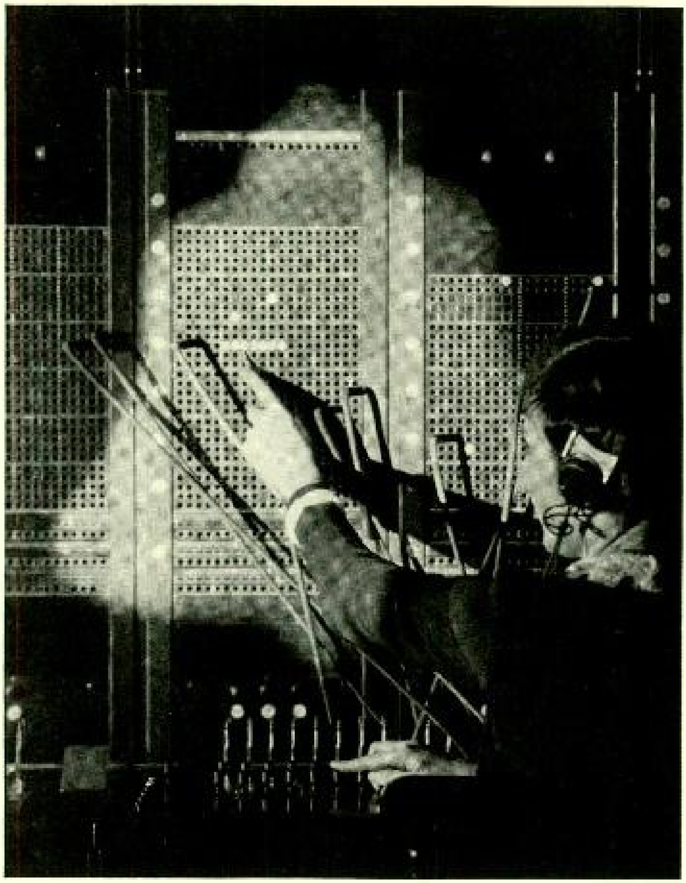
BELL LABORATORIES RECORD



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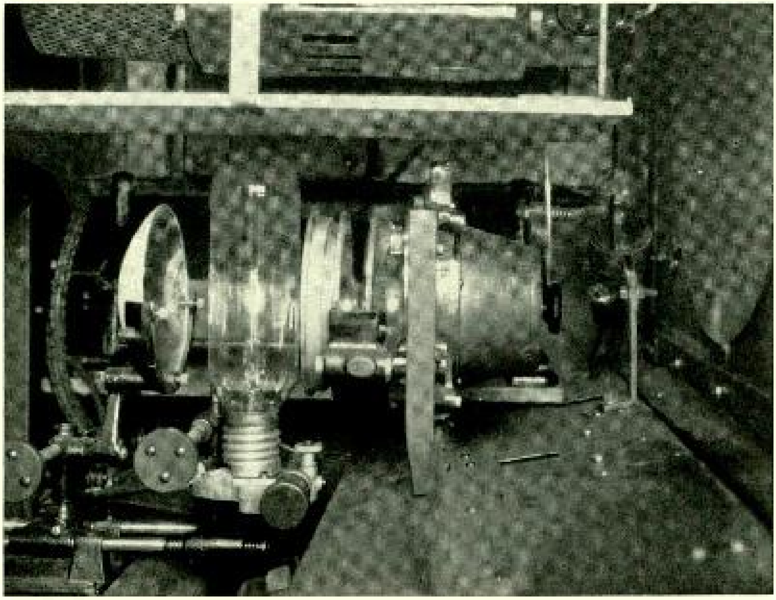


Progress in Two-Way Television

By HERBERT E. IVES
Electro-Optical Research

WHEN two-way television was demonstrated between the Laboratories and the American Telephone and Telegraph building in April of last year, certain improvements were incorporated in addition to the changes necessary to convert the earlier one-way into a two-way system. These have already been described in the RECORD.* Since that time still further improvements have been made, chiefly in the optical features, which make the received image quite appreciably more life-like than it appeared with any of the earlier apparatus. These changes have in addition made the apparatus more compact and have contributed materially toward the ease of operation and upkeep of the system.

One of the modifications has been the substitution of an incandescent lamp for the arc formerly used for scanning. The mounting arrangement of the new light source, which is of the type used with motion picture projectors, is shown in the headpiece. Several advantages are secured by this change. An incandescent lamp avoids the flickering always present to some extent in an arc and thus there is a gain in the steadiness of the image. Also, the maintenance and adjustment of the incandescent lamp, which is of the ordinary projection type, is much simpler. A still further advantage is that the filament, being at a lower temperature than the arc, radiates more light at the longer wave lengths, which facilitates another improvement made in the scanning system.

At the first two-way demonstration, the scanning beam traversed a filter

* BELL LABORATORIES RECORD, *May*, 1930, *p.* 399.

that passed only blue light, and the photoelectric cells used, which were of the potassium-sulphur-vapor type, were sensitive chiefly to light in the blue part of the spectrum. In the two-way system a person looks at the incoming image formed by the glow of a neon tube at the same time that his face is being scanned for transmission to the other terminal. The luminous intensity of the neon tube is not high, and its effective brilliancy would be greatly decreased if the eye were exposed to a bright light from some other source. The human eye, however, is very insensitive to blue light, even when of quite high intensity, so that by making the scanning light blue it has only a very small effect on a person's ability to see the received image. The effect of using only blue light for scanning, however, was to make the yellows and reds in the face too dark in comparison with the whites, such as a linen collar, because very little blue light is reflected from yellowish or red surfaces.

Fig. 1—The two added caesium-oxygen cells appear on either side of the opening through which the television image is seen

To secure greater naturalness in the image, a deep red component has now been incorporated in the scanning beam—making it purple instead of blue—and two photoelectric cells of the caesium-oxygen-type have been added, which are very sensitive to red light. The result of scanning with light from both ends of the spectrum

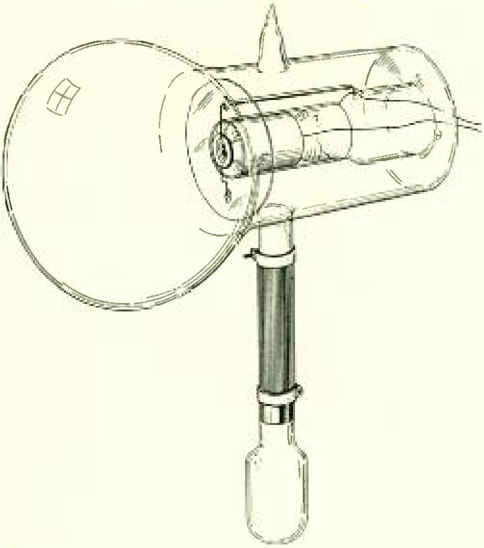


Fig. 2—The new neon tube differs noticeably from the earlier tubes in having a small anode mounted well back from the front of the bulb

is to produce an image that is a much more faithful reproduction of the original. The effect is very much like that which would be obtained by scanning with light from the middle of the visible spectrum: an orthochromatic image is obtained and the definition of certain important points, such as the eyes, is distinctly improved.

The two caesium-oxygen cells are mounted directly in front of the observer — as shown in Figure 1 — one on each side of the rectangular opening through which the incoming image is seen. These cells are only about

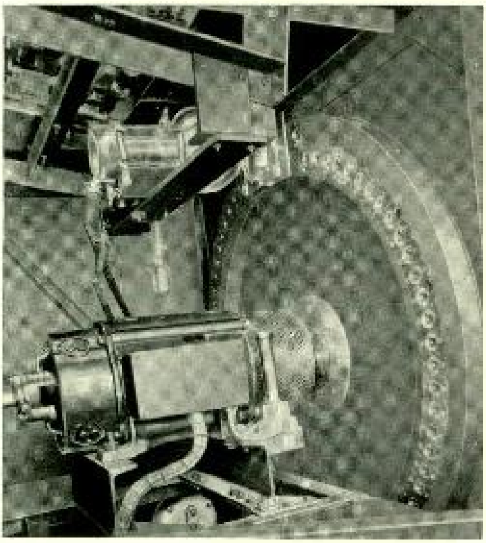


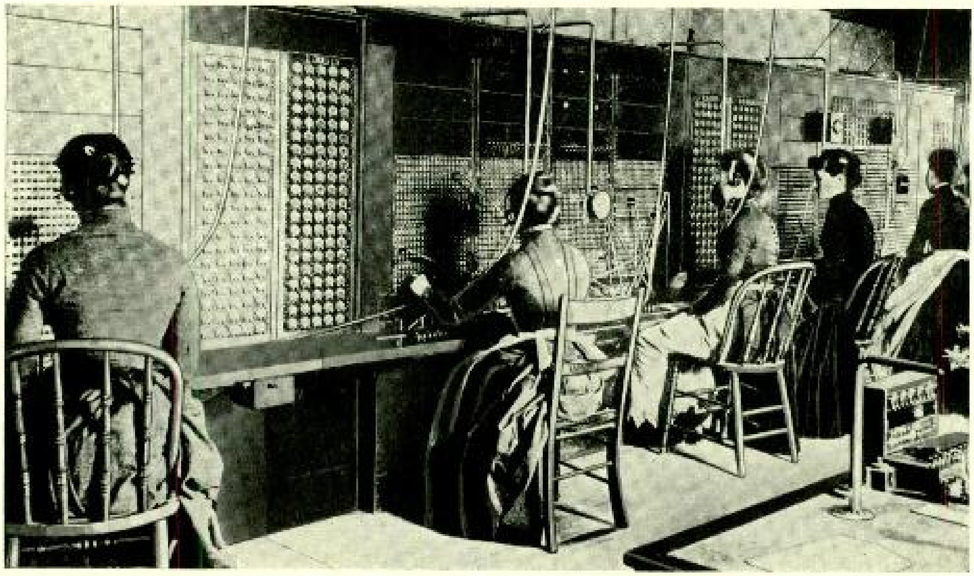
Fig. 3 — The neon lamp is viewed through the lenses in the scanning discs

half the size of the potassium cells but because of their high sensitivity to light of long wave length, and to the richness of the incandescent lamp in light at the red end of the spectrum, two of them are about as effective as the twelve potassium cells.

The caesium-oxygen cells, in addition to being highly sensitive to red, respond somewhat to yellow light, but deep purple filters are mounted in front of them so that only light in the red region is admitted to their active surfaces. The effect of the filters, used both with the scanning beam and with the caesium-oxygen cells, is to make the system completely unresponsive to yellow light, and advantage is taken of this to illuminate the booth with a yellow light of low intensity. This light, while taking no part in the image transmission, prevents the scanning beam from being seen against too dark a background — thus further decreasing its effect on the eye — and also gives enough light in the room to enable the user to locate himself.

A third change that has been made is the provision of a new type of neon tube which has a considerably smaller electrode located farther back from the front of the bulb. A lens mounted in front of the tube, together with lenses carried on the scanning disc, focus images of the glowing anode on each hole of the disc: a very efficient optical arrangement whereby the necessity of the large electrode area and high currents employed in the earlier tubes is avoided. The small aluminum anode is screwed into a large copper cylinder so that water cooling is not required, and the greater distance of the anode from the glass gives a longer life since the sputtering of the hot anode onto the glass surface is one of the factors that limits the effective life of the tube. The arrangement of tube and optical system is shown in Figure 3.

These recent improvements represent no radical change in the system which in its essential features is the same as used previously. They are merely the results of studies which, as was stated at the original demonstration in 1927, would be indefinitely continued in line with the long established policy of the Bell System of developing all forms of communication which might be supplemental to telephony.



Early Manual Switchboard Development

By B. M. BOUMAN
Equipment Development

IN 1878, three years after Bell's invention of the telephone, the first commercial telephone switchboard made its appearance. This board, shown in Figure 1, had a capacity of eight lines with many telephones on each, and was designed by George W. Coy and installed by him for the New Haven District Telephone Company at New Haven, Connecticut. Typical of the boards that immediately followed, it was of the simplest construction. Lines were connected together by the operation of two rotary switches, two pairs of which are mounted along the upper part of the board. Below these, a row of single pole switches, one for each line, were used to connect the lines either to a bus connected to the operator's telephone or to the annunciator drops. At the bottom of the board was another row of switches used for ringing. At the right was the annunciator box for the incoming signals.

It was but natural that switchboard design at this time should change from the rotary switch to the "peg" type of the telegraph switchboards then in use. Such a board, the "Post" fifty-line board of Washington, D. C., is shown in Figure 2. Below two rows of drops at the top were vertical rows, one for each line, of "buttons" or "jacks". Horizontal bars functioned both as cords to connect two lines appearing on the same position, or as trunks to connect lines appearing at different positions. The ten lower cross bars on the sloping portion of the board served as the cords while the upper cross bars, arranged

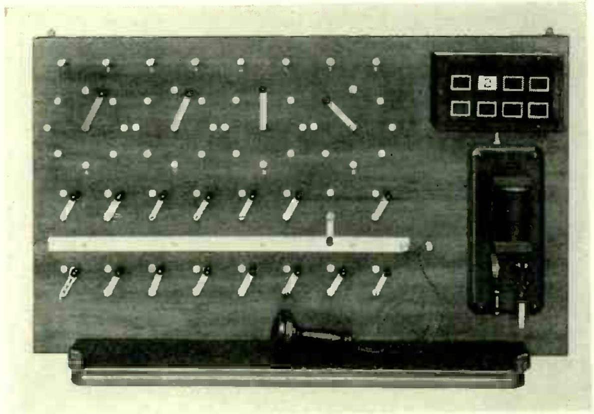


Fig. 1—The Coy switchboard was a simple and, compared to modern standards, crude affair

in groups of five, were trunks to other boards. Ringing was accomplished by the foot-driven magneto shown beneath the board.

The Gilliland board of 1880 was similar to the Post in operation but differed somewhat in construction. The type of "Law" switchboard of Figure 3 (1882) does not appear very efficient with its tangle of cords and pyramidal-shaped jack field, but the use of plugs, jacks, and cords was a step in advance.

In 1879 the Western Electric Company, then known as the Western Electric Manufacturing Company, entered the field with the "Universal" switchboard. Although still without a key-shelf, as we know it, this board was equipped with connecting cords and plugs, and—for the first time—a jack-knife switch for each line, arranged with contact springs that opened the shutter line-drop circuit upon insertion of the plug. Shortly after this time, the "Standard" type switchboard, shown in Figure 4, was put into service. Its design and general arrangement was indicative of the course manual-switchboard development was to follow. The board was arranged for growth, and there were the familiar line signals, jacks, clearing-out signals, and a key-shelf equipped with connecting cords, plugs and keys.

This type of switchboard served its purpose for a while until the demand for telephones grew and telephone service became so familiar to its users that the need grew for greater speed in making connections. It was met by the multiple magneto boards of 1882-84, which had capacities as high as 2,400 lines. The front arrangements of these boards are in-

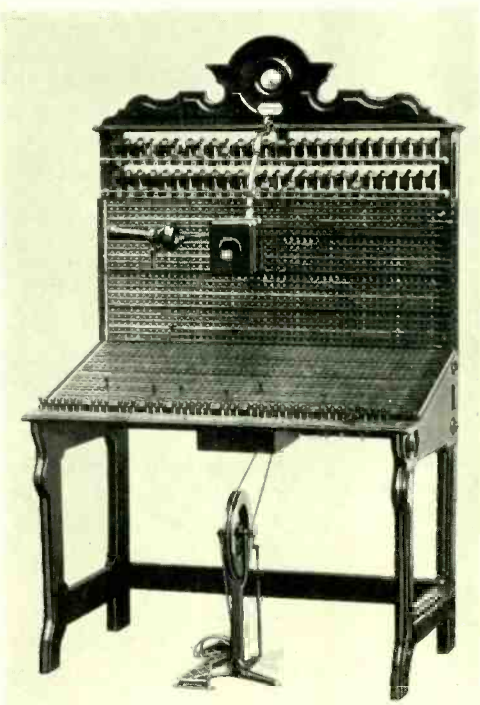


Fig. 2—The Post board, following the telegraph design, reflected the increasing use of the telephone by providing for a very high calling rate

dicative of the difficulties the designers had in finding satisfactory locations for the line signals, cords, and jacks. In the type shown in Figure 5 the line drops were placed near the keyshelf, and the plugs and cords in the roof above the multiple jacks. In the type shown at the head of this article the line drops were placed at both ends of the jack field, and plugs and cords on the keyshelf. The form shown in Figure 6 provided an extra shelf for the calling cords with the multiple jacks above, the line drops below, and the answering jacks and cords in the keyshelf. These difficulties were inherent in the use of manually restored magnetic signals which required considerable space and yet had to be within the reach of the operator.

