney and P. C. Smith appeared before the Court of Customs and Patent Appeals on an application for patent.

L. A. Dorff, L. A. Yost, L. E. Van Damme, R. L. Lunsford and W. L. Roth were at Spartanburg, South Carolina, to observe the use of communication equipment during Army maneuvers.

L. A. O'Brien and K. D. Smith were in Washington to discuss apparatus at the National Bureau of Standards.

M. N. Smalley was in Chicago to observe the tests of production samples of the monopulse teletypewriters.

E. D. Mead, V. F. Bohman and J. C. Rile visited Hawthorne to discuss crossbar and step-by-step switch problems.

R. S. Caruthers investigated troubles in type-J installations at Salt Lake City, Utah, and Wyeth and Portland, Oregon.

B. A. Fairweather, J. C. McCoy, R. W. Marshall, W. D. Mischler and J. P. Radcliff have completed tests on the New York-Princeton-Philadelphia coaxial telephone terminal trial.

D. MacKenzie was in California recently to appear as a witness in patent litigation.

B. Dysart has returned to New York after a stay of almost two years in Eau Claire and Minneapolis on the Stevens Point-Minneapolis coaxial cable installation.

A. R. Kolding and L. W. Morrison spent several weeks working with the Air Corps at Mitchel Field on special apparatus for the Army.

"Telephone Meets Electrons" was the title of a lecture on the early days of transcontinental telephony which John Mills gave in the New York Telephone Out-of-Hour course of lectures on December 8.

A. C. Walker spoke on *Drying of Textiles* before the textile section of the American Society of Mechanical Engineers at a meeting held in New York City on December 3.

The field trial of the 0.8-mc coaxial system between Baltimore and Washington was put into operation in the latter part of November. A system of this type, when fully equipped, provides 180 telephone channels. The trial equipment includes all the apparatus necessary for transmitting the 0.8-mc band of frequencies over about 135 miles of coaxial circuit looped back and forth in the Baltimore-Washington cable. The apparatus for the trial was designed by the Laboratories and manufactured by the Western Electric Company.

A. R. Thompson was the principal speaker at the opening in Boston of an exhibition of modern textbooks. He was also one of the speakers at a reception held at Rockefeller Center in honor of the Director of the Brazilian Government Printing Office.

Obituaries

Edward J. Santry,
1896-1941

Edward J. Santry, General Auditor of the Laboratories, died on the second of December following an illness extending over a considerable period of time. Mr. Santry joined the Engineering Department of the Western Electric Company immediately following the First World War in which he served in the U. S. Army and was overseas with the 345th Infantry. Before the war he had worked for the Colonial Bank in New York City and the American Can Company at its Edgewater, New Jersey, plant.

Mr. Santry's first work for the Western Electric Company was as an accounting clerk. A year later he was made head of the Payroll Department. Upon the incorporation of the Laboratories in 1925 he became its chief accountant. In 1929 he became General Auditor in charge of the General Accounting Department. In this capacity he was responsible for the accounting, auditing and statistical operations of the Laboratories, general methods and standards work, and the preparation of all general executive instructions. Mr. Santry is survived by his parents, his wife, and five children.

The Laboratories record with sincere regret the passing of Mr. Santry and of two other active members and one retired member during the past few weeks. Miss Anna C. Webbe of the Equipment Development Department with service from July 26, 1920,

Miss Marion McCracken,
1892-1941

Charles Widmaier,
1882-1941

Miss Anna C. Webbe,
1889-1941

died on November 16; Miss Marion McCracken of the Transmission Engineering Department with service from February 25, 1918, on November 18; Charles Widmaier, a retired technical assistant in the Research Department, on November 20.

* * * * *

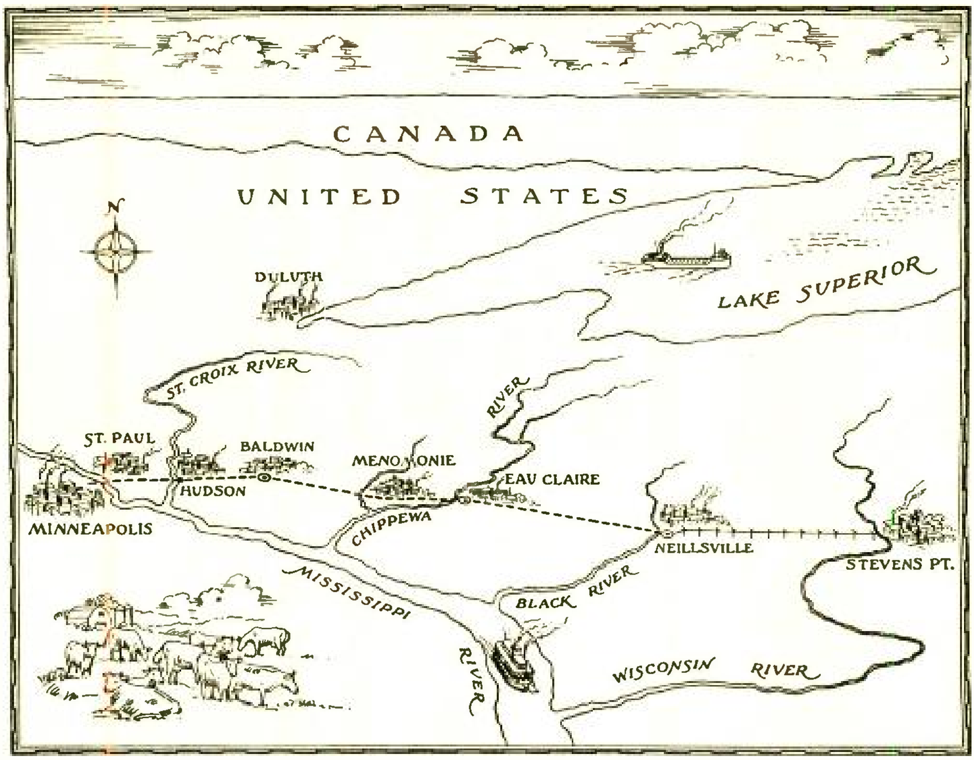
Miss McCracken, a member of the Technical Staff, was graduated by Adelphia College in 1914 with a B.A. degree in Literature and then attended Columbia University, from which she received an M.A. degree in Mathematics in 1915. She joined the Engineering Department of the A T & T in 1918 where she soon was placed in charge of a group of computers working on transmission problems. She continued this work in the D & R when this was organized in 1919, and transferred in 1925 to the group working on low-frequency induction, her concern being principally with statistical studies of inductive disturbances from electrified railways. Later on this work was extended to include similar studies in connection with low-frequency interference from commercial power lines. Beginning in 1934, Miss McCracken was associated with the work conducted by the Joint Subcommittee on Development and Research of the Edison Electric Institute and the Bell System. She worked chiefly on structural coördination problems, most recently on investigations in connection with storm loading of open-wire lines. During this period she also gave material assistance in the general revision of the National Electrical Code and the National Electrical Safety Code and in assembling data on studies made by the American Research Committee on Grounding.

