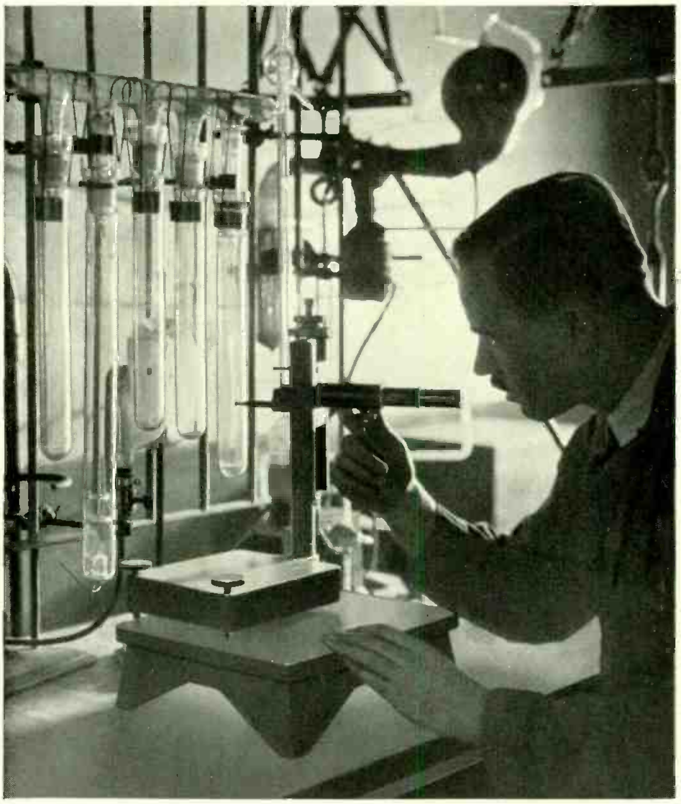
BELL LABORATORIES RECORD



The Chemical Research Department measures the porosity of microphone carbon by weighing, on a fine quartz-spring balance, the amount of moisture it absorbs

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John Joseph Carty

who has retired after fifty-one years of service in the Bell System

GENERAL CARTY'S half-century of service in the Bell System was unique because of his intimate and uninterrupted contact with the vital technical problems of the telephone practically from its inception to its present stage of development.

No one contributed more to the technical development of the art of voice communications, but great as these contributions were they did not exceed his interest in and the power to analyze and contribute to the philosophy of the business and particularly to the spirit of service within the Bell System.

General Carty's vision, imagination, and loyalty to an ideal that found expression in the Bell System, advanced him steadily in usefulness, in power, and in the respect of his fellow workers. His spirit will be reflected in things we do and in the works of those who come after us.

The Dean of Telephone Engineers

By BANCROFT GHERARDI
Vice-President American Telephone and Telegraph Company

IN February, 1895, I was hired as an assistant in the Engineering Department of the Metropolitan Telephone and Telegraph Company (now the New York Telephone Company) by John J. Carty, then its Chief Engineer. For about half of the thirty-five years since that time, I reported directly to General Carty and for the remainder of the time our work was very closely associated. On the occasion of the retirement of General Carty, after more than fifty years of active service in the Bell System, I welcome this opportunity to state in the BELL LABORATORIES RECORD my impressions of his contributions to telephony and to the engineering profession. I am more than glad to have the opportunity to do this as I feel that I am under a personal obligation to General Carty, which I can never pay, for the guidance and instruction which I received from him for many years. As a beginner in the Bell System, I was fortunate to come under the influence of his great mind and personality. The Bell System was fortunate indeed from its early days to have such a man directing its technical development. At the time when the General received the John Fritz Medal, I endeavored to outline his contributions to the Bell System, to the science of engineering, and to the country as a whole in these words:

IN 1879, only three years after Alexander Graham Bell had first publicly demonstrated his telephone invention, a young man eighteen years of age who had prepared for Harvard, but was prevented from continuing scholastic work by temporary impairment of his eyesight, entered the employ of the Bell Telephone Company in Boston.

It is difficult, if not impossible, for any of us now to visualize the telephone problem of that time and the conditions under which it had to be approached by the telephone pioneers of that day. Much of our scientific knowledge of today had not been discovered; there were no schools of electrical engineering to provide trained personnel; the American Institute of Electrical Engineers was not to be founded until five years later; there were no sources of electrical energy except primary batteries and magneto generators; no adequate theories of the transmission of electric currents over wires; no commercial applications of electricity except the electric telegraph and the infant telephone art. At that time there were in the whole of these United States fewer telephones than are to be found today in East Orange, and it was impossible to talk over distances greater than a few miles.

Practically nothing had been done and few of the essentials to the attainment of our present telephone system were known. But there was a small group of men of vision and of courage, confident of the possibilities of the telephone and determined that it should attain the future that they saw for it in their dreams. One of these was John J. Carty.

To tell the story of his life and of his contributions is to tell a very large part of the scientific, technical and engineering developments of the telephone art, not only in this country but for the whole world. After early experience in the design, construction, maintenance and operation of telephone systems in and around Boston and with the Western Electric Company in New York City, Carty in 1889 became the Chief Engineer of the New York Telephone Company. In that position he was responsible for the technical problems of the city which is telephonically the greatest in the world and where new problems are most likely to arise. In 1907 he became Chief Engineer of the American Telephone & Telegraph Company, the parent company of the Bell System. At the outbreak of the War he was ordered to active duty as a Major in the Signal Corps of the United States Army. He saw active service in France and rapidly rose to the rank of Brigadier General. Since his return from France in 1919 he has been Vice-President of the American Telephone & Telegraph Company. These, briefly, are the positions which he has held. What did he do with the opportunities which they offered?

His personal contributions to the telephone art have been notable. He designed and installed the first multiple switchboard which contained the fundamental features of common battery signaling, and later was the first to show how to operate two or more telephone transmitters from a single source of electric supply. These, together, constitute the foundation of the common battery system of today essential to every large telephone switchboard, whether automatic or manual.

From the start of the telephone business, one of the difficulties which had to be met was to prevent induction between closely adjacent telephone circuits, the result of which would be that speech taking place in any one of the circuits could be overheard in all. Closely related to this problem has been that of minimizing external inductive disturbances—those that come from electric currents in other than telephone circuits, and from atmospheric or earth currents. At a time when but little was known on these subjects, Carty made an important scientific investigation of their nature and set forth the view that under many conditions these disturbances were electrostatic and not electromagnetic in character. This view was so novel that it was not generally accepted until it had been checked and verified by others, but it was soon recognized as correct and served as a guide to much essential work in the minimizing of these disturbances. This work of Carty's made it possible to give scientific treatment to the twisted-pair and transposition problems and laid the foundation for keeping inductive disturbances within limits that permitted development of the industry.

Early telephone systems followed the usual telegraph practice of placing telephone instruments, including the signaling devices, in series in the line. The result of this arrangement—when there were several instruments on the same line—was to impair telephone transmission seriously and to interfere with satisfactory signaling. It placed severe limitations upon the number of telephones which might be connected to a single line. Carty's scientific study of this question led him to the conclusion that the instruments should be placed in parallel and not in series, and should be re-designed so that the signaling aparatus would have high impedance. This invention is commonly known as "Carty's bridging bell." It removed many of the difficulties which had formerly imposed serious limitations on the development of the business, and made the party line and the rural subscriber's line a possibility.

Carty prepared the plans and immediately directed the work of converting the New York City telephone plant from open wire to cable, and later from the local battery switchboard system to the common battery system, at a time when the general development of the art was such that almost every move required invention, development and engineering along new lines.

If we were to take out of the present telephone system those things — a few only of which I have mentioned — which John J. Carty personally devised and contributed to the art, essential elements would have been removed and in many important respects the system would no longer be operative. This is some measure of Carty's individual achievements.

But he had qualities not always found in men of individual creative genius. He had the rare ability to organize progress as well as to contribute to it himself. As the telephone system grew and its problems multiplied in number and complexity, Carty early recognized that the work to be done required the development of a technical organization, and he was first in the telephone operating companies to employ technically-trained college graduates and to devote systematic attention to their training both in a thorough knowledge of the telephone system and in the correct principles of engineering.

No one who has ever worked in close co-operation with Carty for any considerable length of time can forget the frequency with which he asked the question, "What are the facts?" and the emphasis which he laid on it. Or the importance that he attached to studying all possible solutions of a problem and ascertaining which was the best, taking into account all relevant factors, including first cost, annual charges, service, and flexibility and adaptability to growth and expansion.

He recognized the interrelationship in the telephone business of operating methods, design of the plant, and the rate structure which would largely determine the volume and character of the telephones to be served. He had in mind that all of these factors must be considered in their relations one to the other and their relation to the final result if the system was to give the best possible, the most extended, and the cheapest telephone service. Always was his engineering dominated by this consideration for the final result, not only immediately but for the years ahead.

His methods not only developed telephone systems and service along sound and effective lines, but he has always been a great developer of people. He inspired them to give the best that was in them; he taught them to do better; and was always lenient to their shortcomings, and both constructive and kindly in criticism. His influence on others extended far beyond those working directly for him. All who had contacts with him felt the power of his keen analytical mind, his breadth of vision, his sense of justice, and his kindly disposition.

The nature of Carty's early contributions to the telephone art showed his clear appreciation of the importance of scientific knowledge to the understanding of telephone problems. When he became Chief Engineer of the American Telephone & Telegraph Company in 1907 he was in a position to do so and he immediately consolidated all of the telephone laboratories and experimental work, which up to that time had been scattered both as to location and executive control, into a single organization which is now known as the Bell Telephone Laboratories. He greatly increased the number of scientists engaged upon this work. Of the many fundamental contributions which have resulted from this arrangement, I shall mention but two. He initiated and pushed to a successful conclusion the work necessary to make transcontinental telephony possible. Through its applications, telephone service has been extended to tie together not only every state of our Union, but to bring into the range of telephonic communication Canada, Cuba and Mexico. He likewise inspired and directed the work which resulted in the sending of the first articulate words across the Atlantic Ocean by radio telephony, and continued this work until today the barrier of the Atlantic Ocean has been overcome and commercial telephone service between the old world and the new is a daily fact. Already four nations of the new world can communicate telephonically with Great Britain and four nations of the Continent of Europe, and it is not too much to believe that through the further extension of these developments all of the principal nations of the world may be brought into communication by the spoken word.

This organization of research and development was not only a service to the telephone art; it was a notable contribution to our present-day American civilization, for the organization of science to lead industrial progress now common in many industries received a tremendous impetus from Carty's work in the organization of the laboratories of the Bell System and in the obvious value of its accomplishments. It is in recognition of Carty's vision and achievement along these lines that he is a trustee of the Carnegie Institution and of the Carnegie Foundation, a trustee of New York University, a member of the National Research Council, and associated with other organizations whose object is the advancement of science and the applying of these advances to the welfare of mankind.

Until 1917 Carty's genius was devoted to the arts of peace. Then our country was plunged into the World War and it became the duty of every American citizen and organization to contribute their all to the successful outcome of the War. Recognizing the importance of communication and Carty's pre-eminent position in relation thereto, our Government which had previously commissioned him a Major in the Reserve Signal Corps of the Army ordered him to active duty. He devoted to the Signal Corps problem that same judgment, skill and knowledge which had produced such outstanding results in civil life, and largely through his efforts the resources of the nation's telephone personnel, laboratories, manufactures and supplies were brought to bear upon the problems of the War and in such a way as not to cripple the communication on the home front which must also continue to function. In June, 1918, he was ordered to France, where he was one of the principal staff officers of the Chief Signal Officer of the American Expeditionary Forces. After the Armistice he remained in France for a time in charge of the communications of the American Commission to negotiate peace. In recognition of his services in the Army he received from our Government the Distinguished Service Medal and from France the Cross of the Legion of Honor.

General John J. Carty, who comes to us this evening in order that we may bestow upon him a token of the appreciation in which his distinguished achievements are held by his fellow engineers represented by the four national engineering societies is—

The creator of telephone engineering;

The discoverer or inventor of many essential methods and devices;

The organizer and director for many years of the Bell System technical and engineering work;

The father of the application of scientific research to the telephone art;

The director of the development of transcontinental and transoceanic telephony;

A pioneer in advocating scientific research in industry;

A leader in the application of the development of electrical communication — which he had such an important part in creating — to the national defense in the hour of our country's need;

The dean of telephone engineers."

Carty—The Engineer and The Man

By FRANK B. JEWETT

AFTER more than fifty years' continuous connection with the Bell System, it was eminently fitting that General Carty's last official act should be to preside at a meeting of the Board of Directors of Bell Telephone Laboratories and at the conclusion of the meeting to tender his resignation as a Director of the Laboratories and Chairman of its Board. General Carty's interest has been so predominantly concerned with research and development, and the Laboratories are so peculiarly the result of his foresight and initiative that his connection with our work is particularly intimate.

In relinquishing his active connection with the organization he loves so much, and in entrusting to the stewardship of the men he has trained and worked with, that part of it which has been his primary concern and principal joy for many years, General Carty must feel that the structure he had labored so long and so hard to create will continue to grow as he has envisaged it, and that he can without regret go about the enjoyment of a well deserved leisure in whatever way fancy or inclination dictates.

Mr. Gifford's appreciation, and Mr. Gherardi's appraisement of General Carty and his work, together with the biographical note, which appears elsewhere in the RECORD, amply cover the scope and value of his achievements. To attempt anything further in similar vein would be reiteration, and yet I would feel deprived of a privilege were I not at this time to add my word of tribute to one who has meant so much in my life. Under the circumstances it seems not inappropriate for me to write in a somewhat more personal fashion. In what follows I have attempted to show how General Carty appeared to us who were his intimate assistants. The illustrations chosen are picked at random from the book of memory. A chapter illustrative of his methods, energy, far-sighted vision and insight into human behavior and reactions could easily be written about a score or more of major things he has done and which have molded largely the development and future of the Bell System.

Those of us who will remain for a time longer as active participants in the further development of electrical communications in the Bell System view General Carty's retirement somewhat like dropping the trusted pilot as we enter an unknown sea. For so many years have we been accustomed to turn to him to check our course and to point out hidden rocks that the thought of having to go ahead unaided comes somewhat as a shock. We may have been good mates — are we capable of being good skippers?

To most of us General Carty was recognized as a distinguished man and a wise leader when we, veritable greenhorns, entered the family of the Bell System. We who were privileged to have long years of close contact and intimate association with this remarkable man learned that this reputation

General Carty at his desk

for distinction and wisdom is well deserved. We learned also that in addition he has a knowledge of human beings and a trait of loyalty which engenders sentiments of respect and admiration which are far deeper than any that can be attributed merely to an appreciation of intellectual capacity. All of us of the generation which followed most closely in Carty's footsteps can testify to the value of his teaching and guidance. Most of us can remember innumerable incidents of personal kindness and consideration, and other incidents where he bravely shouldered, as his own, responsibility for mistakes of which we were the authors. To him this was natural for were we not members of his "gang"?

All of this does not mean that General Carty was always an easy man to work for or with. Equally vivid with our other and more lasting remembrances of the man who we know will continue to be our friend, are recollections of long hours of interminable labor in doing and redoing of jobs until the perfect answer demanded by his meticulous search for every pertinent fact had been obtained. Who of us can forget those times when flesh and mind cried out for rest and yet we kept pegging on because the "boss" willed that we should.