Between 1884 and 1893, progress was rapid. Line circuits were made completely metallic, cord circuits were improved, and distributing frames and relay racks were introduced. Until about the end of this period local batteries were used at the subscriber sets, and line and supervisory signals were of the magnetic type. The following four years saw an intense development which ushered in the central battery both for talking and for signalling the operators. With it, the small incandescent lamp was developed, and both the repeating-coil and

Fig. 3—Plugs and connecting cords as they appear in the Law board of 1882

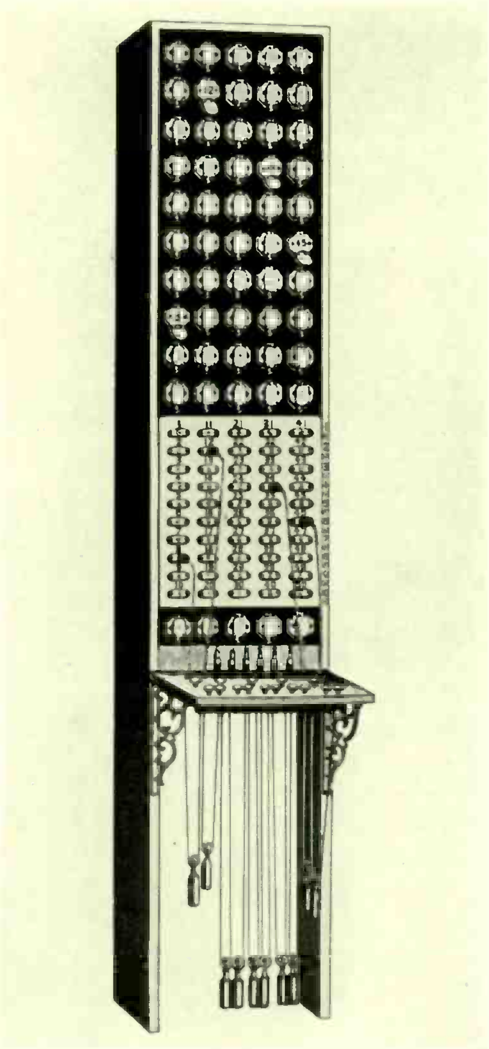


Fig. 4—The Standard board of 1881 *indicated the trend switchboard development was to take within the Bell System*

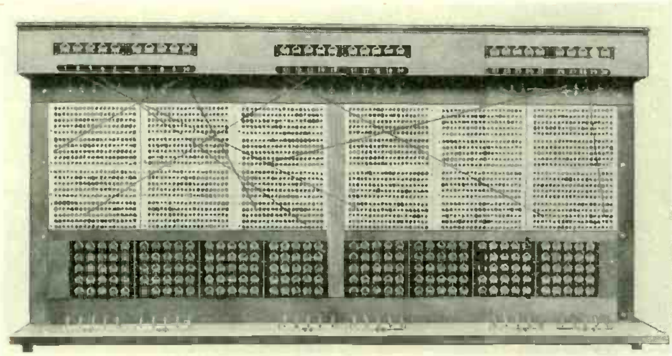


Fig. 5—One early type of multiple magneto board carried the cords and plugs in the roof above the multiple jacks

switchboards available to the Bell System about this time are listed in Figure 7. Comparatively few of the Nos. 2, 3, 4, 5, 6, 7, and 8 switchboards were installed and after 1906 their manufacture for new installations was discontinued.

The No. 1 switchboard has been used for over a quarter of a century and may be found in almost every city with more than 3,000 telephones, in both the United States and Canada. During the early part of the century the No. 49 jacks were the most popular, particularly in the south and southwest, but later the

bridged-impedance type of cord circuits were introduced. The use of lamps marked an important advance in the development of the common-battery multiple switchboard. This development, with the improvement of jacks, made it possible to place as many as 6,300 jacks of the No. 49 type within the reach of a single operator. As the demand for larger units grew, still smaller jacks—of the No. 92 type—and plugs were developed which permitted the use of subscribers' multiples of 10,400 jack capacity.

The first common-battery multiple switchboard employing the No. 92 jack was installed in 1901. Boards of this type, using both No. 49 and No. 92 jacks were known as the No. 1 subscribers' switchboard, as they are to this day. The multiple common - battery

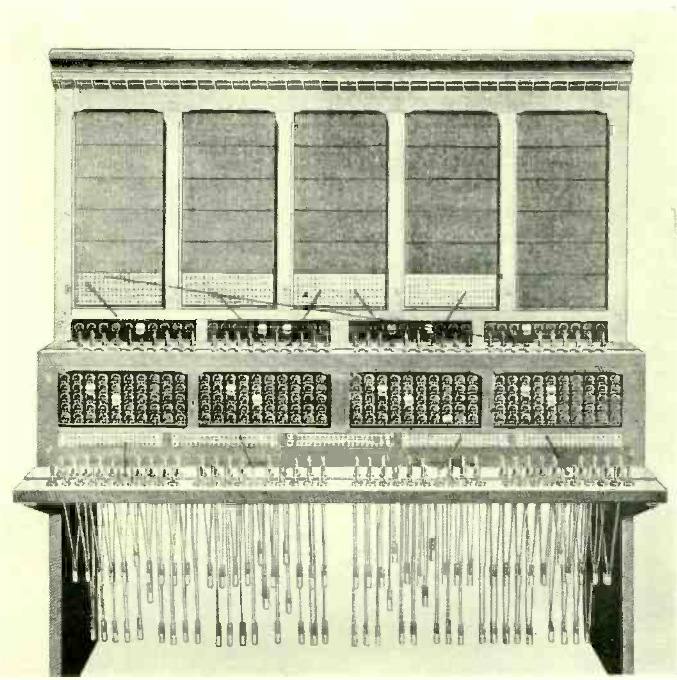


Fig. 6—Another early type of multiple board employed two keyshelves

Code Number	Line Signal	Supervisory Signal	Cross Connection	Positions per Sect.	Multiple Capacity	Remarks
1	Lamp	Lamp	IDF	3	10400	No. 92 Jack
1	Lamp	Lamp	IDF	3	6300	No. 49 Jack (High Type)
1	Lamp	Lamp	IDF	3	4900	No. 49 Jack (Low Type)
2	Lamp	Signal	IDF	3	3500	
3	Signal	Signal	Conn. Rack in Swbd.	2	1000	
4	Drop Signal	Drop Lamp	Conn. Rack in Swbd.	2	1000	Convertible Mag. to CB
5	Lamp	Lamp	IDF	2	2000	
6	Signal	Lamp	Conn. Rack in Swbd.	3	1200	
7	Signal	Signal	Conn. Rack in Swbd.	2	1000	
8	Lamp	Lamp	IDF	2	1500	
9-C	Signal	Signal	Conn. Rack in Swbd.	1	800	(38 Volt)
9-D	Signal	Signal	Conn. Rack in Swbd.	1	800	(24 Volt)
10	Lamp	Lamp	IDF	1	1600	

Fig. 7—Multiple common-battery switchboards in the Bell System in 1901

No. 92 jack was used almost exclusively. A typical up-to-date switchboard of this type is shown in Figure 8. Here it will be noticed that the subscriber's-line multiple has disappeared, its place being taken by an ever increasing outgoing-trunk multiple. With the increasing number of central offices in the larger cities, the number of calls which could be completed in the subscriber's multiple became so small that it was found advantageous to complete all calls over trunks. During the first decade of this century there were several different internal constructions for the No. 1 board but the differences were all eliminated in 1912.

For areas too small to be served economically by the No. 1 board, the Nos. 9 and 10 types were used. The 9-C board was arranged for 38-volt battery and was equipped with magnetic line signals. It originally had a capacity of 200 multiple jacks per panel. In 1927 this was increased to 300 jacks per panel which gave a total multiple capacity of 1200 lines. The 9-D board was practically the same as the 9-C except that it was arranged for a 24-volt battery but was not used for new installations after 1910. The No. 10 board differed from the other multiple common-battery boards in having the cut-off relay replaced by cut-off contacts in each jack. It remained standard till 1916 when it was superseded by the No. 1-D.

The novel feature of the No. 1-D board, which used No. 49 jacks and

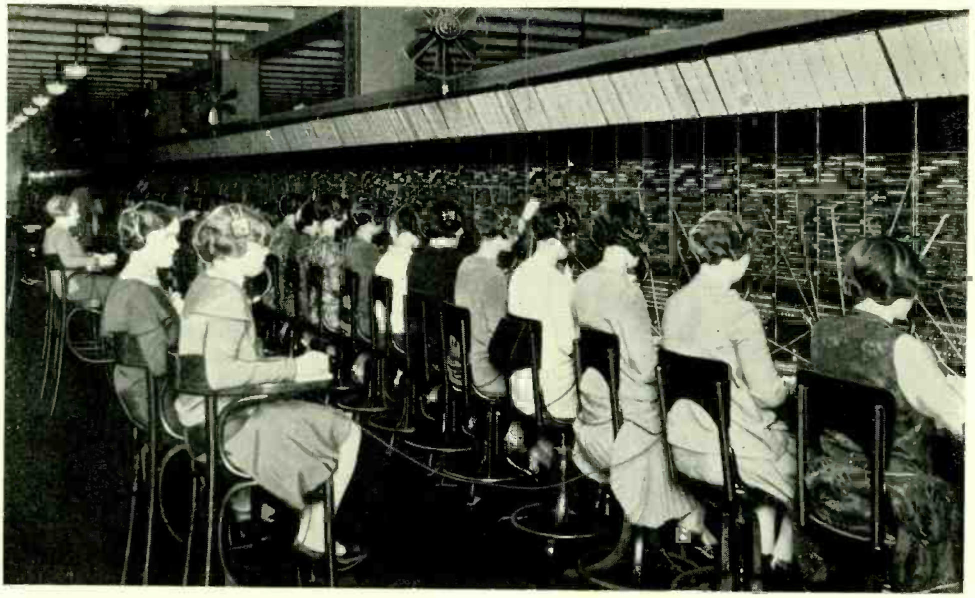


Fig. 8—A typical No. 1 subscribers' switchboard with No. 92 jacks but without subscribers' multiple

had a multiple capacity of 3,000 lines. was that the lower unit of the section—the part of the section up to and including the keyshelf and the rear equipment—could be removed from the line-up without disturbing the upper unit which housed the multiple and answering-jack equipment.

Another outgrowth of the No. 1 board was the No. 1-C, developed primarily for single-office areas. It is equipped with No. 92 jacks, machine-ringing cord circuits, and includes automatic-listening features.

When the use of the telephone grew to such an extent that more than one office was required in a community, the need arose for a separate trunk board. Three types were developed. First was a two-position five-panel board using No. 49 jacks and a multiple capacity of 5,000 lines. Then came a two-position six-panel board with No. 92 jacks and a multiple capacity of 9,600 lines. It was soon found, however, that with the introduction of machine-ringing trunks, the operator could handle more trunks than could be conveniently placed in the keyshelf. A two-position seven-panel board came into use, therefore, which had a multiple capacity of 10,500 lines. The first board of this type was installed about 1906 and this type is still one of our standards. The other two have found few applications since 1914.

There have also been developed during this period various private branch exchange switchboards, toll-boards, service observing boards, non-multiple magneto boards, and chief operator's test, information, and intercepting desks. As improvements and changes have been made to meet new requirements, the fundamental principle that every new board must operate with all others in the field has never been waived. Consequently our present standard boards will operate satisfactorily with any of the boards which are still in service.

Telegraph Ground-Potential Compensator

By H. H. SPENCER
Equipment Development

ONE of the essentials of giving satisfactory service over grounded telegraph systems is that the ground connections at all offices be at approximately equal potentials. Where unstable ground conditions are encountered, therefore, it is desirable to employ some means of correction. To accomplish this a ground potential compensator has been employed which automatically equalizes any differences of potential that may exist between the grounds at the two terminals.

Ground-potential differences that affect telegraph circuits are usually caused by extraneous direct-currents flowing in the earth, and are generally made more serious by the presence of high resistance strata in the path of the ground current. Where the extraneous current is large only a small ground resistance is required — probably only a fraction of an ohm — to cause quite a considerable difference in potential between points within the area in which the extraneous currents exist and points outside this area. One possible situation is indicated in Figure 1. At the distant telegraph station B, the ground potential is normal, and remains so up to some point C beyond the influence of the extraneous current. From C to station A, however, a potential difference occurs that raises or lowers the potential of the station ground by varying amounts, and as a result telegraph operation is badly handicapped and may be impossible.

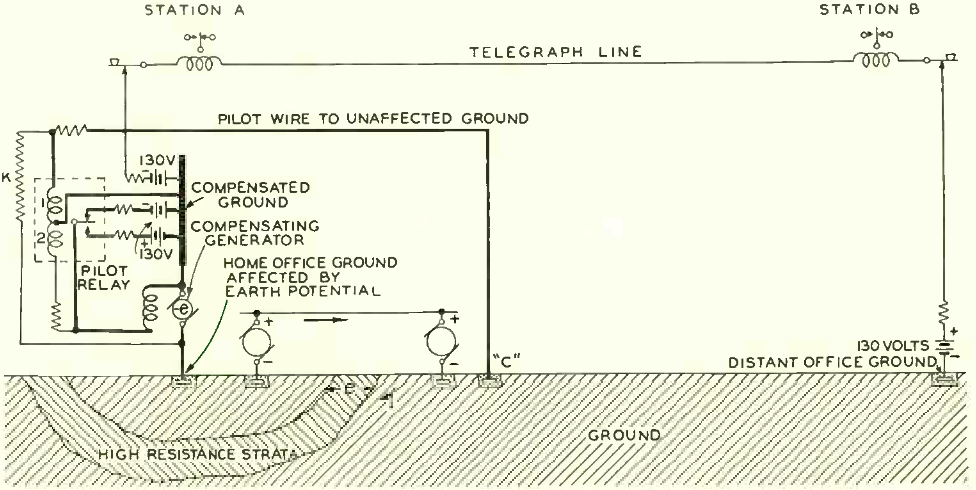


Fig. 1 — The ground-potential compensator acts to neutralize potential differences between grounds at different points brought about usually by the return from direct-current railway systems flowing over a high-resistance path

To neutralize this difference in potential a compensating generator is employed which has its armature in series between the station ground and a compensated ground bus. Associated with the generator is a pilot relay which controls the current in the field winding of the generator. The armature of the relay swings between two contacts each of which is connected to one of the telegraph batteries, one of which is negative and the other positive to the compensated ground. Current may thus flow through the field winding in either direction, depending on which contact is made by the pilot relay, and the generated voltage will accordingly be positive or negative with respect to the station ground.