* * * * *

Miss Webbe was with the Ingersoll-Rand Company as a stenographer for ten years before she joined the Engineering Department of the Western Electric Company in 1920. Her first work with Western Electric was in the Sales Department but she soon transferred to the Equipment Development Department of the Engineering Department where she had since been engaged in general secretarial work. Miss Webbe was a member of the New York Oratorio Society and took an active part in its activities.

* * * * *

Mr. Widmaier, who retired in 1933, joined the Western Electric Company in 1901. From then until 1907 he inspected and tested transmitters and receivers. For the next seven years he was connected with a group responsible for the inspection of transmitter carbon and electrodes. When the manufacture of telephone instruments was moved to Hawthorne, he transferred to the Engineering Department and from then until his retirement was engaged in the testing and calibration of the instrument standards which were used in the determination of the efficiency of transmitters not only in the Laboratories but also in the manufacturing department, distributing houses and repair shops.



Stevens Point and Minneapolis Linked by Coaxial System

By K. C. BLACK
High-Frequency Transmission Development

IN JUNE, 1941, a coaxial cable telephone system, known as the type L-1 carrier system, was put in regular commercial service between Stevens Point, Wisconsin, and Minneapolis. This installation took advantage of knowledge gained from the experimental coaxial cable between New York and Philadelphia. How the new cable differs from the earlier, has been described in the RECORD.*

In an L-1 carrier system, each coaxial unit carries signals in one direction only, and hence two units are required for a two-way system. The cable laid between Stevens Point and Minneapolis has four coaxial units in its sheath and thus provides for two complete lines, one of which is a complete spare and is cut into service automatically when trouble occurs on the regular line.

The cable route, which is slightly under 200 miles in length, divides into four sections of about fifty miles each. At both Stevens Point and Minneapolis are terminal stations, where the

*RECORD, *Jan.*, 1941, *p.* 138.

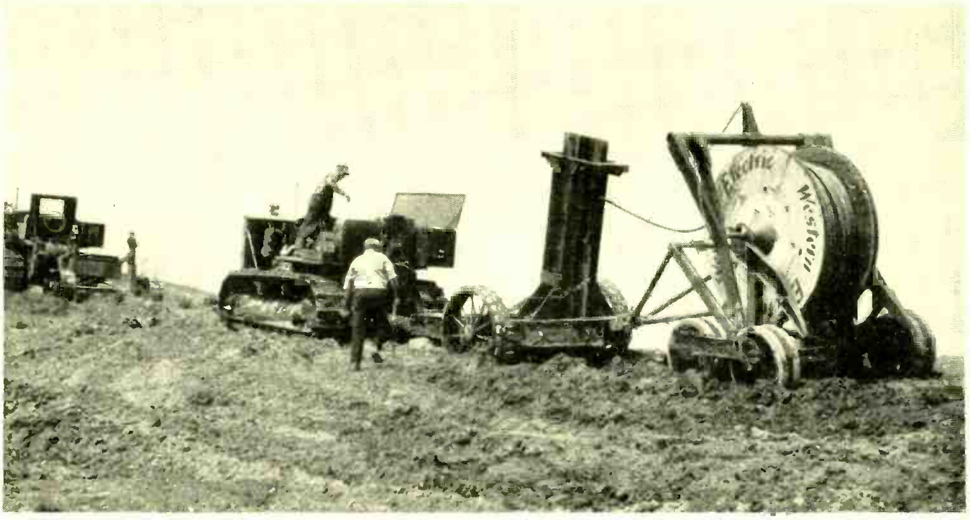


Fig. 1—Cable-laying equipment used for the coaxial cable

modulators are located that transform from voice-frequency circuits to carrier circuits and vice versa. These terminals also include amplifiers, complete regulating and power-supply equipment, and a full complement of testing apparatus and alarms. At the junction points between fifty-mile sections are main repeater stations, also equipped with amplifiers, regulating equipment, and power supply. These main repeater stations may or may not serve as branching stations as well, slightly more repeater equipment being required for branching service. At branching points some of the circuit groups may be tapped off, either as a branch coaxial system, or—more likely—as J or K carrier or voice-frequency systems, and under the latter conditions frequency conversion apparatus is required. Between the main repeater stations are a number of auxiliary repeater stations spaced at about five-mile intervals. These intermediate repeaters may be mounted on poles, placed underground, or enclosed in small surface structures, but they are operated on an unattended basis, and any serious deviation from normal transmission occurring at them is signaled to the nearest main station that is attended continuously. Although the

