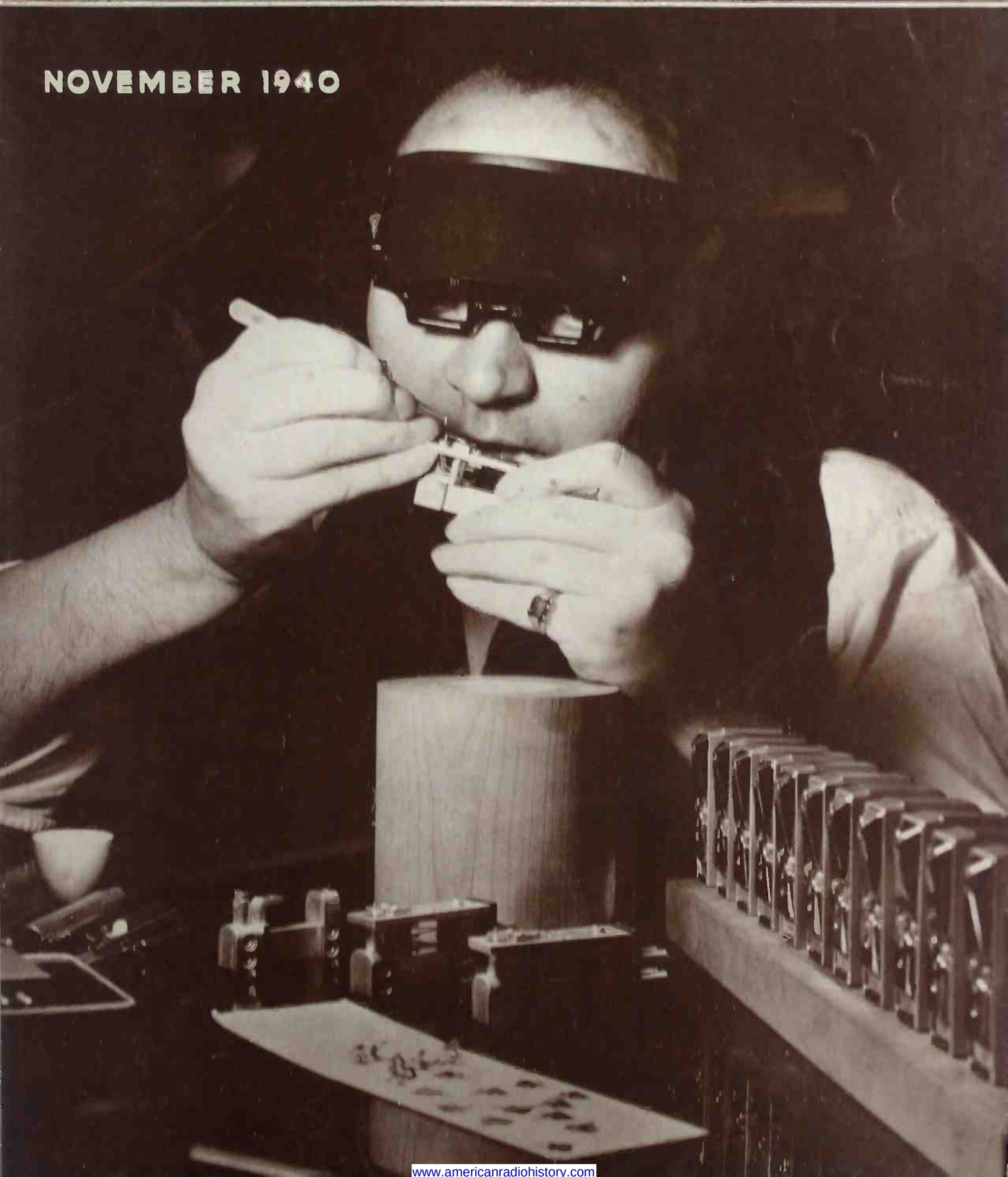
PICK-UPS

NOVEMBER 1940



PICK-UPS

NOVEMBER, 1940

BEING A PERIODICAL DEVOTED TO DEVELOPMENT IN SOUND TRANSMISSION. PUBLISHED BY THE

Western Electric
COMPANY

195 Broadway : New York, N. Y.

C. G. STOLL . . . . . President
H. B. GILMORE . . . . Secretary
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Assistant Editors

THE COVER

Skill and steady hands are essentials of the job of inserting the diamond stylus in the Western Electric 9A Reproducer

THIS ISSUE

DEMOCRACY'S SYMBOL

We can look out of our bedroom window and see the lights of several hundred homes. Lights-out comes early each evening for most of them, but for several weeks before election day windows were bright far into the night. People were anchored to their radios listening to campaign speeches. Those speeches ran the gamut of free expression. The only curb on freedom of speech was imposed by the listener himself who sat at his radio and turned the dial.

Radio played a mighty part in the campaign. It is destined to play an even greater role in the days to come. How infinitely blessed we are that radio is free. Should the founding fathers come to life again and be confronted with the task of designing a seal or insignia for the nation, they might well make the microphone the motif — the central, dominating figure. For the microphone, in truth, has become the symbol of a free and mighty people.

DON LEE

Western Chain Covers Coast, Pioneers in Television, Plans Two City FM Coverage

By WILL WHITMORE

"And so we bought a mountain." These words spoken by Lewis Allen Weiss, executive vice-president and general manager of the Don Lee Broadcasting System, somehow typify the thrust and enterprise of the network and of the people of the West as a whole.

Perhaps it is, after all, the sun, the climate and the scenery that has made them that way. An expansive country produces expansive thoughts in the minds of men. The sun, chiefly responsible for one of America's great industries being in Southern California, is not just an ordinary sun. It shines with a brilliance which at first blinds the visiting Eastener. But it also warms and cheers. Its rays sink deep into one's being, and makes men want to do big things in a spectacular way, and it gives them the strength, vision and courage to carry through with their bold adventures.

But what about that mountain? For 10 years the Don Lee Broadcasting System had been pumping out television images from the top of its eight story building in downtown Los Angeles. However, the image-carrying waves didn't get very far. Mountains intervened and absorbed the waves, yet television's greatest enthusiasts and much of Southern California's population lived on the other side of the mountains. Then along came Frequency Modulation offering all sorts of advantages, but possessing the same disadvantage of being no match for mountains. Something had to be done.

The Bible says, "I will lift mine eyes to the hills from whence cometh my help," and that's exactly what the network did. They looked to the hills and bought one. Two miles from Hollywood projects the highest mountain accessible by road in the Hollywoodland range. Mack Sennett, who made millions acting and directing pie operas for the movies, once owned this mountain, built a road to its top and lopped off its peak for a place to call home. Sennett changed his mind and for years the mountain had remained there, a lovers' retreat and a solid barrier against those television waves. Now the road has been reconstructed and a modern television studio, television and FM transmitter plant are being rushed to completion on that mountain, now called Mount Lee.

The mountain, the cost of reconstructing the road, and the television and FM plant and studios will set the Don Lee Broadcasting System back a cool $100,000. Besides that, another 50,000 watt FM station is planned for San Francisco, and KHJ, 5 kilowatt home radio station of the network, is being moved to a more favorable spot, 5515 Melrose Ave., Hollywood, six and one-half miles distant from its present downtown location.

"We'll serve one and three-quarters million people, practically the entire population of Southern California, with television and FM programs," says Weiss. "Sure, we know it will cost us a lot of money, and that international affairs are scrambled, but in spite of that we can find no excuse for not going ahead. We still have faith in the fundamental strength and health of this country. And we have faith in broadcasting. Our business is growing bigger every month. Gross billings for the network of 32 stations in 1939 amounted to $1,800,000, and we estimate that this year's business will outdistance 1939 by 25 per cent."

Weiss will talk about anything if he has the time, but he will talk about television whether he has the time or not. "We started television out here with last year's underwear and a roll of bailing wire," says Weiss, "but since that start we have telecast more than 2,800 programs, 11 million feet of motion picture film, made more than 70 outside pick-ups and been on the air more than 6,000 hours."

Television actually began at W6XAO when a young man, fresh out of the University of California at Berkeley, made a call on the Senior Lee back in November, 1930. The young man talked persuasively, and when he walked out of the office an hour later he had talked himself into the title of Television Director and a laboratory in which to putter around. The young man was Harry R. Lubcke, and he is still director of television. The first telecast was made December 23, 1931, just a little more than a year after Lubcke's memorable visit. It has been on the air daily except Sundays without notable exception. Each Monday night wrestling bouts, and each Friday night boxing matches are telecast from the Hollywood American Legion stadium. All home games of the local baseball team are telecast. Many other interesting remote pick-ups are made from time to time. It is estimated that there are

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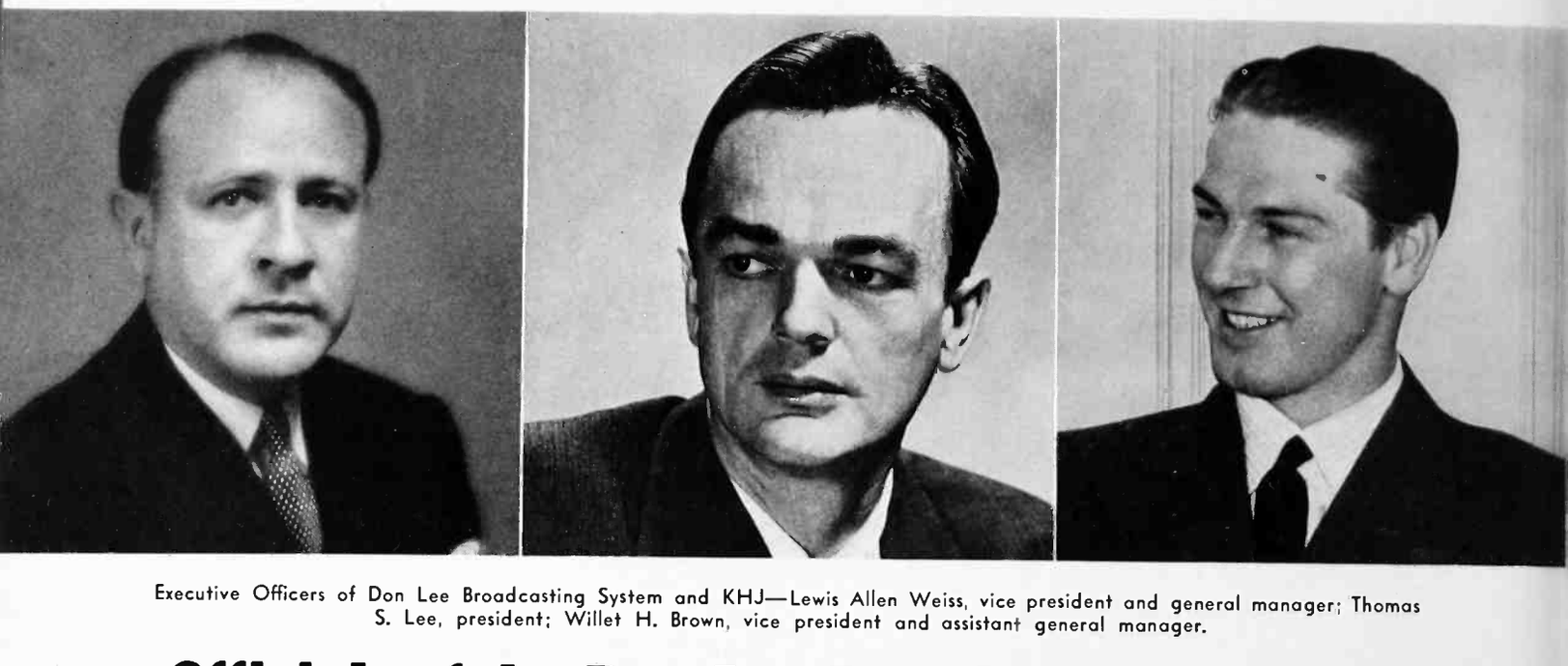
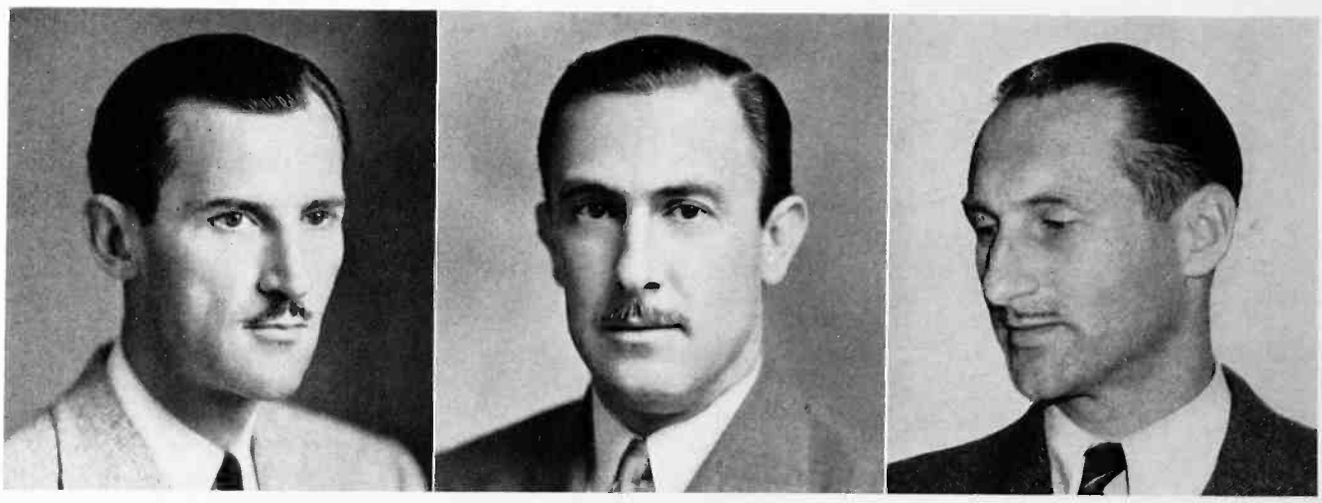


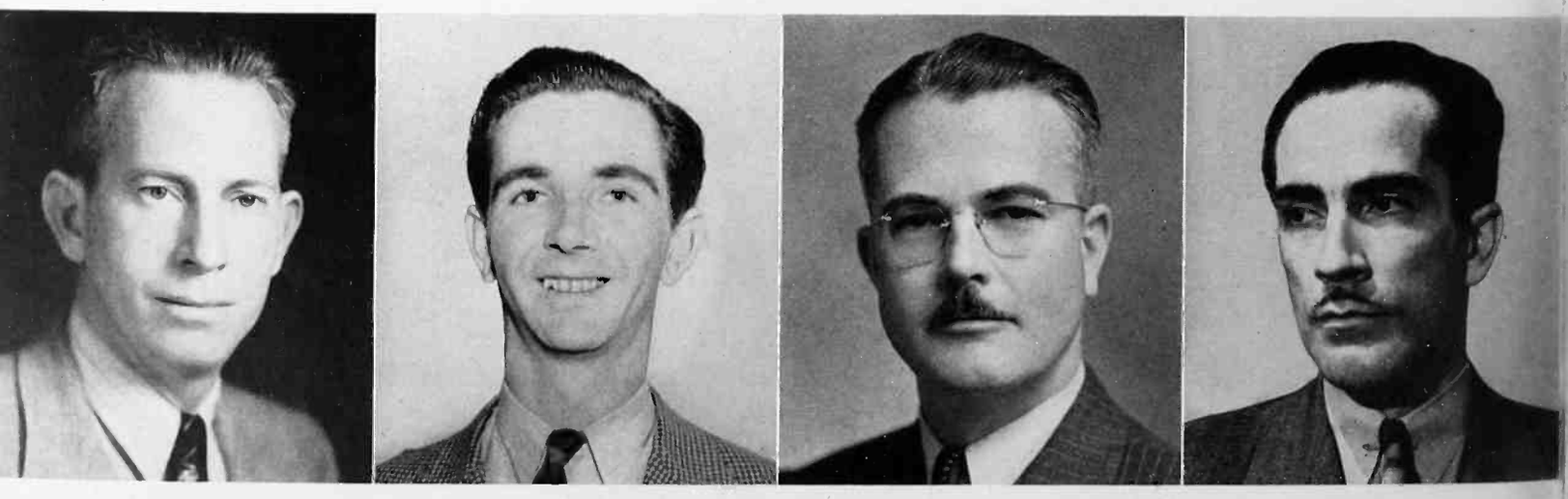
Executive Officers of Don Lee Broadcasting System and KHJ—Lewis Allen Weiss, vice president and general manager; Thomas S. Lee, president; Willet H. Brown, vice president and assistant general manager.