To him truth has always been all important, and the leaving to chance or supposition any definitely ascertainable fact, little short of a crime. No detail, however trivial, which has a bearing on the result sought is too small to receive his attention. Sometimes the artistry with which this attention to the apparently inconsequential is made the capstone of a sparkling success is vividly illustrated.

A striking example of this occurred in connection with the ceremonies of the burial of the Unknown Soldier at Arlington. It is an incident known to few and yet it made a deep impression on those of us who did know.

The burial ceremonies were to mark the first great use of the recently developed public address system as a means of enabling tens of thousands in widely scattered groups to participate in a common ceremony. The Bell System had committed itself to an assurance of success. On this assurance untold thousands of citizens wrought to a high pitch of emotional intensity by the deep solemnity of the occasion were to assemble on the slopes at Arlington, in and around Madison Square Garden and at the great Civic Auditorium in San Francisco. They were to hear the great of the world pay a nation's final tribute to its fallen dead and were to join in unison in the prayers and anthems for those dead.

Was the occasion to be an impressive and august success or a miserable fiasco? It all depended on the perfect functioning of complex telephone equipment and on the skill and fidelity with which the distinguished actors played their several parts.

Every facility of the Bell System, material and human, had been concentrated on the job under General Carty's leadership. The equipment and lines worked perfectly, the operating force was drilled for every emergency. The services would go off without a hitch if only the actors would do their part. But would they? Could they be depended upon to obey instructions or would they under the tension of the occasion be carried away by their emotions and wreck everything?

It was a danger which all who knew foresaw and feared. To most it was an unavoidable hazard that must be risked but to Carty it was something that must and could be guarded against.

What were the hazards? Mainly they were two—either that the speakers would talk too loud or too low, or worse yet, that under stress they would wander from their assigned place. The first danger was relatively easy to forestall. Amplifiers could do much if only they had proper directions. They were within our control and the operators were drilled and drilled again to meet any emergency of too much or too little volume. But the second danger was not so easy to guard against. If only the speakers would stand in one place and not wander about all would be well. Obviously they could not be chained in position or locked in an enclosure. One doesn't deal with the high and mighty in that fashion. We must depend on each individual following exactly his instructions and they must be simple instructions—simple beyond the chance of being forgotten or misunderstood.

Carty called for a little square of carpet, some tacks and a hammer. After a careful trial he personally tacked the carpet just where he wanted it and gave to each speaker the stern instructions "Stand on the carpet." None forgot. How could they? The successful achievement of the nation's day of homage was credited largely to the marvels of science and engineering which the Bell System had brought into play. Few ever knew of the carpet and tacks or of the part they had played in the affair as the result of the knowledge of a man.

An earlier time, another place, a problem of a wholly different sort and the making of a decision that was to revolutionize long distance telephone communication and open the door on the direct path to world-wide telephony.

San Francisco in the winter of 1909 was a dreary place. The wreckage of the earthquake and fire was still only partially cleared away and but the beginnings made on the vast rebuilding operations. Even the weather did its best to accentuate the dreariness. Only the citizens were buoyant and, as if nature had not doled out troubles aplenty, they were busy planning the great Panama Pacific Exposition which was to climax the restoration of the metropolis. Therein lay the pressure which resulted in the decision—they wanted San Francisco put in regular telephonic communication with the eastern cities when the Fair opened. Like their Argonaut forbears, they knew no such phrase as "It can't be done."

In common with everything else, the telephone situation was a mess. Vast sums of money were needed and new facilities of every sort must be provided. Among others Mr. Vail, Mr. Carty, Mr. Gherardi and I were in San Francisco. The need for a transcontinental telephone service was presented to Mr. Vail. Being an Argonaut himself he both understood and sympathized with the appeal and had never heard of "Can't." The fact that we could then only give service for a thousand miles or so and knew of no way greatly to extend the distance left him entirely cold. San Francisco was only two or three times as far from New York as Chicago and Carty must tell him he could promise his friends what they wanted and what he knew would greatly benefit the Bell System.

But Carty would not promise. He had heard the Siren Song before and knew he must be sure of a favoring breeze before entering between Scylla and Charybdis.

The result was long tedious nights following long tedious days devoted to the immediate problems of rebuilding a shattered plant. Each evening found us in a huddle until well past midnight. Every conceivable factor was considered and subjected to Carty's merciless analytical attack. The more purely engineering aspects of the problem were soon disposed of though nothing was taken for granted. He had to be shown that a line could be built and maintained across the mountains and the desert; that the bay could be crossed with a satisfactory cable, and a thousand and one other things.

It was early apparent that the crux of the problem was a satisfactory telephone repeater or amplifier and probably one which would operate in tandem arrangement on loaded lines. Did we know how to develop such a repeater? No. "Why not?" Science hadn't yet shown us the way. "Did we have any reason to think that she would?" Yes. "In time?" Possibly. "What must we do to make 'possibly' into 'probably' in two years?" And so on night after night without end almost.

Finally he took the plunge (we with him), said "yes" to Mr. Vail's stereotyped query, the die was cast and a new and hectic era in what is now Bell Telephone Laboratories began.

New faces began to appear in the

Laboratories—the faces of men who knew little about telephony but much about what telephony was based on. Under the never relaxing pressure of an insistent and searching mind strange things began to happen. Queer leads were followed up, frequently to barren terminations. Out of it all, however, came success and the fulfillment, six months ahead of time, of the promise made on faith and reasoned understanding in 1909.

Nor was the success a meagre one. It was bountiful and with spare anchors to windward. When the transcontinental line was formally opened each repeater station was equipped not with one kind of amplifier but with three kinds! Further, the field of our knowledge was strewn with pay dirt of many different kinds. All of which, if space permitted, would lead to further tales of the lands into which General Carty led us.

We might learn for instance, how even before the final work on the transcontinental line was finished we were embarked on the great transatlantic experiment which so nearly proved the finish of some of us before it was finally successfully completed. The tale of it is a saga of scientific romance and high diplomacy involving many personages in many ways but always under the dominant guidance of one man.

Personal recollection could easily develop a book of interesting incidents relating to General Carty and his work. They would be as diverse as the planning of the Walker-Lispenard Building foundations and the creation of the National Research Council. Each, however, would in part but repeat and emphasize those fundamental characteristics which are the powerful tools of his success. They are tools which are equally applicable to every kind of problem to which he directs his attention.

Being what he is it is little wonder that outside as well as inside the Bell System thoughtful men give heed when Carty expresses an opinion and that a great American statesman once said "Carty can see farther and around more corners than any man I ever met."

John J. Carty—a Biographical Note

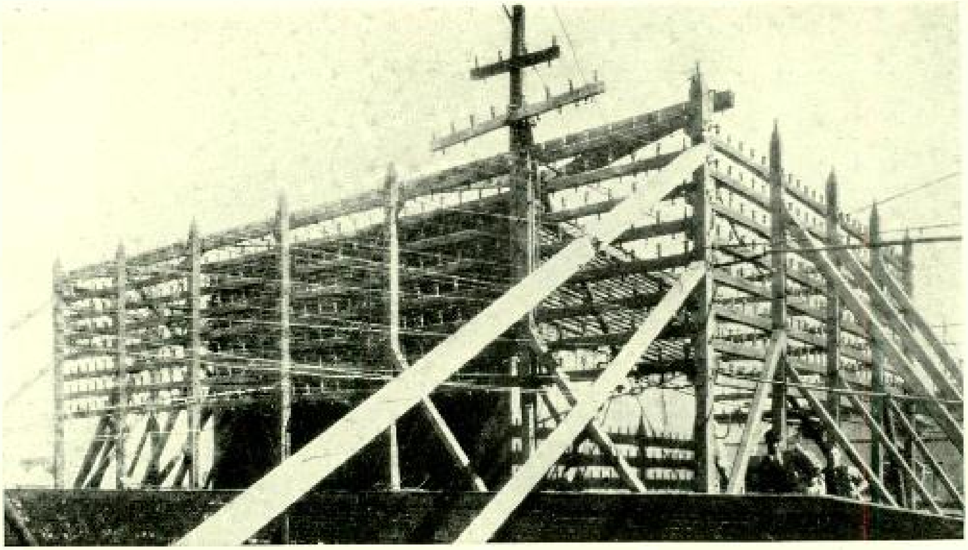
AFTER a career of unusual distinction in the telephone field, JOHN JOSEPH CARTY retired from active service in the Bell System on June 30. At the time of his withdrawal he was a Vice-president of the American Telephone and Telegraph Company, and Chairman of the Board of Directors of Bell Telephone Laboratories.

Mr. Carty was born April 14, 1861, at Cambridge, Massachusetts. Having finished his preparation for college, he was obliged, because of a temporary impairment of his eyesight, to discontinue further studies at school. The possibilities of the telephone which Bell, then residing at Cambridge, had recently invented, made such a strong appeal to his imagination that he sought an opportunity to participate in the development of this new marvel, and in 1879 he entered the service of the Bell company at Boston. With the exception of his service in the United States Army during the World War, he has been ever since actively engaged in the work of the telephone company in different parts of the country.

While at Boston, he designed and installed the first metallic circuit multiple switchboard to be put into service. Some of the fundamental features of this apparatus are employed in all of the multiple switchboards of today. This multiple switchboard employed a common battery at the central office for signaling. Supplying telephone transmitters from a common battery was at that time considered impossible. His services with the telephone company during this period were varied, and covered the entire range of practical telephony, including plant construction, maintenance and design, as well as traffic and operation.

In 1887, he removed to New York and took charge of the cable department of the Western Electric Company in the East. In this capacity he had charge of all the important cable-laying projects which were carried on for several years in the eastern cities During that period, cable manufacturing and laying and subway construction were in their infancy. Each project involved new and unsolved difficulties calling for much engineering skill and oftentimes invention. Metallic circuit cables doing away with cross-talk and extraneous noises had not been perfected, and talking through cables over lines of any considerable length was impossible.

Although charged with the carrying out of difficult practical engineering problems, Mr. Carty found time to follow his strong natural inclination for scientific research. He made an important original investigation into the nature of the disturbances to which telephone lines were subjected, and gave the first public acount of his work in a paper entitled *A New View of Telephone Induction* read before the Electric Club at New York on November 21, 1889. The view put forth in the paper was regarded as revolutionary at the time, but his experiments having been successfully re-



Roof fixtures leading into the office of the Telephone Dispatch Company of Boston, in 1883. Here Mr. Carty made his first acquaintance with the serious problem of the open-wire plant

peated by a number of scientists in this country and in Europe, his views were accepted.

In this paper, using the type of telephone instrument then in general use, he showed the importance of electrostatic induction as a factor in producing crosstalk, and proved that in his experimental telephone lines there was a particular point in the circuit at which no crosstalk could be heard. The paper gave directions for determining this silent or neutral point and described original experiments showing how to distinguish between electrostatic and electromagnetic induction in telephone lines.

On March 17, 1891, Mr. Carty made additional contributions to the knowledge of the working of telephone circuits in a paper before the American Institute of Electrical Engineers entitled *Inductive Disturbances in Telephone Circuits,* describing original experiments showing for the first time the precise manner by which twisting or transposing telephone lines rendered them free from inductive disturbances. This paper cleared the way for a rational treatment of a problem which had theretofore been attacked unsuccessfully by empirical methods.

Growing out of these investigations, he invented a method for neutralizing induction by the employment of condensers. The principle involved in this invention is of great practical value in the most highly organized modern cables for long distance work.

In addition to his cable work in the Western Electric Company, Mr. Carty was placed in charge of the switchboard organization, and once again returned to the common battery problem which baffled him in the early days at Boston. By using storage batteries of very low internal resistance, he was able for the first time to operate two or more telephone transmitters from the same source of current supply. Based upon this principle, the practicability of which he was the first to demonstrate, there has been developed by Richards, Hayes, Scribner and others the modern common battery switchboard.

In 1889, Mr. Carty went to the Metropolitan Telephone and Telegraph Company, afterwards the New York Telephone Company, as Chief Engineer, where he reorganized all of the technical work of the company. He built up an engineering staff, and was the first among the operating companies to recruit their technical personnel from the graduating students of our scientific and engineering schools. Many of these students who were trained in his office have since become leaders in the telephone industry.

During his term with the New York Telephone Company, the switchboard and cable plant of the company was entirely reconstructed and converted from the grounded to the metallic circuit system. Overhead wires carried upon pole lines were removed and replaced by underground cable. New traffic, equipment, and construction methods were introduced, and the service was placed on a high plane not theretofore reached in any other city.

While in the service of the New York Telephone Company, he designed a telephone and signaling apparatus which made it possible to connect many stations upon one line without in any manner impairing transmission. Formerly two or three stations upon one line were sufficient to prevent commercial conversation. The development of this new apparatus made possible the extension of telephone service among farmers and rural subscribers everywhere.

In 1907, upon the return of Theodore N. Vail to the presidency of the American Telephone and Telegraph Company, the parent company of the Bell System, one of his first acts was to appoint Mr. Carty as Chief Engineer to carry out a complete reorganization of its technical forces. Extensive laboratories were maintained at Boston, New York, Chicago, and minor laboratories elsewhere. These Mr. Carty consolidated into one organization at New York, the forerunner of our present Laboratories.

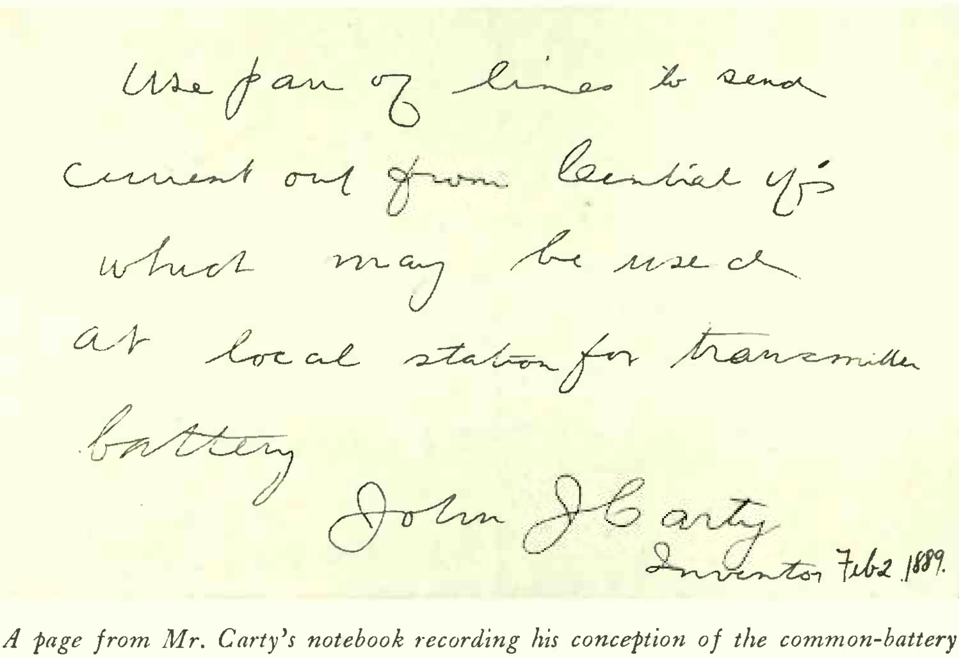
Although the New York and Chicago telephone line composed of open wires on poles was opened to service in 1893, the transmission was not of a high grade, and by 1907 the line seemed to work more poorly than at the beginning. This was because of the constant addition of small sections of cable either overhead or underground. The problem of long distance telephony could not be solved until the difficulty of talking through cables was overcome.