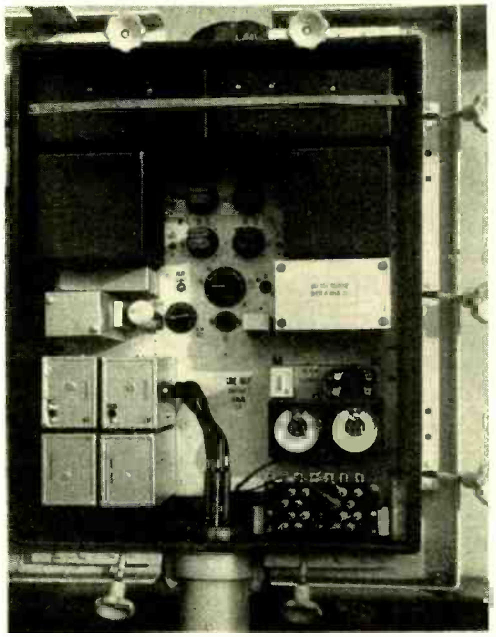


Fig. 2—An auxiliary repeater designed for use on an L-1 system

main repeater stations are approximately fifty miles apart on the circuit between Stevens Point and Minneapolis, this distance is not a requirement of the system, and somewhat wider spacing could be used if circumstances made it desirable.

Over one of the four main divisions — the one immediately west of Stevens Point—the cable is aerial. Over the other sections it is underground. The same cable is used throughout, but for the underground sections "gopher tape"* and jute protection cover the lead sheath. The underground cable was laid by a new cable-laying plow at an average depth of thirty inches. A photograph of this operation, taken near the St. Croix River crossing, is shown in Figure 1.

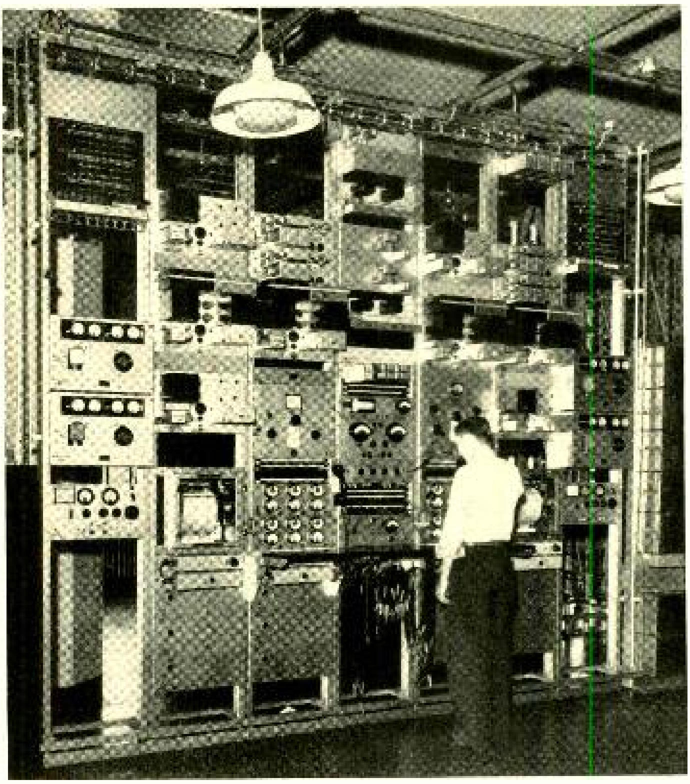


Fig. 3—Part of the repeater station at Eau Claire

The main repeater stations for the L-1 system are normally attended, at least partially, and have power-supply apparatus as well as amplifiers, regulators, and perhaps even frequency-conversion equipment. Some of the equipment at the Eau Claire repeater station is shown in Figure 3. In general, the three bays at the left include the apparatus for the regular two-way coaxial system, and the three at the right, that for the alternate system. The middle bay is chiefly testing equipment. Some of the power equipment is in the power room and is not shown in this photograph. This particular station is designed to serve as a branching point. No branch circuits are taken off at the present time, however, and the equipment arrangement is very similar to that at the other main repeater stations.

For the auxiliary repeaters, the equipment is much less extensive, and all of it is mounted on a single panel about nineteen inches wide and two feet high. This panel is arranged for mounting either on a relay rack or in a weatherproof steel housing, shown with the cover open in Figure 2. Each such repeater handles two-way traffic on one pair of coaxial units, and a repeater is provided for both the regular and alternate systems at each point. A number of methods have been designed for mounting these repeaters, partly to take care of the different

*Record, *Jan.*, 1941, *p.* 165.

methods of running the cable—either overhead or underground—partly to meet the different conditions of the terrain, and partly to secure experience with different types of construction. The simplest arrangement is to mount the weatherproof housings directly on a pole. For underground cable a short stub pole is used,

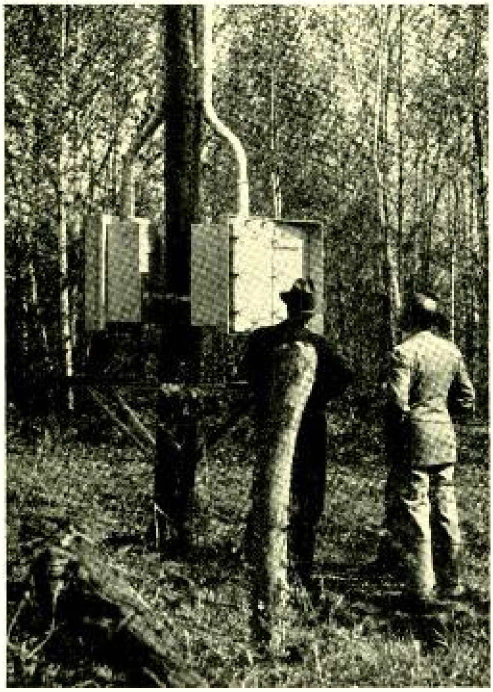


Fig. 4—At some locations the repeaters are mounted directly on the poles

while for overhead construction one of the poles of the line is used. Several types of small huts are also used. One is of steel, one of pre-cast concrete, and one of cement block, and any of them may be used with either overhead or underground construction. For use only with underground construction, a manhole or a semi-underground vault may be used. Some of these arrangements are shown in Figures 4, 5 and 6.