Officials of the Don Lee Broadcasting System

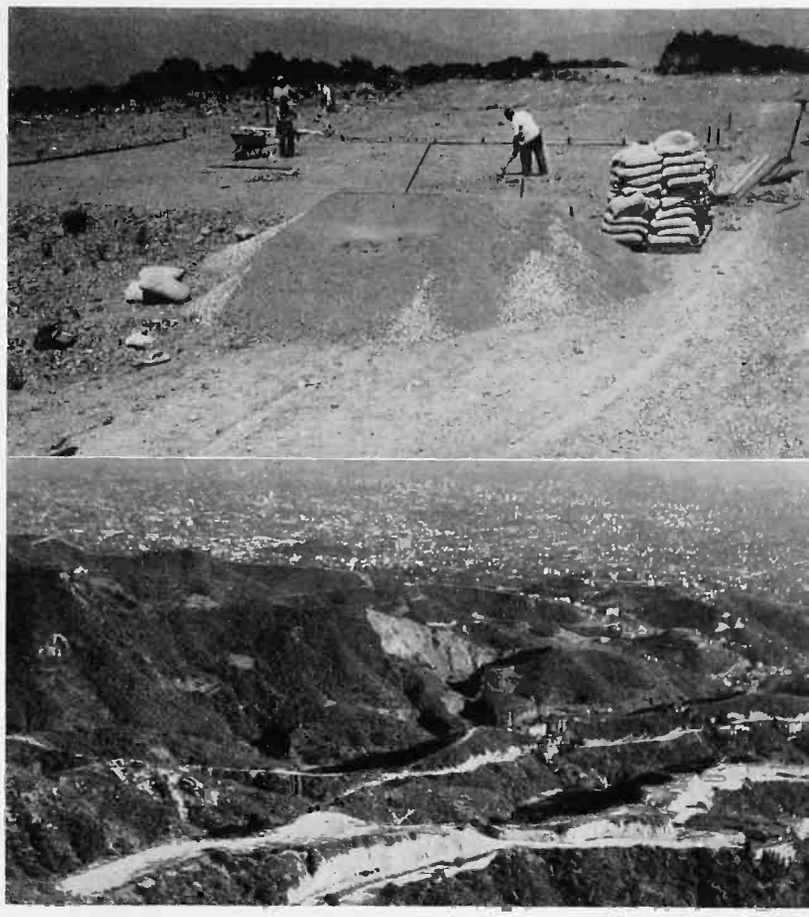


Managers—S. W. Fuller, KGB; William D. Pabst, KFRC; Earl Pollock, KDB.

Chief Engineers—Milam D. Cater, KGB; Robert Arne, KDB; Ernest Underwood KFRC; Frank Kennedy, Don Lee Broadcasting System and KHJ.



Don Lee Network, covering Pacific Coast states, comprises 32 stations. Recently KGBU, Ketchikan, Alaska, joined the system expanding the web to 33. More than nine out of every 10 radio homes are within 25 miles of a Don Lee broadcasting station.



Top: Breaking ground on top of Mt. Lee for new television and FM studio-station building. Above: From its towering height Mt. Lee overlooks the famous movie colony and Los Angeles.

Children's chorus and Easter lilies telvised from Hollywood bowl. Below: Portable television equipment on way to baseball game—Director Harry R. Lubcke (pointing), Assistant Director Wilbur Thorpe (seated atop truck), Technician Harold Jury.

Don Lee Chain Covers Coast

(*Continued from page 3*)

more han 400 television receivers in the area, and this number is expected to increase greatly when the new station goes on the air.

The Don Lee Broadcasting System is the natural outgrowth of a need for a network that would do a good job of covering completely the three Pacific Coast states. To begin at the beginning, the history of the network starts with the Cadillac distributor for the State of California by the name of Don Lee. The automobile business was good in California, and particularly in Los Angeles. In those days movie stars gave physical evidence to their popularity and prosperity by attempting to outdo each other with the cars in which they rode. To meet their extravagant demands Don Lee sold them Cadillacs with special bodies and ornate trimmings which he added in his own special body factory. It was a prosperous business, and Lee looked around for places to invest his money. His eye fell on radio, and his interest for radio developed. On November 1, 1926, Don Lee purchased station KFRC in San Francisco. A year and 10 days later he purchased KHJ in Los Angeles, and whether or not he realized it, the network was born. It naturally occurred to him that a greater diversity of entertainment would be afforded the listeners of the two cities if the programs of the two stations could be interchanged. Lines between the two stations were installed on December 13, 1928, and have been maintained ever since. Four days later the McClatchy stations at Fresno, Stockton, and Sacramento made arrangements with Don Lee to release his programs in these three areas. A year later the transcontinental facilities of the Columbia Broadcasting System were extended to the Pacific Coast and the five stations became the Pacific Coast outlet for Columbia. Soon after KOIN, Portland, KOL, Seattle, KVI, Tacoma, and KFPY, Spokane, became affiliated with the budding network.

In 1931 Don Lee purchased Station KDB at Santa Barbara, and KGB at San Diego, making four stations which he owned outright. Arrangements between Columbia and the Don Lee network were terminated in 1936, leaving the four owned stations and four others which had recently become affiliated. The network immediately entered these eight stations into an affiliation with the Mutual Broadcasting System. Knowing that advertisers would want full Coast coverage, an affiliation was effected with 15 stations of the Pacific Broadcasting Company, and later five more stations were added. Today there are 33 stations in the Don Lee Broadcasting System, made up of the four owned stations and 29 affiliated stations. As a network these stations are affiliated with the Mutual Broadcasting System. These 32 stations stretch from the Canadian Border to Mexico, a distance of 1171 air miles. Recently KGBU, Ketchikan, Alaska, joined the Don Lee network expanding the web to 33 stations. Within these three states of California, Washington and Oregon live 8,000,000 people with an estimated 2,385,690 radio homes, and, claims Don Lee, nine out of every 10 radio homes are within 25 miles of a Don Lee station!

Don Lee died in 1934 and all of his holdings passed to his son, Thomas S. Lee, now president of the network. Young Tommy got his start as grease monkey in his father's automobile agency, and as a part of his training has held jobs in almost every capacity in both the automobile and the radio business. Perhaps there was a time, for a while, when he showed more interest in demonstrating his unusual ability as a dancer than for the business of radio, but he has long since found his true love in television. Its promotion on the West Coast is dependent upon his able leadership. Through his efforts the celebrities of the nation appear before the television camera of W6XAO in a never ending stream. His friends call him "Television Tommy," and he's proud of the name, because he deserves it.

When you visit the home office of the Don Lee Broadcasting System in Los Angeles, you wonder which is more important, automobiles or radio. The building which houses both appears to be a typical automobile agency, at least the first floor does with its rows of shining Cadillacs on display. Then you take the elevator, and although it lifts you only to the second floor, it deposits you in an entirely different world where a cowboy strums a guitar, loudspeakers, pianos, singers and newscasters make a jumble in your ears. Here it's all radio and television. Upper floors show you automobiles again and mechanics, and the eighth floor turns again into radio with its television transmitter and five kilowatt Western Electric transmitter for KHJ. And radio wins the final honors with a roof full of antennas.

"It's a swell combination,"says Willet H. Brown, vice-president and assistant general manager. "Both radio and the automobile business have their ups and downs, but never at the same time, and thus we manage to keep an even keel." Brown's father was general manager of the automobile business in the old days, and Willet had the same sort of training in both radio and automobiles that Tommy Lee obtained. The same holds true for Bill Pabst, manager of the San Francisco station, KFRC. His father Fred is manager of the car agency in the Golden Gate City.

Radio in the West seems to move at a swifter clip. One feels the heightened tempo of the men who direct its destinies. You feel and see the evidence of competition everywhere. Radio stations use the billboards, the newspapers, show windows, taxicabs, sky-writers, and what have you, to advertise the stations and their programs. "It's the competition," says Weiss. "Right here in Los Angeles we have 18 stations. When I was with WJR in Detroit

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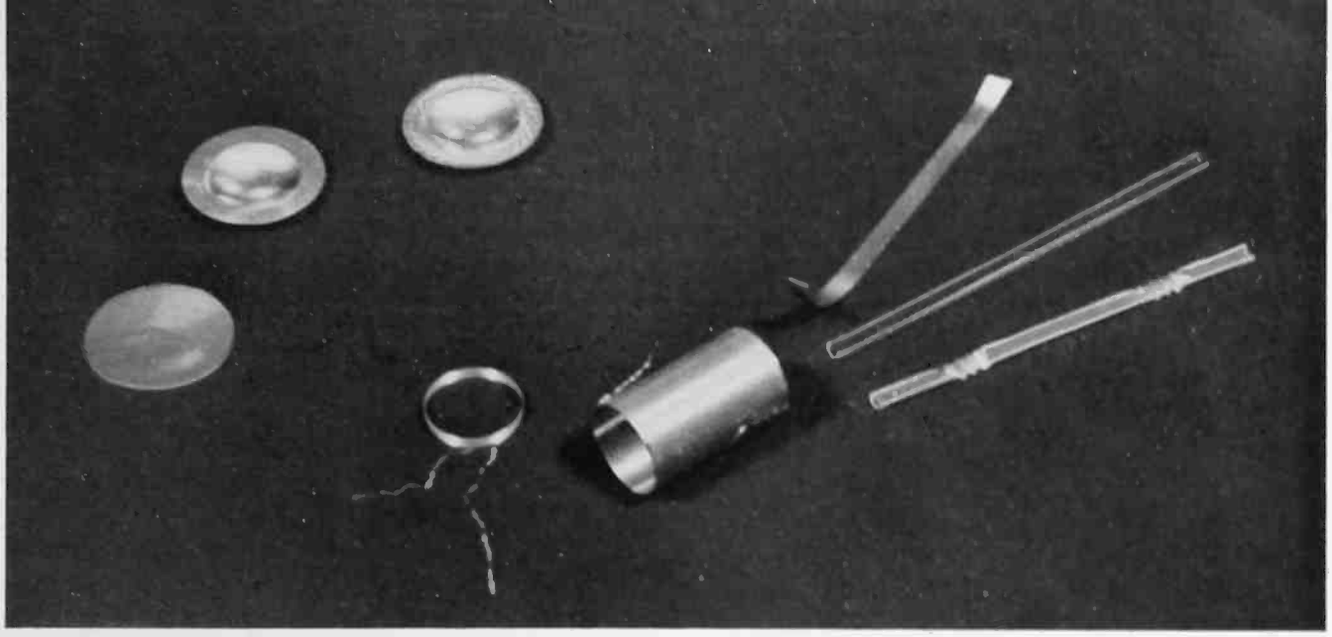


Evolution of the Mike's vital organs—the diaphragm changes from flat disc to miniature "soup plate" with fancy border; from the cylinder made of aluminum tape the voice coil is cut; delicate ribbon foil emerges 15 to 20 times thinner than a human hair.

Case History of the Cardioid

Bell Laboratories' Research Wizards Spent Two Years Perfecting Model; Delicate Parts Built with Microscopic Precision at Kearny

By M. M. BEARD

Those radio soothsayers who have the uncanny sense of foretelling broadcasting's needs before the need actually arises, put their heads together back in 1935 to conjure up future possibilities in microphone developments. True, the eight-ball and salt shaker were going strong, but, being non-directional, they could only take care of a portion of the mike's ever increasing responsibilities as the tempo of broadcasting, public address and sound pictures rapidly increased.

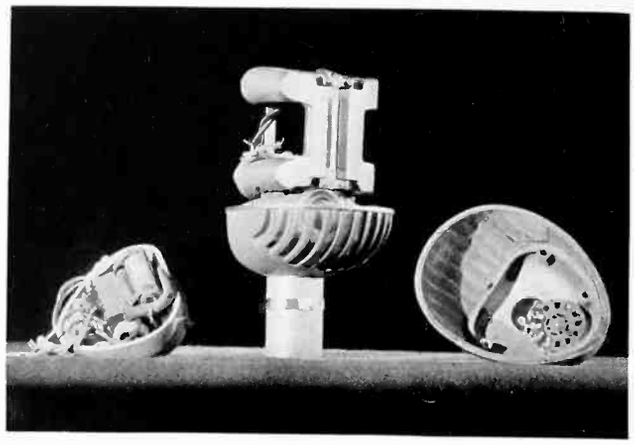
The heads in the huddle belonged to Western Electric's Specialty Products experts and Bell Laboratories research engineers. What the industry needed, they predicted, was a high-quality, really directional microphone—preferably an all-purpose mike—one which would combine both moving coil and ribbon type units. This germ of an idea was destined to make microphone history. Out of it has grown an instrument which, possessing a choice of directional characteristics superior to either of its component units alone, has revolutionized microphone technique. Its name—the Cardioid.

With the stage set for the new development and funds for research appropriated, the Laboratories settled down to an intensive study of the problem. Working methods, narrowed to the last detail, were devised. Reams of technical data were compiled. Mike designs were sketched, mike models built and tested. And then the whole procedure of sketch, build, test, repeated time and time again until there finally emerged a satisfactory working model of the Cardioid.

As is the practice of the Laboratories, when a new product is in the process of development, research engineers farm out portions of the job to numerous other departments. Having specialized in telephone equipment research for over half a century, the organization has accumulated a wealth of incidental data invaluable to radio engineers. This vast storehouse of knowledge, always at their disposal, constitutes their main source of supply.

A telephone call to this or that department often can solve a ticklish problem in a few minutes. A brief chat with Jones straightens out the lacquer situation. One with Smith eliminates a metal difficulty. Brown clears up a spot-welding operation.

This hand holds the finished diaphragm but no hand touches it at Kearny — vacuum lifts do the handling during forming.



A glimpse inside the Cardioid—left case contains the dynamic element, the ribbon transformer and the electrical equalizer.

On occasions when an engineer cannot find the precise method or special material to suit his purpose, experts scurry off to market for his needs. If you want to get a slant on just how exacting research engineers can be, just ask these specialist buyers. Sometimes the quest concerns some rare metal or a combination of materials, which must perform mechanical, electrical or chemical miracles. Through the efforts of these men the engineers learned of a special plaster-of-Paris mold which made possible a unique casting operation. Eventually this was used to cast the complicated grilled housing of the Cardioid — a new mold being used for each mike casting.

The *Chemistry Department,* with its various sub-divisions, shouldered a major part of the "farming out" assignments. The *Organic Group* located precisely the right kind of rubber — long life rubber — that would stand up under the most severe conditions. Information on alloying and casting of magnets fell to the *Metallurgical* men. Wizards of *Physical Chemistry* made exhaustive studies of contacts to the aluminum ribbon. The extreme thinness of the ribbon drove them frantic, but the seemingly impossible finally was accomplished.

The *Materials Group* produced in short order proper finishes, paints, lacquers, which would protect delicate parts from rust and corrosion. Experts from *Special Metals* bent to the task of discovering the best method for cutting the ribbon to exact width. They found that by following a process previously used for the ribbon of a movie recording light valve the Cardioid ribbon could be slit as per specifications.

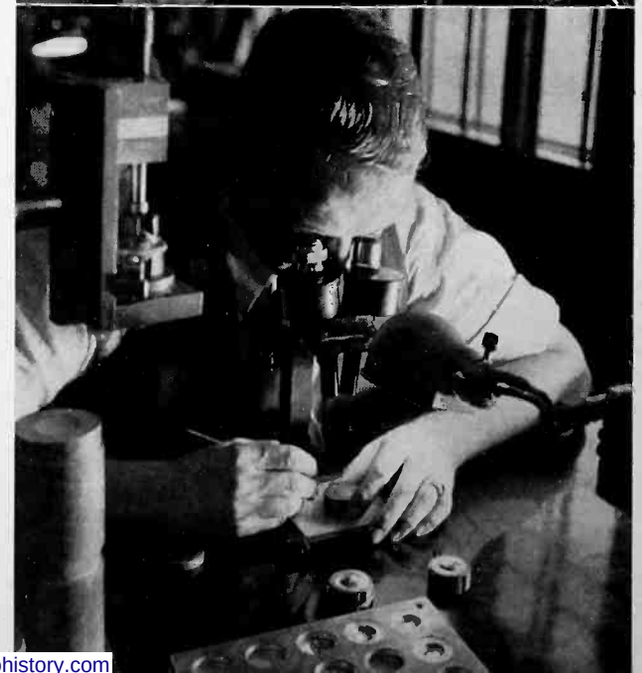
Members of *Metallic Materials,* which lines up under the *Switching Apparatus Department,* also rallied to the Cardioid's aid, and set out to secure all necessary metals. One man specialized in steel and aluminum — another on the method of making castings and a third on spot-welding.

Another department to join forces with the research engineers was the *Physical Research Group,* consulted on the question of magnetic materials, including pole pieces and magnets.

These preliminary steps of investigating methods and materials — of seeking and purchasing ingredients which were to go into the mike — extended over a period of many months. Finally, armed with all the necessary data, the engineers dug into their laboratories to build the Cardioid.

Approximately half of an engineer's time in making a mike is spent at his testing equipment. The knowledge of what effect each change in the model has on its response, as it gradually passes from one stage of development to another, is all-important in producing a superior product. It is build—test, build—test, until a satisfactory instrument has been created.