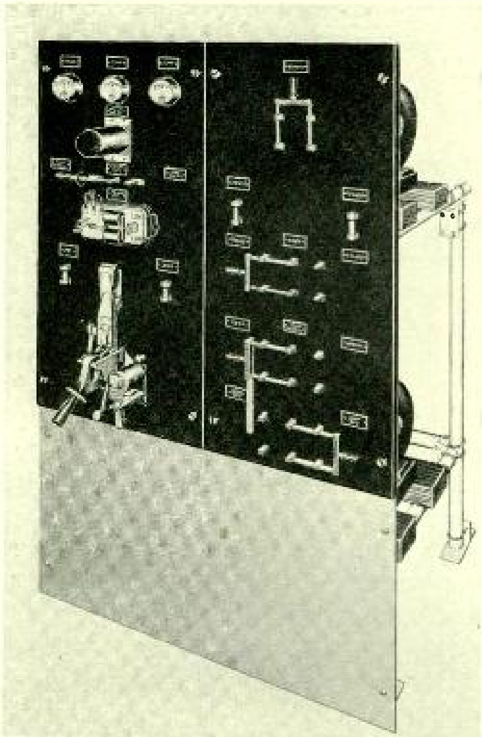


Fig. 2—The ground-potential compensating equipment, consisting of two generators and two control panels, is mounted as a self-contained unit

The pilot relay is controlled by current flowing from the compensated ground through winding No. 1 and over a pilot wire extending to a ground C sufficiently distant to be beyond the influence of the railway system and at practically the same potential as the ground at the distant office. With a difference in potential between the grounds at A and C, current will flow over the pilot wire and operate the relay in a direction to generate a potential in the compensating generator that opposes the potential difference between A and C, which may be designated *e*. Under the influence of the current in its field winding, the voltage of the compensating generator builds up, and as it becomes greater than *e* the current in the pilot wire reverses and the relay swings over to the other contact. This changes the direction of the field current and the generator voltage decreases. When it falls below *e* the pilot-wire current again reverses and the voltage against starts to build up.

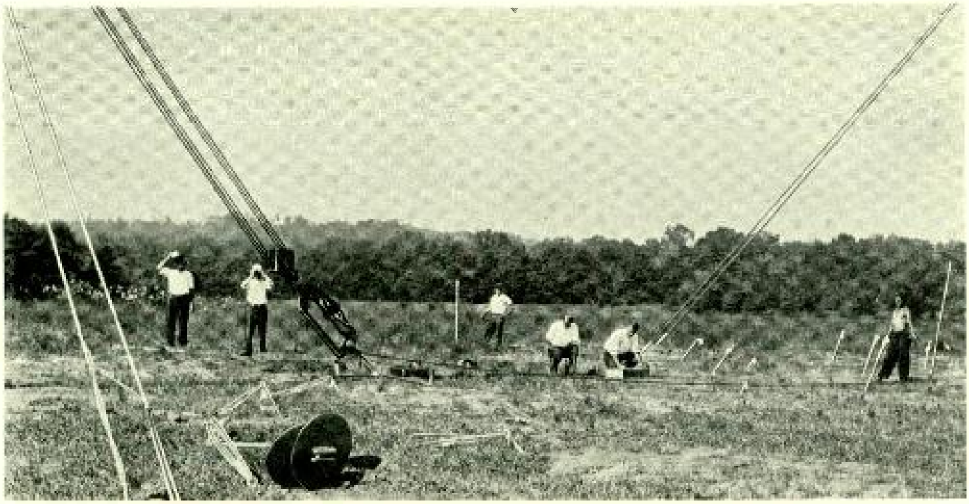
These alternate reversals of the pilot relay take place very rapidly—of the order of 100 or 200 cycles per second—so that the actual voltage of the compensated bus remains approximately constant at a potential equal to that of C. The constancy with which this voltage is maintained depends on the sensitiveness of the pilot relay which is made to respond to smaller differences of potential by the action of a second winding marked No. 2 on the diagram. This winding is connected between the armature of the pilot relay and the compensated ground, and is so poled that current flowing through it tends to move the armature away from whichever contact the relay armature rests upon. This vibrating circuit, as it is called, increases the frequency of the relay vibrations and thus tends to maintain a more constant potential on the compensated ground.

Winding 2 serves another purpose, however. Without it the relay armature, if the pilot wire should become open circuited through accident, would remain on one contact, and the generator would build up to its maximum potential in one direction, thus producing a voltage on the compensated bus which might differ considerably from that at C. This is prevented by winding 2 which keeps the relay vibrating even with the pilot wire open. To further assist this action and to keep the compensated bus at the potential of the station ground when the pilot wire is open, a resistance K is provided connected between the station ground and winding No. 1 of the relay. This resistance acts as a pilot wire between the station ground and the relay so that with the regular pilot wire open the compensated bus reverts to the potential of the station ground. The resistance of K is made sufficiently high to have little effect on the normal operation of the relay.

Certain other features, not indicated in the diagram, are incorporated to insure more satisfactory operation of the compensator. One of these is a resistance shunting the generator field to absorb the discharge when the field is opened so as not to burn the relay contacts. Another is a condenser bridged across the generator armature to smooth out any generator ripple which might interfere with telegraph operation. Still another is the provision of a second pilot wire which normally acts as an alarm circuit but may be used as a spare pilot where the regular one becomes inoperative. Both pilot wires run to grounds of the same potential but are carried over different routes so that a trouble condition will not be likely to affect both at the same time. Should the compensator fail to function, current flowing through the auxiliary pilot wire operates an audible alarm.

Equipment for the compensator has been designed as a self-contained unit shown in Figure 2. Two motor-generators are provided: one for regular operation from an outside power supply, and the other for emergency use from the telegraph battery. A circuit breaker is provided to protect the generator in case of excessive ground currents, which on opening closes a back contact that connects the compensated bus directly to the station ground. As a further protection, fuses are provided in each armature circuit. Three meters are mounted at the top of the relay panel: one to indicate the potential of the compensated bus, one to read current to ground, and the third to read current in the pilot wire. This last meter should read approximately zero under normal operating conditions. Directly below them is the pilot relay, of the 209FA type, mounted so that it may readily be replaced with a spare relay when necessary.

The equipment on this panel is completed by a switch to transfer the compensator to either of the pilot wires, an alarm relay, and the generator fuses. On the second panel are mounted the switches for putting the compensator into or out of service and for controlling the motor generators. The compensator unit has been designed to neutralize potentials as high as 115 volts which it is expected will care for all ground potentials encountered except in rare cases.



Testing Earth Anchors

By C. H. KLEIN
Outside Plant Development

POLE lines, because of the weight of the wires or cables they carry, are subject to severe loads which at times are considerably increased by the effects of ice and wind. The poles themselves are adequate to carry the vertical components of their loads, but to reduce the horizontal components to safe values, it is necessary to guy the poles at more or less regular intervals in the line. This is necessary particularly at the ends of the line or where the line changes direction. Guying is accomplished by a steel strand attached to the pole and secured at its lower end to a guy rod which carries underground some device offering resistance to its extraction. These ground-resistance devices are known as earth anchors, and since the Bell System adds to its plant several hundred thousands of them annually, their proper performance is a matter of considerable importance.

To determine the holding power of various types of earth anchors, a series of tests was recently conducted at Asbury Park by the Outside Plant Department of the Laboratories. Over one hundred anchors were tested in a loose soil consisting principally of sand and fine gravel. Four poles, to serve as points of attachment for the test anchors, were securely guyed to each other and to "dead men"—heavy logs buried deep in the ground. The arrangement is shown in Figure 1. The anchors to be tested were set about eight feet apart in three concentric circles around each pole. The circles had radii of eight, sixteen, and twenty-four feet so that there were three different angles for the pulls. Test anchors were so spaced around the poles that the reaction to the pulling stress was always divided between two of the permanent guys.

The pulling load was obtained from a winch mounted on a truck equipped

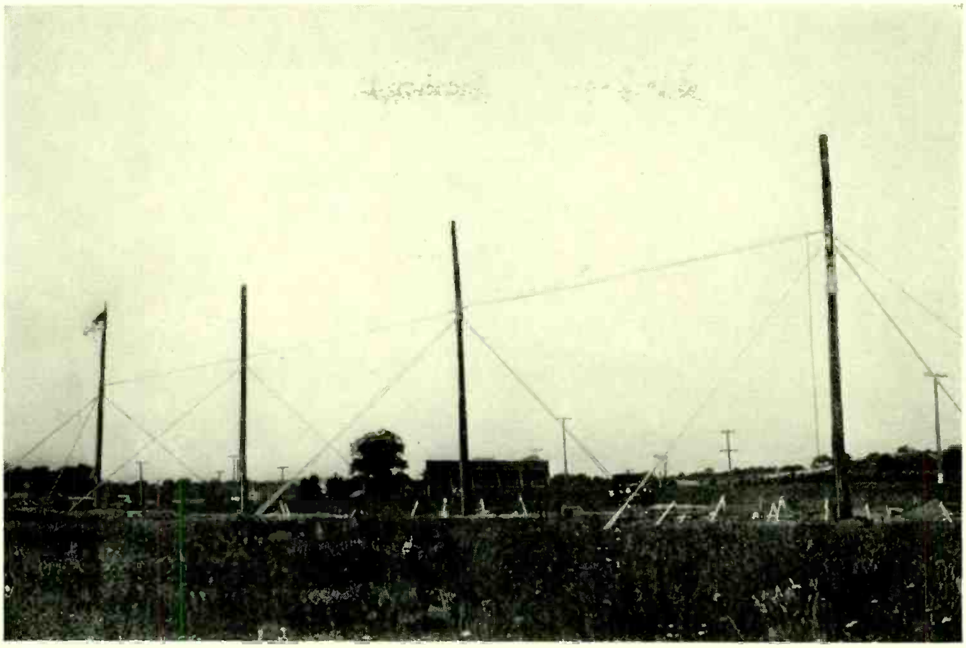


Fig. 1—*Anchors were tested by pulls applied to them through blocks attached to four poles guyed together and securely anchored to the ground*

Fig. 2—*The dynamometer linkage was fastened directly above the anchor rod*

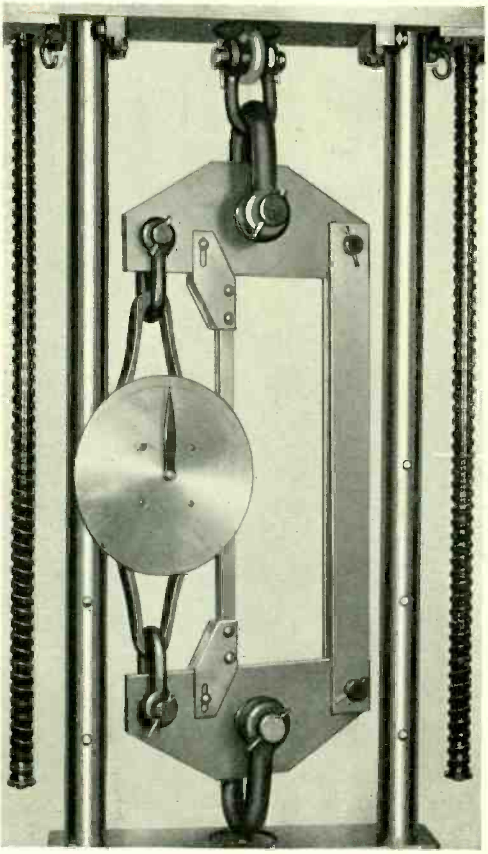


Fig. 3—A 25,000 lb. dynamometer was arranged with a link mechanism which allowed a constant of approximately 2 to be applied to the dynamometer reading to give the total pull

for setting poles. By means of suitable blocks the pull of the winch was multiplied eighteen times, thus applying over 50,000 lbs. to the anchor with a pull of 3000 lbs. at the winch. Loads were measured by a portable dynamometer which is shown, mounted in a testing machine preparatory to calibration, in Figure 3. The highest range dynamometer readily available registered only to 25,000 lbs. so that a linkage had to be designed applying only half of the load on the anchor to the dynamometer.

This was accomplished by the use of two cross pieces connected at one end by the dynamometer and at the other by two rigid bars. The load was transmitted to the cross pieces through shackle pins located just midway between the dynamometer attachments and the pins securing the rigid link. The central bar, evident in the photograph, is a floating member used to prevent damage to the dynamometer from rebounds which occur when the anchors or rods break under load. With this linkage the approximate total load was equal to the dynamometer reading multiplied by two, but calibration curves were used for determining the exact loads. The complete linkage together with the dyna-

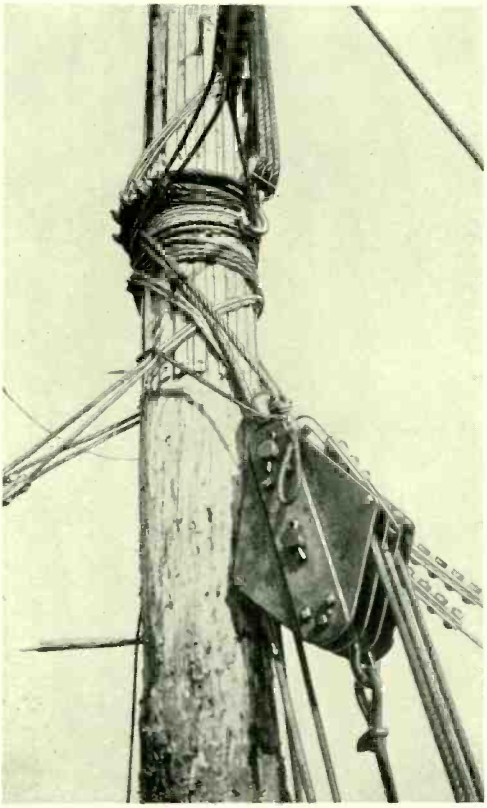


Fig. 4—Metal strips sheathed the pole where the various guys and pulling slings were attached

mometer weighed about 200 pounds.

To prevent the guys from cutting into the poles, metal strips were used as sheathing where the guys and pulling slings were attached. The rigging at the point of attachment to the pole is shown in Figure 4, and the position of the dynamometer, between the lower block and the end of the guy rod, in Figure 2.

The loads at which the anchors pulled out varied between 2,700 and 48,000 lbs. One of the anchors held to 49,000 lbs. without coming out. When being pulled out an anchor would frequently raise the ground for several feet around it as shown in Figure 5. Sometimes an anchor would pull out a cylindrical slug of earth, one of which is shown in Figure 6.

Since all anchors were to be tested

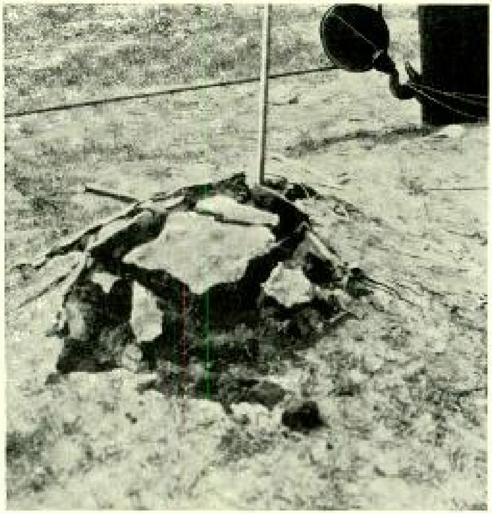


Fig. 5—A considerable section of ground would often be heaved up as the anchor was being pulled out

to 50,000 lbs. or to failure, through either pulling out of the ground, breaking of the anchor, or breaking of the guy rod, all men were kept at a safe distance during the procedure.

