PICK-UPS

JULY 1939

Chief Engineer—Pick-Ups Presents His Composite Picture

NAB—It's Been a Great Year, Says Miller

KRLD—New Voice for the Southwest

New 1 KW Broadcast Transmitter

PUBLISHED BY · · · Western Electric · · · NEW YORK, N.Y.

PICK-UPS

JULY, 1939

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

Western Electric
COMPANY

195 Broadway : New York, N. Y.

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Pick-Ups does not accept responsibility for quoted statements appearing in the magazine. Such statements reflect only the opinions of the person quoted.

Profession or Industry?

Is broadcasting really an industry? It is the name most often used. It is the name that even the leaders in broadcasting use most often. But is it an industry, or is it a PROFESSION!

The dictionary says an industry is "any department or branch of art, occupation or business; especially one which employs much labor and capital and is a distinct branch of trade; as the sugar industry; the iron industry."

The dictionary says a profession is "a calling in which one professes to have acquired some special knowledge used by way either of instructing, guiding, or advising others or of serving them in some art."

Whoever heard of a newspaperman referring to the newspaper industry yet newspapers and broadcast stations to a good extent perform similar functions. Perhaps mere terminology is unimportant, but remember this: "As a man in his heart thinketh, so is he!"

Surely broadcasting has acquired the dignity, the standing and importance of a profession. It serves the people in an art. Somehow, we like "profession" as applied to the art of broadcasting.

Chief Engineer

Many of us just drift into jobs or careers, but destiny has a way of marking certain men for particular careers. Take radio engineers. They seem to know from infancy what their future must be, and nothing keeps them from following the course marked for them. Radio becomes their consuming passion, and in it they find their greatest happiness.

Chief engineers as a group possess very definite characteristics and talents. To learn more about them *Pick-Ups* put 300 engineers under the microscope for detailed analysis. Turn to page five and read for yourself just what this man, America's Chief Engineer, is really like.

Revitalized NAB

With another NAB convention in the offing, we went down to Washington to visit with the men at Headquarters. We came back with our ears buzzing with all the things we were told by Neville Miller and Ed Kirby. *Pick-Ups* relays some of these things to you in its story on page three.

New Voice for the Southwest

July 16 will be an important date for the people of the Southwest for then they will get a new voice, the 50 KW. voice of Station KRLD, Dallas, Texas. This station has been serving a great territory since 1926. With its new transmitter, just five times more powerful than the old, it will be able to do a far better job for the advertiser, and, more important, for the 6,000,000 within its listening area. *Pick-Ups* presents the new KRLD in words and pictures beginning on page 17.

Convention

Much should come out of this NAB convention at Atlantic City. Perhaps the whole foundation of broadcasting will be strengthened. One thing is certain. . . . Old friends will meet again and have the opportunity to discuss common problems and widen their perspectives. That alone is reason enough for a convention.

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"In radio no one can pass the buck," says Neville Miller, President, and Ed Kirby, Director of Public Relations, (left) agrees.

NAB

It's Been a Great Year, Says Miller

By WILL WHITMORE

It's been a great year," says Neville Miller in looking back over the time and events since last July when he took over the presidency of the National Association of Broadcasters. "It's been a year of hard work, fun, excitement and the most dynamic period in my life."

It's been a year of great accomplishment, too, not only for Miller, but also for his entire staff, and for the association as a whole. Several years ago members began clamoring for more action — for an association which would more nearly represent the industry as a whole, provide greater protection: in short an organization that would do a better job of solving the industry's problems.

They asked for action. Since last July they have gotten it. In big doses. In Great Big Doses. This re-born reorganized, revitalized NAB is going to town. At the Atlantic City convention it will give an accounting of its first year. Should every accomplishment be told, it will be a long session, BUT it will be worth listening to because it will point the way to bigger things to come as well as the things that have already been done.

From Neville Miller down to every last one of the men and women at the home office in Washington there is the spirit of coats off, sleeves rolled up and desks cleared for action. As soon as you enter the NAB's new, beautiful and efficiently planned offices in the Normandy building, you get the idea that the staff is working with the sure, swift stride of people who know exactly what they have to do and are doing it in the most efficient manner, free of red tape and cumbersome routine.

Perhaps the biggest job during the past year and one of which the NAB officials are most proud is the writing of a new Industry Code. It will be presented to the membership at the Atlantic City convention. It has taken many meetings with leaders in and out of the industry, months of work and planning to devise this code. Ed Kirby, Director of Public Relations for the Association, has traveled from one end of the country to the other, to discuss and present it to practically every worthwhile association representing large and influential groups of people. For it he has won the enthusiastic support and approval of women's clubs, leading religious organizations and other important organizations. Whether the Code wins NAB approval or not, no one can help but recognize the terrific amount of work and knowledge of the industry that has gone into its preparation.

"The old code amounted to little more than a code of business ethics," says Miller. "The pro-

(*Continued on page 27*)

AMERICA'S CHIEF ENGINEER

SKETCHED BY S. J. WOOLF

CHIEF ENGINEER

Pick-Ups Presents His Composite Picture

Nation-Wide Survey Reveals Average Height, 5 Feet, 10 Inches; Weight, 163; Age, 32; Technical Training, Ability, Rank High

By M. M. BEARD

Back of the elaborate and intricate machinery which turns the wheels of radio broadcasting stands that guardian of the air channels — The Chief Engineer. Over 82 million listeners in this country and millions more in foreign lands reap the benefits of his handiwork yet only a comparative few realize that there is such a person. What of this fellow who spends long days and many weary nights in an isolated transmitter building shooting a barrage of voices and music over the ether?

Although these men shoulder tremendous responsibilities in the radio industry and are called upon time and time again to meet the most dramatic emergencies, they seldom are brought to the public's attention. *Pick-Ups,* therefore, decided to tell their story, material for which has been gleaned from a nationwide survey. One objective of the survey was to draw up a composite picture of the Chief Engineer. To obtain a cross-sectional view of him sounds like a major operation. It was. But it was performed without a twinge in so far as the patient was concerned — for the instruments used were a stack of questionnaires, an adding machine and a lot of gray matter contributed by an expert statistician.

Although the operation proved to be a painless one for the engineers it resulted in a terrific headache for the statistician. Out of the 700 and some odd questionnaires distributed, 293 replies were received. Since a number of men replying are responsible for two, three or more stations, the completed survey represents more than 50 per cent of the chief engineers in the country.

Armed with this mass of information, the statistician set to work to record ages, personal appearance, schooling, marital status and numerous interesting highlights in the lives of these radio experts. Into the adding machine went the various ingredients mentioned. Out of the machine, like the genii of Aladdin's lamp, rose the face and form of the typical Chief Engineer.

Here he is — ladies and gentlemen of the radio audience — a most personable representative for America's great Broadcasting industry. He is 32 years old — he measures five feet ten inches in height — weighs 163½ pounds. Brown hair and blue eyes predominate. Our color chart lists 216 brown heads, 33 blonds, 26 black haired chiefs, 7 sandy heads, 3 auburn, 2 red heads and 7 distinguished gray heads. Blue eyes lead the race with a total of 132. Brown eyes, numbering 102, take second place. Coming up in the rear are 40 gray eyes, 10 hazel, 8 green and one lone black eyed engineer. Our typical chief is married and has one child. Bundling the offsprings into the adding machine en masse the statistician found that they number 258. On the basis of those who reported the sex of their children 53 per cent are boys. One chief offered the information that he is the proud granddaddy of two.

Our chief has spent six years at his present station and four and one half years as head of the engineering staff. And a typical American he is, as only seven out of 293 were foreign born. Travel has colored his background and broadened the scope of his knowledge for he has visited 19 states and three foreign countries.

Evidently it is ability rather than age

← To portray the Chief Engineer of American Broadcasting, "Pick-Ups" commissioned the eminent artist S. J. Woolf, who rendered the sketch on the opposite page after making a critical study of more than 100 photographs of Chief Engineers and a statistical report covering approximately 300 Chiefs. Mr. Woolf has probably interviewed — sketched more world celebrities than any other living person. His great insight into human character gives him the rare dual ability to portray people in both words and charcoal.

According to "Who's Who," his work has hung in most important galleries here and abroad. For years he has sketched and interviewed the world's notables for the "New York Times" and "Time Magazine" has commissioned him to do many of its covers.

"Pick-Ups" is proud to present Mr. Woolf's charcoal conception of The Chief Engineer of American Broadcasting.

that tips the scales in the broadcasting business as the youngest chief, out in Texas, is a mere fledgling of 19 summers while the oldest, in Missouri, will shortly celebrate his 75th birthday. Ages listed range this way — 130 between 20 and 30; 138 between 30 and 40; 20 between 40 and 50; two between 50 and 60 and two over the 60 mark.

Retracing their steps through the days of reading, writing and arithmetic, it was discovered that 278 completed high school — 93 received college degrees, 65 had from one to three years of college training, 185 took supplementary courses in radio engineering. The survey shows a grand total of 261 out of 293 with either college or supplementary education. These amazing figures would indicate that broadcasting engineers as a class have reached a decidedly higher level of education than the average technical employee or for that matter than the average business executive in the United States. For many of the engineers, education has meant more than burning the midnight oil — it has meant working at almost any old trade to earn an education. According to the survey 136 worked their way through high school or college — 46 worked part of the time during school years.

On a few questionnaires there appeared a rather wistful note indicating that the writers regretted not having had a more thorough technical training. Says one chief, "When visiting technical schools and watching some of the young men at their various experimental procedures, it occured to me that if these future engineers could realize how important these facts are which the instructors are trying to drive into their heads, they would give their schooling more serious thought instead of rushing through as if education were a necessary evil in their lives."

The comparative few who were denied higher education have certainly proved that this handicap can be overcome. One man in particular who never had a day of high school training has climbed to top rank in his profession. Today he is known among radio experts throughout the country as an outstanding authority on broadcasting technique.

What some of these men have lacked in so-called formal education they have acquired in that well attended Hall of Learning — Amateur Radio. One hundred and seven of our chiefs-on-parade were hams. And very tender hams they were, having succumbed to the deadly bite of the bug at an early age. Our Typical Chief started experimenting with his tubes and wires about the time he first donned long pants. More than a few were tinkering around radio sets at eight, nine and ten years of age.

The survey discloses one young ham who got his start at four. Another chap explains his early interest in radio this way, "I've been interested in things electrical from the day I took out my first library card and found a book on electricity. I bought a 500 mile two slider tuner with crystal detector and have been at it ever since." Still another contracted the fever when he read a copy of Hugo Gernsback's "How to Build Wireless Receiving Sets." "I built one," he writes, "and I've never been cured." One young man "just hung around the transmitter at a college radio station doing odd jobs until they took me on." And here's a chief who blames it all on heredity — says he, "I come from a family of Radio Nuts." But most of these men were drawn to radio because of its mystery and fascination. They just can't help themselves — it's in their blood.

Although the majority have spent most of their time at broadcasting or in some kindred work, many sampled various jobs in alien fields. In the ranks are ex-teachers, bank clerks, bus greasers, airport mechanics, medical students, truck drivers, factory workers, type setters, druggists, grocery clerks, prospectors, janitors.

As a class they have wandered far over the face of the globe — 47 having sailed the seven seas pounding brass as ships' operators. Our most travelled chief chalks up the record of 47 states and 25 foreign countries. Close at his heels are many of his colleagues, missing the high mark by one or two states and countries.

the ARTIST says

"Give us your impression of America's Chief Engineer," PICK-UPS asked S. J. Woolf, world famous artist who drew his conception of the engineer. Here's what he says after examining more than 100 photographs.

Before drawing this portrait of my conception of a typical radio engineer, I studied the photographs of over 100 men engaged in this profession. The most salient characteristic of all of them seemed to me to be a seriousness of purpose. They all looked as if they realized the importance of their jobs and were doing their best to fill them.

As a class they are not handsome men, on the other hand they looked like strong ones — strong in the mental sense of the word. Appearances are often misleading, moreover I am not sure that a college education leaves any impress upon the physical make up, nevertheless I should say that the majority of these engineers have gained much of their general knowledge through self instruction.

To get down to more definite details, most of them seemed to be in their early thirties, more of them had light eyes than dark ones and few of them were bald. Not many appeared to be heavy and many had athletic figures.

It is difficult, if not impossible, to combine all the looks and qualities of many varied men in one portrait. Accordingly all I could do was to try to express the impression produced upon me by all of the pictures. I have tried to show a serious young man, eager for advancement, possessing a studious nature and who finds both enjoyment and contentment in his chosen profession.

S. J. WOOLF.

a GRAPHOLOGIST says

PICK-UPS submitted many handwriting specimens of Chief Engineers to one of the country's leading handwriting experts. "Tell us what the owners of these hands are like," we asked him. Here is his report.

For the purpose of a broad survey, all persons may be classed under two main types, the "Intuitive" and the "Logical."

The Intuitive type is impulsive and often full of ideas but they invariably judge by first impressions and are incapable of extended study of any one subject. They are guessers and often critical. They take things as they come and rely upon themselves to overcome any difficulty if it can not be side-stepped. Such persons are generally popular and good mixers, making friends easily.

Of the specimens of the handwritings submitted I find that less than 11 per cent are of the Intuitive type. This type is easily recognized—the letters are chopped apart (printing out an answer has no significance except a desire for clarity).

The Logical type includes all who think out the problem — reason by cause and effect — and plan their moves. Lawyers and research workers are of this type.

Of the specimens submitted I find almost 90 per cent are of the Logical type. They can take the ideas of the Intuitive type and by dissection and logic produce results or give reasons for rejection.

Ninety five per cent show perseverance and the power of decision. Five per cent react to their surroundings and are likely to be discouraged when conditions are not congenial — for example when the superiors lack appreciation. They might hesitate even when they are morally sure that they are right. One noticeable feature in the specimens is the evident wish to state facts and in a manner which cannot be misunderstood.

Practically all writings show good animal spirits. They probably eat and play with the same vigor as they perform their professional duties. The sentimental type is conspicuous by its absence.

And what strange and exciting tales these travelers can spin as they keep watch at transmitters during long tedious night hours! Adventure still dogs their footsteps for one never knows what dramatic emergency may tumble upon their broad shoulders.

Here's a chap who worked inside a burning transmitter building trying to save the equipment until he was forced to dive through a window a few minutes before the roof caved in. They piped the show through the local time sharing station and lost only 40 minutes on the air.

Another tells of spending 80 hours in the Pennsylvania mountains using short wave equipment in an attempt to locate a lost child. Antennas had to be sent up with kites and balloons to get a signal out of the mountain area.

A third describes the handling of a shortwave plane job off Barnegat Light Ship when the dirigible "Akron" sank. A fourth aided in the capture of a bank bandit as he followed the chase with a mobile unit.

An exciting tale comes from New Hampshire recalling the 1938 flood. It is told by the engineer who spent four days and nights without sleep operating a transmitter with a temporary generator and Fordson tractor. Another thriller from Oregon describes this happening at Coulee Dam — a huge gasoline scoop shovel exploded, throwing burning oil around the engineer who was arranging a microphone for a broadcast of the construction work at the dam.

Yes, any old emergency is apt to happen and here's a unique one. While operating a relay station from a Japanese rancher's barn, a 60 mile gale took the roof off and sailed it down the hill like a kite. Then came the rains. By piling bales of hay around and over the transmitter the engineer kept the station on the air.

One man broadcasting the approach of a cyclone from the top of a 100 foot tower saw a passenger train lifted from its tracks and completely wrecked. The cyclone missed the transmitter house by a close margin. Pinch-hitting for an announcer who got buck fever had its thrills for the engineer who interviewed four steel workers atop a 440 foot antenna. The five men stood on a narrow platform passing the mike around. Hi — those were dizzy moments!

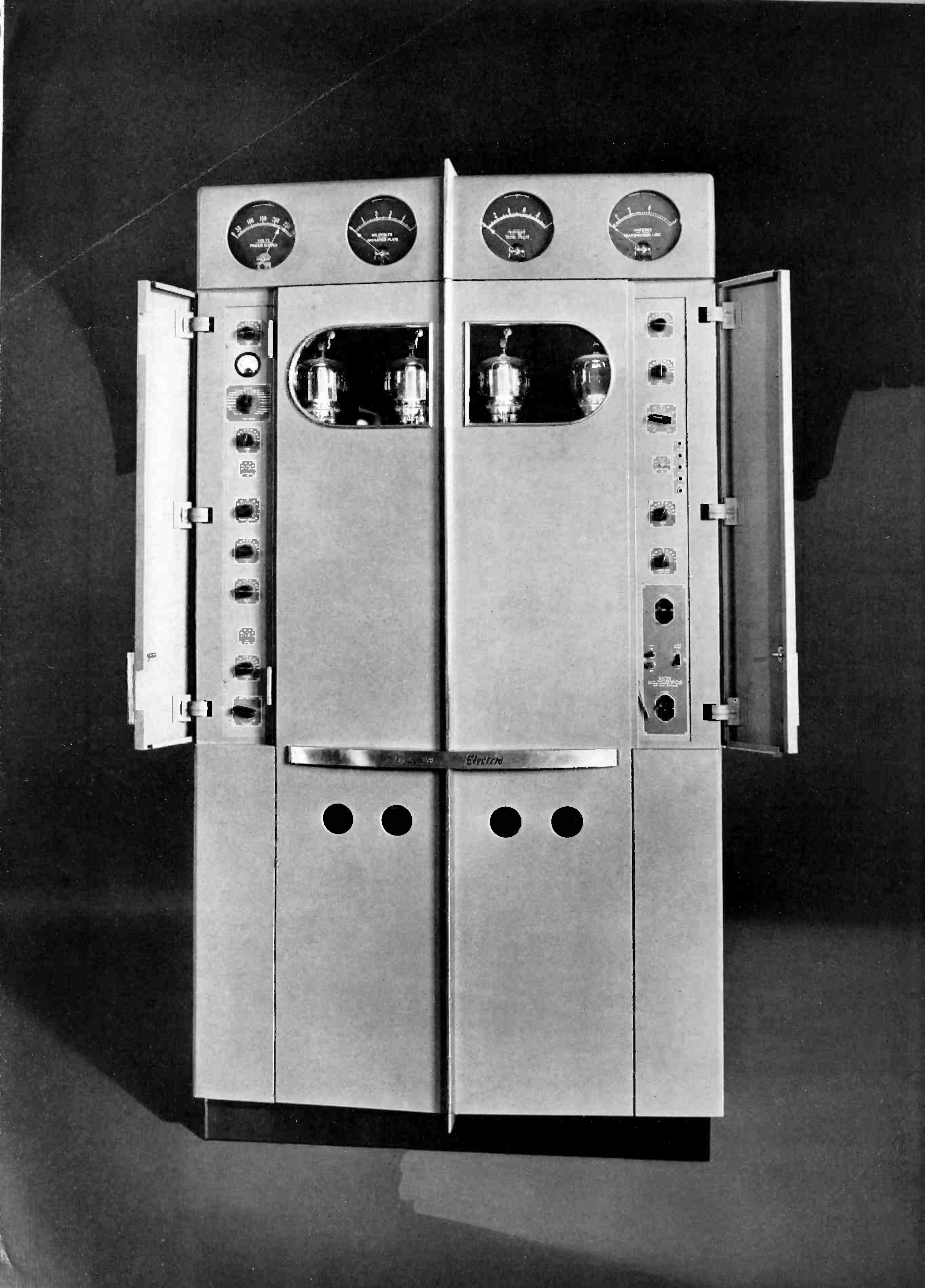
Flood waters may submerge stations, hurricanes tear down antennas, sleet cripple wires, lightning shatter transmitters but it's all in the day's work for a chief engineer. It is his job to get his signal back on the air and back he gets it in record time.