These particular research men have the decided advantage of working in one of the best equipped laboratories in the world. Practically every conceivable kind of equipment known to the science of communications for building and testing new products, is at their finger tips. Yet, with all this wealth of machinery, they are quite likely to concoct a unique gadget or put to use some seemingly unrelated piece of apparatus when new and tricky problems arise. They invent to aid their invention. For example, during one stage of the Cardioid's creation, they took



Spraying the Cardioid's grilled casing with three layers of lacquer—a transparent lacquer is used for final coating. An inspector checks pressure unit with high powered microscope.

apart a portion of the Laboratories' ventilating system to make special wind-noise measurements. Another unusual gadget came into being for detecting leaks in the housing of the mike and for measuring the resistance of silk to air-flow.

Even a common wooden water pipe played an uncommon role in testing at low frequencies. A loud speaker was attached to one end of the pipe; the other terminated in many layers of cloth followed by bronze wool, rock wool, cotton batting and hair felt in successive layers.

Naturally, the engineer constantly uses standard scientific apparatus set up in the Laboratories —the microscopes, micrometers, optimeters, the numerous mechanical devices. But, above all, he depends mainly on the vast outlay of electrical and acoustical testing equipment, including the thermophone. This machine at the Laboratories has been established as a master standard of sound pressure. Only six such machines are known to be in existence — the other five being located in foreign countries.

One of the microscopes used for the Cardioid has binocular lenses through which the engineer, using both eyes, searches for bumps or ridges which may occur on apparently mirror-smooth surfaces. Unlike most microscopes this one presents a right-side-up image instead of upside-down. Countless hours were spent over the instrument seeking ways to eliminate tiny flaws in the delicate diaphragm, voice coil and ribbon foil. The shadowgraph, too, frequently came into play to cast magnified images on a screen of the most minute parts.

A research engineer lives in an atmosphere of mystery and adventure. Like a magician who pulls one rabbit from his sleeve only to find another poking its head out of his pocket, so the engineer, while conjuring up one product, often discovers another lurking under the microscope. In the case of the Cardioid's development, the second rabbit to bob up was the machine-gun mike. Long before the Cardioid appeared on the market this directional mike had made a name for itself.

Perhaps the word "conjure" is misleading. Magical as such inventions appear to the layman, they are not performed by the wave of a wand. It required two years of hard digging on the part of research experts to perfect the first working model for the Cardioid, and one year more to put it into commercial design.

To complete the story of the famous mike's debut the scene shifts from the Laboratories where it was cradled to the Kearny Plant where it is manufactured.

Over at the plant they tell you that building and assembling the Cardioid has proved to be one of the most precise and delicate manufacturing processes ever tackled by Western Electric Specialty Products Division.

Limits of measurements in some cases must be carried to five hundred thousandths (5/100,000) of an inch — so far beyond the range of the finest micrometer that only with the aid of a microscope can certain parts be formed and assembled.

The most minute particle of dust or metal — the slightest tinge of acid — the faintest trace of moisture, invariably present on the best scrubbed fingers, will raise havoc with the mike's sensitive innards. A visitor, viewing the Cardioid in the making, looks in awe at the glimmering bits of aluminum and wonders how anything so fragile and ineffectual looking can have a part in the life of a mike. Other materials built into the famous "birdcage" are brass, silver, nickel, cobalt, monel metal, alnico, rubber, fibre, silk, lambs wool, wax, magnetic iron, lacquer.

In an air-conditioned room, two sides of which are solid window space, hundreds of Cardioids have been fashioned, and hundreds more are being turned out month by month for the broadcasting industry. Men and girl operators, some wearing gloves, others manipulating tiny parts with tweezers, are seated at long tables — washing, forming, inspecting and assembling the various pieces. Air conditioning, it is

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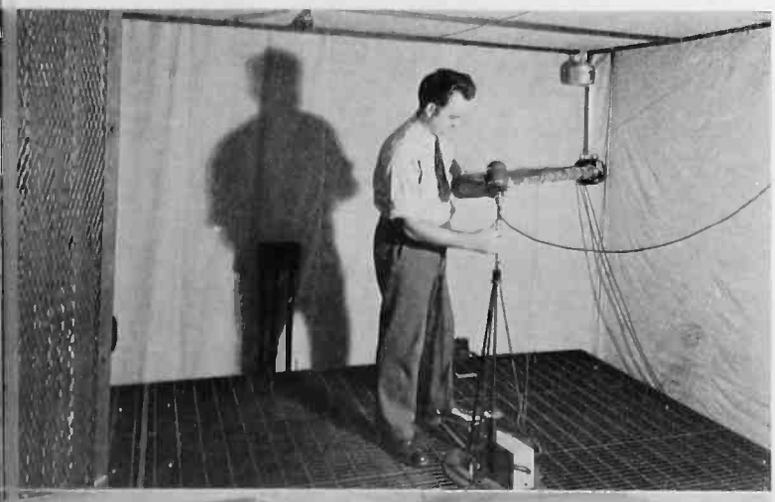
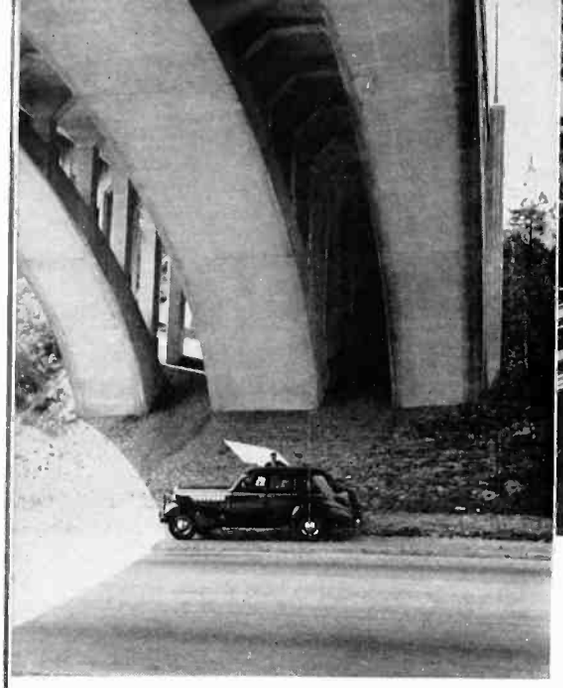
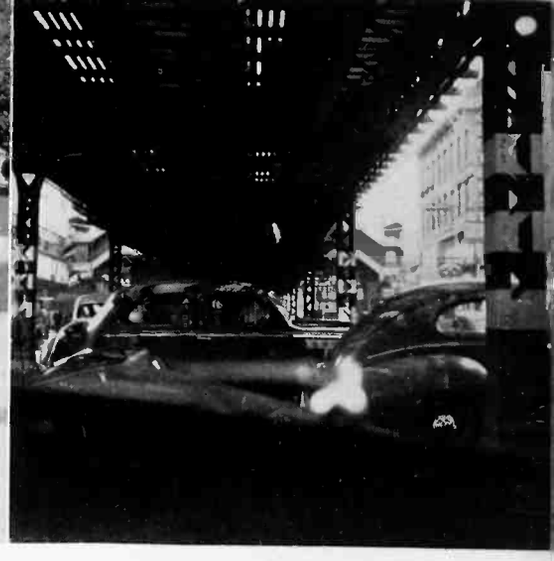


One of the final steps of assembly—enclosing the mike in its grilled casing. Above: In the dead stillness of a completely sound proof room the mike undergoes velocity, dynamic and cardioid characteristics tests—it must pass 100 per cent.





FM Signal Scoffs

Dodging W2XOR Signal in New York Area Tough Job

By WILL WHITMORE

When WOR went on the air with its Western Electric one kilowatt synchronized FM transmitter, it seemed like a good time to place FM on the spot. "Let's put that transmitter of yours through its paces," we told Jack Poppele, WOR's chief engineer. "For once, let's forget all about your elaborate signal measuring equipment, and make a test entirely from the listener's point of view. We won't bother about millivolts and the rest of your fine engineering lingo, little or none of which is understood by the public who will in the end put thumbs up or down to FM. Let's make the test as tough as possible for FM and see what happens."

If you think Jack hesitated at such a challenge, then you don't know your Poppele! "Okay," said Jack, "Name your own poison and we'll supply you with it."

"What we want is an outfit on wheels with which we can come as close as possible to duplicating average conditions to be encountered by the average listener," we told him. "Give us a medium-priced FM receiver hooked up in a car with some sort of antenna no more elaborate than our average listener can hang on the side of his house on a Saturday afternoon."

Well that's exactly what we got. The receiver was a small table model set retailing for seventy dollars, modified to operate from the car storage battery and dry cell B batteries. The receiver was connected through a short transmission line to an untuned di-pole antenna mounted slap-dab against the rear side of a big sedan.

The expedition began at eleven o'clock one bright Friday morning when Charlie Singer, supervisor of WOR-W2XOR transmitters, picked us up in the car at the Howard Johnson restaurant on Queens Boulevard about six miles from New York. As we got in the car W2XOR was coming in on the FM receiver like a house afire. Our first stop was in Forest Hills on a tree shaded street surrounded by big six-story apartment houses. These houses completely shielded the car receiver from a line of sight view of the transmitter, but we noticed no decrease in signal strength or increase in noise level, even though we were just a stone's throw from the boulevard alive with whizzing traffic. Not a sound of ignition noise was apparent in the receiver.

The expedition headed on out Queens Boulevard and thence to Grand Central Parkway. Cars whizzed by us on this busy four-lane highway. A huge metal armored payroll truck pulled along side and continued to keep pace with us for a mile or so. Our antenna was on the side of the car opposite the van and not more than an arm's length away. Result : same old signal without a trace of ignition. As we continued out the island we passed under numerous steel reinforced bridges. Each time we passed under a bridge background noise increased in the standard

Inaugural opening of W2XOR—Major Edwin H. Armstrong, puts the station on the air while Albert J. McCosker, president Bamberger Broadcasting Service (standing), J. R. Poppele, chief engineer (leaning), Edward Content (cigarette) look on.

at Spots Like These

Left to right across panel: 1—AM signal took a nose dive under this bridge, but it had no effect on W2XOR. 2—Charles Singer and the car antenna used in tests. 3—An elevated structure and heavy ignition—no effect. 4—Our car surrounded by six story buildings in Forest Hills, but FM got through. 5—Low trees broke our car antenna, but the signal kept coming through almost the same as ever during repairs. 6—The signal followed us down into this pit 125 feet deep.

car receiver tuned to WOR's 50 KW transmitter. But our FM signal came through the same as ever. To the ear, at least, these bridges cast no shadow whatsoever for FM.

Twelve miles from New York we passed over a large bridge. Here was just the opportunity we were seeking. We cut off the highway and circled around until we were directly under the bridge. The bridge cast a sharp shadow. As we entered it, the WOR signal went from high volume to complete unintelligibility within two or three feet. The FM signal from W2XOR showed no change whatsoever even though we explored every nook and crany of the AM shadow. No matter where or in what position we placed the car under that bridge, the FM signal continued to perk in its accustomed manner.

Driving further along the Island we had the feeling of a criminal trying to escape trailing bloodhounds. It seemed impossible to lose the signal. It became apparent that we would have to resort to the ace I had been holding up my sleeve. "Let's give it the sand pit treatment," I told Charlie. "If that doesn't put a damper on your signal, we might just as well shut down and go home."

The sand pit I had in mind is approximately 25 miles from New York. Close to the shore of Hempstead Harbor lies a high ridge ranging from 50 to 150 feet above sea level. Into this ridge steam shovels have gouged out a miniature "grand canyon." As we neared it, Singer took one look at it and remarked that if the signal didn't die a sudden death there, he would have to toss out his last remaining conception of FM's limitations. The perpendicular wall of the pit lay directly between us and W2XOR. We drove our car right up to the foot of the wall. Steam shovels and trucks worked all around us. We turned on the receiver. There was W2XOR practically the same as ever, the only noticeable difference being a slight decrease in level, but the signal was more than acceptable from a listener's point of view. We drove the car around the bottom of the pit trying to find at least one shadow in which to hide from the signal, but it searched us out wherever we moved.

Then we raised another di-pole on a wooden rod mounted on the front of the car. Although the di-pole reached about twice as high as the permanent antenna on the rear, we could discern little difference in signal strength. When the di-pole was rotated to provide horizontal polarization and turned directionally for maximum signal, there was no noticeable difference between it and the rear antenna. It was sharply directional, however, and at the minimum signal point the receiver response was considerably reduced. Interesting to note was the fact that the direction of the horizontal di-pole for maximum signal pointed nearly at right angle from the direction toward the transmitter. This seemed to indicate that our

(*Continued on page 33*)

WOR's FM station, W2XOR, on the 42nd floor of building at 444 Madison Avenue, N. Y. The one kilowatt Western Electric transmitter (last two cabinets) conforms electrically but not in appearance to the standard one kilowatt Western Electric transmitter.—R. Rast, operator. See Aug. 1940 PICK-UPS for description. See Sept. ELECTRONICS for station description.

WJAX

Jacksonville, Fla.

Seated at this control turret the operator has a clear view of both studios and of three racks of speech input equipment.

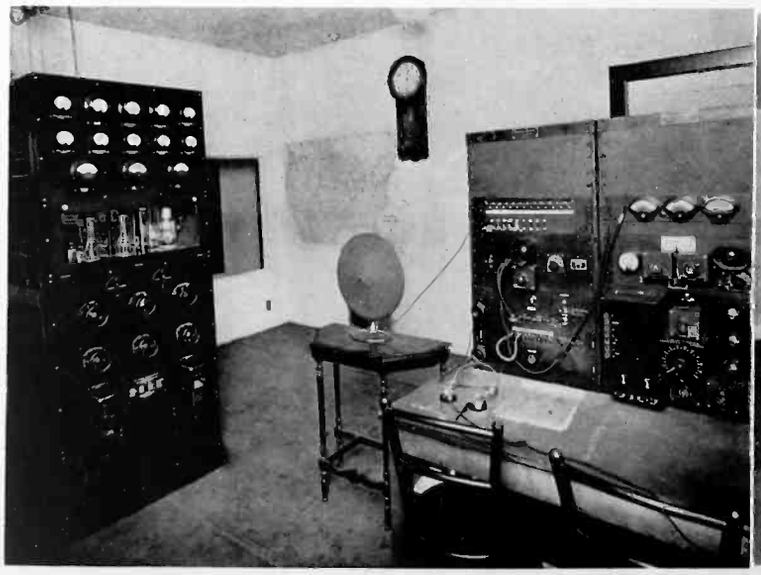
On the air since 1925, municipally owned WJAX, Jacksonville, Florida, recently completed modernization of its entire studio plant. Included in the new outlay of equipment is an elaborate speech input system, practically 100 per cent Western Electric, which was tailor-made to fit the station's own particular needs.

This broadcasting pioneer is so ideally located that it can, with impunity, switch its slogan to suit the calendar. When the northland dons a mantle of snow WJAX lauds Jacksonville as "The Land of Sunshine." During the warm summer months the slogan does a turnabout and becomes "The Land of Ocean Breezes."

Remember those good old days back in 1925 when this Western Electric transmitter was tops in broadcasting and the studio with cretonne drapes, the last word in modernistic design.

Commissioner Thomas C. Imeson who directs operations, steadfastly has adhered to his original policy of public service. Every effort has been made to secure the finest types of programs available, always with the objective of furthering the advancement of Jacksonville and northeast Florida. No matter what emergency may arise WJAX steps into the front lines to aid its wide-spread audience.

The station has done yeoman service during severe storm periods. Through the national farm and home hour programs, the daily stock and market reports, farmers receive invaluable information. Broadcasts especially suited to young listeners are always listed on the schedule. WJAX likewise has been a boon to shut-ins, especially during the long summer months, when reception from distant stations



cannot always be relied upon due to static interference.

The station has rather an unusual set-up in that the manager, John T. Hopkins, 3rd, also shoulders the duties of chief engineer. It is largely due to Mr. Hopkins' efficient and careful management that the station has maintained its position on the air with so little trouble through all these years.

The new speech input system was engineered by the WJAX technical staff, assisted by D. B. McKey, of the Graybar Electric Company, from whom the equipment was purchased.

The studios, including offices and control room, have been completely remodeled and redecorated to conform to the best in modern broadcasting practice.

In the control room the control turret is so placed that the operator has a view of both studios and the three racks of speech input equipment. Three panels are mounted in the control turret. On the large center panel is the seven-channel mixer, on-off buttons for each input circuit, regular-emergency switches, two volume indicators and signal lights. This panel controls the outputs of two transcription machines, six microphones, remote circuit and network. Three of the seven mixers handle the studio and control room microphones. Ahead of each microphone and transcription mixer control, there is a 104A pre-amplifier. All mixer controls, normally working into the regular channel consisting of a 104A amplifier followed by a 105A amplifier, may be switched into the emergency channel, which, also used for auditions, is an exact duplicate of the regular channel. Controls for switching either regular or emergency channel outputs to either transmitter line are also located on the center panel.

The monitoring selector switches and volume controls for the two studios and control room are mounted on the right panel of the turret. With these controls the input of each of the three 94D monitoring amplifiers may be switched to any of six low level monitoring busses on which appear the programs of regular channel output, emergency channel output, network, WJAX on the Air, and the two other local stations on the air.