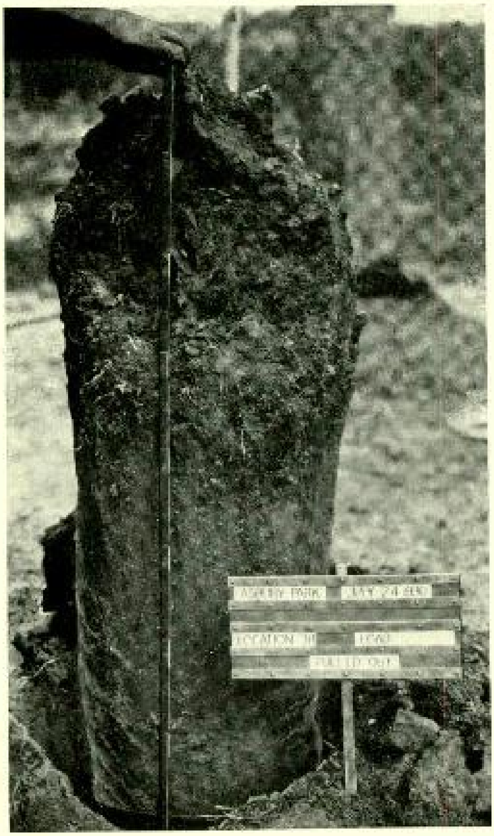
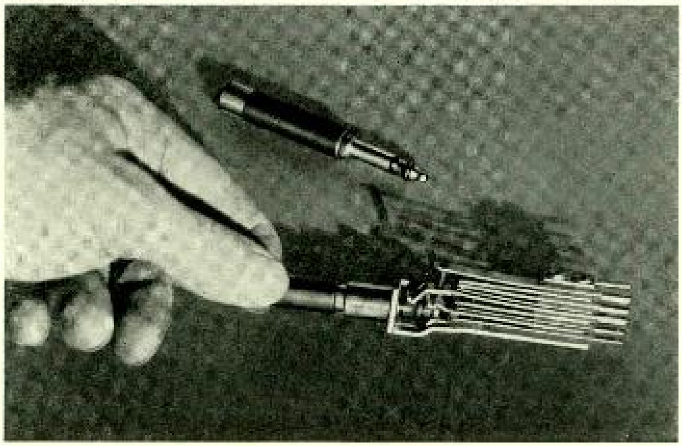


Fig. 6—Sometimes, in pulling out, the anchors would eject large cylinders of soil

The dynamometer was read by an observer using binoculars. A steel tape attached to the anchor was used to obtain the yield. Both the loads and the yields were called off at intervals and were recorded by a third man. Two hand lines were attached to the dynamometer linkage and snubbed at a distance by two workmen to prevent damage from the rebound on sudden failures. A sixth man—usually the line-gang foreman—watched for hazards in the entire field. As a result of the tests a large amount of information has been obtained which will guide the Bell System in its selection of anchors suitable to meet various plant conditions.



Telephone Jacks

By E. C. MUELLER
Telephone Apparatus Development

ALTHOUGH a relatively simple unit and one which has been in use almost since the beginning of the telephone, the switchboard jack has passed through a period of development scarcely less remarkable than some of the more intricate and involved pieces of telephone apparatus. When the first switchboard was put into service in New Haven more than a half century ago, the plug and jack were not used. Connection between subscribers was made by rotary arm switches which had found previous use in the early electrical industry of the time. For telephone purposes they were primitive affairs, consisting of an arm of metal pivoted from a central point and making contact with metal buttons which were screwed into the board. Four of these switches in all had to be used; two to make a connection between the lines, a third to connect the operator into the circuit and a fourth to signal the called subscriber.*

About a year after the New Haven installation a board designed specifically for telephone uses was brought out by the Western Electric Manufacturing Company, the predecessor of the present Western Electric Company. In this board, known as the "Universal" board, the rotary arms were supplanted by a new contrivance, invented by Charles E. Scribner, first chief engineer and later consulting engineer of the Western Electric Company. Known as the "jack-knife" switch from its appearance and operation, it provided connection by means of a plug inserted in the jack which was mounted in a horizontal position flat along the face of the board. The jack contained two holes for plugs, the one for the operator in building up the call, and the other for placing a connection across the jacks

See also Neill on Telephone Plugs, BELL LABORATORIES RECORD, *December,* 1927, *p.* 105.

of the calling and called subscriber. The insertion of the plug forced out of position a bladelike lever and broke the contact to ground. The lever in normal position was held by a spring in contact with the ground contact point insulated from the frame. The switch, the first of Mr. Scribner's many inventions in the telephone industry, derived its unusual name from its appearance and manner of operation, both roughly resembling a pocket jack knife.

About 1880 the "Universal" board was superseded by the "Standard" switchboard, also manufactured by the early Western Electric Company. A redesigned model of the board, which was first installed about 1882, employed a new type plug and jack devised by J. C. Warner in Chicago. The Warner jack differed from its predecessors in two essential particulars. It was of a cast frame and, secondly, its contact springs ran parallel with the sleeve instead of at right angles to it as was the case with the jack-knife switch. By this arrangement a great economy in space much needed in handling the constantly increasing number of lines was effected. The Warner jacks were singly mounted on the switchboard and still further conservation of space was brought about when the singly mounted jacks were supplanted by the present widely used strip jacks.

Cast-frame singly mounted jacks are still used in considerable quantity but have been largely replaced by jacks having frames punched from sheet steel. An early example is the "U" frame type shown in the middle group in Figure 3. This has been supplanted by an improved type, at the left, Figure 3, made into a frame having a right angle cross section which is

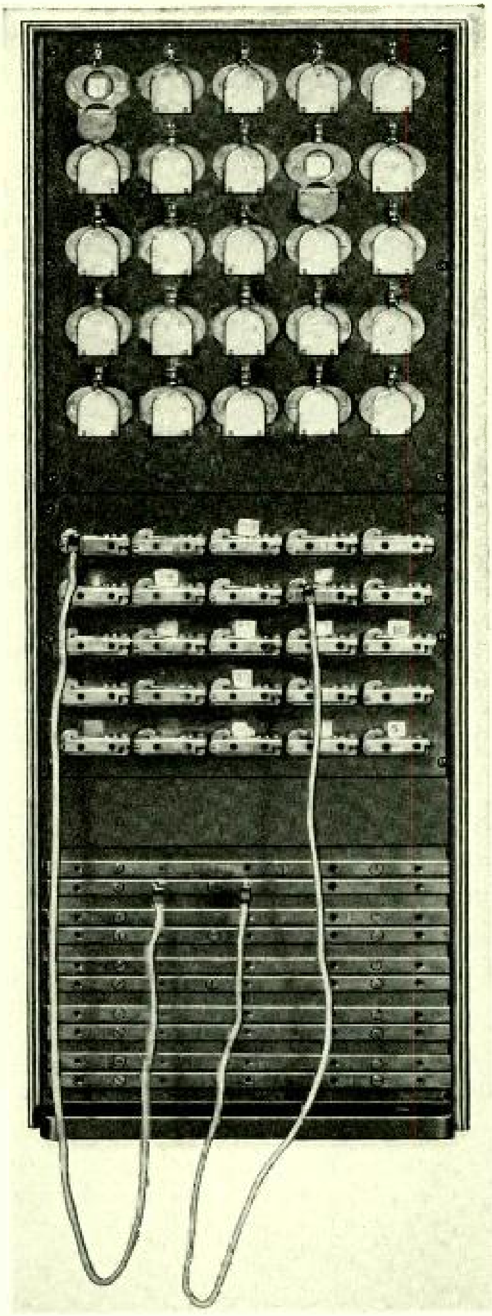


Fig. 1—The Scribner jack knife switch is shown mounted on a "Universal" board. In this type of switchboard, lines were tied together by two cords plugged into the jacks of the calling and called subscribers and interconnected at a metal strap, as shown on the photograph

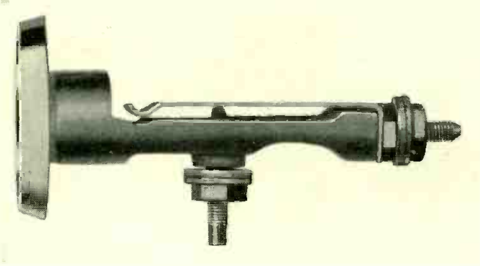


Fig. 2—The singly mounted cast-frame Warner jack. The spring extends parallel to the sleeve instead of at right angles to it as is the case with the earlier jack-knife switch shown in Figure 1

more rigid and better adapted to convenient mounting.

In the early types of switchboards only simple jacks having a sleeve and single spring making a contact with a single- or two-conductor plug were used. But with subsequent development of the telephone service it became necessary to make also available a jack having an additional spring making contact with the associated plug in order to take care of the three conductor multiple. In the single spring jack the spring came into contact with the tip of the plug and was termed the tip spring. When the second spring was added and devised to make contact with the contact ring of the three conductor plug it became known as the ring spring. These springs are usually designated as line springs.

As the development of jacks progressed additional springs, making contact with the line springs and known as cut-off springs, came into use. Jacks were also designed having additional springs entirely separate electrically from the line springs but actuated by them when the plugs are inserted. These springs are usually provided to take care of auxiliary local circuits and are known as local springs. These contact springs are insulated from each other and usually insulated from the sleeve. On both the springs and sleeve, terminals are provided for the soldering of wires. In cases where frequent changes of

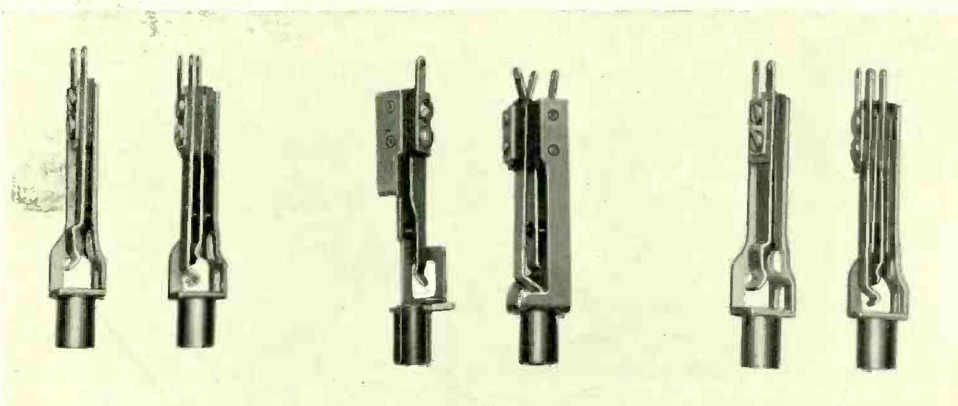


Fig. 3—Jacks punched from sheet metal succeeded cast-frame jacks. The third and fourth jacks are of the early "U" frame type, and part of the third is cut away to show the construction. An improved frame design, having a right angle instead of a "U" cross-section which gives a more rigid mounting, is embodied in the jacks shown at the left. At the right are shown jacks with cut-off springs which are associated with the line springs. The two previous types have line springs only

connections are necessary screw terminals are sometimes provided.

Contact metal particularly adapted for the purpose because of its corrosion resisting qualities is welded to the springs at contact points. The essential feature sought for in contact metal is reliability of contact which is of paramount importance in long distance calls where the connection is built up through a considerable number of jacks. A faulty contact at any one of these jacks would seriously disturb or interrupt the long distance conversation. Dust and dirt collecting on the contacts is also a possible source of trouble with this type of apparatus. As a safeguard the jacks wherever possible are mounted with the springs in a vertical plane to minimize the settling of dust and dirt on the contacts.

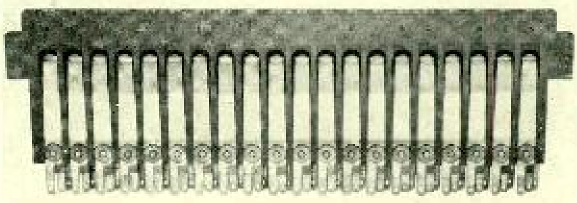


Fig. 5—The No. 49, used with a larger and sturdier plug than the No. 92 type, mounts on seven-sixteenths inch centers as compared to the three-eighths inch centers of the No. 92 jack

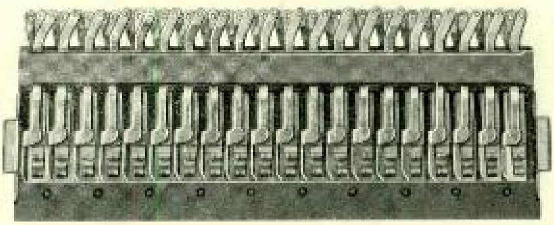


Fig. 4—The No. 92 jack, the smallest standard strip jack used by the Bell System. Twenty jacks are grouped in each strip

The above remarks are more or less confined to singly mounted jacks but the same principles apply to strip jacks. Strip jacks, having as many as twenty jacks grouped together in one strip or mounting, were a development resulting from the constantly pressing need of conserving space on the switchboards. The smallest standard strip jack used by the Bell System is the No. 92 (Figure 4) which is used with the No. 109 plug. This jack which was brought out in 1901 is mounted on three-eighths inch vertical and horizontal centers and enables one operator to reach as many as 10,000 lines. Being essentially a strip jack it is not complete without is associated mounting and requires the mounting parts to hold the tip spring, ring spring and sleeve, which are the essential parts of the jack, in their proper relation to each other. The combination consists of as many pairs of long flat contact springs as there are jacks in the mounting, clamped between insulating strips to a metal frame. One end of these springs is made in the form of a soldering terminal arranged for attaching wires and extends about three-quarters of an inch beyond the clamping point. The other end of the springs is so bent as to adapt it to contact with the tip and ring of the associated plug and at the same time hold the plug securely in place. These bent portions are known as the crimps and when a plug is inserted in the jack the springs are flexed between the crimp and the clamped portion. Directly in front of the ends of the springs the sleeves are held in the face strip which is made from insulating material and securely fastened to the frame. The sleeves of this jack are made from nickel silver and are similar in size and shape to the metal ferrule which holds the eraser in an ordinary lead pencil. A terminal or tang extends from the sleeve back through the point where the springs are clamped and is secured in the same pileup. This jack is used in greater quantities than any other type, as many as 16,000,000 having been made in one year. Within recent years the advent of the dialing systems has lessened the demand for this jack. Nevertheless present production reaches about 2,000,000 per year. This jack is largely used in manual exchanges where a great number of lines terminate and where traffic is heavy.

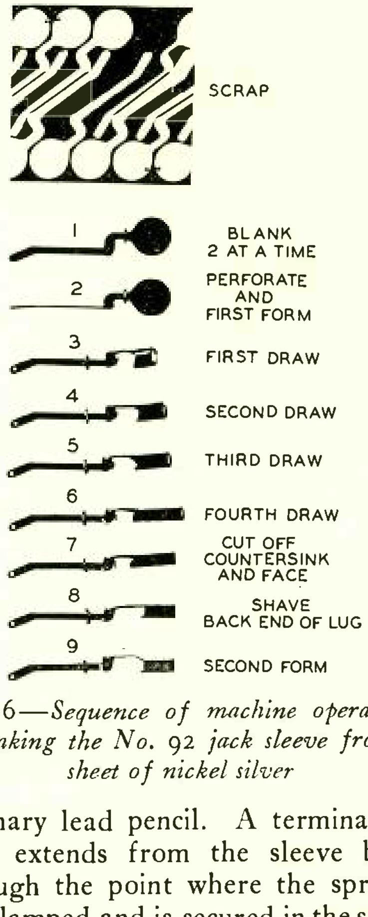


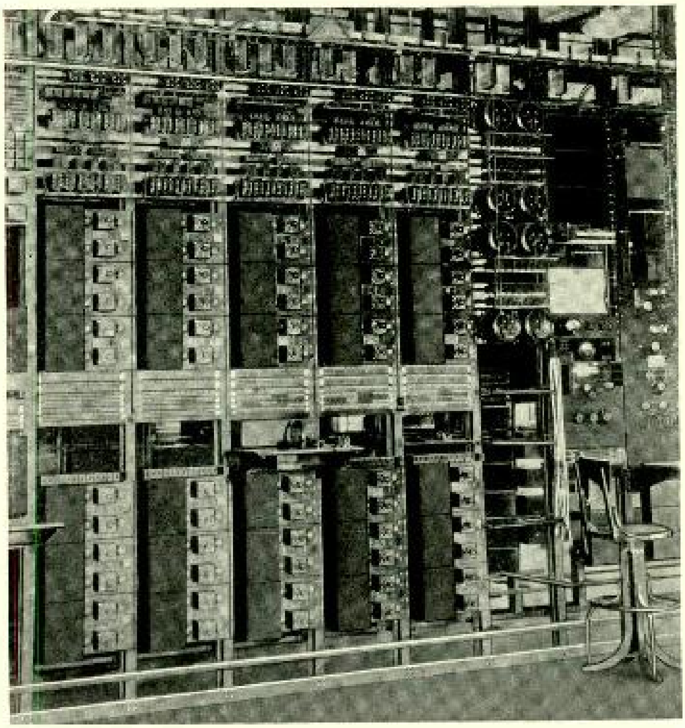
Fig. 6—Sequence of machine operations in making the No. 92 jack sleeve from a sheet of nickel silver

Next to the No. 92 type jack the strip jack most largely used by the Bell System is the No. 49 jack (Figure 5) brought out in 1897. This is also a two-spring jack but functions with a larger and sturdier plug (No. 110) and mounts on seven-sixteenths inch centers in a mounting made entirely from insulating material. This jack is used largely in toll and private branch exchange service as well as in other classes of switchboards where space is not so important a consideration. About 1,500,000 of these jacks are now manufactured per year.