The repeater includes two amplifiers, each a compact assembly as shown in Figure 7. One amplifier is used for each direction of transmission; and besides the two amplifiers, the repeater includes equalizing networks, regulators, alarms, and certain miscellaneous equipment. Each automatically adjusts its gain, under control of a pilot frequency of 2064 kc, to compensate for variations in line loss with temperature. This adjustment is secured through thermistors* in the feedback circuit of the amplifiers, the thermistors being heated from the output of the regulators, which are in turn controlled by the amplitude of the pilot frequency. The line loss varies with change in length of line very nearly as the square root of the frequency; and the

*Record, *Jan.*, 1940, *p.* 106.

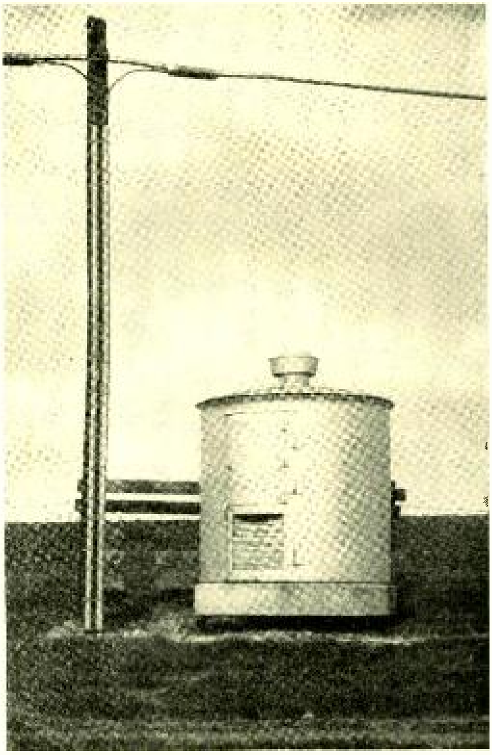


Fig. 5—One of the several types of repeater huts used with the L-1 system

change in loss due to change in temperature also varies approximately in the same manner. This makes it possible for a single adjustment to take care of either a change in length of the repeater section or a change in temperature to a very good degree of approximation. Gain characteristics of a standard repeater for two line temperatures are shown in Figure 8.

This square-root-of-frequency regulation is the only form provided at the auxiliary repeater, but at the main stations, in addition to the 2064-kc

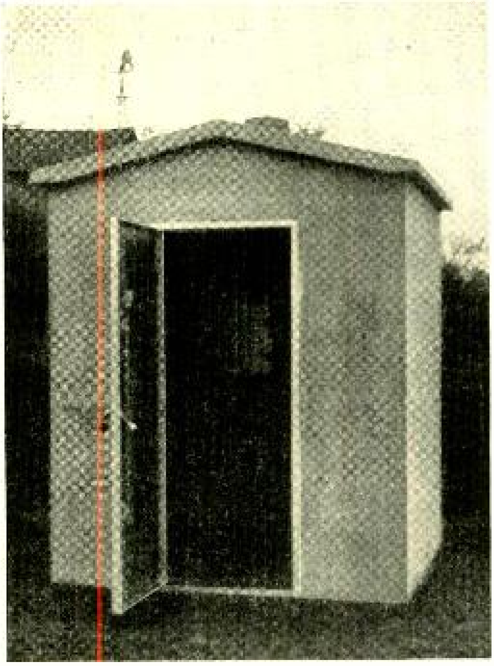


Fig. 6—Another type of repeater hut

regulator, regulation is provided under control of a 3096-kc pilot to compensate for temperature effects in the equipment. Provision has also been made at the main stations for a regulator under control of a 556-kc pilot to correct for inaccuracies in the regulation of the auxiliary repeaters. A 64-kc pilot is used for supervisory purposes and some manual adjustments, and in longer systems it might be used to operate another type of regulator.

Power for the repeaters is transmitted at sixty cycles over a balanced

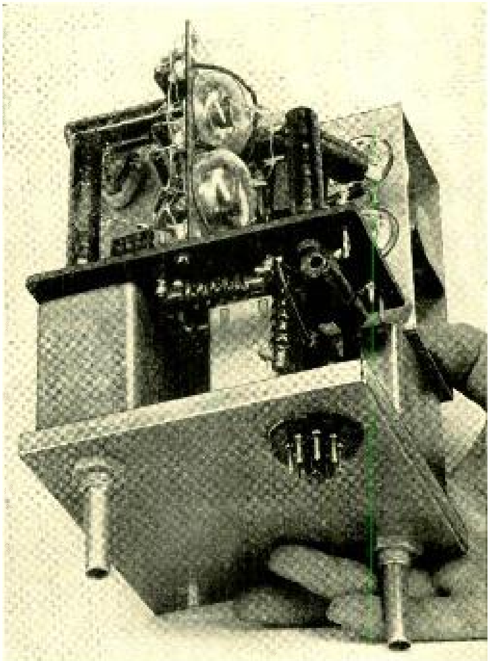


Fig. 7—One of the amplifiers used for the L-1 carrier system

circuit consisting of the central conductors of two coaxial units. It is derived from the commercial supply and fed to the cable at the main stations. To insure continuity of supply, electronic inverters* are provided at each main station to convert direct current from the station battery to sixty cycles in case of a failure of the commercial supply.