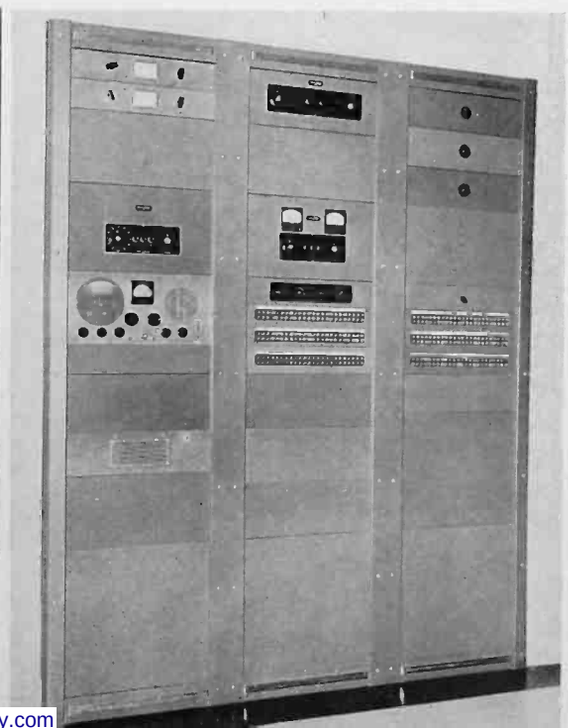
Commissioner Thomas C. Imeson has been in charge of WJAX since the station first went on the air in 1925. John T. Hopkins, 3rd, same length of service, is manager and chief engineer.

On the left panel of the control turret is mounted a jack strip, remote signal and local ringer. A 751A speaker is mounted flush in the ceiling of the control room directly over the operator. Consoles containing monitoring amplifiers with selector switches have been installed in the Manager's office and reception rooms.

All amplifiers are mounted on the equipment racks. There are seven 104A, two 105A, one 106A and three 94D amplifiers. A switch is provided so that the 104A amplifiers may obtain power from either of the 105A's. The input and output of all circuits are connected through jacks mounted on the racks providing maximum flexibility in the event of an emergency. No patching is required for normal operation.

This new speech input installation gives WJAX a high fidelity system throughout. The frequency response from microphone to transmitter line varies less than ±1 DB from 30 to 10,000 cycles.

Time marches on—so does broadcasting. WJAX's 1940 studio and speech input equipment give ample proof of the progress.



WIP-5 KW

Philadelphia, Pa.

By ALAN D. FERGUSON

On August 1, 1940, WIP, Philadelphia's oldest radio station, took another forward step in an unbroken record of progress with the dedication of a new and more powerful transmitter, a 5 KW Western Electric 405B-1 air- cooled unit. Located in a strikingly modern transmitter building at Belmawr, New Jersey, this equipment, combined with a new directional antenna system, now blankets the entire Camden-Philadelphia areas of New Jersey and eastern Pennsylvania with a powerful signal.

Owned and operated by the Pennsylvania Broadcasting Company, WIP has centered its activities from its inception over 18 years ago in the Gimbel building, home of the famous Philadelphia department store of this name. Its broadcasting career dates back to March 1922, when, from two tiny rooms in the Gimbel Building, the station went on the air with a 500 watt transmitter. The first WIP studio was a single room about 10 feet square, used originally by Gimbel's customers while listening to phonograph records. It was separated by a partition from a similar room which housed all of the transmitting and control apparatus. In 1923 the station moved to another location in the building but the set-up remained practically the same except for slightly larger rooms.

When WIP absorbed WFAN in 1931 new studios were built and the transmitting equipment was moved to the roof of the building. Four years later the studio activities were again shifted, this time to a suite of air-conditioned, acoustically correct broadcast studios constructed at a cost of over $100,000. Despite this improvement, in 1937 the management once more found it necessary to provide additional space. Several new studios were added and a general reconstruction took place, resulting in the present WIP studios, among the finest in the country.

There are four main studios, each of them controlled by a Western Electric 23A speech input equipment. Three 300A reproducer panels, for both vertical and lateral transcriptions, are located here, as well as a 1300A reproducer set used by the program department for checking and timing transcriptions. For its microphones, WIP engineers prefer 630A "eight-balls" for studio use and 633A "salt-shakers" for remote pick-ups.

WIP's power was increased from the original 500 watts to 1 KW in 1935. The station's first commercially-made 500 watt transmitter, a 1A Western Electric equipment, now reposes in Philadelphia's famous Franklin Institute as a permanent exhibit. In 1937 the station moved its transmitter loca-

(*Continued on page 33*)

Above: The new transmitter building at Belmawr, N. J., is an example of the trend to functional design in architecture. Top right: "Johnnie" Haeke, studio engineer for WIP's dawn-patrol, handles controls at the 23A Speech Input Equipment. Center right: One of WIP's 1300A reproducer sets is convenient to the custom-built control desk in case of emergency. Lower right: The new 5KW transmitter is an integral part of the interior design of WIP's modern transmitter building.

New Possibilities of Sound Systems Shown in Outstanding Installations

Millions More Enjoy Words and Music when Sound Amplification Widens Hearing Range

Improved sound system engineering practices combined with new and finer public address equipment have brought the business of sound reproduction to a point where no job is too big or too critical for a modern public address system. Cardioid microphones and a new microphone technique resulting from them, better amplifiers and loudspeakers, all together form a base about which today's sound engineers can build a high quality system to fit the needs of any location.

Four outstanding public address installations, two of which were utilized at occasions of national political importance, were installed during recent months in the Chicago area.

A temporary system, used in the Chicago Stadium for the Democratic National Convention in July, functioned so well for this important occasion that the Stadium management has ordered that permanent equipment be installed.

Completed just before the opening gavel brought 20,000 delegates and guests to attention, this Western Electric sound system made every syllable of the convention proceedings easily audible to the huge assembly.

The new 639B cardioid microphone, used for the first time at a national political convention, perfectly handled the high-powered oratory. Because of its controlled directivity convention noises were prevented from feeding back into the system.

Microphones at each state delegation made it unnecessary for state chairmen to go to the rostrum to address the convention. These delegation microphones were turned on and off at the discretion of the convention chairman. When he recognized a delegate on the floor, the microphone for the state represented was switched on and the delegate had the powerful public address system's assistance in reaching every ear.

Special loud-speaking equipment — horns, low and high-frequency units, filters — weighing nearly three tons, was hoisted high above the speaker's rostrum. These units were so designed and located that everyone in the Stadium easily heard every part of the proceedings.

On the other side of the political fence, was the system installed when Wendell L. Willkie delivered his speech accepting the nomination as Republican candidate for president of the United States. To carry his voice to the more than 200,000 visitors in the little town of Elwood, Indiana, it was necessary to install what was probably the largest sound system ever employed for a one-day event.

Actually three systems in one, this huge P.A. installation brought the voices of the speakers not only to the main gathering at Calloway Park but also to a crowd of about 15,000 at the High School and to an unestimated number of natives and visitors gathered in the streets of down-town Elwood.

At Calloway Park, where 1,000 watts of audio power carried every sound to the farthest corners of the 250-acre area, three clusters of six-foot trumpet loudspeakers for long projection and five multicellular speakers for direct projection were employed. Each unit in the batteries of double-throated horns, individually connected to 50-watt audio amplifiers, was adjusted to fit whatever wind conditions developed. Tests made of the park installation were heard in town over a mile away.

To eliminate possible feedback, cardioid microphones were employed both for the speaking and the musical portions of the ceremonies. Remote control stations at the pick-up locations and a main control point in town, all connected by wire lines, enabled the operators to adjust the volume and quality of sound to suit conditions at each of the three listening points.

Besides the main public address system installed to carry the acceptance ceremonies, two smaller Western Electric systems were installed at the Pennsylvania Railroad stations to facilitate the directing of the huge throng of visitors. These systems were designed to cover the area necessary to direct the unloading of two 15-car trains at once. Through microphones especially designed to deliver voice frequencies capable of over-riding crowd noise, announcers controlled the arrival and departure of the crowds.

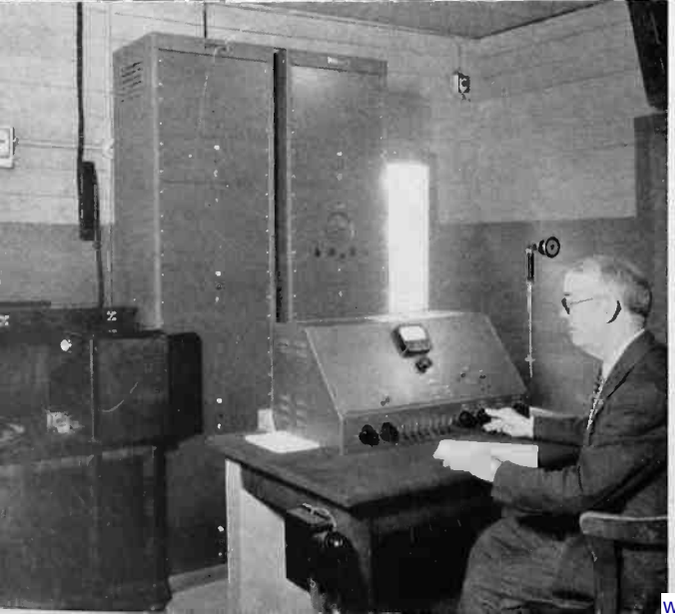
Shifting from politics to music, the installation in the band shell of Chicago's Grant Park proves that a well-engineered sound system can take its place beside the violin and trumpet as an instrument for presenting symphonic music. After listening to the initial performance of the system installed at this gathering place of Chicago's music lovers local critics declared it opened a new era in the presentation of serious music to open-air audiences.

Conservatively-rated amplifiers driving

(*Continued on page 20—Pictures page 18*)

SOUND SYSTEMS

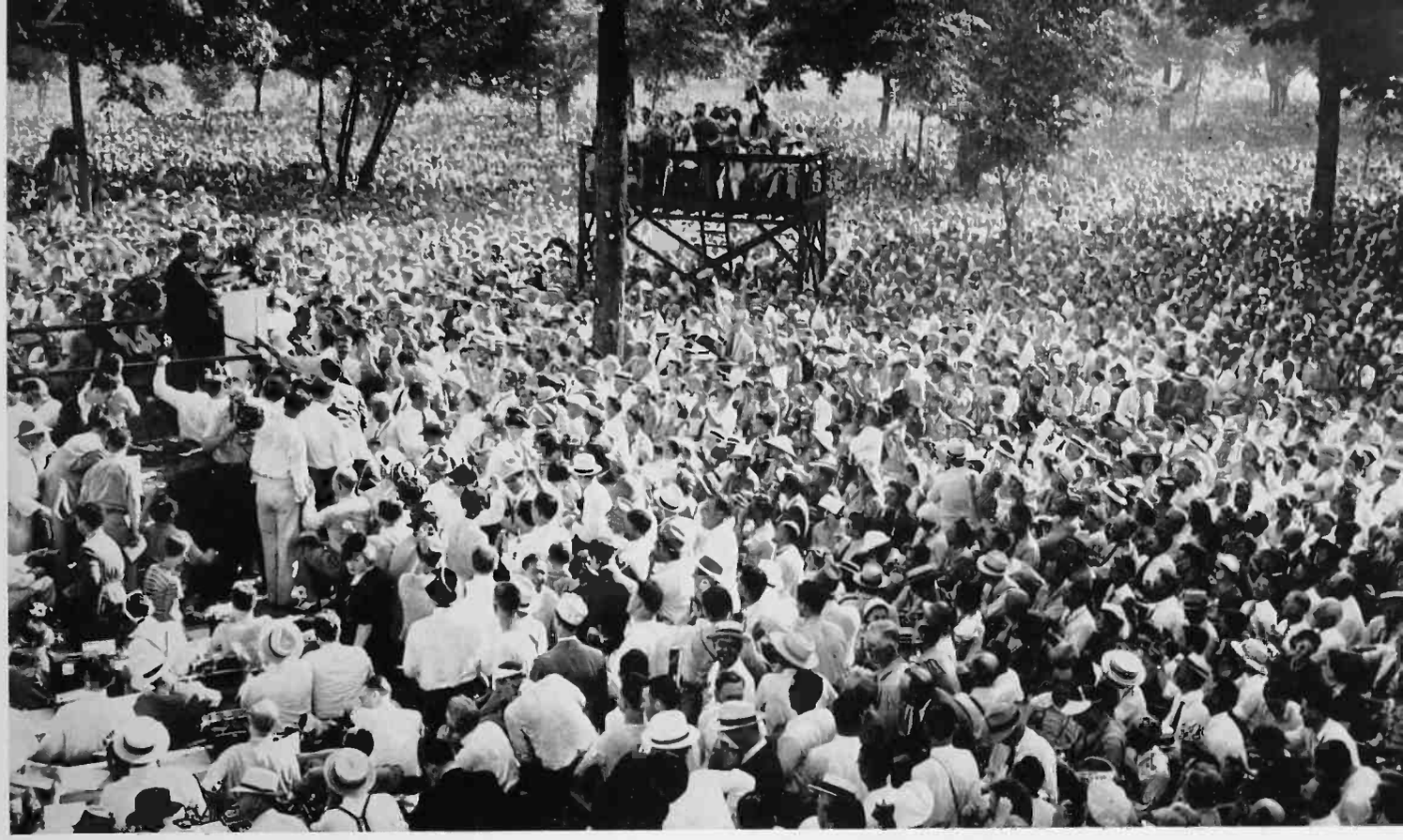
Bring Voice and Music to Multit



Above and right: A tripled audience capacity is the achievement of the sound system at Chicago's Grant Park. Seated among the audience an operator adjusts volume controls for the most favorable levels.

Left: Parachute Jump and Aladdin's Castle at Riverview Park, Chicago, where a Western Electric sound system entertains the crowds. In the control room are shown reproducer panel, amplifier racks, control console and 630A microphone.

Below: This view of workmen mounting loudspeakers gives some idea of the size of the sound system used in the Chicago Stadium during the Democratic National Convention.



At Elwood, Indiana, a Western Electric sound system brought Wendell Willkie's voice to 250,000 people gathered to hear his nomination acceptance speech.

Right: Three racks hold all the amplifying equipment necessary for Madison Square Garden, famous New York sports arena, scene of annual circus festival.

Below are shown amplifiers, control panels and reproducer panel at Ocean Beach Park, New London, and a view of the great boardwalk with central loudspeaker tower which floods a full half-mile of beach with beautiful music.

Outstanding Sound Systems

(*Continued from page 17*)

"two-way" loudspeakers — with individual elements for reproducing bass and treble registers — handle the full symphonic sound range without distortion. The system utilizes three 116A pre-amplifiers, one 117A line amplifier and two 118A power amplifiers. Its output is approximately 100 watts. This is sufficient to cover even the largest audience without driving the equipment at its full capacity.

Naturalness is assured by a remote control panel, placed within a strategic section of the seating area, by means of which the operator adjusts over-all volume to compensate for weather conditions and variations in the size of the audience.

According to critical listeners, the new system, which multiplied the effective seating area three times, provided everywhere within this area reproduction that was richly expressive and faithful to the mood of the composer. They observed "a wide variety of tonal and emotional color and an essential vigor so often lost in outdoor concerts to all except those seated immediately in front of the orchestra."

Riverview Park, the world's largest amusement park, located on the outskirts of Chicago, recently replaced its old Western Electric sound system with a new system which provides sound coverage for the entire 142 acres of thrills, chills and spills. Clever placing of the system's 24 horns make it impossible for the wandering crowds to tell when they cease to hear one loudspeaker and pick up another.

The system, used primarily for music distribution, employs six 118A power amplifiers, a 630A microphone, and a control console mounting three 116A pre-amplifiers, one 117A line amplifier, three mixer positions and one master gain control.

The four systems described above were engineered and installed by the Boom Electric Company of Chicago.

Of the many large public address systems which have been installed in the amusement and recreation centers of New York, the one in Madison Square Garden is most outstanding.

Installed in the country's most famous sports arena, it is not only one of the most powerful indoor sound systems in the United States, but it is used to amplify the widest variety of programs. Among the different types of entertainment for which the Garden system is utilized are boxing bouts, hockey and basketball games, ice carnivals, rodeos, circuses, horse and dog shows, concerts and mass meetings.

Eleven 118A amplifiers provide 550 watts of power for the system. Each of the ten two-channel wide range loudspeakers mounted in the suspended gondola is fed by one of these amplifiers. The eleventh 118A provides power for auxiliary loudspeakers for overflow crowds and basement exhibits.

The loudspeaker gondola is electrically controlled and at the push of a button can be raised or lowered, or moved from the center to the end of the Garden over the orchestra platform and speaker's stand.

The system, while powerful and flexible, is simple to operate. A portable microphone mixing panel, equipped for mixing up to 14 microphones, is used either in the control room or at one of the two remote plug-in locations by the arena which afford the control operator complete observation of all activities. Among the microphones used at the Garden are Western Electric's latest 639B Cardioids, as well as a number of the 630 or "eight-ball" type.

As a service to the radio stations which on many occasions broadcast programs originating at the Garden, a four-channel output bridging panel has been installed in the control room. This enables four different stations simultaneously to "plug-in" on the public address system through their own portable speech input equipments and pick up the Garden programs.