Although the epoch-making invention of the loading coil by Dr. Michael I. Pupin has proved to be one of the fundamental and permanent elements in successful long-distance cable telephony, numberless unsolved problems presented themselves in connection ith its practical engineering application. Talking across the continent from the Atlantic to the Pacific was a boyhood dream of Mr. Carty and his early associates, and now with the backing of Mr. Theodore N. Vail he had the privilege of heading that distinguished group of scientists and engineers who were to make a combined attack upon this problem. Among those who did most distinguished and responsible work were Mr. Bancroft Gherardi in charge of the engineering forces, and Dr. Jewett in charge of the scientific and laboratory forces. Working under them or in association with them were found the names of Craft, Colpitts, Blackwell, Arnold, Stevenson, and a great many others whose work was essential to the solution of the problem. As a result of this organized attack, the problem was solved, and on the 25th of January, 1915, the New York-San Francisco telephone line was opened to public service with impressive ceremonies at New York, Boston, San Francisco and Washington.

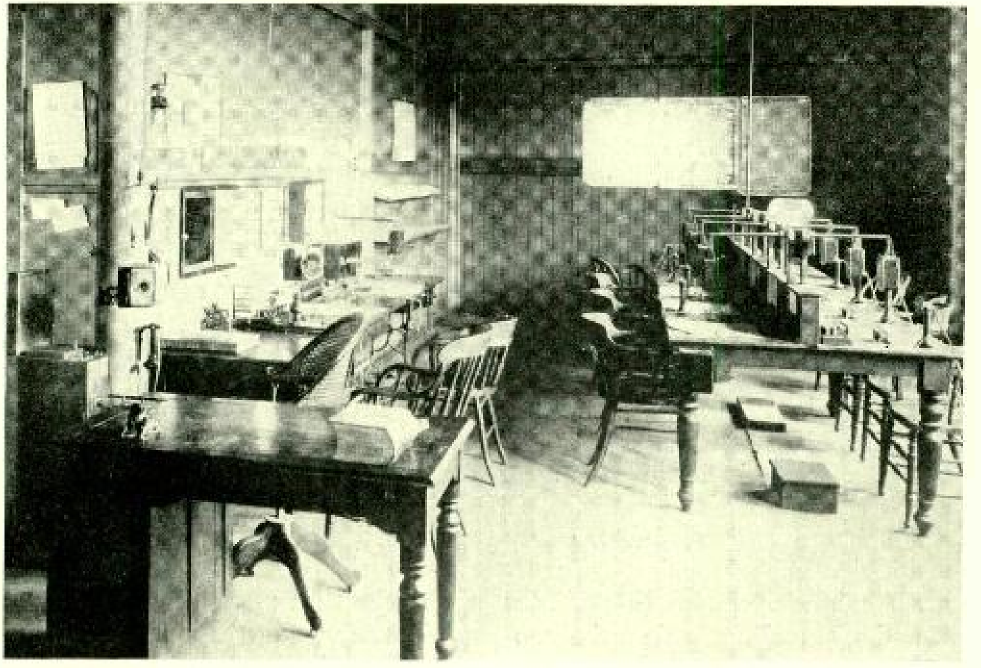
There remained the problem of talking across the Atlantic Ocean. It was the determination of Mr. Carty that this should be done first by Americans. Again with the backing of Mr. Vail and with adequate financial support from the company, Mr. Carty set to work upon the problem those engineers and scientists who had so successfully cooperated in overcoming the difficulties in transcontinental telephony. Again their efforts were crowned with success, and on October 21, 1915, the human voice was for the first time transmitted across the Atlantic Ocean. This was done by radio telephone from the United States Naval Station at Arlington, Virginia, to the Eiffel Tower in Paris.

The difficulties of talking through long distance cables, say for 100 miles or more, still remained, and with the increasing difficulty of erecting open wires on poles, it presented a vital problem, to the solution of which Mr. Carty again directed the energies of his staff. By 1916, as the result of a combined scientific and engineering attack, the difficulties were so far overcome that methods were devised whereby it would be possible to talk through an all-cable circuit for distances as great as 1500 miles.

Mr. Carty has been one of the foremost in urging upon the industries the necessity and immense value of scien-


Use pair of lines to send
current out from Central office
which may be used
at local station for transmitter
battery
John J Carty
Inventor Feb 2 1889.

A page from Mr. Carty's notebook recording his conception of the common-battery system



The desk at which General Carty, in 1883, *started his executive career; at* 40 *Pearl Street, Boston*

tific industrial research, and in encouraging in the universities the work of research in pure science upon which progress in industrial applied science depends. He has been one of the leaders in the movement to obtain from the industries support for university workers in scientific research conducted solely for the purpose of advancing knowledge.

At the outbreak of the war, being a Major in the Signal Reserve Corps, Mr. Carty was called to active duty. With the generous encouragement of his company, he organized from among the telephone personnel, twelve battalions of picked Signal Corps troops, who were called into service when the war broke out, and furnished the principal Signal troops during the first phase of the conflict.

He organized the Research and Inspection Division for the Chief Signal Officer, A. E. F., and was responsible for the maintenance of transatlantic communication between General Pershing in France and the War Department at Washington, which were threatened with interruption by the enemy.

He was promoted to Colonel and was ordered to France in 1918 where he served throughout the war on the staff of the Chief Signal Officer. After the Armistice, he was placed in charge of communications for the American Commission to Negotiate Peace. He was made Brigadier General, his present rank in the Reserve Corps.

For his services as an officer in the United States Army during the World War, he received the Cross of the Legion of Honor from France, and the Distinguished Service Medal from the United States which was conferred upon him by General Pershing at his headquarters in France with the following citation: "For exceptionally meritorious and distinguished services. He was largely instrumental in securing from the telephone and telegraph companies of the United States the best talent available to meet the urgent requirements of the Signal Corps at the outbreak of the war. He has served with marked distinction as a member of the American Expeditionary Forces, and his brilliant professional attainments and sound judgment have rendered his services of exceptional value to the Government."

In 1919, upon his return from France, General Carty became Vice President of the American Telephone and Telegraph Company. With the incorporation of Bell Telephone Laboratories in 1925, he became Chairman of its Board of Directors.

He is a member of the National Academy of Sciences, National Research Council, American Academy of Arts and Sciences, American Philosophical Society, and other scientific and engineering bodies. He is an Honorary Member of the Franklin Institute, and has received the Franklin Medal and the Edward Longstreth Medal presented by that society, and the Edison Medal presented by the American Institute of Electrical Engineers, of which he was President in 1915 and 1916.

For his services in connection with Japanese electrical communications, he received from the Japanese government the decorations of the Order of the Rising Sun and the Order of the Sacred Treasure.

He has received the degree of Doctor of Engineering from Stevens Institute of Technology in 1915, and from New York University in 1922; Doctor of Science from the University of Chicago, and from Bowdoin in 1916, from Tufts in 1919, from Yale in 1922, and from Princeton in 1923; and LL.D. from McGill in 1917, and from the University of Pennsylvania in 1924.

In 1927, General Carty was awarded the John Fritz Gold Medal. In the accompanying citation, his career is effectively summarized:" for pioneer achievement in telephone engineering and in the development of scientific research in the telephone art."

EDWIN HENRY COLPITTS

Recently elected a Director of these Laboratories, Mr. Colpitts brings to his new responsibility a long acquaintance with our organization. Entering the Engineering Department of the Western Electric Company in 1907 after eight years in related work for the American Telephone and Telegraph Company, Mr. Colpitts advanced to the position of assistant chief engineer in 1917. Returning to the American Company in 1924 as assistant vice-president, Mr. Colpitts has since been in immediate charge of the Department of Development and Research

Radio Transmission to South America

By C. R. BURROWS
Radio Research

TO ensure the best possible telephone service to South America, it was necessary to precede its recent opening with a survey of transmission conditions over the contemplated path. The results of this survey form a valuable comparison with the conditions encountered in short-wave transatlantic telephone service for several years.

All long-distance transmissions by short-waves have certain characteristics in common. The "fading" of the amplitude of the received signal, noticed when listening to distant broadcasting stations, is much more pronounced on the short waves. The diurnal variation of receiving conditions and the limitation imposed by static are common to all long distance radio transmissions. But there are quantitative differences in these and other effects, between transmission over one and another path, which dictate the best frequencies to be used in each case.

The effect of difference in length of path can be seen by reference to Figure 1. This plot summarizes observations on the average usefulness of different frequencies in the short wave band for summer transmission by day over paths of different lengths. For the abscissa corresponding to transmission from New York to Buenos Aires, 5300 miles, it shows that the best frequency is slightly greater than 20 megacycles (15 meters). For 3500 miles, corresponding to transmission from New York to London, it is about 18 megacycles (16 meters). While the best frequency for radio transmission over any path depends upon the time of day and time of year, curves for different seasons and times of day all show that for the shorter distances the lower frequencies are better.

In the skip region, above the line marked "skip distance", the signal is not received, probably because* there are not sufficient electrons in the upper atmosphere to refract the wave back

* BELL LABORATORIES RECORD, *June*, 1927, *p.* 349, *and February*, 1928, *p.* 173.

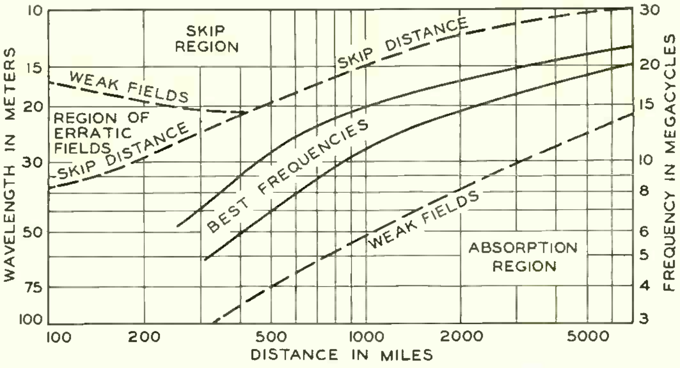


Fig. 1—This composite of observations on transmission at different wavelengths over different distances during summer days shows that higher frequencies are more useful at greater distances

to earth at that distance. When a high-frequency radio wave is transmitted over these long distances it is projected into the upper atmosphere where the density of the air is low and the number of electrons is large.

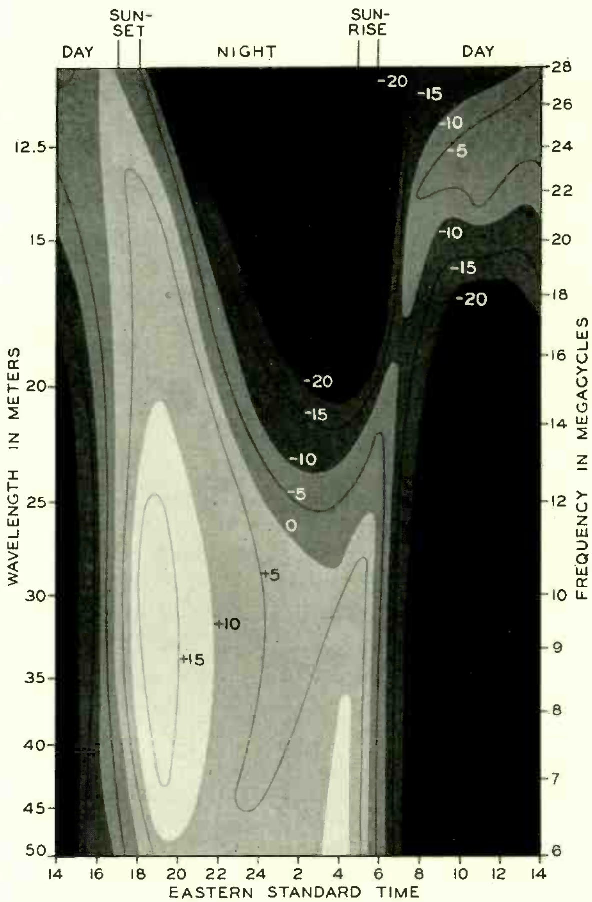


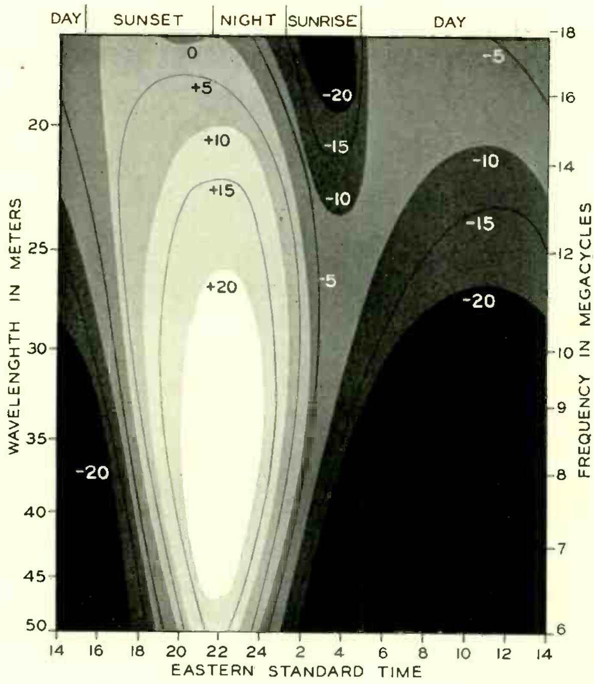
Fig. 2—The frequency transmitted from Deal which afforded the strongest signal at Buenos Aires differed from the day to night

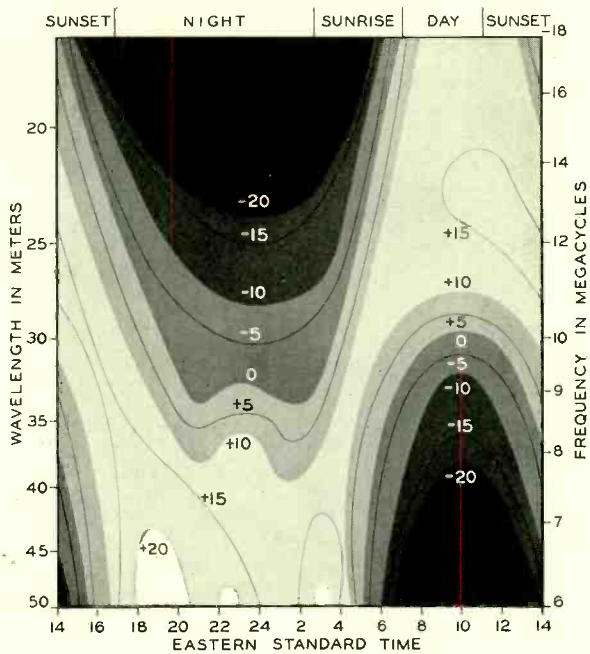
Up to a certain point the number of free electrons increases with the height. Since the upper atmosphere shields the part beneath it from the powerful ionizing forces of the sun, the rate of production of ions at the higher levels greatly exceeds that at lower altitudes. This, combined with the slower rate of recombination of ions at great heights, results in a large number of free electrons at these heights.

When the density of the air is low and the number of electrons is large, the electrons are set into vibration by the radio wave and they in turn cause a refraction of the wave back to earth. The amount of bending of the radio wave depends upon the increase in the number of electrons with increase in height. This may not be sufficient to return the wave to earth within the distance from the transmitter at which the receiver is located, nor indeed sufficient to return it at all. The distance between the transmitter and the nearest point where the wave again returns to earth is the skip distance.

