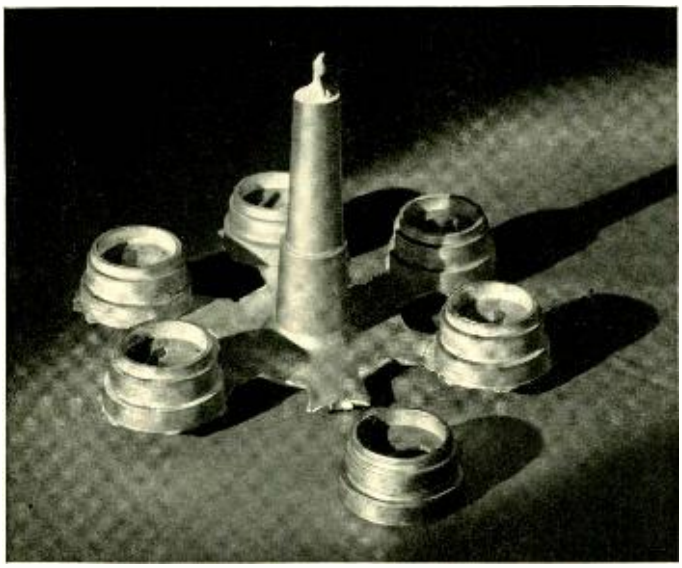
BELL LABORATORIES RECORD

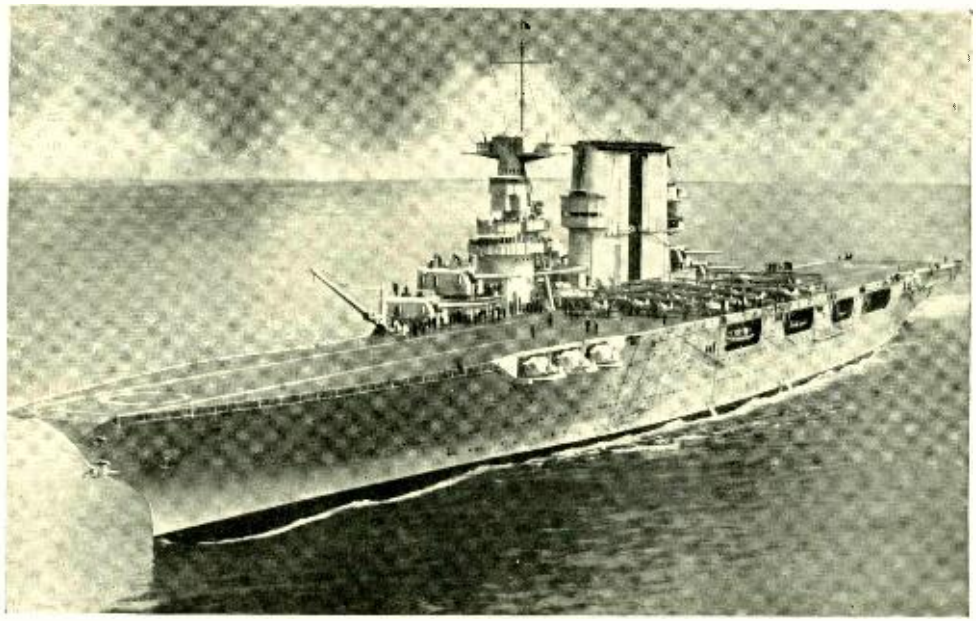


Volume Eight, Number Ten

for

JUNE

1930



Dials for the Flying Fleet

By JAMES G. FERGUSON

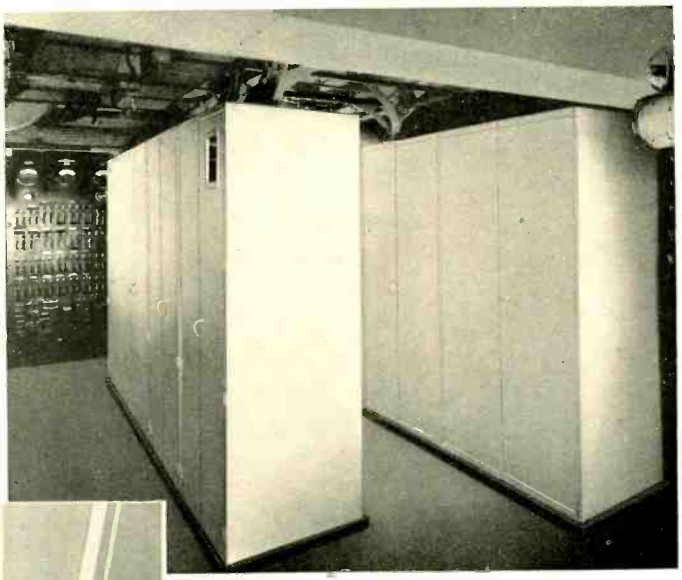
Equipment Development

FAST and reliable communication has always been a first essential aboard a fighting ship. The captain of a wooden frigate had to shout his loudest; and when ships grew and distances became too great to shout across, voice tubes were introduced to supplement lung power. Voice tubes are still used to connect pairs of important stations which are fairly close together but networks of large tubes weaken the structure of a ship and mustard gas might accompany an order "down the pipe." Since the invention of the telephone, standard equipment on every ship has included at least one manual switchboard. Loud speaking telephones have been widely used in recent years to broadcast everything from fire alarms to no-shore-leave orders, and from bugle calls to play-by-play accounts of World Series baseball games. And now dial telephones. Last summer, dial private branch exchanges were installed on the two most unusual ships in the United States Navy.

These are the airplane carriers, U.S.S. *Saratoga* and U.S.S. *Lexington*. They are sister ships of equal hugeness although there are loyal officers on each one who will tell you that theirs is the larger. In two ships 888 feet long, it is quite possible that manufacturing variations will account for a half inch difference. From keel bottom to mast top measures 212 feet. Each of these electric driven ships is equipped with generators which develop 180,000 horsepower — enough power to supply the city of Boston. The water pumps of either would

readily serve 4,000,000 people. On each are mounted eight 8″ long-range guns and twelve 5″ guns which are used for both short-range and anti-aircraft firing. Each ship cost almost $45,000,000 and required seven years to build. On each ship about 2000 officers and men work, play, and sleep.

Nowhere is fast and reliable telephone service more necessary than on these extraordinary ships. Two thousand men living and working in widely separated compartments on eight decks without passenger elevator service require dozens of telephone channels for routine ship service and personal conversations alone. In addition, numerous calls are necessary to correlate



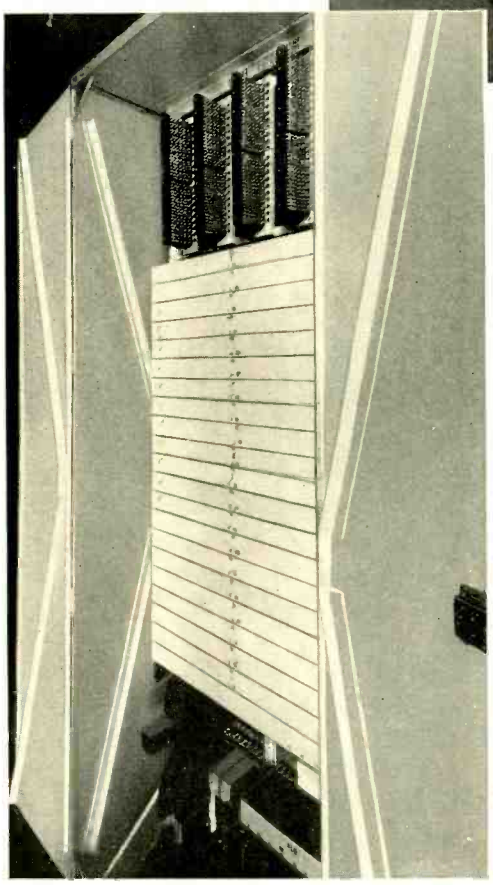


Fig. 2 (above)—Dial equipment enclosed in casings on U.S.S. Saratoga. Fig. 3 (left)—Front view of one line-relay rack with front doors open

boiler, engine, distribution and navigation departments when the ship is under way, and to coordinate these departments with ordnance groups during gunfire, and with aviation stations during air maneuvers. Imagine the peak load that occurs when all sections must cooperate after a general quarters call—for fire or collision. Each dial exchange will handle all ship service calls and a good share of the others.

Each PBX provides 400 dial stations with 80 simultaneous conversations. All 400 lines are at present in service on the *Saratoga;* the initial installation on the *Lexington* provides for only 100 lines but it is expected that the remaining 300 lines will be

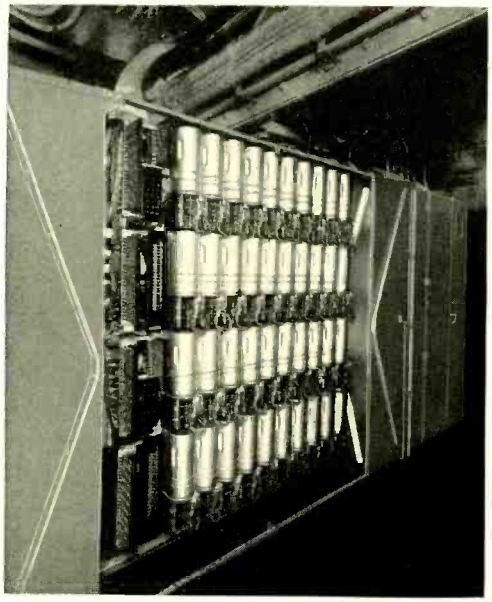


Fig. 4—Front view of line-finder frame with doors open. The equipment arrangement is the same on the rear

added within the next year or two.

Were it not for special demands made on the system due to conditions peculiar to ship operation, a standard 711 PBX* could have been furnished. As it is, the PBX's aboard these ships closely resemble the 711. Line finders, selectors, and connectors similar to the 711 switches were employed except that all circuits had to be modified to provide new executive cut-in and conference features. The executive cut-in permits any desired number of executives to connect with called lines even though these lines are busy. New frames had to be designed because the height was limited to six feet, and because no equipment unit larger than 3 feet x 2 feet x 6 feet could be taken through a hatchway. As a precaution against excessive humidity in the PBX compartment, located two decks below the water line, each frame was enclosed by a casing in which heating units were installed. It was necessary to insulate casings and frames from the steel deck to prevent stray currents in the ship from harming the telephone equipment. Standard apparatus had to be modified somewhat because of humidity and salt air.

Three types of telephones were provided: standard cradle handsets, wall sets with handsets hung on special switch hooks and with water-tight dials having luminous numbers, and water-tight wall sets consisting of the wall sets just described mounted in water-tight cases.

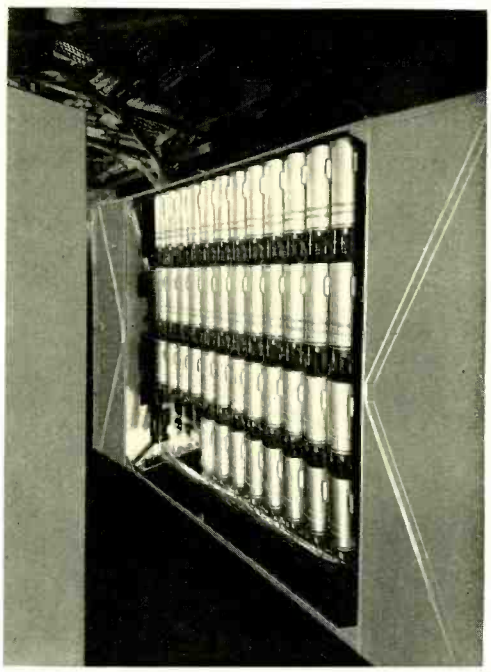


Fig. 5—Rear view of one connector and selector frame. Connectors are on two upper shelves and selectors below

An attendant's cabinet was designed for the *Saratoga* to permit as many as four connections with shore exchanges when the ship is at a pier. A

* Bell Laboratories Record, *September*, 1929, *p.* 36.

tie line, mounted in the manual PBX of the *Lexington,* permits connection of any dial line with either a manual line on the ship or through to shore when the ship is docked.

A seafaring PBX naturally has a more exciting existence than its landlubber cousin. Dial equipment ashore is ordinarily located where atmospheric conditions are normal, where vibration is negligible, and where switches can operate at all times in a vertical plane. We were advised at the start that these PBX's would have to withstand severe conditions of humidity, heat, salt atmosphere, vibration, shock, rolling, and pitching, and that they would have to operate with the ship listing anywhere up to 40° from vertical. To make sure that our equipment would meet the requirements and to gain some first-hand information regarding the conditions under which it would have to operate, it was decided that two men from these Laboratories should supervise the installation and testing aboard the ships then maneuvering off Los Angeles. Both Mr. Plotner and the author enjoyed it immensely.

Arriving on the West Coast, we discovered that during the period of installation and test, the ships were going to be under way a great deal and that we were going to witness some of the most spectacular gunnery and airplane practices. Frankly it would have been much easier to write about these tactics and the experiences of a naval officer than to describe the PBX. A huge ship traveling full speed ahead through the night without lights; an airplane poised on the deck ready for flight with exhausts spitting purple flames; guns firing salvos at targets miles away; searchlights and star shells; squadrons of airplanes taking off in rapid succession and landing again with the ship under way. All of these things lend glamour to the telephones, for telephones feature in every operation, and a picture of the PBX is drab if they are left unmentioned.

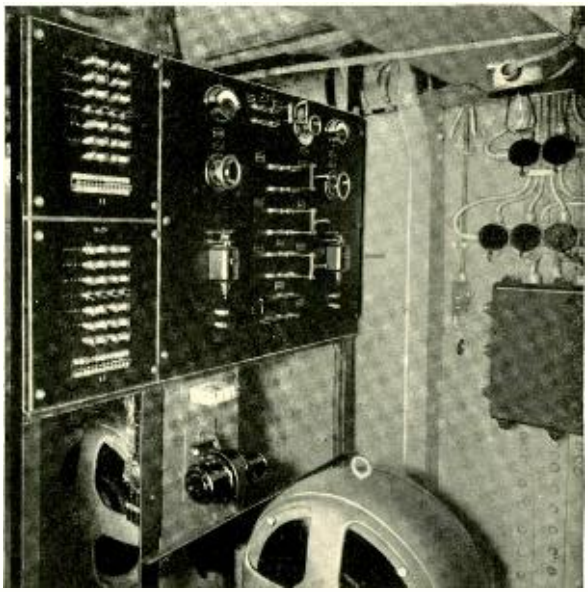


Fig. 6—Power and ringing machine panels on U.S.S. Saratoga

These were the first telephone installations ever made aboard a ship at sea. They are also the largest undertakings ever tackled by a regular ship's crew, as jobs of this size are ordinarily done by Navy Yard installers when the ships are in dry dock. What's more, the equipment works beautifully, which is in no small way due to the whole-hearted cooperation accorded us by the officers and men of both ships.