At Ocean Beach, New London, Connecticut, where a $3,000,000 recreation project has brought order out of the chaos wrought by the hurricane of '38, another Western Electric sound system has been installed which is probably more elaborate than any other permanent outdoor public address installation in the United States. This system serves a full half-mile of crescent shaped beach with its 30-foot boardwalk, adjoining recreational pavilions and the 165-foot Olympic Pool.

The system designed for maximum flexibility, provides for flooding the beach with music or other entertainment from the loudspeakers atop the centrally located 80-foot tower. Each of these tower loudspeakers is powered by a 118A amplifier. An additional amplifier and loudspeaker are used for monitoring in the control room where there is also located a 300A reproducer panel for vertical or lateral recordings and a 633A "saltshaker" microphone for making special announcements.

Amplification is provided by a two-channel system utilizing 117A and 118A amplifiers. A similar system is used in connection with Ocean Beach's beautiful "Gam" restaurant, where the music of visiting orchestras is picked up by two 639 type cardioid microphones and projected through two wide-range loudspeakers and an extension speaker in the grill room. These programs are often fed to the tower loudspeaker.

Another sound system which may operate independently — with its own amplifier and loudspeaker — or feed into the general system, has been installed at the Olympic Pool where a 633A microphone picks up announcements during aquatic contests.

The systems at Madison Square Garden and Ocean Beach were engineered and installed by the Langevin Company.

How to Recondition Vacuum Tubes

A Simple Inexpensive Tube Conditioner Is Adding Thousands of Hours of Service to WOR Vacuum Tubes

By CHARLES W. SINGER,
Supervisor of WOR-W2XOR Transmitters

In practically all types of broadcast transmitters there comes a time when high- and low-powered air- and water-cooled vacuum tubes may become gaseous. This usually happens when a tube has already operated beyond the guaranteed period and there is no recourse except to discard it, for to operate it in a condition which will cause many flash-arcs is extremely risky. However, this gaseous condition can be remedied and many thousands of hours additional life realized by the use of the simple and inexpensive device outlined in this paper.

As one example of the many instances in which this tube "conditioner" has enabled us to recondition gaseous tubes and retain them in service, there is the case of a Western Electric 342A water-cooled tube, one of eight employed in WOR's 50 KW transmitter. On July 3rd, 1940, 342A tube No. 5620 in the final power amplifier had had 5,000 hours of filament life. On this date there occurred a series of flash-arcs in this tube which would ordinarily cause it to be removed after sign-off and discarded as too risky to use.

Instead of being discarded, however, the tube was degassed in our conditioning device, the entire treatment taking only twelve minutes, and then reinstalled in the transmitter. These few minutes of treatment have to date added more than 4,000 hours to its useful life.

Although this tube was treated because of the number of flash-arcs in a series, the same routine may be used to prevent flash-arcs which may cause station breaks. It also helps to make a quick diagnosis of a *faulty* tube, thereby preventing transmitter and program failures.

The construction and operation of the conditioner is simple. A complete list of parts may be taken from the schematic diagram with the exception of the transformer which can be purchased for about $70.00. The entire installation will cost less than $100.00. This investment will be returned in tube savings in less than six months.

Following is the routine at WOR for operating the unit. All of precautions listed may seem unnecessary to some readers but to us at WOR safety is of prime importance and, wherever possible, high voltage circuits are designed to be danger-proof.

1. After checking to insure that the control switch is in the "OFF" position, carefully insert the tube in the socket and be sure that the shorting bar across filament and grid terminals is making proper connection.

2. Turn off the fan in the transformer compartment.

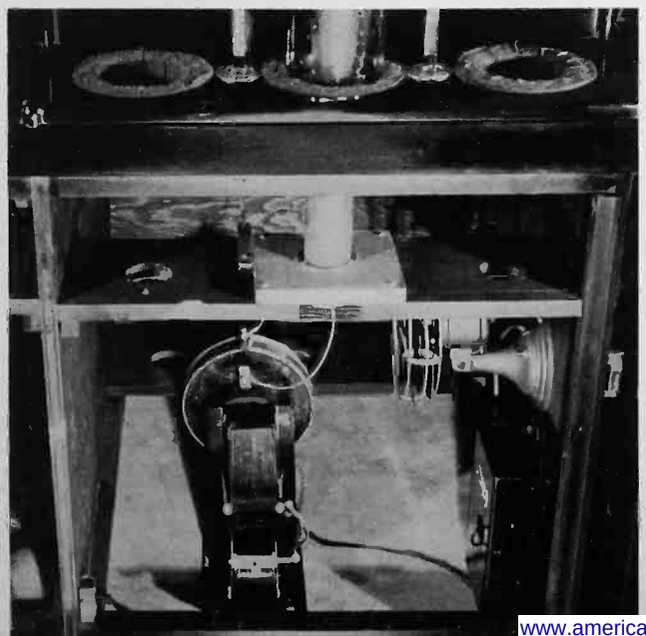
3. Put the transformer in the low voltage position by placing the magnetic shunt all the way in, thus by-passing the magnetic path to the lower leg of the transformer.

4. After closing the transformer compartment door leave the tube room and operate the control switch. If an arc sustains across the transformer protective gap, as seen through the hole in the compartment door, break it by snapping the control switch to the "OFF" position. Switch on again and leave on low voltage for one minute.

5. Throw the switch to the "OFF" position, go into the tube room and put the trans-

(*Continued on page 32*)

Below: The transformer compartment of the conditioner. Right: Operator closes the shorting bar across filament and grid.



Police Radio goes on the air as one of Georgia's state troopers broadcasts an emergency bulletin to patrol car fleet.

Radio Greatest Coordinating Link in Law Enforcement, Says Georgia's Commissioner

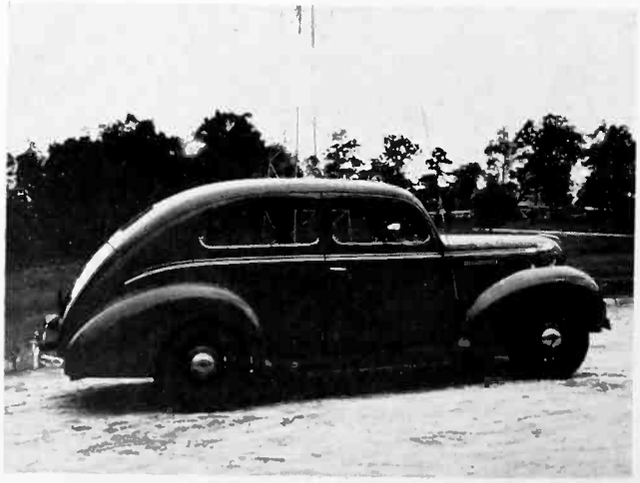
By BEVERLY WALLACE

Director of Public Safety Education, Georgia

Although still in its swaddling clothes, WGSP, Georgia State Patrol short-wave transmitting system, has proved to be of inestimable value to citizens of the Peach State.

Dedicated with much fanfare at Department of Public Safety Headquarters in Atlanta on May 9, the first unit of WGSP immediately became the greatest coordinating link in law enforcement in Georgia. Major Lon Sullivan, Commissioner of Public Safety, told sheriffs and police chiefs who flocked to the dedication that the station was for their bulletins just as much as those from troopers. Local officers took him at his word and in every county where this initial unit is effective, 100 per cent cooperation is being received from local officers.

One of the patrol cars which is helping to safeguard Georgia.



Major Sullivan recommended to his board that the first unit be set up and that additional ones to cover the entire State be added as funds became available.

Thus, a Western Electric 1000 watt transmitter with a 275-foot antenna was installed at the Department's headquarters. Naturally it could not be accurately estimated in advance what distances the station would serve, but tests through actual usage have more than met the Commissioner's expectations. Now, it has been determined, two additional stations will give short-wave police service to all of Georgia.

Georgia is divided into patrol districts and sub-districts. WGSP is able to contact patrol cars in portions of five of the Northern and Central districts. In the day time messages are received at a radius of about 150 miles and much farther at night. Throughout the State they can reach the 19 patrol districts and sub-district headquarters outfitted with stationary sets.

Statistics compiled during September show that radio has been responsible for the recovery of 173 cars, apprehension of 40 wanted persons, immediate investigation of 333 accidents, apprehension

of 17 hit-run drivers, 35 missing persons located, 23 escaped prisoners returned to custody, 2336 miscellaneous messages handled.

Naturally with a complete network system the results will be greater, but the outcome already has convinced the Board of Public Safety that the initial investment has been a wise and beneficial one for the protection of Georgia citizens and their property.

The largest southern state east of the Mississippi, Georgia is composed of 159 counties, covering some 59,265 square miles with almost 12,000 miles of hard-surfaced roads.

Since the number of troopers, including commanding officers and those who remain on permanent duty at State headquarters is not unlimited, they have to be on their toes to get over the State. Even then, as a matter of course, their patrol duty can't be spread out too much or they'd never cover all of the territory. However, by spot maps based on accident investigation records, they know where the greatest danger points are and they focus their attention on these places.

With radio to direct them to points of emergency and pilot them in chasing criminals, the State Patrol has been strongly augmented. With complete short-wave coverage this "extra" column will triple its effectiveness to the patrol.

Georgia's worst accident, as far as the fatality rate was concerned, took place ironically enough on May 26, Safety Sunday. A young man crashed his car head-on into an old machine loaded with eight passengers. Four them were instantly killed. Two died the following day.

An alert farmer who witnessed the tragedy immediately began a half mile hike to the nearest telephone where he put in a long distance call to the State Patrol headquarters. Within a few seconds a bulletin was going over the air instructing the nearest patrol car to report immediately to the scene. Much to the amazement of the farmer, troopers were on the job administering first aid by the time he returned to the wrecked car. The two survivors probably owe their lives to the rapidity with which WGSP dispatched troopers to the scene.

One night a group of boys who had the idea they were big-time gangsters held up and robbed a liquor store in a small North Georgia town. The constable frantically telephoned the broadcasting station, then with several cars at his disposal he began an almost clueless search for the bandits.

The call went out for State troopers to be on the lookout for the suspects, but not even the license number or a description of the fleeing car was available. Near the State line two patrolmen stopped three young men for speeding, and, because officers were on the watch for liquor robbers, investigated the car. In the trunk they found enough contraband to

(*Continued on page 34*)

Typical of the South's stately dwellings is this headquarters building of Georgia's Public Safety Department. Below: Major Lon Sullivan listens to police radio message in his office.

Below: Complete accessibility of apparatus is one of the many outstanding features of the Western Electric 1 KW transmitter.

A Stereophonic Transmission System For the Bach Choir of Bethlehem

By IFOR JONES[1] and HENRY C. KNUTSON[2]

The annual May Festival of choral music by Johann Sebastian Bach, given by the Bach Choir of Bethlehem, Pennsylvania, in the beautiful Packer Chapel on the campus of Lehigh University, is considered one of the most significant musical events in America. The performance, by the Bach Choir, made up of men and women from all walks of life, the finest soloists available, and players from the Philadelphia Symphony Orchestra, have won world wide acclaim. For several decades the Chapel has become the destination of a pilgrimage for many thousands of music lovers in this continent and in Europe. Unfortunately, the seating capacity of the Chapel is far too limited to serve the increasingly large number of applicants for tickets. Those who cannot be accommodated sit on the lawns and try to hear the music through open windows. At the 1939 Festival, there were 1200 seated inside the Chapel and 1500 on the lawns.

To alleviate this condition it was suggested that the program be transmitted by an amplifying system from the Chapel to the auditorium of the Packard Laboratory of Electrical and Mechanical Engineering, which is located directly across the street from Packer Chapel. Such a project was approached with considerable trepidation. It was apparent that the nature and quality of the music would impose severe requirements on the transmission system. Another point to be considered was whether the attendance at a reproduced program would be sufficient to make the project self-supporting. After a careful consideration of all factors involved, and with the active cooperation of Bell Telephone Laboratories, a system was finally devised which proved entirely satisfactory.

Before planning any details, the following basic requirements were formulated for the system:

1. A wide frequency range.
2. Ample or excess output capacity so as to cover the whole volume range.
3. Low noise level.
4. Low distortion.
5. Auditory perspective if possible.
6. Some control of the carryover of the reverberation effects of the chapel.
7. Flexibility of the equipment to permit adapting to local conditions.
8. Reasonable cost.

A survey of the equipment on the market showed that no complete system, which would satisfy all these requirements, was available. The only possibility, therefore, was to design and assemble the transmission system locally. As a nucleus around which to build, Western Electric 119A and 118A amplifiers were chosen since they would fulfill all the technical requirements. Because of their relatively low cost it was found possible to plan a two channel system, thus providing the desired auditory perspective. The entire system was assembled and installed by the Electrical Engineering Department of Lehigh University, using stock Western Electric parts purchased through the local Graybar Company.

Figure 1 is a simplified block diagram of the transmission system as installed. The left and right microphones feed through individual 116A preamplifiers to the 119A amplifiers of the left and right channels respectively. The center microphone bridges the left and right channels through two 116A amplifiers. Type 30 volume indicators are connected across the outputs of each of the 119A amplifiers. For monitoring purposes a set of crystal headphones is arranged so that the left earpiece connects to the left channel and the right earpiece to the right channel.

To simplify the control of volume during the program, corresponding left and right volume controls are ganged in a control cabinet that also houses the volume indicators, i.e. V_L and V_R are dual potentiometers; similarly, V_{CL} and V_{CR} and V_{ML} and V_{MR}. To permit individual adjustment of gain to compensate for any amplifier unbalance, all the volume controls have small series connected controls mounted on the amplifier cabinet.

The physical arrangement of equipment in Packer Chapel is shown in Figure 4. The 119A amplifiers are the first and third panels down on the cabinet in the center of the picture. The three individual compensation volume controls for each of the amplifiers are mounted on these panels. The dual controls for right and left microphones, center microphone and master control are mounted at the bottom of the control cabinet at the right. The volume indicators with their attenuators are at the top of this cabinet.

The second panel down on the amplifier cabinet is entirely for the purpose of preliminary adjustment and testing of the whole system. This

(*Continued on page 26*)

[1]Ifor Jones, Conductor of the Bach Choir.
[2]Henry C. Knutson, Associate Professor of Electrical Engineering, Lehigh University, Bethlehem, Pa.

STEREOPHONIC SOUND SYSTEM

FOR

BACH CHOIR

BETHLEHEM, PA.