While the No. 49 and No. 92 jacks are two-spring jacks there are some strip jacks used in considerable quantity which have auxiliary contact springs. Such are Nos. 141, 275, 295 and 308, used largely in smaller telephone exchanges, private branch exchanges and a few in toll service.

Perhaps the most interesting operations in the manufacture of No. 92 jacks are those for making the seamless sleeve or thimble and its terminal in one piece from a sheet of nickel silver. Nine machine operations are required to form it and make it ready for the mounting strip. Besides this there are various cleaning and inspection operations. The various steps of development are shown in Figure 6.

To the casual observer, jacks would appear to be a rather insignificant and simple piece of apparatus but in the manual switchboards they play a very essential part and on account of the severe service to which many of them are subjected and the varying conditions of wear of the jack and associated plug under which they must function, their design, the materials from which they are made and the requirements to which they must be held are very exacting and important.



Telephone Order Wires for Toll Circuit Maintenance

By W. V. K. LARGE
Toll Systems Development

TEST on long toll circuits may involve the employment of test board or repeater attendants, not only at the two terminals of the circuit under test but also at one or more intermediate points. In order that these tests may be completed in the shortest possible time it is necessary that the men so engaged on any particular group of circuits have a means of readily communicating with each other. Spare telegraph circuits were the facilities first used for this purpose. Later, certain telegraph circuits were reserved for this use and were designated telegraph order wires. Not all plant employees, however, are telegraph operators and so, with the great increase in the number of intermediate stations, the need for other facilities to replace the telegraph order wire became apparent. For many purposes a telephone circuit is the most convenient.

The provision of a telephone circuit for this service does not present any particular difficulties, at least at the terminal stations, but the design of an adequate signalling circuit for use with this telephone circuit is a somewhat more complex problem. The attendants in the larger toll terminal rooms are usually organized for specific functions and a plant group in one office will usually require the cooperation of certain plant groups in other offices. It is no longer practical in present-day toll-terminal rooms to pass all calls to the test-boardman requesting the cooperation of a particular plant group. A signalling system, therefore, to be of real value must make it possible, not only to select one of many operating stations, but also to pass a direct signal to any one of several position-groups in each station. To provide the desired flexibility it must also be possible for each position-group to call any other position-group in the same or any other office. In general the telephone order wire may be considered to be a multiparty line serving an unusually large number of subscribers and equipped with a signalling system of such selectivity that the impulses released by the calling subscriber will operate an audible and visual signal at the called party's station and at other stations on the system no signal other than lamps which flash during the process of signalling.

In a survey of existing signalling systems which might be applicable to this service, consideration was given to the train dispatching system that had been developed in the Laboratories some time before. In a few cases where immediate relief was required, installations using this equipment were made by the Long Lines Department and some of the Associate Companies. This system was designed however to fulfill a set of conditions which were considerably different from those governing the choice of equipment for telephone order-wire service. For train dispatching operation it is necessary that the controlling office be able to call any one station or selected groups of stations, but there is seldom any need for a signal to originate in any except the control office, and calling equipment is very seldom located at any other place. In addition the equipment designed for this railroad service is special and not of a type or arrangement found in telephone terminal rooms so that for maintenance reasons and because of its large space requirements, its employment is not desirable.

Development work was started, therefore, upon a signalling circuit to meet the particular requirements of telephone order-wire service. The schematic circuit of Figure 1 shows in abbreviated form the arrangement developed for sending and receiving signals. The talking circuit is not shown; the jacks however indicate its appearance at each position-group. Any commercial telegraph circuit provides a suitable channel for this signalling service. Operation is set up on a closed circuit basis, line relay L in each office normally remaining operated. Impulses may be impressed on the circuit by the operation of a push-button key CK at any one of the position-groups in any office. These impulses, if correctly punched out in accordance with a predetermined code, will produce a signal at the station called. The code is arranged on a two-digit basis, the first digit selecting the particular office desired, the second the position-group in that office. The code required to light line lamp LL at position-group 1 of office A, for example, is 5-1. The code required to light any line lamp is determined by the arrangement of the M and LU leads on the 200 type selector.

The detailed operation of the circuit is as follows: Let us assume that a call, originating at some office B is impressed on the circuit to operate the line lamp at position-group 2 in office A. The calling code is 5-2. The person calling will operate his push-button key five times, pause, and after an interval operate it two times. The first pulse on the circuit causes the line relay L to release which results in the operation of relay BD and the advancement of the selector brushes by the operation of the stepping magnet to the first contact. Succeeding pulses produce a similar effect with the exception that relay BD, which is of a slow-release type, remains operated until the pause at the end of the first five pulses. Relay BD then releases and supplies 24-volt battery through its contacts to the selector brush which is now resting on contact 5. This operation occurs simultaneously in all offices connected to this particular signal circuit. Only in office A, however—the called office in this case—is the M lead connected to contact 5, so that the battery supply operates the CM relay in office A alone. Relay CM locks up through its own contacts and connects ground, through an off-normal contact on the selector, to the operating winding of all LU relays in office A.

At the same time that relay BD releases, another relay, which has been omitted from the sketch for sake of simplicity, operates in each office as a pulsing relay and flashes all line lamps in that office. This serves both as an indication to the calling party that he may send the pulses for the second digit, and as a busy signal at all lamp appearances.

During the reception of the pulses representing the second digit, in this case 2, relay BD operates on the first pulse and remains operated until the completion of the last, and the selector brush advances to contact 7. Relay BD again releases and battery

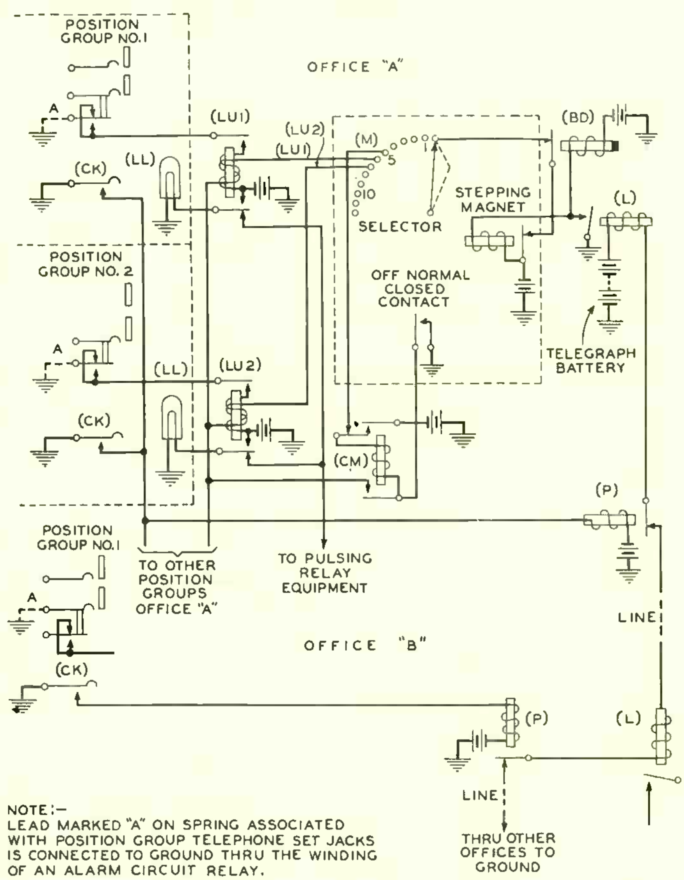


Fig. 1—Simplified circuit diagram of signalling system omitting certain relays and equipment used for group calling and other purposes

is again supplied through its contacts to the selector brush and thence through lead LU2 to relay LU2 which operates and lights line lamp LL at position group 2. Relay LU2 locks up on a second winding under control of contacts on one of the two jacks used with the order wire for this position group. As relay BD releases the second time, the pulsing relay mentioned above is again started. These pulses, generated in each office, flash the line lamps in that office with the exception of the line lamp in the position circuit which was called. Here the lamp burns steadily. At the same time these pulses operate the stepping magnet and automatically restore the selector to its initial position, thus placing the circuit in condition to receive the next call.

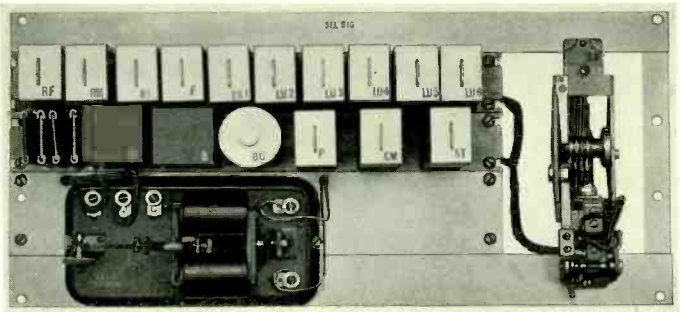


Fig. 2—Panel for signalling equipment. Line relay L is below at the left and the selector at the right. Relays RF, RM, RI, F, and ST are not shown on the diagram

At the called station, position group 2 of station A, the line lamp remains lighted until the telephone circuit plug is inserted in the telephone jacks. This operation momentarily opens the contacts associated with the jacks which permits relay LU2 to release and extinguish the line lamp. The double contact arrangement makes it possible to receive a signal even though the plug happens to be left in the jack

In addition to its use for making calls to an individual station, this circuit permits the calling of various groups of stations. The first digit for group calls is 1, a number which is reserved for this type of call; all individual calls use digit 2 or higher digits for the first set of pulses. The second digit which may be any number from 2 to 19 will then complete the signal to any one of the pre-arranged groups.

An operator, desiring to abandon a call after having completed the first digit or having sent the first digit incorrectly, may restore the circuit to normal by sending one or two digits of 10 pulses depending on the position of the selector at the time of abandonment.

The position-group equipment, which may be located in toll test boards, transmission test boards, or repeater line-ups, consists of the telephone-set jacks, a lamp, and a push-button key. The office equipment, consisting of selector, relays, and miscellaneous resistances and condensers, is arranged on a 9"x 19" panel designed for relay rack mounting as shown in Figure 2. The equipment mounted on the panel will care for six position-groups and should the office require more than this number the installation of six additional LU relays on a separate mounting plate will increase the capacity to 12 position-groups. A typical order wire arrangement provides position-group equipment at the transmission test board, the repeater line, and the toll test board in each of eight offices, a total of 24 position-group equipments. This by no means represents the maximum number possible, however, as provision is made, when the six additional relays are added, for serving a total of 174 position-groups in 21 offices, and 21 group calls.

The telephone circuit over which the conversations take place requires no particularly new features. The circuit used may be any voice-frequency line circuit which connects the offices using the above signalling system. At the two terminals of the line the operators connect to the pair by means of suitable telephone sets while at intermediate points the operators' telephone sets at transmission test boards may be connected to the monitoring windings of the repeaters with which the line is equipped.

Wired and Wireless

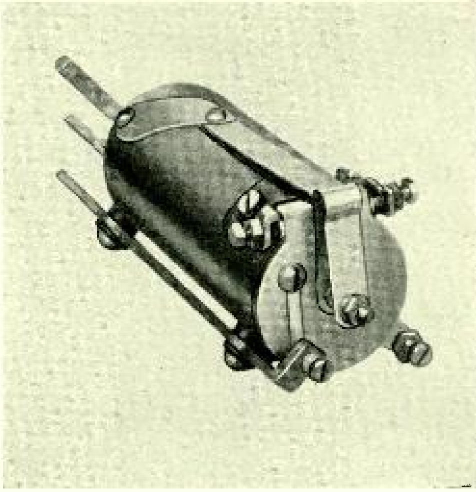
"It is to the telephone, not to radio, that we owe the development of the equipment whereby speech and music are made available for broadcasting.

"More than this, it is the telephone wire, not radio, which carries programs the length and breadth of the country. John Smith, in San Francisco, listens of a Sunday afternoon to the New York Philharmonic Orchestra playing in Carnegie Hall. For 3200 miles the telephone wire carries the program so faithfully that scarcely an overtone is lost; for perhaps fifteen miles it travels by radio to enter John Smith's house. And then he marvels at the wonders of radio!

"But what of programs from overseas? Here, indeed, wireless telephony steps in, but not broadcasting in the ordinary sense. The program from London is telephoned across the Atlantic by radio, but on frequencies entirely outside of the broadcast band. . . .

"Broadcasting, then, is the child of the telephone; in America it is certainly the child of the American Telephone and Telegraph Company. The whole structure of commercial chain broadcasting as we know it today has grown out of the pioneer work done prior to 1926. . . . Telephony has largely created the mechanism of broadcasting."

—from "Broadcasting: a New Industry" by H. A. Bellows, Harvard Alumni Bulletin, Dec. 18, 1930.



Maintenance of Tripping Relays

By D. O. JONES
Local Systems Development

IN the manual telephone system several methods have been used for ringing subscribers. In all the earlier ones the duration of ringing was controlled by the operator, but with a method now employed the operator need only insert a plug into the line wanted, or at most momentarily depress a key; the rest is done automatically. This automatic control of ringing, called "machine ringing," is used as well in all forms of the dial system. When the subscriber answers, ringing is stopped by the operation of a tripping relay. The tripping relay shown in the headpiece to this article is thus an important link in the completion of a call and its adjustment and maintenance become matters of considerable importance.

The function of the tripping relay may be understood from Figure 1, a typical manual arrangement, which represents diagrammatically the circuit associated with an operator's cord, and a subscriber's set. Most of the equipment not concerned with tripping the ringing current has been left out. By a closure of the circuit at "X", a ground is placed (through the back contacts of the tripping relay designated TR, and of another relay "B") on one end of the winding of relay "A" which operates. This closes a path for the ringing current through the winding of the tripping relay to the subscriber's line.

The tripping relay must remain unoperated while the subscriber's bell is being rung, and must be operated by the greater current that flows when the subscriber lifts his receiver from the hook. The relatively low impedance of the transmitter allows more current to flow than does the higher impedance combination of ringer and condenser. When the tripping relay operates, the winding of the "B" relay is placed in series with that of the "A". Relay "B" operates as a result and holds itself operated through a front contact. In so doing, however, it releases relay "A", since with "B" operated both ends of the winding of "A" are at the same potential. The release of "A" disconnects ringing current and connects the called line through for talking.

