BELL LABORATORIES RECORD

Marking buoys used in laying the Key West-Havana cable were balloons retained within networks of rope

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Walter S. Gifford

President of the American Telephone and Telegraph Company

An Address

at the annual luncheon of the Associated Press, New York, April 20, 1931

By WALTER S. GIFFORD

Mr. Chairman and members of the Associated Press:

One of the particular characteristics of our civilization is the diffusion of knowledge and a common understanding. In this the Associated Press plays an essential part, and the Bell Telephone System contributes by the maintenance of practically instantaneous nationwide intercommunication, including telephone and telegraph networks that serve the press and radio broadcasting stations. We have the common interests that grow out of large dealings with each other, but I would like to speak to you about a common interest in an enterprise far more important than either of our organizations.

I want to reaffirm my faith in the continued progress of our country, in the common sense and ability of its people — in short, I want to reaffirm my faith in American democracy — political, social and economic, and to add that the experiences of this depression have done more to confirm this faith than the experiences of the boom that preceded it.

When I speak of democracy I do not mean only the opportunity for all citizens to participate in the government of the nation. That seemed of such overwhelming importance that our forefathers considered its accomplishment as almost an ultimate objective in itself. Other people who do not have it still attach such an importance to it. And if we did not have it, so would we, although as it is in our possession we take its existence for granted and do not even trouble always to make the best use of it.

In the last century we added democratic education to democratic government, intellectual freedom to political freedom. The initiative for democratic education never came from an autocratic government. And when an autocratic government establishes a school system, education is not allowed intellectual freedom but is forced to follow the theories of the autocracy. And as goes education so goes its handmaiden, the press — free in a democracy, controlled in all other forms of government.

As our industrial development proceeded we have added to political freedom and intellectual freedom, freedom from economic want as one of our objectives. The present American conception is a country in which every man has a vote, a chance to be educated, and an opportunity to make a decent living. I know that there are right now several million men and women who want to work but are unemployed in this country. I have spent a good part of the Winter helping to raise money to provide work for the unemployed in this city. But as bitter a picture as that is, it does not change the fact that our industrial civilization has brought us within sight of a democracy of well-being, and has crystallized our intention to see it accomplished.

Before machines added to man's ability to produce, the cycles of depression were caused by underproduction. Years came when there was not enough to go around — when people died of cold, hunger and disease in such numbers that the world accepted Malthus' theory. The condition of having people out of work in a country that has more of everything than it needs is, humanly speaking, a vast advance over having people without clothes, food or shelter in a country that has not enough of the essentials to go around. Before the era of the capitalistic industrial democracy there was no escape from the periodic calamities of underproduction except in those places where people could find virgin territories to exploit and in those only for comparatively short periods.

American democracy is founded on the participation of all the people in government, in the benefits of education, and in the well-being made possible by ample production.

True, none of these work perfectly. Some people do not vote, some resist education and some have, through no fault of their own, failed for the time being to find employment and well-being. But as imperfect as is our use of our democracy its essentials constitute the foundations on which the progress of the future will be built and the very independence that comes from political liberty and the intelligence that comes from widespread education is complete assurance of continued improvement.

In this depression some folk of intelligence but little faith have been calling for immediate remedies, for strong leaders to make everything all right at once for everybody, and if not for these for some one to sacrifice on the altar of their discontent. As a matter of fact there are plenty of men in the United States who have the capacity to become the "strong leaders" of history. But to be such they must have power, autocratic or tyrannical power. Uneducated peoples that cannot attend to their own affairs must have such leaders. Educated peoples do not need them and will not tolerate them. Forty years ago there may have been an idea that our people would like such leaders in industry, but the course of events since then has made it as clear as a Summer sky that the atmosphere of the United States is as bad for the autocrat in industry as for the autocrat in politics.

In my opinion there is no use looking for any Napoleons to lead us on to economic Austerlitz — or to Waterloo.

We are going to go forward out of this valley as we have from others before by the democratic road — by the thought and efforts of thousands of intelligent, able people — by the wisdom of the many.

I know that to the impatient, to those who want an overnight remedy, this is a discouraging prospect, for the democratic method does not work overnight, nor do the remedies it provides come in dramatic fashion, wrapped and labeled for all to see and to admire. A dictator produces better headlines than a democracy but in the rest of the story the advantage is the other way.

I had an experience in the war that gave me an abiding faith in the democratic method. I was director of the Council of National Defense and its Advisory Commission. These organizations, as you know, were the planning and mobilizing boards for all industrial and non-military war activities and these activities were legion and attached to each activity were large numbers of people. Most all were new at their jobs and their jobs were new and the scope and size of everything changed like a kaleidoscope. It looked like confusion worse confounded.

Many thought the only solution was a minister of munitions with autocratic powers. I confess that then I rather hoped one would be appointed. But as matters progressed I began to realize that in all that welter of confusion there were a great many men of brains and ability and that their combined efforts and initiative resulted in few errors and on the whole very effective action. And I realize even more now than I did then that there was an immense amount of essential information and knowledge and wisdom that finally was brought to bear on the conduct of the war that never could have been obtained in any other way.

In a democracy programs are not fixed and orders are not given. The action of the nation is not limited by the knowledge and the objectives of a few, with the rest, like the light brigade, "not to reason why," but "to do and die." The result is that the initiative of the mass of the people is stimulated and their knowledge is not thrown away. The accumulated energy and knowledge of all the people gradually comes together through thousands of discussions until a line of conduct tested from all angles evolves. This has behind it the support and understanding of the people who will make it work, not as if it were a routine order but as a thing which is part and parcel of their own convictions.

The Russian war effort was run by an autocracy because Russia was an uneducated country. The Russian war effort failed in technique, in knowledge and in popular support. Ours was a democratic effort — and it succeeded. But as it was a democratic war it was a drama without the heroes characteristic of the historic past. That did not arise because there were not men of as great ability as heretofore, but because so many of ability cooperated that none stood out alone.

The present situation brings to my mind another incident that happened in Washington in war time. A gentleman of considerable ability engaged in war work got into a critical state of mind as some of our people are now. He went into another war worker's office, sat down and with great force and eloquence damned the President, the Cabinet, the Generals, the Admirals, the food administration and every other agency that was struggling with the war and wound up with the statement that he was going to resign.

His friend's only comment was:

"Whose war is this you are going to resign from?"

That is a pertinent question now. Whose depression is this? If, as has been said, a fundamental cause of it is greed, who are they that did not add their part to the picture? This is a democracy of blame as well as opportunity. We were all in it — flapper, financier, newspaper man and manufacturers, laborers and politicians. It is true that its evil effects do not fall on all equally, but the evil effects have been pretty widely distributed nevertheless. Fixing the blame is the occupation of the people who have lost their nerve. Finding the causes and planning the future is the part for the constructive-minded people.

And we have with us also those who want to return to the good old times. They are of the order of the Wufus Birds. As you know, these interesting birds fly backward to keep the wind out of their eyes and they are not interested in where they are going, but only in where they have been.

And then there are those who shout from the housetops that if we do not take their particular medicine the Bolsheviks will get us. These folk, unlike the Wufus birds, want to go somewhere. They want us to progress, but they want us to progress from terror rather than by conviction. These people are all wrong. The Wufus birds and alarmists are talking to the wrong people. The American people are not looking backward, they are not afraid, and no one can direct them by threats. We have a far more impelling and higher motive to continue to improve American life. We believe in it. We have the same determination to improve the lot of mankind that our forefathers had. We are not as a nation conservative, if conservatism means content merely to keep what we have. Neither our ambitions nor our imaginations are dead and we intend to go much further forward from where we are now or even from where we were just before this depression. And we shall do it by our own particular methods.

Are we getting anywhere? I think so.

In this depression the American people have decided that in so far as it is possible, the people least able to bear depression shall no longer bear practically the whole brunt of it. That is more important than anything most autocrats or most laws ever accomplish. By the democratic process we have concluded that the idea of the greatest mutual good for the greatest number is accepted as it has never been before and that it has come nearer working than ever heretofore.

We like to see wage scales maintained — we are committed to the theory of a high standard of living for all. That was not always so. That is the result of the vision of possibilities which capitalistic industrialism has opened to us. That is not only the general desire, but those in a position to do so have made unprecedented efforts to make that desire a reality. In no other cycle of this kind have wages ever been maintained as they have in this. It is true all wage scales have not been maintained. It is likewise true that where wage scales have stayed up in many places full time has not been maintained. Although the present scale of wages would be equivalent to a large increase if commodity prices and the cost of living should stay down, we ought, I believe, to make every effort to maintain the wage scale.

Moreover, the standards of social welfare work are now based upon a standard of living unheard of no further back than the panic of 1893. As bad as unemployment has been this Winter, the problems it presented have been alleviated by social welfare agencies and governmental agencies in a way that has kept distress far above the starvation level that used to obtain.

And this could not have been done

without the margins of prosperity accumulated under our industrial system. I do not say that we have accomplished a good result, for my hope of the future is as high as yours and I do not believe that the word "good" can be associated with the present unemployment situation, but I do want to say that it is both in objective and accomplishment better than the past; and further, that our social point of view and industrial ability has in it the elements to continue to improve, not only in alleviating distress when it comes but in mitigating its severity and frequency of occurrence. Out of the money panic of 1907 we learned enough to organize our finances better. Out of this we will learn likewise, but the processes of prevention cannot start until the period of distress is over. The study of sickness leads to the prevention of disease, but while the patient is sick it is the doctor's first job to get him well with the best knowledge then available. From that experience comes the hope of better curative knowledge for the future and likewise the spur to preventive measures.

I have tried to make clear my belief in a few simple propositions:

1—That the path of progress is an evolution from our present situation;

2—That the democratic method followed in America not only provides abler and more effective though less spectacular leadership than any other, but also far more ability for attainment amongst the public generally; and

3—That democracy provides a far higher economic, social and spiritual objective than any other form of society.

I believe in the common sense and ability of the American people and I have, therefore, no fears of the present or the future. The immediate present, the statisticians of the telephone company tell me, shows signs of improvement. How fast that improvement will be measured in weeks or months I don't know. But in the telephone company we have every confidence in the future—not only confidence, but the keenest interest in the possibilities ahead of us.

Industrial democracy has given this generation the tools to accomplish great things for humanity. We are living in a time of great opportunity, of stimulating appeal to the imagination. The mastery of depression is one of the challenges ahead of us. Let us continue to attack it. Every day in the papers we read of some action taken, of this plan or that program, for the press is the medium for the interchange of ideas. Every week, at least, some one comes forward with a program and the desire to start an association to further it. You go nowhere where it isn't discussed. This process is going on with thousands and thousands of people in every part of this country. Out of it we shall get an answer—we shall get plans for progress perhaps never clearly defined but plans that take account of the needs of the many, that have been tested from every angle, and that have behind them the power of the American people, and are likely to be in effective operation before any one has time to make a good description of them.

Key West-Havana Cable No. 4

By J. J. GILBERT
Submarine Cable Research

A FEW minutes after midnight on January 4 of this year, I was struggling with a heavy ax to cut the rope that bound the last splice of the fourth Key West-Havana cable to the bow of the cableship *Neptun*. As the cable dropped to its final resting place on the floor of the ocean near Havana, a member of the crew drew a circle on the deck around my feet. This constituted the conventional announcement that the crew felt their job was done and that they were entitled to an extra round of beer at the expense of the Cuban American Telephone & Telegraph Company for whom the cable had been manufactured and laid.

This new cable forms the fourth link between Key West and Havana. All four cables are owned and operated by the Cuban American Telephone & Telegraph Company which is controlled jointly by the American Telephone and Telegraph Company and the International Telephone and Telegraph Corporation. Designed by the Laboratories — as also were the three earlier cables — the new cable was manufactured in Nordenham, Germany, at the works of the Norddeutsche Seekabelwerke, who also laid the cable. J. F. Wentz of the Laboratories served as chief inspector during manufacture, and supervised the electrical measurements at the German factory.

The new cable differs from the three earlier ones chiefly in being non-loaded and in employing thicker insulation which is of paragutta — the new insulating material recently developed by the Laboratories. With the improved deep-sea cable and carrier technique which is today available, the use of non-loaded cable was found to be the best engineering solution. Aided by the gain from the thicker insulation and that from the superior characteristics of paragutta, the new non-loaded cable has a potential message-carrying capacity greater than that of the three earlier cables combined.

All four cables have a single central conductor and a return conductor of copper tape spiralled over the insulation. Another difference between the old and new cables, however, is the structure of this return conductor. That of the new cable differs from those of the cables already in service in employing more tapes and in having them wound on in a spiral with a greater pitch.

The appearance of the new cable is shown in the accompanying illustrations. On a central copper wire are wound spirally six thin copper tapes to preserve continuity of the circuit should the main conductor break. After these tapes have been wound on, the conductor is carried through a vacuum chamber and a bath of melted rubber, which fills all interstices between the tapes and conductor — thus preventing water from travelling along the conductor should the cable break. All but a very thin film of rubber is wiped off. Over this sealed conductor is placed the paragutta insulation — nearly twice as thick as the insulation of the earlier cables — and around it, a protecting layer of thin cotton tape. Directly on this a copper tape is wound with a slight overlap to serve as protection against the teredo. The six tapes forming the return conductor are wound in contact with the teredo protection. A fabric tape holds the copper spirals in place and completes the "taped core", as this inner unit is called.

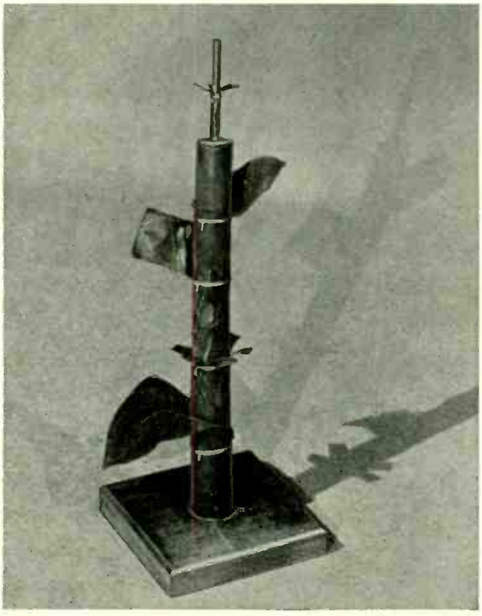


Fig. 1 — The "taped core" of the Key West-Havana cable

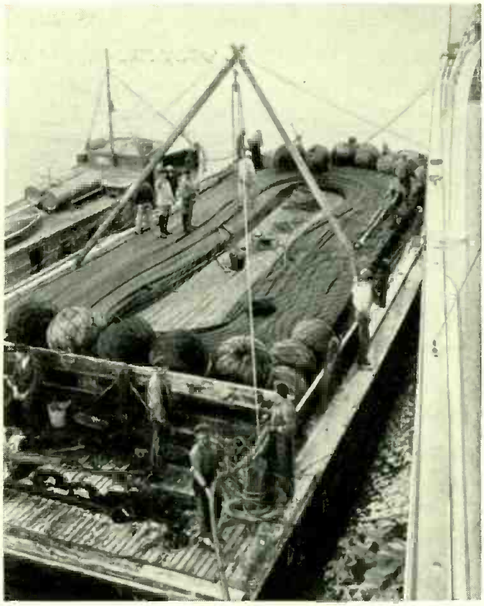


Fig. 2 — The cable-laying barge at Key West showing the balloon buoys

For the entire length of the cable the taped core is the same but the outer covering and armor differ depending on the degree and type of protection needed. For short sections at each end, the taped core is covered with a lead sheath to prevent exposure of the core to air and its consequent drying out. For the rest of the cable the taped core is served with two layers of jute to act as a bed for the armoring, of which three types are used.