In the daytime electrons are numerous at lower levels where the density of the air is so much greater that the electrons frequently collide with air molecules. When such collisions occur the electrons lose that part of their kinetic energy which originally came from the wave. This is the case in the absorption region in the lower right-hand corner of Figure 1. For transmission over the longer distances, the lower frequencies undergo too much attenuation to be useful during the daytime.

Between these two regions, that in which the radio wave is not refracted to the earth and that in which the energy is absorbed by the transmitting medium, there is a poorly defined region most favorable to radio trans-





Figs. 3 (above, for summer) and 4 (right, for winter)—In transatlantic transmission, the longer transition between day and night requires a more prolonged use of transition frequencies

mission. This region is marked "best frequencies" in Figure 1. Its boundaries are not definite; those shown separate the frequencies on which transmission is equally good from those on which transmission is noticeably poorer. Transmission conditions become progressively worse as the frequency departs further from the boundaries of the region of "best frequencies".

The region marked "erratic fields" in Figure 1 is one of particular interest because normally no signal would be expected within the "skip distance". A possible explanation of this phenomenon is that the signal received in this region first strikes the surface of the earth at some distance greater than the "skip distance" and is there diffracted. Part of the diffracted wave is again transmitted back through the upper atmosphere and received at a point nearer the transmitter. Although the signal at times is strong within this region it is not reliable enough for commercial communication.

With these different regions in mind, Figure 2 is readily interpreted. This figure is a plot of the signal strength received at different times of day (abscissa) on different frequencies (ordinate) over the path to South America. The black region in the upper central part of the figure is recognized as the "skip region". It occurs on the higher frequencies during the night when the ionization of the upper atmosphere is reduced because of the absence of the ionizing effect of direct rays from the sun. This occurs on the higher frequencies because they require a greater number of electrons to cause refraction. The black region in the lower right-hand corner of the figure is the absorption region. These low frequencies are absorbed in the daytime because of the relatively large ionization at the lower altitudes. The high frequencies are able to penetrate this absorbing blanket while the low frequencies cannot do so.

Fig. 5—Field-strength tests in South America, first carried on in the open, were later housed

These are the regions in which short waves are not useful for transmission between New York and Buenos Aires. As shown in Figure 2, the greatest signal strength during the spring of 1929 occurred at about 7 P. M. (19 E. S. T.) on about 9 megacycles. Frequencies near this value are useful for transmission during nighttime. During daytime the maximum field occurred at about 24 megacycles* at that time of year. This signal strength is not as great as that on the lower frequencies, but it is sufficient to give good communication because the "static" is lower.

Since Buenos Aires and New York are about equally distant south and north from the equator, the seasons are opposite and transmission conditions over this path are almost the same throughout the year. This is not so in the case of transmission between New York and London. Figures 3 and 4 show the difference in transmission conditions over that path during the summer of 1926 and the winter of 1926-27, respectively. During the summer when the sun is more nearly directly overhead, and consequently the ionization is greater, both the skip and absorption regions are at higher frequencies than in winter. As a result of this, the skip region in the upper part of the figures is smaller in summer than in winter, while the reverse is true of the absorption region in the lower right-hand corner of the figure.

By comparing Figure 2 with Figures 3 and 4 it can be seen that it is desirable to employ higher frequencies between New York and Buenos Aires than between New York and London. It is also evident that the transition between day and night conditions is more abrupt over the former than the latter path. This is because the local time at Buenos Aires is almost the same as that of New York, while in London it differs by five hours.

During the afternoon transition period, when the sunset line lies be-

** A slightly lower frequency was better during the remainder of the year.*

tween the transmitter and receiver and part of the transmission path is in daylight and part in darkness, conditions are adverse for radio transmission. Since the best frequencies are different over the parts of the path which are in daylight and in darkness respectively, a compromise must be made. This necessarily results in poorer transmission. Hence, the fact that this transition period is less for the New York-Buenos Aires circuit than for the New York-London circuit, is favorable to the former. In fact the weak period in the afternoon encountered on the circuit to London has not been present on any of the tests to Buenos Aires.

The abruptness of the morning transition from night to day conditions results at times in a short period during which conditions are relatively unfavorable for transmission on any of the short waves to Buenos Aires, but even this period is shorter than the corresponding one on the path to London.

Another difference between transmission to South America and that to England is the effect of solar disturbances. Since long-distance radio reception is dependent upon the ionizing effect of the sun, it is natural that the condition of the sun would be reflected in radio transmission. Short-wave transmission conditions are disturbed whenever an active area on the sun is properly oriented. The presence of this active area is usually indicated by a dark spot on the sun, although there is evidence that in some cases its effect on the earth precedes the appearance of the "sunspot" and persists after its disappearance.

The exact effect of solar disturbances on the ionization in the upper atmosphere is not known, but they probably make it erratic as well as change its average value at any height. At times when the solar disturbance is sufficient to cause a severe "magnetic storm" the effect on transatlantic transmission is to render all short waves useless. The adverse effect of such solar disturbances is very much less on transmission to South America, probably because this transmission path is farther from the auroral regions where the conditions of the upper atmosphere might be expected to be most turbulent.

All of these considerations tend to make the transmission conditions between New York and Buenos Aires more favorable than those between New York and London.

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Measuring Flutter in Loading Coils

By F. J. RASMUSSEN
Telephone Apparatus Development

IN the design of new types of loading coils, accurate measurements must be made of the changes in their high-frequency resistance, and inductance when low-frequency currents are superposed, in order to make sure that the coils will give satisfactory service when installed in telephone circuits that are composited for simultaneous telegraph and telephone operation. The telephone transmission distortion that results from these changes in the loading coils caused by superposed telegraph currents is known as "flutter" and has already been described in the July RECORD.

The effect of flutter on voice currents is shown graphically, but considerably exaggerated, in Figure 1. At the left is a 25-cycle current representing the telegraph currents and a 1600-cycle frequency serving as a substitute for the voice currents. After these are passed through a loading coil, they would appear, when separated, as shown at the right. The wave form of the low-frequency output is similar to that of the impressed voltage. The received voice-frequency current, however, is found to follow a cycle of amplitude variation, at double the rate of the low-frequency current.

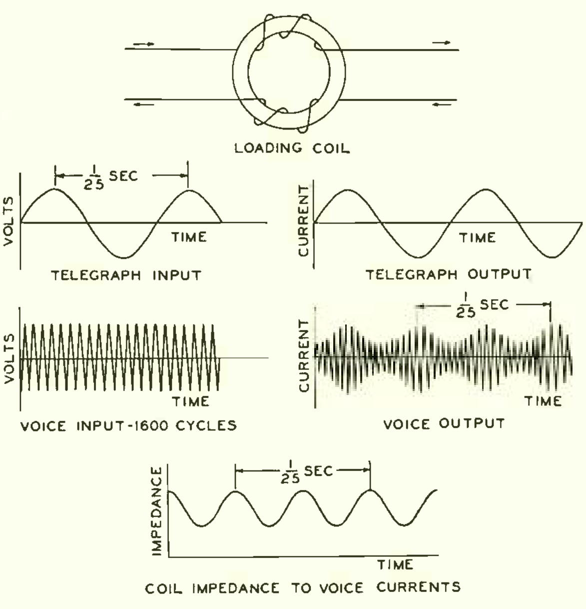


Fig. 1—Flutter is caused by a varying change in the resistance and inductance offered to voice currents by a loading coil when a low-frequency current is flowing through it at the same time

If pictures of these two output currents were taken on an oscillograph calibrated in terms of volts and amperes, the average impedance of the loading coil to voice currents could be computed for each moment of time. A curve of impedance so found would be similar to the bottom curve of Figure 1. The impedance would rise and fall at twice the rate of the low-frequency current. Both inductance and resistance components vary but the flutter effect of the change in inductance is of much smaller magnitude.

By measuring the relative variations that take place in both resistance and inductance,

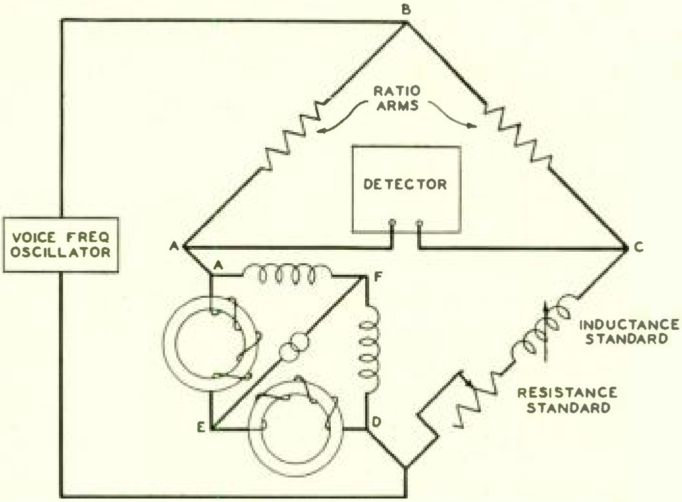


Fig. 3—Diagram of the measuring bridge showing the auxiliary bridge in one arm

solved. The changes in high-frequency resistance to be measured take place only when a superposed low-frequency current is passing through the loading coil. The first problem was to devise a bridge network which would allow this low-frequency current to pass through the loading coil but not through the inductance standard or the detector circuit. The second problem was to make instantaneous measurements of inductance and resistance, or to make repeated observations at the recurring moments when the instantaneous values of inductance and resistance repeat themselves.

The first problem was solved by connecting two similar loading coils into an auxiliary bridge as shown in Figure 2. The loading coils are bal-

it is possible to predict which of several types of loading coils would produce the least flutter effect when used for loading composited telephone circuits. Although it could not be assumed that the results of measurements made with two arbitrary frequencies, such as 25 and 1600 cycles, would give results identical to those obtained with actual telegraph and telephone currents, it has been found from tests that results so obtained can be used to estimate the actual flutter to a first approximation.

To compute the varying quantities from the oscillograph would obviously not be practicable. For accurate and easily made measurements some form of bridge seemed desirable. Two problems in the design of the bridge network, however, had to be

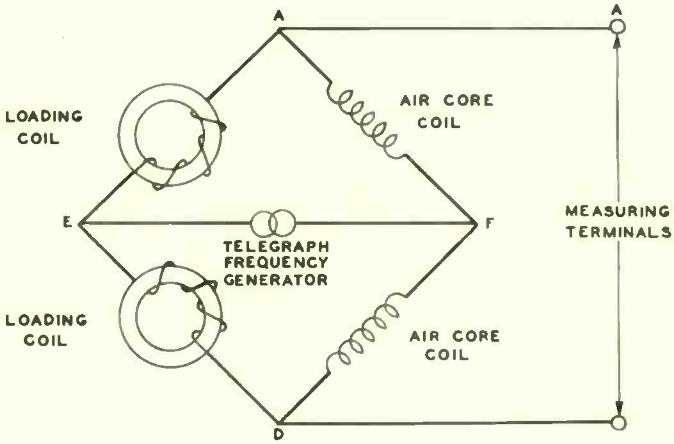


Fig. 2—An auxiliary bridge consisting of two loading coils and two air-core inductances is used to prevent the low-frequency current from flowing through the circuits of the measuring bridge

anced by two air-core coils of much higher inductance. When a low frequency is connected to the points E and F and the bridge is balanced, current will flow equally into the two loading coils, but there will be no difference in potential across A and D and no current will flow into any circuit connected across these two points. This auxiliary bridge is used as the unknown arm of the flutter measuring bridge which appears as shown in Figure 3. The high-frequency measuring current for the bridge is obtained from an oscillator. The portion of the current flowing through the arm AD divides between the two arms of the auxiliary bridge but the inductance of the air-core coils is made so much greater than that of the loading coils that nearly all of the current flows through the latter. The bridge is balanced for an instantaneous condition by an adjustment of the resistance and inductance in the arm CD. Due to the presence of the low-frequency current in the loading coils, the high-frequency impedance across A and D varies at double the rate of the low-frequency current and the detector must be designed therefore to measure instantaneous values of a varying resistance and inductance.

An ordinary mirror-type oscillograph was originally used as a detector. Its arrangement and relation to the bridge is shown diagramatically in Figure 4. At the left are shown the 1600 and 25 cycle supplies, and at the right the output—from AC of Figure 3—is shown connected to a high-gain amplifier which, in turn, connects to the oscillograph. The mirror of the oscillograph vibrates with an amplitude proportional to the output of the bridge. A beam of light is reflected from this vibrating mirror to a set of mirrors which are rotated by the motor driving the low frequency generator.

The rotating mirrors spread out the beam of light in a direction at right angles to its vibrating motion so that the actual wave form of the output current appears on the screen of the oscillograph. The number of mirrors used and their arrangement is selected with regard to the design of the generator so that successive sections of the output wave reflected by successive mirrors are superimposed at the rate of 25 per second. This speed is so great that the persistence of vision enables one to see on the oscillograph a stationary section of wave form representing the recurring sec-

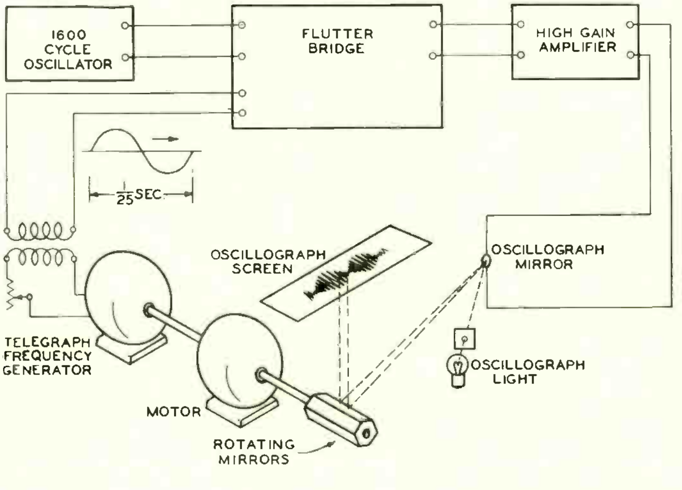


Fig. 4—Light from the mirror of an oscillograph is reflected to a screen by a mirror rotating at a speed corresponding to that of the low-frequency current

tions of the amplified output current.

The oscillograph screen may be marked to show definite points of phase with respect to the low-frequency current. By adjusting the resistance and inductance standards, an instantaneous balance of the bridge can be obtained for any definite point of phase on the low-frequency wave, such balances being indicated by a constriction of the standing wave to zero width, at a corresponding point on the longitudinal axis of the standing wave. By making a series of instantaneous bridge balances, the points of zero output can be made to shift from one end of the screen to the other. When suitably corrected, the bridge resistance and inductance settings for this complete cycle of measurements give the variation of the high-frequency resistance and inductance of the loading coils for a complete cycle of low-frequency current. The curves in the lower part of Figure 1 are samples of data obtained in this way.

This bridge met the needs of the Laboratories for fourteen years. Recently it became necessary to build another flutter bridge, but before undertaking the work the older method was carefully studied with the object of making improvements. One of the important betterments was to substitute an improved bridge, arranged for "balanced to ground" measurements, which eliminated certain possible errors of the older type. Another improvement was to use coils of much higher inductance and wound in toroidal form for the air-core coils of the auxiliary bridge. This not only reduced the error due to the shunting action of the coils but eliminated their external field which, in the old form of bridge, made it necessary to place them at some distance from the rest of the apparatus. A third major improvement was the use of the cathode ray oscillograph in place of the vibrating mirror type.