For any one connection to a subscriber's line there is a considerable difference between the amount of current flowing through the tripping relay before and after the receiver is lifted. It might seem, therefore, a simple matter to adjust the tripping relay to remain unoperated while the receiver is on the hook and to operate when it is lifted. When the variation in ringing voltage, in impedance of subsets, and in lengths of line with which the tripping relay may be connected, are taken into account, however, this is not an easy accomplishment. The tripping relay must act properly under the most unfavorable conditions. It must not operate on ringing with the highest possible voltage and lowest overall impedance, and must operate, when the receiver is lifted, with the lowest ringing voltage and highest overall impedance.

To make sure that the relay meets these requirements, it is tested by inserting non-inductive resistances in series with its winding and applying known voltages to it; different resistances, of course, are used to check

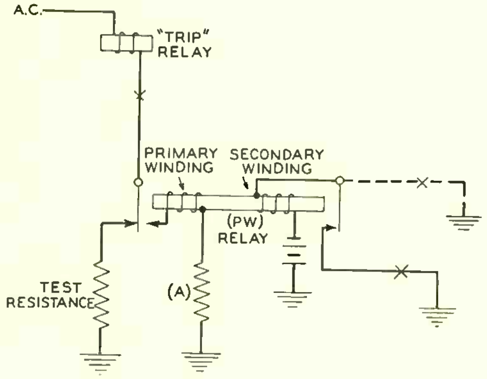


Fig. 2—With the scheme shown here relay PW releases and applies the test to the tripping relay at a definite point on the wave depending on the value of the direct current in the secondary winding

the operate and non-operate performance. The resistances selected are of such a value that when held to a variation of plus or minus one per cent, they will be approximately equivalent to the limiting conditions imposed on the relay by the subscriber's line with its subset ringers, and condensers.

This method of test is open to certain objections because with alternating-current ringing, the instantaneous current that flows when the test resistance is inserted depends on the point of the alternating current wave at which the circuit is closed. Around the core of the tripping relay is a copper sleeve in which a current is induced when the current in the relay winding is changing in value. This induced

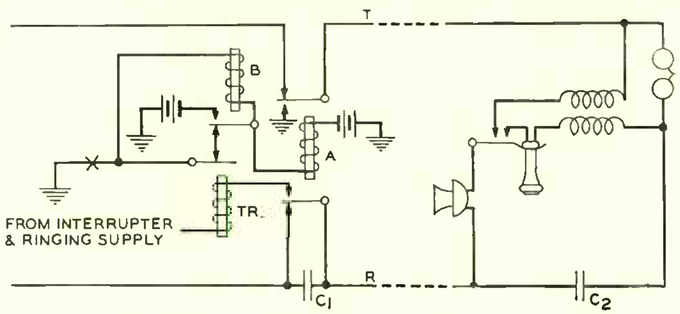


Fig. 1—The part played by the tripping relay can be seen in this simple schematic of a typical manual circuit from which has been omitted most of the equipment not required to trip ringing

current is in a direction that opposes the effect of the current in the winding and its value depends on the rate at which the current in the winding of the relay is changing.

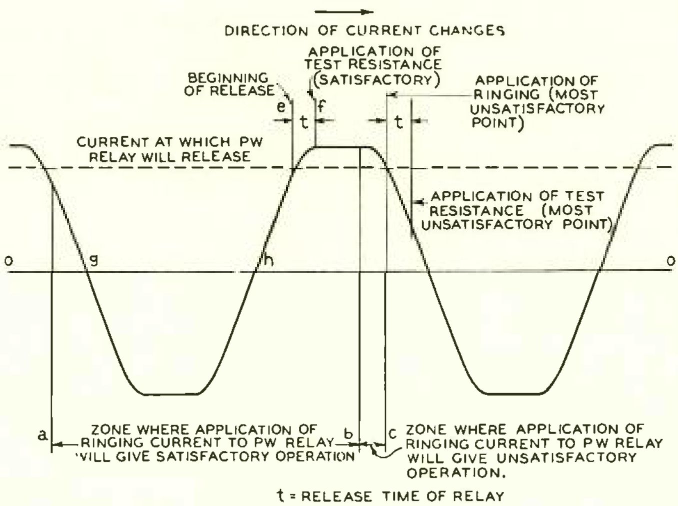


Fig. 3—Conditions for alternating current ringing. Consistent action of the test circuit depends on whether the ringing current is applied to the PW relay on the increasing or decreasing side of the wave

If the test is applied to the relay at the instant that the alternating current wave is passing through zero, a minimum opposing current will be induced in the sleeve because the current in the winding will build up slowly—following the sine wave. If the test is applied when the current is at its maximum value, however, the increase in the current in the winding will occur at a very high rate, and a correspondingly high opposing current will be induced in the sleeve which will partially offset the effect of the current in the winding. Laboratory tests have indicated that if .065 ampere (rms alternating current) is sufficient to operate a certain relay in the former case, .100 ampere is required in the latter.

Although alternating-current ringing was the earliest form used, most of the ringing today is done by a combination of direct and alternating current: the alternating current is superimposed on a direct current which may be either negative or positive and any of several values, depending on the type of ringing system.

When a combination of alternating and direct current is used the conditions are not so severe as with alternating current alone. The direct current component makes the tripping relay less dependent on the point of the wave at which the test is applied because even though the test is applied when the alternating current wave is zero, the direct current component is sufficient to cause a fairly rapid rate of change in current and

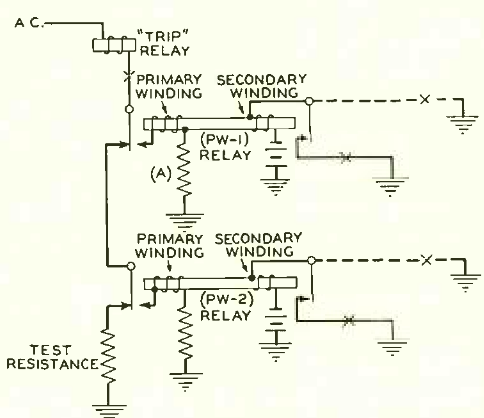


Fig. 4—The use of two relays insures that the test is always applied at a particular point of the wave

hence more nearly the same opposing effect in the copper sleeve. Ringing currents with direct components of sufficient magnitude thus tend to make the tripping relay independent of the point of the wave at which the test is applied.

How effective the direct current is in making the action of the tripping relay independent of the point of the wave at which the test resistance is applied depends on the relative magnitudes of the direct and alternating current components. With ac-dc ringing used in the manual system and in the dial system of the panel type, the direct-current component is relatively small so that although the particular point of the wave at which the test is applied is of less importance it cannot be entirely disregarded.

A method of test insuring that current is always applied to the tripping relay at a particular point of the wave would be satisfactory for any of the three ringing systems, but it would be much better than necessary for ringing currents with a large direct-current component. To obtain as economical an employment of equipment as possible, therefore, three testing methods are in use. For "superimposed" ringing, where the direct component is large with respect to the alternating component, satisfactory maintenance of the tripping relay does not require that the current be applied at a particular point of the wave. For straight alternating-current ringing a somewhat elaborate scheme is needed to make sure that the test current is always applied at a particular point of the wave. For ac-dc ringing, where the direct-current component is small, some attention is required not to apply the test current at an unfavorable point of the wave but there is not needed quite as elaborate a system as used for straight alternating-current ringing.

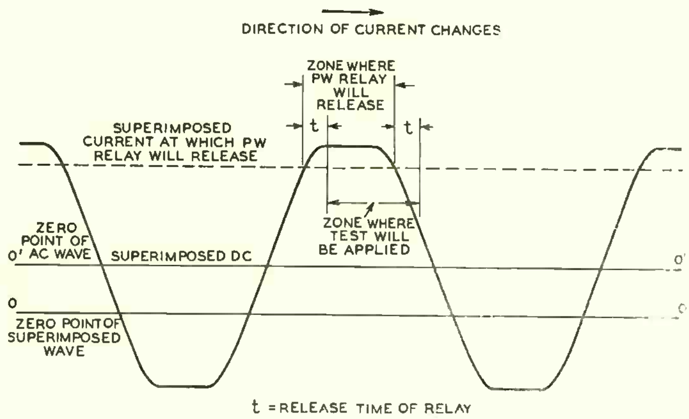


Fig. 5—Conditions for superimposed ringing. A direct current component in the ringing makes the action of the tripping relay less dependent on the point of the wave at which the test is applied

The system employed to apply the test for ac-dc ringing uses a two winding relay as shown in Figure 2. Relay PW is held operated by direct current through its secondary winding. To start the test the connection (X), between the tripping and the PW relays, is closed and a low value of ringing current, controlled by resistance "A", begins to flow. If the direction of the ringing current is such as to assist the effect of the current in the secondary winding, the relay will remain operated until the succeeding half cycle. It will release on this cycle when the ringing current has reached a value that counteracts the effect of the current in the secondary winding sufficiently to allow the relay to release. An instant later, allowing the necessary time for the armature to move to its back contact, the test resistance will be connected into the trip relay circuit.

The objection to this system for straight alternating-current ringing is that the ringing current may be applied to the PW relay during the half cycle when its effect opposes that of the direct current in the secondary winding but when the instantaneous current is decreasing in value. Under this condition the armature may release and by the time it reaches the back contact the current will have decreased to too low a value to apply a proper test. The actual point chosen for the application of the test is near the peak of the wave because the ringing current wave usually has a flat-top characteristic which maintains a constant value long enough for the armature to make connection to the test resistance if the PW relay starts to release on the increasing side of the wave.

This situation is illustrated in Figure 3. If the ringing current is connected to the PW relay at any part of the wave from "a" to "e", the relay will not start to release till "e" is reached, and the test will be applied at "f", when the current is at its peak value. Connected anywhere from "e" to "b", relay PW would at once start to release, and the value at the application of test would still be approximately the peak value. If, however, ringing were connected between "b" and "c" the application of the test would not occur at peak value, and in the worst case would not be applied till the current was very nearly zero.

To avoid this possibility a two-relay scheme, shown in Figure 4, was devised for alternating-current ringing. The two relays are similar in winding and action except for the half cycle of current upon which they are poled to release; both must be released to apply the test resistance to the tripping relay. The function of the first relay is to insure that the ringing current is applied to the second relay during the half cycle preceding the one upon which it releases. The first relay releases during the half cycle from "g" to "h" of Figure 3 so that the second relay will always start to release at point "e".

With ac-dc ringing the two-relay test is not necessary because even though ringing current is applied to the PW relay at point C of Figure 3 there would still be enough current flowing, due to the direct-current component, to give a satisfactory test. The situation is shown in Figure 5. It is necessary only to pole the PW relay of Figure 2 so that it releases on the half of the cycle when the alternating and direct-current components are assisting each other.

Trial installations in central offices using both ac and ac-dc ringing have proved the success of this "particular part of wave" method in its two forms. As a result it has been the standard practice for several years. That many of the difficulties of maintaining the tripping relays under the older method (using a non-inductive resistance and applying the test at any part of the wave) have been overcome is borne out by the more consistent action of the tripping relays since the new test has been in use.

NEWS AND PICTURES

of the

MONTH

Officers of Bell Laboratories Club for 1931
D. D. Haggerty, Secretary-Treasurer; L. S. O'Roark, President; L. P. Bartheld, First Vice-President; Miss Mary Brainard, Second Vice-President

General News Notes

Radio Telephone Service to Bermuda Planned

American tourists in Bermuda will be no further out of hailing distance from their homes than the nearest telephone, according to plans announced for the establishment of short-wave radio telephone service to the islands. Application has been made by the A. T. & T. Co. to the Federal Radio Commission for permission to construct short-wave stations at Lawrenceville and Netcong and arrangements have been concluded with the Imperial & International Communications, Ltd., working in conjunction with the Bermuda Telephone Company, to handle the service in Bermuda.

The plans call for the construction of a transmitting station adjacent to the short-wave transmitters now used at Lawrenceville in services to Europe and South America. The transmitter will have a power of about 500 watts and will be associated with two directive antenna arrays. The design of the transmitter is now being carried on in the Laboratories by K. L. King, B. G. Griffith and R. W. Friis under the direction of N. F. Schlaack, who is handling the electrical details, and M. E. Fultz, in charge of mechanical arrangements. The design of the antennas is being undertaken by F. F. Merriam assisted by N. J. Pierce.

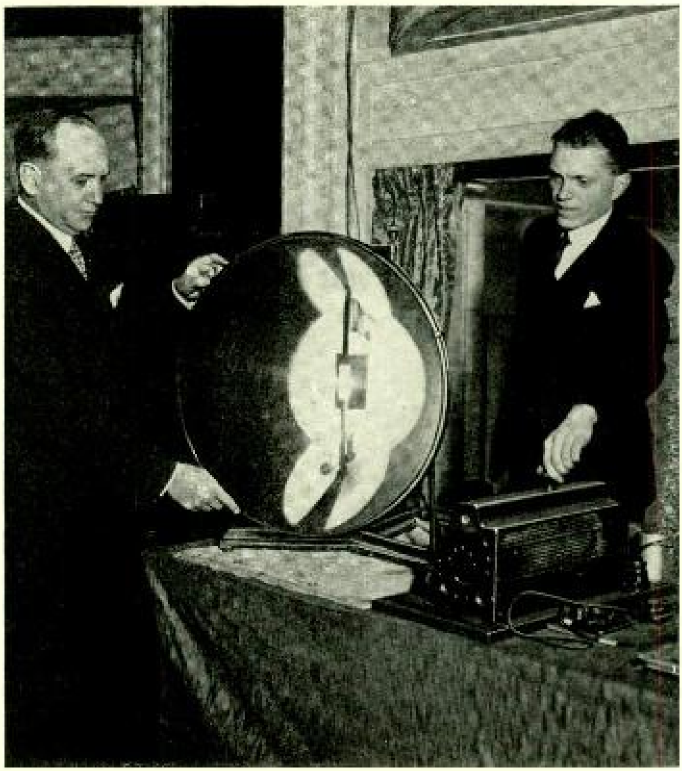
The receiving station, to be situated at Netcong on the site of the European and South American receiving stations, will be designed for automatic volume control, and will have directive antenna characteristics similar to the present receivers. The receiver, which was designed by D. M. Black and C. H. Swannack, is at present being constructed in the Laboratories for the Western Electric Company. The design of the antenna, handled by E. J. Howard, has been approved and will be constructed by the Long Lines Department, who will also build the transmitting antenna. The work on the receivers is being carried on under the direction of F. A. Polkinghorn.

Exhibits from Laboratories in Cleveland Display

The Laboratories exhibit, centered about the quartz crystal clock and the rapid-record oscillograph, elicited much comment at the meeting of the American Association for the Advancement of Science at Cleveland early in the month. In addition, photographs of typical quartz crystals and methods of cutting as well as views of the minor apparatus of the oscillograph were on display as part of the general research exhibit held in conjunction with the Cleveland meeting.

The quartz crystal clock was described by W. A. Marrison in a paper delivered before the National Academy of Sciences last April. It provides high precision measurement of time and time interval by means of crystal-controlled oscillations and was cited by *Science* as among the outstanding advances in physical sciences for 1930.

The rapid record oscillograph, a modification of the string oscillograph utilizing the light-valve, permits almost immediate examination of the oscillogram after exposure. The characteristics of voice or musical instrument, the operation of a relay, phase distortions in transmission networks, or other circuit manifestations, may be recorded and within a few seconds inspected. Delay or suspension of the work while awaiting, as in former instances, the development of the oscillogram negative is thus obviated. At the exhibit, individual voice oscillograms were given as souvenirs. A. C. Melhose and J. H. Bollman were in charge.