For the shallower waters, where the depth is not over 1000 feet, the armoring consists of twelve heavy iron wires .3-inch in diameter. For intermediate depths of from 1000 to 2000 feet, sixteen smaller iron wires are used — each about .2-inch in diameter. For the deeper waters twenty-two wires, only slightly over .1-inch in diameter, are employed and the wires are made of high tensile-strength steel instead of iron. Because of their smaller diameter, each of these wires is covered with a fabric tape as a slight protection against corrosion. Over all types of armor, two layers of jute are applied.

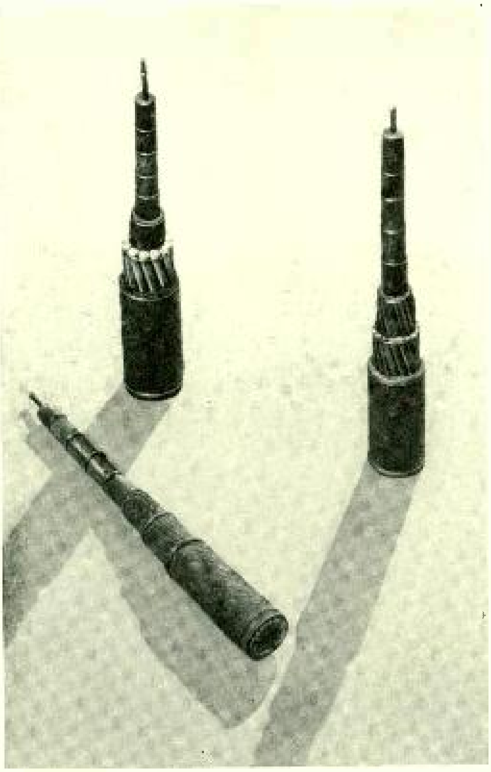


Fig. 3 — Three types of armor are employed depending on the depth of the water in which the cable is laid

The taped core was made up in lengths of about one nautical mile, and then spliced at the factory before the armor was applied so that there would be as few joints as possible in the completed cable. Joints in the insulation of the earlier gutta percha insulated cables were made by hand by the use of a spirit lamp. These methods were found to be poorly adapted to joining the new cable, and a joining machine was used exclusively. With the new method the spirit lamp is replaced by steam and electric heating, and the greater part of the joining process is performed by simply turning a crank.

Laying of the cable started on December 15 when some six nautical miles of cable of the heavy armored, shore type was coiled on a barge at Key West. Because of the shoal water near Key West the cableship could not be used to lay the shore end. The following day the barge anchored a few hundred feet off the beach and one end of the cable was pulled ashore by a winch. The barge then lifted anchor and proceeded to lay the remainder of the cable out to where the cableship was anchored. Here the other end was brought aboard the ship and spliced to the main length of cable.

Early on the morning of the seventeenth, the cableship weighed anchor and, following the prescribed route, started paying out cable towards Havana. The ship had previously gone over the course and set out four buoys at about equal intervals along the route. Each was provided with lights

Fig. 4 — A marking buoy about to be launched from the deck of the Neptun

and a flag so as to be visible at some distance either by night or day.

Over the greater part of the course, laying proceeded without incident. As the ship approached the last leg of the voyage, however, the fourth buoy was not to be seen. The Gulf Stream had been playing tricks and an unusually swift current had carried off the buoy. Havana was only twenty miles distant and as the mountains of Cuba were already beginning to appear over the horizon it was decided to continue paying out cable, correcting as well as possible for the effect of current on the ship. It was now dusk, the worst time of day for getting sights to check up the course, and when the lights of Havana finally blazed out and the end of the cable was reached, it was decided to anchor and buoy the end preparatory to the work of laying the Havana shore end. The end was dropped overboard, therefore, with a mark buoy attached. Again the Gulf Stream got in its work. The buoy immediately disappeared beneath the surface.

Several days were spent in waiting for good weather and in searching for the lost end of the cable among the maze of cables converging on Havana. Finally the end was located and put into its correct location. In accordance with the original program, cable was paid out from Havana by barge to this position where the final splice was made. A new communication link was now ready for use.

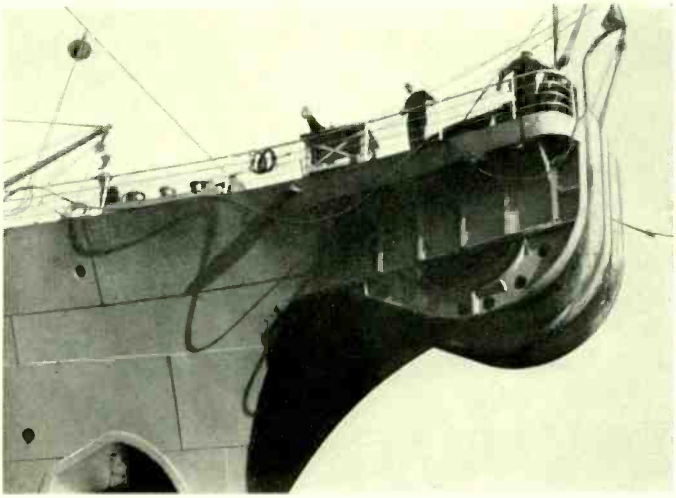
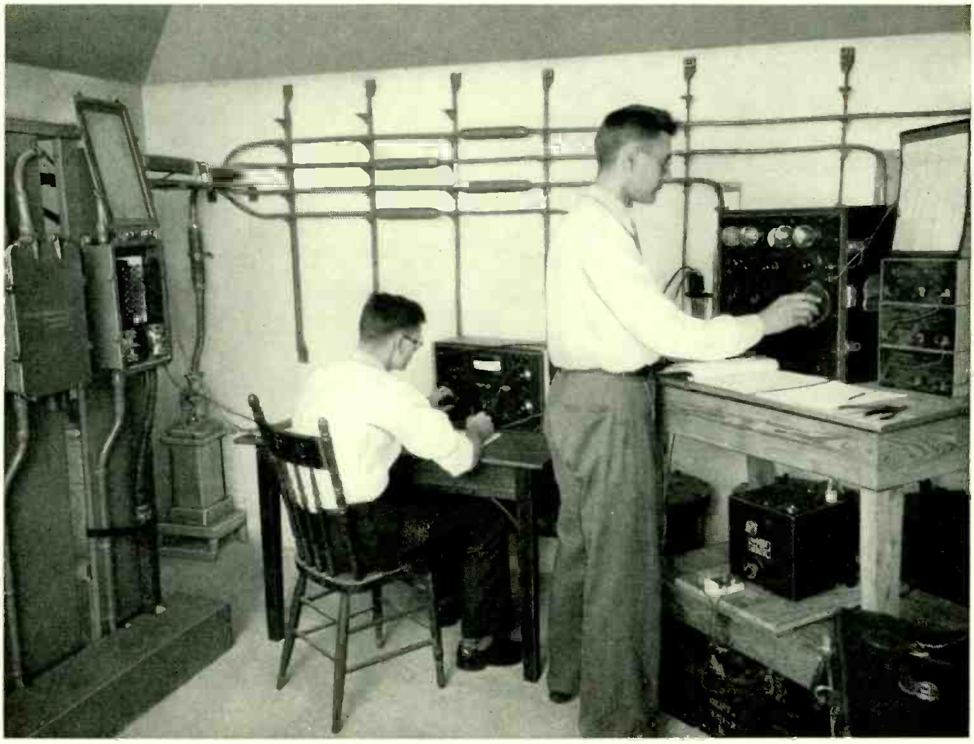


Fig. 5—Bow of the Neptun showing the arrangement of the cable-handling equipment



Carrier Equipment for Key West-Havana Cable

By W. F. KANNENBERG
Toll Systems Development

OVER a single-conductor submarine cable, 108 nautical miles in length, three telephone conversations may now be carried on simultaneously between Key West and Havana. With the three voice channels in use, additional communication capacity remains in the cable for a direct-current telegraph circuit and a channel about 5000 cycles wide in the voice range for future utilization. The system is unique in certain respects. It is the first time that so great a length of submarine cable has been used for multi-channel carrier telephony. It is also the first time that so great an amplification has been used in a carrier repeater. The energy received at the terminal of the Key West-Havana cable is only one

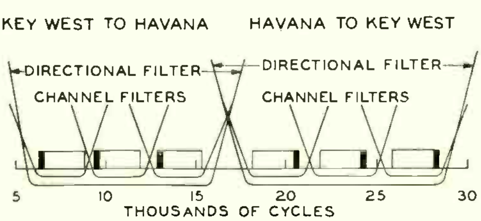


Fig. 1 — The lower frequencies comprise the channels from Key West to Havana, and the higher frequencies comprise those in the opposite direction

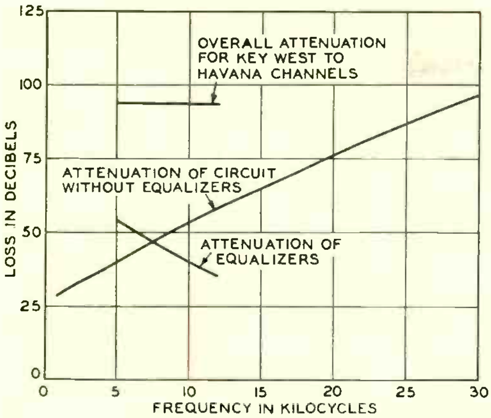


Fig. 2 — Equalizers in the outgoing circuit compensate for the attenuation of the cable and produce a practically flat curve of loss with frequency

one-thousandth of the energy applied at the input side of an ordinary carrier amplifier.

The cable itself, described elsewhere in this issue, is interesting in being the first telephone cable to be insulated with paragutta — the new insulating material recently developed by the Laboratories. It is largely due to the superior characteristics of this insulation that so great a communication capacity can be obtained from so long a cable.

Although the transmission conditions over this long section of submarine cable are radically different from those existing on land lines, it was found possible by the design of supplementary equipment to use the standard type-C carrier system and equipment. This system, already described in the RECORD*, provides three voice channels in each direction over a total frequency range of from about 6000 to 28,000 cycles. Only a single sideband, without a carrier, is transmitted for each channel. The three North to South channels use the upper sidebands of the carriers of 6300, 9400, and 12,900 cycles, and the three channels from South to North employ the lower sidebands of carriers of 20,700, 24,400, and 28,500 cycles. This is shown in Figure 1.

* BELL LABORATORIES RECORD, *December*, 1925, *p.* 154.

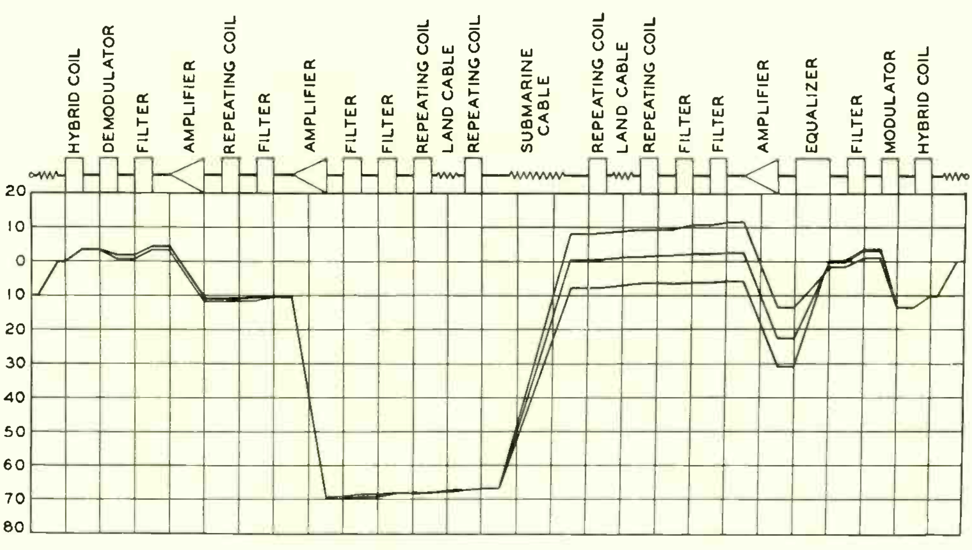


Fig. 3 — Level diagram for the group of channels from Key West to Havana. Transmission proceeds from right to left

The difficulties in applying this system to the Key West-Havana cable, arose chiefly from having to operate over a long length of cable without the help of intermediate repeaters. Thus at the highest channel frequency the energy received out of the cable is only one hundred-millionth of that sent into it. This corresponds to a receiving level, at the office equipment, of approximately −66 db. This extremely low level required additional amplifiers at the receiving end to raise it to that for which the standard type-C system is designed.

Another addition to the standard system was the insertion of two equalizers in the transmitting circuit of each terminal. The calculated attenuation for the new cable is given on Figure 2 and the equalizers introduce a loss complementary to that of the cable. The loss curve for the equalizers at Key West is also plotted on this graph, as well as that of the cable and equalizer combined, which is practically flat.

With the equalizers at the transmitting end, the outgoing modulated voice currents are at widely different levels as shown in Figure 3, while the received currents are all at practically the same level. This arrangement was found preferable to that having the equalizers at the receiving end because of the resulting improvement in near-end cross-talk.

Another modification of the standard system is the provision of additional directional filters. These are necessary because of the very wide difference in level between the trans-

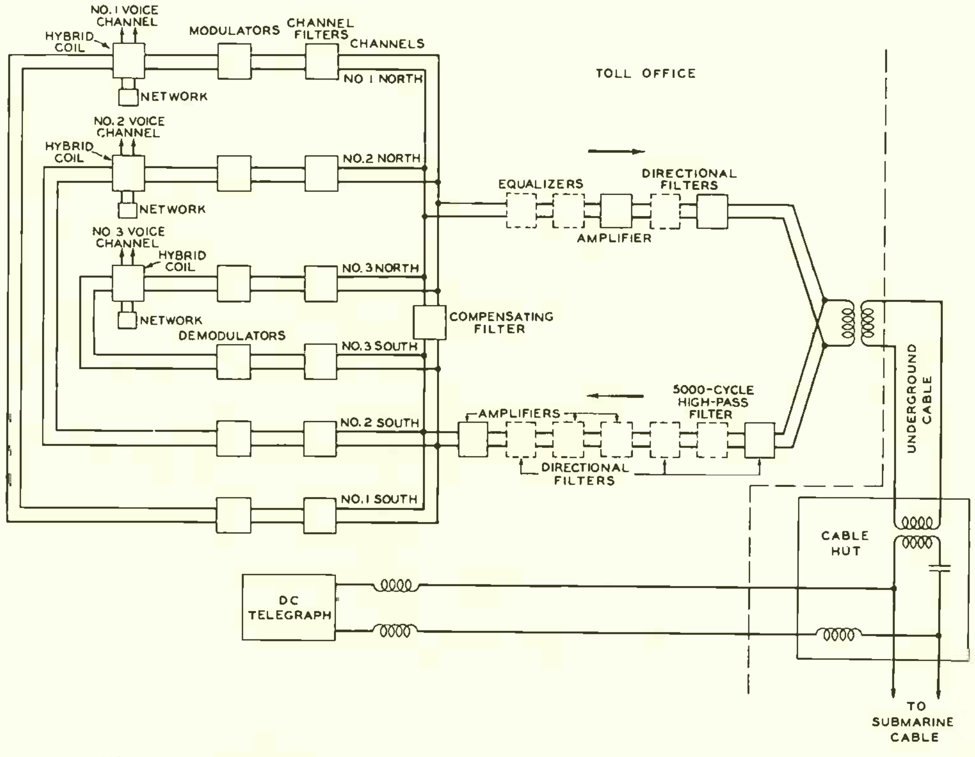


Fig. 4 — Schematic diagram of equipment at the Havana terminal

Fig. 5 — The cable hut at Key West

filters in the outgoing channel pass frequencies above 17,000 cycles approximately, and attenuate all lower frequencies, while those in the incoming channel pass frequencies below 17,000 cycles and attenuate all higher frequencies. The incoming signals, in the band from 6,300 to 15,400 cycles, are some 50 to 60 db lower than the outgoing signals. A single filter in the outgoing channel would not have reduced the level of those products of the outgoing signals that are of frequencies comparable to those of the incoming signals sufficiently to prevent the outgoing signals from interfering with the incoming ones.