So much for emergencies. But what about the ordinary problems which accompany any job? Here's the biggest headache of them all, say our engineers in unison — SELLING THE MANAGEMENT THE NEED FOR NEW AND UP-TO-DATE EQUIPMENT. This is where technical and non-technical minds clash. The chief engineer follows new developments like a hawk. Sensing the keen competition among stations to win the public's patronage, he realizes that you can't perform miracles with an old, out-dated "rig." He knows that quality programs without quality transmission do not amount to a hill of beans. Therefore, he is constantly striving to improve the quality and range of his signal — while the management is inclined to keep its eye steadily focused on programs, sponsors and the budget.

Second on the problem list is rebuilding old equipment and trying to make it work like new.

These men growl too, about night work — but who can blame them for that! One chap has difficulty in convincing his wife that staying at the transmitter in the wee sma' hours is really necessary. Other problems are: meeting FCC regulations — keeping within the budget — trouble shooting — climbing

(Continued on page 30)


VOLTS
POWER SUPPLY
Electric

NEW 1 KW.

Transmitter Has Modern Styling; Employs Famous Doherty Circuit

By H. A. REISE

Commercial Products Development
Bell Telephone Laboratories

In the 443A-1 Radio Transmitting Equipment the Western Electric Company is making available for medium powered broadcasting and high quality police service the latest developments in the radio industry, embodying superior electrical performance with an accesible and attractive mechanical design. Incorporated in this modern equipment is the well known Doherty Circuit which makes possible low power consumption and low tube complement cost. This single unit transmitter is designed primarily for either 1000 or 500 watt operation, but the necessary switching facilities are available as optional equipment for installations requiring reduced power night-time operation.

The modern design of the cabinet is shown on opposite page and in figure 1. The upper section where the meters are located is finished in a shade of blue that blends well with the grey on the remainder of the unit. All trim is satin chrome finished. Large black-faced meters with white numerals and markings provide splendid legibility. Complete access to all apparatus, including the tubes, in the front section is gained through the main front door. On each side of the main door is a small door behind which all operating and tuning controls are located, thus preventing accidental operation of these controls by the operator or casual visitor to the station. All normal servicing, such as changing tubes and neutralizing of the last stage, is done from the front of the unit. A minimum of time is therefore required to locate and replace a tube that has reached the end of its normal life. On the back of the cabinet are two full length doors that give complete access to all apparatus in the back section of the unit. Except for three door switches no electrical apparatus is mounted on the cabinet. It can therefore be considered as an attractive housing for the main central structure on which the apparatus is mounted and is readily installed or removed from this structure. When installing this transmitter the cabinet is placed in position after all electrical connections to the main assembly are completed.

The apparatus of this transmitter has been designed to give long trouble-free life. All the electrical components, except the three door switches, are mounted on a central structure as shown in Figures 5 and 6. The heavy plate power equipment and blower are on the base plate while the remaining apparatus is mounted on the vertical plate structure. Most of the components are mounted on the back of the vertical structure with the terminals extending through to the front. In this manner practically all the wiring is on the flat front surface where it is easily accessible. Much thought was given to the mounting of apparatus in a manner that will permit quick removal and replacing of a component should it become necessary. Figure 3 illustrates the manner in which all filter and audio blocking condensers are mounted on the vertical structure. After the wires are removed from the terminals, two nuts are loosened which permits moving two small clamps from their normal position and removal of the condenser.

Referring to Figure 2, the lower group of five rectifier tubes supply the plate, screen and biasing potentials for the entire transmitter. Behind and below these tubes are most of the associated filters, transformers and control circuits. The second group of tubes includes, from right to left, the audio monitoring recti-

SPECIFICATIONS

Power Supply—
- Single phase, 187 to 250 volts, 50 to 60 cycles
- 4.3 KW at 85% P.F. for 1000 watts carrier output
- 4.4 KW for average program modulation

Frequency Response—
- Flat within ± 1.5 db, 30-10,000 cycles

Distortion—
- Less than 2% for all values of modulation and frequencies from 50 to 3000 cycles and less than 5% to 7500 cycles

Noise—
- 60 db or better below 100% modulation

Floor Space—
- 44" wide, 39" deep

Height—
- 78" high

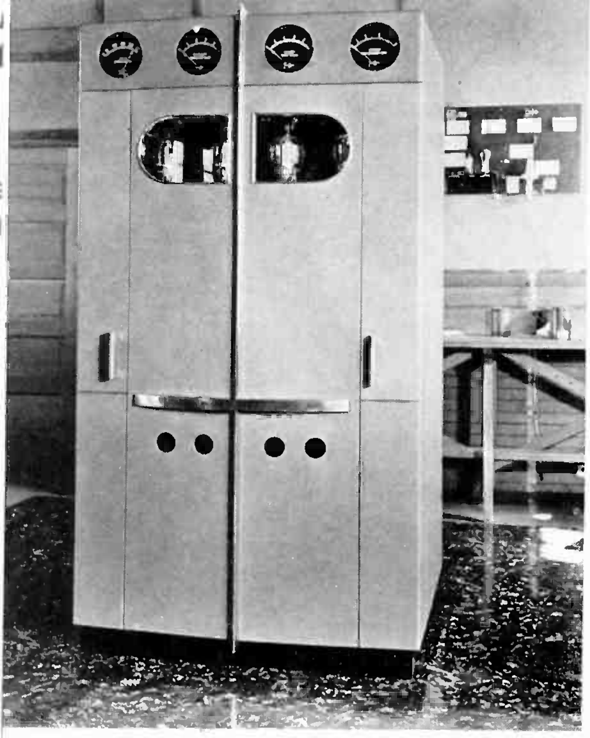


Fig. 1

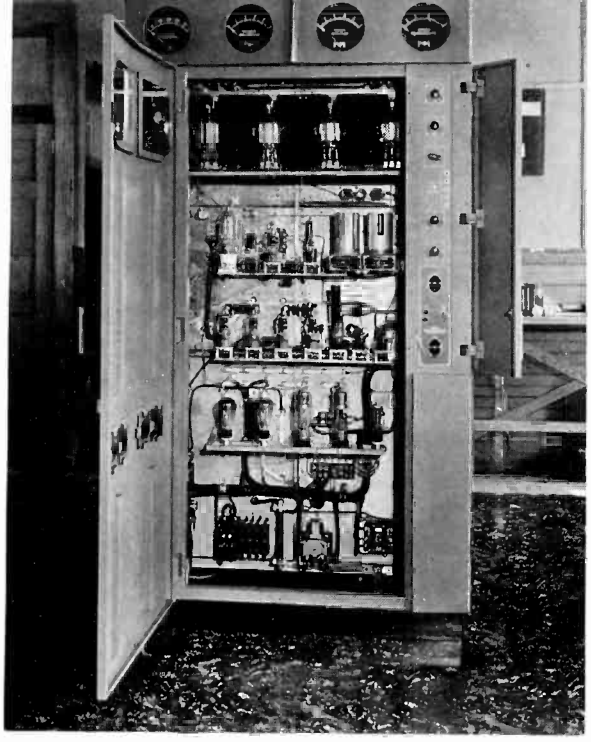


Fig. 2

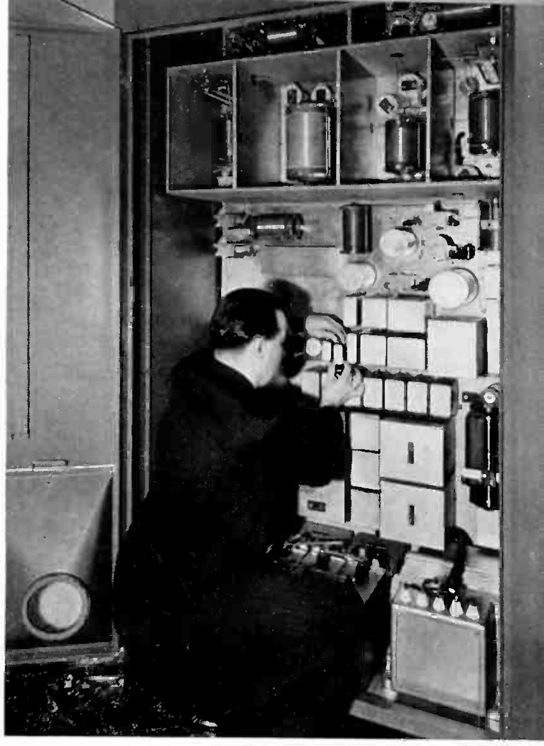


Fig. 3

fier, feedback rectifier, first audio stage and the second audio stage in which four tubes are used in parallel.

Two 702A Radio Frequency Oscillators are shown on the next shelf on the right with three successive stages of amplifiers on their left. Final stage tubes are on the top shelf with the two parallel connected tubes on the right supplying the carrier power and the two on the left contributing power during modulation. The extreme right and left tubes are removed for stations operating at an output not exceeding 500 watts. All the audio and radio circuit components that demand close association with their respective tubes are located directly behind these tubes.

Bleeder and potentiometer resistors from which plate, screen and grid voltages are obtained are located above the final stage tubes. In this manner the main heat generating components are located near the top where the air leaves the unit, thereby avoiding unnecessary heating of other electrical components of the transmitter.

All tuning and operating controls, a test meter with its associated transfer switch, and the phase sampling jacks are mounted on the narrow side vertical panels. In most cases the controls are directly coupled to the associated apparatus. However, where electrical requirements demand an extended drive, a rack and gear system is used. This gives a positive and smooth operating control with a minimum of backlash. Since these control panels form a part of the main central structure and the individual controls are installed and mechanically adjusted at the factory, considerable time is saved in the field installation.

Undoubtedly the question will arise as to the reason for the different physical types of control knobs that are provided on these side panels. It is altogether too easy to turn the wrong control when all knobs are of the same physical type. For this reason the controls have been divided into three groups, according to their functions, and a distinctive type of knob or slot provided for each group. Controls that are rarely used and require, in addition to their operation, the opening or closing of links within the cabinet are provided with screw driver slots. In the second group are the plate and grid circuit tuning controls where octal shaped knobs are used. The three controls used for the routine operation of the transmitter constitute the third group and are supplied with rectangular knobs. Included in this last group are the line voltage and r-f output controls and the test meter switch. This detail is just another indication of the care and thought that has been given to the design of this transmitter. The test meter and switch provided on the left panel permit reading the cathode currents of all audio and radio stages and some of the more important grid currents. It is therefore relatively easy to locate a defective tube.

A back view of the central structure is shown in Figure 6. All components are mounted to give the desired electrical performance and retain complete accessibility. Power equipment occupies essentially the lower one-third of the structure. Upward from this point is mounted the audio, low powered r-f, final r-f, and r-f output coupling apparatus in the order mentioned. Ceramic forms are used for all radio frequency coils.

A blower located in the back of the unit provides forced air cooling to the entire transmitter. This cooling system is designed to provide a slight air pressure within the unit, thus preventing dust from filtering into the equipment. The air intake is through a spun glass filter located in the lower section of the left rear door. The blower discharges toward the lower front section of the unit where the air passes upward and provides the necessary cooling for the tubes and associated apparatus. A very thin spun glass filter is provided at the outlet on the top of the cabinet directly above the final stage tubes, to prevent the accumulation of dust within the unit when it is not in operation. A thermostat and buzzer are provided to give warning of excess temperature within the unit such as could be caused by either failure of the blower motor or clogging of the air intake filter.

A simplified schematic of the transmitter

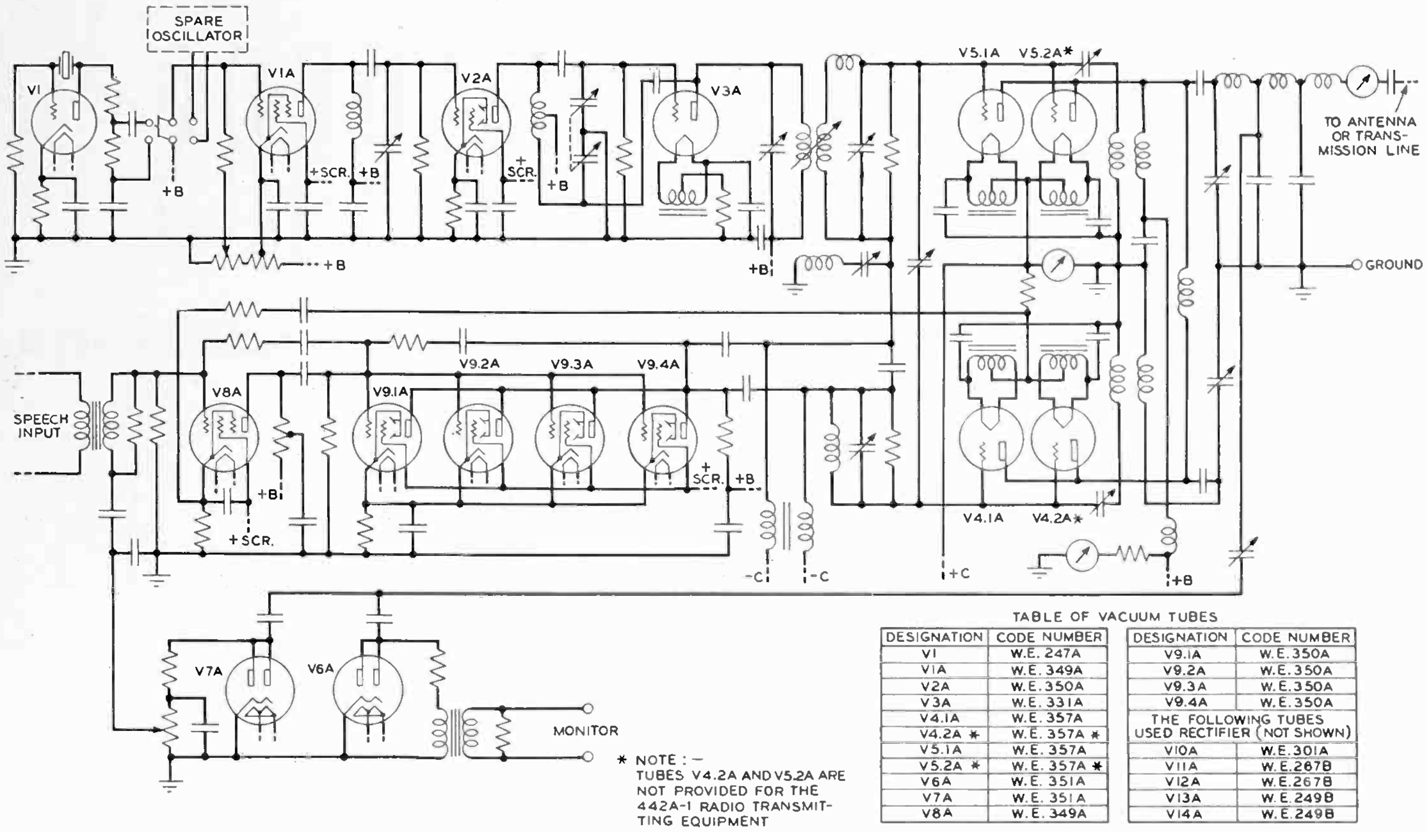


TABLE OF VACUUM TUBES

DESIGNATION	CODE NUMBER	DESIGNATION	CODE NUMBER
V1	W.E. 247A	V9.1A	W.E. 350A
V1A	W.E. 349A	V9.2A	W.E. 350A
V2A	W.E. 350A	V9.3A	W.E. 350A
V3A	W.E. 331A	V9.4A	W.E. 350A
V4.1A	W.E. 357A	THE FOLLOWING TUBES USED RECTIFIER (NOT SHOWN)	
V4.2A *	W.E. 357A *	V10A	W.E. 301A
V5.1A	W.E. 357A	V11A	W.E. 267B
V5.2A *	W.E. 357A *	V12A	W.E. 267B
V6A	W.E. 351A	V13A	W.E. 249B
V7A	W.E. 351A	V14A	W.E. 249B
V8A	W.E. 349A		

Fig. 7—Simplified schematic of the 443A-1 1000 watt transmitter.

circuit is shown in Figure 7. Positions are provided for two 702A Radio Frequency Oscillators, either of which may be selected by means of a switch. This oscillator is capable of maintaining its frequency within a few cycles for any temperature and voltage variations that are encountered in broadcasting service. The output of the oscillator is amplified by three successive direct coupled and tuned radio frequency stages which precede the final and modulated stage. This final stage uses Western Electric 357A Vacuum Tubes in the Doherty high efficiency circuit. Modulation is achieved by applying the audio frequency to the grids of this stage.