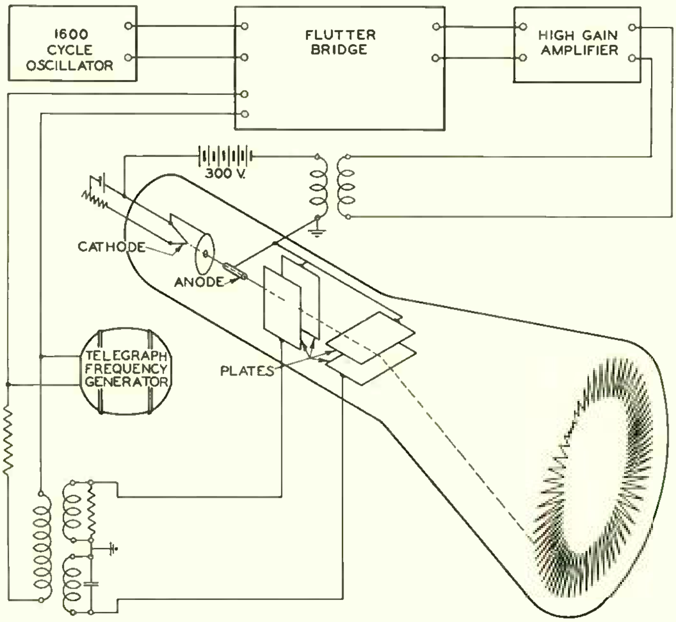


Fig. 5—Substituting the cathode ray for the vibrating mirror oscillograph avoids the necessity of rotating mirrors

The arrangement is shown in Figure 5 which except for the detector is like the preceding figure. Instead of using rotating mirrors to spread the amplified wave horizontally, it is drawn out into a circle on the front of the oscillograph. A small portion of the output of the low-frequency generator is passed through a transformer with a double secondary winding. Across the terminals of one of the windings is connected a resistance, and across the terminals of the other, a condenser. The current through the first winding is thus 90 degrees out of phase with that through the second, and the voltages across the two output circuits bear a similar phase relationship to each other. Connecting these secondary windings to the plates of the cathode ray oscillograph, which are 90 degrees apart in space, causes the stream of electrons to rotate and to appear as a circle on the front of the oscillograph. One complete revolution is made in 1/25 of a second, or for each low-frequency cycle.

Between the filament, which acts as the cathode of the oscillograph, and the anode is a 300-volt battery and in series with it, the secondary winding of a transformer connected to the output amplifier of the bridge. With no current flowing in the output circuit, the potential of the cathode remains constant at 300 volts below the anode, and a smooth circle would be formed on the front of the oscillograph. With an alternating output, however, the constant 300 volts is increased or diminished alternately by the amount of the amplified voltage of the bridge output, and the electron stream will have as a result a greater or less velocity, and be deflected less or more by the voltages impressed on the plates. Under these conditions the stream of electrons follows a vibrating path in its rotation, and at each point the amplitude of the vibrations corresponds to that of the output wave.

With this new arrangement, therefore, the output of the bridge, instead of being spread out straight, is curved into a circumference which is traversed once during each cycle of the low-frequency current. The front of the oscillograph screen may be marked with radial lines each indicating a definite point of phase on the low-frequency wave. A zero amplitude of vibration of the image on the oscillograph indicates that for that point of phase on the low-frequency wave the resistance and inductance of the loading coils is equal to the setting of the bridge.

This arrangement, therefore, makes it possible as with the original flutter bridge, to determine the variable high-frequency resistance and inductance of the loading coils as a function of time.

This new detector for the flutter bridge has been in service several years and has proved satisfactory in every respect. The elimination of rotating apparatus has simplified the equipment and with the other modifications has greatly increased both the speed and precision of measurement.

Age Hardening Lead-Calcium Alloys

By EARLE E. SCHUMACHER
Chemical Research

UNTIL some twenty-two years ago, steel was the only metal used for large structures where great strength was required. Researches conducted during the years 1903 to 1911 by Dr. Alfred Wilm, however, led to a discovery which has gradually changed this situation. Dr. Wilm discovered that the properties of a certain aluminum alloy could be vastly improved by heat treatment. From this alloy, there has evolved the present commercial material known as duralumin which has the strength of mild steel but with a weight only approximately one-third as great. It was this alloy that was so extensively used in the structural framework of

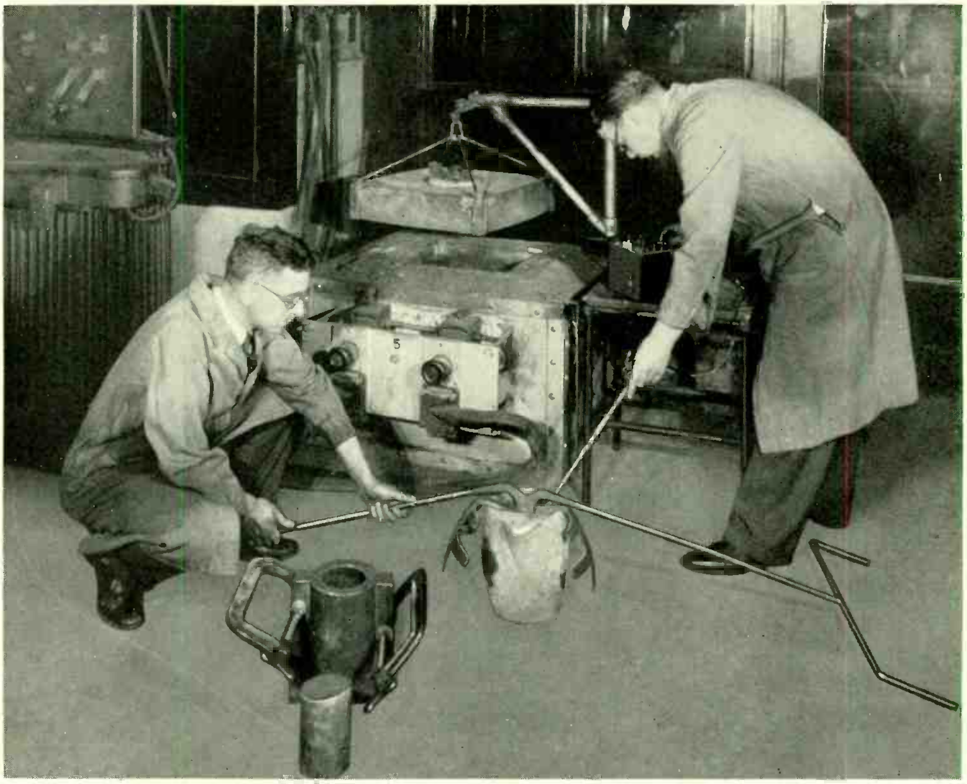


Fig. 1—G. M. Bouton and E. E. Thomas measuring the temperature of a molten lead-calcium alloy which has just been removed from the furnace. When the correct temperature is reached the alloy will be cast into the mold shown in the foreground. In front of the mold is a finished slug ready for extrusion

Zeppelins during the World War.

The nominal composition of one of the duralumin type alloys is: aluminum 94.3%, copper 4%, magnesium 0.6%, manganese 0.8%, and silicon 0.3%. Its tensile strength before heat treatment is only about 25,000 pounds per square inch, but upon heating to 500°C., rapidly cooling to room temperature, and aging a few days, its strength increases to about 60,000 pounds per square inch. The hardening process differs from that of steel in that steel is hardened by rapid cooling from a high temperature, while duralumin is hardened by aging at room temperature after rapid cooling.

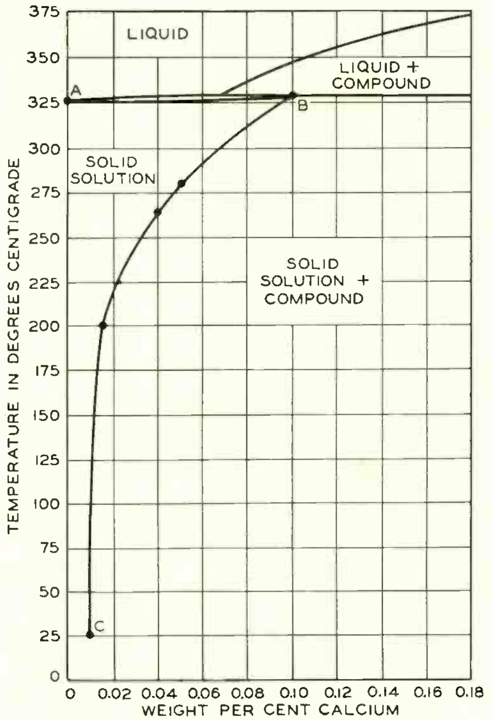


Fig. 2—From this equilibrium diagram of the lead-calcium system the metallurgist can predict the behavior of any alloy. Age hardening takes place in those alloys which have been cooled from the area ABC (solid solution) into the area below the curve BC. The excess calcium is expelled in the form of fine particles of Pb_3Ca *which act as keys to prevent slip between and within lead crystals*

For several years after Dr. Wilm's discovery no plausible explanation for the behavior of this alloy was advanced. Finally in 1919, Merica, Waltenberg, and Scott presented a theory which described the strengthening action as dependent upon solution and reprecipitation of some of the constituents of the alloy. According to the theory, these constituents (copper, manganese, magnesium, and silicon in duralumin) dissolve in the alloy at high temperatures. Upon cooling quickly to room temperature, they at first remain dissolved forming a supersaturated solid solution. During subsequent aging at room temperature, however, they are precipitated as small evenly distributed particles which act as stiffeners or strengtheners.

Some authorities still question whether precipitation of strengthening particles is the major cause of the type of age hardening occurring in duralumin, and there are many different opinions as to the way in which these particles could cause hardening, but, right or wrong, the precipitation theory has served admirably in developing new commercially useful age hardening alloys. According to the theory, any alloy system may be age hardening if it contains a solute harder than the solvent and more soluble at higher temperatures than at lower.

To date at least a dozen useful systems of this type have been discovered. One of the most interesting as well as important is the lead-calcium system. The age hardening properties of lead-calcium were discovered here in the Laboratories and independently at the Hawthorne Works of Western Electric while conducting tests on numerous alloys to develop a better cable sheathing material.

As soon as preliminary studies showed that some lead-calcium alloys were age hardening, a careful and complete study was made of the lead-rich alloys in order to construct accurately the thermal equilibrium diagram for the system. This diagram, it was known, would be very useful in predicting the behavior of the different alloys in the system and in determining the best heat treatments for any one alloy. Figure 2 shows this equilibrium diagram for the lead end of the system.

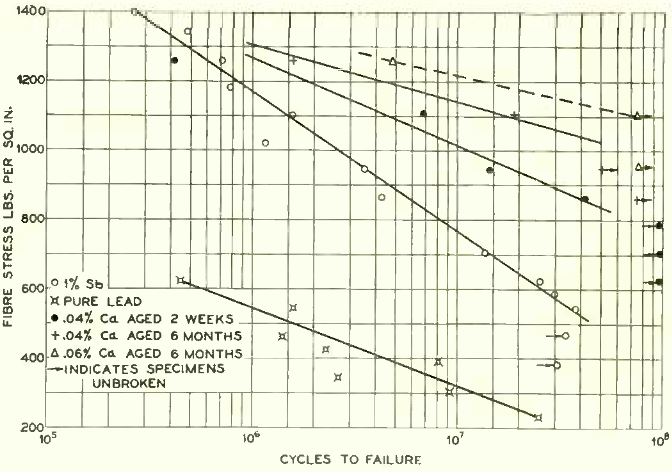


Fig. 4—Comparison of the fatigue resistance of lead, lead-1% antimony (the present Bell System Standard Cable Sheath Alloy), and lead-calcium alloys

According to this diagram the solubility of calcium in lead changes from 0.1% at 327°C. to 0.01% at 20°C. It is this change in solubility that makes the age hardening possible by appropriate heat treatment. Figure 3 illustrates the increase in tensile strength obtained by aging quenched lead-calcium alloys containing up to 0.26 per cent calcium. Curve 1 shows the strength of these alloys immediately after being quenched from a temperature of 300°C., while curve 2 shows their strength after aging 18 months at room temperature.

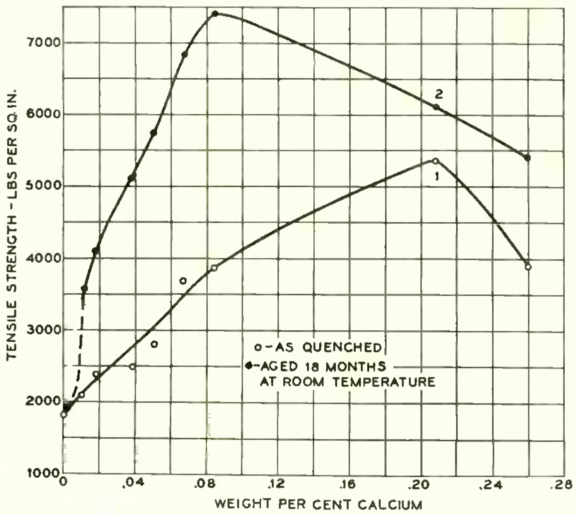


Fig. 3—Effect of calcium concentration on the tensile strength of quenched and aged lead-calcium alloys

These results are exceedingly interesting when it is remembered how small an amount of calcium has been added to the lead, and what remarkable increases in strength result. The strength of the alloy containing eight parts of calcium in ten thousand, for example, increases from approximately 1800 pounds per square inch for pure lead, to almost 7500 for the heat treated alloy. Alloys containing even as little calcium as one part in ten thousand age harden and show an increase in strength of over 1000 pounds per square inch. Other physical properties are also improved, as evidenced by the fatigue resistance data in Figure 4.

Considered solely as scientific curiosities these alloys are well worth studying, but besides this, laboratory tests indicate that their physical properties such as fatigue resistance and tensile strength are far superior to those of any other alloy now used as cable-sheath material.

At the present time, extensive field tests are being made on cables with a lead-calcium alloy. If these tests prove as successful as is expected, it cannot be long before considerable quantities of cables sheathed with lead-calcium alloy will be in commercial use.