The submarine cable is brought, at each end, to a terminal box in the cable hut. The three older cables terminate in the same hut and the terminal boxes for all four cables, as well as a spare box, are shown in Figure 6.

mitted and received energy. The standard type-C system has but two directional filters at each terminal: one for the northbound channels and one for the southbound. With the difference in level between incoming and outgoing channels existing in ordinary open-wire carrier systems, the loss introduced by a single filter in the outgoing channel is sufficient to reduce component frequencies beyond its pass band to a level sufficiently below that of the incoming signal to be unobjectionable. With the large level difference in the Key West-Havana cable, this is not true. It has been necessary to provide additional directional filters for each direction to obtain sufficient loss.

The arrangement of equipment at the Havana terminal is shown in Figure 4. In this illustration the equipment added to the standard type-C system is shown in dotted lines. The directional

Fig. 6 — Terminal boxes in the Key West cable hut

Fig. 7 — Carrier apparatus at the Key West Office

In the hut also is a repeating coil for matching the impedance of the submarine cable to that of the mile of underground cable running to the toll office, and the necessary compositing equipment for separating the direct-current telegraph from the carrier channels. This equipment is potted in loading-coil cases, and leads from it are brought to the terminal boxes in two lead-covered cables — shown entering the tops of the boxes in the photograph.

At the toll office the underground cable from the cable hut is terminated in a repeating coil to match the impedance of the office equipment. The terminal apparatus at Key West is shown in Figure 7 where the first three bays on the right comprise the standard type-C system and the bay at the left, the supplementary equipment that has been added.

The low receiving levels have made it imperative to take special precautions against noise pick-up. The two lowest-level amplifiers, added to the standard carrier apparatus, are specially designed to prevent noise introduction at this point of the circuit.

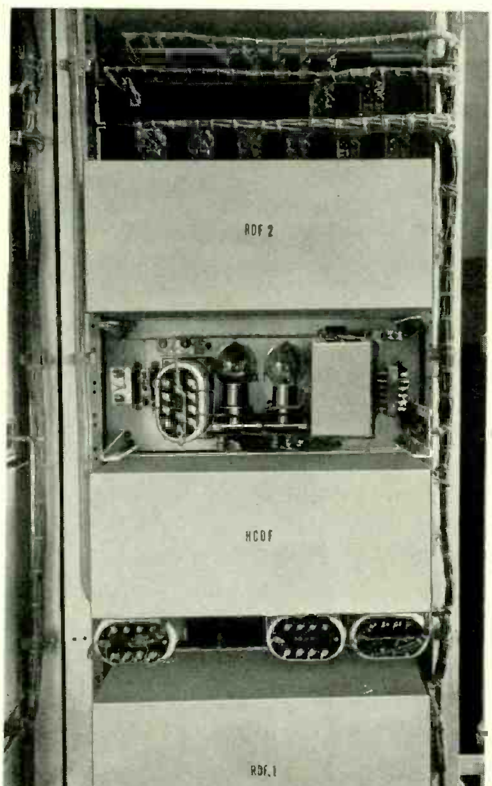
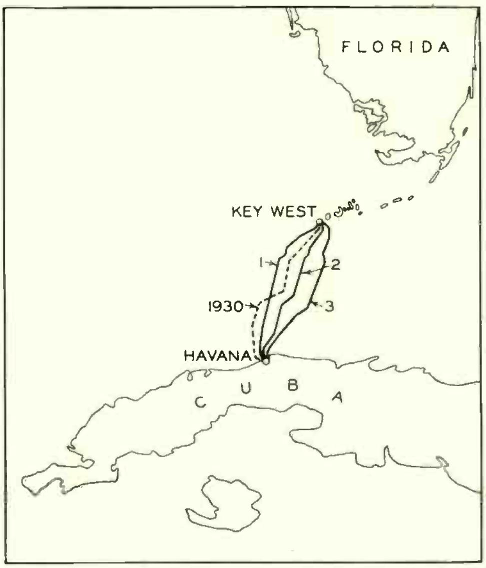


Fig. 8 — The additional amplifiers are specially designed to prevent noise pick-up

Shock-proof sockets are employed and the tubes are mounted under can covers, as shown in Figure 8, to guard against acoustic shock. These covers, together with the panels themselves, also serve as shields against stray magnetic or electric fields. Similar precautions against pick-up are taken with all leads and cables from the toll offices to the submarine cable.

The three channels of this new cable are now in commercial use. At Key West the channels connect to open-wire carrier channels which continue them to New York. With this development another forward step has been taken in the development of carrier telephony and in the linking together of countries which cannot be joined by land lines.



Location of voice cables between Key West and Havana

Paragutta

By A. R. KEMP
Chemical Research

TO take care of the growing telephone traffic between the United States and Cuba, a new cable has been provided to supplement the three cables placed in operation in 1921. A novel feature of its construction is its insulation by "paragutta", which plays an important part in extending its frequency range for carrier-current operation.

The electrical requirements placed upon the insulation of deep sea telephone cables are much more drastic than those for telegraphs. At the higher frequencies of telephonic operation the electrical losses in the insulating material become an important factor and limit the length of cable which can be operated.

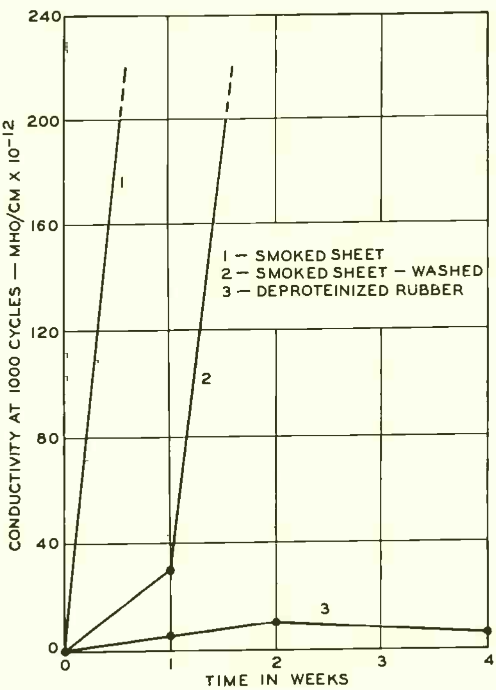


Fig. 1 — Washing and removing proteins largely eliminates the increase in conductivity of rubber immersed in sea water at room temperatures for a period of weeks

These circumstances led to an exhaustive investigation of the factors influencing the electrical and physical characteristics of submarine insulation. One result of these studies was the development of paragutta, which, by virtue of its superior insulating properties, is expected to be a vital factor in making feasible the installation of submarine telephone cables with long spans as well as in improving telegraph transmission.

The improved insulating properties of a new material would be offered in vain if any of the unusual virtues of the present materials were sacrificed. Mechanically they are unique and almost ideal and years of manufacture have surrounded them with machinery and technique which it would be expensive to abandon. Thus in developing a new insulating material it was necessary to preserve the important features of the old.

For the past seventy-five years the standard materials for insulating deep sea cables have been gutta percha and balata. Aside from a small production from leaves on plantations, these substances for the most part are gathered and worked up by primitive people from the latex of certain tropical trees and therefore come upon the market dirty and in many forms. Excepting dirt and water-soluble substances such as albumens and sugars, their two main components are gutta hydrocarbon and resinous substances, in amounts which vary widely according to the source of the gum.

It is to their peculiar colloidal hydrocarbon, of a chemically unsaturated type, that these materials owe most of their valuable properties: their plasticity when warm, their toughness when cold, and the stability of their electrical characteristics when at sea bottom. By virtue of their plasticity, the materials can be readily washed free from dirt and water-soluble impurities, the various grades can be thoroughly blended, and the mixture can be extruded onto the conductor in a continuous sheath of multiple layers free from mechanical defects. When the insulated conductor is drawn through cold water, the material quickly sets to a firm covering sufficiently tough and flexible to resist the handling in factory and cable ship.

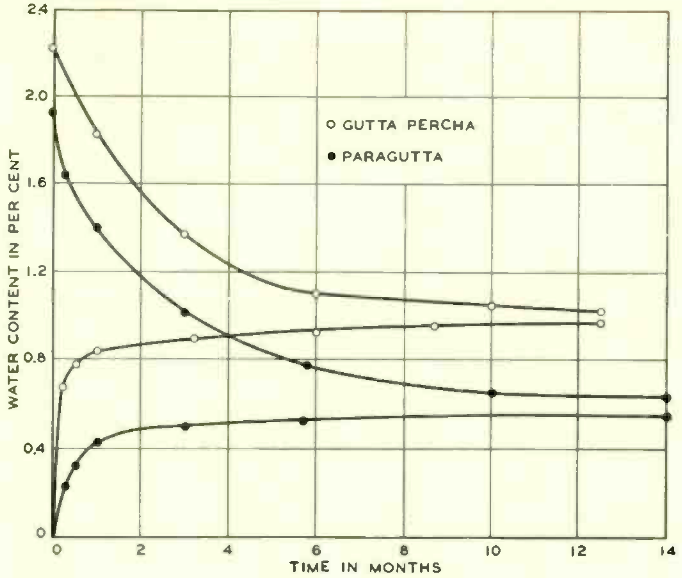


Fig. 2 — A comparison of the equilibrium values of water content when immersed in sea water, and the rapidity with which these values are approached from both higher and lower initial contents, gives an indication of the comparative stabilities of gutta percha and paragutta

Though the natural resins are usually allowed to remain in the material, they are sometimes removed to obtain the comparatively pure hydrocarbon. This can be done either by dissolving the material in warm, light petroleum naphtha, and filtering and refrigerating the solution to precipitate the hydrocarbon, or in a simpler manner by soaking the material in the same solvent at ordinary temperatures. The completely deresinated gutta when carefully prepared from selected raw materials has a specific conductance only one twentieth of that of the resin-bearing material and a substantially lower dielectric constant. But the advantages of these desirable electrical characteristics are for most practical purposes annulled by the added cost of the material and even more by its insufficient plasticity at safe working temperatures.

It would be possible, however, to take advantage of these improved properties if there could be blended in appreciable proportion with the gutta hydrocarbon another cheaper material which would increase the plasticity when warm without impairing the electrical properties or contributing undesirable mechanical characteristics. Since rubber is the next of kin to gutta among materials commercially available at low cost, it naturally suggested itself for the purpose.

The principal constituent of crude rubber is a hydrocarbon, chemically undistinguishable from gutta hydrocarbon, but possessing radically different physical properties in that it is soft and elastic without thermoplastic properties. Upon heating and mastication, rubber becomes more or less permanently plastic, and in this state it blends perfectly with gutta to give a product of better working properties than gutta alone. Crude rubber besides being physically unsuited for use alone will also deteriorate electrically when immersed in water. Extensive experiments have shown that this instability is due to water-absorbing impurities and that the pure rubber hydrocarbon possesses as good electrical characteristics and stability in water as pure gutta hydrocarbon.

In contrast with gutta percha and balata, it was found that crude plantation rubber contained nitrogenous or protein bodies which were difficultly soluble in water and could not be readily removed by washing. The electrical instability of washed crude rubber in water appeared to be due to the proteins existing as a network throughout the mass, forming paths through which electrical conduction took place as soon as they absorbed sufficient water. As it was known that proteins could be changed by hydrolysis into water-soluble products, attempts were made to hydrolyze the proteins in rubber so that they could be subsequently removed by washing. This was finally accomplished by heating the rubber with water in an autoclave at an elevated temperature without injuring the hydrocarbon. The improvement in electrical stability thus secured is shown in Figure 1.

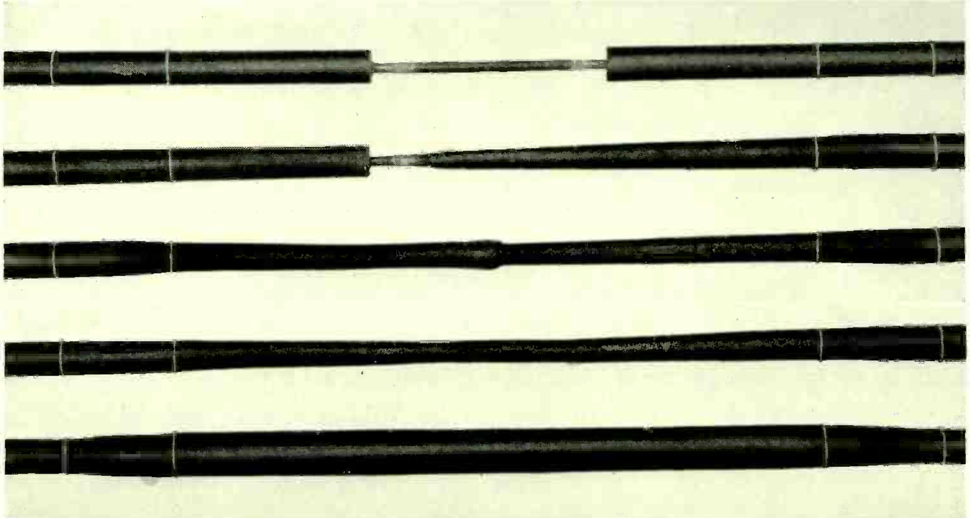


Fig. 3 — The plasticity of paragutta is of great use in joining lengths of cable. Successive stages in splicing a core are shown above: 1. Conductor splice completed. 2. Insulation of one end drawn down over the splice. 3. Insulation of the other end drawn down over its mate. 4. Insulation shaped off. 5. Application of additional paragutta leaves completed joint ready for application of jute and armor wires

With two suitable materials for blending at hand — deresinated gutta percha or balata, and deproteinized rubber — it remained to determine the optimum proportions for a blend of these and whatever waxes might be used to modify mechanical properties and reduce cost without electrical degradation. The superior mixture proved to be one of about 50% gutta, 40% rubber, and 10% hydrocarbon wax, and was christened "paragutta", a name compounded from those of its two principal constituents. Exhaustive tests have shown that paragutta closely approximates gutta percha in mechanical properties, is fully its equal in electrical stability in water, and is a substantial improvement over it in specific electrical properties. In the latter respect, a superior grade of paragutta may under sea-bottom conditions have a specific conductance as low as one-thirtieth of that of ordinary cable gutta percha, and a twenty percent lower dielectric constant. The practical importance of these characteristics may be seen by noticing, for example, that had paragutta been available to insulate a permalloy-loaded telegraph cable laid in 1926, its maximum satisfactory signalling speed would have been 30% greater.

In the manufacture of paragutta, after the gutta percha or balata has been washed by warm water and leached of resin by naphtha, and the rubber has been autoclaved to hydrolyze the proteins, the processing is similar to that previously used for gutta percha insulation and can be carried out with the same machinery. The treated gutta and rubber are blended and washed together, and masticated to remove excess water and to incorporate the wax. The mixture is then strained through fine sieves under hydraulic pressure to further remove impurities, kneaded to express air, and finally placed on the rolls of the covering machine to be forced around the conductor.