This is the first medium-power broadcasting transmitter to use the Doherty circuit and the three to one reduction in plate dissipation, made possible by the use of this circuit, results in a very inexpensive complement of radiation-cooled tubes. Four 357A Tubes are used for stations that operate at 1000 watts output, or have a day-night rating of 1000-500 or 1000-250 watts. Only two tubes are required for stations having a rating of 500 watts or less. The output of this final stage is fed through a radio frequency filter and coupling circuit to the thermocouple meter where connections can be made either directly to an antenna or to a transmission line. Terminals connecting to the third and fourth stages provide the necessary radio frequency for frequency and modulation monitoring purposes.

Through the use of stabilized feedback, both distortion and noise are made very low. A small portion of the radio frequency output of the transmitter

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Fig. 4

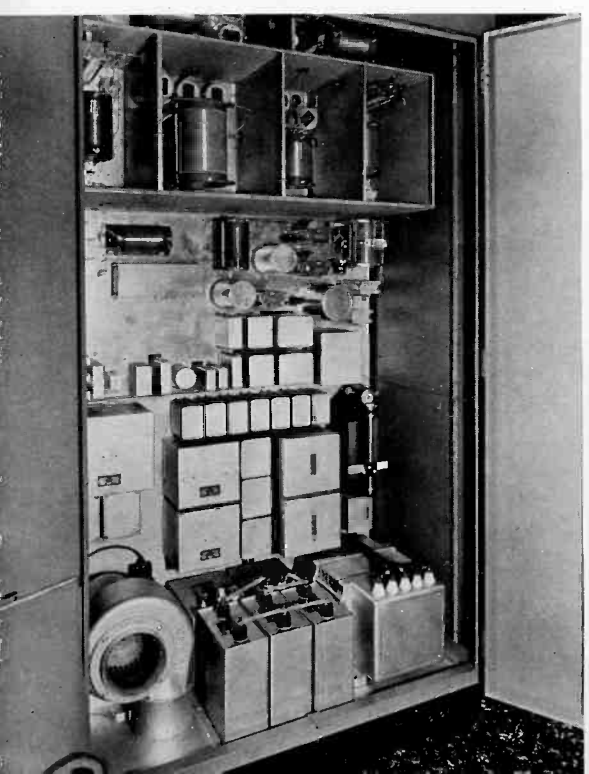


Fig. 5

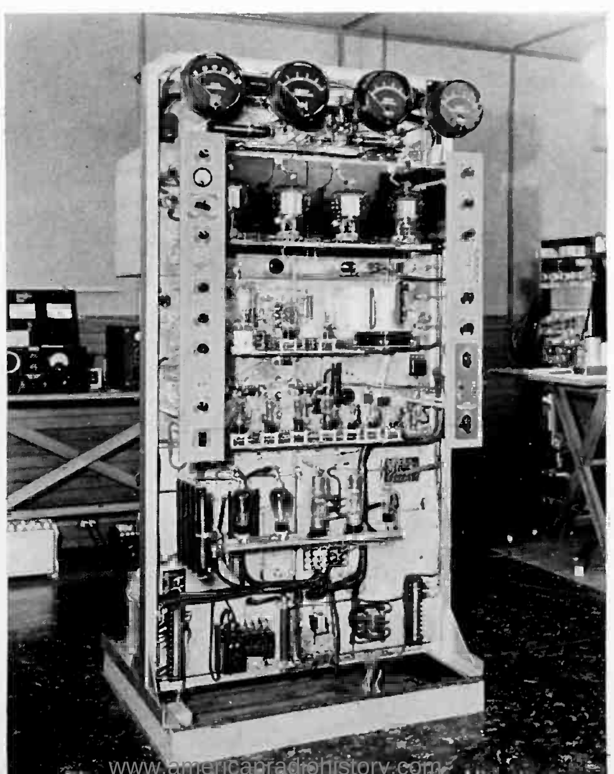
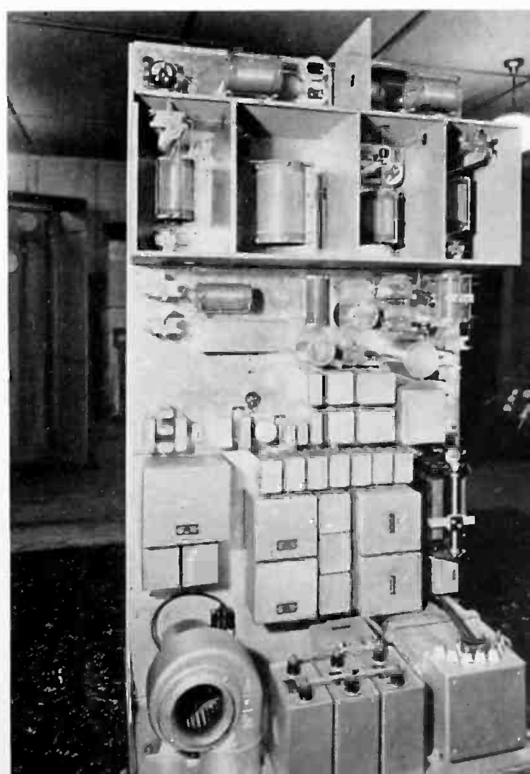


Fig. 6



BROADCAST ANTENNAS

Some Notes on Their Design Computations

By JOHN F. MORRISON

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The broadcast transmitting antenna being a vital link in the chain of components contributing to the coverage and service rendered by a broadcast station has received much attention and study during the last decade. Through the publications of the results of these studies the broadcast engineer is being equipped with material whereby he can under assumed conditions make fairly close predictions of the results to be expected from certain antenna designs.

The three important questions usually confronting the station engineer when considering a new antenna installation are:

1. The expected unattenuated field intensity produced at one mile in the horizontal plane for one kilowatt input. For the sake of simplicity this characteristic might be defined as the horizontal "figure of merit."
2. The impedance of the antenna at the point where power is to be applied in order that suitable constants for the coupling apparatus may be determined.
3. In the case of 5 kw. or higher power stations, the radiation characteristics in the vertical plane are of interest for the purpose of estimating the probable fading-free radius of the station.

In this paper we plan to review and discuss the assumtions generally made in arriving at answers to these three questions and compare these, in so far as possible, with the conditions actually met with in practice. The assumptions generally made are:

1. That the current is sinusoidally distributed along the antenna.
2. That the antenna is a perfect conductor erected perpendicular to a perfect conducting plane earth.

When these assumptions are made the field intensity at points in space a large distance from the antenna can be computed by following expression:

$$\text{E millivolts/meter} = \frac{37.3I}{d} K_\Theta \qquad (1)$$

where: I = the current at the antinode "current loop," (amperes).
d = distance from the antenna, (miles).
K_Θ = the "polar coefficient."

Now providing the antenna has no horizontal radiating sections:

$$K_\Theta = \frac{\cos(2\pi h/\lambda \sin\theta) - \cos 2\pi h/\lambda}{\cos\theta}. \qquad (2)$$

where: h/λ = height of the antenna in wavelengths.
θ = the angle included between the horizontal and a line between the base of the antenna and the point in consideration.

Equation (2) is a simple trigonometric equation and gives the radiation diagram for various height vertical radiators with the assumptions, "sinusoidal current distribution and perfect conducting earth." However, in order to obtain the intensity of the signal for given operating powers we must obtain a knowledge of the radiation resistance.

For vertical radiators the radiation resistance can be obtained by integrating the normal component of the energy flow perpendicular to the surface of a hemisphere enclosing the radiator and this gives for the radiation resistance lumped at the current antinode.

$$R = 60 \int_0^{2\pi} K_\Theta^2 \sin\theta \, d\theta \, . \qquad (3)$$

While the solution of this equation has appeared in many published papers an approximate solution is given here since it obviates the use of integral functions and is very close for all practical antenna heights above 0.2 wavelengths.

$$R \approx 15 \Big[-\frac{\pi}{2} \sin 4\pi \frac{h}{\lambda} + (2.303 \log_{10} \frac{2h}{\lambda}\ 1.722) \cos 4\pi \frac{h}{\lambda} + 2\,(2.415 + 2.303 \log_{10} \frac{2h}{\lambda}) \Big] \, . \qquad (4)$$

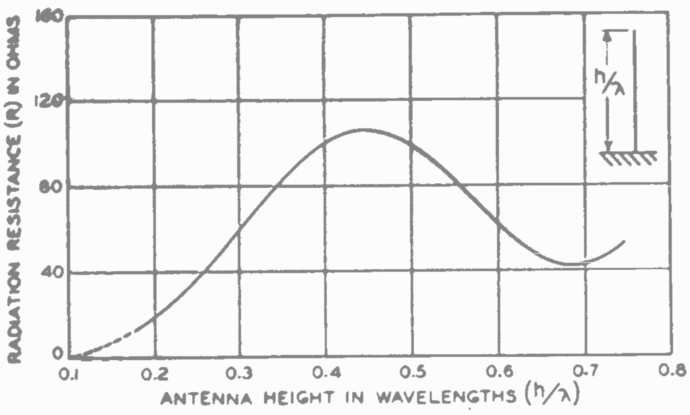

Fig. 1—Radiation resistance of vertical antennas.

This equation is plotted in figure 1 as a function of antenna height in wavelengths.

Now evaluating equation (1) in terms of 1 kw antenna input power and a distance of one mile we have:

$$E \text{ mv/m} = \left(\frac{1180}{\sqrt{R}}\right) \frac{\cos\,(2\pi h/\lambda \sin\theta) - \cos 2\pi h/\lambda.}{\cos\theta} \tag{5}$$

R = radiation resistance computed from equation (4).

If we are interested only in the ground plane field intensity then $\theta = 0$ and "the horizontal figures of merit" equation (5) reduces to:

$$E \text{ millivolts/meter} = \left(\frac{1180}{\sqrt{R}}\right)\left(1 - \cos 2\pi\frac{h}{\lambda}\right). \tag{6}$$

Equations (4), (5) and (6) give the radiation characteristics of vertical antennas of various heights when the assumptions 1 and 2 mentioned above are made. Equation (6) gives for "horizontal figure of merit,"

195 mv/m for a 0.25 wavelength antenna,
218 mv/m for a 0.4 wavelength antenna,
253 mv/m for a 0.55 wavelength antenna,
277 mv/m for a 0.64 wavelength antenna.

The 0.55 wavelength height is seldom exceeded because, above this height, considerable radiation is produced in a high angle lobe which in turn reduces the fading-free radius of the station. Examining the values given in the above table we observe that only 12%, or 1 db, improvement is realized when the antenna height is increased from 0.25 wavelength to 0.4 wavelength. On the other hand, a 30% or 2.5 db, improvement can be expected if the height is increased to 0.55 wavelength. It therefore appears that if the "horizontal figure of merit" is the main concern there is very little advantage in exceeding a height of 0.25 wavelength unless one is prepared to go to a height of approximately 0.5 wavelength.

Our first assumption was that the current is distributed along the antenna in a sinusoidal manner. We shall try to determine to what extent this assumption is justified. However, before doing so, it will be well to point out that no exact solution for the current distribution along an antenna has been evolved. We can, however, obtain a fairly good approximation by treating the antenna as a dissipative transmission line. In depicting the antenna in this manner I have chosen to use illustrations which may appear crude or artificial to the mathematical physicist but it is believed they will serve in giving a clearer picture of the problem to the engineer.

In figure 2 is shown a vector diagram of the currents along a lossless open ended transmission line or antenna which is slightly longer than ½ wavelength. The vector, I, represents the current transmitted in a "positive" direction up the the conductor from the generator. It is assumed to be rotating clockwise and since no losses are present, it is the same length at all points along the conductor. At the open end of the conductor the field collapses and induces in the conductor the current I′, opposite in direction to the current vector, I. I′ is then the reflected current traveling in the "negative" direction toward the generator. I′ is also rotating in the clockwise direction and is the same length at all points since no losses are present. The vector sum of these two traveling waves of current produce the standing wave of current I_0.

If we now plot the amplitude of I_0 along the antenna we obtain the diagram (b) and find that the amplitude of I_0 varies as the sine of the angular

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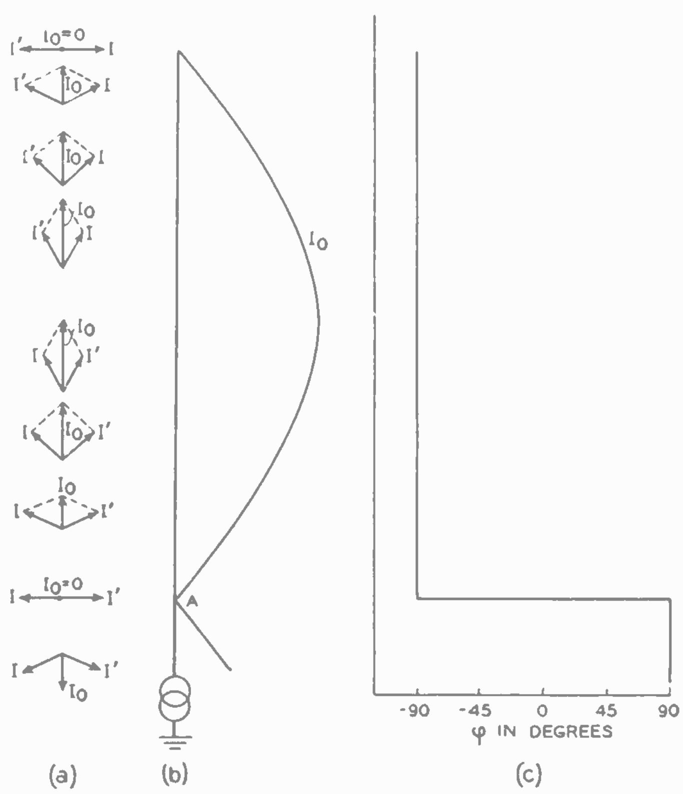
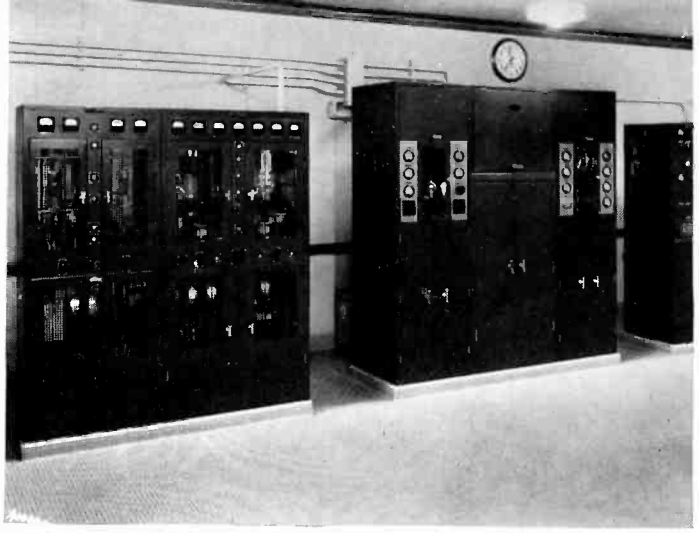


Fig. 2—Vector diagram of current amplitude and phase distribution along a lossless open ended transmission line.



(Left) Lt. Roy DeShaffon, in charge of the Communication Division.

(Above) Western Electric 309B and 14C transmitters, shown also in general view of transmitter room (right).

POLIC

Kans

By F. E. NIMMCKE
Commercial Products Development
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The most complete and elaborate layout of police radio equipment in the country — that's KGPE, the police radio station at Kansas City, Missouri. Facilities to meet every conceivable communication need are at the fingertips of this modern police department which recently rounded out its complement of equipment with the installation of a new Western Electric 309B transmitter and associated speech input equipment. KGPE first went on the air in June, 1931 with a Western Electric 9A transmitter operating at 250 watts and providing one-way communication with twenty five receiver equipped patrol cars. In September, 1936, a Western Electric 14C 10-channel transmitter was installed to provide communication on the national police radio network.

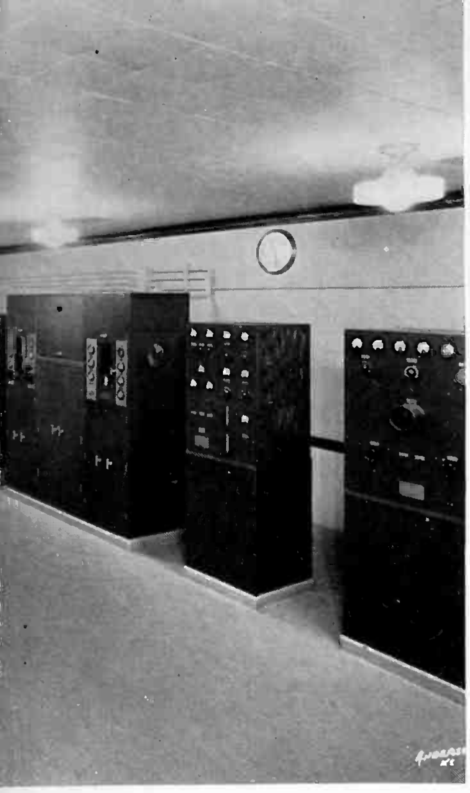
In December of 1938 a new police headquarters building was completed and it is here that the new equipment and that already in use have been combined into a system that would delight the eye and heart of any radio engineer. The transmitter room, floored with tile, and with walls and ceiling of acoustic panelling, provides plenty of space for the equipment arranged within it. Along one side of the room are three transmitters, the new Western Electric 309B telephone transmitter, the 10-channel 14C combined telephone and telegraph transmitter and a 500 watt radio telephone standby. In the center of the room is the control desk, a thing of beauty designed to afford the operator the maximum of control with a minimum of effort. Near the wall to the left of the control operator stands the audio frequency panel assembly, whose five bays hold more equipment than is usually found in a good-sized broadcasting station.