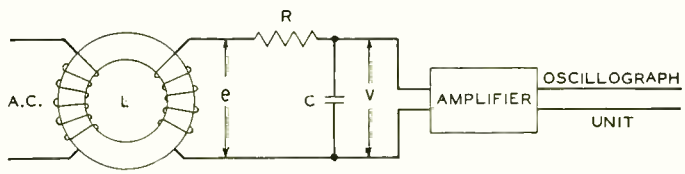
A Cathode Ray Hysteresigraph

By R. A. CHEGWIDDEN
Magnetics Research

HYSTERESIS loops give, either directly or by simple calculation, practically all the important magnetic characteristics of a material. For an institution such as the Laboratories, therefore, where magnetic materials are constantly studied, a simple method of testing them is of great importance. The cathode-ray hysteresigraph, developed within recent years by J. B. Johnson, combines simplicity with speed of performance in a way that makes it indispensable for certain types of hysteresis measurements. No previous method equals it in general usefulness for giving information of instantaneous states.

The historic and usual method of determining hysteresis loops employs a ballistic galvanometer or a fluxmeter, and may require as much as an hour to obtain sufficient data for a single loop. Although the high accuracy obtainable by this method makes its employment still necessary, the time involved sometimes renders it inconvenient — and for certain information, impossible. Instantaneous or short time variations in permeability, such for example as caused by sudden strain, cannot be determined by its use. This has led to many attempts to develop speedier methods of obtaining hysteresis loops.

One of the earliest efforts was by Ewing who built apparatus for the purpose in 1893. The employment of the apparatus was restricted to magnetic rods of a certain size which limited its usefulness, and in addition the results obtained from it were subject to error due to a rather large air gap in the magnetic circuit. Notwithstanding these defects, however, some interesting results were obtained.



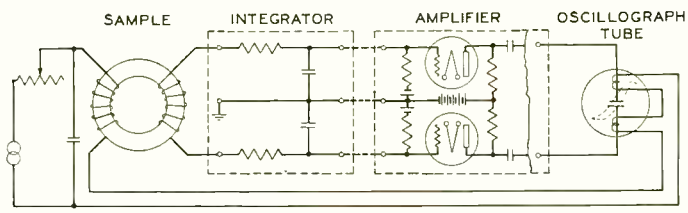


Fig. 1 (*above*)—*By an integrating circuit a voltage is obtained which is proportional to the instantaneous flux in the sample.* *Fig.* 2 (*below*)—*General circuit arrangement of the cathode ray hysteresigraph*

Early experimenters with the Braun tube also found it possible to reproduce instantaneous hysteresis loops but the results were only approximately correct. The Braun

tube is somewhat like the cathode-ray oscillograph tube but its electron stream is obtained by ionization of residual gas by potentials of from ten to fifty thousand volts which also give the electrons high velocities. When used to produce hysteresis loops, two coils on opposite sides of the tube caused a deflecting field proportional to the magnetizing force. In a plane at right angles to these coils were placed the ends of the magnetized sample to cause a force intended to be proportional to the flux. The flux flowing across this large air gap did not, of course, truly represent the flux within the sample so there was a very appreciable error in the results.

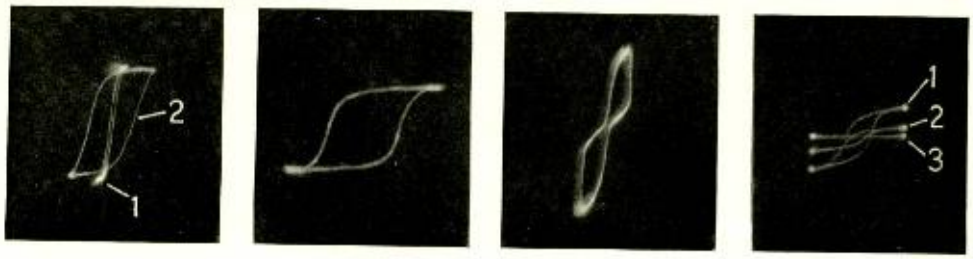
The Johnson hysteresigraph, employing a cathode-ray oscillograph, overcomes the inaccuracies and limitations of these earlier methods. The curve-tracing element of the cathode-ray oscillograph is a stream of electrons given off by a hot cathode and drawn with high velocity toward a tubular anode which is maintained at a potential of about 400 volts above the cathode. A small portion of these electrons pass through the hollow anode instead of striking it, and these are acted upon to form the hysteresis loop. The tube is equipped with two pairs of parallel plates mounted perpendicular to each other which, when voltages are applied to them, may be used for deflecting the electron stream. In the hysteresigraph, however, only one pair of plates is used and deflection at right angles to them is obtained by coils outside the tube.

A hysteresis loop is, of course, a curve of the flux density in a magnetic specimen plotted against the momentary strength of the exciting field as the current varies over a complete cycle. To obtain it, a sample is wound with a number of turns of wire through which passes the exciting current, and the magnetizing force, or field intensity, is directly proportional to the current flowing. It is possible,

Fig. 3—H. J. Williams operating the cathode ray oscillograph

therefore, to put a pair of coils in series with the exciting coil and to allow them to produce a field which deflects the electron stream as was done in the early Braun tube hysteresigraph, and this is what is done in the new hysteresigraph. The chief difficulty is to obtain a deflecting force along the ordinate that is proportional to the actual flux in the iron.

The flux cannot be used directly to deflect the electron stream because as soon as an air gap is formed in the core to insert the tube carrying the electron stream, a leakage of flux develops, and the actual air gap flux is no longer the true flux in the metal. This, of course, was the error of the Braun tube apparatus. It is avoided in the new hysteresigraph by an elec-



A B C D

Fig. 4—Typical prints of hysteresis loops obtained with the apparatus

trical method of measuring the flux.

If wire is wound on a core carrying a varying magnetic flux, an electromotive force will be generated in the coil proportional to the rate of change of flux, or to — in other words — the time derivative of the flux. The time integral of the instantaneous voltage is thus proportional to the actual flux in the core at that moment, and it is this value of flux that is wanted to deflect the electron stream. To obtain this integral value a circuit shown in Figure 1 has been devised and called, due to its function, an integrating circuit. To explain completely the action of this circuit requires rather extended mathematical reasoning but the overall result is that if both the resistance and capacitance (R and C) are large enough the voltage (V) across the condenser will be proportional to the instantaneous flux.

Since R and C are very large, the voltage (V) is exceedingly small, so that usually a three-stage and sometimes a four-stage amplifier is required to amplify it to a usable value. The complete arrangement is shown in Figure 2. The magnetizing current is obtained from a motor generator having a frequency range of from 10 to 25 cycles. An electrolytic condenser is connected as shown, which serves to smooth out any ripples that may exist in the current wave and to slow up the change in flux for the steep portion of the loop. This action of the condenser on the flux in the specimen, together with the use of a low frequency and a well laminated specimen reduce the eddy current losses which otherwise might affect the size and shape of the hysteresis loop.

With this new apparatus means are available for taking instantaneous hysteresis loops, which is of great value for certain studies. The loop may be viewed directly as shown in Figure 3 or photographed with an exposure of two or three seconds, and prints obtained as shown in Figure 4. Here print "A" gives for comparison a loop for 78.5% permalloy (1), and Armco iron (2), taken on the same negative but at different times. Print "B" gives the same permalloy loop shown in print "A" but widened along the axis of field strength to make the calculation of loss easier. Print "C" is a loop for perminvar.

When certain alloys are heated, rapid changes in magnetic properties sometimes occur as the temperature changes, and in some instances even while the temperature remains constant. "D" in Figure 4 is a good illustration of the use of the hysteresigraph for observing hysteresis loops under such conditions. (1) gives loops for a nickel-iron alloy at temperatures of 23°C — (2) at 48°C and (3) at 55°C, where the alloy has become non-magnetic.

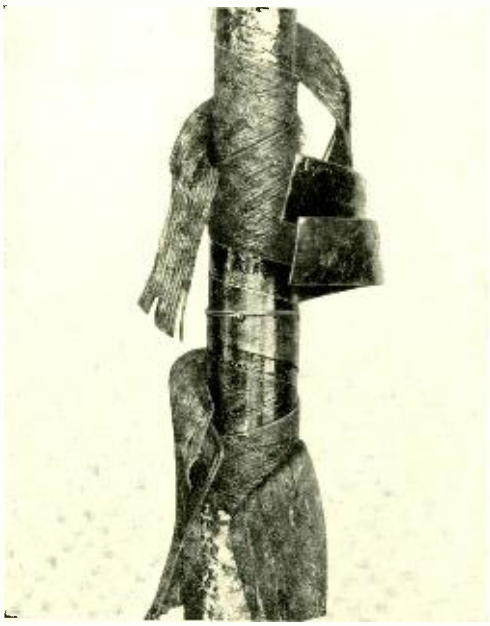
Steel-Tape-Armored Toll Cable

By W. E. MOUGEY
Outside Plant Development

DURING the past year there was manufactured by the Western Electric Company about 200 miles of steel-tape-armored toll cable, and according to plans some 500 miles of it will be made during 1930. Although steel-tape armoring for lead-covered cables is not new, having been used in Europe and especially for power distribution in this country, considerable development work was necessary to assure a design well adapted to our conditions of manufacture and to important long toll cable service.

At the beginning of 1929 there were approximately 15,000 miles of toll cable in the Bell System and at the same time there existed a program calling for 5000 miles additional for 1929 and for from six to seven thousand miles for each of the few following years. This very large increase in the use of cable precipitated a reinvestigation of all types which has resulted in the decision to use steel-tape-armored cable for a certain portion of the expansion program.

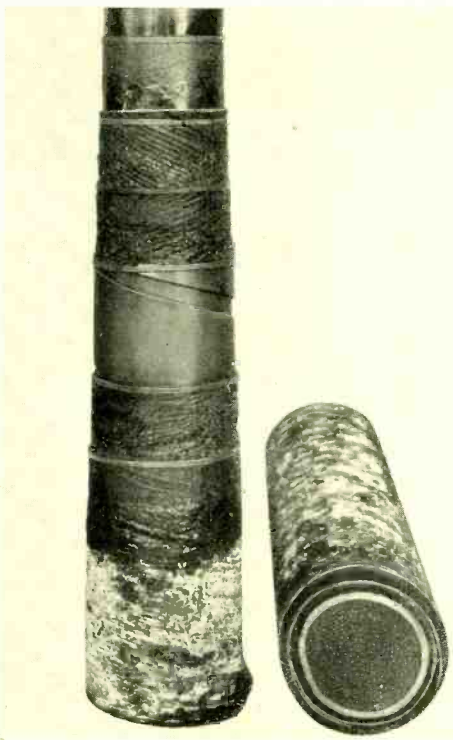
Up to the present time a large part of the long-haul toll cables of the Bell System have been aerial. Only short-haul circuits, chiefly in suburban areas, and a few longer haul circuits where there is the possibility of several additional cables being required over the same route, have been underground, and for this work the ordinary toll cable has been run in multiple tile duct. Underground construction has certain advantages, however, even for routes containing only one or two cables. Aerial cables are subject to certain types of troubles which can never be entirely eliminated, and it appears that the probability of future reductions in cable trouble are much greater with underground than with aerial cable. Underground cable has the additional advantage of more stable temperature. Out of the direct rays from the sun, underground cable will not reach the high summer temperatures, and the reduced range of variation in resistance and in other



The various layers applied in building up the armoring are here plainly evident

transmission characteristics is of considerable value from the standpoint of repeater operation.

A distinct advantage of the new cable is the fewer manholes that will be required as compared with ordinary underground construction. With armored cable they will be needed only at loading points so that but about one-tenth the number ordinarily used will be necessary. There is the still further advantage, as compared with aerial cable, of improved appearance brought about by the elimination of poles. The steel tape also has a marked effect in decreasing the voltages induced in the cable conductors by neighboring power circuits, both at power frequencies where the induction might be of such magnitude as to be a hazard, and at frequencies in the audible range which would interfere with voice transmission.



To a diameter of 2⅝ inches over the lead, the armoring adds about ⅝ of an inch and weighs approximately four pounds a foot

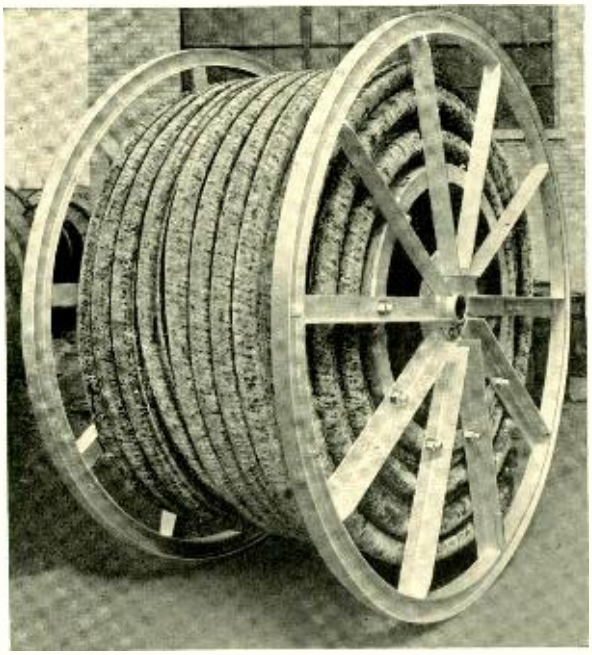
A second form of underground construction consisting of unarmored cable in fibre ducts is also being tried experimentally. This construction, like the use of steel-tape-armored cables, also eliminates the need of frequent manholes and gains the advantage of a more even temperature, but it loses the protection from inductive interference given by the steel-tape armor. A choice between the two types of construction must take these and other factors into account.

The design of armor for underground cables will vary somewhat for different conditions of service. The lead covered cable being armored at the present time is first passed through a bath of hot asphalt compound to obtain a uniform coating over the lead, and then a wrapping of paper, impregnated with asphalt, is applied with a small overlap to give at least one thickness of paper at all points. On this paper two layers of impregnated jute strands are wrapped in reverse directions. The jute serves as a bedding for the steel tapes which are next applied in open spirals in the same direction. These tapes are each 2 inches by .041 inches, and the outer one is laid over the gap between turns of the inner tape.

On top of the steel are two more layers of jute strands, again applied in opposite directions, which serve as a protection for the tape. After each layer of paper, jute, or steel—the cable is passed through a bath of hot asphalt to fill all interstices as far as possible with water-proof compound. As a final step the cable is given a coating of calcium carbonate, common

whiting, to prevent turns of the cable from sticking together on the reels and to reduce the absorption of heat from the sun on hot summer days before the cable is buried.

The chief objects of the armor are to protect the cable from chemical and electrical corrosion, and from mechanical injury. The layers of asphalt and impregnated paper next to the lead sheath provide the chief protection against corrosion. The two layers of jute strands, besides providing a bedding for the steel tape armor, furnish a protection to the layers of compound and paper next to the sheath. In addition to reducing the inductive disturbances from power circuits, the chief purpose of the steel tape is to prevent mechanical injuries. The two layers of tape are sufficient to protect the cable from all ordinary hazards to which it might be subjected.