The coaxial cable itself does not have any very definite upper frequency limit for practical communication purposes. The frequency band transmitted over it is determined primarily by the repeater equipment. Repeaters designed for the L-1 car-

*RECORD, *July*, 1941, *p.* 338.

rier system will transmit frequencies up to a little above three million cycles, which enables the coaxial cable to be used for a single television channel if desired. To show the effectiveness of these cables for television transmission, a demonstration was given in May of 1941 using an 800-mile circuit formed by connecting the four coaxial units between Stevens Point and Minneapolis in series.* There is no immediate prospect of requiring a television channel between Stevens Point and Minneapolis, but the availability of the circuits provided an opportunity to study television transmission over a longer cable circuit than had ever been tried for this purpose before.

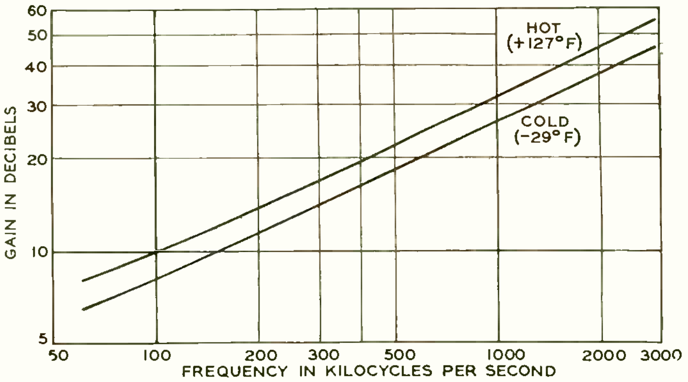


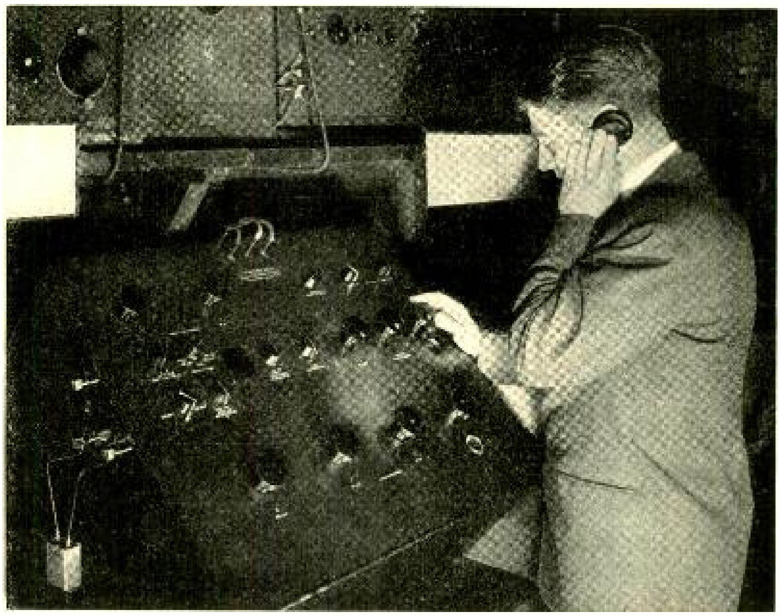
Fig. 8—Gain characteristics of the repeaters for two widely separated line temperatures

Although the system provides for a possible 480 telephone channels, only forty-eight are equipped at the present time. Besides the four coaxial units, however, the cable includes eighteen 19-gauge quads, four 19-gauge pairs, and six 22-gauge pairs. A few of these conductors are used for alarm and maintenance work, but most of the quads provide voice channels, and thus there are more than forty-eight message channels in the cable as now operated.

Experience in two lightning seasons has shown the coaxial units to be less subject to lightning damage than the paper-insulated conductors of the same cable. A severe electrical storm in October, 1940, badly damaged a number of the paper-insulated conductors, but although the coaxial system was operating at the time, the lightning surges had no effect on it. Storms in April, 1941, also damaged the paper-insulated pairs without causing a failure of the coaxial system. In May, 1941, lightning damaged one coaxial unit and a number of paper-insulated conductors but did not interfere with service over the coaxial system itself.

The first commercial service was given during the snowstorm of November 11, 1940, which disrupted service over open-wire lines in the Minneapolis area for several days. Although all the circuit elements were not on hand at the time, a sufficient number of channels were made available to tide over the emergency by dint of strenuous efforts on the part of the men working on the system. This temporary service lasted four days. Similar service was given on two subsequent occasions when paper-insulated pairs were damaged by lightning. The coaxial system also went into service for seventeen days beginning December 16, 1940, to supply extra channels for the holiday rush. It was placed in service on a permanent basis on June 7, 1941.

*Record, *June*, 1941, *p.* 314.



An Improved Capacitance Bridge for Precision Measurements

By W. D. VOELKER
Formerly of Transmission Apparatus Development

TO MEET the demand for increased precision a new standardizing capacitance bridge, known as the No. 12 type, has recently been developed by the Laboratories. This bridge, operating at frequencies up to 200 kc, has a range of from 0 to 1.11 μF, and from 0 to 1000 μmhos. Like the ones it succeeds, it is of the equal-ratio-arm type; these ratio arms are of woven-wire resistance, and in general follow a construction already described in the RECORD.* A slide wire at the junction of the two resistances, and an air condenser that allows capacitance to be shifted from one arm to the other, permit a small amount of adjustment that may be required at infrequent intervals to offset the effects of aging The resistances form the ratio arms AB and BC of the bridge, and permit a capacitance in arm CD to be measured by an adjustable standard capacitance in arm AD. This is the basic principle of the bridge, which is represented at "a" of Figure 1, where the adjustments for the ratio arms have been omitted from the diagram for the sake of simplicity.