Fig. 4 — A cable, damaged after it has been laid, is hauled aboard ship by a grappling hook and repaired

Since the expense of failure in a submarine cable is unusually great, and minute defects in its insulation can do far-reaching damage, it is only after prolonged and careful tests that the present confidence in paragutta has been established among cable users and manufacturers. From much confirmation, the assurance in paragutta now justifies its commercial use.

A Wear Test for Finishes

By R. BURNS
Telephone Apparatus Development

ONE of the difficulties in selecting proper finishes for use in the telephone plant has been the lack of suitable tests for determining their mechanical durability. Corrosion testing is well developed but for many applications of finishes, resistance to corrosion is not of any great concern; resistance to wear is far more important. The black japan finish on desk stands is a case in point. These are made of brass so corrosion would be negligible under any ordinary conditions. The real criterion of satisfactoriness of the finish is its resistance to ordinary usage which in a large majority of the cases consists mainly of mechanical rubbing or wear.

The need for a practical device to evaluate the wear resistance of finishes has been felt for some time and an apparatus has recently been developed to obtain it. The basic feature is rotation in sand of a disk of material coated with the finish to be tested. A photograph of six of the completed machines is shown in Figure 1, and of a single unit with sand chamber removed, in Figure 2. A four-inch specimen is fastened to the top of a vertical shaft coupled to a vertical motor. A chamber surrounding the upper end of the shaft and the sample is filled with a standard grade of sand to a depth of five inches over the finished surface. A compressed air injector arrangement circulates the sand while the test is under way by taking it from the bottom, and carrying it through an outside tube connection to the upper part of the sand chamber. A suction connection is also made to the upper part of the sand chamber and serves as a vacuum cleaner to remove light waste material. This circulating and cleaning arrangement acts also to cool the surface undergoing

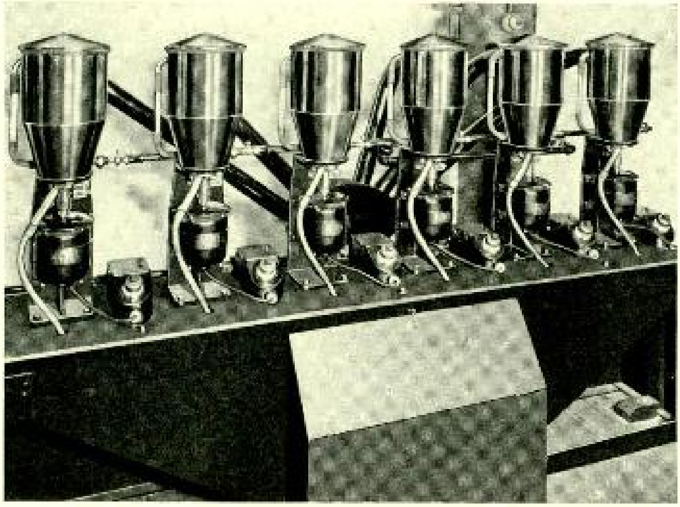


Fig. 1—In the arrangement adopted, six finish-testing machines are mounted as a unit. The large pipes connecting to the upper part of the sand chambers are the suction connections, and the smaller horizontal pipe at the rear carries the compressed air for sand circulation

wear. After each test, about a quarter of the sand is removed and replaced with new sand, which establishes a constant condition after about twenty tests.

The speed of the surface of the sample relative to the sand varies directly with the distance out from the center of the shaft. The wear, in other words, increases progressively toward the periphery of the disk. Under standard conditions of sand and speed, therefore, the distance from the center to the line of wear is a measure of the ability of the finish to withstand mechanical wear. By multiplying this distance by the number of thousands of revolutions that the sample made, a wear index is obtained which is a very satisfactory gauge of wear resistance. For metal samples, a speed of 1000 rpm has been found most satisfactory, while for wood, because of the difficulty of getting specimens sufficiently free from warping, 750 rpm has been found more satisfactory.

For accurate comparison, the thickness of the finish films should be alike to rather close limits. While accurate results may be obtained with other methods, it has been found that a little practice with a spray gun will produce results that are reasonably accurate, and this method is desirable as representing the more generally used method of application. This is particularly true of slow drying solutions which have a chance to level out before drying. The satisfactory application of lacquer films is more difficult. Due to their more rapid drying, a uniform thickness over the whole surface is difficult to obtain. The preparation of lacquer specimens, therefore, must be done with great care to get consistent wear results. Not only

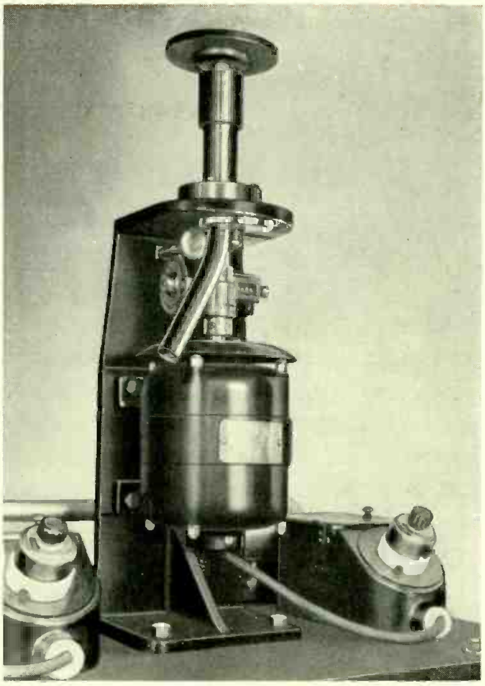


Fig. 2—A single finish-tester with sand chamber removed but with a specimen in place. A revolution counter geared to the driving shaft forms part of each unit

should the finish be of equal thickness over the surface but the specimen on which it is sprayed should have faces accurately parallel and the central hole should be precisely located, and perpendicular to the flat surfaces.

The usual practice in the preparation of samples is to spray the desired number of test disks, among which have been placed promiscuously several disks which have been previously measured for thickness. After the finishing processes have been completed the special disks are remeasured and the film thickness determined. Extreme care in obtaining equal thickness of film is desirable for all samples but is particularly so in comparing finishes of the same type, since for them the wear varies considerably with thickness. For finishes of different types, however, thickness is not quite so important. A good baked japan, for example, no matter how thin so long as it "covers", will outwear a cheap bronzing liquid even if made of maximum commercial thickness.

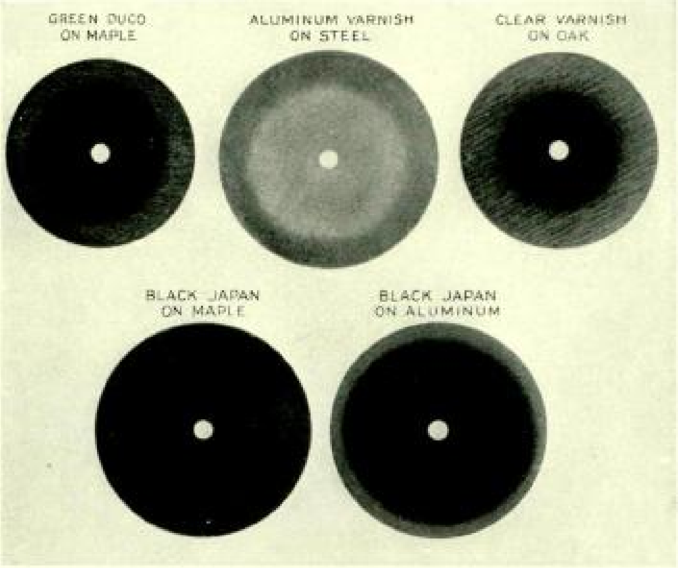


Fig. 3 — The distance of the wear line from the center can easily be measured from these tested specimens but the determination of the wear index requires that readings of the revolution counter be made at the beginning and end of test as well

Typical specimens that have undergone test are shown in Figure 3. The standard four-inch disk run at 1000 rpm will serve for a wide range of finishing materials. Inexpensive bronzing liquids carrying aluminum powder as a pigment will wear off rather rapidly. After a thousand revolutions — one minute's run — the wear line will be about half way out to the periphery of the disk so that the wear index is about one. A two-coat japan finish, on the other hand, of approximately .0005 inch in thickness, will normally run about 15 minutes before the wear line reaches the same point so that its wear index is in the neighborhood of 15.

The design of the apparatus involved some interesting problems. The specimen must be rotated with a minimum of eccentricity and this seemed to require a bearing directly beneath the specimen. Since the chamber is filled with sand from several inches below the specimen to five inches above it, this requirement necessitated that the bearing run continuously immersed in sand — a rather difficult requirement for a bearing to meet.

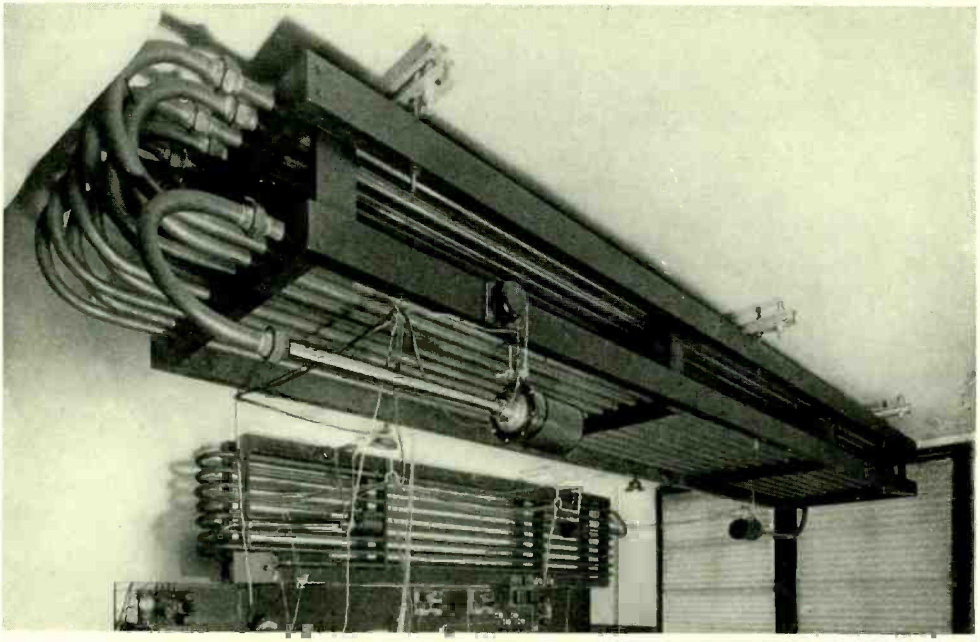
Another difficulty due to the use of sand was the selection of material for the outside connection through which the sand is circulated. In the experimental models this was made of rubber hose and gave very good service. In the refined design, however, metal tubing was employed which soon blasted through at the corners. In the final machines the corners are made of rubber and the straight section of metal, which has proved a very satisfactory combination in service.

To remove the specimen after testing it is necessary to partially empty the sand chamber. For this purpose a quick-opening slide valve was designed, which was gasketed with felt. The pipe shown in Figure 2, bending out diagonally from the bottom of the chamber, is the outlet from this valve and may be extended with hose to conduct the sand to a chamber below the apparatus, or any convenient place.

This apparatus furnishes means whereby the resistance of finishes to mechanical wear can be evaluated on a commercial basis. No feature in its operation is critical, and the apparatus can be used successfully under ordinary shop or laboratory conditions although it is always better, whenever practicable, to make the tests in conditioned rooms.

ELLIOTT CRESSON MEDALS

have been awarded by the Franklin Institute to CLINTON JOSEPH DAVISSON AND LESTER HOLBERT GERMER "*in consideration of pioneer work in the scattering and diffraction of electrons by crystals, and of its direct bearing on our theory of the constitution of matter". Among other holders of these medals are Henry Ford, Elmer A. Sperry, Dayton C. Miller, and Gustaf W. Elmen of the Laboratories. Presentation of the medals will be made on the occasion of the Institute's annual Medal Day exercises to be held on Wednesday, May 20.*



Acoustic Delay Circuits

By W. P. MASON
Transmission Research

FOR many years studies have been made of the propagation of sound waves in tubes. Over a century ago Regnault used the water mains of Paris for an extensive series of tests to determine the velocity of sound in pipes and whether it varied with their diameter. A pistol would be discharged at one end of an empty main and the time of the arrival of the sound at a diaphragm stretched across the other end would be recorded. Sound waves in a tube are propagated in a manner comparable to that of electric waves over a wire, but with the outstanding difference that their speed of propagation is much slower. Whenever it is desirable to obtain a large delay in the transmission of electric waves, therefore, this slow propagation of sound waves is very useful. The electric waves are converted to sound by telephone receivers, and the sound, after being transmitted over the length of tube necessary to obtain the desired delay, is reconverted to electric waves at the other end. The arrangement of tubes and receivers used for this purpose is known as an acoustic delay circuit.

Sound waves transmitted by a tube consist of a series of compressions and rarefications. The motion of any individual particle of air is in the same line of direction as the propagated wave. At the input end, the motion of the air may not be uniform across a cross-section of the tube: the wave motion may be started, for example, by a diaphragm which has a larger amplitude of motion at its center than at its periphery. For ordinary sized tubes, however, say two inches or less in diameter, it has been found that for voice frequencies the wave will become uniform, or plane within a short distance. At higher frequencies or for larger sized tubes other forms of wave motion may be transmitted, but for voice frequencies plane waves may be produced by selecting the proper size of tube.

For such plane waves, the acoustic tube is equivalent to an electric line with distributed inductance, capacitance, and resistance. No element exists in the tube corresponding to leakance in a line. In the acoustic system of units the excess pressure in the tube is the equivalent of voltage in electrical units, and volumetric velocity, of electrical current. By comparing the equations for an electrical line with the corresponding equations for the tube, it may be shown that inductance per unit of length is equivalent to the density of the air divided by the cross-sectional area of the tube. Similarly the capacity may be shown to be equal to the cross-sectional area divided by the coefficient of cubical elasticity. The resistance of the tube to the motion of air arises from two sources: viscosity and heat conduction.

Viscosity is the frictional force opposing relative motion between two layers of air or between a layer of air and a containing wall. Because of the walls of the tube, therefore, a frictional force is always exerted on the adjacent layer of air and this layer exerts a similar but smaller force on the next inner layer and so on. The result is a damping action equivalent to electrical resistance, which at voice frequencies is proportional to the square root of the frequency and inversely proportional to the radius of the tube. This effect is somewhat analogous to the skin effect in an electrical line.

The effect of heat conduction is also proportional to the square root of the frequency so that the two resistance terms are additive. When air is compressed, heat is generated which, if air were a perfect heat insulator, would be reconverted to mechanical energy at the following rarefications. Because the air is conducting to some extent, however, heat flows to the colder parts of the gas and to the walls of the tube during most of the compression and rarefication cycle so that there is a loss of energy and hence a resistance attenuation of the wave.

Knowing the equivalent inductance, capacitance, and resistance per unit length, one can calculate the properties of the tube from the ordinary line formulas. Calculated attenuation constants for a tube one inch in diameter

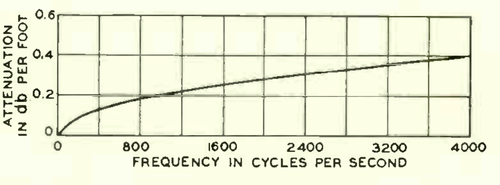


Fig. 1 — Calculated attenuation of an acoustic tube one inch in diameter

are shown in Figure 1, and are very close in value to those determined experimentally. The attenuation constant varies inversely as the radius and directly as the square root of the frequency. Phase velocity of such a tube is very uniform down to a low frequency, and the characteristic impedance of the tube is nearly a pure resistance over the voice range of frequencies. The attenuation per wavelength is considerably less than that of the best electric lines so that the acoustic tube is a very good device for delaying a wave without seriously distorting its form.