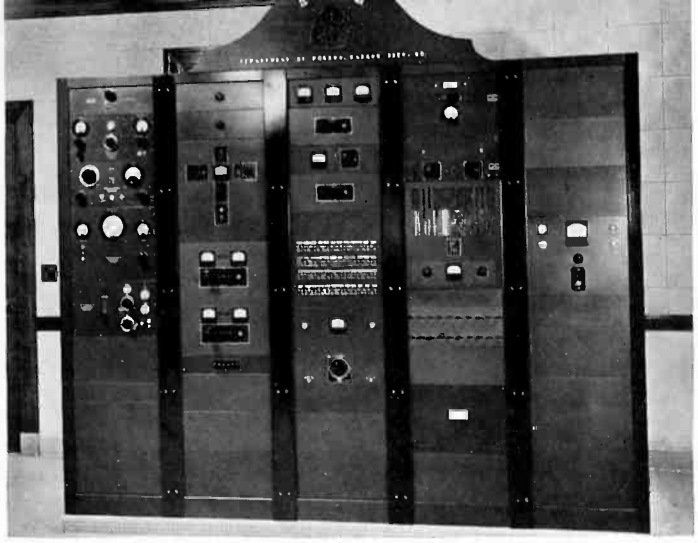
The radio operator at the control desk in the transmitter room has complete observation and control over the entire system. He controls the audio frequency level into the audio amplifiers and the radio transmitters by adjusting the gain controls and observing the volume indicator. He may also at any time dispatch messages to the mobile units. Signal lights are provided on his desk and in the dispatchers' studio to indicate when the telephone transmitter is in use.

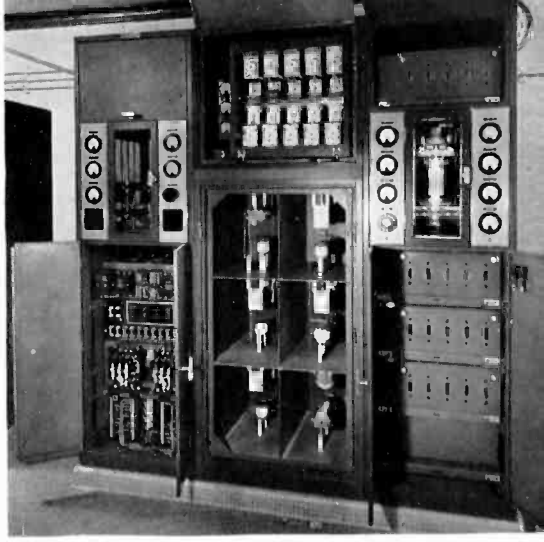
In the "dispatchers' studio" next to the transmitting room are located the main controls for the radio telephone transmitting equipment. Two dispatchers, with duplicate equipment, are seated at the control desk facing a large map of Kansas City and its environs. On this map small colored indicating lamps controlled by a multitude of switches on the dispatchers' desk show the location and disposition of every one of Kansas City's 126 radio equipped patrol cars, in addition to 25 cars used by North Kansas City and Independence and by Jackson, Clay and Johnson counties.

The officers in the cars talk back to the dispatchers by means of ultra high frequency equip-

Dispatchers' studio. Keys in center of control desk operate car indicating lights on large wall map. Loudspeaker from output of remote receivers is located in the center of control desk.







(Above) Audio frequency amplifier panels and measuring equipment.

(Right) The 14C transmitter with doors open. At bottom center is the special filter for simultaneous transmission.

RADIO

City, Mo.

ment. The signals from these mobile transmitters are picked up by any of ten remote receivers installed in various locations about the city. The outputs of these receivers are connected by wire lines to the Headquarters Building and amplified and reproduced by several loudspeakers one of which is located in the dispatchers' studio.

To converse with the patrol cars the dispatchers use 630A microphones, the output of which is amplified for the proper input level to the 309B transmitter by Western Electric 104A and 105A amplifiers and a 110A program amplifier. There is provided a duplicate for each of these amplifiers, except for the 110A which may in emergency be omitted from the circuit since the 105A amplifier has sufficient gain to provide the proper audio frequency input level for the radio transmitter. Under normal operating conditions there are no patch cords in the jack panel of the audio frequency amplifier assembly. Only in an emergency or when an amplifier in service is to be inspected are patch cords required.

The output of the 309B equipment is monitored by means of a monitoring amplifier and a loud speaker in the transmitter room. There are, in addition to the audio frequency amplifiers mentioned, a Western Electric 1086B and two 109B amplifiers used for the purpose of announcing throughout the building.

The 14C transmitter is under the sole control of the radio operator in the transmitter room. Kansas City has been selected by the FCC as an interzone station of the national police zone and interzone radio telegraph network, and for telegraph transmission to the various zones, KGPE uses nine of the 14C's ten channels. These nine channels are divided into three groups, with one calling and two working frequencies to each group. In carrying on the job of zone and interzone communication, the radio operator is regularly called upon to communicate, by CW telegraphy, with St. Louis, Topeka, Jefferson City, Houston, Memphis and other cities, often as far west as California.

One of the most important features of the entire system is an ingenious filter unit designed by Bell Telephone Laboratories which permits simultaneous transmission of the telephone and telegraph transmitters from a single 135 foot Blaw-Knox vertical antenna erected on the top of the new headquarters building. The circuits of this filter unit function to eliminate the interference caused by cross-modulation which would otherwise be present. Provision has also been made in the filter unit to permit voice modulation of the tenth channel of the 14C transmitter on the radio telephone frequency should an emergency arise.

A concentric transmission line distribution box is located on the wall of the transmitter room in the rear of the transmitter assembly. This box provides terminating and switching facilities for the transmission lines. Three transmission lines are routed from

(*Continued on page 34*)

Control desk showing receiver at left, speech input control panel at top center, 14C transmitter control panel at bottom center, and UHF remote receiver termination panel at right.

New Multi-Purpose 357A Operates at Full Ratings up to 100 Mc.

(Illustrated on cover and page 8)

No branch of radio engineering has advanced more surely and rapidly than that of the design and manufacture of transmitting tubes. There are tubes today which only a few years ago were undreamed of. Such advance is due to the evolutionary increase in the knowledge and techniques of the art, the introduction of new materials, and particularly to the insistent demand for high power tubes which would work efficiently in the higher frequencies.

This demand for high-power-high-frequency tubes has in recent years tremendously speeded tube development. Just a few years ago there were no tubes, except, perhaps, a few of the receiver type, which would work much higher than fifty or sixty megacycles. When Western Electric introduced the 304 type tube in 1936 it was considered a great advance because it delivered a full 50 watts at 100 mc.

Now through Bell Telephone Laboratories research and design, Western Electric introduces the 357A having a rating of 350 watts plate dissipation and full voltage rating up to 100 megacycles. It is the direct result of research efforts to produce an efficient high-power tube capable of taking high frequencies in its stride plus the use of the newly developed molded glass techniques which provides both stemless and baseless construction. Bell Telephone Laboratories designs of the 316A and 356A and improved water-cooled tubes also use this technique.

First application of the 357A will be in the new high efficiency Western Electric one kilowatt broadcast transmitter, (described on page 9 of this issue), but it is destined to receive heavy duty in police, aviation, and marine radio transmitters. It is also suitable for use at audio frequencies, particularly in Class B audio amplifiers or modulators, and because of its high amplification factor requires relatively low biases for high voltages.

Besides its outstanding high-frequency performance, the tube is noteworthy for its reduction in size and cost of manufacture over other tubes of similar power ratings. These economies in size and cost are direct results of designing tubes for use at higher frequencies through the elimination of costly base material and the conventional stem construction. Further reduction in size was made possible by the present practice of designing transmitters with proper air cooling facilities. The tube has a horizontal diameter of 5⅛ inches and its overall height is only 8 inches.

The tube's electrodes are supported independently and individually entirely by their own short and heavy leads directly from the hard glass envelope. The unusually short leads and the elimination of solid radio frequency dielectric inside the envelope greatly reduce radio frequency losses.

The leads are welded, rather than soldered, to the exterior copper terminals, thus eliminating any damage to the copper through longer application of heat required in soldering. More rigidity is secured in the welded grid assembly through the use of eight vertical supports for the helical grid winding. Reduced grid currents also result from this type of construction.

Longer tube life is assured by employing the exclusive Western Electric copper-to-glass lead seals which reduce the likelihood of loss of vacuum from glass cracks around the seals so often occuring in tungsten-to-glass seals of large size.

Inter-electrode capacities between plate and grid, and plate and filament are greatly reduced through the use of the cylindrical type plate. Heat radiating capacity of the plate is considerably increased by the six fins which run the length of the plate.

These many features all combined in the 357A result in a tube of extreme efficiency capable of a variety of applications throughout the entire commercial radio frequency spectrum. It is the highest power commercial radiation cooled tube for operation at the ultra-high frequencies.

Characteristics of 357A

General				
Filament voltage	10.0 volts			
Nominal filament current	10.0 amperes			
At a plate current of 0.5 ampere				
Amplification factor	30			
Grid-plate transconductance	9000 micromhos			
Plate resistance	3300 ohms			
Perveance	800x10^{-6} amp/volt 3/2			
Average values of the direct capacities between the electrodes:				
Grid to plate	4.25 μμf			
Grid to filament	9.5 μμf			
Plate to filament	2.5 μμf			
Maximum ratings				
Maximum direct pate voltage	4000 volts			
Maximum direct plate current	0.5 ampere			
Maximum continuous plate dissipation	350 watts			
Maximum direct grid current	0.100 ampere			
Class B Audio Amplifier or Modulator 2 Tube Circuit				
Direct plate voltage	4000	3000	2000	3000*
Grid bias voltage	—130	—85	—50	—85
Approx. static plate current	.120	.120	.160	.120
Maximum signal plate current	.535	.700	1.0	.435
Load Impedance—plate to plate—ohms	18500	10500	4650	14700
Approx. Maximum Output per pair of tubes with total distortion less than 5 percent—watts	1625	1580	1400	850
Actual driving power—watts	30	40	50	13.5

(*Continued on page 34*)

The men who have made KRLD, left to right, Clyde Rembert, Station and Commercial Manager; Tom Gooch, Editor-in-Chief, Dallas Times Herald; John W. Runyon, Advertising Manager of the paper and Managing Director, KRLD; and Edwin J. Kiest, Owner and Publisher of the paper.

DALLAS **KRLD** TEXAS

A New Voice Comes to the Southwest

By WILL WHITMORE

Visitors are apt to go overboard in talking about Texas and Texans. There is so much about the state and its people that folks at first don't quite understand their own reactions. "How do they accomplish so much and yet appear so easy going," the stranger invariably asks. It's a good question.

Texans never seem to hurry. They have plenty of time to stop and chat with you, and if you don't return the courtesy they think there's something wrong with you. There's always time to drop things and amble over to the soda fountain for a Coca-Cola, and when an Easterner perspires and wilts in the summer sun, the Texan manages to keep cool and comfortable. When the sun goes down he has accomplished just as much or more than the man who goes tearing around burning himself out. And Texans do accomplish things in a great big way. What a paradox!

Take Dallas for instance. Its population figures began in 1860 with a mere handful of 775; today, it proudly boasts 365,000 loyal, boosting, enthusiastic inhabitants. Of all Texas cities, Dallas, perhaps is hardest to explain. Sitting squat upon the plains of north central Texas, its buildings have grown up into the air and stretched out to cover an amazingly wide area. It has developed a culture and a way of living that is distinctly its own, being neither southern, southwestern, northern, nor eastern.

Its business tentacles have reached out and sucked in much of the trade of Texas as well as a great deal of that of the four states which rest upon its far-reaching borders. Its taste in feminine fashions does much to dictate what women shall wear from coast to coast. Its dazzling sky is pierced by planes which take off and land at busy Love Field in a never ending procession. Its retail shops compare in looks and business with those on Fifth Avenue, and its hotel dining and dancing rooms are as smart and sophisticated as anyone could want. And now with the installation of a new transmitter at Station KRLD it joins New York, Chicago and Los Angeles in becoming one of the country's four cities which have two 50 KW radio stations each.

The greatest period of growth in size and prestige for both Dallas and KRLD coincide. Undoubtedly they helped to boost each other. Today, behind the radio station, and also to a remarkable extent behind the city of Dallas stands a small 78-year-old man, Edwin J. Kiest. He is owner and publisher of the Dallas Times Herald which in turn owns and operates the radio station. You can't explain Dallas without mentioning Kiest and others like him.

Today, although ill health has tempered his pace, he still gets to work as early as his youngest cub reporter, and his carriage is just as erect. He smokes his cigars to the nubby point where his fingers begin to burn, a frugal habit learned years ago when the price of a cigar was no small investment for him. His keen, young eyes can drill a hole through you, or twinkle merrily at his telephone operators. He knows radio from swing to Toscannini, from Kate Smith to Lawrence Tibbett, but first and last he is a newspaperman.

Born on a farm on the outskirts of Chicago, he first came under the spell of printer's ink

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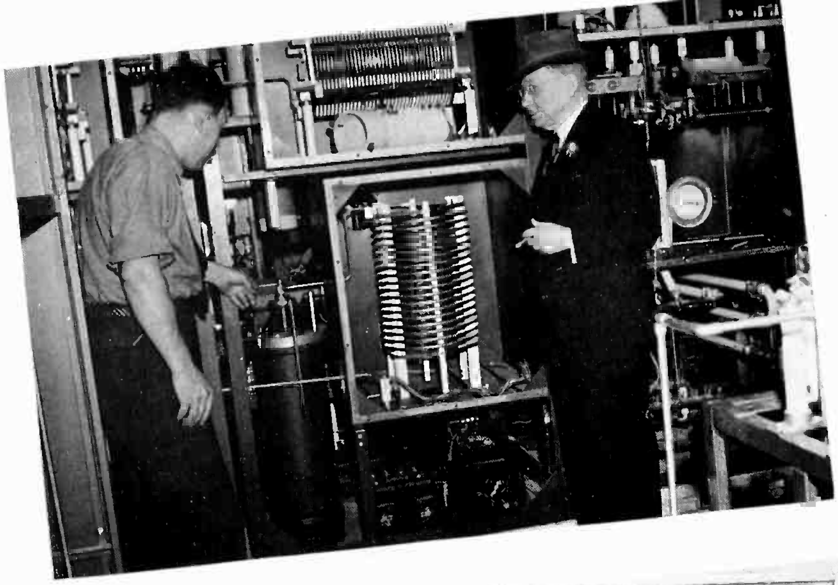