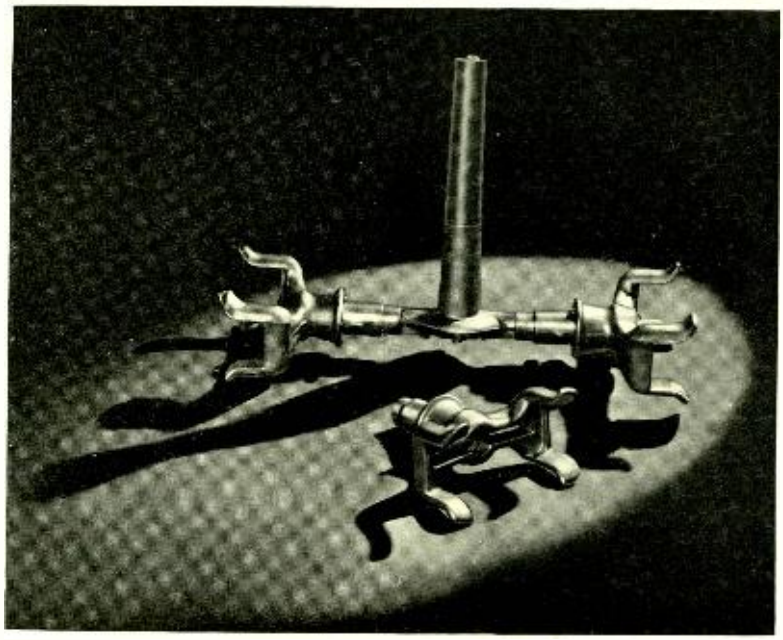


For facility in shipping and laying, the cable is wound on heavy steel reels

One of the chief difficulties in designing the armor for such cable has been the choice of suitable compounds. The cable is subject to considerable variations in temperature during transport and laying, and the compounds used must be sufficiently viscous not to flow out of the cable when it is exposed to the sun during a hot day in summer, and also sufficiently soft at the lowest temperature conditions under which the cable will be laid to bend without damage. Until lately the compounds used both in Europe and in this country consisted of coal tar derivatives, chiefly coal tar pitch. Petroleum pitches, or asphalts, appear to offer considerable advantages since they are less susceptible to change in temperature. They are being used, therefore, for the new cables.

The method of laying varies with the terrain passed over. In arable ground, the cable is laid two or three feet deep so that plowing and cultivating will not disturb it. In rocky soil it is sometimes necessary to cut a trench through solid rock below a few inches of soil. When crossing roads the cable is buried sufficiently deep to be out of reach of any probable road improvements. In all cases special laying equipment is used to reduce the installation cost to a minimum.

The first section of the new cable to be installed runs from Fort Worth to Cisco, Texas. With experience gained from the use of tape-armored cable, it is probable that the trend of development, manufacture, and use will be toward increased scope and greater economy.



Die Castings

By C. H. GREENALL
Telephone Apparatus Development

THE term "die castings" as used throughout the engineering world is applied to both pressure and gravity mold castings. Pressure die castings, which are more adaptable to quantity production necessary for telephone equipment, are cast by forcing the molten metal from the melting pot into the die by air or hydraulic pressure. The alloy, obtained in ingot form, is melted in a melting pot or iron pressure retort, and is then forced through a goose neck into the die, filling the gate, vents, overflow cavities and various runners which lead the metal to the various impressions in the die which are to be fabricated.

After a short period of time during which the die is continuously cooled by water, the molten metal solidifies and the cast part is ejected from the die. The machines used in this process are called automatic or semi-automatic, depending on the manner in which the die is opened and closed during the charging operation as well as the method employed for ejecting the casting. After ejecting, the casting is then ready to have the gates, vents, overflow cavities and fins removed, after which the necessary finishing operations, such as machining and plating, are carried out. The alloys most generally used for die castings are of lead, zinc, tin or aluminum base.

The choice of a proper steel for a die is very important and is one of the most essential factors in maintaining an efficient plant as well as close control over the quality of output.

Most dies for casting aluminum alloys are manufactured from a chromium-vanadium steel which is usually given a special heat treatment. The American Society for Steel Treating has set up a temporary practice for the heat treatment of this type of die. The dies are given a protective covering of oxide or carbon which is usually applied during the tempering of the die. When the castings begin to show checks or ridges on their surfaces—which indicates a type of fatigue failure due to contraction and expansion of the die surface caused by cycles of thermal expansion as the die surface is heated by the molten metal and contraction when cooled by the water—the life of the die is practically over, for die checks are usually undesirable on the finished castings. These die checks may be observed by referring to the title page which shows receiver cups for the handset as they appear after ejection from the die. In this particular case the die has been used approximately 30,000 times and the appearance of the die checks on the surface of the castings indicate that its life is about over.

In die-casting of aluminum base alloys, a temperature of approximately 450° C. in the die itself is usually maintained. Control of this temperature is obtained by special water cooling features in the design of the die and by the use of thermocouples. If lower melting alloys than the normal aluminum base alloys are to be used, the temperature of the die should be reduced accordingly. Care in controlling the temperature results in increased life of the die.

After being ejected from the die usually little or no machining has to be done on the casting, other than tapping for screws, threading, and removal of fins. The die-casting process itself owing to the extremely high cost of the die is essentially a quantity production method of manufacture, and usually cannot be justified unless the number of parts to be made exceeds 5,000. This number may of course be considerably changed, depending on the size and shape of the desired casting.

Up to a few years ago die-cast parts were rarely used in the Bell System. This was because satisfactory alloys of uniform quality and appearance were not as yet developed. Recently, however, the advisability of die casting apparatus parts has been given greater consideration than in former years. The large multiplicity of apparatus parts in the telephone plant presents certain production problems of which die castings are the obvious solution. Owing to the increased use of die castings throughout the country, the manufacturers have been forced to devise methods of increasing both the quality and production of these parts. It was realized

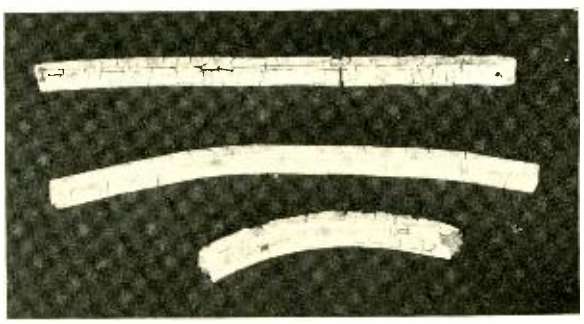


Fig. 2—An exhibit from the investigations now being carried out by the Laboratories on aluminum and zinc-base alloy. Some test specimens showing corrosion and disintegration under exaggerated weathering tests

that numerous parts could be die cast from commercial alloys now in use, but no information was available with respect to the possible variations in the physical properties of these alloys such as strength, impact, corrosion resistance and changes in linear dimensions. Although marked improvement has been made within recent years, the need of specifications for alloys from which apparatus parts are to be manufactured has been felt very seriously.

For quite a few years the Laboratories have been investigating the properties of various die-casting alloys. In addition we have recently participated jointly with the Western Electric Company in an investigation conducted under the supervision of the American Society for Testing Materials.* Studies of the physical properties of aluminum- and zinc-base die-cast test specimens are being made with the expectation of setting up engineering requirements for these alloys. Programs covering an investigation of lead- and tin-base alloys will also be under way within a short time. Studies of shelf-life aging, and variation of the physical properties under outdoor corrosion are being conducted as well as determination of the effect of high temperatures on the physical properties such as may be encountered during a japanning operation.

The use of die castings presents important problems of apparatus design. In choosing an alloy the designer must study the relationship of the number of parts to be made and the cost of the individual part when completed. Tensile and impact strength, resistance of the alloy to warpage and change of linear dimensions, corrosion resistance, ease of machining and subsequent finishing operations such as riveting, polishing and plating, the weight of the finished part must all figure in the selection of the alloy. The plating process is a problem not without its difficulties and extensive studies are now being conducted by our Laboratories in types and methods of plating.

In addition the designer must determine whether or not the part may be produced cheaply and in quantity. Production in the mill may be seriously interfered with if the alloy chosen has a corrosive effect on the die, for the cost per part will be raised considerably if the die is ruined after a comparatively small number of castings are made. Other features such as "hot shortness", — where the alloy lacks high tensile strength at the temperature at which the part is ejected from the die — play

* *The following members of the Laboratories have been actively associated in this work: Messrs. H. A. Anderson, J. R. Townsend, W. A. Shewhart, C. L. Hippensteel, C. W. Borgmann and C. H. Greenall.*

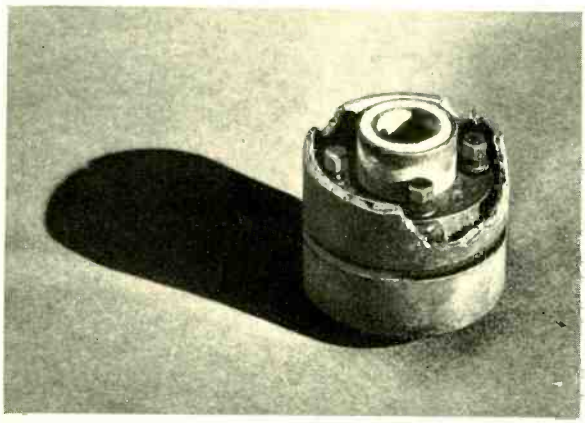


Fig. 3—A coupling for sound-film equipment subjected to accelerated weathering tests. The break in the shell occurred when the coupling was dropped from a 15-inch height

a very prominent part in the quality of output. The amount of shrinkage, porosity and tendency of the alloy to contain blowholes must also be considered. Porous castings will result from the use of alloys which have a tendency to absorb gases while these gases are being released during solidification. Some alloys cannot be used for the molding of intricate apparatus parts owing to the inability of the molten metal, despite the high pressure applied, to fill out the die completely.

The physical and chemical properties of the alloy also figure prominently in the designer's calculations. Aluminum alloys, which are generally specified when light-weight castings are desired, will disintegrate under outdoor exposure if high percentages of copper are present. The rate of corrosion of these alloys is considerably increased in industrial regions where sulphur dioxide is present in the atmosphere. In such instances, and again where good machining and polishing qualities are desired, the chemical composition must be carefully controlled. The conditions under which a part is to be used such as high temperature or vibration effects, likewise must be taken into consideration before specifying the alloy. Certain alloys cannot stand up under impact during riveting operations. Others are particularly adaptable to this process. In cases where oil or air leakage must be avoided alloys with porous structures should not be used.

Aluminum-base alloys have been introduced to the trade in the past two or three years in which slight additions of copper, nickel or silicon have not only improved to a great extent their physical properties but also have obtained increased resistance to warpage, corrosion and better machining characteristics. Zinc-base alloys are also under investigation by the Laboratories at the present time.

One of the main factors to be taken into account during the consideration of an alloy for an apparatus part is the question of machinability. The cost of the finished part will be considerably increased if the machining quality of the alloy is not satisfactory. In the case of the transmitter and receiver cups used in the molded handset this characteristic is particularly important.

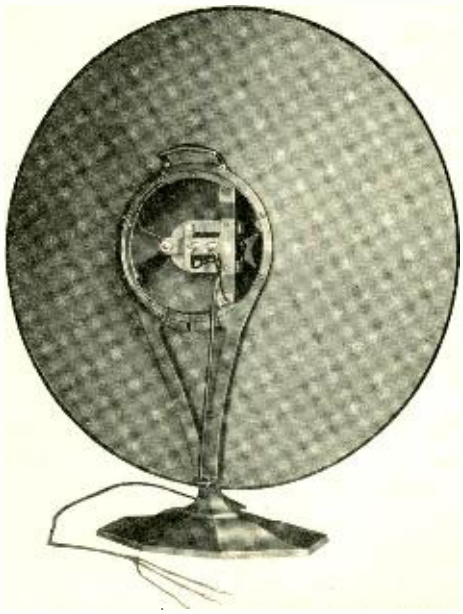


Fig. 4—Another example of die-cast products—the base and frame for the 540-AW and 560-AW loud speaking units

Other die-cast parts used in the Bell System are the base and frame for the 540-AW and 560-AW loud speaking telephones, the cradle for the molded handset, and the handset base. In Figure 3 is shown a coupling which has been subjected to an accelerated

test in the laboratory to determine its relative resistance to embrittlement and corrosion. The coupling illustrated was subjected to high temperature for a period of ten days and then dropped from a height of approximately 15 inches. The results show the necessity for careful choice of an alloy. Other uses for die-cast alloys are now projected and it is anticipated that in the next two or three years the use of die-castings in the Bell System will comprise one of the important manufacturing items.

Transatlantic Rates Reduced

Under a revised schedule effective May 11, *the basic rate for telephone calls between New York and London has been reduced from* $45 *to* $30 *for the first three minutes and from* $15 *to* $10 *for each additional minute. Rates between other points will be reduced by an equal amount.*

Chief among factors enabling this reduction was the increased use of the service amounting in 1929 *to about* 60 *per cent as compared with* 1928. *There are now four two-way channels, and service is available twenty-four hours a day.*

Toll Tandem Switchboard

By C. E. HOKANSON

WITH the old method of handling outgoing toll calls, a ticket was made out for each call at the recording board and was then sent to an outward or line board having toll lines to the desired place. With the new combined-line-and-recording method, known as CLR, all calls are routed to operators who must themselves be able to reach all outgoing toll lines. In the larger cities, however, it is not possible to have all the toll lines appear in the multiple before each CLR operator, so that a toll tandem board containing all the toll multiple has been developed. This board acts as a central point in the toll office through which the operators may secure additional circuits, either when the toll lines appearing before them are busy, or when toll lines to the point desired do not appear in their own switchboard.

At the combined-line-and-recording boards a certain amount of space is necessary for answering jacks and for toll switching trunks to the local switchboards. In the remaining space, available for the toll line multiple, only about 600 lines can be accommodated. In cities where there is insufficient space for all of the toll lines, a toll tandem board is necessary. Where such a board is used some of the toll-line jack space on the CLR boards is taken for trunks to the tandem board.

The toll tandem board has been developed to work on the straightforward, automatic-listening, and automatic-ringing basis. Calls from a local

The death of Mr. Hokanson on March 22 was noted in the April issue of the RECORD.

subscriber to distant toll points are handled as illustrated by Figure 2. A subscriber calls for "long distance" and obtains a CLR operator who makes out a ticket covering the toll connection desired and selects an idle toll line. If, however, all the toll lines in her multiple to that point are busy, or if she has no toll lines to that point, she selects an idle trunk to the tandem board and after receiving a tone indicating that the tandem operator is ready to receive the call, informs her of the city desired. The tandem operator then selects an idle toll line to the city specified and plugs in. The act of plugging-in automatically disconnects her from the circuit and the CLR operator proceeds with the completion of the call as though she had plugged into an idle toll line in her own multiple.