The simplest way to use such a tube as a delay circuit in an electrical system is to connect one high-quality loud speaker to each end of the tube as shown in Figure 2. To economize in space, the tube may, of course, be bent into any desired form. If it is desirable to employ a tube of cross-sectional area larger than the opening of the loud speaker, so as to decrease the attenuation, tapered horns—which are essentially acoustic transformers—can be used to connect the loud speakers to the tube.

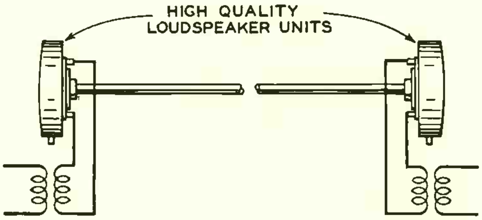


Fig. 2—A typical acoustical delay circuit includes two high-quality loud speakers, one connected to each end of the tube forming the delay circuit

Such devices form very good delay circuits for many purposes, but for certain high-quality circuits, difficulties are experienced caused by echoes produced in the tube. The loud speakers connected to the tube do not have an acoustic impedance that matches that of the tube. As a result, wave energy reaching the loud speaker is not all absorbed. Part is reflected, travels to the other end where it is again partly reflected, and returns to the receiving end as an echo.

The simplest means of eliminating these echoes would be to construct loud speakers whose acoustic impedance equaled that of the tube, and considerable progress in this direction has been made. Another method used is to employ as the receiving element a small condenser transmitter shunted across the tube. With this arrangement, the tube is either terminated in an acoustic resistance or continued a distance sufficient to make the impedance of the termination essentially the same as that of the tube. The condenser transmitter serves as a high impedance voltmeter. It is actuated by the pressure of the air waves and causes no reflection.

Another method is to build an acoustic equalizer or attenuator of constant resistance and to insert it before the receiving loud speaker. Since the equalizer has the same charactertistic impedance as the tube, no reflection is caused until a wave reaches the loud speaker. Although the received wave is reduced by the attenuation of the network, the first echo will be attenuated by three times that amount.

Acoustic delay systems have been used by the Laboratories for a variety of purposes. Two typical delay systems of this type are shown in the headpiece. Such systems, among other uses, have been employed to study the effect of delay distortion on the intelligibility of speech, and a recent system, producing a delay of ½ second, is being used to simulate the delay of a long land line. Repeaters are placed between sections of the delay system to overcome the attenuation of the acoustic circuit and equalizers are employed to compensate for its attenuation distortion so that the overall effect is a distortionless delay. With this apparatus it is possible to study the effect on transmission over long lines of the delay due to the operation of voice-operated relays.

A Loud Speaker Good to Twelve Thousand Cycles

By L. G. BOSTWICK
Transmission Instruments Research

TWELVE thousand cycles—over five octaves above middle C in the musical scale—of what advantage is a loud speaker that is capable of so greatly exceeding the pitch limit of any voice or musical instrument? Twelve thousand cycles is within the highest octave that can normally be perceived by the ear, but yet it has been found that certain musical instruments and voices, and many common sounds such as hand clapping or the jingling of keys or coins, have overtones or harmonics that make such a loud speaker necessary for perfect reproduction. In some cases the change in the character of the sounds resulting from suppression of the high frequencies is not objectionable, but in others it may be such as to cause the reproduced sound to bear but little resemblance to the original. Extension of the frequency range of a reproducing system to include the very high frequencies results in marked improvements in the reproduction of impulsive sounds and in the naturalness, color, and brilliance of the reproduced sounds of speech and music.

Although it is possible for the high frequencies to be suppressed at many points in a reproducing system, the loud speaker is almost certain to be blamed, and often justly. Loud speakers are usually inefficient at very high frequencies because the mass of the diaphragm impedes the vibratory motion and thereby diminishes the acoustic output. Existing diaphragm shapes and materials do not permit a sufficiently light structure to avoid this effect.

The loss in acoustic output at high frequencies, however, may be diminished by using a horn. The horn improves the acoustical coupling between the diaphragm and the air and there-

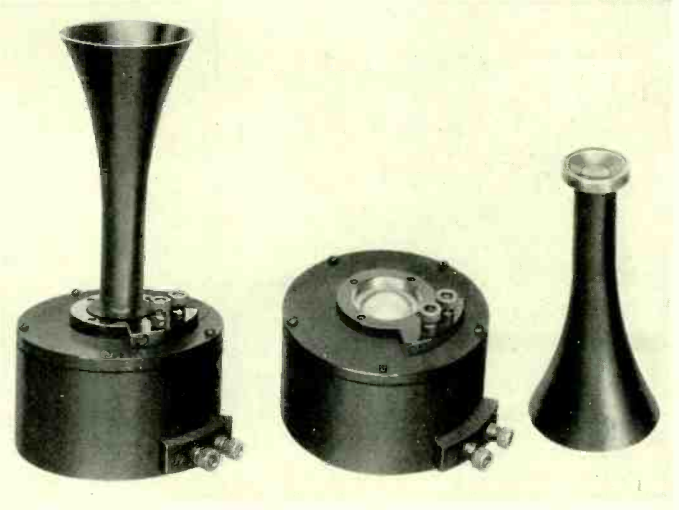


Fig. 1—The new high-frequency loud speaker efficiently reproduces the higher audible sounds

by makes possible greater sound radiation with smaller vibrational amplitudes. The effect of the mass of the diaphragm in cutting down the acoustic output is consequently minimized because the larger vibrational amplitudes are not required.

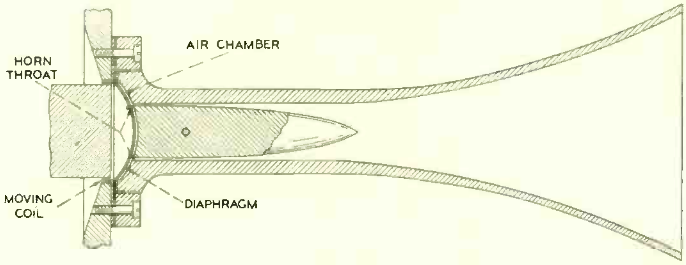


Fig. 2 — The chamber separation in the high-frequency speaker is very small

The use of a horn, however, involves another limiting factor, the air chamber between the diaphragm and the horn throat. The air in this chamber is compressible and as a result tends to diminish the vibratory motion at the horn throat. At low frequencies this compressibility of the air chamber does not usually cause difficulty but at high frequencies it becomes dominant.

In the loud speaker shown in Figure 1 these and other factors that usually cause the high frequencies to be suppressed have been taken into consideration. The diaphragm is made of .002 inch duralumin and is a little over one inch in diameter. A spherically embossed section at the center provides rigidity and causes the diaphragm to vibrate as a whole, like a piston. A moving coil of aluminum ribbon wound edgewise is attached to the diaphragm at the periphery of the embossed section and vibrates in a very strong magnetic field in the usual way. The diaphragm and moving coil weigh together but 160 milligrams. A sufficiently incompressible air chamber is obtained by making the separation between the diaphragm and horn very small. The chamber stiffness (the reciprocal of the compressibility) is inversely proportional to the separation, and by making this about .010 inch the adverse influence of the chamber is substantially eliminated up to the very high frequencies. The throat end of the horn conforms to the contour of the diaphragm as can be seen in Figure 1. Since for equal radiation, the amplitude must be larger for low frequencies, this small chamber separation, in limiting the amplitude of the diaphragm, makes it impossible to radiate the low frequencies. Consequently only a small horn, suitable for the high frequencies, is required. The horn shown in Figure 1 is of the exponential type and suitable for frequencies above 2000 cycles. Its mouth is a little over two inches in diameter, and its throat is formed as an annular

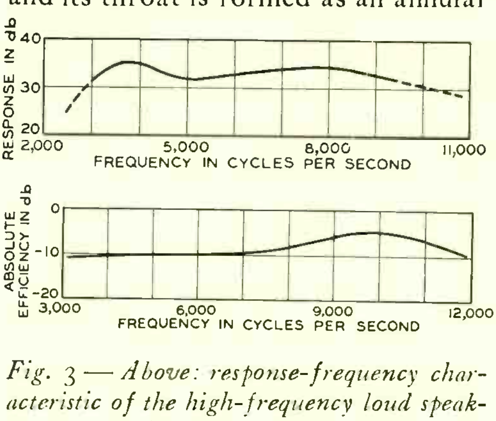


Fig. 3 — Above: response-frequency characteristic of the high-frequency loud speaker, measured up to 10,000 cycles on the axis of the horn three feet from its mouth. Below: output characteristic of the high-frequency loud speaker, in decibels relative to the ideal

slit to minimize high-frequency interference effects within the air chamber.

The curves in Figure 3 were obtained from measurements of the performance of this loud speaker at different frequencies. One curve shows measurements of the sound pressure on the horn axis at a distance of about three feet. A calibrated condenser microphone was used as the acoustic meter; the results are expressed in decibels. The other shows the absolute efficiency of the speaker, determined from measurements of the electrical motional impedance. This efficiency is the amount by which the output of this loud speaker is less than the maximum possible output obtainable from an ideal speaker. The average value for the absolute efficiency throughout the frequency range from 3000 to 12,000 cycles is about twenty per cent.

Since this loud speaker cannot radiate the low frequencies, it must be used in conjunction with a loud speaker designed for the low-frequency range. Either baffle or horn type speakers of existing design may be used with it. Figure 4 shows a curve obtained by using the high-frequency loud speaker with a standard Western Electric theatre speaker having a large 60-cycle cut-off exponential horn. The small

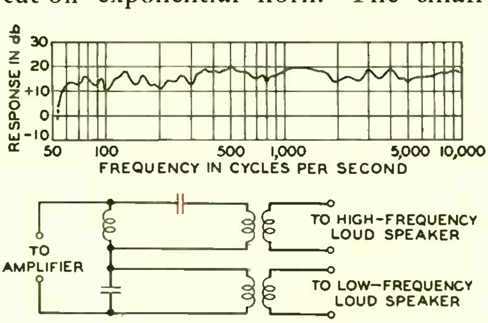


Fig. 4 — Connected to the power supply, through the circuit shown, the high-frequency loud speaker and a low-frequency speaker will efficiently reproduce almost all audible sounds

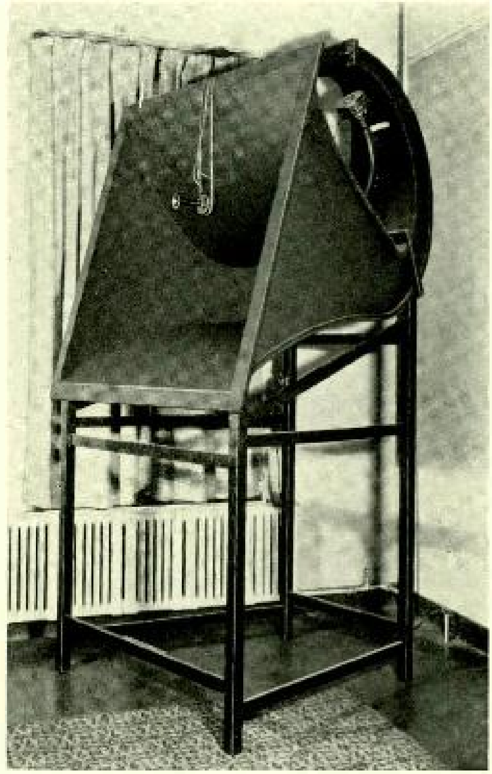


Fig. 5 — In obtaining their combined frequency characteristic, the small speaker was suspended in the large horn's mouth

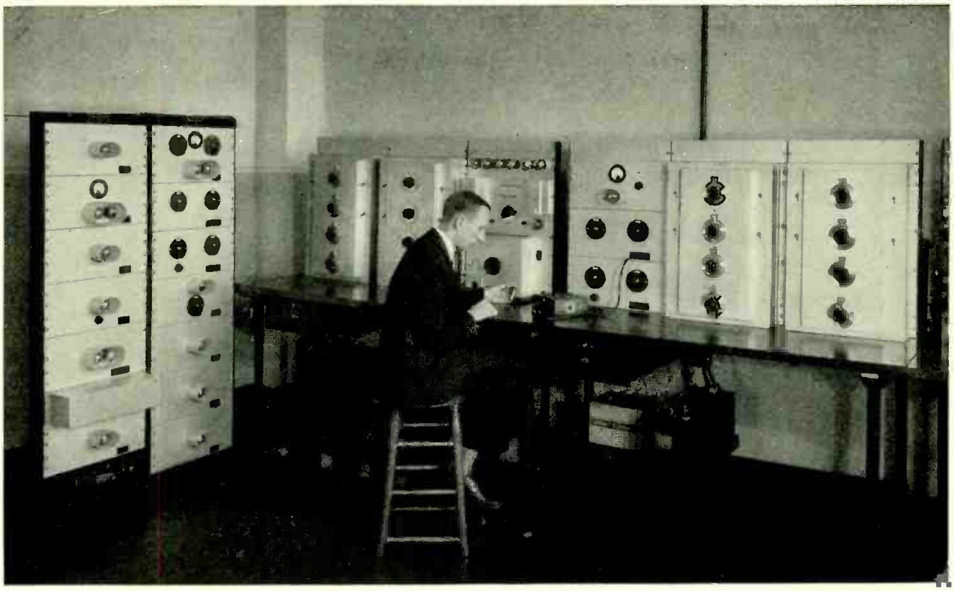
speaker was suspended in the mouth of the large horn (Figure 5), and the two speakers were connected to the electrical supply through a simple electrical network (Figure 4) which delivered most of the electrical power above 3000 cycles to the high-frequency loud speaker and most of that below 3000 cycles to the low-frequency speaker. This arrangement makes most effective use of the electrical supply and prevents possible damage to the more delicate high-frequency speaker by large amounts of low-frequency power. The measurements were made in a large felt-lined room with a condenser microphone rotated in an inclined circle six feet in diameter about a point on the large horn axis twelve feet from the mouth.

The use of such a loud speaker has several advantages aside from the improved frequency range. It permits a more favorable design of the associated low-frequency loud speaker because the delicate parts and the restricted dimensions necessary to radiate the high frequencies are not needed. This makes possible greater power capacity and in some cases better efficiency in the low-frequency speaker. Another advantage is that it affords more uniform sound-field distribution. The sound field of loud speakers of the dimensions necessary for low-frequency radiation often becomes too concentrated in one direction at the high frequencies. This excessive concentration is due to the large dimensions of the radiating surface compared to the wavelength. By radiating the high frequencies from a small loud speaker the restriction of the sound field is greatly diminished.

On the other hand, a loud speaker efficient at high frequencies introduces other difficulties that would not be encountered if the high frequencies were suppressed. For example, amplifier overloading becomes much more strident, and noise may increase to an objectionable extent. A loud speaker of the type described, therefore, cannot be used to full advantage in systems where these factors are not favorable.