For measuring the larger values of capacitance, silvered-mica condensers are employed as standards in arm AD. For smaller values of capacitance, air condensers are more convenient, and instead of connecting them directly in arm AD, they are arranged in a Y circuit connected to corners ACD of the bridge as indicated at "b" of Figure 1.

**Jan., 1932, p. 173.*

This air-condenser standard consists of three decades of fixed capacitance and a movable plate condenser for fine adjustment. Both the decades and the continuously adjustable condenser are arranged so that capacitance is either removed from the CD arm and added to the AD arm, or vice versa. The control dial is calibrated to indicate directly the capacitance of the unknown for each position of the dial. In the connection between this air condenser and corner D of the bridge is a "multiplier"-condenser that may be cut into or out of the circuit as desired. When it is in, the effective capacitance of the air-condenser standard is cut to 1/10 of its normal value, and unknowns of correspondingly smaller values may be measured.

Any condenser has a certain amount of conductance as well as capacitance, and the amount of conductance determines the quality of the condenser—the lower the conductance, the higher the quality. It is necessary, therefore, to be able to measure conductance as well as capacitance, and thus conductance standards are included in the bridge. These are made of woven wire, as are the ratio arms, and are of the rotor-decade type already described.* Like the air-condenser standard, they are connected into the bridge circuit in a Y arrangement with a multiplier to extend their range. These major elements of the bridge circuit are indicated at section "c" of Figure 1.

All the standards employed can be made to a high enough precision to give the accuracy of measurement desired; the improvements in the new bridge lie chiefly in reducing the residuals that must be corrected or balanced out, in improving the stability so as to insure that the precision sought is always obtained, and in simplifying the operation, both to reduce the time required to make a measurement, and to reduce the likelihood of errors in applying corrections and calibrations.

The wide range of capacitance, conductance, and frequency for which the bridge is designed necessitates the use of a large amount of apparatus, and much of it is of fairly large size. The bridge of the best previous design occupied a panel area about fifty-one inches long by twenty-eight inches

*RECORD, *Jan.*, 1935, *p.* 136.

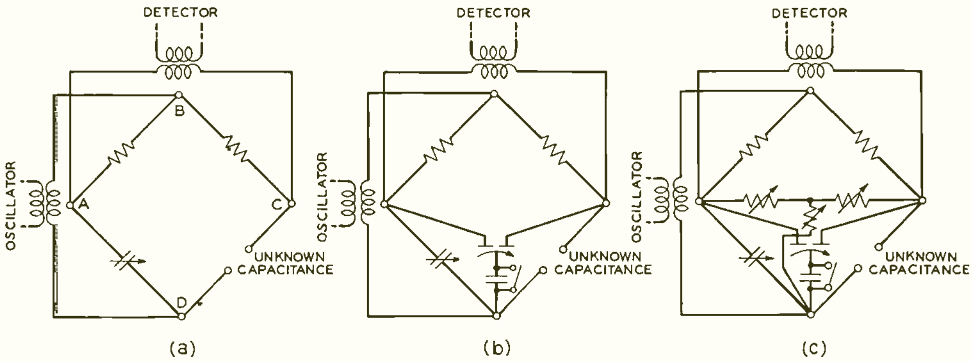


Fig. 1—*Simplified schematic of the capacitance standardizing bridge: "a," in its simplest form with silvered-mica standard condensers; "b," with air condensers for measuring smaller values of capacitance; and "c," with the conductance standard connected into the bridge circuit in a "Y" arrangement* wide. In designing the new bridge, therefore, an effort was made to obtain smaller size and a more compact arrangement. The use of a multiplier for the conductance standards permitted four units to replace the seven of the former bridges. The size of the individual air condenser units was also reduced. These reductions and a more compact arrangement permitted a panel area of twenty-nine by twenty-two inches—less than half the area of the former bridge. This reduction in size has decreased the residual impedances by decreasing the length of the connecting leads. The residual impedances of the leads were further reduced by employing $\frac{3}{16}$-inch copper tubing, which not only provides ample cross-sectional area, but secures stiffness for the leads, and thus greatly reduces variations in residual capacitances due to their flexing.

To secure overall rigidity, most of the major pieces of apparatus are mounted on a strong sub-panel which is fastened to the panel that serves as a cover for the bridge. This cover carries all the controls, and is hinged to a heavy case that houses the bridge. The sub-panel on which most of the apparatus is mounted is not at ground potential, and thus must be insulated from the front panel to which it is attached. To provide such an insulated mounting is not easy because besides being heavy, the sub-panel must be held so rigidly that no jarring or other handling force can change the relative positions of the control panel and sub-panel by any appreciable amount. Insulating materials are not as satisfactory structurally as are metals because of lower tensile strength. Ceramic materials, however, under compression are amply strong and the requirements were met by clamping the sub-panel between ceramic spheres so arranged that they would never have any but a compressional force applied to them. The arrangement is shown in Figure 2.