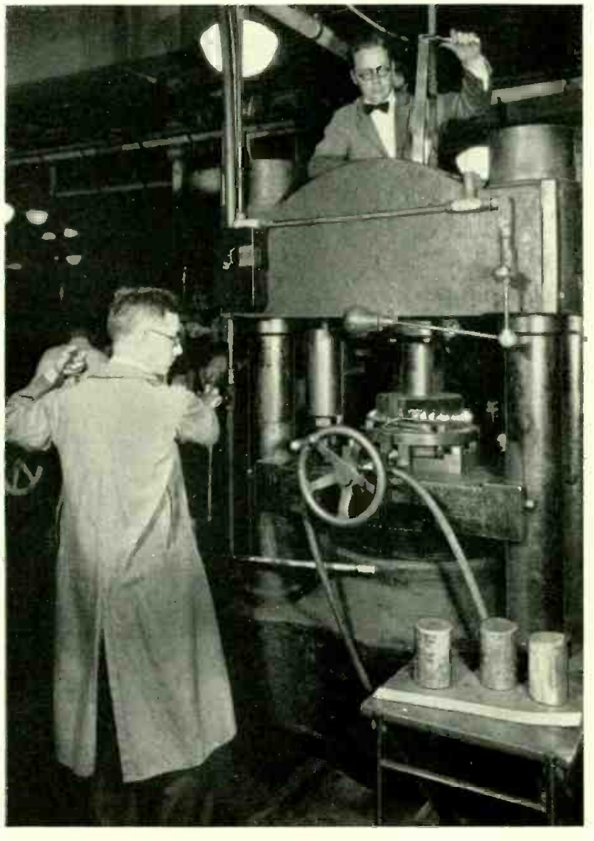
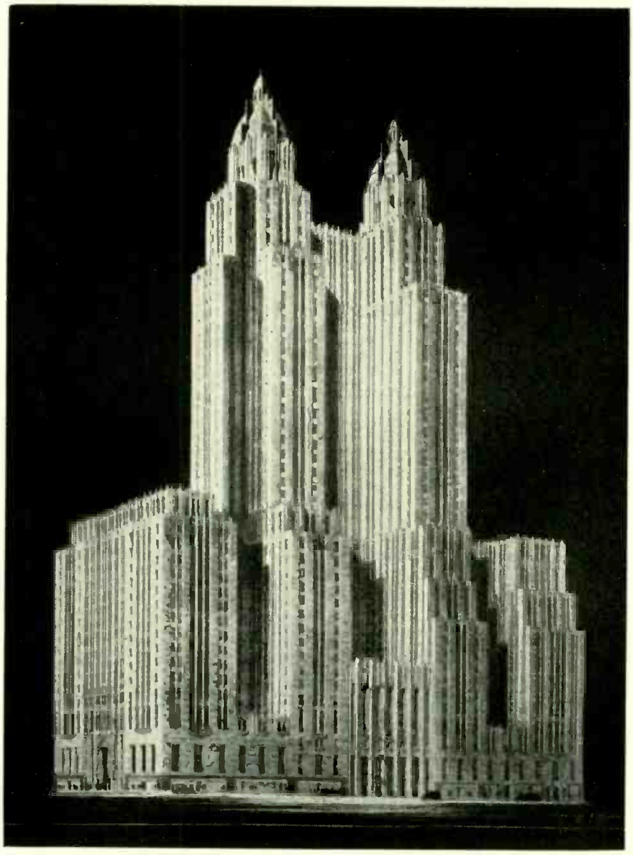


Fig. 5—After the slug has been cast it is placed in the die block of the extrusion press and heated to a temperature slightly below the melting point of the alloy, and emerges at the top of the press as tape

NEWS AND PICTURES

of the

MONTH



Model of the new Waldorf-Astoria Hotel, which is to be equipped with Western Electric public-address systems, radio receiving apparatus, sound-picture systems, and a telephone switchboard including unusual features

John Joseph Lyng

THE Laboratories learned with profound regret of the death of John J. Lyng, Vice-president of Electrical Research Products, former executive of our organization, and valued friend of many of our staff.

Mr. Lyng met his death on Saturday, August 9, while attempting to rescue his sister-in-law who was being carried out by the current while bathing.

After working for the New York Telephone Company as an installer, and for other telephone interests, Mr. Lyng entered the Western Electric Company in 1905. Soon taking up apparatus design, he was given supervision of this work in 1907. During more than twenty years his responsibilities grew with the Engineering Department and its successor, the Laboratories. In 1928 he relinquished the position of Director of Apparatus Development to become Vice-president of the Products Company, in charge of its engineering.

Throughout his long association with us, Mr. Lyng contributed many patents and fruitful ideas to the telephone art. No less important was his influence on many of our present creative and supervisory staff, who gratefully acknowledge his vigorous leadership as a potent factor in their own careers.

General News Notes

WESTERN Electric radio equipment for airplanes was demonstrated to officers of four squadrons of the Air Service Reserve Corps, U. S. Army, at Mitchell Field on July 16. The Laboratories' airplanes, piloted by A. R. Brooks and P. D. Lucas, made a number of flights during which the officers talked with their associates through our mobile ground station which had been set up at the field by D. K. Martin, W. K. Caughey, and others of the Radio Development group.

Communication was also had with the ground station at Whippany, and between planes. About seventy-five officers participated in the tests, which were sponsored by Major J. M. Hayward, O. R. C.

Airplane radio equipment was demonstrated two days later in the new role of adjunct to New York City's marine fire-fighters. Ground-station equipment, installed at Marine Division headquarters at the Battery, was used to maintain communication with plane equipment on the fireboat *John P. Mitchell* on a test run up the East River around Welfare Island, and up the Hudson a like distance. W. K. Caughey had charge of the shore station, and D. K. Martin and H. E. J. Smith were in charge of that on the ship. Other Laboratories' men on board as observers were W. B. Wallace, O. M. Glunt, H. W. Dippel, G. F. Morrison and P. B. Findley.

The demonstration was made at the request of the Fire Department to investigate the possibility and usefulness of continuous communication with fireboats. It is planned to have the boats' receivers operating continuously while they are absent from their stations, so that the captain or pilot can be called through a loud speaker. The radio link will give Headquarters complete control of the movements of the boats, and enable assistance to be summoned without recourse to the fire alarm network ashore.

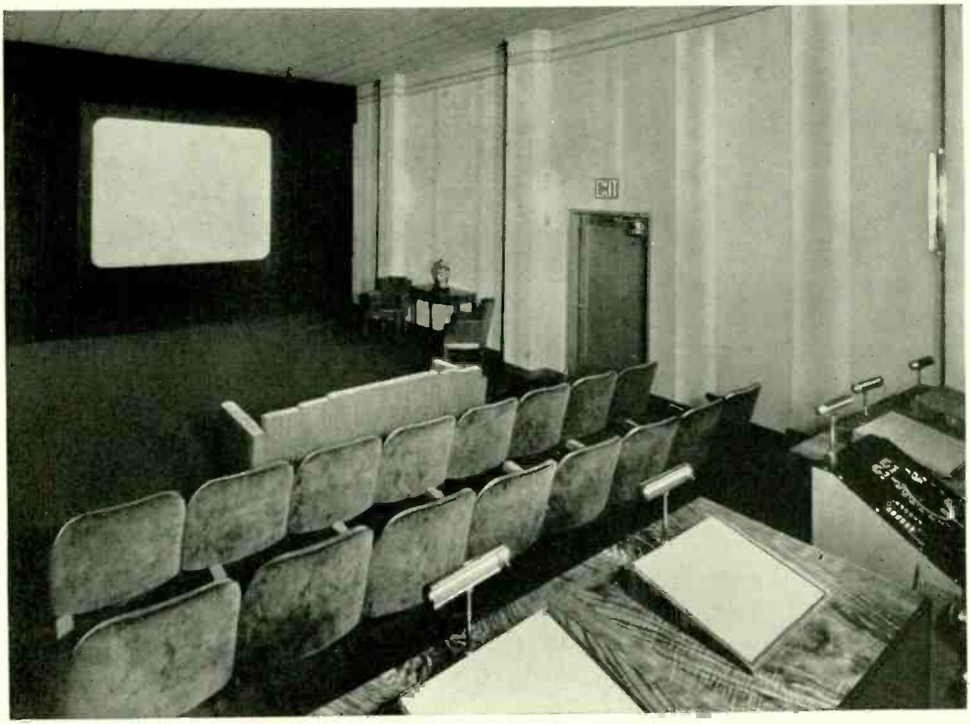
New Waldorf-Astoria Plans Elaborate Communication Network

A PRIVATE branch exchange of twenty-eight positions is part of the order placed with the New York Telephone Company by the management of the new Waldorf-Astoria Hotel now under construction on Park Avenue. The board, of the 702 type, will be equipped with machine ringing, flashing recall, and idle trunk indication. It will serve 2535 stations and 125 central office trunks. Each of the double rooms will have one permanently wired telephone and one arranged to plug into either of two outlets. Service to the offices and departments of the hotel will be through a dial PBX. Two telephone-typewriter systems will be installed, one for reporting arrivals and departures and one for paging and message work.

An unusually elaborate network for program transmission has been designed by engineers of our Special Products group, under the direction of J. J. Kuhn. Each guest-room will have access to any of six program-channels, and the apartments, 140 in number, will have access as well to a central antenna system for their own radio sets. Public address facilities will be provided in nine of the public meeting halls, and these facilities may be used in conjunction with telephone lines to tie together distant gatherings, or for broadcasting. Facilities have also been arranged for distributing the programs originating in a public address system to each of the guest rooms.

A centralized antenna system will be used for the reception of broadcast programs. Wires will be strung between two towers approximately 600 feet above the street level. Three antennas will be provided, one for the six programs distributed throughout the building and two for use of the apartments occupying the twentieth up to the forty-second floors.

Laboratories engineers are coopererating with the architects and engineers representing the hotel to locate the permanently-installed loud speakers in harmony with the architectural design of the public-room interiors. Although in practically all cases the 555-type loud-speaking telephone is being employed, several different types are also being used. The most unusual is perhaps the No. 6016-A designed especially for the purpose of reducing the depth required for housing the horn. A Western Electric sound-picture system, independent of the public address system, will be installed in the ballroom of the hotel.

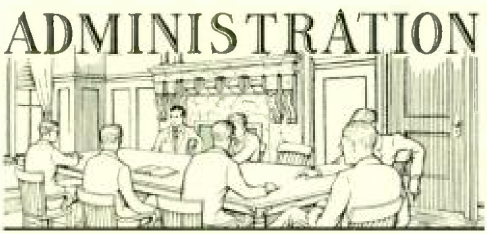


A photograph cannot do justice to the soft blending of colors in the review room of our Sound-Picture Laboratory

Dr. Shewhart to Conduct Course at Stevens

W. A. Shewhart will conduct during the coming autumn semester a special course at Stevens Institute of Technology as part of a new program of graduate instruction in the college. It is cataloged as *Statistical Theories and Methods Applicable to the Economic Control of Quality in Manufactured Products* and will be given twice a week during the late-afternoon hours. It will deal with the theory of statistics; and the application of modern statistical theory to the analysis, interpretation and presentation of data, to the planning of physical investigations, to the development of economical production and inspection methods, and to the establishment of standards for quality. Study will also be given to criteria of sampling. Dr. Shewhart will use much of the material presented in his Out-of-Hours courses, which with added material he has incorporated in a recently completed text to be issued during the coming months.

In its annual meeting the Board of Trustees of the Institute voted the appointment of Dr. Shewhart as Lecturer, with professorial rank in the Department of Economics of Engineering.



Dr. Jewett attended on July 31, a joint public meeting of borough and township officials of New Providence, over which Mayor R. F. Newcomb presided, and which was attended by more than a hundred citizens of the locality. On that occasion Dr. Jewett made the formal public announcement of the Laboratories' purchases of property at Murray Hill. Expanding on the brief statement prepared for the press, which appeared on the last page of the Record for August, Dr. Jewett said that within the next three or four years the personnel at Murray Hill was expected to be about three or four hundred people. No housing development on the property is contemplated. Dr. Jewett felt that it might take two years to complete the first building unit.

Cordial addresses of welcome were made by officials of the borough and township, and a vote of thanks was tendered by the borough council to Dr. Jewett and other executives of the Laboratories for their frank explanation of the Laboratories' plans.

The Murray Hill property adds about two hundred acres to the area outside New York City which is used for research and development work. Including the radio research laboratories at Deal, Cliffwood and Holmdel, the radio development laboratories at Whippany and Mendham, the outside-plant testing ground at Chester, and certain smaller plots elsewhere, a total of about 1200 acres is now, or will be shortly, utilized by the Laboratories for most effectively developing electrical communication for the benefit of the Bell System.

Among honorary pallbearers at the funeral of John J. Lyng were Messrs. Charlesworth, Dixon, Jones, Roberts, Moravec and Glunt.

Vice-president Charlesworth entered on August 1 upon the term as vice-president of the A. I. E. E. to which he was recently elected.

Departmental News

Patent

June, 1930, was an outstanding month in the number of patents issued to members of the Laboratories. The list of patents granted contains sixty-three names, more than the combined previous three months.

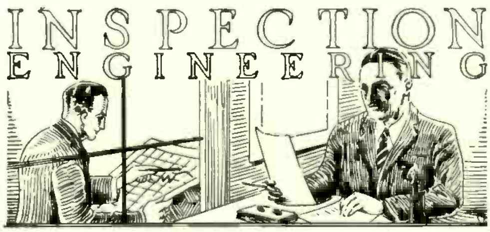
S. E. Anderson
J. H. Bell (2)
A. F. Bennett
P. H. Betts
H. S. Black (3)
O. E. Buckley
E. T. Burton
W. W. Carpenter (4)
P. P. Cioffi
E. H. Clark (5)
R. E. Collis
V. M. Cousins
A. D. Dowd
G. W. Elmen (4)
C. R. Englund
F. S. Entz
A. H. Falk
F. F. Farnsworth
J. C. Field
H. A. Frederick
H. T. Friis
J. R. Fry
A. G. Ganz
J. J. Gilbert (4)
C. L. Goodrum
C. W. Green
H. C. Harrison
R. V. L. Hartley
R. A. Heising (2)
E. E. Hinrichsen
H. B. Johnson
W. C. Jones (2)
G. V. King (2)
C. D. Koechling
J. A. Krecek
M. E. Krom (2)
V. E. Legg
W. A. Marrison (3)
R. C. Mathes (3)
E. D. Mead (3)
D. C. Meyer
O. R. Miller
C. E. Mitchell
F. Mohr
E. R. Morton
A. A. Oswald
E. Peterson
N. Y. Priessman
D. A. Quarles
J. C. Schelleng (2)
E. L. Schwartz
O. A. Shann (2)
L. J. Sivian
L. J. Stacy
G. H. Stevenson
H. M. Stoller (3)
R. V. Terry
W. F. Vieth
E. C. Wente
E. B. Wheeler
H. Whittle
E. B. Wood (2)
J. C. Wright

During the period from July 3, 1930, to August 5, 1930, members of the Patent Department visited the following cities in connection with the prosecution of patents: Washington; F. G. Braham, H. A. Flammer, R. J. Fluskey, W. C. Kiesel.

Personnel Department

R. J. Heffner visited Stevens Institute of Technology to investigate vocational guidance tests given to college graduates.

Miss G. L. Prouty has been appointed a member of the program committee of The Personnel Club of New York.



During the latter part of July, G. D. Edwards, in company with I. W. Whiteside, Field Engineer for the Philadelphia territory, and A. J. Boesch, visited Washington, Richmond, Charlestown, West Virginia, and Baltimore for the purpose of introducing Mr. Boesch as the new Field Engineer for that territory. Earlier in the month A. G. Dalton and J. A. St. Clair were in Philadelphia with Mr. Boesch, and in company with Mr. Whiteside visited Harrisburg and Pittsburgh for the same purpose.

Mr. Dalton was also in Boston and Worcester, Massachusetts, during the first week in July to introduce T. L. Oliver who has succeeded D. S. Bender as Field Engineer of New York No. 1 territory comprising the operating areas of the New England Telephone and Telegraph Company, The Southern New England Telephone Company and the New Jersey Bell Telephone Company. At a later date Mr. Oliver was again in Boston in connection with miscellaneous engineering items.

D. S. BENDER, formerly Field Engineer in the New York No. 1 territory, has been transferred to the Complaint Bureau in charge of Telephone Products, replacing A. J. Boesch.

A. F. GILSON and P. S. OLMSTEAD visited Hawthorne for a meeting of the Apparatus Tolerance Committee of which Mr. Gilson is chairman.

F. I. SMITH spent several days in Philadelphia inspecting conduit delivered to the Bell Telephone Company of Pennsylvania.