THE JOHN PRICE WETHERILL MEDAL

has been awarded by the Franklin Institute to EDWARD C. WENTE, *Acoustical Research Engineer, for his invention and development of the condenser transmitter.*



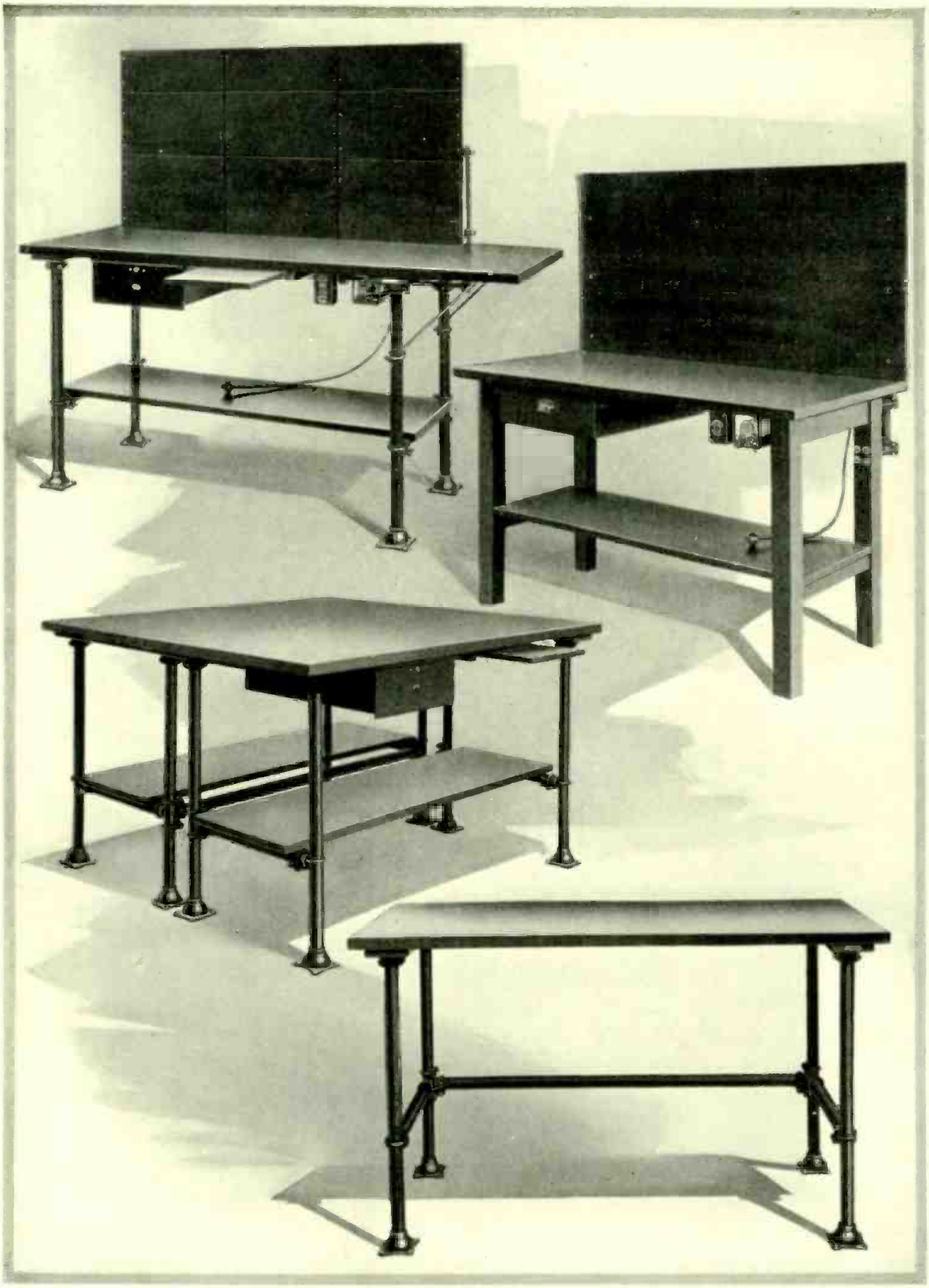
A New Type of Laboratory Bench

By C. A. KOTTERMAN
Research Laboratory Engineering

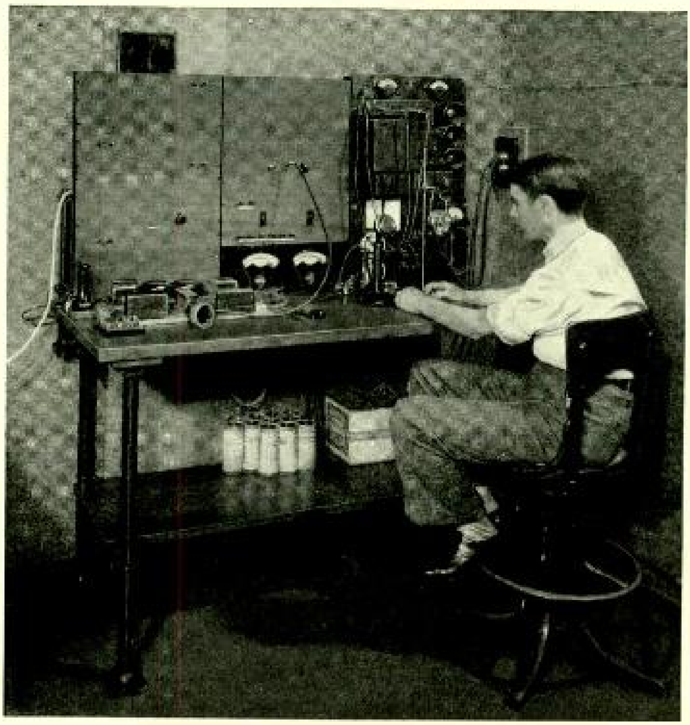
BENCHES are a major part of the equipment of these Laboratories in the Research and Apparatus Development Departments. In fact, nearly three miles of benches have been built into the quarters at West Street. Due to the rapidly changing conditions of our research and development work we have frequently been handicapped by a lack of flexibility of the built-in bench and particular attention has been paid by the Research Department Space Committee under R. H. Wilson to the suggestion of a portable-unit bench to replace the present built-in types. As a consequence a new style of bench has been evolved, which retains the rigidity of built-in construction and, because of its unit assembly, possesses additional features making it very suitable to our laboratory requirements.

The final design features of the new bench were the responsibility of R. O. Mercner and the first models were brought to the attention of the Laboratory Requirements Committee of the Apparatus Development Department headed by H. J. Delchamps. As a result of the cooperation of that department a change was made in the width of the unit benches, and as now designed they meet the general needs of both the Research and Apparatus Development Departments.

Two types of unit benches have been adopted as standard equipment by the committees. The one fitting most conditions of our laboratory work consists of an iron-pipe framework rigidly held together by stand-



The new type bench with relay-rack panels (upper left). Accessories attached include metal drawer, bench slide, electric outlets, soldering-iron cage holder and extensible top. All-wood bench (upper right) with 30-inch backboard, for use where pipe framework interferes with electrical measurements. Island bench (lower left) formed by joining two portable units. The foundation unit (lower right), the basic structure of the pipe-frame bench



Standard articulation testing board set up on relay-rack panels mounted on portable-unit bench

iron pipe and standard clamps, either a low or high backboard can be rigidly attached to the units. Interchangeability of backboards and their installation or removal in a short time affords a further measure of flexibility. The cross members of the foundation unit support a wooden undershelf which is adjustable in height and can be removed without weakening the structure.

An innovation made possible by the portable-unit bench is the use of relay-rack panel mountings instead of backboards. Engineers doing laboratory work are finding it more and more convenient to mount apparatus and wire up circuits on standard relay rack panels. These can be supported on the portable-unit bench in place of, and are interchangeable with, backboards. The supporting gear for the relay rack panels has been designed so that they can be mounted flush with the back edge of the bench or they can be projected forward on the bench top to allow clearance behind the panels for can covers, apparatus, and the like. A unit bench equipped with relay-rack mountings affords nearly fifty percent more panel space than the standard 101-A rack.

The units are self-contained in that each can be fitted with power and soldering-iron outlets. These power outlets consisting of one or two double outlets, have been standardized and

ard clamps and supporting a hard wooden top. This is called the foundation unit and is 36 inches high, 28 inches wide and 61 inches long. The parts for the foundation unit can be carried in the storerooms and a unit can be set up in a short time by unskilled labor with the use of a wrench and screw driver. It is equal in strength and rigidity to a built-in section of bench and because of the mobility of the unit, it answers perfectly the need for flexibility. In addition, its design permits a variety of bench combinations impossible with the built-in type, although it is expected that there still will be some use for the built-in bench largely owing to its rigidity.

The construction of the foundation unit is such that by the use of more

A section of the Transmission Instrument Standards laboratory at the Graybar-Varick Building. Portable-unit benches joined end on end

will be carried in the storerooms. They can be installed on any unit bench in a few minutes' time without interfering with any of the other accessories and the flexible length of cable enables a bench unit to be pulled away from the wall for the purpose of working around it. A soldering-iron cage holder, also stocked, can be added to a unit bench if required.

After a foundation unit is set up, any or all of the accessories can be attached in a short time to meet any condition of work. In addition, it is possible to join the unit benches end to end to form a long wall bench. By means of strap-iron cleats under the bench tops and on the backboards, a bench installation of several unit lengths can be assembled having a continuous flat top and possessing all the rigidity of the built-in type, but without any of its shortcomings.

The other standard unit is all wood, with interchangeable low and high backboards and has the same physical overall dimensions as the iron-pipe type. It is used where the iron-pipe framework interferes with work involving high-frequency currents.

In special cases where extreme mobility is desired, a modification of the standard unit can be obtained, fitted with rubber tired casters with floor locking brakes. Island bench installations of one or more foundation units also can be set up easily and quickly to meet some unexpected or unusual laboratory arrangement of space and as easily and quickly dismantled for storage or erection at another place.

The metal parts of the new benches are finished with a black lacquer which provides a serviceable color and one that can easily be touched up when marred. The bench tops and all wooden accessories have a brown mahogany finish. An initial installation of some 450 portable unit benches of both the iron-pipe frame style and the all-wooden style has been made at the Graybar-Varick building.

NEWS AND PICTURES

of the

MONTH

Acme Photo

Their Imperial Highnesses, Prince and Princess Takamatsu of Japan, who recently paid a visit to the Laboratories

General News Items

IMPERIAL COUPLE VISIT LABORATORIES

ON April 14 the Laboratories were greatly honored by a visit of their Imperial Highnesses the Prince and Princess Takamatsu of Japan, who were spending a few days in New York on a round-the-world tour.

On arrival at the Laboratories, the Imperial couple and their suite were welcomed by Vice-President Charlesworth and his staff. The party then proceeded to the auditorium to witness a demonstration of television. Both the Prince and Princess, as well as the members of their entourage, spoke over the two-way television system with members of the Imperial Suite who were at the 195 Broadway terminal.

The visitors then proceeded to the magnetic materials laboratories where the operation of the cathode-ray oscillograph, used in the studies of permalloy, was demonstrated. They observed with much interest the visual record made by the cathode-ray oscillograph of the variations in telephone current occasioned by words spoken into a transmitter. The Prince and Princess were also invited to speak into a transmitter associated with the rapid-record oscillograph. The visual records of the current changes corresponding to the words they spoke, developed and printed in a few seconds, were retained by them.

In the dial system laboratories the "call announcer" was demonstrated. Prince Takamatsu dialed a series of four numbers and the visitors were amazed as the words, corresponding to the numbers dialed, issued an instant later from a loud speaker associated with the call announcing apparatus. Demonstration was also given of the progress of a telephone call from a dial telephone through the complex machine switching apparatus to another dial station.

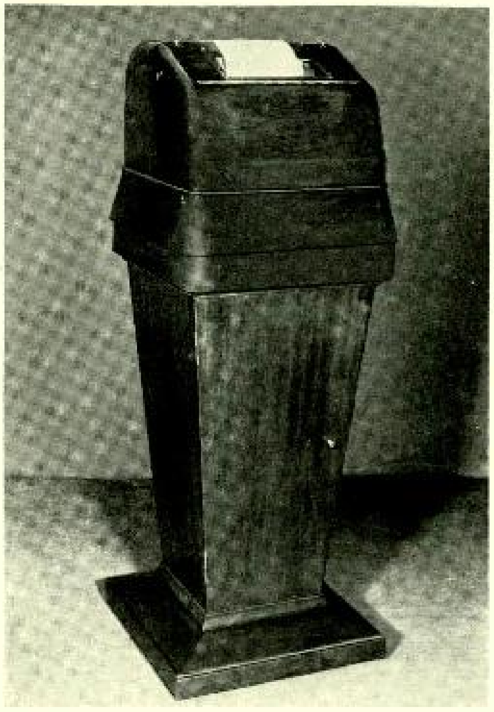
From the dial systems laboratories the party proceeded to the Historical Museum where they viewed with much interest exhibits of the progress in the development of the telephone. As souvenirs of their visit to the Laboratories, Mr. Charlesworth presented to the Prince and Princess specially prepared small replicas of Alexander Graham Bell's original telephone.

New Teletypewriter System Placed in Service

A new high speed news dissemination system recently developed by the Laboratories is now in service for the New York News Bureau Association. It was furnished and will be maintained by the New York Telephone Company. Several hundred of these machines located in the offices of the News Bureau's clients, which include brokerage houses, newspapers and banking institutions throughout the metropolitan area continue the system of financial news publication which the Bureau has maintained since 1893.

The high speed instruments, capable of receiving 60 words per minute, will be encased in walnut or mahogany finished covers containing glass apertures, so that those at the distant points interested in the financial news can read it at the same time that it is being typed in the bureau's office. A remote control feature associated with the sending machines at 32 Broadway will permit the operator to start and stop all machines connected with the system, and a bell arrangement will enable the operator to signal attention to the ticker when there is news of unusual interest coming over the wire.

The machines at the subscribers stations are the No. 15 Teletypewriter arranged for receiving only. They are mounted, at the user's preference, on a low table convenient for a seated reader; or on a pedestal, designed by J. A. Mahoney and A. Zitzmann of our Toll Equipment group.



New teletypewriter pedestal used by the New York News Bureau

Columbia Sigma Xi Chapter Views Two-Way Television

Members of the Columbia University Chapter of Sigma Xi were guests of the Laboratories on March 19 to observe two-way television. Divided into two groups which were assigned respectively to the 195 Broadway and Laboratories terminals of the system, those attending were permitted to carry on individual conversations in a program which lasted from 5:30 until 8 o'clock. A special dinner was served in the restaurant for those who participated in the demonstration from this building.

The members of the society were very much pleased with the exhibition which was scheduled as one of the important events on its winter program. About sixty persons were at hand at each terminal. G. F. Fowler was in charge of their reception and A. L. Johnsrud supervised the operation of the two-way television system.

Ship-to-shore Demonstration

Bell Telephone Laboratories was prominently represented at the Merchant Marine Luncheon recently held at the Hotel Pennsylvania by the New York Junior Board of Trade. During the course of the luncheon W. I. Plitt, President of the Board, talked by telephone with Commander A. B. Randall of the United States liner *Leviathan* which was 390 miles off Ambrose Lightship. Loud speakers were used so that all could hear.

Those attending the luncheon from the Laboratories were: H. P. Charlesworth, W. Wilson, A. A. Oswald, R. A. Heising, R. H. Wilson, E. L. Nelson, B. B. Webb, A. F. Weber, E. J. Santry, P. B. Findley and J. S. Hartnett.

ADMINISTRATION

Mr. Charlesworth has been elected as a representative of the American Institute of Electrical Engineers on the Division of Engineering and Industrial Research of the National Research Council for the three-year term beginning July 1, 1931, succeeding Dr. Jewett, whose term expires at that time.

Mr. Charlesworth was a guest at the reception and luncheon given by the City of New York to the Prince and Princess Takamatsu on Saturday, April 11. He also attended the dinner given in honor of Their Highnesses by Consul General Horinouchi at the Plaza on Monday evening, April 13.

S. P. Grace addressed a large audience of university undergraduates and townspeople at the University of Kansas at Lawrence on March 18. Mr. Grace and R. M. Pease were guests of the President, Department Heads and the Engineering Staff of the University at luncheon on the day of the meeting. On March 24 and 25 Mr. Grace addressed capacity meetings at Fort Worth, Texas. The talk was under the auspices of the Texas Independent Telephone Association.