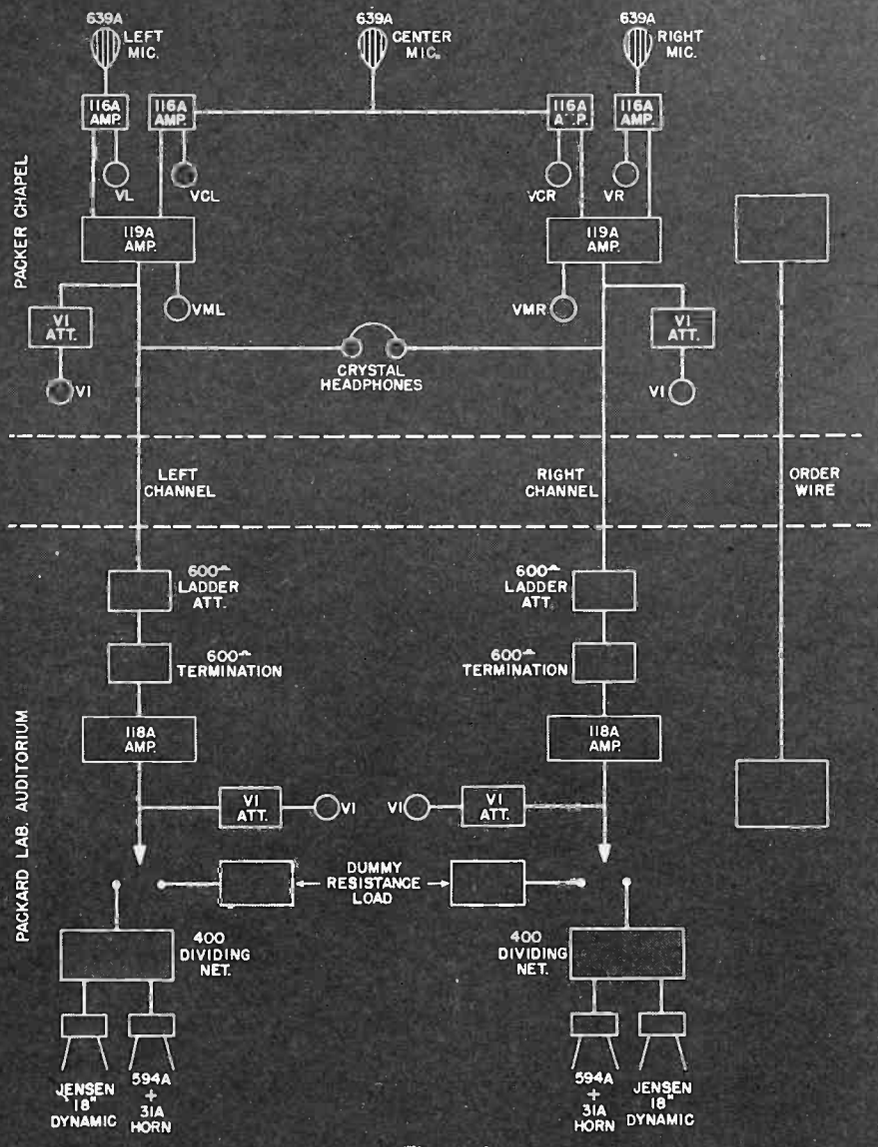


Figure 1

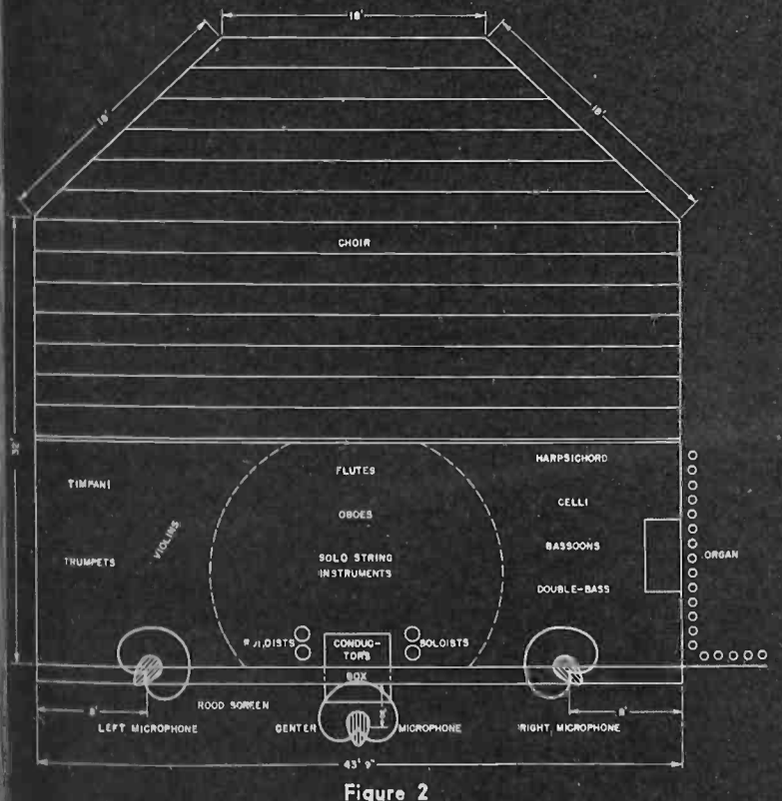


Figure 2

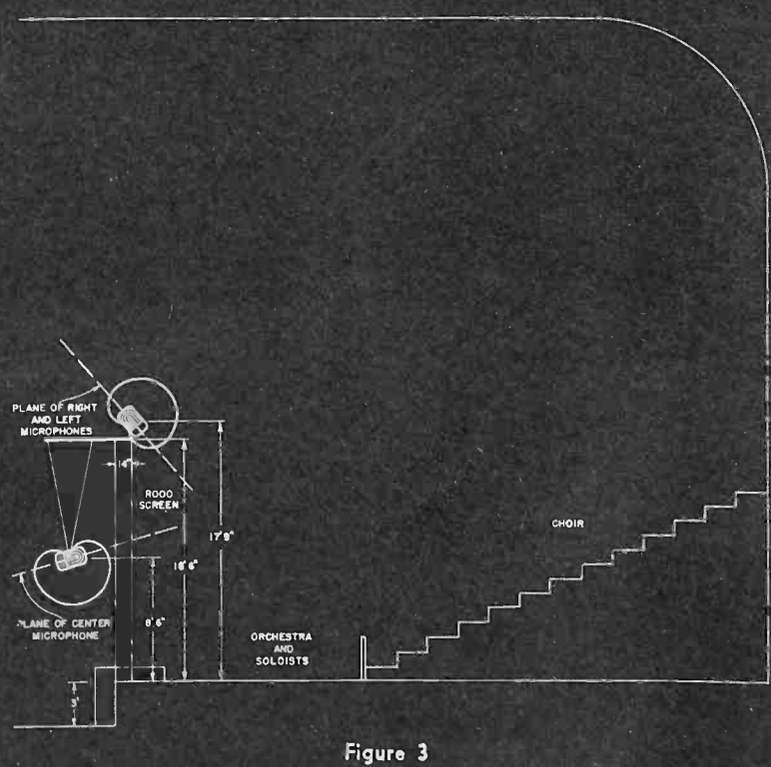


Figure 3

Bach Choir Sound System

(*Continued from page 24*)

panel, which for simplicity is not shown in Figure 1, houses two switches, resistance networks and an attenuator that is connected across the output of a beat frequency oscillator. When the left switch is thrown the left and right microphones are disconnected and the oscillator introduced in their place. This permits the setting of the compensation volume controls on the left and right preamplifiers and the left and right master controls so that the entire system may be balanced. The right switch performs the same function for the center microphone. With this switching arrangement, it is also a simple matter to run a frequency response curve.

For transmission lines between the two buildings, simple No. 14 weatherproof twisted pair run overhead is used. Inside the buildings all wiring is in steel conduit. Tests indicated that the noise introduced by the connecting lines is inaudible.

In Packard auditorium, the incoming lines as shown in Figure 1, pass through 600 ohm attenuator volume controls to 600 ohm terminations. The 118A power amplifiers are bridged across these terminations. The 600 ohm attenuators are ganged together on a control cabinet that also houses two volume indicators connected across the output of the amplifiers. The volume controls on the 118A amplifiers themselves are used only as compensation controls for balancing purposes. The arrangement of this equipment can be seen clearly in Figure 5.

Normally, the 118A amplifiers feed into 400 cycle dividing networks and then to the loudspeakers. Each speaker consists of two units. The low frequency unit is a Jensen 18 inch dynamic, while, the high frequency unit is a Western Electric 594A loud speaking telephone with a 31A horn. Figure 6 shows the arrangement of the speakers at the front of Packard Auditorium during the May Festival. The distance between speakers is approximately the same as that between the right and left microphones in the Chapel.

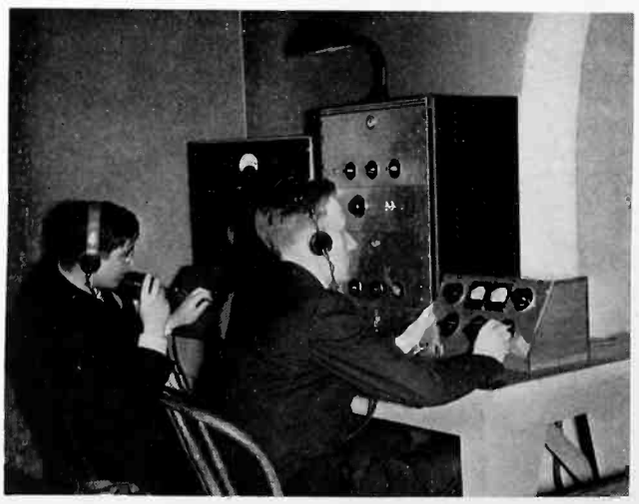


Fig. 4—Henry C. Knutson (right) at controls in Packer Chapel.

Fig. 5 — Volume controls on 118A amplifiers are used as compensation controls for balancing purposes.

A dummy load to replace the loud speakers is provided as shown in Figure 1. This permits last minute balancing and testing with oscillator tone even when the audience is present.

The order wire shown in Figure 1 is terminated at each end in an ordinary headset and carbon microphone.

One of the major problems involved was the placement of the microphones. The compact arrangement of the choir and orchestra as well as the effect of a massive oak rood screen separating the performers from the audience had to be considered. Figure 2 shows the horizontal arrangement for the Festival, of the choir and orchestra, while Figure 3 gives a vertical cross section. To add to the difficulties was the fact that at no time before the final dress rehearsal did the orchestra rehearse with the choir and soloists. For the choir alone a series of listening tests with the microphones in different positions indicated that the best reproduction was obtained with the right and left microphones in the plane of the rood screen. Ordinary microphones at this point would have resulted in the orchestra overbalancing the choir.

In Bach choral music the balance between the orchestra and the singers is critical, since both are equally important. It was hoped that the use of the cardioid pattern of the 639A microphones would give a satisfactory compromise. Bearing in mind this cardioid pattern, the left and right microphones were placed and tilted as shown in Figures 2 and 3. To the gratification of everyone concerned, the balance obtained at the dress rehearsal was so nearly perfect that no further adjustments of the microphones were necessary.

The effectiveness of these 639A microphones was strikingly demonstrated at a rehearsal of only the orchestra. It was noticed that in the repro-

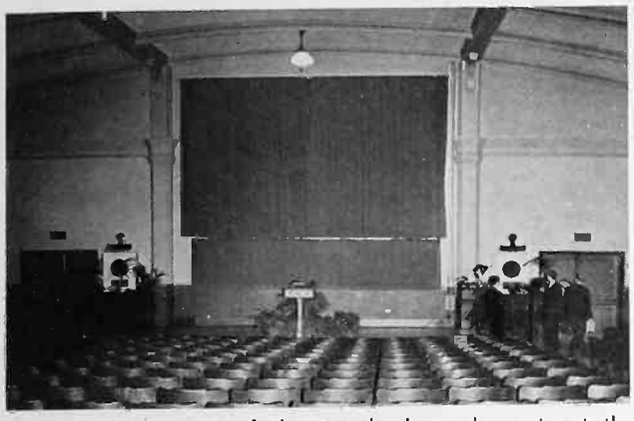


Fig. 6—Arrangement of the two loud speaker sets at the front of Packard Auditorium.

duced music the double-basses which were immediately in front of the choir seemed to predominate, while the Novachord (operated at a harpsichord) directly below the right microphone was weak. By interchanging positions, i.e. placing the double-basses almost directly below the microphone and hence, nearer to its dead zone, and moving the Novachord towards the choir, an excellent balance was established. Full use was made of the three dimensional cardioid pattern of the 639A microphone on the right side. Since this microphone was rather close to the organ it was shifted about a vertical axis until the organ was nearly in the dead zone.

The center microphone, shown in Figure 7, was used for two purposes, first to pick up and give proper emphasis to the soloists, and second, to move forward the center of the virtual stage. Steinberg and Snow* have shown that in a two channel auditory perspective system, the center of the reproduced stage recedes into the background. When they used a non-directional microphone at the center of the pickup stage and bridged this across the two channels, they found that the whole center of the stage moved into the foreground. In the Bach Festival system, the center microphone was set for the cardioid pattern and so tilted (Figure 3) that its pickup was confined mostly to the front of the stage center. Since this microphone was closer to the artists than the side microphones, the 116A amplifiers associated with it were operated at a lower level than those of the side microphones. In this way, a very satisfactory auditory perspective was obtained with only two channels.

At the controls during the actual Festival were men thoroughly familiar with the music. Professor Cyril Hoyler of Moravian College for Men, a former member of the choir, operated the controls in Packer Chapel. In Packard Auditorium, Mr. Jack Stein, who had assisted in some of the musical arrangements, acted as operator and critic. Also at each end a man was stationed on the order wire.

Immediately before each of the four sessions, these men balanced the amplifiers as previously described and took a quick overall frequency run using the dummy resistance load. A minimum of monitoring was done during the program since the aim was to reproduce the program as faithfully as possible. In general the only adjustments made were a slight increase in level of the center microphone during solos. There was no need to compress the volume range, due to the excess output capacity available and the low noise level of the system.

One of the best indices of the audience response to the installation was the attendance at each of the four sessions. No particular advance publicity had been given out regarding the installation since it was felt that the public should be allowed to form their own opinions. As a result, the attendance at the first session was poor. It was noticed, however, that the same people returned for the succeeding sessions and in each case brought friends with them. At the last session the auditorium was completely filled. At the end of each session the most favorable comments were heard. Many of these comments were particularly interesting. Everyone seemed to agree that after the first few minutes they were completely under the illusion of the choir and orchestra being hidden behind the curtain at the front of the auditorium. Those familiar with reproducing systems attributed this to the faithfulness of the reproduction with no audible distortion as well as to the stereophonic effect.

The behavior of the audience during the programs served as another index of the success of the installation. Complete absorption in the music

(*Continued on page 33*)

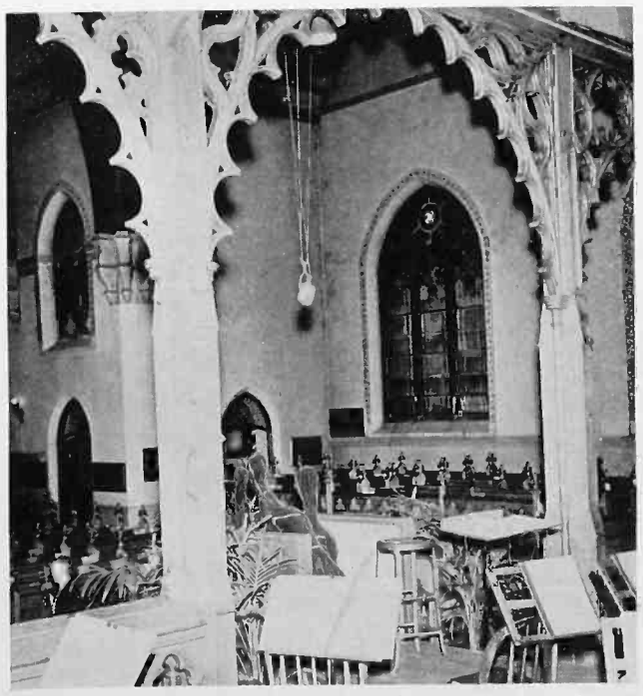


Fig. 7—Center microphone was used to pick up and give proper emphasis to the soloists as well as to move forward the center of the virtual stage.

* Physical Factors, J. C. Steinberg and W. B. Snow, Electrical Engineering, Jan. 1934; also in Bell System Technical Journal, Apr. 1934. This paper is one of a series in a Symposium on Wire Transmission of Symphonic Music and its Reproduction in Auditory Perspective.

Nassau County Police Radio

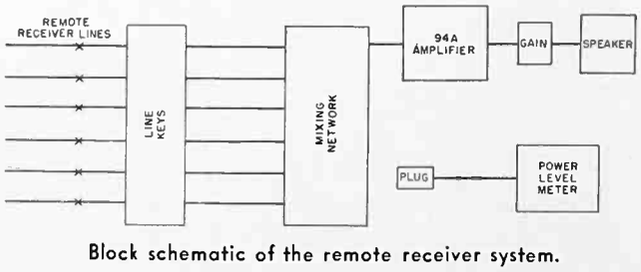
(*Continued from page 11*)

position. The sloping panels forming a semicircle around the top of each desk mount tone-voice key, volume indicator, gain control and pads for speakers and microphone. A clock whose rotating numerals appear before openings in the center panel makes time reading quick and errorless. An interlocking foot-switch beneath the desks permits either dispatcher to turn on the transmitter at will. With the exception of an overmodulation meter and remote antenna current meter on the desk at the right the equipment at both positions is the same.

The trim gray and blue 443A-1 transmitter, which first went on the air April 22, 1940, is mounted in one wall of the room. Operating day and night, the warm glow of its four 357A vacuum tubes gives a visible indication of the energy that needs only the pressing of a switch to flood the ether with power — 1,000 watts during the day and 500 watts at night.

The door to the right of the transmitter leads into a large closet or small room into which the rear of the transmitter opens. The closet furnishes storage space for vacuum tubes and spare parts. In addition there are located in it all AC switching units, remote switch for the emergency power supply, nitrogen cylinder for the transmission lines, termination of both 9C and 443A-1 transmitter outputs and the line to the antenna coupling unit with switches for connecting either transmitter to the 89-foot Blaw-Knox antenna mounted on the roof of the building.

Across the room from the transmitter stand two racks of speech input and auxiliary units. At the top of the left panel are two 119A amplifiers, one of which is a spare. Each of these 119A's is equipped with four 116A pre-amplifiers, two of them converted to oscillators to provide the tone signal used for calling cars. A 94D amplifier is used for the monitoring speakers and a 94A boosts the incoming remote receiver signals. Other units on the racks are two radio receivers, two volume indicator panels with one meter for measuring at the racks, frequency standard, power level indicator for adjusting lines, modulation monitor, power supply for receivers, mixing network for the remote receivers, keys on incoming remote receiver lines. All equipment is terminated on jacks so that spare amplifiers, meters or other units can be patched into the circuit should any of the equipment in operation cease to function.



Block schematic of the remote receiver system.

Abram W. Skidmore (left), police commissioner of Nassau County, Captain William K. Allen, supervisor of radio.

Against the fourth wall, facing the windows, is a desk on which is mounted the auxiliary transmitter. This is the 9C Western Electric 400 watt transmitter with which the Nassau Couny Police Department first went on the air on September 14, 1933, and which served them faithfully and efficiently for seven years. According to Captain William K. Allen, supervisor of radio, this transmitter is still in perfect operating condition, and is ready at the flip of a switch to jump into action in the event of an emergency.