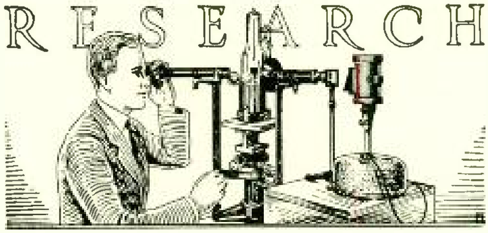
AT A QUALITY SURVEY conference on echo-suppressor equipment held in Kearny, H. F. Kortheuer represented the Inspection Engineering Department.

W. E. WHITWORTH, Field Engineer in Cleveland, visited Elkhart, Indiana, Cincinnati, Columbus and Youngstown, in connection with various engineering matters. Mr. Whitworth also spent several days in Akron where a change from manual to step-by-step equipment is being made for the entire city.

IN CONNECTION WITH general engineering matters, E. J. Bonnesen visited Springfield, Illinois and Joplin, Missouri. He was also in Wichita, Kansas, to investigate a complaint on gas engines.

SPECIAL FIELD investigations called J. H. Shepard to New Orleans, McComb (Mississippi), Mobile and Birmingham, and T. A. Crump to Washington and Harrisburg.

GENERAL inspection matters took R. C. Koernig to Denver, Des Moines and Minneapolis; H. W. Nylund to Seattle and Los Angeles, and R. C. Kamphausen to Saginaw, Bay City, Flint, Petoskey, Grand Rapids, Holland and Lansing, Michigan.



HERBERT E. IVES has contributed a chapter headed *Television* to a book on radio by Martin Codel recently published by Harper Brothers.

DURING THE WEEK of July 28 C. H. G. Gray and L. E. Krebs were at Hawthorne attending a conference on machines for use in testing transmission apparatus.

IN CONNECTION WITH the new operator's transmitter W. G. Breivogel was also at Hawthorne. On August 26 he completed twenty years with the Bell System.

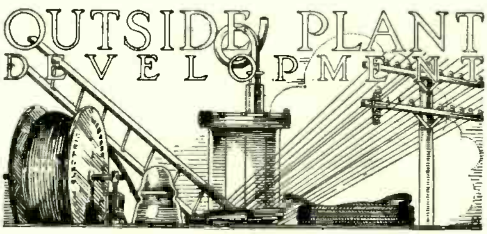
A section of the magnetic research laboratory. E. A. Nesbitt using the Kelsall permeameter for measuring permeability

MATTERS PERTAINING to a new loud speaker were discussed by D. G. Blattner in a recent visit to Hawthorne.

R. B. MEARS attended a meeting of the American Electroplaters Society at Washington.

B. L. CLARKE and H. S. DAVIDSON visited Hawthorne to discuss the analysis of lead-calcium cable.

MODULATION TESTS on the proposed wave-antenna and associated equipment were made by R. O. Wise, M. E. Campbell and L. G. Kersta at the American Telephone and Telegraph Company's long-wave radio station in Bradley, Maine.



CABLE DEVELOPMENT

WITH ENGINEERS OF the American Telephone and Telegraph Company, J. G. Brearley was at Phoenixville, Pennsylvania, to observe a trial installation of pulp-insulated cable.

G. A. ANDEREGG visited the Western Company's Point Breeze works in connection with general cable-development problems. L. S. Ford and W. E. Mougey were also at Point Breeze on similar studies.

PLANT APPARATUS

A STUDY OF CHESTNUT poles, particularly from the standpoint of the size and distribution of knots, was made by A. H. Hearn, L. M. Lindenmuth, and R. C. Eggleston at Waynesboro and Natural Bridge, Virginia. They then visited Spartanburg, South Carolina, and inspected pine poles. From there Mr. Eggleston proceeded to Minneapolis where problems on cedar poles engaged his attention.

O. B. COOK attended a trial installation of mechanical protection for cable at Morristown, New Jersey.

THE INSTALLATION FOR field trial of newly designed grade clamps in the territory of the New Jersey Bell Telephone Company was supervised by E. St. John.

S. C. MILLER and B. A. MERRICK assisted at tests of outside-plant hardware at Asbury Park.

WIRE DEVELOPMENT

MECHANICAL attachments for drop wire were inspected in New Haven by I. C. Shafer, accompanied by Mr. Kane of the American Telephone and Telegraph Company.

ON AUGUST 8, C. B. Robertson completed twenty years of service in the Bell System.

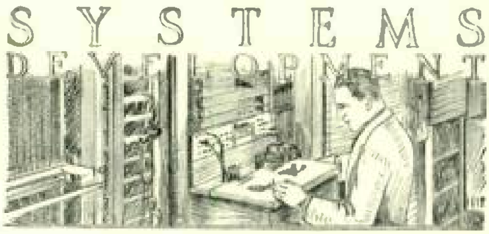
CERAMICS

C. R. MOORE consulted with engineers of the Schollhorn Company at New Haven in regard to a new method of manufacturing pliers.

MANUFACTURING METHODS for drop wire were discussed by A. H. Blake at the Simplex Wire and Cable Company's plant at Boston.

W. S. HAYFORD and R. J. NOSSAMAN were at Pittsburgh, and at Ogdensburg, New York, where they worked on field trials of recently-developed tools for making rolled joints in line wire.

C. D. HOCKER has been at Hawthorne in connection with the manufacture of solder. While on this trip he also investigated matters pertaining to cases for the protection of splices in tape-armored cable.



Equipment Development

H. D. Bruhn visited Washington to investigate PBX switchboards installed by the Chesapeake and Potomac Telephone Company for secretarial service.

The pneumatic-tube systems for distributing tickets in the new toll offices at Milwaukee, Chicago and Detroit were inspected by G. A. Benson in recent visits to these cities.

J. R. Kidd visited Pittsburgh and Indianapolis to assist in the installation of improved differential duplex equipment for telegraph repeaters.

C. A. Sanborn spent two weeks in Wisconsin supervising the installation of an improved signaling system in six telegraph stations between Milwaukee and Superior.

Ringing-tone conditions at Rensselaer office were investigated by F. C. Volkert in a recent visit to the Albany territory.

Step-by-step developments occasioned a visit by G. K. Smith to Bridgeport. He was also at Atlantic City in charge of a group of younger transmission engineers who visited the step-by-step central office there to inspect equipment details.

N. H. Thorn visited Springfield, Massachusetts, in connection with the development of aisle pilot equipment.

Operating tests on the "R" type gasoline engine installed at Stroudsburg, Pennsylvania, were made by V. T. Callahan.

H. M. Spicer attended the cutover of the 24 Kva. alternators which are to supply reserve power for the toll a-c busy signal and idle indicating lamps at Atlanta and Akron.

Theodore Paul completed twenty years of service in the Bell System on August 1.

Ellsworth Emile Sancier died suddenly on July 28, in his eighteenth year. He entered the Laboratories in July, 1929, and shortly after enrolled in the training course for draftsmen. He showed especial aptitude for this work and in February of this year was assigned to the Systems Development as a drafting assistant.

The interest among outside organizations which is displayed in Laboratories activities described in the Record is attested by numerous letters recently received by W. L. Heard. In the June issue Mr. Heard in an article entitled *Short Cuts in Drafting* described a method used in the Laboratories of making drawings in pencil directly on tracing cloth, thus eliminating the tracing step necessary when the penciled drawing has been made on paper.

Within two weeks after the article appeared Mr. Heard began getting inquiries by letters and telephone requesting additional information on this short-cut process successfully used in the Laboratories. In one instance a call was made from overseas: the London office of the International Telephone and Telegraph requesting over the radio-telephone of the New York office to make inquiries from Mr. Heard regarding the procedure used. In addition letters were received from the Associated Companies and others and from universities both in this country and abroad.

Local Circuit Development

J. L. Dow completed twenty years of service in the Bell System on August 12.

D. H. Pennoyer went to Wilkes-Barre to observe the functioning of the No. 14 centralized local-test desk in connection with step-by-step dial equipment.

J. B. Retallack was in Hawthorne in connection with the shop test of the new automatic test frame arranged to test panel district selectors having the new zone and overtime registration feature.

C. D. Koechling has returned from Pittsburgh where he observed the operation of the No. 701-A PBX recently installed in Gimbel Brothers department store.

Quietly and without a great deal of fuss or ceremony A. W. Horne, engineer on sender and adjuster circuits, entered upon his thirty-first year

A. W. Horne

with the Bell System on August 8. Beginning as a night operator in Laconia, New Hampshire, Mr. Horne advanced rapidly in the New England Telephone and Telegraph Company with which he was associated until 1919. He was made inspector and installer of sub-station equipment in 1902; PBX installer, 1906; district equipment inspector, 1908, and wire chief, 1911. In these various capacities he traveled widely over the New England territory.

Upon America's entrance into the World War in 1917 he joined the Signal Corps and saw service overseas. He returned to the New England Company for a short period after being mustered out of service in 1919 and then joined the Western Electric Engineering Department where he worked on line finders and district selectors. Between 1920 and 1923 he represented the Engineering Department at Omaha and Seattle in connection with the initial installation of panel-type equipment in these cities. In 1924 and 1925 he was engaged in field-inspection work in the eastern territory for the Inspection Engineering Department. He returned to the present building in 1925, and has since been engaged on circuit design work.

T. L. Dimond visited Montreal to investigate the operating conditions of step-by-step traffic registers.

A field study of panel-dial circuits called C. H. McCandless to Atlanta during July.

T. F. Le Fevre has been at Albany where a trial of new type armatures for step-by-step relays is in process.

A visit to Hawthorne was made by O. R. Miller to discuss the introduction of a new interrupter (varying) machine for use in conditioning step-by-step switches.

Twenty years of service in the Bell System were completed by H. W. Baker on August 8.

W. J. Lacerte was in Albany to test step-by-step relays equipped with a new armature structure.

THE TRIAL of new "R" magnet protections was checked by R. C. Paine in a recent visit to Philadelphia.

Toll Circuit Development

A JOINT ENGINEERING study is being made by the A. T. & T. Co., the Western Electric Company, and the Laboratories on shop assembled and tested relay-rack bays of telephone repeater equipment. In connection with this work, F. H. Chase and B. R. Blair made a several days' visit to Glens Falls.

A NEW METHOD of paralleling relay contacts on pilot wire regulating circuits was inspected by F. S. Entz at Kingston.

J. B. SHIEL was at Garden City, and G. N. Saul and R. E. Ressler were at Bayshore, testing recent improvements in A-B trunks.

Telegraph Development

A. M. KOERNER and C. B. SUTLIFF are still in El Paso and Denver in connection with the study of prevention of static interference on open-wire carrier telegraph circuits.

AT INDIANAPOLIS and Pittsburgh, R. G. Loeffel inspected the new combination differential and the two-path polar telegraph repeaters which have been installed for trial.

C. C. LANE visited Milwaukee and several other offices in the Wisconsin territory supervising the installation and operation of a telegraph way-station selector system for printing telegraphs.

Staff

IN 1890 practically all of the telephones used in the eastern section of the country were made in a small shop of the Western Company on Thames Street. A group of fifteen girls working under Miss Susie Merkle was sufficient to turn out all the coils that were needed. They were wound of silk or cotton-covered wire—the laboratory-research work, which enabled the replacement of the costly silk and cotton covering with the black enamel coating now in use, had not then been organized.

Addie Knoeller who works in the Development Shop winding small coils became a member of this group on August 17 forty years ago. Now despite the tremendous growth of the then-small telephone industry, after the lapse of the gay nineties and the eventful three decades that have followed, things to her don't seem to have changed much. And her interest

Addie Knoeller

in her work connected with the telephone hasn't waned. "Each new coil I begin," she says, "has the same interest for me as the first ones I wound in the Thames Street factory."

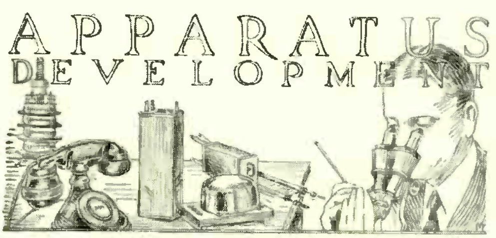
In 1898 she came here when her work was transferred to the first sections of the present building. She was made assistant inspector in November, 1900, but after a year and a half of this work her health failed. Following an absence of six months she returned to her original work of winding coils. When the manufacturing activities were moved to Hawthorne in 1914 she was transferred to the coil-winding group in the Model Shop, forerunner of the present Development Shop where she has worked since.

During the war she was active in Liberty Loan work, and as a member of the coil-winding group in the Development Shop she worked on coils used in the first transcontinental trials in 1915 and the transmission of pictures over wire which was first demonstrated in 1924.

Following a luncheon at which Miss Knoeller was entertained by the secretarial staff of the Plant Department, a service emblem bearing eight stars was presented to her by Mr. Sanford.

TWENTY YEARS of service with the Bell System were completed by Eric Lund on August 19.

PROCUREMENT of transmitting licenses for the Laboratories' experimental stations took G. H. Bogart to Washington on August 13 and 14.



THE PARIS EDITION of the New York *Herald* reports William Fondiller's name among a list of American scientists and electrical engineers who made a tour through the Scandinavian countries following the close of the World Power Conference in Berlin.

SPECIAL PRODUCTS

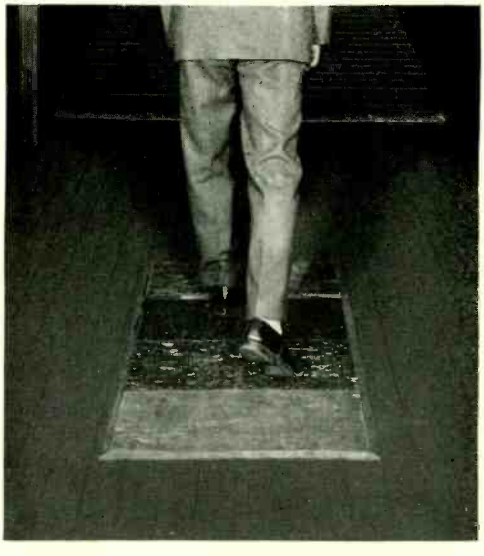
T. E. SHEA and W. HERRIOTT accompanied by E. C. Wente of the Research Department were at Rochester to confer upon optical matters relating to sound-picture work at the Bausch & Lomb plant.

TO CONDUCT reverberation tests at the various sound-picture studios, C. F. Eyring and R. L. Hanson are in Hollywood. They will undertake the tests in collaboration with engineers of the West Coast Electrical Research Products, Inc.

H. C. CURL visited the Brooklyn Navy Yard to inspect the announcing system on the *U.S.S. Chester*. Accompanied by L. B. Cooke, he was also in Pittsburgh to inspect the music-reproducing systems in several parks.

TRANSMISSION APPARATUS

THE DEVELOPMENT of a filter for suppressing interference in radio was supervised by C. E. Lane at Mendham.