An installation of toll tandem sections is shown at the head of this article. The switchboard framework is, in general, of the same construction as the local tandem board. Two operators' positions per section are provided, each having a capacity of fifty incoming trunk cords as shown in Figure 3. Thirty-six hundred toll lines with their associated idle-indicating lamps can be placed in the multiple field. Make-busy jacks are placed above the line multiple in the first section and double-ended cords provided so that any line in trouble or to be taken out of service may be made busy. The position equipment is mounted in the usual location in the rear, and the incoming trunk, overflow, and idle-line indicating equipment is arranged on shop wired units for mounting on relay racks as shown in Figure 4. Certain testing facilities are provided at the head end of the board to care for such testing and mainten-

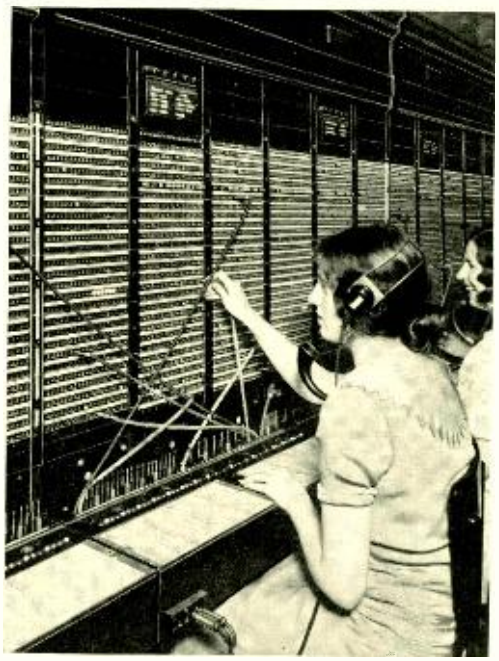


Fig. 3—View of a toll tandem position showing cords and trunks

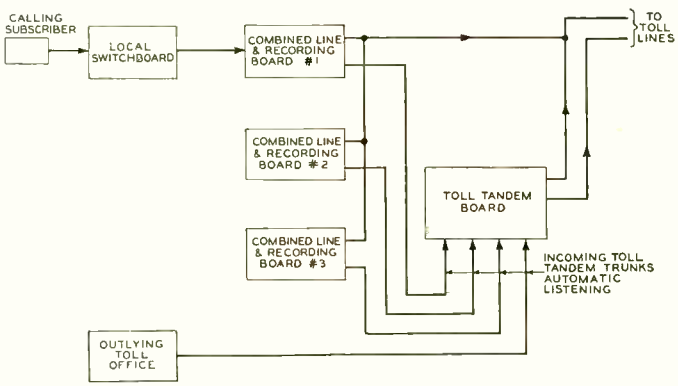


Fig. 2—Schematic diagram showing typical arrangement of trunks when a toll tandem board is used

ance operations as will be required at this location.

Part or even all of the toll lines to the larger or more important cities may appear in the CLR multiple which will allow most of the calls to be completed directly by the CLR operator. Lines to the smaller places, however, will appear only at the tandem board in many cases.

To facilitate finding an idle toll line by requiring as little hunting as possible, each jack in the tandem board has an idle-line indicating lamp associated with it. These lamps are located above the jacks in combined lamp-socket mounting and designation strips. The toll lines to a particular point are so connected that the associated indicating lamps function in sequence from left to right. Thus if the first line to the particular point is idle its associated lamp remains lighted, indicating that this toll line is idle and also that it is the first idle line from left to right in the group. This lamp remains lighted until the line is seized by an operator, when the indicating lamp of the next idle line lights up.

Since the tandem operator is essentially a switching operator, it is not desirable that she be called upon to pass information verbally back to the toll recording operator. For this reason if all the toll lines are busy, the calling operator is informed of the fact automatically by means of what are known as overflow circuits. Each group of toll lines has an overflow jack, with its associated lamp located at the head of the group. The lamp is wired in sequence with the idle-line indicating lamps and lights up when all toll lines are busy. A tandem operator, having a call for a given toll point and finding all lines busy, plugs into the overflow jack. This overflow jack circuit sends a tone back to the calling operator, informing her that all toll lines are busy. As soon as a line becomes idle the combined-line-and-recording operator is automatically informed by means of her supervisory lamp. She then selects another trunk to the tandem board and asks for the distant point.

In addition to the regular overflow circuit, common overflow circuits individual to each position are provided.

Fig. 4—Incoming trunk, overflow, and idle-line indicating equipment in shop wired units is mounted on relay racks

When the regular overflow circuit is in use the operator can plug incoming calls into this circuit which, by a tone of different character from that of the overflow circuit described above, informs the operator that there is already a call waiting to be completed to the point she is trying to reach. Under such circumstances the operator will then disconnect from the toll tandem board and arrange to complete the call a little later.

In spite of a superficial resemblance, the toll tandem board is yet quite unlike the local tandem board. This somewhat older cousin forms a trunking center for a city through which calls from nearby local switchboards for distant points in the city can be passed. By the use of the toll tandem board the number of trunk conductors required between distant centers are materially reduced due to the high efficiency resulting from the use of large trunk groups. The local tandem board, therefore, brings about an economy of trunks while the toll tandem board facilitates the use of combined line and recording operation in larger cities.

The use of the toll tandem board for completing toll connections permits extension in some localities so that certain calls, which otherwise would be handled through the CLR positions, may be completed by going direct from the local switchboard to the toll tandem board, thereby speeding up the time required for completing connections and considerably reducing duplication of effort. There are also certain locations where calls from nearby toll offices for distant points can be economically routed to the toll tandem board and there completed. This makes it unnecessary to maintain toll line facilities for such calls in these offices.

Two-Way Aircraft Radio Telephony

On March 31 two-way radio-telephone communication with the first of a group of F-32 Fokker planes purchased by the Western Air Express and all equipped with Western Electric aircraft telephone apparatus, was constantly maintained from Whippany during the time the plane was in flight from Teterboro Airport until it arrived at Albany. The plane was en route to Los Angeles where it is to be placed in coastwise service. W. K. Caughey was in charge of the controls at Whippany.

Reduction of Noise in Cables by Electrolytic Condensers

By J. T. WILMARTH
Telephone Apparatus Development

TELEPHONE circuits running parallel to power lines are frequently subjected to appreciable noise induction. With cable circuits such noise may generally be reduced by directly grounding the sheath. A single ground is sufficient to protect the cable from electrostatic induction but for electromagnetic induction, two grounds are required. One should be placed on each side of the exposed section, or if — as frequently happens — the aerial cable is connected to an underground cable, a single direct ground could be placed at the aerial end of the exposed section and the underground section would serve as the other ground. Where an aerial cable connects two underground sections, additional direct grounds are not required.

Multiple grounds, however, should be avoided when there is possibility of an exchange of direct current from one ground to another, such as may result from the ground return circuits of electric railways. Such stray currents may cause corrosion of underground sheaths where they cause the sheath to become positive to earth. When tests indicate the possibility of such an occurrence, it may be necessary to break the continuity of the sheath where overhead and underground sections meet.

To provide the effect of a continuous and grounded sheath for the alternating currents induced by nearby power circuits and yet to prevent the flow of direct current, the possibility of using condensers, bridged across the insulating joints or connected to ground, was investigated. The arrangement would be as shown in Figure 1. With a continuous sheath and a direct ground at the outer end, stray current from a railway ground return might enter the cable at the grounded point, pass along the sheath in the overhead section and, leaving it along the underground section nearer the power house, cause corrosion. This is

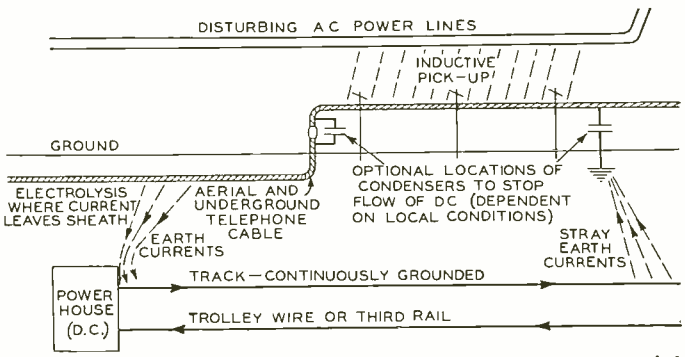


Fig. 1 — A possible arrangement of underground and aerial cable, direct current railway system, and alternating current power line showing the location of protecting condensers

likely to happen particularly if the outer ground is another underground cable sheath which parallels the electric railway line. Disturbances from alternating current circuits would be a minimum, however, because the sheath and ground would form a closed path to shield the conductors.

When, to prevent corrosion along an underground section, a break is made in the cable sheath between the overhead and underground sections, the sheath no longer acts as a shield to the alternating current disturbances.

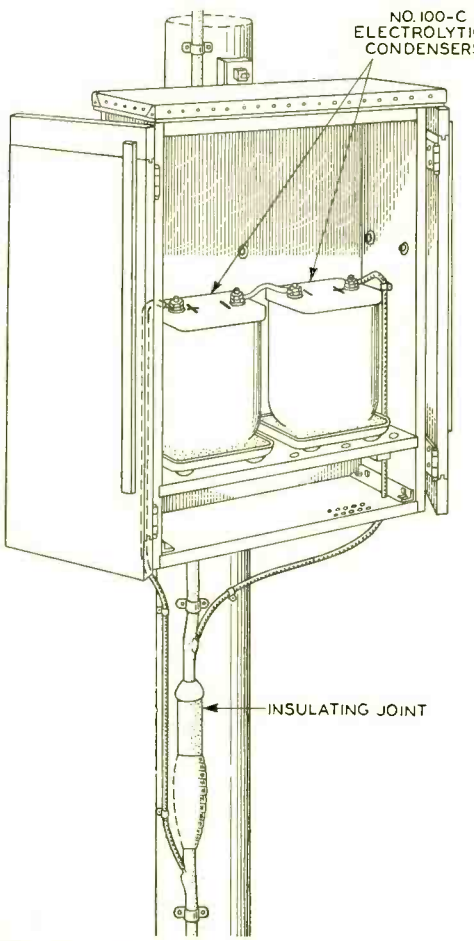


Fig. 2—Two condensers connected in series but with like polarities connected together are mounted in a standard terminal box for field use

The use of condensers at either of the points indicated in the illustrations blocks the direct currents but gives the alternating currents a closed path through the condensers, thus furnishing the necessary protection against electrolysis and at the same time providing a shielding action for noise reduction. The condensers may be placed either at the junction of the aerial and underground cables, or at the remote grounding point, depending on local conditions. Only in special cases will it be found necessary to locate condensers at both of these points on the same aerial cable.

After a series of field tests it was found that capacitances of at least 1000 microfarads would ordinarily be required to provide a path of sufficiently low impedance to prevent objectionable noise in the talking circuits. For capacitances of this size operating at low potentials, it is generally economical to use electrolytic condensers similar to those already described in the RECORD.*

These condensers consist of two sets of aluminum plates immersed in a conducting fluid. The dielectric is a film formed electrochemically on one set of plates. The other set merely introduces the potential into the electrolyte which acts as the other surface against the dielectric. The condenser so formed is polarized, blocking direct currents in but one direction. To currents of the opposite polarity it acts only as a low resistance. To secure condenser action for currents which may change in polarity from time to time, two of the condensers are connected in series but in reverse polarity. This arrangement in an installation is shown in Figure 2.

* BELL LABORATORIES RECORD, *April*, 1927, *page* 276.

e fluid commonly employed for electrolytic condensers was designed for use at room temperatures, whereas the protection of cable sheaths requires that the cells be used out of doors. The fluid is subjected therefore to temperatures which vary from those of midsummer in Arizona to those of midwinter in North Dakota, and although it would withstand the heat of summer weather, the electrolyte would freeze if the temperature dropped to thirty degrees Fahrenheit. Actual freezing will cause a considerable increase in the resistance of the electrolyte, and might even result in breaking the glass container or in buckling the aluminum plates of the condenser. Something had to be added which would prevent the solution from freezing at low temperatures, but which would not harm the plates or film. Glycerine was found to be the most satisfactory substance and it is added in sufficient amount to prevent freezing solid even at extremely low temperatures. To prevent an excessive increase in resistance with a decrease in temperature, a concentrated solution is employed for outdoor use. The glycerinated solution becomes slushy at low temperatures and its resistance rises somewhat, but the condenser still remains effective in reducing the noise because its capacitance, which makes up a large part of its impedance at frequencies corresponding to the more prominent power circuit harmonics, changes but slightly.

Occasionally a cable sheath may become crossed with a high voltage direct current circuit such as a trolley line, which would subject the condenser to a voltage considerably greater than its operating potential. To determine the effect of such an occurrence, a condenser intended for operation at 18 volts was connected to a 540-volt direct current supply with a small value of resistance in series to simulate the effect of a short length of cable between a power cross and a condenser. The results were as indicated in Figure 3.

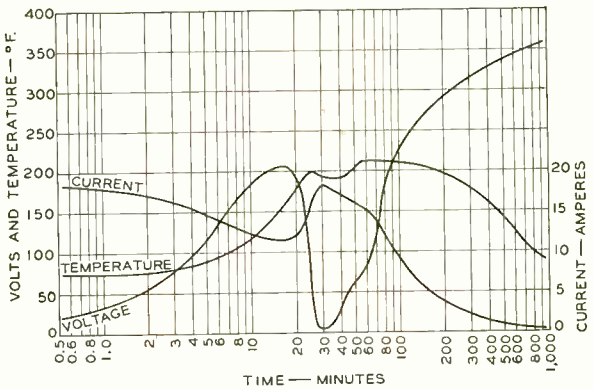


Fig. 3—A graphical representation of the result of impressing 540 volts direct current across an electrolytic condenser "formed" to only 18 volts. Resistance equal to that introduced by a short length of cable sheath is in series with the condenser

A heavy current flowed through the cell at once and began to "form" additional dielectric on the positive plate. Due to this action, the voltage across the condenser rose, and the electrolyte started heating because of the increased power input. At a temperature of approximately 160 degrees Fahrenheit the effectiveness of the film began to decrease, and as it did so, the current, which had dropped somewhat during the "forming" of the dielectric film, started to increase. This continued until the film offered almost no resistance to the current flow. The temperature of the fluid increased nearly to the boiling point.

At this time a new film apparently started to "form," which caused the original action to resume. The voltage again rose and the current decreased. The film continued to "form" until only a relatively small current was flowing and the temperature had dropped to a moderate value.

Additional cells were tested under similar conditions and all produced nearly the same results. The time taken for a cell to build up protection against these voltages depends entirely upon the resistance of the circuit and the resulting current permitted to flow through the cell, and may vary from several minutes to more than a day.

A number of these condensers have been operating in trial installations for nearly five years under severe conditions and have been entirely satisfactory. Changes in temperature and all sorts of weather conditions have proven incapable of seriously reducing their effectiveness in decreasing interference from power lines.

Carrier Telephone Cable to Cuba

A carrier-telephone cable embodying latest developments of the Laboratories will soon be placed in operation between Key West and Havana to care for increasing telephone traffic. Extending 127 miles across the mile-deep Florida straits, it is to be the longest deep-sea cable to be operated on a carrier basis. Frequency ranges up to 30,000 cycles will be utilized.

Whereas existing telephone cables between United States and Cuba are of the loaded type, the new cable will be non-loaded. Through carrier operation it will provide as many circuits as do three of the present cables on this route.

Short Cuts in Drafting

By W. L. HEARD
Equipment Development

CIRCUIT and equipment drawings, giving all information for manufacture, installation, and maintenance, are essential elements in the production of telephone plant. Their cost is far from negligible, sometimes running to several hundred dollars per tracing. In studies leading to cost reduction, therefore, which comprise an important part of the Laboratories' work, they cannot be overlooked. For this purpose the production of drawings may be regarded much the same as the production of any other part that goes into the plant of the Bell System. Each step in their manufacture should be studied and advantage must be taken of new procedures, materials, or equipment which will reduce their overall cost.

One of the characteristic traits of cost reductions is the importance of small savings. The use of electrically operated erasing machines shown above, and electrically operated ink dryers, which furnish a supply of hot or cold air to dry heavy lines rapidly, are but two of the many possible small economies. Other and greater savings, covering special methods of preparing elaborate drawings and tracings,* or improved tools** for the draftsman's use, have already been described in the RECORD.