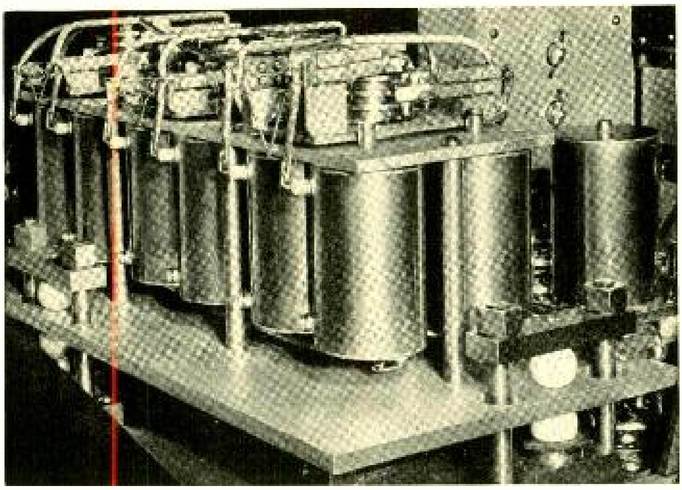


Fig. 2—One end of the bridge showing the method of clamping the sub-panel between ceramic spheres

The spheres rest on sections of spherical surfaces, both on the sub-panel and on the two clamping bars, and are clamped under considerable pressure by large bolts. Regardless of the position of the sub-panel—horizontal, vertical, or intermediate—the spheres are always under compression; and their rigidity avoids the small displacements that would occur with almost any other form of support. Ceramics are also employed at all other insulating points to avoid looseness and lack of stability that commonly develops because of "cold flow" of most of the other types of insulating materials.

The condensers and resistances mounted on this sub-panel are controlled by dials on the front panel; and the linkages between the dials and the apparatus controlled must provide

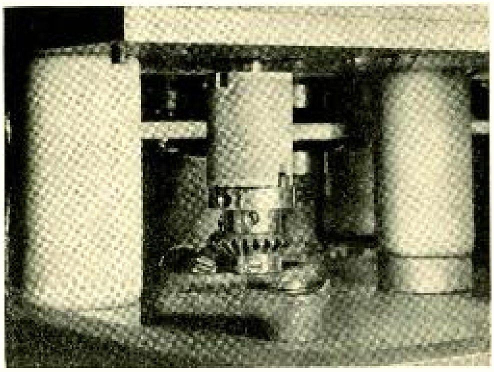


Fig. 3—Ceramic cylinders provide the linkage between the dial and the apparatus that is being controlled

adequate insulation and at the same time avoid any thrusts that would tend to deflect the plate or cover. The necessary torque is supplied through constant-capacitance ceramic insulators arranged as shown in Figure 3. These cylinders are slotted at each end, and the slot at one end runs at right angles to that at the other. Torque is applied by the control dial to the cylinder, and by the cylinder to the apparatus, through rectangular keys that fit these slots with a slight clearance. Such a construction gives a certain amount of "universal joint" action, so as to provide for slight misalignments, and supplies a long insulating path and no thrust.

The efforts to secure rigidity and compactness were carried to the individual pieces of apparatus as well. A new fixed air condenser was designed that is so stable that the capacitance of the 2000 $\mu\mu f$ unit changes less than .01 $\mu\mu f$ when it is held sidewise and dropped through a height of one inch. It is made up of two interleaved pileups of gold-plated invar steel discs, spaced as little as .015 inch apart in some units. These condensers are sealed in a container filled with dry nitrogen. They serve as the decade units of the air-condenser standard. For the fine adjustment of this standard, a small air condenser was developed whose deviation from linearity as the movable plates are rotated is so small that it is possible to use an engine engraved scale and an easily read vernier scale without the need for a calibrating chart to secure accuracy.

The arrangement of the various units in the bridge is shown in Figure 4, where the main shield has been removed. In the foreground, mounted on a sub-panel of their own, are the silvered-mica condenser standards. To shorten the leads between these units, they are mounted two high, with their terminal ends facing

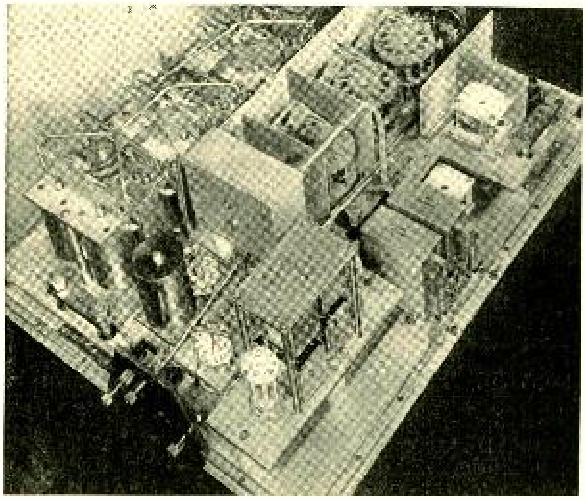


Fig. 4—The No. 12 bridge with most of the shielding removed

each other. The appearance of the control panel with the set in use is shown in the photograph at the head of this article. The decade control dials are all of the drum type, and expose only a single large number in each position, and the continuously adjustable dials are made by engraving through a thin opaque coating on a translucent base. With a small light behind the dial, the scale may be easily read, and an index in the plane of the scale avoids parallax errors.

Errors of computation are eliminated, and substantial savings in time are secured, by adjusting the bridge to indicate the correct values of conductance and capacitance without the necessity of computing corrections. This is accomplished by providing trimmer condensers for each unit, and these are adjusted, if necessary, when the bridge is calibrated each year. Accuracy has been improved and maintenance decreased by using precious metal for all contacts.

In the design of this bridge, C. H. Young coöperated, and contributed some of the novel features. Although, as already pointed out, the fundamental circuit and most of the component elements are not new, the bridge marks a distinct advance in measuring technique. Not only is a new order of accuracy obtainable, but measurements may be made with an ease, speed and freedom from error that has not hitherto been attained.