"The Singing Flame" demonstrated by S. P. Grace and R. M. Pease

A Television Tea

The first Television Tea in social history was held on January 7 simultaneously at the Laboratories and Telephone Headquarters at 195 Broadway. Appropriately, the guests were members of the Engineering Woman's Club, some forty of whom were present at each place. One by one, they were called from the tea-table to the television booth. Since the conversations had all the privacy of a telephone call, it could not be learned whether the talk was of slide rules and cosines, or whether it was merely on such subjects as women usually discuss at afternoon functions.

Mrs. Frank B. Jewett was hostess at the downtown gathering, and Mrs. Harry P. Charlesworth was hostess at the Laboratories.

Laboratories Represented at Popular Science Award

At the presentation of the *Popular Science Monthly* award to Dr. G. R. Minot and Dr. G. H. Whipple, which took place at the University Club on December 18, these members of the Laboratories were in attendance: C. J. Davisson, K. K. Darrow, John Mills, P. Norton, and P. B. Findley. Dr. Jewett, who was chairman of the Committee of Award, had been scheduled to make the presentation address but was unable to attend.

The award was conferred upon Drs. Whipple and Minot in recognition of the discovery of a positive cure for pernicious anaemia. Dr. Whipple, who is dean and professor of pathology at the School of Medicine and Dentistry in the University of Rochester, discovered the principles of the cure and Dr. Minot, professor of medicine at Harvard University Medical School, perfected its application to sufferers from the disease. The award, which consists of $10,000, is presented this year for the first time.

R. W. King Here on Visit

R. W. King of the London office of the A. T. & T. Co. and Bell Telephone Laboratories arrived January 12 on the *S.S. Volendam* for a visit in this country. Dr. King, former editor of the *Bell System Technical Journal,* has been in London since 1928.

ADMINISTRATION

H. P. Charlesworth has been re-appointed a member of the A. I. E. E. Committee on the Engineering Profession. He was also chairman of the committee in charge of the 1931 winter convention held January 26-30.

H. D. Arnold has returned from the Pacific Coast, where he addressed A. I. E. E. sections at Spokane, Seattle, San Francisco and Los Angeles and the Universities of Oregon, Washington, California and Southern California as well as State Colleges of Oregon and Washington and Leland Stanford University.

Twenty years earlier a trip through the same territory emphasized to John J. Carty the importance of telephonic communication between the Coast and New York. As a result, attention was centered on the development, by further research, of a telephone repeater suitable for operation on long loaded lines. A small group of scientists was selected, among them H. D. Arnold, who had just completed the academic work for his doctorate. That group of scientists was the nucleus of our present Research Department and Dr. Arnold eventually became its head. During his twenty years of service he has seen the vacuum tube—whose development for commercial service was his earliest problem—become a basic element in telephony, with some 200,000 in use in the Bell System.

S. P. Grace was in Portland, Maine, January 8 and spoke before 3,500 persons in the Municipal Auditorium. On the following day Mr. Grace and R. M. Pease were speakers at the Rotary Club luncheon.

COLLOQUIUM

Authorities in physics from European universities addressed the Colloquium on December 15 and January 5. At the December meeting Professor R. Ladenburg of the University of Berlin and of the Kaiser Wilhelm Institut spoke on *Dispersion of Light and Atomic Processes.*

On January 5 Professor G. Hevesy of the University of Freiburg delivered a talk on *Electrical Conduction and Diffusion in Non-Metallic Solids.* Professor Hevesy is celebrated for his important investigations in the field covered by his talk. He is noted in addition for brilliant research work carried out in cooperation with Dr. Coster at Bohr's Laboratory in Copenhagen which led to the discovery of the element hafnium. Professor Hevesy at the present time is filling the George F. Baker non-resident lectureship at Cornell University.

Departmental News

Systems Development

Manual Equipment

A visit to the Leeds & Northrup Company in Philadelphia was made by A. J. Wier and A. J. Pascarella to discuss improvements in the precision Wheatstone-bridge equipment for toll test-boards.

A. D. Knowlton visited Bryn Mawr to examine equipment in connection with studies of the No. 1 switchboard.

Power Development

C. W. Van Duyne attended an inspection conference of power equipment at the General Electric factory in Fort Wayne, Indiana. He also visited the factory at Lynn in order to supervise tests of improved-tone equipment.

V. T. Callahan was in East Pittsburgh to investigate the Westinghouse Company's gasoline engine-driven generators. He was accompanied by F. B. Woodworth of the Radio Development group.

J. H. Sole visited Boston on work connected with improved voltage regulators installed in the Long Lines Office in that city.

Dial Equipment

G. K. Smith discussed with the Manufacturing Department at Hawthorne the proposed arrangement whereby condensers are to be mounted directly on the step-by-step selectors instead of on the rear of the selector shelf framework.

New developments affecting dial "A" switchboards have recently required C. H. Achenbach's attention at Hawthorne.

A trip to Stamford, Conn., to inspect local and toll step-by-step equipment was made by H. L. Bostater and W. McA. Smith.

H. L. Bostater completed twenty-five years in the service of the Western Electric Company and the Laboratories on January 8. Graduating from the Ohio State University in 1904, he worked with the Central Union Telephone Company in Columbus, Ohio, and the National Cash Register and then entered the employ of the Western Electric Company, Clinton Street, Chicago, on equipment engineering work.

H. L. Bostater

When the work at Clinton Street was moved to Hawthorne in 1907, Mr. Bostater was supervisor of equipment engineering on small central-office switchboards. At Hawthorne, he worked on analyzation and standardization of central-office circuits.

Transferred to New York in 1912, Mr. Bostater was assigned to the circuit laboratory, and was later with the group on the development of semi-mechanical systems. Upon the completion of this work he was engaged for several years on dial PBX development and from 1918 to 1921 was in charge of circuit work in connection with the introduction of the step-by-step system which had its first Bell System installation in Norfolk, Virginia.

In 1922 he was assigned to telephone systems engineering engaged on fundamental development studies. He became a member of Equipment Development in 1928, where he has since specialized on price studies of central office equipment.

Local Central Office

C. E. Germanton, in Boston, assisted in the tests of new circuits for providing multiple registrations on a timing and zoning basis in panel central offices.

Operation tests of the call announcer system by means of which calls from the new East 13th Street panel tandem office in New York City are to be completed to distant manual points in New Jersey were conducted by R. C. Kraft, at Asbury Park, and by J. W. Brubaker, at Ramsey.

W. M. Stuart, a member of the Analysis and Testing group, completed the twenty-fifth year of his association with the Bell System on January 19.

In Philadelphia, Mr. Stuart entered the service of the Bell Telephone Company of Pennsylvania and worked as a subscriber's-station installer and later as an inspector of this work. He was transferred to inspection work on PBX installation, and before coming to the Western Electric Company in this building, he was special inspector for the entire city of Philadelphia.

Mr. Stuart came to the Engineering Department of the Western Electric Company in 1915 and was assigned to the old circuit laboratory.


W. M. Stuart

His early years with the Bell System in Philadelphia admirably fitted him for his work on subscriber's station circuits on which he has been chiefly engaged while with the Western Electric Company and the present Bell Telephone Laboratories. He has had a prominent part in the work of adapting subscriber's station apparatus to the dial system of operation.

Carrier and Repeater Development

Accompanied by A. B. Clark and S. B. Wright of the American Telephone and Telegraph Company, C. W. Green visited several repeater stations between Richmond, Va., and Greenville, S. C., to inspect equipment installed at these stations for use on the field trial of 4,000-mile four-wire cable circuits which is to begin shortly.

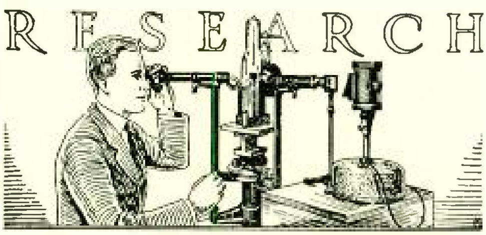
He extended his journey southward to inspect the carrier-telephone terminal equipment which has been installed at Key West on the new Key West-Havana cable. Standard CS-4 carrier telephone equipment modified to take care of the high attenuation of the submarine cable is employed at both terminals of the cable.

A. W. GREER was in Charlotte, N. C., to place in operation a laboratory model of the 10-A transmission measuring set which will be used during the field trial of the 4,000-mile four-wire cable circuit.

TELEGRAPH DEVELOPMENT

J. H. BELL lectured before the Pittsfield, Mass., section of the A. I. E. E. on December 16. His subject was *Telegraphy, a New Art with an Old Name.*

J. CATTOGGE completed twenty years of service in the Bell System on January 13.



TRANSMISSION INSTRUMENTS

TO DISCUSS questions regarding transmission-instrument development, W. C. Jones was at Hawthorne for several days.

H. A. LARLEE was also at Hawthorne on matters in connection with handsets and operator's transmitters. With C. Brotherton of Graybar and F. C. Hogan of Western Electric, he visited the Signal Corps Laboratories at Ft. Monmouth to inspect and discuss their equipment for testing telephone apparatus.

CHEMICAL RESEARCH

A GENERAL chemical conference between the representatives of the Western Electric Company at Hawthorne and the Laboratories, held at Hawthorne, was attended by the following members of the Chemical Research Department: R. R. Williams, A. R. Kemp, R. M. Burns, J. E. Harris, J. M. Finch, H. E. Haring, G. T. Kohman, R. L. Peek, C. S. Fuller, L. T. Smith, S. O. Morgan, R. E. Waterman, H. Lathrop, L. A. Wooten and W. S. Bishop.

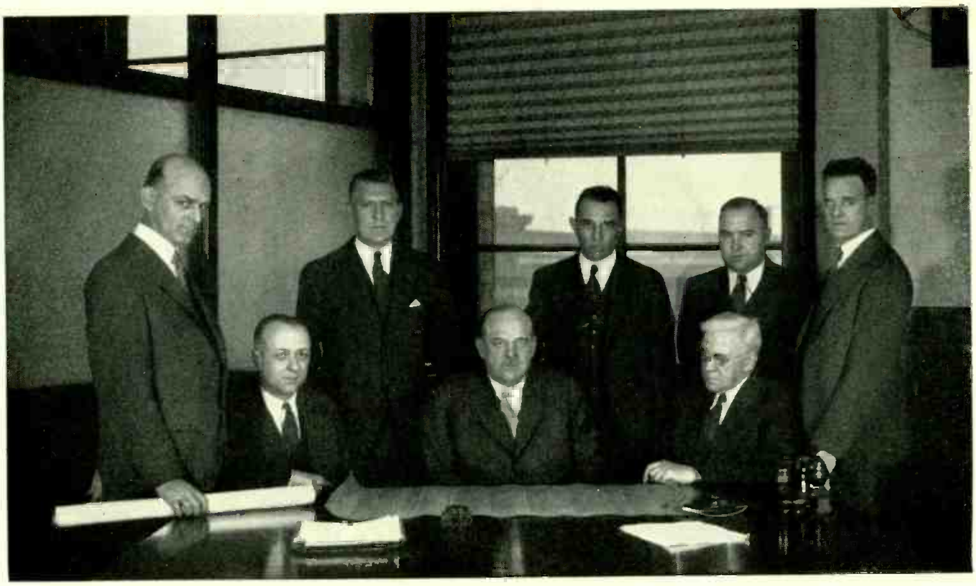
ON HIS RETURN from Hawthorne G. T. Kohman stopped off at Ann Arbor to confer with Professor Bartell on the method and apparatus for measuring adhesion tension developed in his laboratories. Later, with R. L. Peek and D. A. McLean, Mr. Kohman visited the New Jersey Zinc Company at Palmerton, N. J., to observe the application of this method.

L. A. WOOTEN and J. D. STRUTHERS visited Hawthorne in connection with lead-calcium analysis.

AT CHICAGO, E. E. Schumacher conferred with representatives of the Illinois Bell Telephone Company on cable problems. Following this conference, Mr. Schumacher accompanied J. E. Harris to Collinsville, Illinois, where an inspection was made of the National Lead Company's smelter.

ELECTRO-OPTICAL RESEARCH

A. R. OLPIN gave a talk before the American Physical Society in Cleveland, December 30, on *Correlating Selective Photoelectric Effect with the Selective Transmission of Electrons Through a Cathode Surface.* He also read a paper on *Formation of Photographic Images on Cathodes of Photoelectric Cells* written in collabora-



J. W. Upton, head of the new Plant Shops Department with the title of Plant Shops Manager, and members of his staff. D. P. Barry, Assistant Plant Shops Manager, is seated at Mr. Upton's right, and G. F. Atwood, Consultant, at his left. Standing, H. H. Wooden, Superintendent, Building Shop; W. G. Knox, Superintendent, Finish Shop; A. H. Sass, Superintendent, Development Shop; C. W. Brown, A. J. Parsons, Production Engineers. Through changes effective January 1, the Development and Building Shops were merged into one department known as Plant Shops

tion with G. R. Stilwell. H. E. Ives, C. J. Davisson, K. K. Darrow and J. A. Becker also attended the meeting, held as part of the convention program of the American Association for the Advancement of Science.

EARLY IN DECEMBER H. E. Ives attended a meeting of the Federal Radio Commission at Washington which was called to consider outstanding problems in television.

TRANSMISSION RESEARCH

A TRIP to Tuxedo Park was made by R. C. Mathes, W. A. Marrison, J. H. Bollman, G. Hecht and W. L. Bond for the purpose of installing equipment for comparing the accuracy of the crystal-controlled clock with a group of Shortt astronomical clocks at the A. L. Loomis Laboratory.

ACOUSTICAL RESEARCH

AT THE MEETING of the Acoustical Society of America at Hollywood, December 12 and 13, papers were presented by Harvey Fletcher, R. L. Wegel and L. J. Sivian. Dr. Fletcher also gave a talk, *Some Physical Principles of Speech and Music,* at the Physical Society meeting in Cleveland.

While in California Dr. Fletcher attended the Pacific zone annual conference of the American Federation of Organizations for the Hard of Hearing at Santa Barbara.

RADIO AND VACUUM TUBE

N. F. SCHLAACK and B. G. GRIFFITH spent several days at the transatlantic radio station at Lawrenceville to test a new type of radio tube.

Submarine Cable

J. B. Johnson read a paper, *The Cathode Ray Oscillograph,* before the Franklin Institute at Philadelphia. F. S. Goucher, R. M. Bozorth, H. W. Weinhart, C. J. Davisson and J. B. Flanagan attended the meeting.

G. W. Elmen addressed the Neighborhood Club of Leonia on developments in magnetic materials.

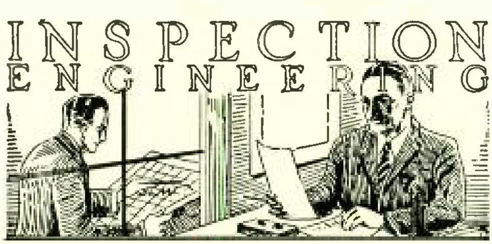
PUBLICATION

Typical methods employed in attacking research and development projects in the telephone industry were described by Paul B. Findley in an address before the senior class of Syracuse University. Following the talk he was the guest of Dean Raper at luncheon in the Faculty Club.

A. N. Holden delivered a talk, *Telephone Exemplification of Elementary Physics,* before the New York State Science Teachers' Association at its convention in Syracuse.

PATENT

During the period from December 4, 1930, to January 5, 1931, members of the Patent Department visited the following cities in connection with the prosecution of patents: Atlantic City, H. F. Beck; Washington, H. A. Flammer and J. G. Roberts. Mr. Roberts also visited Philadelphia.