A recent development strikes perhaps even more directly at the cost of making drawings. Usual procedure makes an initial pencil sketch on paper which is then traced to furnish the

* BELL LABS. RECORD, *September*, 1927, *p.* 22.
** BELL LABS. RECORD, *February*, 1928, *p.* 194.

Motor-driven driers reduce the drying time, during which little work can be done on the tracing without danger of blotting

master copy for the production of blueprints. It is obvious that a considerable saving would result if the tracing step could be omitted, if blueprints could be made directly from the pencil drawings. This has offered many difficulties, however. Efforts have been made to find some grade of tracing paper which would permit the use of a pencil and yet make suitable prints, and some success has been obtained. If the paper is satisfactory for the use of hard pencils, however, it is generally too dense to make satisfactory prints, or vandykes, while if soft pencils are used, the drawings are apt to smear, particularly if extensive changes are required. Then, too, the life of a paper drawing is very short when used in a blueprint machine, and the ease with which they are torn further shortens their period of usefulness.

Regular tracing cloth has been unsatisfactory for this purpose because it will not take lead, but recently a new cloth has become available which seems to solve the problem. It has a finely woven mesh with a dull finish on one side and on the other a glossy finish designed for pencil. A fairly hard pencil, either F or 2H, may be used depending on the touch of the draftsman. Since the drawing is made on the glossy side, dirt is not readily picked up and the drawing will not smear while being worked on. The life and freedom from tearing is about the same as for the ordinary tracing cloth.

Such pencil drawings may be used as masters for making vandykes or reproduced tracings may be made from them either by the "Litho" or "See Bee" process which have already been described in the RECORD.* Either of these two methods will yield the equivalent of a regular tracing from

* BELL LABORATORIES RECORD, *November*, 1927, *p.* 88.

a pencil drawing without the extensive and costly labor of tracing. Whether the pencil drawing will be used to make reproduced tracings or serve as a master itself, depends chiefly on the life that is expected of the drawings and the extent of the changes that may be required. In either case the blueprints resulting are indistinguishable from those obtained by the more usual procedure.

The new method is a distinct step forward in the reduction of drafting costs. It is estimated that nearly one half of the draftsman's time is saved since all the layout work usually done with pencil may be done on the original drawing.

United States Is World's Greatest Telephone Country

The latest telephone census shows a total of 32,712,284 *telephones in the entire world on January* 1, 1929. *Of these* 19,341,295, *or* 59 *percent, were in the United States. On the same date Europe had* 9,236,685 *telephones, which is less than one-half the number in the United States and* 28 *percent of the world's total. The remaining* 13 *percent of telephones were distributed widely throughout the rest of the world. During* 1929 *the number of telephones in the world increased by* 1,726,908, *about one-half of the increase resulting from telephone development in the United States alone.*

Vail Medal Awards for 1929

TWO gold medals and seven silver medals have been awarded by the National Vail Medal Committee to men and women selected from the fifty-five to whom bronze medals were awarded during 1928 by Associated Companies of the Bell System.

To be selected for National Vail Medal recognition an act must have for its objective the accomplishment of something of real value in the public interest through the medium of Bell System facilities, organization, training or experience, and must reveal to a high degree many, if not all, of the positive qualities of intelligence, initiative and resourcefulness, and usually courage, endurance and fortitude.

Awards and Citations

Gold medals to Gerald Taylor Mahaffey and Gladys I. Gibson; silver medals to James Joseph Roonan, Benjamin George Spaeth, Walton Andrew Turner, Jr., all of Cleveland, Ohio, for conspicuous courage in saving human life, resourcefulness, loyalty and devotion to duty in the face of grave personal danger.

A fire and several explosions in the Cleveland Clinic immediately filled the building with poisonous gas which caused more than one hundred deaths. Miss Gibson, the private branch exchange operator, perished at her post although escape was open. Mr. Mahaffey, Mr. Roonan and Mr. Turner at great personal peril rescued many persons. Mr. Spaeth and also Mr. Mahaffey organized telephone personnel and facilities to restore service and care for a flood of telephone calls incident to the disaster. Mr. Roonan and Mr. Turner assisted in the installation of emergency telephone equipment, remaining on duty for nearly forty-eight hours until service was permanently established in a nearby building.

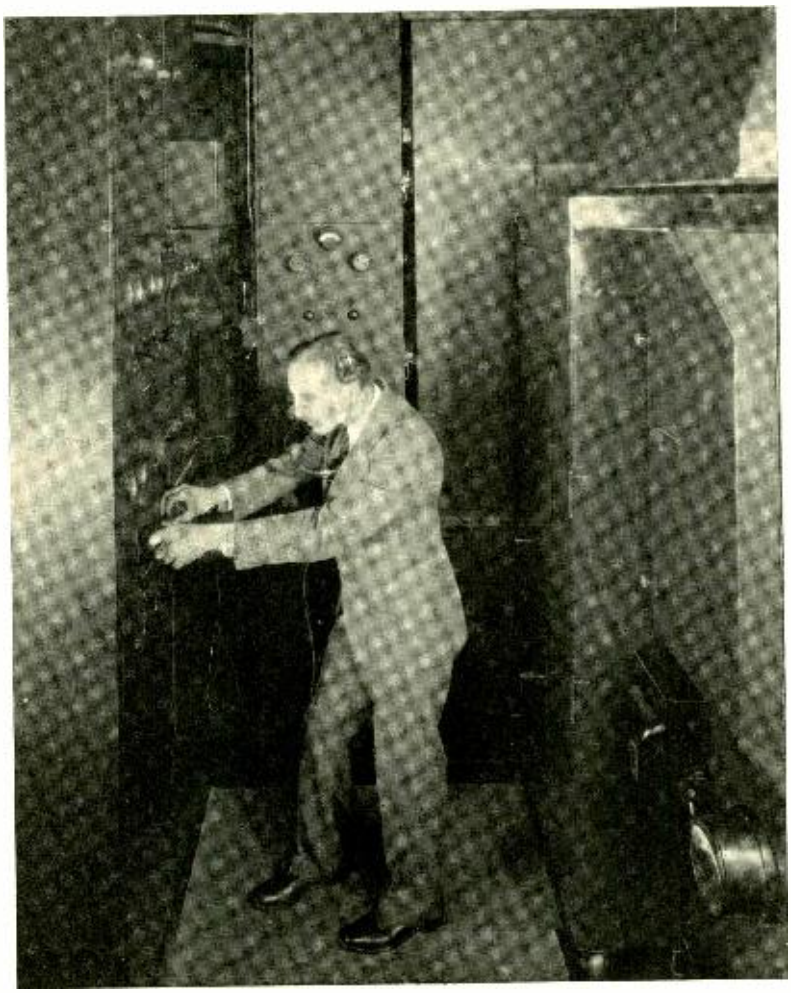
Silver medal to Vivian Harper, Elba, Alabama, for courage, initiative and devotion to duty in continuing telephone service despite grave personal danger at a time of flood which eventually destroyed the central office.

Silver medal to Ephraim Walter Decker, Rosebank, New York, for prompt and courageous action and persistent application of artificial respiration which resulted in saving a human life after electric shock.

Silver medal to Iola Delett Gibbons, Woodbridge, New Jersey, for courageous action and devotion to duty during an emergency following an explosion and fire which wrecked the building adjoining the central office.

Silver medal to Myrtle Dorothy Dull, Elmdale, Kansas, for courage, initiative and exceptional devotion to duty in continuing telephone service in the face of grave personal danger during a severe flood.

NEWS AND PICTURES *of the* MONTH



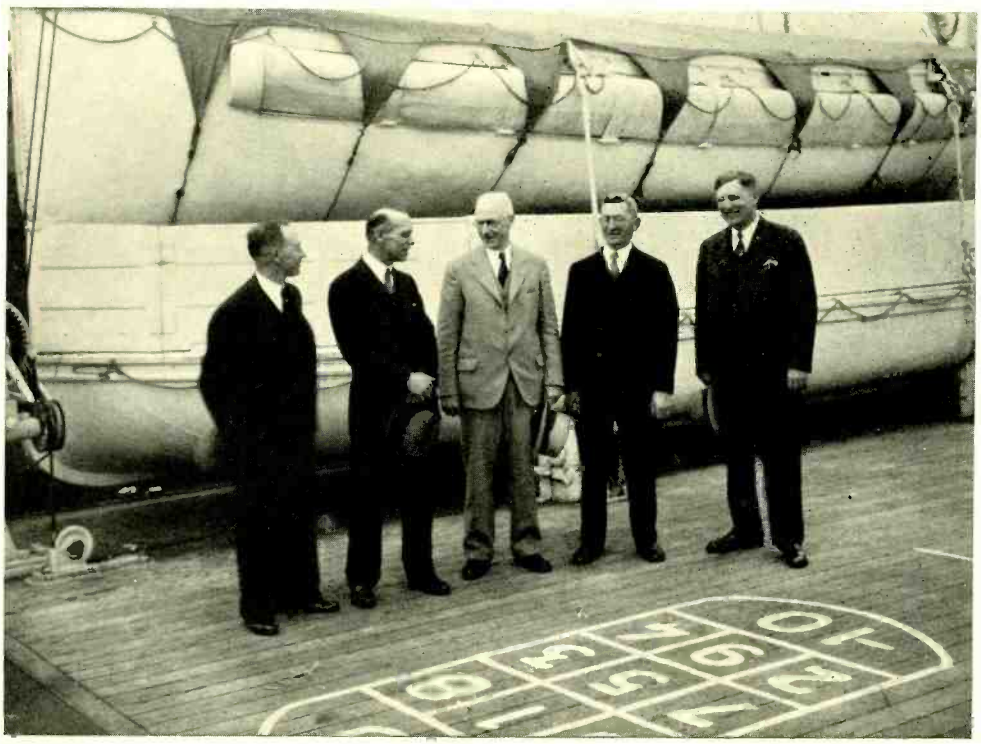
J. G. Knapp at the control board of the apparatus used in the two-way television demonstration

General News

WITH the object of visiting telephone companies in capitals and industrial centers of Europe to observe operating practices, maintenance and equipment, W. Fondiller, W. H. Matthies, H. N. Van Deusen, O. F. Forsberg, and C. Borgmann sailed for Europe on May 2 on the *S.S. Paris*. In addition they plan to investigate new developments in magnetic materials, plastic molding compounds, die-casting alloys, rustless iron and steel, finishes for materials, base metal contacts, and like developments of the European telephone industry. Mr. Fondiller plans also to attend the World Power Conference at Berlin in June and will act as a delegate to the International Electrotechnical Commission which will hold sessions at Stockholm, late in June.

* * * *

ADDRESSING the Executives' Luncheon on May 15, H. Blair-Smith, Treasurer of the American Telephone and Telegraph Company, described the work of his department. There are now over 500,000 stockholders of that company, of whom about 90,000 are Bell System employees.



Members of the Laboratories embark for Europe. Left to right: C. Borgmann, W. H. Matthies, O. F. Forsberg, W. Fondiller, and H. N. Van Deusen

K. P. Seacord, A. Meyer, and J. C. Steinberg examine the automobile horns tested in the Laboratories for the Noise Abatement Commission of New York City

About one-fifth of all the security holders of the United States are holders of securities of the Bell System. Mr. Blair-Smith was accompanied by C. S. Van Cise and W. J. Stout, Assistant Treasurers.

At a previous luncheon, accounting problems of the Bell System, ranging from the preparation of eleven million subscribers' bills every month to the tabulation of statistics fundamental to all plans for the future, were reviewed by C. A. Heiss, Comptroller of the American Telephone and Telegraph Company. Other guests were J. F. Behan, C. Uhrig, P. W. Saxton, R. B. Shaver, S. L. Andrew, T. R. Keyes, and J. W. Green of Mr. Heiss' staff.

Responsibilities of the American Company's Legal Department were outlined by J. H. Ray, General Solicitor, at the Executives' Luncheon on April 17. Of particular interest were some of Mr. Ray's experiences in connection with the projected transatlantic telephone cable system.

* * * *

THE NERVE-GRATING qualities of automobile horns and means necessary for relief were demonstrated in the Laboratories on April 23 before members of the Noise Abatement Commission and the National Automobile Chamber of Commerce, together with members of the Society of Automotive Engineers. These tests were repeated a week later before an informal jury of newspapermen, each of whom was furnished with a tally sheet on which he was asked to indicate his judgment as to each horn.

Thirty-four commonly used automobile horns were arrayed on a table in a sound proof room of the Acoustical Research Department. The newspapermen were asked to rate the horns from the standpoints: (1) sufficiently startling to be objectionable; (2) not adequate as to loudness in presence of street noises; (3) louder than neces-

sary to overcome street noises; (4) disagreeable sound. The tests in the presence of street noises were effected by combining the horn blasts with street noises reproduced at a loudness of 80 decibels from phonograph records made of actual noise conditions encountered in recent tests at busy New York street corners.

The loudness of pitch of each of the horns was tested by means of a harmonic frequency analyzer. It was shown that there was considerable energy in the range above 2000 cycles —well toward the top of the piano scale — which, when abruptly sounded as an automobile warning signal had a highly disturbing effect on the nervous system. To give the audience an idea of what might be expected were the horn manufacturers to redesign their products so as to minimize these high frequencies, certain specified pitch ranges were eliminated by the filters and the auditors were asked to note the improved quality, from the standpoint of the jarring effect on a person's nerves, of the horn. In earlier tests by members of the Laboratories' technical staff the noise intensities of the horns were measured by means of the noise meter developed by the Laboratories and used in the city wide survey under the auspices of the Noise Abatement Commission.

The demonstration was supervised by Harvey Fletcher who is a member of the Noise Abatement Commission J. C. Steinberg, W. B. Snow, D. W. Farnsworth, K. P. Seacord and A. Meyer assisted Dr. Fletcher and have been active on these noise abatement tests which have been carried out over a period of several months.

* * * *

A DEMONSTRATION of two-way radio-telephone communication from the Laboratories' tri-motor plane was a prominent feature at the opening of the New York Air Show on Saturday, May 3. Eddie Rickenbacker, vice-president of the Fokker Company and former war ace, spoke from the plane which circled above New York, for the most part at a height above 5,000 feet. At the ground station at Madison Square Garden, H. E. Young of the Western Electric Company was in charge and introduced Capt. Frank Hawks, holder of the non-stop transcontinental record, Ruth Elder, Luther K. Bell of the Aeronautical Chamber of Commerce and other notables of the aviation world, as they spoke with Capt. Rickenbacker. In his talk from the plane which was broadcast by both the National and Columbia systems, Capt. Rickenbacker described the view from the air and the group of planes flying about the Ford plane, and spoke of the great advance in aviation made possible by the radio-telephone in safeguarding flying. Graham McNamee representing the National Broadcasting system, Ted Husing, the Columbia network, and several newspaper representatives were also in the plane.

Capt. A. R. Brooks, with P. D. Lucas as co-pilot, handled the Laboratories plane. F. S. Bernhard was in charge of the transmitting apparatus, assisted by F. B. Woodworth. At the ground station at Whippany W. K. Caughey, assisted by J. P. Dolbear, was at the controls. An auxiliary receiving set manned by E. S. Dobson and J. M. Henry, was set up at the Columbia Broadcast building.