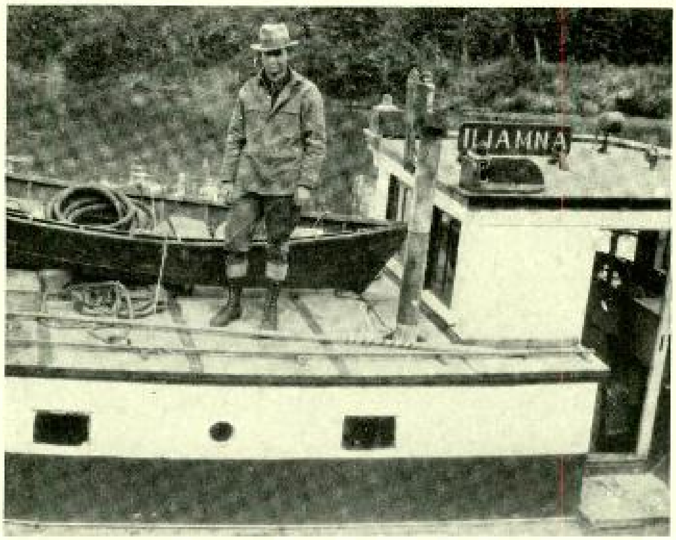


Materials engineers hit upon an ingenious means for testing the wearing qualities of rubber flooring for telephone booths. Strips of it were fastened to the floor of the corridor in Section K, fifth floor, for passers-by to walk over

F. J. RASMUSSEN and T. SLONCZEWSKI were at the Philadelphia Instrument Shop in regard to the design of an automatic oscillograph to be used in inductive interference studies.

R. W. DE MONTE installed and tested high-voltage rectifier equipment for Station KMOX, "The Voice of St. Louis".

TESTS ON motor-generator equipment under manufacture for the Laboratories were made by W. J. Thompson at the Electrical Specialty Company, Stamford.



F. B. Woodworth of Radio Development, disguised as an Alaskan. Completing his investigations as to the possibilities of radio-telephony in the salmon fisheries, Mr. Woodworth made an adventurous overland trip back to civilization in advance of the fishing fleet

C. H. YOUNG was at Whippany in connection with the use of a radio-frequency bridge for antenna-impedance studies.

MATERIALS DEVELOPMENT

J. R. TOWNSEND was at Hawthorne during the early part of July where he attended a conference on gauges and gauging methods for the Bell System. He later visited the Watertown Arsenal at Watertown, Massachusetts, in connection with welding-inspection methods.

I. V. WILLIAMS spent the week of July 28 at Hawthorne on matters concerned with the heat treatment of pawls for dial apparatus.

W. W. WERRING was also at Hawthorne to discuss the use of Bakelized paper for handset transmitters.

STUDIES OF noise conditions on base-metal contacts required the presence of C. E. Nelson at Dallas, Texas and Huntington, West Virginia.

D. W. MATHISON was at Montreal on contact-cleaning tests made in the Wilbank office of that city.

TWENTY YEARS OF service in the Bell System were completed by J. T. Butterfield on August 1.

MANUAL APPARATUS

FOR THE PURPOSE of conferences on problems in connection with the manufacture of manual and dial apparatus R. F. Elliott was a visitor to the Laboratories and conferred with J. N. Reynolds and H. T. Martin.

THE FIRST OF THE NEW automatic recording oscillographs were tested and adjusted by W. J. Means and T. Slonczewski at the Philadelphia Instrument Shop.

DIAL APPARATUS

WORK ON new busy signals for toll lines required W. C. Slauson's presence at Harrisburg, Pennsylvania.

G. B. Baker was in Albany on problems pertaining to step-by-step relays.

J. Abbott visited Hawthorne to discuss questions on dials with members of the Manufacturing Department.

August 7 marks the completion of A. C. Garrecht's twentieth year in the Bell System.

Radio Development

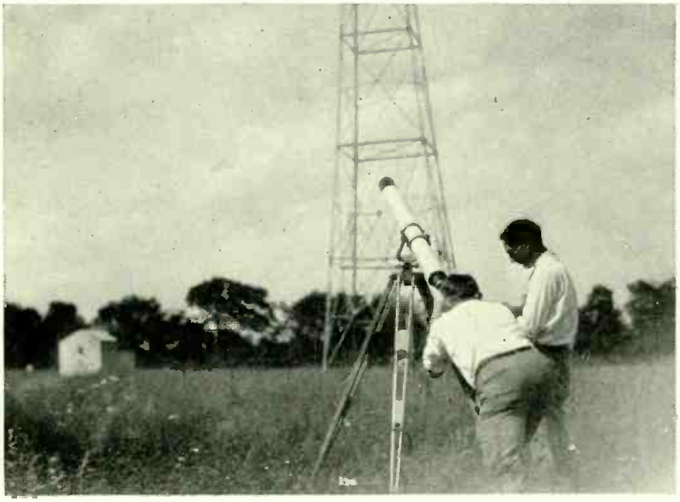
A visit to the Signal Corps Aircraft Radio Laboratory at Wright Field, Dayton, to confer with officers of the Signal Corps in regard to future development of radio for aircraft applications in the U. S. Army was made by O. M. Glunt, F. M. Ryan and J. O. Gargan.

W. L. Tierney attended a meeting of the Town Board of Hempstead, Long Island, as an expert witness concerning the application of the Columbia Broadcasting System for permission to erect a 50 kw broadcasting station in the township. Later he made a survey of the projected site of a 50 kw broadcasting equipment for the Consolidated Gas Electric Light and Power Company at Baltimore.

Accompanied by Captain A. R. Brooks, J. W. Greig visited the Bureau of Standards in Washington to investigate materials used in soundproofing aircraft.

A. B. Bailey visited Roanoke, Virginia, to inspect station WRBX owned by the Richmond Development Corporation. He also inspected the five kw radio telephone broadcasting equipment owned by the Atlanta *Journal*, Atlanta.

A survey for the installation of a 1 kw radio telephone broadcasting equipment and associated speech input equipment for Onondaga Radio Broadcasting, Inc. of Syracuse, was made by B. R. Cole.



Not star-gazing, but engaged in the serious business of measuring antenna currents, are these two engineers at our Whippany laboratory. When W. N. Mellor calls off the reading of an ammeter suspended in the antenna, E. F. Brooke writes it down

S. A. Harness inspected the broadcasting stations of Gimbel Bros., Pittsburgh, Radio Wire Program Corporation of America, Oil City, and Commercial Radio Service Company, Columbus, Ohio.

F. H. McIntosh has been in the midwest where he made an inspection tour of several stations equipped with Western Electric apparatus.

The installation of a remotely-controlled monitoring receiver to be used in connection with the synchronous operation of stations WOC and WHO was supervised by G. D. Gillett at Marengo, Iowa. Mr. Gillett spent some time in Marengo studying the synchronous operation of these stations under commercial conditions.

J. F. MORRISON inspected the Electrical Equipment Co.'s 1 kw broadcasting station at Phoenix, Arizona.

H. E. J. SMITH supervised the installation of 400 watt radio-telephone equipments for the Police Departments of Detroit and Minneapolis.

O. W. TOWNER made a survey of the proposed location for a 1 kw radio-telephone broadcasting equipment for the Seattle Broadcasting Company, Seattle, Washington. He also inspected stations KOMO and WSPD owned respectively by Fisher's Blend Station, Inc., Seattle, and the Toledo Broadcasting Company.

C. H. HAMILL visited St. Louis in connection with the installation of a 50 kw broadcasting station for the Voice of St. Louis, Inc.

AT MITCHELL FIELD, Long Island, J. O. Gargan, W. J. Adams, R. S. Bair, R. H. Herrick, B. O. Browne, I. R. Horn and W. A. Woods inspected Army combat planes for the purpose of collecting information for the design of two-way radio telephone equipment suitable for use with these machines. Later the Laboratories planes were used to demonstrate for officers attached to the Army Signal Corps Radio Laboratory the Western Electric two-way radio-telephone communication between planes while in flight and between the planes and the Laboratories' ground station at Whippany.

JULY FLYING presents a typical example of summer-month activity of the Laboratories airplane fleet, if two planes may be referred to as a fleet. During the seventy-six flights made, the character of the work varied from transmission studies in the aircraft frequency band to special demonstrations. This work involved several flights to Boston, Hartford, Washington, and Bellefonte, Pa.

Tests were made on the Boston flight of a model of an improved weather and beacon radio receiver operating in the frequency band of 230 to 500 kilocycles which is now under development. The advantage of the large cabin space in the tri-motor plane is amply demonstrated in this kind of work. The engineers in charge are enabled to make numerous changes in circuits while the plane is in flight, meanwhile noting results and discussing, by means of the interphone system, their results and the possibilities they suggest. Much substantial accomplishment is obtained from a few hours of this kind of work supplementing longer periods of design and construction work at West Street.

In the interest of safety and in order to keep informed of the practical effectiveness of the equipment already developed it is an unwritten law that frequent two-way telephone communication shall be maintained with W3XN at Whippany from the Ford (W10XXA) or the Fairchild (W2XBX) insofar as possible during other than near-to-base flights. This communication, of course, is in addition to the regular use of the beacon and weather service. It goes without saying that much data on the variation of transmission efficiency with distance, altitude, time of day, direction, character of country and frequency are obtained from these tests. As time goes on these data will provide a great deal of information as to the capabilities and the limitations of the frequencies allocated to aircraft services. The frequency used throughout July both in planes and at Whippany for these routine contacts was 3076 KC. The Bellefonte flights were made at different hours of day and night to observe the stability of transmission employing this frequency. Data from the Bellefonte area are of great importance as the trip west to Cleveland, passing over the Alleghany Mountains, is one of the most difficult and treacherous flights of the air mail.

To August 1 the total flights of the two planes were 719; 74,555 miles have been covered and 1413 passengers carried (omitting crews).

Anniversary of Sound Pictures

Four years ago, on August sixth, 1926, the premiere showing of "Don Juan" was made to the public in Warner Brothers Theatre. Two days previous to this showing, members of the Laboratories' staff who had been associated with the development work, together with many from the Western Electric Company and Warner Brothers, and others who had contributed to the new form of entertainment witnessed a "dress rehearsal". This was the first public showing of a picture made with the Western Electric system, and the occasion was therefore the birth of the present sound picture industry.

In the time that has elapsed, the new art has undergone extremely rapid growth. Four years ago, there was one sound picture theatre in the world. A short time ago, and significantly in the Comédie Cinema, Marseilles, there was completed the six thousandth installation of Western Electric apparatus.

A Frequent Question Regarding Your Insurance

What happens to my life insurance should I leave the service? Can I continue it? Shall I be forced to pay a higher premium? These questions are frequently asked with reference to our Company plan. They are best answered by the statement that The Employees' Life Insurance Plan is not Group or Industrial Insurance. It is sold at standard rates, the only difference being that under this plan the premiums may be collected through payroll deductions each month.

If an employee leaves the service, it is only necessary for him to arrange through the insurance counselor to pay the premiums on his policy direct to the insurance company. There is no change in rates.

If you wish other information, call L. H. Bunting, Extension 264, or see him in Room 144 at West Street.

Contributors to This Issue

AFTER receiving his B.S. degree from the Massachusetts Institute of Technology in 1919, F. J. Rasmussen spent two years with the American Smelting and Refining Company, engaged in the electrolytic refining of copper and tin. He then joined the Laboratories where he first spent one year on the mechanical analysis of apparatus. For the past eight years he has been occupied by the development of electrical measuring apparatus. At present he heads the group handling the development of oscillators, detectors and frequency measuring equipment.

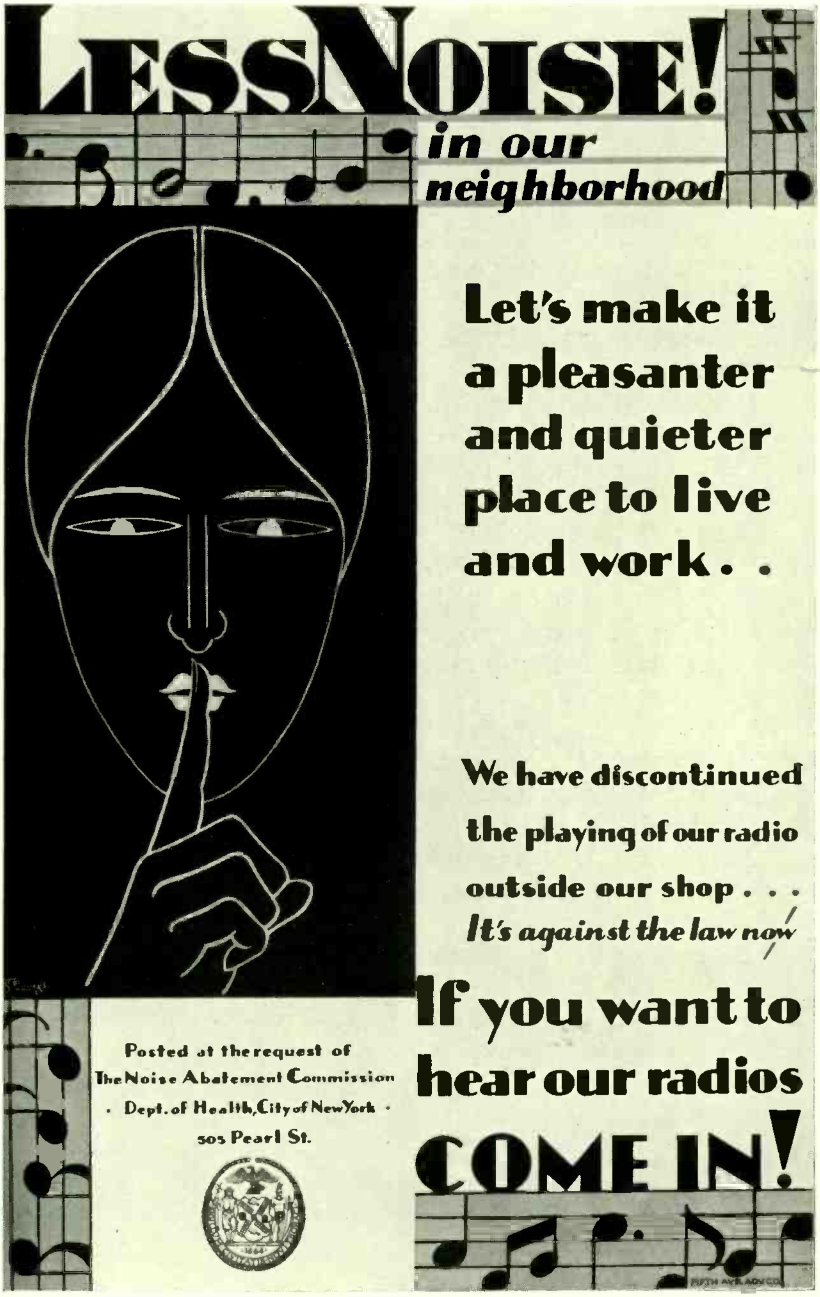
E. E. SCHUMACHER is a graduate from the University of Michigan. He entered the Research Department of these Laboratories in 1918 and for several years immediately thereafter was engaged with the development of vacuum tube filament. Since then his work has been primarily in the metallurgical field.

DURING THE summer of 1923, while still enrolled at the University of Michigan, C. R. BURROWS worked at Rocky Point in the development of the long-wave transatlantic radio transmitter. On receiving the degree of B.S. in electrical engineering in 1924, he returned to these Laboratories and undertook the design of the test oscillator for the Rugby long-wave transmitter. His present association, with short-wave radio development, began with the inception of intensive work along these lines. In the meantime he has received the degree of A.M. in physics from Columbia University.

F. J. Rasmussen

E. E. Schumacher

C. R. Burrows



The unwonted quiet which now blesses the neighbors of our city's radio shops is explained by this poster in display-windows. Since noise is a foe to telephony, the Bell System cooperated with New York's Noise Abatement Commission by placing the services of Dr. Fletcher, Dr. Galt and other members of our Technical Staff at the disposal of the Commission for a scientific study of noise