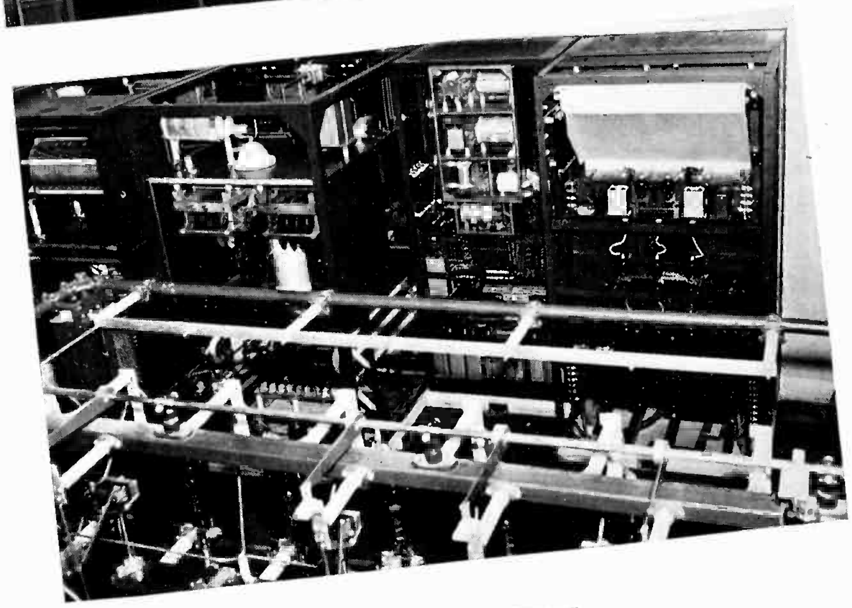

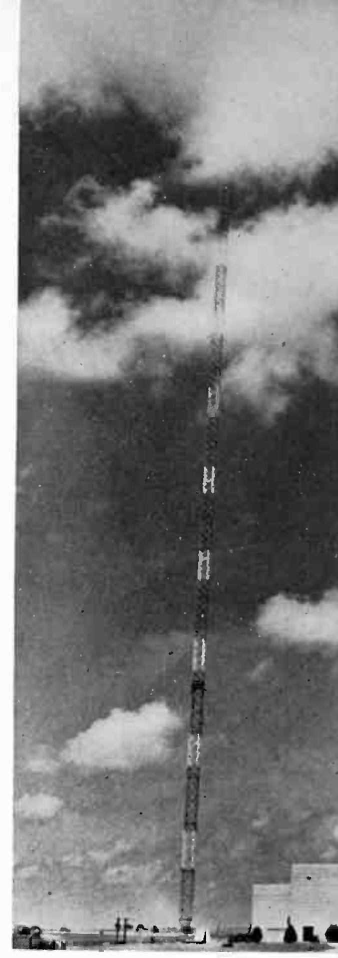

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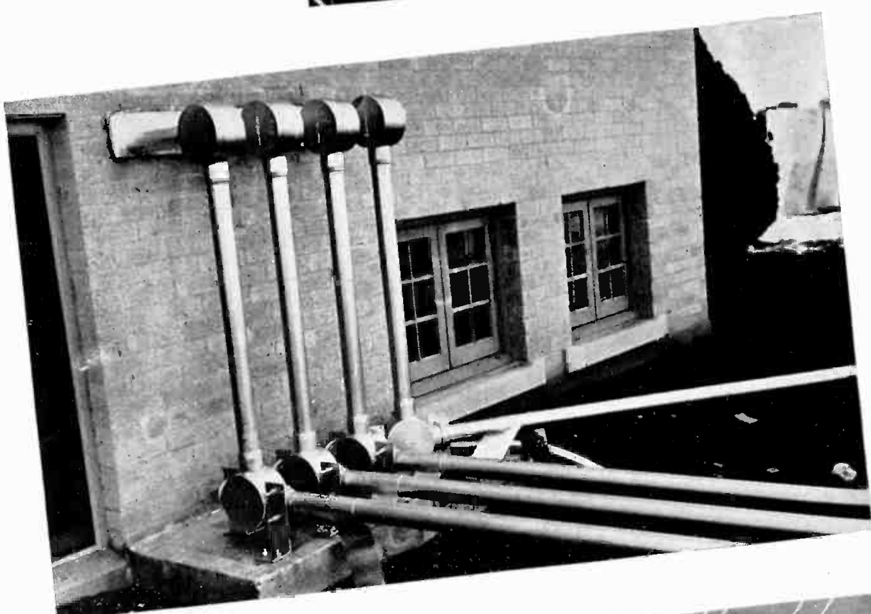
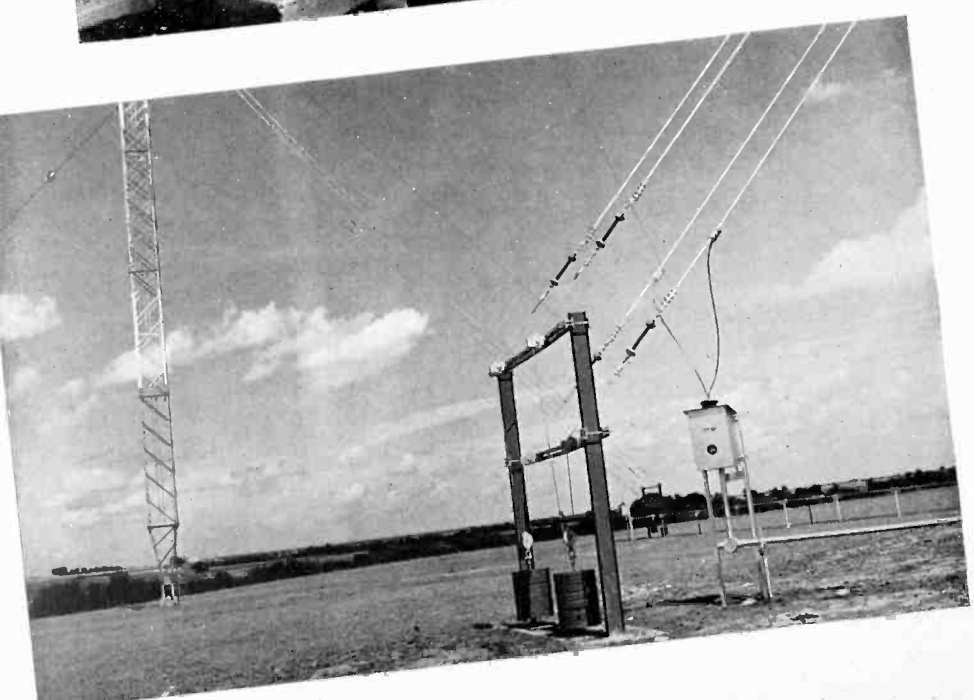
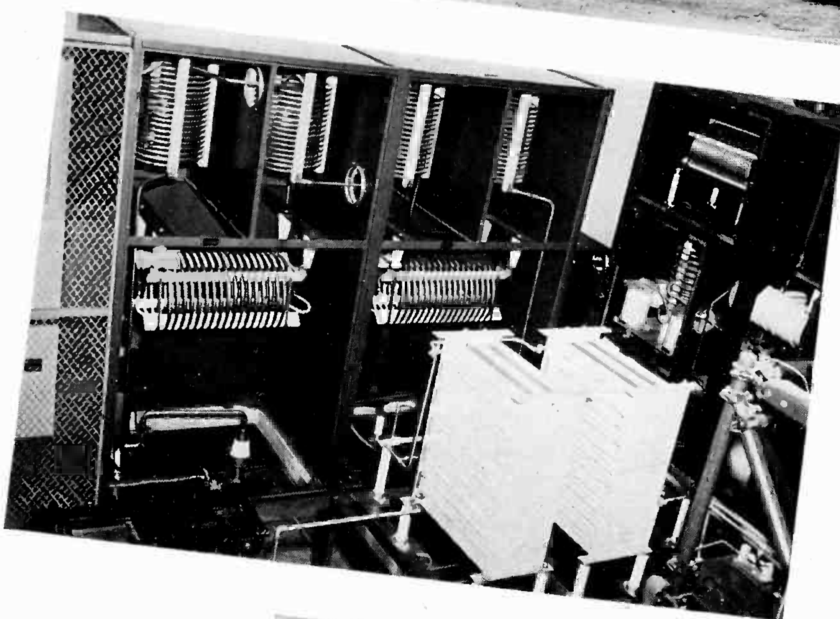
Top left: Jack Herber, Bell Telephone Laboratories, explains transmitter to Edwin J. Kiest during installation. Below: Rear view of transmitter units. Left: Concentric transmission lines and harmonic shunts leaving building. Lower left: Multiple conductor coupling system, anchorage and counter weights. Below: F. J. Riley, station operator, checks up on the high and low pressure nitrogen manifolds which are used in connection with compressed nitrogen condensers, concentric transmission lines and shunts.







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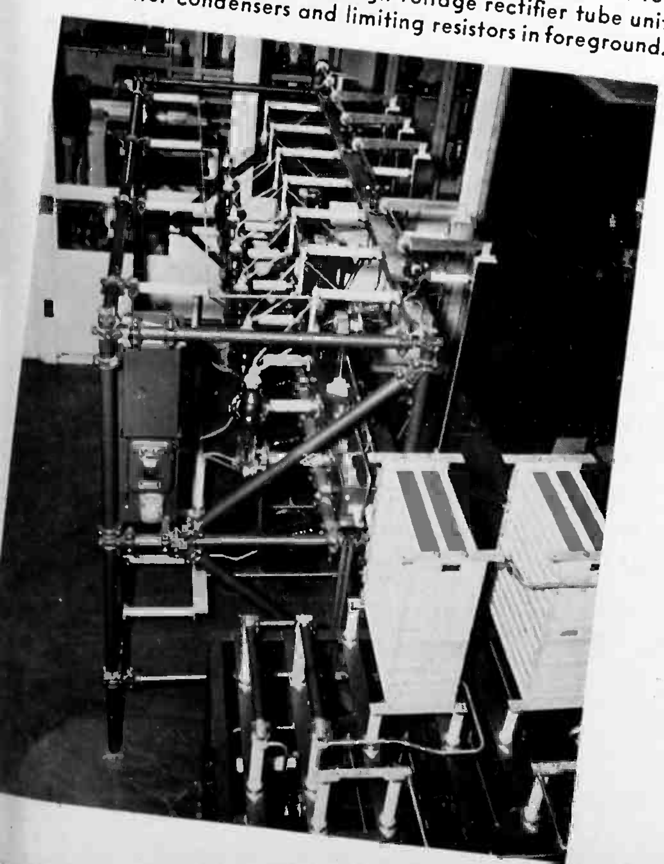
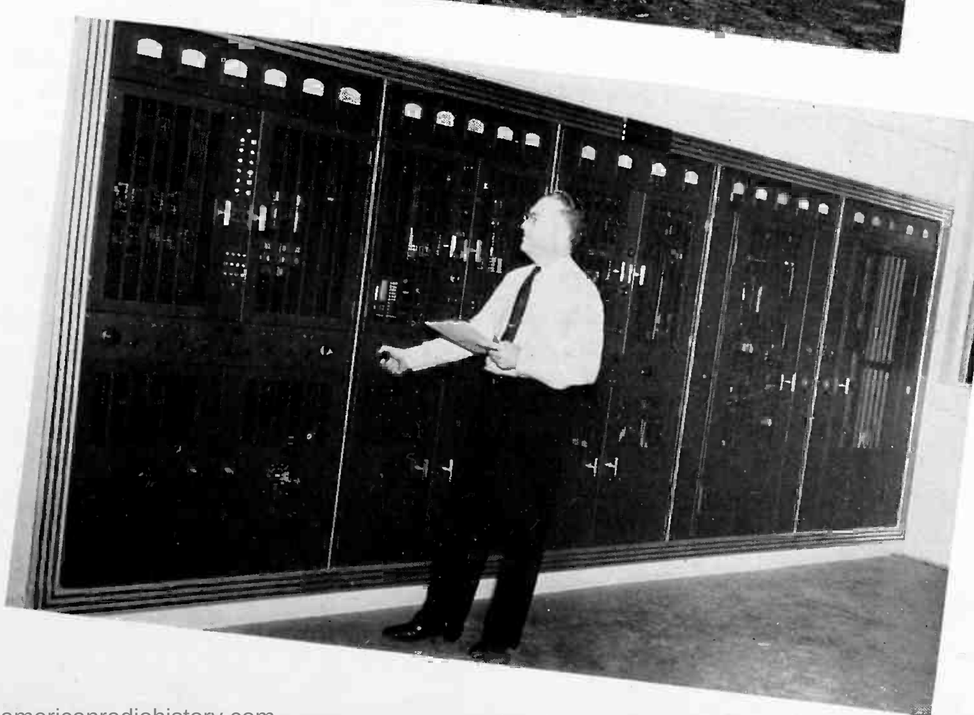
50 KW.

Below the close up view of KRLD's transmitter building is shown the "34-B" transmission line branching and phasing units for the directive antenna system. Right: A long distance view of concentric transmission lines and shunts. Lower right: That smile on the face of the Chief Engineer, Roy M. Flynn, viewing the new 50 KW transmitter would indicate that KRLD's powerful voice is in good trim for the gala opening. Below: High voltage rectifier tube unit with filter condensers and limiting resistors in foreground.





KRLD, Dallas, Texas

(*Continued from page 17*)

during the great Chicago fire which separated him from his parents and forced him to sell newspapers to feed a young and ravenous stomach. As a newsboy he came to admire the publishing genius of Victor F. Lawson, editor and publisher of the Chicago Daily News, and dreamed of the day he could operate a paper of his own modeled on the same successful Lawson formula.

That chance came when he purchased the Dallas Times Herald in 1896, a small 20-year-old rag then looking forward to an untimely death. Kiest still carries the watch famed for the many two-way nocturnal visits it made to the local pawn shop to meet the Saturday payrolls in those days. Under his shrewd leadership life began to bloom on the pages of the Herald, and today it is recognized as one of the South's leading and most prosperous papers.

Kiest's interest in radio began back in the days when the wireless first began to fling dots and dashes through space. He recognized its vast potentialities as a gatherer of world-wide news, and when radio began to put lumps on the ears of headphone listeners, he was among the first to see in it the great disseminator of news and entertainment it has become. Interest grew into participation in the operations of WRR which was used principally for police broadcasts, and then in 1926, together with business associates, he opened KRLD with a meagre power of 500 watts. The Times Herald assumed full ownership of the station the following year, and later that same year became a member station of the newly formed Columbia Broadcasting System, a relationship both continue to enjoy. Since 1935 the station has operated on 10 KW.

KRLD is first, last and always a newspaper-operated station. Kiest has made it so. "Successful operation of a newspaper or a radio station depends upon giving the public what it wants," he says, "and who knows more about that than newspaper men!" He scoffs at the charge of the danger of too much monopoly in newspaper stations. "The same checks against this apply to both because each appeals to and receives its support from the same source, the public," he points out.

Picking up a recent edition of his paper, Kiest pointed to a picture of the arrival of the King and Queen in Washington. It was made just a few hours before and sent by cable and wirephoto to every part of the country. "What's television and facsimile going to do to radio," he wanted to know. One would think that a man of his age would be content to let younger men bother about such things, but not Edwin J. Kiest. Looking ahead has been his constant purpose and accounts for his success. "Seems to me they will eventually replace sound broadcasting as we know it today," he says, "and they hold a definite threat to newspapers. They will provide a perfect medium for disseminating national and international news. Perhaps someday a newspaper's only job will be to provide local news." Kiest sweeps aside the present limitations and objections to television and facsimile with the observation that technological development has always managed to overcome obstacles which stood in the way of giving the public what it wants and that our scientists and researchers are capable of solving any problems which may at present impede the progress of television.

Believing as he does in the affinity between newspapers and radio stations, Kiest has studded KRLD with his newspaper executives: Tom Gooch, Editor-in-Chief is also President of the KRLD Radio Corporation, and J. W. Runyon, Advertising Manager, is also Managing Director of the station. Long skilled in analyzing the public's mind and giving it what it wants, Tom Gooch has successfully applied his newspaper training to the operation of KRLD.

"Going from 10 to 50 KW does not consist merely in paying the bill for a new transmitter," he says. "At least a million-and-a-half people live in the territory which we are adding to the station's present coverage. It's going to take lots of research to find out what these people want and how we can best serve them. That's one of the biggest problems we have. We have already tackled the job. But our problem is not unique. It confronts every radio station in the country.

"Radio has grown so fast, become so influential and powerful, we need to develop more men who are just as big as radio itself. We must attract young men who possess a broad and intellectual grasp of the forces and trends of modern times, and who are capable of transferring this knowledge to the daily operation of stations," he insists.

Clyde Rembert, who doubles in brass as station and commercial manager, while not a newspaperman by experience, thinks and acts like one. "We use exactly the same formulae in preparing the day's program that an editor employs in making up the front page of his paper," he says. "First of all it must be as timely and fresh as a front page. It must have the same delicate editorial balance between local and national interests; it must have something of interest and appeal to every listener and possess the same punch and pace.

"In increasing our listening audience with our new transmitter the problem becomes more difficult but the principle remains the same. Ever since we knew almost a year ago that we were to increase power this summer we have been improving and developing our programs. New personnel has been added. We have improved our program and announcing staffs, and laid careful plans for appealing to our new audience.

"When we inaugurate our new station

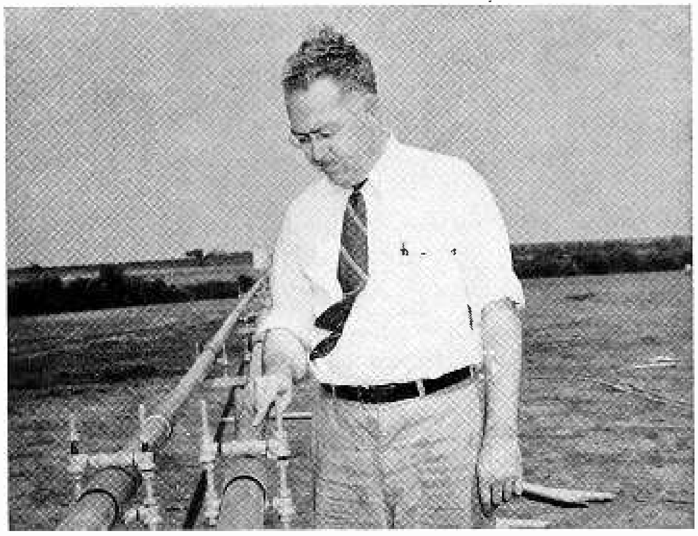
on July 16, our signal will reach out to embrace a population of almost 6,000,000 people living in Texas, Louisiana, Arkansas, Oklahoma and New Mexico. We will bring the finest possible reception to a great population whose radios formerly were plagued with summer static and fading. With a heart shaped directional pattern pointing due southwest we are straightening our signal particularly to the west, south and east. The extent of our immediate and most important coverage, particularly for programs of Columbia can be seen by studying a map. The nearest Columbia stations are to the southwest, San Antonio, 260 miles; southeast, Houston, 220 miles; east, Shrevesport, 191; northeast, Little Rock, 305; north, Oklahoma City, 183; and west, Tucson, 880 miles.

"We have always enjoyed the goodwill of our listeners, and have spared nothing to give them service. Our microphones have always been open to all civic enterprises. Our educational programs go into many of the schools of the state, and our agricultural broadcasts are particularly successful; yet the nature of these programs will have to change in line with the customs and occupations of our new listeners. We are increasing our coverage of the ranching country; the oil industries; wheat farmers; lumbering; and many other phases of the varied and wealthy Texas scene.

"In the past we have thought nothing of linking up stations all over the state to broadcast interscholastic athletic and other state events using as much as 2,500 miles of telephone lines. Such service will be not only continued but increased," says Rembert.

And so millions of Texans and others in neighboring states are looking forward to July 16 when a new and more powerful KRLD comes to the Southwest. Millions of listeners will get better radio service. Advertisers will get more for their money, and growing, humming Dallas will be in a position further to widen its scope of trade and influence.

Roy M. Flynn—KRLD



Roy M. Flynn, Chief Engineer, KRLD, Dallas, Texas.

Right now down in Dallas, Texas, there is a man working practically 24 hours a day to meet one of the most important deadlines of his life. He is Roy M. Flynn, Chief Engineer of KRLD, and the important date is July 16 when the station goes on the air with an all-day special program inaugurating its new 50 KW. Western Electric transmitter.

KRLD's going from 10 to 50 KW. places Roy high in the ranks of Broadcasting engineers, a position he most eminently deserves. As a boy in his native city of Gainesville, Texas, he became interested in electrical engineering and has followed Ohm's Law ever since. He early gave a foundation to his wide practical experience and training by taking courses in mathematics at Southern Methodist University.

One of his first radio jobs was to build and operate for the Sun and Humble Oil companies communication equipment used in coordinating the field work with the home offices. Later he joined the Public Address Service Company, and installed some of the first public address systems in that part of the country. He will never forget one job. The Anti-Saloon League employed him to erect giant speakers at Fair Park Stadium for a special address to be given by Herbert Hoover. When a bank of speakers was hoisted to the top of a high pole, the entire unit crashed to the ground. Mr. Hoover had to depend upon his own lungs, and Roy still blushes when he recalls the incident. Many of the theatres of the southwest were given voices by Roy when talking pictures began to replace the silent ones.