Mr. Grace's address at Austin, Texas, on March 31, was by far the largest attended of any that he has yet given. Nine thousand persons crowded into the auditorium and nearly 500 were turned away at the meeting which was jointly sponsored by the Austin Chamber of Commerce and the University of Texas.

While at Austin, Mr. Grace made a brief address to the State Senate in session and was officially received by Governor Sterling. Messrs. Grace and Pease were also dinner guests of President Benedict and Department Heads of the University of Texas.

COLLOQUIUM

On March 16, Karl K. Darrow addressed the Colloquium on the subject *Space Charge Sheaths in Gases.* Mr. Darrow reviewed the extant knowledge of the cathode dark space in the ordinary glow discharge where the cathode is not independently heated. He touched on the researches of Langmuir, Schottky, Compton and their collaborators on dark sheaths which appear around negatively-charged "probes" immersed in the positive columns of mercury-vapor arcs and similar discharges. He pointed out that all are instances of the same thing, but the artificial sheaths of the probes are much simpler and more intelligible than the natural sheaths of which the cathode dark space is an example.

W. A. Shewhart addressed the Colloquium, March 30, on the subject, *The Logic of Discovery.* He briefly outlined the practical significance of some of the recent developments in the scientific method of rational induction consistent with modern concepts of indeterminateness of causation and of the statistical nature of physical properties and physical laws. He showed why it is in the light of this information that some of our present engineering practices in the accumulation and interpretation of data call for modification. For example, he showed that customary emphasis on *numbers* of routine observations is in many instances entirely misleading, and he indicated the economic importance of recently developed criteria for determining when variations in a phenomenon indicate the presence of discoverable causes.

Departmental News

Apparatus Development Special Products

At the request of the Western Electric Company, L. B. Cooke attended the annual Legislative Press Association Dinner at Albany to supervise the installation and operation of a public address system used during the dinner.

Various problems in connection with intercommunicating and announcing systems on battleships were discussed by A. F. Price, H. C. Curl, E. G. Fracker and W. A. Bischoff at Washington with navy officials and various Western Electric and Graybar representatives.

W. L. Betts and E. Soreny visited Hadley Field recently to get first-hand knowledge of various types of airplanes for use in the preparation of designs for radio telephone equipment for these planes.

Production problems in connection with the manufacture of improved type of light-valve ribbon for sound picture work occasioned a visit to Hawthorne by T. E. Shea, W. Herriott, and W. R. Goehner accompanied by W. J. Farmer of the Materials group. While in Chicago an inspection trip was made to the Yerkes Observatory where they were the guests of Professor F. E. Ross of the University of Chicago.

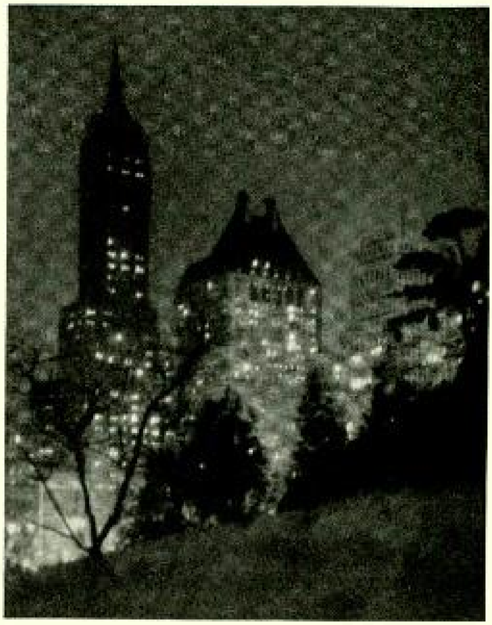
To film an instructional picture for use in the field to show how mortar-bandage joints in underground cable are made, F. L. Hunt and W. T. Pritchard were at the Chester Field Laboratory.

While in the Southwest with Mr. Grace, R. M. Pease spoke before an assembly of over 1600 students at the Central High School, Oklahoma City, on the technique of sound pictures.

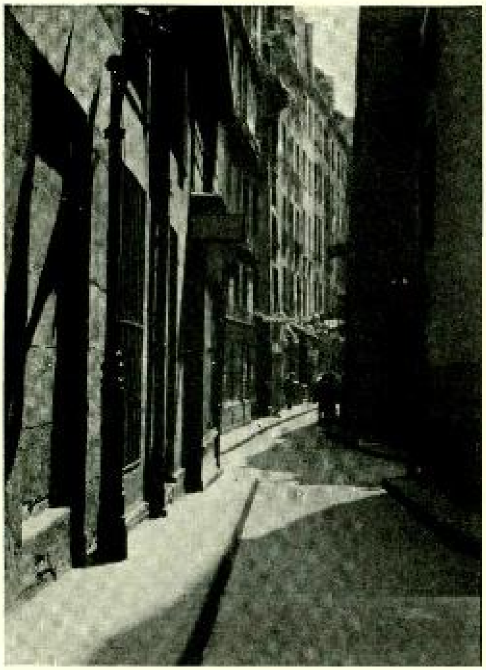
J. K. Beins was in St. Louis to assist Mr. Pease on the handling of the equipment at Mr. Grace's talk.

H. E. J. Smith visited Omaha to direct the installation of a 400-watt radio-telephone equipment for the Police Department of that city.

J. F. Morrison was at St. Louis to supervise the conversion to crystal control of the 1-kw radio-telephone broadcasting equipment owned by the Concordia Theological Seminary.



First prize, landscape group, Senior class, Club photo contest; by E. Alenius



First prize, miscellaneous group, Senior class, Club photo contest; by J. E. Rogers

While in Missouri he inspected the Greater St. Louis Broadcasting Corporation's station KWK in St. Louis and the station of the WHB Broadcasting Company in Kansas City.

THE INSTALLATION of 1-kw radiotelephone broadcasting equipments for WOKO, Incorporated, at Albany and WOBU, Incorporated, at Charleston, West Virginia was supervised by B. R. Cole.

Transmission Apparatus

WELDED LOADING coil cases were inspected by C. R. Young in a recent visit to Cortland, New York.

W. J. SHACKELTON attended a regional meeting of the A.S.T.M. held at Pittsburgh. A. C. Walker was also at the meeting.

A SYMPOSIUM on welding, held in Pittsburgh under the joint auspices of the A.S.T.M and the American Welding Society, was attended by K. F. Rogers. He also visited the East Pittsburgh Works of the Westinghouse Electric Company in connection with the welding of loading coil cases.

R. M. C. GREENIDGE was at Hawthorne relative to the production and testing of loading units.

O. C. ELIASON, accompanied by G. H. Downes, E. G. Hilyard and R. V. Jones of A.T.&T., were at Boston to observe installations of lacquer-treated wire in telephone exchanges.

Materials Development

H. N. VAN DEUSEN attended committee meetings of the A.S.T.M. held at Pittsburgh in his capacity as member of the Executive and chairman of the Membership committees.

J. R. TOWNSEND was in Waterbury where he discussed with representatives of the American Brass Company and the Scovill Manufacturing Company the proposed investigation of cold-heading wire in the manufacture of screws. Mr. Townsend was also at Pittsburgh to attend A.S.T.M. committee meetings.

G. R. GOHN was at Yale University to make the final adjustment on the machine for sheet-metal testing recently installed in the laboratories of the Sheffield Scientific School. The machine is of the same type as that at present used in the Laboratories which was designed especially for the sheet-metal fatigue testing carried on in the Materials Laboratory.

L. E. ABBOTT and H. L. MCCABE attended the Welding Symposium held at Lehigh University.

AT PITTSBURGH, W. W. Werring attended a meeting of the A.S.T.M. committee on impact testing.

F. F. LUCAS was also at Pittsburgh during the A.S.T.M. convention and attended the committee meetings on

Fatigue of Metals. On April 3 he addressed a meeting of Western Electric executives on microscopy.

I. V. WILLIAMS went to Hawthorne to introduce a method which will avoid season-cracking of a piece-part in handset transmitters.

D. W. MATHISON was at Montreal on contact studies.

AT PITTSBURGH, C. H. Marshall attended meetings of the A.S.T.M. committees of Tension Testing, of which he is secretary, and Sheet Metal Testing for which he was temporary chairman.

TWENTY-FIVE YEARS in the service of the Western Electric Company and the Laboratories were completed by Albert Weller on April 9.

Mr. Weller entered the employ of the Western Electric Company as an

A. Weller

electrician in the 463 West Street building. In those days the electricians not only wired up the motors and performed like electrical jobs but in addition installed and cared for the telephone communicating system within the building, the annunciators and so forth. He was engaged on this work for fifteen years and gained valuable experience in the maintenance of electrical apparatus.

In 1919 he became a member of the Engineering Department. He has been occupied since this time on the protection of apparatus from lightning and power crosses. The building of new models of protection apparatus and special testing equipment fall within the scope of Mr. Weller's work.

DIAL APPARATUS

W. FONDILLER, J. N. REYNOLDS and O. F. FORSBERG were in Hawthorne for conferences on new dial apparatus developments. While at Chicago they also visited the Teletype Corporation in connection with printer matters.

MEMBERS OF the Dial Apparatus group learned with regret of the death of D. W. Bernard which occurred in the Willard Parker Hospital, New York, after a week's illness.

Mr. Bernard became a member of the Laboratories in July of last year following his graduation from Iowa

D. W. Bernard

State. His home was in Charles City, Iowa. At the time of his death he was engaged in dial apparatus work.

P. T. HIGGINS completed twenty-five years of service in the Bell System on April 4. He is engaged on the design of step-by-step apparatus.

His association with the telephone industry began with the New England Telephone Company following his graduation from Lowell Institute. He first worked on the installation of branch exchanges and then was made an inspector. At the end of three years he transferred to central-office maintenance and two years later to test-board operation. Mr. Higgins came to the Engineering Department

P. T. Higgins

of the Western Electric Company in 1919 with wide experience in the practical branches of telephone work.

His first work in the Engineering Department was as a member of the Systems Development group engaged on relay requirements and adjustments for dial apparatus. He was later assigned to field requirements and maintenance methods on this same work. He became a member of the Apparatus Development group in 1926 where he has since worked on improvements in step-by-step apparatus.

MANUAL APPARATUS

W. J. MEANS visited Hawthorne to discuss the manufacturing processes on the new mercury-type ringing interrupters. In order to observe the operation of these interrupters under field conditions he also visited new installations of the Ohio Bell Telephone Company in Toledo, the Cincinnati and Suburban Bell Telephone Company in Cincinnati, and two offices of the Bell Telephone Company of Pennsylvania in Pittsburgh.

J. R. FLEGAL visited the plant of the General Electric Company at Pittsfield in connection with development work on new types of resistance material.

DRAFTING AND SPECIFICATIONS

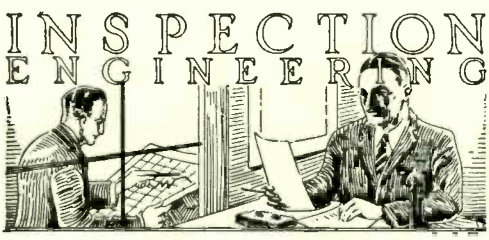
A. W. LAWRENCE, Assistant Specifications Engineer, completed twenty-five years as a member of the Bell System on April 16.

He entered the employment of the Western Electric in the present building on engineering inspection work.

A. W. Lawrence

About three years later he became a member of the Apparatus Design Department. The activities of the Special Order group in the above department were placed in his charge in 1914 and he continued in this capacity until 1917 when he sailed for France as a member of the former Sixty-ninth New York Regiment.

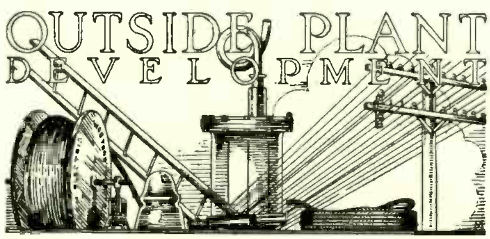
While in France Mr. Lawrence was transferred to the research and inspection division of the Signal Corps under Colonel H. E. Shreeve. Returning to the Apparatus Design Department after being mustered out of service in 1919, he was placed in charge of a group designing substation and protective apparatus. He assumed his present position as Assistant Specifications Engineer in charge of manual and testing specifications in 1922.



DURING THE LATTER part of March H. L. Kitts completed a week of investigation work on sound-picture apparatus at the Hawthorne plant of the Western Electric Company and at the Chicago warehouse of Electrical Research Products, Inc.

W. A. SHEWHART in Pittsburgh attended a meeting of a committee on Interpretation and Presentation of Material, sponsored by the American Society of Testing Materials. As chairman of the committee Dr. Shewhart led a discussion of various steps included in the determination and specification of the quality of raw material and finished products.

W. E. WHITWORTH, Field Engineer at Cleveland, attended the cut-over of the Lawndale-Kingswood step-by-step office in Toledo which took place during the latter part of March. This office replaces three manual offices and is one of the first large offices to use ringing machines equipped with induction alternators and mercury interrupters. Another interesting feature was the use for the first time of rotary switches instead of plunger-type switches, to give each selector access to more trunks than are available through the ten contacts of a selector level. A trial of the new cut-over tool, recently designed by the Laboratories for use with cut-off relays, was made.



C. D. HOCKER, C. S. GORDON, and F. F. FARNSWORTH attended the committee meetings of the American Society for Testing Materials held at Pittsburgh.

L. H. CAMPBELL was at Florida to inspect motor-vehicle finishes under test in that climate.

J. M. HARDESTY visited Philadelphia to observe field trials conducted by the Bell Telephone Company of Pennsylvania on mortar-bandage joints in underground conduit.

ACCOMPANIED BY several representatives of the American Telephone and Telegraph Company, J. B. Dixon and F. W. Twyman made a trip to Trenton to observe a field trial of bridging connectors.

AT NEWPORT, developments are under way on splice protection of tape-armored cable which recently required the presence of V. B. Pike and

First prize, still life group, Senior class, Club photo contest; by J. E. Rogers

H. Baillard, with Mr. F. E. Waters of the New England Telephone Company and Messrs. J. H. Gray and J. B. Moses of the American Telephone and Telegraph Company.

L. W. KELSAY conferred with Western Electric engineers at the Point Breeze Works, in connection with development work on distribution terminals.

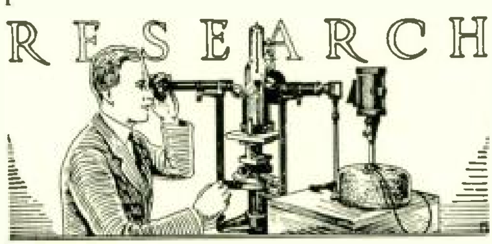
TO PROCURE poles for installation in the test plots at Chester, Gulfport and Limon, G. Q. Lumsden visited Spartanburg, South Carolina, and Brunswick, Georgia. Mr. Lumsden and R. E. Waterman of the Chemical Laboratories were in Gulfport to make an inspection of the pole-test plot there.

W. C. REDDING gave an informal talk on telephone cables before the Cooperative Club at its luncheon meeting on April 1 at the Fraternity Clubs Building in New York.

PRODUCTION OF ready-made leads for capacity-unbalance tests during cable-splicing was discussed by R. C. Dehmel at a recent conference with engineers of the Simplex Wire & Cable Company at Boston.

E. H. EISKAMP and I. C. SHAFER, JR., went to Wallingford, Connecticut. in connection with the development of drop-wire having improved adhesion between the conductors and their rubber insulation. Mr. Shafer also went to New Haven to observe tests on the proposed vertical-type reel for drop wire used on installation trucks.