Rolling along the roads and streets of Nassau County, 81 cars and six motorcycles constitute the county's field force. In each one of these vehicles a radio receiver, fixed tuned to 2490 kc, awaits its call from headquarters. In 12 of the cars Western Electric 28A ultra-high-frequency transmitters provide two-way communication with Mineola. The number of two-way equipments is being steadily increased and eventually every car in the fleet will be equipped for two-way conversation with the headquarters station.

To provide for clear reception of incoming signals from the cars, seven 19A remote receivers equipped with 50A half-wave coaxial antennas have been installed in strategic spots throughout the county. Connected to headquarters by wire lines, these unattended receivers, four of them mounted on telephone poles and three in police booths, operate 24 hours a day, in sun, rain or snow. They are so located that any message transmitted from a car anywhere in the county is picked up by more than one of the receivers, thus insuring reception of messages even though one or more receivers may be temporarily out of service.

It might be expected that messages coming into headquarters through more than one receiver would be unintelligible due to the different distances they travel over the wire lines. However, at headquarters these lines are terminated in a mixing circuit which balances the outputs of the seven lines. The output of this circuit feeds into the 94A amplifier and thence to the loudspeaker. Since the incoming remote receiver lines pass through keys before reaching the mixing networks, any receiver that becomes noisy can be cut out of the circuit. Pressing the key cuts off the noisy

receiver line and replaces it with a 600 ohm resistance to keep the mixing network balanced.

Long Island Sound, one of the finest sailing locations in the East, attracts a great number of pleasure boats to the waters off Nassau County. To assist in patrolling this off-shore area the county police operate a 38-foot twin screw cruiser as a police launch. This boat is equipped with a Western Electric 226B, 25 watt marine radio telephone system. The transmitter operates on any of three crystal controlled frequencies, 2490 for communication to headquarters, 2670 to the Coast Guard and the "other ships" frequency of 2738.

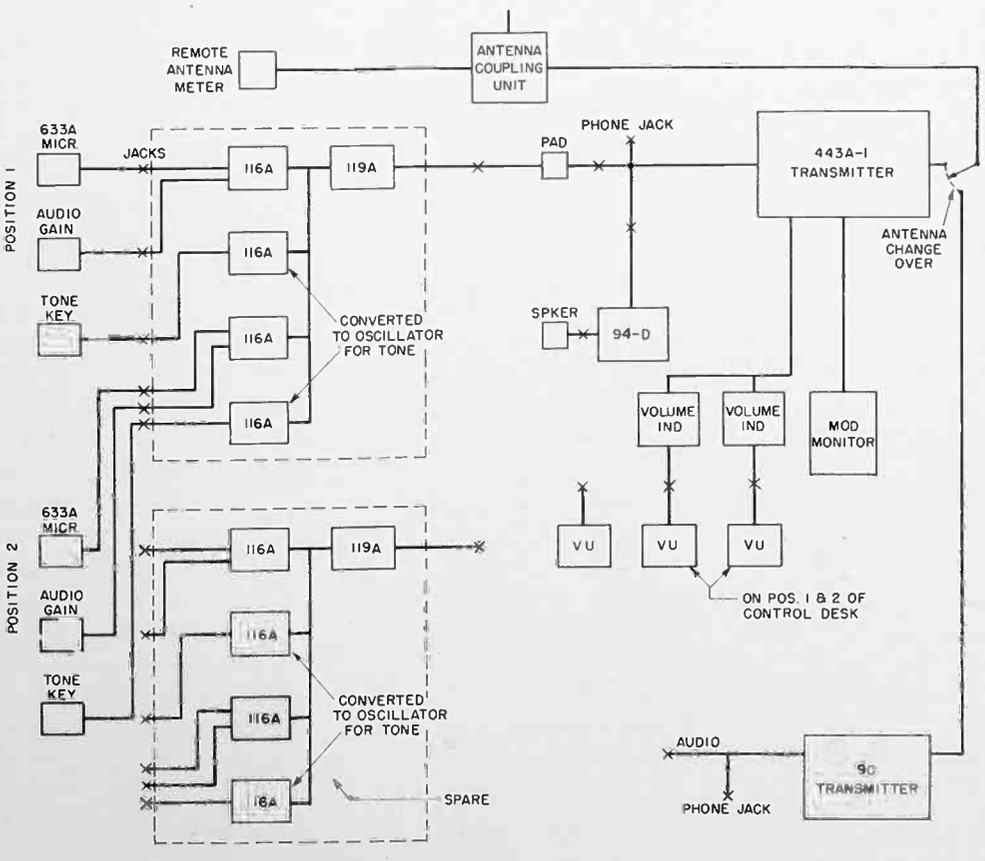
Another auxiliary which the Nassau police have found to be of great assistance in their work of patrolling the county is their airplane, a five-passenger Stinson monoplane. To keep in constant touch with headquarters, this plane had been equipped with a 10 watt, 19A transmitter and a 20B receiver.

During the past summer there arose one occasion in which the department made good use of both police boat and plane, as well as the radio equipment on board both. While on a routine patrol over Long Island Sound, Captain Whitney, the pilot of the plane, spotted a boat on fire a few miles off Hempstead Harbor. Dropping closer he saw that the boat's six occupants, finding it impossible to fight the fire, were climbing into their tiny dinghy. Whitney immediately called the police launch by radio telephone, notified them of the fire and found they could reach the scene in about 3 minutes. He then dropped a note tied to a small container informing the ill-fated seafarers that the police boat was on its way. In a short time the boat was towed to shore, the fire extinguished and the six victims safe on dry land.

Another, but less serious incident in which the plane was employed involved the breaking up of a "floating" gambling ring. The police had known for some time that a group of gamblers were operating a dice game on the county's little used back-woods roads. They had not been caught, however, because patrol cars that just happened along would be seen by "spotters" and the gamblers would climb into their cars and disappear. One day while cruising at an altitude of 1,000 feet, Captain Whitney spotted a ring of men on a back road going through motions that meant but one thing — a dice game. He notified headquarters, cars were dispatched to the scene, the area was surrounded, and the gamblers caught.

In cases such as these, and in numberless other instances, radio has been an important aid in achieving the department's main objective — that Nassau County shall be well policed. Last year 56,000 calls were put on the air. Excluding the 20-minute time signal the total is nearly 30,000, a figure which gives some indication of the way this police force depends on radio.

Abram W. Skidmore, Police Commissioner of Nassau County, expressed the thought of his entire department when he stated recently: "It is difficult to imagine how we could effectively police the widespread area of Nassau County without radio communication. Our experience has shown that an efficient system of police radio, combining dependable equipment with a well trained operating personnel, is an absolute necessity for any modern police force."



Block schematic of the speech input equipment and two transmitters employed by the Nassau Police Radio System.

History of the Cardioid

(*Continued from page 9*)

explained, eliminates the hazards caused by small particles ordinarily floating around in the atmosphere. Temperature and humidity too, are important factors, affecting as they do, the various lacquers used.

This assembly room at Kearny is indeed a kind of sanctum sanctorum where only a chosen few may enter. Machine shop operators, for instance, working in an adjacent room, are barred, as they might carry in specks of metal or other unwelcome substances on clothing or hands.

At one table, narrow strips of aluminum alloy are being dipped into chemically pure acetone baths to remove oil and dirt. You learn right at the start of your tour that aluminum, one of the most common metals on the face of the earth, plays a leading role in microphone making. Out of it are formed the diaphragm, ribbon foil and voice coil. These are the vital "organs" of the Cardioid which contains both dynamic and ribbon magnetic units.

The diaphragm, the heart of the dynamic unit, whose function it is to drive the voice coil, is never touched by hand once the aluminum has been cleaned. Vacuum suction lifts do the handling as acid from the skin will reduce its life and even the most delicate fingering would mar the shape.

Rolled out to a thickness of .0005 inch plus or minus .00004 inch, the aluminum is cut into discs approximately 1⅛ inches in diameter and weighing 25 milligrams. Quite a feather weight when it is remembered that a milligram is one thousandth part of a gram and it takes 28 grams to make an ounce. It would require 1134 diaphragms to balance a one ounce weight.

Next the disc is placed in a screw press and subjected to 15 tons of pressure to give it its final shape. As the operator picks up the disc he flexes it with a stiff brush. He can tell by the sound whether or not two discs are stuck together. You take his word for it but it is positively uncanny to one whose ears certainly are not attuned to any such faint vibrations. Fifteen tons of pressure seem pretty drastic treatment for anything so frail but the disc survives the ordeal and comes out looking for all the world like a miniature soup plate with a fancy border.

Here the operator goes technical—tells you that the curved inner portion of the diaphragm must be in the same plane or a maximum of .002 inch above the plane of the outer portion.

Now the diaphragm must be carefully inspected for pin holes, wrinkles or cracks which may have occurred during the forming process. This test is made by means of a "light-gate" worked by a foot pedal. The disc is placed on a circular glass, covering a powerful light that reveals the slightest imperfection.

"Aluminum is such pretty stuff — it must be fascinating to work with," remarks this visitor. "It's the very old Nick to work with," replies the operator as he tosses what appears to be a perfect diaphragm into the scrap basket.

Over at another table rows of fragile silver cylinders glitter in the sun. These the operator explains, are made of edge-wise-wound layers of aluminum tape which measures .001 inch plus or minus .0001 inch thick by .008 inch wide. Cut into slivers of rings they become the voice coils and are later cemented to the diaphragms.

Amazing as these infinitesimal measurements have been up to now, you are actually aghast when you are introduced to the ribbon foil — the major actuating element of the ribbon unit. Here is thinness carried to the nth degree. The little shimmering strip of aluminum approximately two inches long and 3/16 inch wide has been rolled to a thickness of .00026 of an inch with a tolerance of only .000025 inch. This, you discover, is 15 to 20 times thinner than a human hair.

"Close your eyes," the operator tells you, "and hold out your hand. Now — do you feel something in your hand?" There isn't the slightest sensation of anything touching your skin. But, when you open your eyes, the ribbon foil is squirming in your palm like an imprisoned silver fish gasping for breath. They say it weighs 5 milligrams but the layman would swear it couldn't balance a grain of sand.

The process of rolling the aluminum sheet out to such dimensions requires the greatest precision — an art in itself. Special microscopes are used to do the measuring as even the finest micrometer is not accurate enough for the job. It takes approximately a year for operators assigned to microphone making to become what Kearny considers highly skilled. But then Kearny has its own definition for that word "skilled."

Attaching the ribbon foil to the magnet assembly also requires the most delicate handling. If the ribbon is not suspended properly, the frequency characteristic of the completed microphone will be out of limits anywhere from 40 to 300 cycles.

Further along in the shop other piece parts of the Cardioid are being built and assembled. Rows of knotty little bundles about the size of a large fist are lined up on a shelf. These, it is learned, are the completed inner assemblies aptly nick-named "rats' nests" by the operators. They contain the pressure unit (diaphragm and voice coil assembly) breather tube, transformer and equalizing networks.

A line-up of outer casings like rows of crusaders' helmets, stands ready for final assembly. This casing is one of the few units moulded outside the Western Electric plant. Delivered in sets of three sections Kearny machine shop operators fit, buff, heat-treat and polish them before they travel along to the assembly room. Once these operations are completed the sets cannot be interchanged.

One of the final assembly processes is the fitting and sealing of the "rat's nest" onto the lower casing of the microphone. If a perfect seal is not obtained all the necessary breathing done by the pressure unit will not take place through the breather tube, provided for this purpose, and frequency characteristics of the mike will be impaired.

Now the Cardioid, fully assembled on its base, but still not enclosed in the grilled housing, is put to the crucial test. Will it work? And by work Kearny means 100 per cent perfect.

Out it goes to a testing room patterned after Bell Telephone Laboratories' famous sound proof room. Walls and ceiling are composed of layer upon layer of sound absorbant cloth. Steel gratings form the floor which rests upon large steel springs. In fact the room is practically suspended in space.

As the door swings closed the soft, drab walls envelop you with a strange stillness. You speak —and the sound of your voice startles you—it has such a weird, dead quality. It seems to float away from your lips into endless space. If you close your eyes you have the illusion of standing in the middle of a desert. No reverberation, no reflection, no friendly little echo breaks the spell of aloneness. It's depressing. Even the engineers feel a bit sunk if they stay long in that room.

They explain that this eerie sensation is merely due to the fact that your voice refuses to play ball with you under these extraordinary conditions. In other words it will not bounce back at you from walls, ceiling and floor as happens in an ordinary room. Not only is sound from inside completely deadened but, since the room hangs in space, sounds and reverberations from outside sources cannot enter.

If the Cardioid does not pass muster in these dead surroundings it must be taken apart—the trouble diagnosed and corrected and again it is put through the preliminary test. After the outer casing has been fitted and sealed a final test takes place in the sound proof room. Thus the mike completes the last lap of the journey through the Kearny Plant. To date approximately 3000 instruments have been shipped to the field.

Were those predictions made back in 1935 correct? Did Radio need the Cardioid? Well — the broadcasters can answer that.

Don Lee Chain Covers Coast

(*Continued from page 6*)

we had only five stations. But competition naturally raises the standards of program quality and we welcome it."

You feel the pressure of competition when you talk to Henry A. Gerstenkorn, merchandising director, and learn how his department goes to town in promoting the programs and products of sponsors. You feel it again when you talk to Wilbur Eickelberg and examine his charts, curves, surveys, and promotions with which he lures more and more sponsors. Syd Gaynor, KHJ commercial manager, is a young man with his eye on the business ball too.

You feel it again when you talk to Van C. Newkirk, program director, and learn how his microphones go roaming all over the Pacific Coast in search of new and better programs. You learn something more, too, and that's how KHJ and the Don Lee Broadcasting System is serving its public with programs in the public interest. "Eighty per cent of the classrooms in Los Angeles County are equipped for radio reception, and all schools built in the last year have radio," according to Newkirk. Surely, with such a record, radio must be giving the schools programs of educational merit.

For instance: There's the Don Lee School of the Air which aims five and one-half hours of program material directly into those classrooms. Material for these programs is prepared in cooperation with school authorities.

There is the quarter-hour program, presented by Mrs. Elizabeth Goudy, Director of Radio for Los Angeles County Schools. It is called "Young America Presents," and is originated by and for the schools of the county. There is the program, "Dramas of Youth," now in its eighth year, written, directed and presented by young people in radio and the movies. There are 15 minute weekly programs presented by Mrs. Walter H. Boyd, California Federation of Women's Clubs and Bruce Merman, American Legion. There is the program called "Nobody's Children," which originates in a California orphan home where Walter White, Jr., interviews orphans. There's the historical presentation called "This Day in History," a quarter-hour weekly show; there's the weekly half-hour, 12 piece musical program called "The Hancock Ensemble," personally directed by Dr. G. Allan Hancock, noted philanthropist.

The coverage of municipal affairs is just as complete, and then there are California's sports to cover. KHJ averages 25 remotes a week. These often call for the coordination of pick-ups from yachts, planes, cars and permanent remotes.

The programs of the Don Lee Broadcasting System are coming more and more into prominence through the Mutual Broadcasting System affiliation. The 32 stations of Don Lee cover the Pacific states, and soon television programs will be painting pictures in the air over the homes of almost two million people in Southern California. Frequency Modulation programs soon will be reaching out to the same audience, and also to the San Francisco audience. Yes, that California sun is not just an ordinary sun.

New Vacuum Tube Hearing Aid

Western Electric has introduced a new vacuum tube hearing aid known as the Ortho-tronic Audiphone in which stabilized feedback is used.

How to Recondition Tubes

(*Continued from page 21*)

former in the high voltage position by placing the magnetic shunt all the way out, thus concentrating the magnetic path to the secondary of the transformer.

6. Leave the control room and operate the control switch. If an arc sustains across the gap break it by throwing the switch to the "OFF" position. Condition the tube on high voltage for ten minutes.

In the design of the conditioning unit WOR has enjoyed the full cooperation of the Western Electric and Bell Laboratories tube departments. The following information, received from them, is of value to anyone intending to use a conditioning unit similar to the one just described.

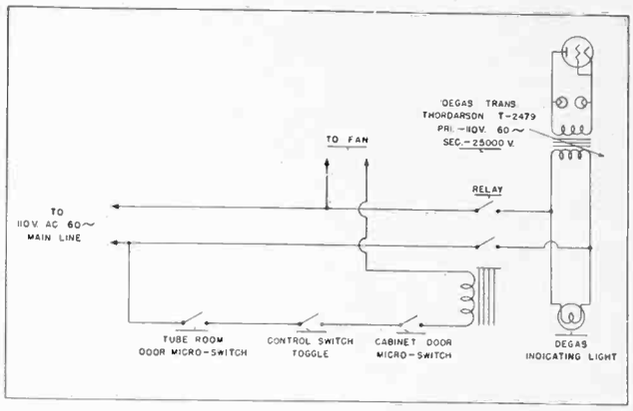
Initial operation of power tubes which have been kept on the shelf in the customer's premises for extended periods may be improved by a conditioning treatment before they are placed in service.