* * * *

THE LABORATORIES was host, on May 13, to about 75 officers of the Atlantic fleet anchored on the Hudson. Divided into several groups, the

officers were taken on an all-day inspection tour of the various departments and manifested keen interest in the numerous aspects of the Laboratories work demonstrated to them. The aviation officers in particular showed great curiosity as to the plane and ground station equipment and method of operation of the aircraft radio apparatus. Arrangements for the tour of the building were in charge of G. F. Fowler, assisted by A. H. Leigh, S. T. Curran, A. M. Robinson, R. F. Massonneau, E. J. Kane, W. C. F. Farnell and P. M. Neave. The developments demonstrated and those in charge were: Aircraft Radio Equipment, R. S. Bair; Carrier Development, H. S. Black; Step-by-Step Telephone System, W. E. Viol; Standard Frequency Development, W. A. Marrison; High Power Vacuum Tube Development, H. E. Mendenhall; Panel Type Telephone System, O. A. Adam; Sound Picture Laboratory, H. S. Price; Two-Way Television, J. G. Knapp and A. L. Johnsrud.

* * * *

WHAT WAS perhaps the most widespread publicity yet given to a Laboratories development was accorded to two-way television following its first public demonstration on April 9. Accounts of this new communication advance, totalling in most instances more than three-quarters of a column, appeared in practically every newspaper in the country in cities of more than 50,000 population. Liberal mention was also made in many smaller newspapers. In addition the development was widely written up in foreign newspapers and later in Sunday supplements and numerous magazines.

The machinery for this publicity venture was set into motion several weeks previous to the demonstration. A press release was written and accompanying statements prepared by President Gifford and Dr. Jewett; mimeographed copies run off; photographs were taken and schematic drawings of the functioning of the apparatus were made. An illustrated booklet with an attractively designed cover was prepared and printed for distribution with the press releases. Invitations to send representatives to the demonstration were sent by Dr. Jewett to the managers of the large press services, and to the editors of all of the New York City and nearby dailies, and also for a showing two days later to representatives of general and technical magazines.

The magnitude of these preparations was on account of widespread popular interest in television and in no way indicative of the value placed upon this development by the Bell System. These anticipations were well borne out by the prominence given the story by the press throughout the country, but the conservative statements as to the technical and economic situation of television as issued by our executives served to hold popular prophecy within some bounds of reason and probability.

As a conclusion to the work, a printed copy of the press release and a zincographed folder of representative newspaper clippings on television, together with a copy of the illustrated booklet, were sent to the various schools of journalism throughout the country. This provides some interesting "source material" illustrating a method whereby modern industrial organizations make known to the world their technical achievements, and the styles of newspaper treatment of the material.

Departmental News Notes

Administration

On April 27, at the special invitation of the Canadian National Railways officials, Dr. Jewett was one of the party on the special train operating on the new six-hour schedule from Toronto to Montreal on which two-way telephone conversation from moving trains was formally demonstrated to the press and a numerous assemblage of officials and other guests. Following this demonstration he went to Washington where he attended the annual meeting of the National Academy of Sciences.

Dr. Jewett and Vice-President H. P. Charlesworth were at the operating conference at the Sea View Golf Club at Absecon from May 7 to 14.

With Thomas A. Edison, Dr. Robert A. Millikan, and other distinguished scientists, Dr. Jewett participated in a symposium on *The Future Service of Electronics to Mankind* in the inaugural issue of the magazine *Electronics*.

Messrs. Charlesworth, Arnold, Dixon, Jones and Grace visited the Hawthorne Works of the Western Electric Company for a few days last month.

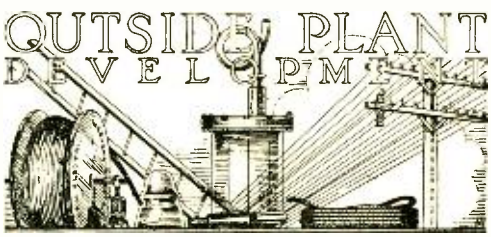
During the past month S. P. Grace and R. M. Pease were received by large audiences at Indianapolis and Salt Lake City in addresses and demonstrations of recent developments in the communication field. On May 7 at Indianapolis Mr. Grace's talk was the feature of the afternoon session of the Indiana Telephone Association meeting in its annual convention. At night he spoke before the local section of the A. I. E. E. and an invited audience which jammed Keith's Theatre in Indianapolis to the doors. On May 15 the talk and demonstration were given before a large audience at the West Side High School auditorium at Salt Lake City.

On April 22 W. A. Shewhart attended a meeting of Committee E-1, Methods of Testing, of the American Society for Testing Materials in Philadelphia. At this meeting he reported the progress of the newly formed technical committee on presentation of data and outlined the tentative plans of the committee for the ensuing year.

Apparatus Inspection—S. H. Anderson visited Providence to discuss power equipment installed in station WJAR of that city. He also attended a quality survey on gasoline engines for engine generator equipment at the Buffalo Gasoline Motor Company in Buffalo. ¶ R. M. Moody visited the Gray Telephone Pay Station Company at Hartford in connection with coin collectors. This company manufactures all of the coin collectors for the Bell System. ¶ E. G. D. Paterson and R. D. Smith attended quality sur-

veys on outside plant equipment held at the plants of the Seamless Rubber Company and the United States Rubber Company in New Haven and Providence respectively. At Providence they were joined by A. F. Gilson who then accompanied Mr. Paterson to Cambridge (Mass.) to discuss bronze drop wire with the Simplex Wire and Cable Company. Mr. Paterson later visited the American Brass Company at Waterbury in the same connection. Mr. Gilson was also at the Western Company's new cable plant at Point Breeze. ¶ Also on quality survey work W. H. Stracener (hard drawn copper line wire), and J. F. Chaney, on various types of switchboard plugs, were at Hawthorne. At Kearny H. F. Kortheuer attended a survey on voice-frequency telegraph equipment and H. C. Cunningham was present at a similar survey on filters and networks.

Systems Inspection—An examination of the ringing machine equipment in the unattended step-by-step office at Delmar (N. Y.) was made by H. K. Farrar. ¶ Various matters pertaining to the recently installed step-by-step system were discussed by D. S. Bender with representatives of the operating company at Worcester. ¶ R. C. Kamphausen, field engineer in the Detroit territory, visited Niles (Mich.) to investigate an engineering complaint on toll and subscriber's line noises. Mr. Kamphausen was also in Kalamazoo to inspect the receiving end of the new toll line dialing project between that city and Jackson, and later spent several days in New York discussing field engineering matters with other members of the department. ¶ Visits to Baltimore, Washington and Richmond were made by I. W. Whiteside, field engineer in the Philadelphia territory, in connection with complaint investigation and field review conference work. He was also in New York to discuss various engineering complaints with the investigating engineers. ¶ C. A. Johnson made trips to Evanston, Arlington Heights, Crystal Lake, Riverside, Aurora, Joliet and Lockport, Illinois, and Milwaukee, Wisconsin, in connection with general field engineering and complaint matters. In this same connection R. C. Koernig visited Sioux City, Fargo, Denver, and Minneapolis; and H. W. Nylund visited Arcadia, Oceanside, Del Mar, La Jolla, Pacific Beach and San Diego, California. ¶ W. E. Whitworth has been appointed field engineer in the Cleveland territory replacing G. Garbacz. A. G. Dalton, accompanied by Messrs. Whitworth and Garbacz, visited Cleveland, Cincinnati and Columbus to introduce Mr. Garbacz to the Ohio and the Cincinnati and Suburban Bell Telephone Company people, and to the Installation and Distributing House forces of the Western Electric Company.



D. A. Quarles, C. D. Hocker, and L. H. Campbell, with several members of the American Telephone and Telegraph Company, made a trip to New Haven to examine experimental paint colors on cable terminal boxes, aerial loading-coil pots, and associated aerial equipment. ¶ R. J. Nossaman spent three weeks with the New York Telephone Company in the

Long Island area, observing Outside Plant construction work.

Cable Development—Visits to the Point Breeze works were made by L. S. Ford and R. P. Ashbaugh in connection with general cable development problems. They also visited Norfolk to observe the installation of some tape-armored cable. Mr. Ashbaugh spent several days at Kearny and New York on cable development problems. ¶ Accompanied by engineers from the American Telephone and Telegraph Company, J. G. Brearley went to Bridgeport to observe a commercial trial installation of lead-covered cable having a new type of sheath. ¶ W. C. Redding and several American Telephone and Telegraph engineers attended at Cleveland a commercial trial installation of lead-covered cable in which a new type of paper insulation is employed.

Ceramics Apparatus—C. D. Hocker visited Pittsburgh, Altoona, State College and Sandy Hook, to observe the corrosion resistance of A. S. T. M. sheet and hardware samples finished with various protective coatings. ¶ W. H. S. Youry attended inspection survey conferences on rubber gloves at the Seamless Rubber Company plant in New Haven and at the United States Rubber Company at Providence. ¶ V. B. Pike and F. D. Waldron went to the United States Gauge Company plant at Sellersville, Pennsylvania, to inspect the fifteen gas-tight cable terminals and associated pressure contactors recently procured for field trials. Mr. Pike also made several trips to Delaware in connection with placing the toll cable between Wilmington and Dover under gas pressure. ¶ A field trial on a new method of sealing the joints of clay conduit was observed by J. M. Hardesty and S. M. Sutton at Philadelphia. ¶ On durability tests of vehicle paints, L. H. Campbell visited New Haven to supervise the application of paints on a number of line installation trucks of the Southern New England Telephone Company.

Wire Development—C. S. Gordon and W. J. Lally have been at Pittsburgh in connection with development work on weather-proof finishes for wire. Mr. Gordon, with members of the Inspection Engineering and Research Departments, visited also the American Brass Company plant at Waterbury on development work on alloy conductors. In addition he went to New Haven with members of the Western Electric and American Telephone and Telegraph Companies to check up on manufacturing facilities for the production of construction tools. ¶ Work in regard to the manufacture of sleeve-rolling tools required C. R. Moore's presence at Hawthorne. While on this trip he visited the M. Klein and Sons Company plant in Chicago on matters concerning the manufacture of linemen's climbers. ¶ W. S. Hayford made several visits to our Chester field laboratory in connection with sleeve joints for line wire.

Plant Apparatus—C. H. Amadon and G. Q. Lumsden, with several members of the Chemical Research group, were in Gulfport and Jackson, Mississippi, to develop methods of creosoting southern yellow pine poles and crossarms. ¶ S. C. Miller and L. W. Kelsay were at Hawthorne to discuss new designs of outside plant apparatus. ¶ C. H. Klein went to Asbury Park to select land for earth-anchor tests.

THE SPRING meeting at Washington of the Society of Motion Picture Engineers, May 6-8, was attended by the following members of the Research Department: H. Fletcher, L. J. Sivian, E. C. Wente, D. D. Foster, L. E. Hunt, H. C. Harrison, D. G. Blattner, P. B. Flanders, H. F. Hopkins, A. C. Keller, H. B. Ely, L. F. Smith.

A REPORT ON outdoor noises was read by R. H. Galt at the meeting of the Acoustical Society at Grand Central Palace on May 9. Mr. Galt's data was gathered in recently conducted noise surveys. At this meeting L. G. Bostwick read a paper entitled *An Efficient Loud Speaker at Higher Audible Frequencies.* About forty members of the Laboratories were in attendance. At this meeting Harvey Fletcher was re-elected president of the society.

AT THE MEETING of the American Physical Society at Washington, April 24-26, F. S. Goucher read a paper *Contact Resistance and Microphonic Action.* Other members of the Research Department who attended the meeting were P. P. Cioffi, R. M. Bozorth, C. J. Christensen and J. M. Eglin.

THE FOLLOWING members of the Research Department attended the meeting of the American Chemical Society held in Atlanta: B. L. Clarke, W. Hartmann, H. W. Hermance, J. H. Ingmanson, G. T. Kohman, P. A. Lasselle, A. E. Schuh, L. T. Smith, A. H. Staud and L. A. Wooten.

Transmission Instruments—General questions associated with the manufacture of telephones were discussed by W. C. Jones at Hawthorne. ¶ On April 28 at the Cornish Arms Hotel a luncheon was given by the

H. A. Larlee

transmission engineering group to H. A. Larlee in honor of the twenty-fifth anniversary of his association with the Bell System. The presentation of his twenty-five year service emblem was made by H. A. Frederick and, as a gift from his associates, he was also presented with a marble desk set by A. W. Hayes. ¶ Mr. Larlee's career with the Bell System began in the inspection group of the American Bell Telephone Company in this building. He continued on this work when it was taken over by the Western Electric Company in 1907, and in 1910 he transferred from inspection work to the Engineering Department of the Western Electric. For two years he was engaged on general transmission engineering and in 1912 he was assigned to transmission instruments. On this work he was instrumental in the development of the centrally-damped transmitter and later, the sta-

tion handset, which was first put into commercial use in 1927. At the present time Mr. Larlee is in charge of engineering of transmission instruments.

Chemical Laboratories—E. E. Schumacher, with C. S. Gordon of the Outside Plant Department and E. G. D. Paterson of Inspection Engineering visited the American Brass Company at Waterbury to discuss the possibility of using a new age-hardening copper alloy for drop wire. ¶ L. T. Smith, P. A. Lasselle, C. S. Fuller and C. L. Erickson visited the Bureau of Standards and Institute of Paint and Varnish laboratories to look over apparatus and equipment pertaining to paints and enamels. ¶ In connection with their investigations of corrosion of buried specimens C. L. Hippensteel and V. J. Albano made visits to Princeton, Lawrenceville and Forked River during the past month. Mr. Hippensteel is now in California on corrosion tests. ¶ W. Orvis and W. B. Warren visited Hawthorne where they discussed problems concerned with granular carbon and observed the manufacturing processes which the carbon undergoes for use in telephone transmitters. H. Lathrop was also at Hawthorne on permalloy studies. ¶ R. M. Burns, H. E. Haring and K. G. Compton were at the Bureau of Standards on general matters regarding corrosion and battery investigations. Mr. Burns also visited Norfolk, Virginia, and Hartford in connection with investigations of tarnish on base-metal contacts. ¶ Completing their investigation of preservative methods on southern yellow pine, R. E. Waterman, C. J. Frosch and W. McMahon have returned after a five-week stay in Gulfport, Mississippi. ¶ A. G. Russell and R. B. Mears attended the meeting of the American Electroplaters' Society at Rochester. ¶ E. W. Kern and W. L. Van Arnam visited the Dupont laboratories at Philadelphia for the dual purpose of investigating testing methods and to confer on general varnish problems.

Electro-Optical Research—Representing both the American Physical Society and the Optical Society of America, Herbert E. Ives attended the fiftieth anniversary celebration of the A. S. M. E. at New York and Washington.

Transmission Research—A clock, controlled by the oscillations of a quartz crystal instead of by a pendulum and an outgrowth of a new high precision standard of frequency in use at the Laboratories, received much attention when described by W. A. Marrison before the National Academy of Sciences. A high degree of accuracy is obtained with quartz crystals which are utilized in a similar manner to those regulating the frequency in radio stations. In the clock which Mr. Marrison described, the quartz crystal vibrating at the rate of 10,000 times per second controls a generator of constant frequency which regulates a small synchronous motor operating the clock mechanism. An important application of the crystal clock may be the simultaneous operation of mean solar and sidereal clocks from the same crystal. The coupling means can be so arranged that the ratio of the rates will not differ from the assumed true value by more than a second in a century.

Acoustical Research—E. G. Shower was in St. Louis installing in the Central Institute for the Deaf a specially constructed heterodyne audiometer which has been presented to the Institute jointly by the Southwest-

ern Bell Telephone Company and American Telephone and Telegraph Company.