Later he went to work for the Dallas Laboratories, in charge of the technical department. This company first operated KRLD. Its call letters would have been KDRL had not some ship at sea grabbed them first. When the station was taken over by its present owners, the Dallas Times Herald, Roy went with it and became Assistant Chief Engineer and in 1929, Chief. The station increased power to 10 KW. in 1928 with a composite transmitter built under Flynn's supervision. He also found time to build the station transmitter at KUT, Austin. But his real love is speech input equipment.

Flynn and his wife are now enjoying the comforts of a beautiful new home built this year in University Park. In the odd moments he can steal away from radio, he goes in for all phases of photography, and his many friends who have seen his fine color shots and motion pictures will testify to his photographic ability. He has been a member of the Institute of Radio Engineers since 1927.

Broadcast Antennas

(Continued from page 13)

length of the conductor. The phase distribution of I_0 is equally important in our problem and we note from the vector diagram (a), that, starting from the top of the conductor, at each succeeding point I_0 is in the same direction until a point is reached where the amplitude of I_0 goes through zero. Below this point I_0 has changed its direction 180°. Diagram (c) is a plot of this phase distribution and we see that within each half-cycle the current I_0 is everywhere in phase but changes abruptly 180° when the amplitude of I_0 goes through zero. Figure 2 represents sinusoidal current distribution and, since to obtain the field intensity at a point in space we must sum up the fields contributed by each elementary element along the antenna, taking full account of the amplitude and phase of the current in each element, it may be readily seen that our summing up process is greatly simplified if we assume a distribution of current such that its phase is constant and its amplitude proportional to a simple mathematical law.

To arrive at this simplification, however, it was necessary to assume that the currents experienced no loss in their travel along the conductor. This, of course, is not true in an actual antenna which is intended to disperse energy into space in the form of radiation. The very fact that there is radiation involves energy loss along the antenna and corresponding departure from sinusoidal distribution of current.

With our simple picture we will then assume that the current vectors are attenuated, because of radiation, in their travel along the conductor as in

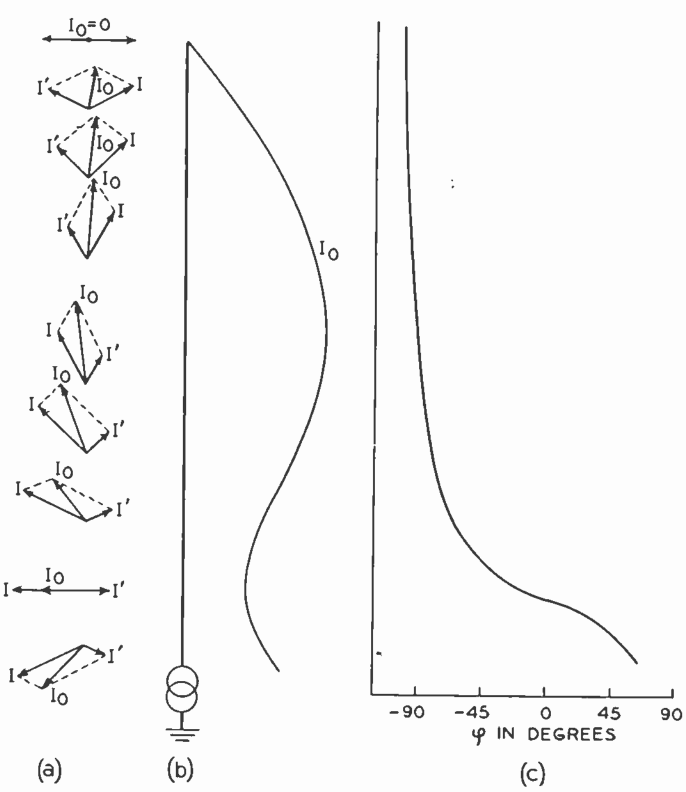


Fig. 3—Vector diagram of current amplitude and phase distribution along an open-ended transmission line with distributed losses.

figure 3. We note that the vector I becomes progressively shorter in its travel up the conductor and the vector I′, the reflected current, while equal to I at the open end of the conductor, becomes progressively shorter in its travel toward the generator. It will be then noted, figure No. 3 (b), that the current I_0 is not equal to zero anywhere along the conductor except at the open end. Furthermore, while the greatest phase change occurs near the current minimum point there is a progressive phase change throughout the length of the conductor. It is also interesting to note that in the first quarter wavelength from the top of the conductor the two vectors I and I′ are more nearly equal in their length than is the case in the lower portion of the conductor, indicating that the sine wave assumption holds much more closely for conductors one-quarter wavelength or less in length than it does for nominal one-half wavelength conductors.

Work has been published within recent years treating the antenna as a dissipative transmission line. [1, 2, 3, 4] This approach to the problem appears to lead one more closely to the conditions actually observed in practice. In transmission line theory we are interested in deriving two circuit constants, the characteristic impedance and the propagation constant.

The characteristic impedance:

$$Z_0 = \sqrt{\frac{r + j\omega L}{G + j\omega C}} \,. \qquad (7)$$

When r and G are negligible quantities as would be the case in a lossless line:

$$Z_0 = \sqrt{\frac{L}{C}} \,. \qquad (8)$$

For vertical conductors in terms of physical dimensions:

$$Z_0 = 138 \log_{10} \frac{h}{\rho} - \left(60 + 69 \log_{10} \frac{2h}{\lambda}\right) \qquad (9)$$

where:

- h = length of the conductor
- ρ = radius of the conductor
- λ = wavelength

Equation (9) holds to a close approximation for conductors less than one wavelength long and it is of interest to note that Z_0 is a function of the ratio, h/ρ, and there is also a correction factor for the operating wavelength. This equation has been plotted and is shown in figure 4.

Since, we are considering a dissipative line the characteristic impedance will be changed slightly from the lossless value given by equation (8), that is:

$$Z_0^1 = \sqrt{\frac{r + j\omega L}{j\omega C}} \,. \qquad (10)$$

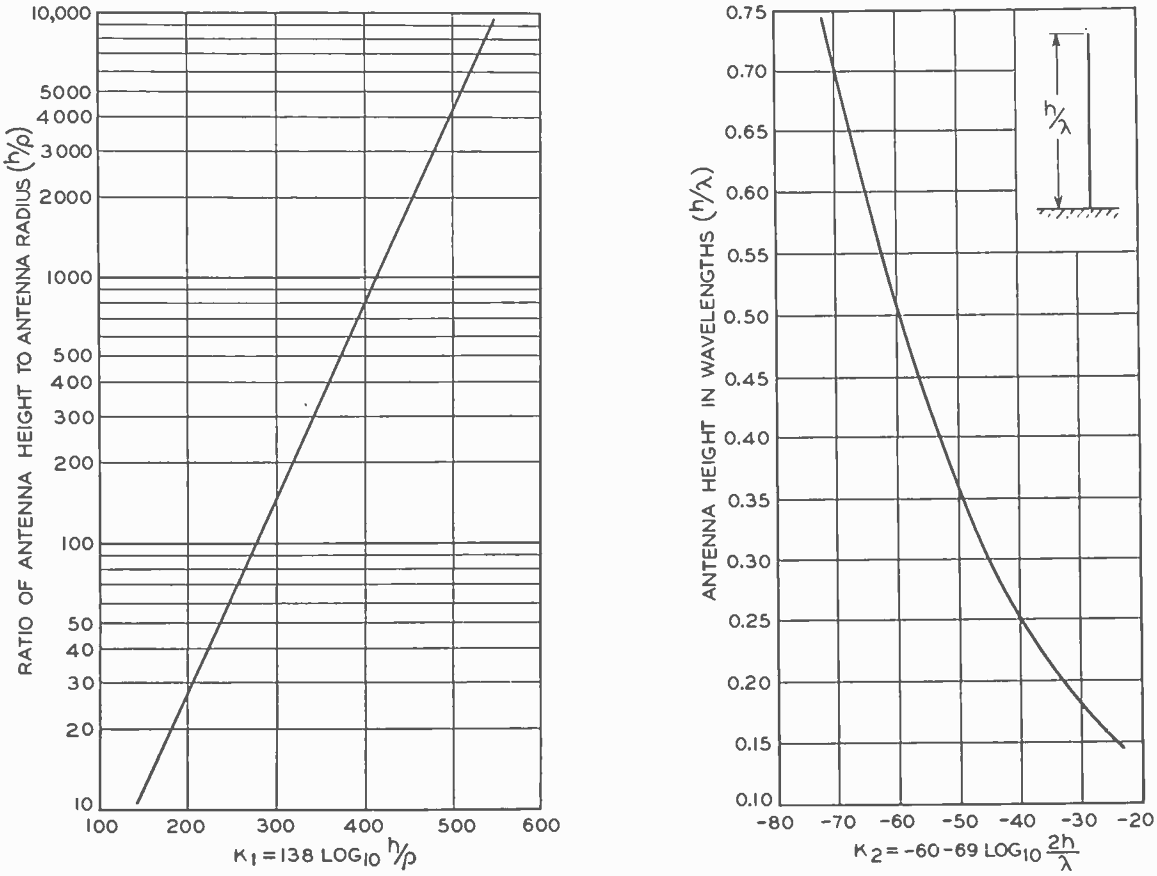


Fig. 4—Characteristic impedance of vertical antennas
"$\mathcal{Z}_0$" $= K_1 + K_2$

It can be shown that equation (10) may also be written with close approximation in the form:

$$\mathcal{Z}_0^1 \approx \mathcal{Z}_0 \left(1 - j \frac{\alpha h}{\beta h}\right) \qquad (11)$$

where:

$\alpha =$ the dissipative term of the propagation constant

$\beta =$ imaginary term of the propagation constant.

Now the propagation constant:

$$P = \alpha + j\,\beta, \approx \tfrac{1}{2}\, r \sqrt{\frac{C}{L}} + j\omega \sqrt{LL} \qquad (12)$$

and the real or dissipative term, α, may be derived from the radiation resistance. While the radiation resistance expressed by equation (4) relates the power radiated with the current at the antinode it has no physical reality as the power is radiated from all parts of the antenna. The actual distribution is complicated, but for practical computations it is sufficient to assume, since we are considering the antenna as a uniform transmission line, that the radiation resistance is distributed uniformly throughout the length of the conductor, that is, the integral of the current squared times the resistance per unit length equals the square of the current at the antinode times the resistance at that point. This integration leads to an equation by which we can compute the total distributed resistance of the conductor:

$$rh = \frac{2R}{1 - \dfrac{\sin 4\pi \dfrac{h}{\lambda}}{4\pi \dfrac{h}{\lambda}}} \qquad (13)$$

where: $R =$ the radiation resistance obtained from equation (4).

The value of rh has been plotted as a function of h/λ and is shown in figure 5.

Having obtained the total distributed loss resistance, the real or dissipative term of the propa-

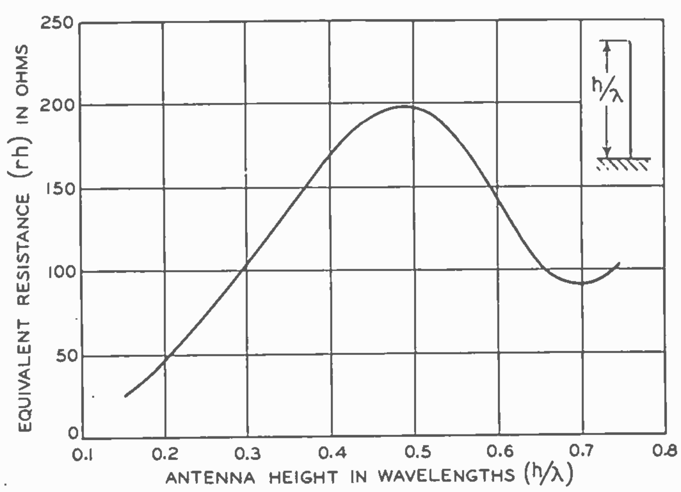


Fig. 5—Equivalent resistance (rh) of vertical antennas.

gation constant is then given by:

$$\alpha h \approx \frac{rh}{2Z_0} . \qquad (14)$$

The imaginary term of the propagation constant:

$$\beta h \approx 2\pi \frac{h}{\lambda} . \qquad (15)$$

From (14) and (15) the propagation constant for a conductor length h:

$$Ph = \alpha h + j\,\beta h = \frac{rh}{2Z_0} + j\,2\pi\frac{h}{\lambda} . \qquad (16)$$

From these derived constants; Z_0 and Ph, we are able to compute an approximate current distribution which experience shows is more in keeping with the actual conditions observed in practice than is the sine wave assumption.

If we let,

I_x = the current at a point x along the conductor
V_s = the voltage at the base of the conductor

We have from transmission line equations:

$$I_x = \frac{V_s}{Z_0} \cdot \frac{\sinh P\ (h\text{-}x)}{\cosh Ph} \qquad (17)$$

This equation may be greatly simplified[3,1] if we take as our reference the current at the antinode and assign the value 0 to terms having very small values. This simplification gives:

$$I_x = I_0 \left[\operatorname{Sin} \frac{2\pi\ (h\text{-}x)}{\lambda} - j\,\frac{rh}{2Z_0}\,\frac{(h\text{-}x)}{h}\cos\frac{2\pi\ (h\text{-}x)}{\lambda} \right] \qquad (18)$$

Where: I_0 = current at the antinode which may be taken as unity for relative purposes.

Equation (18) says that the current I_x consists of two components, one represented by the first term corresponding to sine wave distribution and a second, 90° related to the first and therefore in phase with the voltage. This second term represents the energizing or power component. Figure 6 shows current distribution curves computed from (18) for antennas having a characteristic impedance of 220 and 500 ohms and the measured current distribution on the uniform cross section vertical radiator at station WWJ, Detroit. We observe that the current distribution varies with the characteristic impedance, Z_0, of the conductor which in turn is related to the height divided by the radius of the conductor.

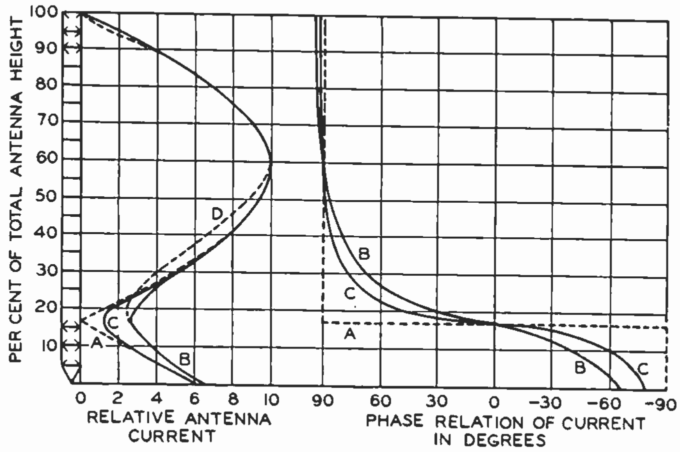


Fig. 6—Current distribution curves for vertical uniform cross section antennas. A—Sine wave distribution; B—Computed using transmission line hypothesis, Z_o = 220 ohms; C—Computed using transmission line hypothesis, Z_o = 500 ohms, corresponding to a ¾-inch diameter wire; D—Curve obtained from observed data on WWJ 400-foot vertical tower radiator.

The polar radiation diagram resulting from the current distribution given by (18) may be approximated by computing separately the fields produced by each component of the current[3], where, as in the case of sine wave distribution, the first current component gives a polar coefficient:

$$K_\theta = \frac{\cos\frac{2\pi h}{\lambda}\sin\theta - \cos\frac{2\pi h}{\lambda}}{\cos\theta} .$$

The second current component gives a polar coefficient:

$$K_{\theta 1} = \alpha h \left[\frac{\sin\frac{2\pi h}{\lambda}}{\cos\theta} + \frac{\lambda\,(1+\sin^2\theta)\ (\cos\frac{2\pi h}{\lambda} - \cos\frac{2\pi h}{\lambda}\sin\theta)}{2\pi h\cos^3\theta} \right]$$

And the modified polar coefficient equals in magnitude:

$$K_{\theta 2} = \sqrt{K_\theta^2 + K_{\theta 1}^2} . \qquad (19)$$

Figure 7 is a polar diagram for 0.6 wavelength uniform cross section mast computed by (19). It is of interest to note that the diagram departs materially from that given by the simple sine wave assumption in the region of the expected high angle null.

Using the transmission line constants, Z_0 and ph, it is also possible to obtain a close estimate of the base or driving point impedance of a vertical conductor. From transmission line equations for an open circuited line we have:

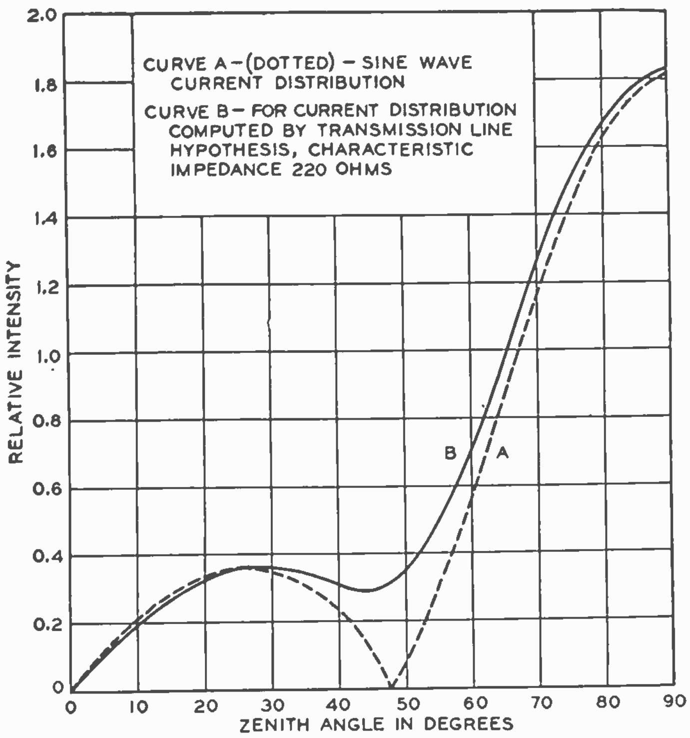


Fig. 7—Radiator diagrams of a vertical uniform cross-section antenna 0.6 wavelengths in height, perfect earth assumed.

$$Z_b = Z_0 \left(1 - j\frac{\alpha h}{\beta h}\right) \coth ph \qquad (20)$$

which when expanded and rationalized gives:

$$R_b = Z_0 \frac{\sinh 2\alpha h - \dfrac{\alpha h}{2\pi h/\lambda} \sin 4\pi h/\lambda}{\cosh 2\alpha h - \cos 4\pi h/\lambda} \qquad (21)^4$$

and

$$X_b = -Z_0 \frac{\sin \dfrac{4\pi h}{\lambda} + \dfrac{\alpha h}{2\pi h/\lambda} \sinh 2\alpha h}{\cosh 2\alpha h - \cos 4\pi/\lambda} \qquad (22)^4$$

These equations (21) and (22) do not take into account the effects of base insulator capacity, the impedance of tower lighting filter circuits, etc. These quantities are specific to individual cases and must therefore be considered separately.