As all Western Electric power tubes are held at the manufacturing plant and retested just prior to shipment, tubes that have just been purchased require no treatment before being placed into service. Inasmuch as broadcasting stations are now required to maintain a complement of almost 100 per cent spares, some tubes may deteriorate on the shelf before being replaced in service as a result of a very slow leak or the absorption of gases on the parts of the tube which ran at very high temperatures in service.

Before a tube that has stood for several months is put into operation, it is recommended that it be given a conditioning treatment such as that described above.

If the tube envelope shows a hazy type of discharge on the first application of voltage, the tube may be gassy as a result of a small leak. The ten minute treatment recommended above should clean up this haze condition unless the tube has developed a leak sufficiently large to cause trouble when put into service.

The second part of the treatment, which has been tried with some success in the laboratory, consists of filament aging at the normal operating voltage for several hours. The tube is placed in the transmitter socket with standard water-cooling conditions and the filament lighted at the correct operating voltage as measured at the tube terminals. Lighting the filament at normal operating temperature tends to clean up residual gases and also tends to clean off both the filament and grid surfaces. The tube is then in shape to be tested in the transmitter under normal starting and running conditions. In case the first high voltage treatment is omitted the filament aging procedure is still of some value. It has also been found that the above treatments are effective in cutting down initial flashing during operation, even though the tube is returned to the spare shelf for a week prior to being installed for regular service.



Circuit diagram of the tube conditioner used at WOR.

It is recommended that tubes held as spares be conditioned periodically to insure continuity of service when the tubes are inserted for use. Unless a spare socket is available for treating tubes, the conditioning process can be done during off hours when more than one tube can be treated simultaneously, so that more than one spare is always conditioned for use.

High vacuum rectifier tubes such as the water-cooled 222, 233 and 237 types may be conditioned in the same manner as amplifier tubes mentioned above.

Mercury rectifiers, such as the 315, 255 and 266 types, are to be preheated and tested under standard operating conditions to determine that there is no vacuum leak and that all of the mercury splashed on the tube elements during shipment and handling has been evaporated to the lower and cooler part of the envelope. After the initial acceptance test the tubes should always be handled and stored vertically to insure that excess mercury does not splash on the electrodes.

If a tube fails to rectify without arc backs after the recommended preheating time, another laboratory treatment has been found to be useful. This consists of inserting a resistance bank of approximately 1 megohm, such as 20 - 20 watt, 50,000 ohm "Red Devil" resistance units, connected in series with the anode of the tube which has shown arc-backs. Using the maximum available voltage in the transmitter, the inserted resistance prevents excess currents from flowing through the tube which tends to arc back. The voltage should be left on for at least one hour, or until all visible mercury is removed from the anode. Room temperature air should be blown on the lower end of the envelope during this treatment. Then the tube may be operated under standard conditions without the resistance and put back into the spare tube cabinet for future use. Periodic tests during off hours will insure that tubes which may have developed vacuum leaks are not inserted. A definite rotation schedule of spare tubes will insure a longer operating life for spares as well as for tubes in the rectifier.

Air-cooled amplifier tubes kept as spares for long periods may develop very slow leaks

which gradually impair the vacuum. If these tubes had been used in service as soon as received, approximately normal life probably would have been obtained. Alternate use of spare tubes in the transmitter is therefore recommended in order that tubes held as spares will always give satisfactory operation. When tubes of this type are first inserted in the sockets, the filaments should be lighted without plate voltage. In case of a crack in the glass envelope the filament will "smoke up" due to the formation of tungsten oxide.

It is recommended that the filament be operated at normal voltage for several hours to clean up any residual gas and to insure that the filament is fully activated. Tubes operated in spare transmitters should preferably be run with a filament voltage of about 80 per cent normal to obtain the maximum life from the standpoint of evaporation of active materials.

FM Tests Around New York

(*Continued from page 13*)

strongest pick-up came from a reflected wave.

Knowing no worse location on the Island we headed back toward town, crossing the Whitestone Bridge, to the Hutchinson River Parkway, and on up the Parkway for a distance of approximately 25 miles north of New York. On this long drive we encountered places where the signal strength momentarily dropped or the signal seemed to wobble a bit. In each case, however, it was noticed that the position of the car placed the car between the path of the signal and the antenna. It seemed reasonable to assume that the car was shielding the antenna. This effect was obtained only while driving at speeds between 50 and 60 miles per hour.

Returning to New York we passed over the lower level of the double-deck bridge across the Spuyten Duyvil. The signal from WOR was completely mixed up with car ignition noise while W2XOR continued with full strength. Back in the city we cruised under elevated railway lines, through streets lined with New York's highest buildings and filled with rush hour traffic. There was no variation whatsoever in signal strength. As I write this, the same receiver is bringing me the music of W2XOR in my home in Manhasset, Long Island, 18 miles from the transmitter. The receiver is connected to an eight foot piece of bell wire which hangs down from the second story window. The vacuum cleaner, electric razor, oil heater have absolutely no effect on it.

From this report of a test of FM, unscientific and unrehearsed as it was, you may read any significance or none at all. To us, it seemed to indicate that FM is perfectly capable of serving the entire metropolitan area of the greatest city on earth. It further indicates that the average listener may receive his FM programs irrespective of location and without an elaborate antenna array. And, also, should not our ideas about FM and car reception be changed?

WIP, Philadelphia, Pa.

(*Continued from page 16*)

tion from the roof of the Gimbel Building and installed a new 1,000 watt equipment at a better spot on the outskirts of Philadelphia.

In November, 1939, the FCC having granted an increase in power to 5,000 watts, the station's officials decided to build a completely new transmitter plant. After a thorough investigation the site at Belmawr was selected, a Western Electric 405B-1 transmitter was ordered and construction of the building was begun.

The entire installation was carried out under the supervision of Clifford C. Harris, WIP's technical supervisor, who also designed the new directional antenna, a two-element system with 275-foot towers surmounted by steel crowns 30 feet in diameter.

The transmitter building was designed with an eye for utility as well as beauty. A maximum of daylight floods the transmitter room through the glass brick wall which curves half-way around it. The control desk with its sloping panel directly faces the wall mounted transmitter. To the left of the desk stands a 1300A reproducer set, providing the transmitter operators with programs at their fingertips in the event of any emergency.

Additional equipment used by WIP includes a 110A program amplifier, a spare 106A amplifier, a 94C monitoring amplifier and a 1A frequency monitor. The old 6B transmitter, located in the master control room, is now used as the station's auxiliary unit.

After two months of 24 hours-a-day operation, WIP's progressive president, Benedict Gimbel, Jr., stated that everyone concerned was "highly gratified with the excellent performance of the transmitter and its ability to 'stand the gaff'."

Bach Choir Sound System

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was apparent. The slightest disturbing movement on the part of anyone drew silencing looks from his neighbors. Many followed the music note by note from open scores. During the magnificent crescendos in the B Minor Mass the audience would sit up almost breathless and when the music suddenly dropped to the barest whisper, one could hear audible sighs. This response of the audience was particularly striking in view of the altogether too common habit today of carrying on a conversation during any reproduced program.

Judged on the basis of public acceptance, the success of the installation was most gratifying to all concerned. It was felt that the reproduction during the May Festival was in keeping with the dignity and tradition of the Bach Choir.

College Station WKAR Begins 19th Year by Boosting Voice to 5KW

Back in 1922 a little 250 watter, owned and operated by Michigan State College, nailed its broadcasting license on the wall, unfurled the call letters "WKAR" and proudly joined the ranks of the country's pioneer stations. Prior to the official opening, the College's Electrical Engineering Department had spent some time putting the infant prodigy "radio" through its paces.

In 1925 the station fell heir to WWJ's Western Electric transmitter and boosted its power to 500 watts. Three years later the signal increased to 1000 watts and finally, in June of this year, WKAR took to the air with a new Western Electric 5000 watt transmitter employing the Doherty Circuit.

Founded in 1855, Michigan State College puts in the claim to being the oldest agricultural college in the world—a Land Grant institution. Today it has a student body of 7,000 members, drawn not only from Michigan, but also from 43 other states as well as several foreign countries. In addition to instruction in six divisions (Agriculture, Home Economics, Engineering, Applied Science, Liberal Arts and Veterinary), the the Federal Agricultural Extension service is centered there.

WKAR's policy, as set by the College Radio Committee, bars commercial broadcasts. No time is sold. The station's aim is to serve gratis Michigan's 4,000,00 inhabitants. Two factors have helped considerably in attaining this laudable objective—the new transmitter with its far-reaching, high-quality signal and the excellent location of the station.

Situated at East Lansing, WKAR stands in the very heart of the State, second largest east of the Mississippi. Its area equals that of England and Wales combined. Approximately 86 per cent of the total population of the State reside within 100 miles of the transmitter site, and 73 per cent of the 196,000 farms are located within the same radius. Being so centrally situated, all of the signal is usable—nothing being lost over the lakes. Since the new system started operating, the college claims that WKAR reaches 85 per cent of the total population.

For the first time since the original debut on the air in 1922, WKAR is broadcasting with a completely new system. It is the first 5,000 watt Western Electric installation in the country to employ air cooled tubes. Heat from the transmitter tubes will warm the building, supplemented by a heating unit during severe weather. The Blaw Knox 300-foot self-supporting antenna is of the shunt-fed type. More than 20 miles of wire have gone into the ground system which consists of 240 radials 400 feet long terminated in a six foot ground rod. There are also 240 radials 50 feet long tied to a circular bus with six foot ground rods located at intervals of 20 feet. A coaxial cable is used for the transmission line.

The transmitter building contains the transmitter room, transformer room, auxiliary emergency studio, office, work shop and garage. Main studios are located in the beautiful new million dollar auditorium situated approximately half a mile from the transmitter site. The suite includes three acoustically treated studios with interconnecting control room, transcription room, offices, reception lounge and work rooms. A sound-lock corridor permits visitors to observe the studios through large windows. The control console, especially designed for WKAR, has proved to be extremely flexible in handling programs.

Two Western Electric submarine cables, containing 11 pairs, carry the transmission lines from the studios to the transmitter building. These have been run under the Red Cedar River—a name which rings out in Michigan State's lusty song.

On the air 11 hours daily, WKAR's broadcast schedules include programs prepared by the College faculty and student body, State Departments, Federal and State-wide agencies. The announcing staff is composed of students chosen for their adaptability to this work. Most of the men plan to enter the field of radio after graduation. The College officials are very proud of the fact that eight former WKAR announcers are now employed at other Michigan stations.

Robert J. Coleman, director, heads the following staff: L. D. Barnhart, production manager; Norris E. Grover, chief engineer, Linn Towsley, technician; John Blakeslee, John Isatala, Emerson Gorton, Richard Cole, George Fraser, operators; Forrest Owen, Jr., chief announcer, Paul Ritts, Jack Callaghan, Edward Root, announcers.

Police Radio in Georgia

(*Continued from page 23*)

assure them they had the suspected men. Without the short-wave bulletin the troopers probably would have lodged only a speeding charge against the robbers. They in turn would have paid their fine to the county judge and would have been on their way into Carolina before the patrol had learned of the hold-up.

Georgia's Department of Public Safety still is a new outfit—established just three years ago. By reducing the traffic accident fatality rate 30 per cent in those 36 months, the State Patrol has the public pretty well sold on the new Department.

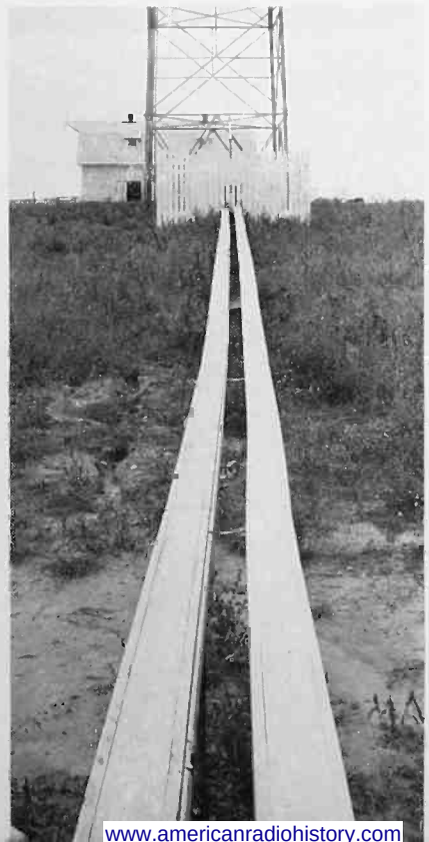
Chief Engineer Norris E. Grover puts the new 5 KW transmitter on the air.

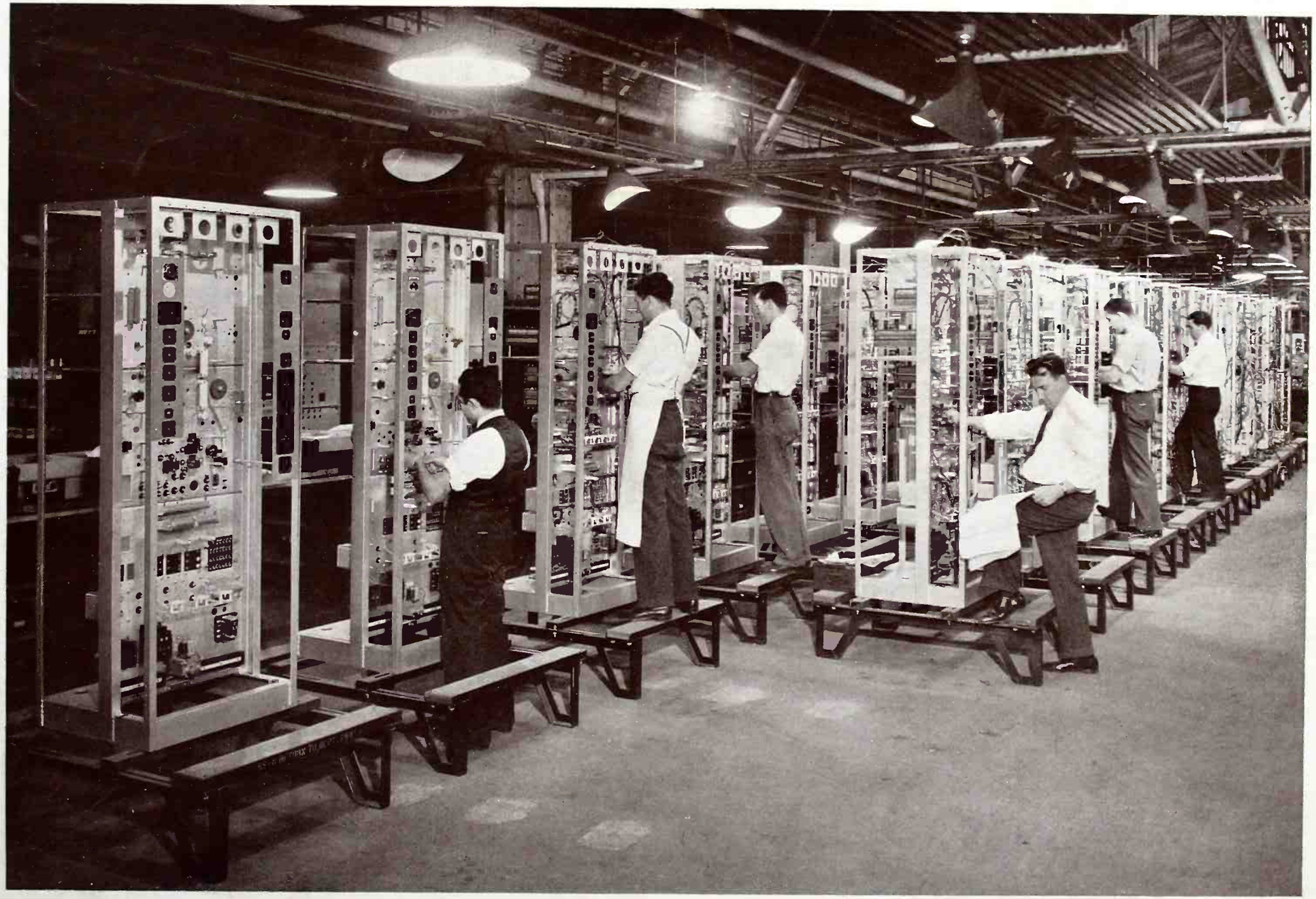
WKAR's 300-foot Blaw Knox shunt fed radiator.

Announcer Jack Callaghan and members of Poultry Husbandry Dept. on the air. Below: Kenneth Greer announces piano solo while Mary Berkey awaits her cue.

Director Robert J. Coleman heads a staff of 11 members. Below: Transmission lines which carry the signal to base of tower.

Operators Richard Cole, Emerson Gorton, John Isatala, Linn Towsley, George Fraser, and John Blakeslee discuss the new control console. Below: Operator Cole gets ready for action.





Soon to be in service—twenty seven 405A-1 250 Watt Western Electric transmitters reach final assembly at the Specialty Products Shop, Kearny, N. J. This transmitter was described in *Pick-Ups*, August, 1940.