Charles Frederick Chandler Medals

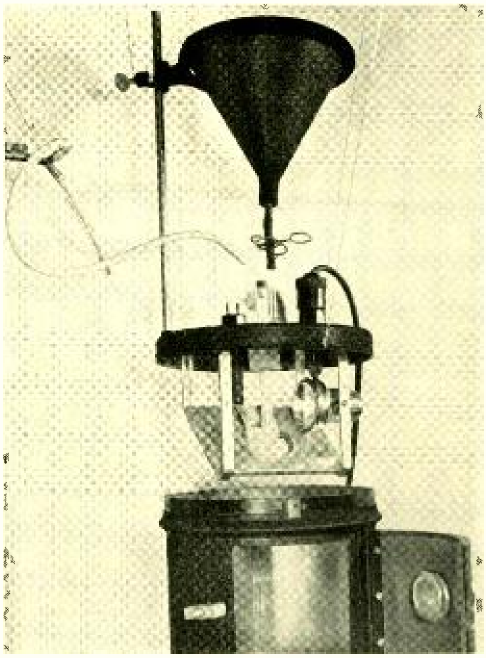
have been awarded by Columbia University to R. R. Williams, Chemical Director of the Laboratories, for his isolation of Vitamin B_1 and his contributions to the elucidation of its chemical structure and synthesis; and to his brother, R. J. Williams, of the University of Texas, for his discovery of pantothenic acid, the "acid of life" essential to all living creatures, and for his contributions to the knowledge of the Vitamin B complex.

Abrasion Test for Finishes

RESISTANCE to abrasion of finishes on metals and wood is evaluated by the Laboratories by directing a blast of air containing a finely divided abrasive against a coated test specimen and determining the weight of abrasive required to wear through the finish. This test is used to measure the wear resistance of different types of finishes including organic, metallic and oxide coatings.

The apparatus has a glass nozzle which mixes carborundum with compressed air and projects the abrasive onto the specimen at an angle of forty-five degrees with its surface. This angle and the distance between the nozzle and the specimen were chosen arbitrarily and the separation was made as small as possible for convenience of operation. The pressure of the air in the nozzle is measured on a mercury manometer and is usually maintained constant within ± 1.5 millimeters. The fine abrasive, 180 mesh, is fed into the nozzle from a funnel above the apparatus and the nozzle and specimen are housed in a cylindrical container which has a small window to view the progress of the test. The experiments are usually made at fifty per cent relative humidity and at seventy-seven degrees Fahrenheit and are continued until an area approximately two millimeters in diameter has been cleared of finish. Abrasion values are expressed as grams of abrasive required to wear through one mil of finish.

Results show that this apparatus with careful control gives abrasion data of a high order of reliability.



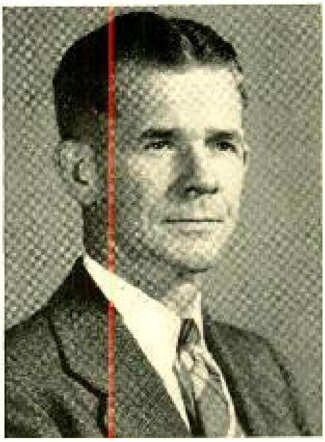
Contributors to this Issue

OUT OF TWENTY years' experience in development of textile insulations, DAVID R. BROBST wrote the article which appears in this issue. He graduated from Lehigh in 1917 and after a year and a half in the Army during the First World War as an instructor in tractor artillery schools, and positions elsewhere, he entered the Laboratories in 1922. Here, he was detailed to insulation studies. Among projects to which he has contributed are the adoption of a cellulose acetate lacquer over the textile covering of central-office wires; purification of insulating fibers by removal of water-soluble salts; and the substitution of acetate rayon for silk.

A. E. K. THEUNER joined the Engineering Department of the Western Electric Company in New York in 1920. After about three years in the panel-switching laboratory, he transferred to circuit development work, and for the next ten years engaged primarily in manual and step-by-step developments. Following this, he worked for about four years on the preparation of patent specifications, chiefly those pertaining to the crossbar system. Since 1938, again with the circuit development group, he has been occupied in developing crossbar trunks and switching circuits.

W. D. VOELKER graduated from Cornell University with the degree of Electrical Engineer in 1929 and at once joined the Technical Staff of these Laboratories. Here with the Telephone Apparatus Development Department he first worked principally on the development of electrical measuring apparatus and also engaged in the design of power transformers and retard coils. He left the Laboratories last August to affiliate with Leeds and Northrup Company, Philadelphia.

R. M. C. GREENIDGE graduated from Harvard University in 1924 with the degree of B.S. in Mechanical Engineering, and at once joined the Technical Staff of the Laboratories. With the Apparatus Development Department he first took part in the development of magnetic materials and of loading coils with powdered-permalloy cores. He later was in charge of a group developing loading coils and cases and retardation coils. In 1940 he



D. R. Brobst

A. E. K. Theuner

W. D. Voelker

transferred to the Outside Plant Development Department to develop testing apparatus for locating cable faults, but at the present time, again with the Apparatus Development Department, is working on quartz-crystal units.

K. C. BLACK received the A.B. degree in physics from Harvard in 1924, and in the three following years received the A.M. and Ph.D. degrees. During the summer of 1926 he worked on inductive interference studies in Virginia with the D & R Department of the A. T. & T. After two years as instructor in physics and communication engineering, he then became associated with the Boonton Research Corporation—working on high-frequency measuring equipment, vacuum tube design, and automatic volume control. In 1930 he joined the Transmission Development Department of these Laboratories, where he has since been engaged chiefly in the design and development of repeaters that are used in the coaxial system.

R. M. C. Greenidge

K. C. Black