While it is realized that the use of transmission equations are also open to some criticism, they do, however, make use of terms which are familiar to the engineer and take into account more adequately the conditions met with in practice. For those who are interested in a more rigorous approach to these problems reference is made to the work of L. V. King[5]. In his paper Dr. King attacks the problem in terms of electromagnetic field equations with due regard to the boundary conditions. The difference between his results and those obtainable by the more simple expressions above are not, in the practical sense, very large.

When an antenna is placed perpendicular to a large conducting medium, such as the earth, the medium reflects the energy radiated in its direction similarly to the action of a mirror on light waves. The assumption that the earth is a perfect conductor is generally made because it greatly simplifies the mathematics involved in the computation of the polar radiation diagram. In this case the energy would be reflected from the surface of the medium without change in amplitude or phase and may therefore be considered as originating from a conductor below the earth's surface and having the same configuration and current as the actual conductor above the earth.

When the medium is not a perfect conductor as is the case in actual practice the reflected energy is altered both in magnitude and phase at the point of reflection. This alteration is expressed by a reflection coefficient "R_e" which is sufficient for calculating the polar diagram of the radiation field:

$$R_e = \frac{\cos \theta' - T\sqrt{1 - T^2 \sin^2 \theta'}}{\cos \theta' + T\sqrt{1 - T^2 \sin^2 \theta'}} \qquad (23)$$

where: $T = \dfrac{1}{\sqrt{\varepsilon - j\, 2c\lambda\sigma}}$

$\varepsilon =$ dielectric constant of the earth
$\sigma =$ conductivity of the earth
$\lambda =$ wavelength
$c =$ free space velocity
$\theta' =$ zenith angle

If the earth were a perfect conductor R_e would be equal to unity but for imperfect earth R_e is in general a complex number. The solution of (23) for a wide range of soil constants and frequency has been plotted in a series of curves by C. R. Burrows.[6]

If with a vertical conductor we assume a sine wave current distribution and multiply the image term in the expression for field intensity by the reflection coefficient, R_e, we obtain after integration an expression for the polar radiation diagram:

$$E = \frac{1}{2CD}\sqrt{(R+1)^2 A^2 + (R-1)^2 B^2} \qquad (24)$$

Where:

$$A = -\frac{1}{\sin \theta'}\left[\cos\left(2\pi \frac{h}{\lambda} \cos \theta'\right) - \cos 2\pi \frac{h}{\lambda}\right]$$

$$B = -\frac{1}{\sin \theta'}\left[\sin\left(2\pi \frac{h}{\lambda} \cos \theta'\right) - \left(\sin 2\pi \frac{h}{\lambda}\right) \cos \theta'\right]$$

$\dfrac{h}{\lambda} =$ conductor height in wavelengths.

$\theta' =$ zenith angle.

Figure 8 is a computed polar radiation diagram for a 0.55 wavelength antenna with assumed earth constants, $\epsilon = 30$ e.s.u., $\sigma = 2 \times 10^{-14}$ e.m.u. and a frequency of 1110 kc.

This diagram is of particular interest for two reasons. First, we see that the null expected at about $(\theta') = 35°$ over perfect earth has practically disappeared due to the effects of the imperfect earth. Furthermore the field directly along the earth's surface is equal to zero. This latter effect may also be seen by a study of equations (23) and (24), which say that when the ground constants are any finite value the field at $\theta' = 90°$ is zero. This, at first thought, does not seem to be in keeping with the conditions found in practice. However, the fact that the receiving and transmitting antennas are of finite height together with certain other secondary effects combine to account for the field at the earth's surface.

While a well designed and installed buried wire ground system provides a low resistance return path for the antenna currents and thereby improves the antenna efficiency, its shielding effect upon earth of poor conductivity in the vicinity of an antenna is very limited. We generally desire to suppress sky wave radiation between zenith angles of zero and 45. Energy radiated in this sector is due to direct radiation from the antenna and reflected energy from points on the earth's surface within an area covered by a radius equal to the antenna height. If the earth conductivity in this region is poor and we wish to obtain performance in close accord with that predicted by the perfect reflection theory, a continuous copper sheet placed upon the surface of the earth would be necessary. This of course is prohibitively expensive and the only practical solution is the selection of a site for the antenna where the earth conductivity is as high as is obtainable, consistent with other limitations on the choice of the site.

In the above considerations it has been assumed that the earth is level in the vicinity of the antenna. When an antenna site having decided changes in level within a radius of about two wavelengths from the antenna is used the reflected energy is likely to alter the polar radiation diagram in a practically unpredictable manner. Certainly one could not set up any general equation to predict antenna performance under these varying conditions.

When serious consideration is given to the many factors controlling the overall performance of a radiating system and the many assumptions regarding these factors that must be made in order to develop workable equations it is gratifying and somewhat amazing that the performance in many cases agrees so well with the predictions. However, most performance checks have considered only the ground plane field intensity, "horizontal figure of merit." If one had accurately measured data for the complete polar radiation diagrams they would probably show up to a greater extent the shortcomings of the general assumptions. There is very little experimental data for complete polar radiation diagrams available and until a goodly amount of such data are made available the design engineer is wise in being conservative in his engineering estimates of antenna performance.

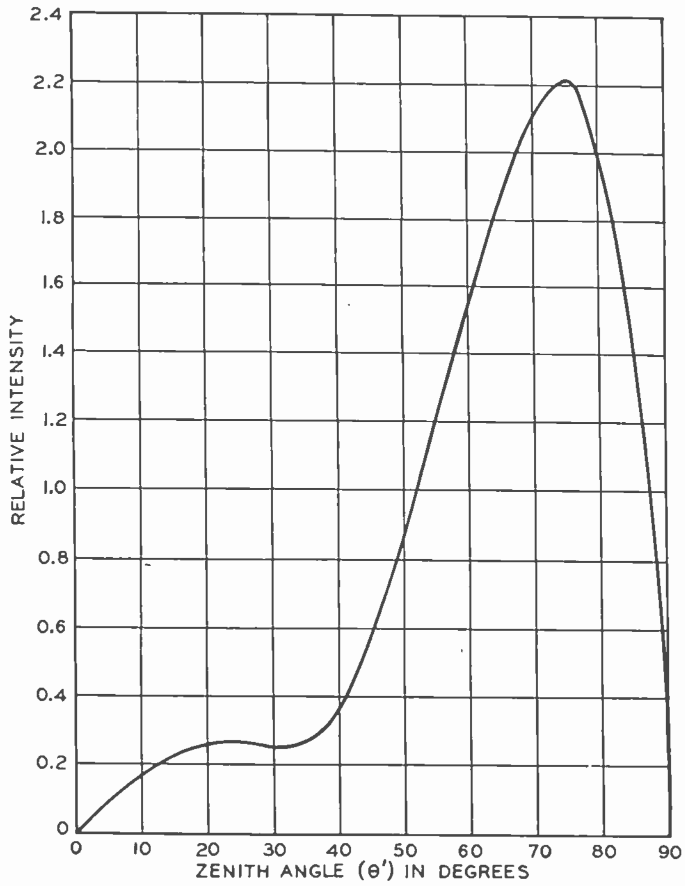


Fig. 8—Polar radiation diagram for a 0.55 wavelength antenna, sinusoidal current distribution, assumed earth constants, $\epsilon = 30$ e.s.u., $\sigma = 2 \times 10^{-14}$ e.m.u., frequency = 1110 Kc.

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A Great Year, Says Miller

(*Continued from page 3*)

posed code marks the first step in recognizing the sociological side of radio. We naturally believe its adoption will be the finest thing that has ever happened to the industry.

"Adoption of the code and application of it will give Radio a united front, and eliminate a great deal of the pressure and criticism now being exerted upon the individual station. However, this does not mean that any station manager or owner will be able to hide behind the code and sidestep responsibility. Living up to the code and interpreting it in the operation of the station will continue to call for the same integrity, good taste, and knowledge as in the past.

"Neither the industry as a whole nor an individual member can pass the buck in deciding whether some programs should or should not go on the air," says Miller. "There are certain obligations and responsibilities in running a radio station that can be met only by the station itself. When I was Mayor of Louisville, I found that there were questions always coming up which had to be answered. Often I was urged to put the questions to leaders in the community and abide by the majority. I knew such a course would mean that I was simply dodging the job I had been elected to do. You can't 'pass the buck' in that fashion, nor can any radio station do a good job without facing its responsibilities and meeting them fairly and squarely."

Running a radio station is a tremendous undertaking. It calls for men who have an understanding and knowledge of many fields. As Ed Kirby put it, "To run a radio station, an owner or manager must be an engineer, lawyer, showman, educator, diplomat, impressario, musician, shrewd business man, a master of the social sciences, and a gentleman." That's putting quite a load on one man, but the load exists, and recognition of the fact accounts for much of the work that

NAB executives confer in the Board of Directors room at headquarters. From left to right, Everett E. Revercomb, Auditor; Edward M. Kirby, Director of Public Relations; Paul F. Peter, Director of Research; and Edwin M. Spence, Secretary-Treasurer.

Just a few of the splendid pamphlets issued during the past year by the NAB, each of which is designed to provide definite information and assistance to members.

the NAB has done in the last year.

The aim of any organization which represents an industry is to protect its interests, fight for its rights, and be its spokesman. It is primarily a service organization and a problem solver. These duties come first. The NAB is that sort of organization and its record since reorganization is fresh in every member's mind.

Since the inception of broadcasting, the industry has been faced with one problem after another, and much of its past has been an uphill struggle over unknown terrain. Owners and managers have had to be more interested in where and how they were to make the next step than in taking a long range view toward the ultimate goal of broadcasting. In examining the work of the NAB during the past year, it appears that this fact has been recognized and that in addition to servicing the industry, the NAB has taken steps to aid its members in broadening their outlook and equipping them for the added responsibilities that have been thrust upon them.

In an important public statement Miller declared that "the responsibility to accept or to reject broadcast material is one placed squarely on the shoulders of the American Broadcaster. It is up to him to evaluate what is and what is not in the public interest." Much of his philosophy toward broadcasting is summed up in that short statement. Although he has not publicly said so, it is evident that he regards it as a duty of the NAB to do everything in its power to aid the broadcaster in carrying out this responsibility to the utmost. It is a tremendous responsibility. To evaluate what is or is not in the public interest calls for a broad knowledge of the social, political, cultural, and economic life of the country, as well as a specific knowledge of broadcasting.

This new phase of its work can be plainly seen in the many fine pamphlets the NAB has published in the last year. The *NAB News Review* is a splendid example. No better method could be employed to enable broadcasters to develop a knowledge of the thoughts, temper and feeling of the public toward broadcasting, and the many other subjects and problems which affect the course of a station's operation. It ought to be "required reading."

Much has been accomplished through the district meetings which have been held all over the country. These meetings provide excellent opportunity for broadcasters to talk over common problems, elevate their viewpoint and enlarge their perspective. While Open House Week was perhaps primarily intended to make new and better friends for radio, it actually had a deeper effect, because it brought managers and owners in intimate contact with the public. No industry is better than the men who represent it. You can take it for granted that in the years to come more than a few of the future leaders of the industry will be able to say that they got their first ambition to be a broadcaster from an open house visit to a radio station during the week of April 17, 1939.

Let's take a quick look at the record of accomplishment of a purely service nature for the past year. Many vexing things happened suddenly that brought the industry into the spotlight and put it on the front pages of every newspaper in the country. It seems to be the consensus that the industry got a very favorable press through the quick and level-headed action of NAB headquarters acting as industry spokesman. Many difficult labor problems were handled expertly, as were numerous other difficult problems.

From the number of booklets published by the NAB you would almost think it is in the publishing business. Such booklets as *Radio in the Classroom, How to Use Radio,* and *The ABC of Radio* are representative of the fine work that is being done. They are splendidly written and edited, and are a distinct credit to the industry. They should accomplish much.

The NAB-RMA campaign is going great guns, and much has already been accomplished. The industry as a whole has been far too negligent in selling itself to the public, and it is good to see that it is at last going ahead in this direction at such a fast clip. The *Bureau of Radio Advertising* is another step in the right direction, and if its brochure, *Radio Reaches People,* is any indication of what it will do in the future, it ought to be a big success.

This little report has in no way tried to catalog all the things that the NAB has done and is doing. Rather, it has attempted to highlight only a few. If it sounds congratulatory and enthusiastic, that's the way it was intended to sound, but remember, it's just one man's opinion. What you think of the work of the new NAB, we don't know, but this we do know. You can't talk to Neville Miller and Ed Kirby long without becoming pretty darn enthusiastic yourself, and if both say, as they did, that "Next year is going to be even bigger and better," you can bank on it.

KDLR—Devil's Lake, North Dakota

Ask any farmer what he prizes most next to his crops and the chances are he will point to his radio. Up in the northern part of North Dakota, the heart of the greatest Durum wheat area in the country, these men of the fields simply say, "KDLR." Those call letters not only stand for entertainment but they also symbolize education and better business in the minds of the wheat growers.

Located at Devil's Lake, this 100 watter takes pride in the fact that it belongs to the old timers of broadcasting and that it has remained under the same management since its inception in 1925. During the first few years of operation the station was forced to eke out a living by renting Western Electric public address equipment to road shows and county fairs.

By degrees KDLR won its way into the hearts of Devil's Lake merchants who found it profitable to buy more and more time on the air. Business naturally took an upward trend for the station and to reciprocate the generous support given, the management decided to improve its service to the community by completely rebuilding the transmitting plant. KDLR's new voice includes a Western Electric 310B transmitter, new Western Electric eight ball microphones, vertical transcription equipment and a 199 foot Blow-Knox shunt-excited tower.

Realizing the important role broadcasting can play along educational lines, KDLR inaugurated a series of school programs which are broadcast five times a week direct from Devils Lake Central high school. The Western Electric equipment which was donated to the school consists of double turn tables, a public address amplifier, and microphones. The same equipment is used to broadcast basketball games and various school entertainment programs. Eight other remote lines to various points in the city are maintained.

Other popular features scheduled by the station are farm bulletins, grain market and livestock market reports, road conditions and weather forecasts. All of these are of vital interest to the rural listeners who comprise the greater part of KDLR's audience. The territory served by this busy little station is a typical American melting pot — its inhabitants consisting mostly of Scandinavian, German, Russian and Bohemian farmers.

Bert Wick, general manager, who has directed the station's activities since it first went on the air, also steps into the role of announcer, handling many of the news and sports broadcasts. On his staff are: Hildur Marie Wick, treasurer; Merle Bjork and Wesley Jones, announcers; Richard Moritz, chief engineer; Quentin Prochaska, press operator and assistant engineer; Kermit Myhre, music director.

KDLR

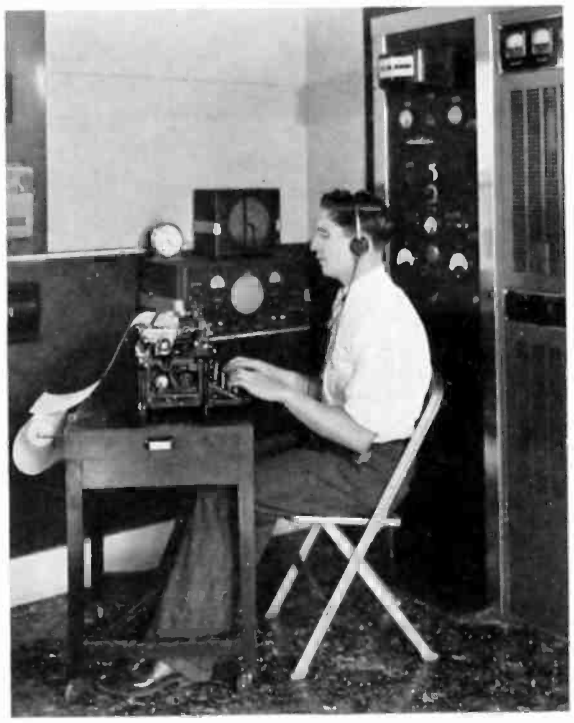
Devil's Lake, North Dakota

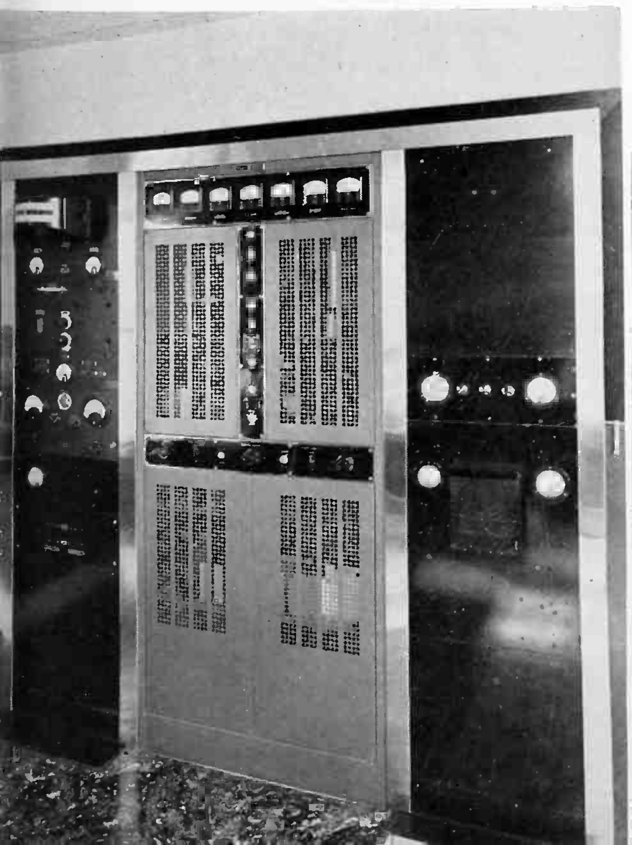
The peaceful rural scene above is a fitting site for KDLR's transmitter structure as the station serves a large rural audience. Base of the tower stands 18 feet below the house.