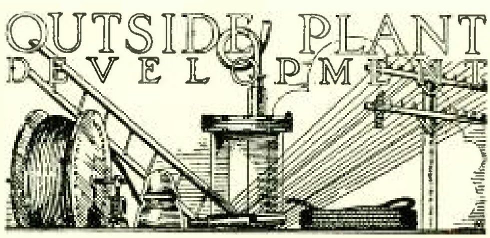
W. A. Shewhart presented two papers before the American Statistical Association at its meeting held in Cleveland during the latter part of December. Dr. Shewhart's papers were *Statistical Methods from an Engineering Viewpoint* and *Application of Statistics in Engineering.*

E. G. D. Paterson and W. H. Stracener spent several days at the Point Breeze plant of the Western Electric Company to attend a quality survey on cable terminals.

In connection with a quality survey on step-by-step equipment, R. O. Hagenbuck was at Hawthorne for several days.

J. H. Shepard, Field Engineer at Atlanta, visited the recently completed toll installation at Charlotte, North Carolina. He also made an investigation of intercepting board circuits at Jacksonville, Florida.

L. E. Gaige visited Evansville, Indiana, and H. K. Farrar visited Rochester, New York, in connection with circuit investigations.



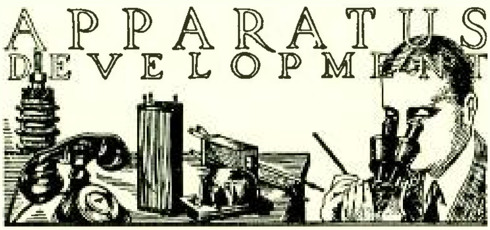
D. A. Quarles and C. S. Gordon were at the Simplex Wire and Cable Company's plant, Boston, to discuss the specification for new rubber-insulated wire to be manufactured by that company. Mr. Gordon also visited Pittsburgh, in regard to drop-wire conductor, and Baltimore, in connection with the manufacture of rubber-insulated wire.

V. B. Pike observed field tests on gas-pressure contactors at New Haven.

A visit to the Point Breeze plant was made by I. C. Shafer, Jr., in connection with the manufacture of drop wire.

Questions connected with the manufacture of manila rope required D. T. Sharpe's presence in Auburn, New York, and Plymouth and New Bedford, Massachusetts.

R. P. Ashbaugh of Outside Plant development, who is stationed at Hawthorne in charge of current engineering, completed twenty years of service on January 3.



Special Products

The Society of Motion Picture Engineers announce the appointment of O. M. Glunt and T. E. Shea as members of the Papers Committee of the society. Mr. Glunt has been named chairman of the committee. Mr. Shea also has been re-elected manager of the New York Section of the society.

R. A. Miller and C. H. Rumpel were in charge of the demonstration of the automatic noise-level recorder conducted for the New York newspapers at the E. R. P. I. offices on Fifty-seventh Street. This instrument is the one proposed for use in measuring noise levels in the New York City subways.

H. C. Curl was at the Newport News Shipbuilding and Dry Dock Company to inspect the general announcing system installed on the *U. S. S. Augusta*.

Radio Development

J. C. Herber inspected and adjusted the 50-kw radio telephone broadcasting equipment owned by the Voice of St. Louis at St. Louis and similar equipment of the Crosley Radio Corporation, Cincinnati.

Surveys for the installation of 400-watt radio telephone equipments for the Police Departments of Pittsburgh, Pa., and Rochester, New York. were made by H. E. J. Smith.

Captain A. R. Brooks and R. J. Zilch were in Hartford to supervise the overhauling of the motors of the Laboratories' Ford airplane at the Pratt and Whitney plant.

J. F. Morrison conducted a field intensity survey for the Consolidated Gas, Electric Light and Power Company, Baltimore.

B. R. Cole visited Cleveland to survey the proposed location for a 1-kw radio telephone broadcasting equipment for WGAR Broadcasting Company. He also inspected station WOR, owned by the Bamberger Broadcasting Service, Inc., Newark.

On an inspection tour of Western Electric equipped broadcasting stations in the Eastern States, W. P. Fisher visited stations WJAR, WHDH, WEEI, WHAP and WABC.

F. H. McIntosh supervised the installation of a specially designed speech-input equipment for the Atlas Investment Company, Chicago.

Accompanied by V. T. Callahan of the Systems Development Department, F. B. Woodworth visited East Pittsburgh, Pa., to discuss with Westinghouse engineers the design of a double voltage generator driven by a gasoline engine.

O. W. Towner made a field strength survey for the Oregonian Publishing Company of Portland, Oregon. He also visited California to inspect stations KFI, KFWB and

KNX in Los Angeles, KFOX at Long Beach, and KFSD at San Diego.

Telephone Apparatus Development

P. Neill visited the Kearny Works of the Western Electric Company in connection with new developments in the design of switchboard jacks.

A. D. Hargan visited the Boston Distributing House Shop of the Western Electric Company for discussion of matters connected with the repair of printing telegraph apparatus.

January 3 for Mr. Hargan was a twenty-fifth anniversary with the Western Electric Company and Laboratories. At the Webb Institute of Naval Architecture and Marine Engineering he prepared himself for engineering work and became a member of Western Electric in New York as a draftsman on cabling plans for central offices. After two years on this work, he joined the Apparatus Drafting division, and then was made chief draftsman of the manufacturing department at New York, a position which he held for four years.

A. D. Hargan

Mr. Hargan went to Hawthorne in 1913 to take charge of technical correspondence. After two years in this capacity and a year in charge of one of the drafting divisions at Hawthorne, he returned to New York in 1916 to the Engineering Department. He was assigned to the design and development of panel dial apparatus, on which the labors of the Engineering Department were concentrated at the time. He continued on dial apparatus development until 1928, devising improvements and refinements of the apparatus after the initial units were installed in the field, and supervising a group of development engineers from 1925 to 1928. Since then he has been engaged on studies of the economics and requirements for repaired apparatus.

C. E. Nelson was again at Harrisburg, Pa., on contact noise studies. During the latter part of December this work required his presence in Dallas, Texas, for ten days.

Transmission Apparatus

W. L. Casper attended the general chemical conference at Hawthorne.

In connection with equipment for flash welding of loading-coil cases F. J. Given, C. R. Young and K. F. Rodgers were at the General Electric plant at Schenectady and the Thomson-Gibb plant at Lynn. L. E. Abbott of the Materials group and Mr. Weston of the Western Electric Company at Hawthorne were also members of the party.

E. B. Wheeler accompanied by E. W. Niles of A. T. & T. were at Cleveland to observe the manufacture of dry cells and batteries.

At Washington A. C. Walker attended the A. S. T. M. committee meeting on Insulating Materials which considered tests on the deterioration of paper. While there he also attended a meeting of the committee on Electrical Insulation of the National Research Council. On his return he stopped at Point Breeze plant on work concerned with the purification of textiles for telephone use.

R. M. C. GREENIDGE was at Hawthorne to observe and to assist in the initial manufacture of loading coils for the Newark-Philadelphia cable. He also discussed plans, while at Hawthorne, for tests of loading-coil cores using improved permalloy dust.

ALSO AT Hawthorne, J. E. Nielsen made an examination of cross-talk measuring equipment for loading coils to be used on the Newark-Philadelphia cable. He visited the Leeds & Northrup factory at Philadelphia to inspect a set for cross-talk measurements now under manufacture for the Laboratories.

L. E. HERBORN and F. R. DENNIS were at Morristown for a final check-up on an impedance bridge for measurements in conjunction with the trial of carrier cable conducted at that place.

IN CONNECTION with the production of terminal plates for retardation and repeating coils using improved terminal punchings, A. R. Swoboda made a recent visit to Kearny.

HENRY WAGNER completed twenty years of service with the Bell System on January 20.

SOUND PICTURES

R. L. HANSON and W. A. MACNAIR attended the meetings of the American Association for the Advancement of Science at Case School of Applied Science at Cleveland on December 30 and 31.

R. M. PEASE addressed the Noise Abatement Commission of Providence preliminary to the noise survey which is to be taken in that city. Mr. Pease described the noise measuring devices and the methods employed in charting a city's noise. He also acquainted his hearers with numerous aspects of the survey undertaken recently in New York City. Mr. Pease has been in Portland, Maine, Baltimore, and Washington in connection with S. P. Grace's lecture-demonstrations.

DRAFTING AND SPECIFICATIONS

JAMES G. BYRNE, a checker in the drafting department, died from pneumonia on December 24 in Victory Memorial Hospital, Brooklyn, following an illness of five days. His service with the Western Electric Company and the Laboratories extends from October 4, 1918.

J. G. Byrne

Mr. Byrne was a member of the drafting group all during his service with the company. He was actively engaged in Laboratories Club affairs and for several years played on the Apparatus Development baseball team. He represented the Drafting and Specifications Department as an elector in the recent selection of the Club President.

Dial Apparatus

J. Abbott, Jr., visited Montreal to discuss questions pertaining to dials with the Northern Electric Company.

G. W. Folkner was in Hawthorne for conferences on multiple banks.

E. D. Mead visited Hawthorne in connection with manufacturing problems on universal relay-mounting plates and molded resistances.

Contact studies on sender relays occasioned a recent visit by J. R. Irwin to the Trinity Exchange in Philadelphia.

STAFF

Members of the Purchasing Department were saddened by the news of the death of Miss Helen Lawless which occurred January 12 at her home, 331 West 11th Street, following two days' illness of pneumonia.

Helen Lawless

Miss Lawless was a member of the Western Electric Company and Laboratories since March 18, 1920. In the Purchasing Department she had charge of the maintenance of files for buyers' information on the status of purchase orders. She carried on this work with painstaking thoroughness, and her many helpful ways and friendly disposition make her loss keenly felt.

PERSONNEL

M. L. Wilson recently spoke on *Training for the Junior Technical Staff* before the Industrial Education Section of the American Vocational Association Convention at Milwaukee. As part of the same trip he visited Hawthorne, the Wisconsin Telephone Company, and also the University of Wisconsin. Fourteen former student assistants and technical assistants are now studying at the University of Wisconsin.

CLUB NOTES

L. S. O'Roark was elected president of Bell Laboratories Club for the coming year in the first election held under the new electoral system. Four names were placed in nomination at the meeting of the electoral committee and Mr. O'Roark was declared elected on the thirty-second ballot when he received three-quarters of the vote.

L. P. Bartheld was the successful candidate in the race for vice-president. In this contest the field was narrowed down to two candidates and Mr. Bartheld was elected on the first ballot. In the choice for second vice-president Miss Mary Brainard was victorious after fifty-two ballots were taken. Seven names were proposed for election.

Mr. O'Roark was on the committee which organized the club seven years ago. Since then he has taken an active interest in its affairs and has rendered invaluable aid by advice and suggestions for the welfare of the organization. He is Assistant Director of Publication.

Mr. Bartheld is also a veteran member of the club and has participated in many of its activities. For four successive terms he served as chairman of the committee in charge of Men's Interests and as a member of the club's Executive Committee. He is a member of the Systems Department in charge of a group on trial installations in the development of equipment.

At the time of her election Miss Brainard was serving as second vice-president of the club, to which office she was appointed in September, 1930, to complete the unexpired term of Miss M. E. Murtagh, who resigned from the office. She is a member of the Personnel Department in charge of the employment of women and has been an active member of the club.

The new method of election was instituted owing to the growth of the club and to a feeling that another system of election would harmonize better with the general spirit of the Laboratories. Selection of club officers by a convention of electors was decided upon by a special committee named in 1930 by President D. R. McCormack to assist L. E. Parsons, Chairman of the Rules Committee, in considering a change in the method of club elections. The committee consisted of H. F. Dodge, E. J. Johnson, L. S. O'Roark, W. Wilson, J. G. Motley and D. D. Haggerty. After holding three sessions the committee proposed the present electoral system which provides for the election of president and first and second vice-presidents by a three-quarters vote of electors named by the club members at a general election. The major departments were divided into districts and each district was allowed one elector for each 200 members or fraction thereof. Through this method of selection, forty representatives were named to the electoral convention.

Departmental representatives who were chosen in the same general election of electoral delegates are: R. E. Merrifield, Commercial; H. T. Reeve, Research; W. P. Trottere, Telephone Systems; G. J. Hanily, Tube Shop.

Contributors to this Issue

AFTER OBTAINING a B.S. degree from the University of Pennsylvania in 1905, Herbert E. Ives spent two years as a fellow in physics at Johns Hopkins University and from it received his Ph.D. He spent a year as assistant physicist in the Bureau of Standards and in 1909 was appointed physicist to the National Electric Lamp Association of Cleveland. Three years later he became physicist to the United Gas Improvement Company. In 1918 he entered the United States Air Service as captain in charge of methods and instruments for airplane photography. Discharged at the end of the war with the rank of Major, Dr. Ives joined the technical staff of Bell Telephone Laboratories. His first work was on electrical contacts which was followed by investigations of photoelectric cells and of their possible uses in the communication industry. He was in charge of the general development of picture transmission, first demonstrated in 1924, and of that of television demonstrated in 1927. Dr. Ives was also responsible for

Herbert E. Ives

B. M. Bouman

E. C. Mueller

color television demonstrated last year. Two-way television demonstrated for the first time last year, is the latest of a very long line of achievements credited to Dr. Ives' inventive ability and direction.

B. M. BOUMAN graduated from the University of Minnesota with the degree of E.E. in 1904. He spent a year and a half with the Stromberg-Carlson Telephone Manufacturing Company and then joined the Equipment Engineering Department of the Western Electric Company in New York. In 1907 he was transferred to Hawthorne and later was associated with the Equipment Development Department. For three years, beginning in 1913, he was with the American Telephone and Telegraph Company in New York, engaged in general standardization work for Central-Office Equipment. In 1916 he returned to Hawthorne and three years later came to the Laboratories in New York where he has been engaged in equipment development up to the present time.

D. O. Jones

E. C. MUELLER'S career in telephone work dates from 1909 when he entered the drafting department of the Western Electric Company here in New York. He fitted himself for drafting work at the Newark Technical School. At the end of two years he was transferred to engineering work on manual apparatus and during the war period he participated in the program of work on submarine-detection devices and Signal Corps developments. In 1918 he was placed in charge of a section of switchboard apparatus work. Since then the scope of his duties has been extended until at the present time it includes all of maintenance and manual central office apparatus.

D. O. JONES received a B.S. degree in electrical engineering from the University of Vermont in 1922 and joined the Technical Staff of the Laboratories in the same year. In the Local Systems Laboratory group, he was at first engaged in fundamental studies of ringing and tripping problems, and later in the prepa-

W. V. K. Large

C. H. Klein

H. H. Spencer

ration of Bell System practices covering the maintenance of central-office and PBX apparatus. At the present time, he is occupied in fundamental pulsing studies for the panel system.

FROM THE Field Artillery Officer's Training School, W. V. K. Large returned at the end of the war to the Colorado Agricultural College and received a B.S. degree in electrical engineering in 1919. Following two and a half years with the Great Western Sugar Company, he joined the Equipment Engineering Department of the Mountain States Telephone and Telegraph Company. In 1929, he transferred to the Toll Systems Development Department of the Laboratories where he has since been associated with the terminal and repeater group.

C. H. KLEIN joined the Installation Department of the New York Telephone Company in 1903. The following year he transferred to the Equipment Engineer's office where he was responsible for the development of the receding-door telephone booth. In 1910 he transferred to the Engineering Department as engineer in charge of station and drop wiring, building wiring and cabling, telephone booths, and tools for installers and repair men. During this period he studied at Cooper Union in the evenings and received a B.S. degree in Civil Engineering in 1910 and an M.E. degree in 1916. In 1928 he transferred to the Laboratories where, with the Outside Plant Department, he has been engaged in the design of hardware for outside-plant work.

AFTER RECEIVING a B.S. degree in mechanical engineering from the University of New Hampshire in 1923, H. H. Spencer joined the Technical Staff of the Laboratories. With the power group of the Systems Department, he has been associated chiefly with the development of power plants for toll systems.