Physical Research — K. K. Darrow spoke on May 5 before the graduate physics seminar of New York University, University Heights, on *Mean Free Path and Diffusion of Electrons in Gases.*

Submarine Cable Research — On May 14, O. E. Buckley sailed on the *Europa* for Nordenham, Germany, on work connected with the transatlantic submarine telephone cable. While in Europe he will also attend a conference of the C. C. I. at Brussels. Earlier in the month W. S. Gorton sailed for Nordenham on the *Bremen,* also on transatlantic telephone cable work.

Tube Shop — O. J. Short completed twenty years in the Bell System on May 31.

Equipment Development — A preliminary field survey for the carrier terminal equipment associated with the new Key West-Havana Cable took W. F. Malone to both those cities. ¶ The first field installation of a new carrier telegraph pilot channel on the Chicago to Denver line was made under the supervision of J. Nedelka. ¶ L. C. Krazinski and A. J. Pascarella were at Harrisburg and Reading to inspect a new test board for high insulation testing. ¶ H. M. Hagland visited the Stromberg-Carlson Co.'s plant at Rochester to discuss manufacturing matters concerning the 506 PBX. ¶ M. A. Froberg visited Detroit to discuss the design of safety equipment for the protection of power services in telephone power plants. He also conducted tests on the power supply unit for the No. 8 test and control board which is under test at the Detroit Toll Office. ¶ J. R. Stone made a study of centrifugal exhauster equipment at Worcester. ¶ H. M. Spicer inspected the control equipment for the emergency alternator for busy signal and idle toll line indicating lamps at the General Electric plant in Schenectady. ¶ W. S. Ross went to Harrisburg to inspect unit automatic power plant for the 740-A PBX. ¶ At the Buffalo Gasolene Motor Company's factory V. T. Callahan made an inspection of the engine for an automatically controlled generator set and also the "R" engines equipped with radiator cooling units. ¶ R. L. Lunsford discussed improvements in tungar rectifiers with engineers of the General Electric Company at Boston. He also conferred with the power engineers of the New England Telephone and Telegraph Company. ¶ F. T. Forster visited the East Hartford, Conn., central office to make tests on the degree of corrosiveness of battery fumes. ¶ J. E. Rogers made final tests and attended the cutover of the 2-A order turret at Gimbel Brothers department store at Pittsburgh.

Local Circuit Development — The Laboratories learned with regret of the death of R. C. R. March of the Analysis & Testing group which occurred in St. Mary's Hospital, Passaic, after an illness of three weeks. Mr. March first came to the Laboratories in the summer of 1925 between his junior and senior years at Lehigh University. Immediately after his

graduation he returned to the Laboratories and at the time of his death worked on manual circuit analysis. He aided in the development of the manual connections for the new call announcer and was also instrumental in perfecting the connecting circuits for small community dial offices. ¶ E. H. Clark completed twenty years of service in the Bell System on May 23. ¶ W. J. Lacerte attended at Hartford, Conn., a trial of relay timing test sets; and at Worcester, inspected step-by-step switch wipers. ¶ T. F. Lefevre continued tests of improved "E" type relays at Albany. ¶ M. C. Goddard, C. P. Stocker and H. A. Sheppard inspected the unattended office at St. James, L. I., which is tributary to the Smithtown office. A stop was made at Floral Park on their return. ¶ Messrs. H. W. Flandreau and R. Mueller were at Manhasset, L. I., making tests on the 114-EA relays. ¶ R. C. Paine was at Philadelphia to observe the effect of circuit modifications looking toward reduced pitting of cams and relay contacts.

Toll Circuit Development—W. Fritschi visited Indianapolis to make tests of toll line signals. ¶ L. F. Porter and J. Meszar went to Detroit to take part in testing of the Detroit toll board. ¶ W. F. Kannenberg was at Key West making measurements of interference conditions in preparation for installation of the new Havana telephone cable. ¶ J. P. Kinzer visited trial installations of the two-wire repeater on the New York-Jacksonville circuit, at Washington, Richmond and Jacksonville. ¶ To make field tests on a trial installation of an improved carrier telegraph system, T. A. Jones was in Chicago recently. The trial equipment is installed on a New York-Chicago circuit. ¶ C. B. Sutliff at Denver and W. C. Gunter at Chicago participated in field tests of a trial installation of pilot channel equipment for use on carrier telegraph systems. The trial equipment is installed on a Chicago-Denver circuit.

Recent Service Honors—Thirty-five years with the Western Electric Company and the Laboratories were completed by F. L. Cox during April.

F. L. Cox

He began work in the Thames Street shop of the Western Company installing power and light equipment. Occasionally his group would be called upon to connect up wiring for a telephone, but as Mr. Cox explains, it was only in hotels and stores as telephones in those early days were rarely installed in residences. When the present building was being constructed he assisted in wiring the first sections—B and C. He later was permanently transferred to wiring work in this building and at the present time is in charge of the group in section 4-K which connects up new circuits for test.

DURING the past month twenty-five years of Bell System service were completed by A. C. Chaiclin, O. H. Kopp and V. W. Langborgh.

As an expert on circuits and wiring, it has been Mr. Chaiclin's fortune to have a hand in almost all of the major communication developments of the Laboratories. He worked on the original repeater circuits of the first transcontinental line; on the first transoceanic link from Arlington to Paris in 1915; the ship-to-shore demonstration in 1920; the wiring for the original demonstration of transmitting pictures over telephone wires; and on the initial carrier-frequency circuits. In addition he laid out the wiring and trained men on the short-wave receiver circuits used in transatlantic and South American telephony. He received his early training on wiring as an installer for the Western Electric and was transferred in 1912 to the Engineering Department for trial installation work. In 1928 he took charge of the wiring and maintenance of the toll development laboratory. With the transfer of part of that work to Varick Street, he has moved to the new location.

O. H. Kopp, V. W. Langborgh, and A. C. Chaiclin

O. H. Kopp began as a laboratory assistant in the circuit laboratory and worked there until 1912 when he was sent into the field at Newark and Wilmington on the first installation of panel equipment. Returning in 1916, he worked on the design of sender circuits for several years and later was assigned to special studies. At present he is engaged on the development of automatic circuits for testing senders.

V. W. Langborgh's association with the Bell System began at the Clinton Street factory of the Western Electric Company in Chicago as an equipment draftsman. His department was transferred to the then new Hawthorne works in 1907 and he came to this building on equipment drafting work during the war. In 1920 he was transferred to his present work on power engineering. Mr. Langborgh handled the power work in connection with the demonstration of transmission of pictures over wires in 1924.

Publication

L. S. O'Roark has returned from a trip to the southwest where he delivered a series of addresses on modern communication developments. On May 12 he spoke before the Telephone Pioneers of America at St. Louis and also the Senior Engineering Seminar at Washington University. On the following day he gave talks at Kansas City before the Kansas City Electric and Radio Association dinner and at the Accounting Forum dinner. On the two subsequent days he addressed respectively the Kansas Telephone Association Convention at Topeka and the engineering assembly of two hundred fifty stu-

dents at the Kansas State Agricultural College at Manhattan.

Patent

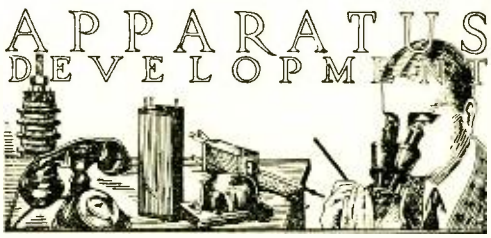
During the period from April 5 to May 5, 1930, members of the Patent Department visited the following cities in connection with the prosecution of patents: Washington, F. E. Ward, J. H. Cozzens, A. G. Kingman, W. B. Wells, E. W. Adams, W. C. Kiesel, W. C. Parnell; Urbana, Illinois, G. M. Campbell; Princeton, J. W. Schmied.

Personnel

G. B. Thomas and M. B. Long attended the spring meeting of the Atlantic Section of the Society for the Promotion of Engineering Education at Bethlehem. Mr. Long was also at Massachusetts Institute of Technology, assisting in the selection of students for the Bell System Cooperative Course. This course provides for instruction in electrical engineering at Massachusetts Institute of Technology in cooperation with the American Telephone and Telegraph Company. Selected students during the third, fourth and fifth years in the course spend alternate terms at the institute and with the Bell System.

Students from the University of Pennsylvania, Lehigh University and Pennsylvania State College made inspection tours through the Laboratories during the past month. A group of students from the Physics section of Washington Square College, New York University, in the charge of Professor Grisewood also visited the Laboratories.

Miss H. B. Mayhew, D. W. Eitner and M. L. Wilson, with other representatives of the Bell System, visited a number of high schools in New Jersey, Long Island and New York City to confer with coming graduates on employment.



General—The following members of the Department attended the meeting of the Society of Motion Picture Engineers in Washington, May 6-8: O. M. Glunt, F. L. Hunt, T. E. Shea, H. Pfannenstiehl, J. F. D. Hoge, G. Puller, W. Herriot, W. A. MacNair, R. L. Hanson, N. R. Stryker, J. Crabtree. A lecture film by Harvey Fletcher entitled *Acoustic Principles of Recording and Reproduction of Speech and Music* was presented by F. L. Hunt. Technical papers were presented as follows: C. F. Eyring—*Conditions under which Residual Sound in Reverberant Rooms May Have More than One Rate of Decay;* N. R. Stryker—*Scanning Losses in Reproduction;* R. L. Hanson—*A Type of Acoustic Distortion in Sound Recording.*

Materials Development—By invitation of the National Academy of Sciences F. F. Lucas presented a paper *The Architecture of Living Cells as Shown by Optical Sectioning with the Ultraviolet Microscope and Recent Advances in Methods of Biological Research* at the annual meeting of the Academy in Washington April 28-30. He repeated the discourse on May 7 at the seminar of the New York Homeopathic Medical College and Flower Hospital. In his capacity of consulting engineer for the

War Department Mr. Lucas visited the Watertown (Mass.) Arsenal during the latter part of April. ¶ H. N. Van Deusen and D. T. May visited the Nevins office of the New York Telephone Company to discuss matters involving base metal contacts. Mr. Van Deusen was also in Hawthorne to confer on various materials problems. ¶ Base metal contact investigations were also undertaken by E. Montchyk in visits made to unattended step-by-step offices at Pearl River, Haverstraw and Croton and by C. E. Nelson who went to Topeka, Kansas, and Harrisburg, Pennsylvania. On this same work L. E. Dickinson made a prolonged visit to Trenton during the latter part of April. ¶ H. G. Arlt has been at Hawthorne on general matters concerning finishes, particularly color finishes for handsets, on which he is working at the present time. ¶ The control of the extrusion temperature for lead-calcium cable sheath occasioned a recent visit of J. R. Townsend at Kearny where he discussed the problem with Mr. Rossbacker of the Cable Shop. He also attended a recent committee meeting of the A. S. T. M. at Philadelphia. ¶ At the Queensboro Works of the Western Electric Company H. E. Van Siclen conferred on finishes for telephone booths.

Dial Apparatus — C. G. McCormick was at Worcester to investigate adjustment practices on step-by-step switches of Western Electric manufacture. ¶ In connection with an investigation of requirements for line-finder switches, P. T. Higgins was in Hartford where he inspected equipment in a step-by-step PBX office. ¶ B. Freile recently made a survey of unattended step-by-step offices in Rockland and Westchester counties with engineers of the New York Telephone and the American Telephone and Telegraph Companies.

Manual Apparatus — F. A. Kuntz visited the Queensboro Works of the Western Electric Company in connection with the manufacture of the new telephone booth. ¶ B. O. Templeton together with R. M. Moody and R. Burns visited the plant of the Gray Telephone Pay Station Company in Hartford to discuss various features in the design of coin collectors. ¶ C. W. Stevens formerly of the Commercial Relations group has been transferred to work on Manual Apparatus design.

Transmission Apparatus — An inspection of the crosstalk measuring equipment to be used in the manufacture of new loading coils was made at Hawthorne by J. E. Nielsen. R. M. C. Greenidge was also at Hawthorne to discuss improved methods of insulating permalloy dust for loading coil cores. He also was interested in the continuous assembly of loading coil units. ¶ A. C. Walker was at Point Breeze in connection with the testing of purified textiles and the installation of a high sensitivity humidity recorder. In conjunction with E. J. Ernst he has had two articles, *Preparation of Air of Known Humidity and its Application to the Calibration of an Absolute-Humidity Recorder* and *Moisture Content of Compressed Nitrogen* published in the recent Analytical Edition of *Industrial and Engineering Chemistry*. ¶ W. R. Lyon was again at the Pittsfield plant of the General Electric to test equipment to be used with high voltage rectifiers at Whippany. ¶ J. A. Kater conferred at Hawthorne on the development of mica condensers to be used on a trial installation of carrier on cable. ¶ D.

R. Brobst who has been active on the development of lacquered wire visited Point Breeze to observe the manufacturing processes inaugurated for the production of the wire.

Radio Development—The installation of a 1 kw transmitter and associated speech input equipment for the Richmond Development Company's station WRBX at Roanoke was supervised by B. R. Cole. ¶ J. C. Herber conducted a survey of proposed locations for the installation of a 1 kw Radio Telephone Broadcasting Equipment for the Onondaga Company, Inc., Syracuse, N. Y. ¶ The conversion to crystal control of the 1 kw transmitter operated by the city of Camden and the installation of the 1 kw transmitter and special input equipment for the Waterloo (Iowa) Broadcasting Company were supervised by F. H. McIntosh. ¶ J. F. Morrison inspected stations WHK of the Radio Air Service Corporation, Cleveland, and WSPD of the Toledo Broadcasting Company, Toledo. While in Cleveland he visited WTAM-WEAR, Inc., to discuss the proposed installation of Western Electric speech input equipment. Mr. Morrison completed surveys of the proposed location of a 1 kw Radio Telephone Broadcasting Equipment for the WHB Broadcasting Company, Kansas City and of the sites for relocating the 1 kw station WREN of the Jenny Wren Company, Lawrence, Kansas. ¶ Inspection of two-way radio-telephone equipment and flight tests were made by J. W. Greig at Detroit on the F-32 Fokker plane purchased by L. F. Fisher of the Fisher Body Corporation, and by D. B. McKee on a Marine Corps Vought-Corsair plane at Hadley field during the past month. ¶ W. C. Tinus supervised the installation of Western Electric radio telephone equipment in the ground station of Boeing Air Transport, Inc., at Cheyenne, Wyoming, and in several trimotored Boeing passenger planes. ¶ F. B. Woodworth is en route to Libbyville, Bristol Bay, Alaska, to direct the installation of Western Electric radio-telephone equipment for Libby, McNeill and Libby. Radio telephone equipment is to be installed on the cannery tender "David B" and at the salmon cannery at Libbyville. ¶ F. W. Cunningham appeared as an expert witness before the commission holding hearings on the Columbia Broadcasting System's application to establish plant equipment at Hempstead. ¶ C. F. Boeck visited Montreal and Toronto to attend the preliminary demonstration of the Train Communication System installed on the *International Limited* of the Canadian National Railways. The use of this equipment was officially inaugurated shortly afterward by conversation between London and the moving train. ¶ To coordinate the operation of printing telegraph apparatus with radio reception, H. T. Budenbom, C. J. Custer and W. Y. Lang visited several airports in the Metropolitan district, in New Jersey and Long Island. ¶ Upon the invitation of the Department of Physics at Princeton University, C. B. Aiken spoke on *Radio in Aviation* at the Palmer Physical Laboratory on May tenth.