LABORATORY METHODS and equipment of the Bureau of Standards at Washington were studied during a several-days' visit by R. G. Watling and T. A. Durkin, with E. V. Mace of the Apparatus Development Department.



TRANSMISSION INSTRUMENTS

C. H. G. GRAY and L. E. KREBS were at Hawthorne to confer on construction and maintenance of telephone instrument testing equipment.

A. W. HAYES at Hawthorne discussed various developments on the handset transmitter with Western Electric engineers.

J. L. CROUCH visited distributing house shops in the eastern district in connection with handset transmitters.

W. C. BUCKLAND and W. H. SMITH visited the Philadelphia Distributing House Shops to inspect repaired handset transmitters.

CHEMICAL RESEARCH

C. W. BORGMANN and R. B. MEARS on March 23 examined corrosion samples of non-ferrous metals at the New Jersey Zinc Company. The samples had been placed in various sections of the country and subjected to four years' atmospheric exposure.

COMMITTEE MEETINGS of the A.S.T.M. at Pittsburgh were attended by C. L. Hippensteel and E. J. Basch.

A. E. SCHUH at Hawthorne discussed certain improvements in the mixture used in cementing terminals to switchboard lamp bulbs. He also investigated some finish problems. Extending his trip to Madison, Wisconsin, he conferred on wood finish problems at the Forest Products Laboratory.

AT CORTLANDT, New York, C. C. Hipkins looked over some aerial loading coils.

C. S. FULLER was at Hawthorne on problems concerned with enameled-wire development.

ELECTRO-OPTICAL RESEARCH

K. K. DARROW visited the Bartol Research Foundation at Swarthmore.

TRANSMISSION RESEARCH

AS A MEMBER of the Visiting Board of Brown University, T. C. Fry attended the annual meeting of the University at Providence.

L. F. SMITH and N. W. BRYANT are in Charlotte, North Carolina, where they are assisting in the field trial of the 4000-mile toll circuit.

T. G. CASTNER is co-author, with E. Dietze and R. S. Tucker of the A. T. & T. Co., and G. T. Stanton of E. R. P. I., of a paper *An Indicating Meter for the Measurement and Analysis of Noise* to be read before the Northeastern District meeting of the American Institute of Electrical Engineers at Rochester.

A TALK ON the role of mathematics in communication was given by S. A. Schelkunoff before the Mathematics Clubs of Rutgers University.

TRANSMISSION RESEARCH

W. A. MARRISON led the colloquium on *High Precision Standards of Frequency and their Applications to Physical and Engineering Problems*, April 13 and 14, which was conducted at Massachusetts Institute of Technology under the auspices of the Department of Electrical Engineering.

SUBMARINE CABLE

O. B. JACOBS described submarine telephone cables in a talk before the

First prize, portrait group, Senior class, Club photo contest; by E. Alenius

Association of Employees of the Long Lines Department. He noted the limitations on transmission, particularly as to input level, noise interference at the receiving end, and loss-frequency characteristics.

J. F. Wentz and W. M. Bishop, who have been concerned with the transatlantic telephone cable project, have returned from Germany to resume their work in the Laboratories.

Laboratory Engineering

Ira L. Hartinger, supervisor of the mechanical and wiring group, died on March 27 in the Mary Immaculate

Ira L. Hartinger

Hospital, Jamaica, after an illness of several months. Mr. Hartinger came to his present work after several years' experience in the Plant Department. His association with the Western Electric Company and the Laboratories dated from 1920. Members of the Laboratory Engineering group were saddened to learn of his death.

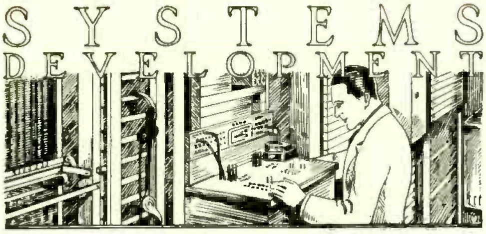
Completion of twenty-five years in the Bell System was marked for R. C. Winckel by a luncheon tendered him on April 6 by his associates in the Laboratory Engineering Department.

Mr. Winckel became a member of the Western Electric Company in 1906 and worked for two years on the design of automatic machine tools for the manufacture of telephone apparatus. He then transferred to the

R. C. Winckel

Engineering Department and was engaged on the design of plugs, generators, ringers and the automatic panel system, then in the infancy of its development. In 1909 he was placed in charge of all of the drafting work of the Engineering Department.

In 1916 Mr. Winckel was assigned to the transmission design branch of the Engineering Department's work. He worked on the experimental design of receivers for several years and then devoted himself to transmitters. In 1918 when the present handset was first projected, he contributed to the design of the instrument. He was concerned with the early transmitter designs of deaf sets, airplanes, and bank protection devices. The present high-quality microphones, of both the condenser and double-button carbon types, received their mechanical design at his hands.



Manual Equipment

W. W. Brown discussed problems in connection with the manufacture of relay-rack units for various types of equipment with Western Electric engineers at Hawthorne.

G. A. Benson visited Chicago to confer with engineers of the Illinois Bell Telephone Company pertaining to the ticket-distributing system in the toll office there.

D. C. Meyer and G. E. Bailey were in Bridgeport to view an installation of a combined toll and D.S.A. switchboard and its equipment.

In connection with modulation measuring equipment for the short-wave radio transmitter, W. A. MacMaster was recently at Ocean Gate.

Dial Equipment

D. Ross and N. H. Thorn visited the step-by-step office at Trenton in connection with the development of a new mounting for aisle pilot lamps and designation cards.

Power Development

A joint paper entitled *Automatic Power Plants for Telephone Offices* prepared by R. L. Lunsford of the Power Development group and R. L. Young of the A. T. & T. Co. was presented at the Middle Eastern District Meeting of the A.I.E.E. held at Pittsburgh on March 13. Discussion on the paper was presented by representatives of the Electric Storage Battery Company, Westinghouse Electric & Manufacturing Company, Pennsyl-

Sinister in black draperies, this scene lacks only the headsman's block and axe. But then the radio tower and automobile reassure that the time is 1931; *the place, Whippany; and the action, acoustic studies of a sound-picture set* vania Railroad and the Bell Telephone Company of Pennsylvania.

R. P. JUTSON has just completed extensive field tests of automatic plate supply equipment at Greensboro, North Carolina.

J. H. SOLE has been at Washington studying the operation of d-c voltage regulators of the centrifugal type used with larger charging generators.

VISITS TO Boston and West Lynn, Massachusetts, were made by J. R. Stone in connection with small exhauster sets and commercial-type ringing machines.

M. A. FROBERG discussed with factory engineers at Bridgeport the application of Hubbell-type receptacles to fuse boxes for drive-motors in machine switching.

LOCAL CENTRAL OFFICE

L. M. ALLEN was in Chicago to make studies in connection with the service performance of the new panel tandem board.

TOLL CIRCUIT DEVELOPMENT

A. F. GRENELL was at the ship-to-shore radio transmitting station at Ocean Gate for three days making tests on a new modulation and distortion measuring set.

TESTS AT THE Morristown repeater station as part of an investigation of the 12-C program supply repeater were recently conducted by R. W. Chesnut, R. A. Leconte and T. C. McFarland.

A. D. DOWD was in Philadelphia for four days in connection with metallic telegraph operation.

W. F. KANNENBERG and A. B. ELLICOCK have returned from Key West and Havana where they have been making installation tests of the carrier-telephone terminal equipment for the Key West-Havana cable circuit. They also cooperated in the systems tests and collected considerable data for use in development work.

SPECIAL DEVELOPMENT

E. E. HINRICHSEN completed twenty-five years in the service of the Western Electric Company and the Laboratories on April 23.

Before becoming associated with the Western Electric Company, Mr. Hinrichsen had already several years of varied experience in telephone work. Impatient to get into the young telephone industry of the Middle West, he left the University of Illinois in 1901, in his junior year, and

E. E. Hinrichsen

for the next five years worked for the Central Union Telephone Company on central-office installation and maintenance, trouble shooting, and was wire chief in Springfield.

After a short stay with an independent company, Mr. Hinrichsen started on equipment engineering for the Western Electric Company in Chicago. He wrote specifications for No. 1 central-office installations and for long-distance cable offices. Within a year he was placed in charge of a group engaged in this work. In the fall of 1907 he moved to Hawthorne and transferred to the standardization group in charge of circuits.

In 1908 Mr. Hinrichsen came to New York and worked on circuit design in the former Circuit Laboratory of the Engineering Department. Three years later the engineering of special circuits was placed under his direction. During this period until 1918 he was active in the early work of connecting step-by-step systems with Bell long-distance systems and in the development of feature switchboards for non-associated companies.

Following this, he was assigned to the study of designs as shown in current issues of patents. Shortly afterward the Special Studies Engineering group was formed and he was included in this group on studies of patents, inventions and new problems. Approximately fifty U.S. patents stand to his credit in his long service in telephone engineering.

PUBLICATION

L. S. O'Roark spoke on the communication work carried on by the Laboratories before an assembly of six hundred engineering students on March 18 at the University of Kentucky. At the request of the faculty Mr. O'Roark held an informal discussion with the Senior Engineers following the meeting and gave a more detailed account of several of the points brought out in his talk. With

A Noon-hour Battle
The chess players are: W. Salis, J. Kosmol, J. Erickson, and P. Gordon. J. Gerry and H. Ulrich are looking on. All are members of the Building Shops Department

the full undergraduate ceremony he was admitted as an honorary member into the Triangle Fraternity.

John Mills was a member of the Bell System twenty years on April 1.

PATENT

E. W. Adams and A. G. Kingman were in the South for a few days in connection with pending patent litigation. Their trip included stops at Atlanta, Birmingham and Raleigh.

H. A. Flammer visited Philadelphia for the purpose of investigating some early work on telephone-booth construction. He also made a trip to Washington.

W. C. Kiesel attended two patent hearings at Washington, one before the Board of Appeals and the other before the Examiner of Interferences.

G. F. Heuerman also appeared before the Examiner of Interferences at Washington.

H. F. Beck was in Buffalo for a few days on patent matters.

STAFF

Thirty Years in the service of the Western Electric Company and the Laboratories were completed on April 24 by John W. Upton, Plant Shops Manager in charge of the Development and Building Shops.

As head of the shop work in conjunction with the laboratory development of telephone apparatus, Mr. Upton has had a significant part in the remarkable advance made in telephonic communication within the past thirty years he has been associated with it. The various apparatus parts and the first assembled models of machine-switching apparatus were made in the shops under his foremanship. He likewise supervised the shop manufacture of the original models of the printing telegraph, sound picture and the exacting television apparatus, as well as the experimental transoceanic radio apparatus.

Mr. Upton entered the Western Electric in Chicago on repair work of telephone apparatus. Two years later he transferred to the then-called Ex-

J. W. Upton

perimental Shop in Clinton Street. Development work similar to that carried on in the present Development Shop, although of course on a much smaller scale, was carried on in the Experimental Shop which was placed under Mr. Upton's supervision two years later.

In 1907 when the engineering work carried on in Chicago, Boston and New York was consolidated in one department in New York, he was placed in charge of the shop development work. He continued in this capacity until the beginning of the present year when the combined development and building shop work was made into one department and placed under his supervision.

Building Service

Thomas Creaven completed a

quarter century's service in the Western Electric Company and Laboratories on April 29.

Mr. Creaven worked for a time as a porter when the manufacture of

Thomas Creaven

telephone apparatus was carried on by the Western Electric Company at 463 West Street and then became an elevator operator. For the past several years he has been watchman and doorman.

Tom Creaven is one of the best known members of the Building Service group. A man of genial demeanor and unfailing courtesy, he is held in high regard by his countless friends among the members of the Laboratories who wish him well on the twenty-fifth anniversary of his association with the Bell System.

Mary McCrystal of the restaurant staff completed twenty years of service in the Western Electric Company and Laboratories on April 21.

Shipping

Members of the Shipping Department were shocked to learn of the death of Patrick Hurley, one of the packing force, which occurred April 7. Mr. Hurley succumbed on the platform of the 14th Street Elevated station on his way home from work.

Patrick Hurley

His pleasing personality had well earned the liking of his co-workers and supervisors during the eleven years of his connection with the Laboratories.

Contributors to this Issue

J. J. GILBERT received an A.B. degree from the University of Pennsylvania in 1909, and remained as instructor in physics for the following year. The next two years he spent at Harvard University and at the University of Chicago. From 1912 to 1915 he studied at Armour Institute of Technology from which he recevied an E.E. degree and where he remained as instructor in electrical engineering for two years. At the beginning of the war he enlisted in the Army and obtained a commission as a Captain in the Signal Corps. After the armistice, he joined the technical staff of Bell Telephone Laboratories where he has since been engaged in the development of submarine telephone and telegraph cable. At the present time he is supervisor of the group concerned with submarine cable research.

W. F. KANNENBERG received a B.S. degree from the University of Minnesota in 1923 and at once joined the staff of the Northwestern Bell Telephone Company at Minneapolis. The following year he obtained a leave of absence to continue his studies at the University from which he received an M.S. in 1925. He then transferred to the Laboratories where he has since been engaged in carrier-telephone development with the Systems Department. In 1928 the University of Minnesota conferred an E.E. degree upon him. He has been associated with the development of the Key West-Havana cable from the beginning and spent several months in Key West and Havana during its installation.

AFTER receiving from California Institute of Technology the B.S. and M.S. degrees in chemistry, A. R. Kemp joined these Laboratories in 1918. For two years he supervised the work of the analytical laboratory. Since 1920 he has been mainly engaged in chemical research on rubber

J. J. Gilbert

W. F. Kannenberg

A. R. Kemp

R. Burns

W. P. Mason

L. G. Bostwick

and allied materials used as insulation. He is now in charge of the organic division of the Chemical Research group.

R. BURNS joined the Laboratories in 1919 and for two years worked on the development of household appliances. He then engaged in apparatus testing, specializing on the insulating materials used in various types of apparatus. Since 1928 he has been in charge of a group occupied with the development of testing methods and with the requirements for materials used in telephone apparatus.

W. P. MASON received a B.S. degree in Electrical Engineering from the University of Kansas in 1921 and immediately joined the Technical Staff of the Laboratories. While here he took post-graduate work at Columbia University and received an M.A. degree in 1924 and a Ph.D. degree in 1928. The first four years of his work with the Company were spent in investigations of carrier transmission systems. Since then he has been occupied in the development of wave transmission networks, both electrical and mechanical.

C. A. Kotterman

L. G. BOSTWICK received the B.S. degree in electrical engineering from the University of Vermont in 1922. From 1922 to 1926 he was with the Development and Research Department of the American Telephone and Telegraph Company working on systems for the high quality transmission of speech and music. Since 1926, with the Research Department of these Laboratories, he has been dealing with loud speakers and other acoustic problems.

C. A. KOTTERMAN came to the Laboratories in 1927 with a broad experience in several fields of research. From 1913 to 1923 he was with the Department of Terrestrial Magnetism of the Carnegie Institution of Washington as laboratory assistant in magnetics and atmospheric electricity. During that period he took part-time work at the George Washington University. He spent the next year at the University of Chicago as research assistant in physics, continuing his undergraduate studies. In 1924 he went to the Physics Department of Yale University as research assistant with instructor's rank, where he received the B.S. degree in 1926. The following year he took graduate work in physics at Yale in addition to his duties as research assistant. Since joining the Laboratories he has been engaged in laboratory engineering, one important phase of which is the responsibility for special electric power and power devices for the Research Department and the development of special research apparatus for general laboratory equipment.