Special Products—Problems of factory production of the reproducing system recently announced by ERPI for small theatres took H. Pfannenstiehl and G. Matejka to Hawthorne. Other visitors to Hawthorne were E. W. Gent, concerning portable sound-

recording equipment, and J. H. Sailliard, who was interested in motor drives for theatre reproducers. ¶ J. E. Crowley, who supervised the installation of the horns used in the public address system in the Atlantic City convention hall, and W. L. Betts, designer of the horns, were at Atlantic City to inspect the functioning of the system. They were accompanied by P. H. Betts, representing the Inspection Engineering Department. The public address system in the Atlantic City hall is the largest in the country. ¶ In the new addition to the High School at Milburn, New Jersey, the Board of Education has decided to install an extension of the system. J. E. Crowley recently visited Milburn to secure data for engineering the new system. ¶ So exacting are the requirements placed upon the sapphire knife which shaves wax discs for sound recording, that R. Nordenswan visited the factory of a supplier at Perth Amboy to offer suggestions as to manufacture and inspection.

Electrical and Acoustical Development — H. C. Curl visited Newport News to inspect the announcing systems installed on the United States Navy cruisers *Augusta* and *Houston,* latest of the treaty cruisers and similar to the *Pensacola* recently completed at Brooklyn. Both are equipped with an announcing system to provide instantaneous transmission of commands and information from central points to all parts of the ship.

Recent Service Honors — May 2, the date on which O. F. Forsberg sailed for Europe with other Apparatus Development members, marked also the anniversary of his thirty years with the Bell System. He began as a model maker in the Clinton Street factory of the Western Electric and for several years previous to his coming to New York in 1907 he was foreman of the model room in Chicago. As a designer in the model room of the present building he worked for a number of years on coin collectors and those in use at the present day still retain many features of Mr. Forsberg's design.

In 1913 he was transferred to the Dial Apparatus Development Department. His work here has been supervising the development of new design problems on both the panel and step-by-step apparatus, necessitated by the extended use of the dial system during this period.

His wide experience with the various kinds of telephone apparatus resulted in his being selected to make the trip abroad which is being undertaken to promote the interests of our development work. Mr. Forsberg is shown third from the left in the picture of the group taken on the French liner *Paris*.

TWENTY YEARS in the Bell System were completed by L. E. Dickinson on April 1.

STAFF

In W. B. Wallace's forty years with the Bell System, he has seen its personnel grow from less than ten thousand to more than 450,000. After some twenty years in the financial department of the Western Electric Company, he became in 1911 the Credit Manager of its Atlanta House. In 1924 he became an Assistant Treasurer of Western Electric. Upon the incorporation of the Laboratories in 1925, he was elected its Treasurer. In addition to his responsibility for receiving, safeguarding and disbursing the Laboratories' money and securities and for insurance matters,

W. B. Wallace

Mr. Wallace has always made time for members of the Laboratories who wished to take advantage of his long and varied financial experience by consulting him on matters of personal finance, investment and insurance.

Plant—W. G. Knox attended the meeting of the Paint and Varnish Division, American Chemical Society, held in Atlanta during the week of April 7. ¶ At the invitation of Navy officials, G. F. Atwood visited the Naval Research Laboratory in company with F. R. Lack and O. M. Hovgaard, to discuss quartz-crystal manufacture. ¶ J. G. Motley represented the Laboratories at the convention of the National Fire Protection Association at Atlantic City. ¶ Building operations at Deal Beach, Holmdel, Mendham, and Whippany took S. H. Willard to those outposts of the Laboratories early in May. ¶ Preparation of the Graybar-Varick Building for occupancy goes on apace under the supervision of G. F. Morrison.

Commercial Relations—B. B. Webb and H. W. Dippel were at Chattanooga recently to visit the American Lava Corporation in regard to the supplying of certain purchase requirements of the Laboratories. ¶ G. B. Graeff of the Purchasing Department was at Lynn, Massachusetts, to discuss deliveries of special power equipment.

General Service—D. R. McCormack attended during May the annual convention and exposition of the International Association of Blueprint and Allied Industries held at St. Louis.

Recent Service Honors—The fourth day of last month marked the completion of Edward Boland's forty-five years of service, one of the longest in the entire Bell System. Back in 1885 he entered the employ of the Western Electric shop then located on Church Street, New York. At that time the manufacture of telegraph instruments was a prominent part of the Western Company's activities and it was on this work that Mr. Boland began his employment. Shortly afterward the shop was moved to Thames Street and in 1898 when the first sections of the present building were completed, he came here with his department and was placed in charge of a group making coin boxes. In 1903 he was transferred to the assembly department, assembling telephone relays and drops and in 1906 he returned to his original work on telegraph instruments. In 1919 he was transferred to the model room where he is at present employed.

Forty-five years of service in the employ of one organization is a mark of no small distinction, signifying as

it does the capable workmanship, fidelity, and esteem in the eyes of his employer and associates. In addition to these honors, Mr. Boland's service enjoys the distinction of beginning when the telephone was looked upon as hardly more than an ingenious mechanical toy and extending through the years that future history will probably regard the most remarkable in its development.

Charles Sauerbrey and Edward Boland

LIKE MR. BOLAND with whom he has been associated for so many years Charles Sauerbrey was engaged on telegraph and electrical instrument manufacture during his early years with the Bell System. He began work in the Western Electric shop at Thames Street and was transferred to this building upon its completion in 1898. During the Spanish-American war he worked on telegraph instruments for use by the United States Army in Cuba. Shortly afterward he was transferred to electrical instrument work, making galvanometers, bridges and testing instruments, and came to the Development Shop, then known as the model room, in 1908. In his twenty-two years in the Shop he has worked on such outstanding developments as the telegraph printer, train despatching system, and machine switching. He takes much pride in having performed the mechanical work on the flat type relay designed by the late E. B. Craft. Mr. Sauerbrey completed thirty-five years of service on May 20.

MAY 27, which to most of us was just another day, was to Nelson Meats, in charge of the storeroom for the Equipment Development Department, the thirty-fifth anniversary of his association with the Bell System. He began as a punch press operator in the Thames Street shop and came to this building with the transfer of his department here when the first sections were completed in 1898. He was made assistant foreman of punch press work in 1910 and went to Haw-

Nelson Meats

thorne when his work was transferred there in 1913. He returned to New

York in 1918 on special punch press work during the war time. In 1921 he was assigned to his present duties, handling Equipment Development stores.

TWENTY YEARS OF service with the Western Electric Company and the Laboratories have been completed during the past two months by A. O. Jehle, P. Kohnert, L. Kubic, W. E. Newton, and A. Friguglietto.

THOMAS DONOVAN, stern-visaged watchman at the court gate on West

Thomas Donovan

Street, completed twenty-five years of service on April 4. With the exception of a few months at the outset of his employment when he operated an elevator Mr. Donovan has been a gateman during the entire quarter century of his service and has achieved a reputation for the painstaking and rigorous performance of his duties.

COLLOQUIUM

DISTINGUISHED AUTHORITIES on physics from European universities have been speakers at recent meetings of the Colloquium. On April 22 Professor Gregor Wentzel of the University of Zurich spoke on *The Emission of Electrons from Metal Surfaces.* On April 30 Professor Otto Stern of the University of Hamburg talked on *Refraction of Molecular Rays.* Professor Stern is noted for his discovery, in collaboration with properties of single atoms and also Professor Gerlach, of the magnetic for his findings in wave mechanics. On May 12 F. C. Nix of the Electro-optical Research group spoke on the subject *Photo-and Electrolytic Conductivity in Non-metallic Crystals.*

ON MAY 7 the Communication Group of the New York Section, A. I. E. E., discussed *Phase Distortion and Quality* at a meeting in the auditorium. A paper *Phase Distortion in Telephone Apparatus* was presented by C. E. Lane and another, entitled *Effects of Phase Distortion on Telephone Quality,* was read by J. C. Steinberg. A recently prepared talking film illustrating the various factors affecting telephone quality was shown by Harvey Fletcher. In addition H. Nyquist and S. Brand of the American Telephone and Telegraph Company presented a paper *Measurement of Phase Distortion.* Application of radio for police purposes was discussed by Lieut. K. R. Cox of Chicago.

BELL LABORATORIES CLUB

Track—Stiff and sore muscles on the part of Club members and worn and dragged-out looks accompanied by persistently lingering smells of ar-

nica, which have been the source of no little gossip in many quarters of the Laboratories, finally have turned out to be the results of limbering-up activities for the track meet with the New York Telephone Company, Manhattan Area, at Erasmus Field, Brooklyn, on June 21. The prowess of the men will be tested in the 100, 220, 440 yard dashes; the 880 and mile runs; the high and broad jumps; the shot put; 1 mile relay; and tug-of-war. The women will compete in the 60 yard dash; ¼ mile relay; and basketball throw.

In the men's events, with the exception of the tug-of-war and relay race, high quality wrist and pocket watches will be awarded to the winners. Those finishing in second and third places will be given respectively silver and bronze medals. Gold medals will be awarded in the tug-of-war and relay events. Prizes of course will be also bestowed upon the victors in the women's events. The exact nature of these awards the committee is not yet prepared to announce, save that they will be of a nature sure to rise high in feminine esteem.

Golf — The official debut of outdoor golf for the season will take place on June 7 which will mark the opening of the Spring Golf Tournament to be held on Course No. 5 of the Salisbury Country Club at Garden City. Two Saturday afternoons will be given over to the affair, the first on June 7 for the qualifying round and the finals on June 14. The committee has been assiduously at work during the past month adjusting handicaps and dividing players in three groups compatible with their respective abilities. As a result the players will compete in these handicap classifications: Class A — up to and including 15; Class B — from 16 to 25; Class C — from 26 to 35.

For the finals it is planned to qualify a total of 32 players in all from the three classes. From their past experience in such matters the Committee predicts that not more than 6 players will qualify in Class A, with about 12 and 14 respectively in Class B and C.

Baseball — With due ceremony the Laboratories baseball season was opened on May 8 when the Plant & Shops team crashed through with a 4-3 victory over the Junior Assistants. Jorgensen of the Plant & Shops pitched airtight ball and held the Assistants scoreless until the sixth inning when all three of their runs were scored. Downes of the Assistants also pitched well, holding the Plant & Shops men to seven hits.

As the committee had promised, President D. R. McCormack was on hand and opened the season by throwing the first ball. The inaugural pitch, which was a low ball and not a little wide, was snared by Catcher Bodenstedt of Plant & Shops after a lunge which brought the entire assemblage to its feet in acclaim. The Club President was later overheard confiding to friends on the sidelines that it was a bit early in the season and if the League opened in August when the hot weather had set in, undoubtedly he would have done much better. Despite this, several gray-haired old-timers whose memory of the President extends back to the time when as a bushy-haired youngster he was known as the flash of the Jersey sandlots, were seen to shake their heads in sad dismay.

On May 13, the hard-slugging Systems Development team defeated Apparatus by a 16-4 score.

Contributors to This Issue

AFTER obtaining the degree of B.S.E.E. from Kansas State College in 1911, W. L. HEARD entered the employ of the Automatic Electric Company in Chicago. The next year, however, he became affiliated with the Western Electric Company in Hawthorne and remained with it until 1919 when he transferred to the Laboratories. Both at the Hawthorne plant and in New York, his field of work has been equipment engineering.

C. H. GREENALL's college course was interrupted by his service overseas in the United States Field Artillery, where he was wounded while his company was stationed in the Marne-Oisne-Aisne sector. After being mustered out of service he resumed his studies at Lehigh University and was graduated in 1922 with an M.E. degree. He then became associated with the Laboratories and worked on apparatus analysis and protection. In 1927 he transferred to the Materials group where he has since been engaged on development of specifications for non-ferrous materials and design of equipment and application of methods for fatigue tests on these materials. He has been occupied mainly with tests on lead cable sheath and die castings.

W. E. MOUGEY graduated in Electrical Engineering from Ohio State University in 1907 and joined the Western Electric Company in Chicago. In 1909 he transferred to its Engineering Department in New York and since 1910 has given practically all his attention to cable development except for a year and a half with the army during the war. For several periods, totalling about nine years, he was in England and his time in this country has been divided between West Street, Hawthorne, and Kearny where he has his office at present.

W. L. Heard

W. E. Mougey

C. H. Greenall

R. A. Chegwidden

J. T. Wilmarth

James G. Ferguson

R. A. CHEGWIDDEN joined the Laboratories in 1919 and entered the three-year student assistant course. At the completion of this work he continued his studies at the Brooklyn Polytechnic Institute. Most of his time at the Laboratories has been spent with the Magnetics Research group. He is at present working on magnetic materials of the Apparatus Development Department.

J. T. WILMARTH entered the Transmission Instruments group as a technical assistant in 1921. After two years he left the Laboratories to attend Colgate University where he received the B.S. degree in 1926. Returning immediately to the Laboratories, he joined the Apparatus Development Department where he has been concerned principally with developing and applying electrolytic devices.

AFTER GRADUATING in electrical engineering from Queens University, Canada, in 1923, JAMES G. FERGUSON spent three years in Montreal engineering step-by-step equipment for the Northern Electric Co. He then joined the Systems Development Department of the Laboratories where, affiliated with the Equipment Development group, he has specialized in equipment for private branch exchanges of the dial type.

Electrical Research and the Talking Machine

"The recent development of the gramophone has presented a striking example of the great benefits to be derived when industrial research can be directed upon the basic phenomena of an industry. . . . For a period of some twenty-five years, gramophone research was purely empirical and the meagre results gave only a product which the establishment of broadcasting threatened to exterminate. Then the whole gramophone industry was suddenly revitalised by the introduction of electrical recording and the matched impedance type of reproducer. The present volume deals more especially with these remarkable advances, all of which originated in the Bell Telephone Laboratories in New York and, we would emphasize, were merely by-products of an enormous fundamental research.

"To know their origin, which happened to lie in practical telephone designing, lends a deeper significance to the book. Some fifteen years ago, an advanced stage had been reached in the art of accurately analysing fluctuating electrical currents into their component frequencies and in the correlated art of describing and measuring the characteristics of mechanically vibrating systems. A part of telephone design was, however, empirical, because speech and hearing could not then be defined quantitatively in physical terms. At this stage the step was taken which ten years later yielded results of such importance to the gramophone. It was decided to attempt a quantitative definition of speech and hearing. Now, although the ear is so delicate, it is so accommodating that its use as a measuring instrument is quite invalid and apparatus of remarkable precision had to be developed. Since this apparatus proved to be costly and often complicated and difficult to adjust, it appeared to be of interest only in the research laboratory. Nevertheless, one of the instruments, an electrical transmitter developed in the early stages of the research, is now used to produce the modern gramophone record. . . .

" . . . Since the book was written, still another ingenious application of electro-mechanical analogies has resulted in the construction of a motor capable of rotating the original wax master-record with remarkable constancy of speed, ensuring that the grooves in the record are even more faithful to the original sound (Elmer, Bell Labs. Record, *7, 445-50; 1929)."*

(*From a review of "Modern Gramophones and Electrical Reproducers" in Nature for April 5, 1930*)