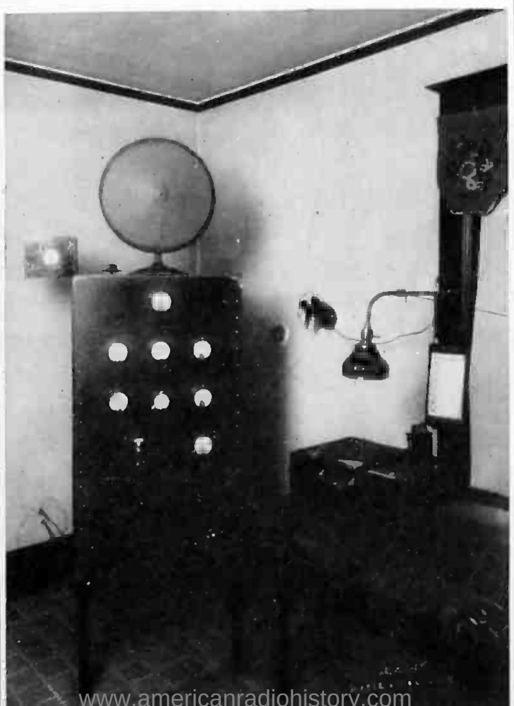
Manager Bert Wick steps into the role of announcer handling important news broadcasts.

Quentin Prochaska doubles up on jobs too, hopping back and forth from press operator to assistant transmitter engineer.

Broadcasting's progress nicely pictured in the display of old and new transmitters. Richard Moritz, chief engineer, checks the new 100 watter which bears the signature "Western Electric."







From Studios to Twin Towers WGAN Typifies Broadcasting at Its Best

In the dark of night WGAN's red tower lights, reaching 350 feet skyward, flicker their friendly greeting to Portland residents. Although the station is less than a year old these call letters have become symbolic of education, culture, entertainment and public service throughout the state of Maine. Owned and operated by the Portland Broadcasting System WGAN takes its place as one of the finest equipped 500 watt stations in the country. Being an affiliate of the Columbia Broadcasting System, the station carries many of that network's programs although two thirds of its schedule is composed of local presentations.

The Western Electric transmitter ground system consists of 19 miles of copper wire used in 120 350-foot radials extending from each tower. The wires are spaced eight inches apart in the center of the circle and 18 and one half feet at the outer edge. For protection against damage to cables all telephone and power lines to the transmitter house are run underground. A double electric power line to the station guards against the failure of any one unit.

Foundations of the radio towers are exceptionally strong. Each corner is capable of withstanding a downward pressure of 116,000 pounds or an upward pull of 51,000 pounds. The towers are of sufficient strength to withstand hurricane wind at a velocity of 115 miles per hour. Because of the directional antenna system, the first in the Pine Tree State, a maximum signal is sent into the most densely populated area of the state and into Northern Maine and suppressed towards Providence, Rhode Island and Columbus, Ohio.

WGAN studios were designed by consultants of Electrical Research Products and embody the most modern acoustical treatment known to radio science. Of special interest to visitors is the principle of floating studios which is explained on all conducted tours. The main structure is suspended from three massive steel beams. To do away with outside noises and vibrations, each studio is a room built within a room, with two inches of space between inner and outer walls. This gives perfect insulation and soundproofing.

The walls of the studios are built in such a fashion as to defy an echo and control reverberation. The plaster surface of the walls are scientifically angled instead of straight so that no two walls are parallel. Acoustical panels are divided into strips and alternate places are treated with sound absorbing material. These conditions prevailing at WGAN give perfect sound control.

The studios are all air conditioned, with workers, artists, and spectators at the station enjoying a change of air every ten minutes. The lighting system was designed to be easy on the eyes. Although daylight is admitted in all offices indirect lighting is used; the visible source in studios, offices and lobby being squares of frosted glass set flush with the ceilings.

The colonial effect is achieved in the reception room and lobby of the station with knotty pine sheathing forming the wall finish and large pine beams lending a characteristic touch to the ceiling. A specially made rug of light moss green with the woven monogram WGAN in rust, carpets the floor. Window drapes are attractively accentuated with figured patterns on a tan background. The reception room houses three showcases built within the walls where sponsors may exhibit products from time to time.

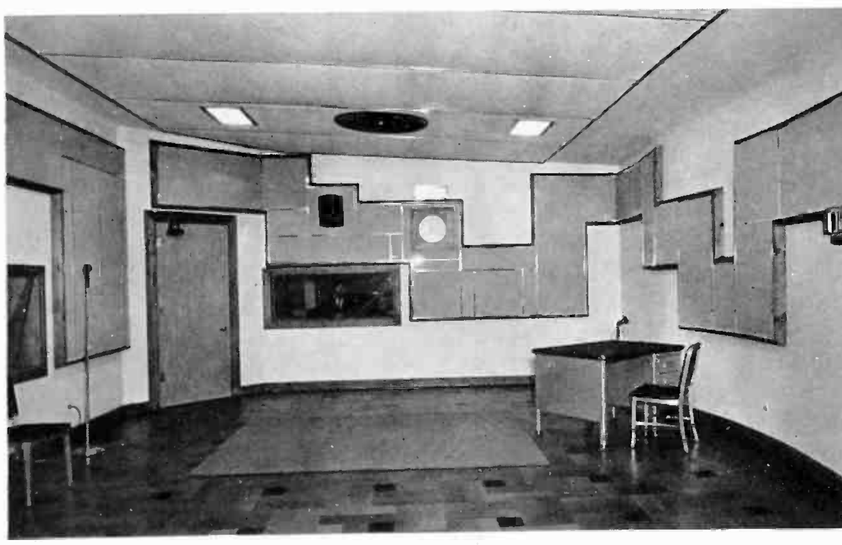
WGAN began regular broadcasting August 3, 1938. Since then, thousands of letters and telegrams sent in by listeners have acclaimed the station as functioning perfectly and as a definite progressive influence in the state.

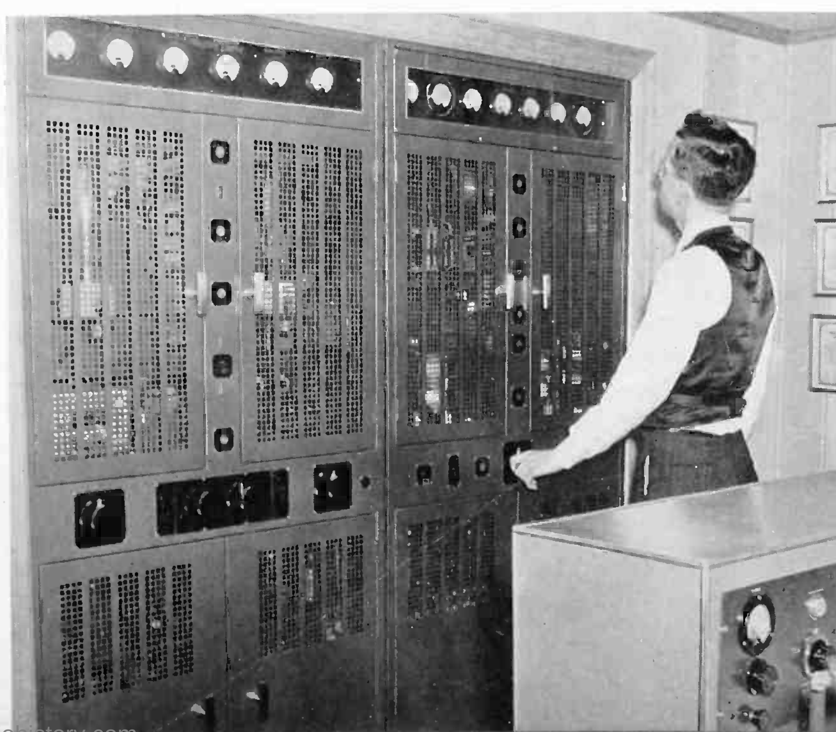
WGAN's entire staff as they appeared on opening day when they greeted hundreds of guests. Front row, Alvin F. Wright, bookkeeper; Curtis B. Plummer, engineer; Roger W. Hodgkins, chief engineer; Florence E. Kenney, stenographer; Gwendolyn Graves, receptionist; Laurence H. Stubbs, assistant treasurer; Richard E. Bates, program director; Arthur K. Atherton, salesman; Lyman F. Brewer, engineer; back row, Stanley Letson, salesman; Kenneth B. Woodbury, engineer; Howard Stanley, continuity-publicity; Warren A. Hamilton, engineer; Lewis R. Collins, engineer; Sam Henderson, chief announcer; Russell Dorr, baritone and announcer; Carl deSuze, announcer; Guy P. Gannett, president; Harnold Falconier, who has since left the organization; and Creighton E. Gatchell, manager.

WGAN

Portland, Maine

Similar in design to those snug little Cape Cod cottages so typical of the New England scene this cosy building houses WGAN's new Western Electric transmitter shown at the bottom of panel. Studio A features latest acoustical developments with wavy walls and slanted ceiling. Below: C. B. Plummer and W. A. Hamilton, engineers, admire one of the two 251A tubes used in the transmitter. Lower left photograph shows Chief Engineer R. W. Hodgkins peering into the studio while L. R. Collins manipulates the 23B console.





Characteristic of 357A

(*Continued from page 16*)

Recommended power capability of driving stage—watts	50	60	75	25
Peak grid to grid driving voltage	512	490	490	345

*As high level modulotor for 500 watt transmitter total harmonic approx. 1.5% at full output.

Class B Radio Frequency Linear Amplifier—Operating Conditions per Tube				
Direct plate potential—volts		4000	3000	2000
Grid bias volts		—140	—100	—60
Direct plate current (carrier) (modulation off)—ampere		0.130	0.175	0.260
Max. carrier power output—watts		175	175	175
Power of driving stage (carrier) recommended—watts		10	15	40
Peak grid driving voltage (carrier)		125	125	135
Class C Radio-Frequency Oscillator or Power Amplifier Operating Conditions				
D.C. plate potential—volts		4000	3000	2000
Grid bias—volts		—250	—225	—200
D.C. plate current—amperes		0.400	0.45	0.50
Nominal power output—watts		1250	1000	700
Peak R.F. grid voltage		450	445	445
Plate dissipation—watts		350	350	300
D.C. grid current—ma.		60	70	85
Approx. driving power—watts		25	30	35
Class C Radio Frequency Amplifier—Operating Conditions (Carrier) subject to 100% modulation				
Direct plate potential—volts	3000	3000*	2500	2000
Grid bias—volts	—320	—270	—310	—310
Direct plate current—amperes	0.340	0.240	0.360	0.390
Direct grid current—amperes (approx.)	0.065	0.035	0.060	0.070
Peak R.F. grid voltage—(approx.)	520	420	520	535
Driving power (approx.)—watts	35	20	35	35
Carrier power output	780	550	670	550

*For 500 watt Broadcast Transmitter Application.

New 1 KW Transmitter

(*Continued from page 11*)

is rectified by vacuum tube V8A, and the audio component of the rectified wave is fed in series with the program input to the first audio stage. Four tubes are used in parallel in the second audio stage, which is then resistance coupled to the grids of the modulated or final radio frequency stage.

This transmitter operates from a single phase 187 to 250 volt, 50 to 60 cycle power supply, and requires 4.3 kilowatts for a carrier output of 1000 watts. A manual regulator is provided to adjust for the proper input voltage. Plate and screen potentials for all tubes are obtained from a single phase four-tube bridge type rectifier and the associated potentiometer circuits. Surge free starting of the transmitter is accomplished by the use of a two-step starting system for the rectifier. The bias potential for the final stage is obtained from a single phase full wave rectifier. All other radio and audio frequency stages are self biased.

A feature that will be of considerable interest to both the broadcasting station owner and operator is the absence of the conventional types of fuses. Overload protection is provided by the use of magnetic circuit breakers that also serve as switches and make possible a very simple and effective control circuit.

Three door switches afford protection to the operating personnel by causing the primary power of the plate and grid supply rectifiers to be disconnected when the front or back doors are opened. Additional protection is provided by a switch that grounds the high voltage circuit when the front door is opened, a feature never before provided on transmitters of this power rating.

Kansas City Police Radio

(*Continued from page 15*)

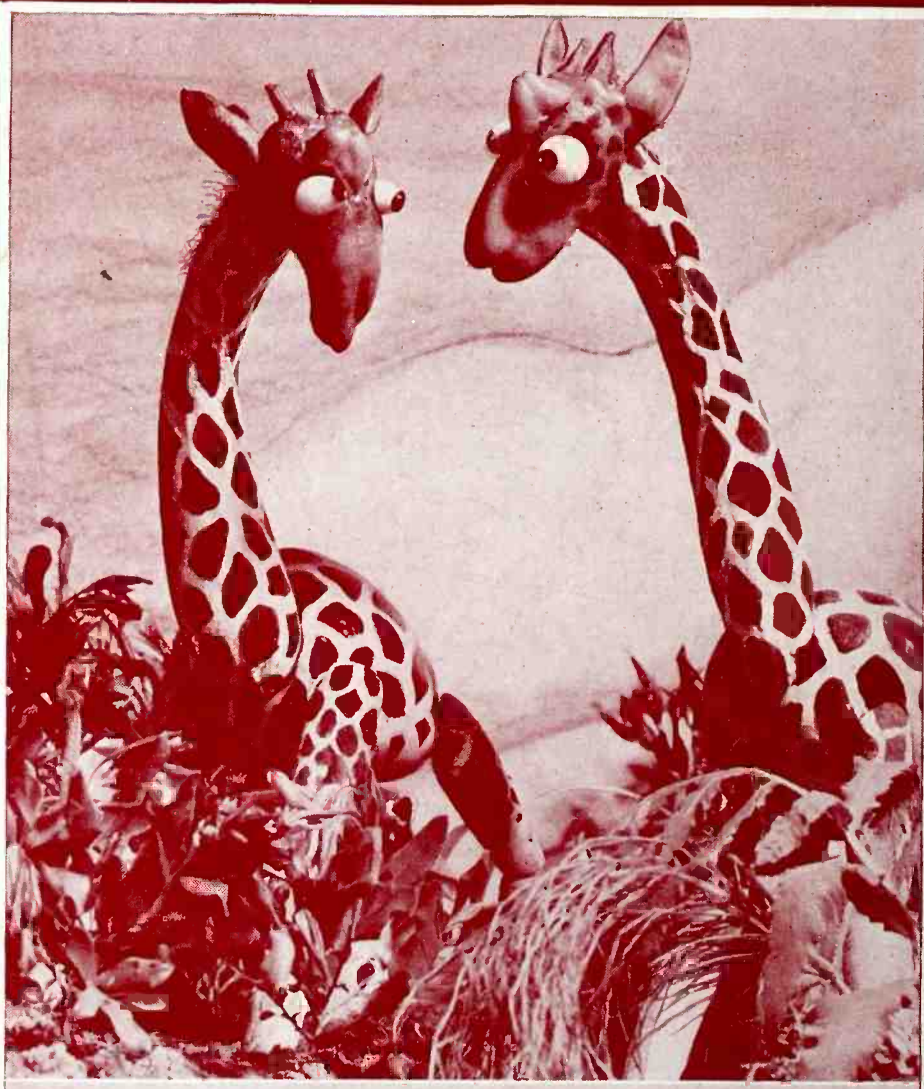
this box to the base of the radiator; one connecting to the output circuit of the filter unit, one as a spare line, and the other serving as a filter for the 5 megacycle telegraph channels. Transmission lines from each of the transmitters and from the filter unit also terminate in this box. Link switches located in the distribution box permit the selection of either transmission line to the radiator or the selection of either telephone transmitter.

There is adequate measuring equipment located on the left-hand side of the audio frequency panel assembly for measuring the performance of the transmitting equipments. This equipment includes a modulation meter, a 400 cycle audio frequency oscillator, a noise and distortion factor meter, and a frequency monitor.

There is also provided on the right-hand side of the audio frequency panel assembly a control button which starts the 25 kilowatt emergency power plant in the event of failure of the building power supply. This emergency plant will generate sufficient power to permit operation of all the radio equipment described above, thereby assuring uninterrupted police service.

Most of the credit for the fine system now in operation at Kansas City is due Lieutenant Roy DeShaffon, in charge of Communications Division. DeShaffon started with the Kansas City police department back in 1913 as an electrician in the signal department, of which, in a few years, he became the head. In 1920, when radio was in its early stages, Roy became interested in it as a hobby. In another few years he began to combine his hobby and his business and by 1931 had sold his superiors so well on the value of radio in police work that in June of that year they set up a Communications Division and purchased their first equipment. In 1932 DeShaffon was promoted to lieutenant and placed in charge of this division. Since then it has grown steadily in importance and much of Kansas City's fine police record is attributable to his department.

Just as the heat of sun baked tropical lands is dissipated before a spanking offshore breeze, so is the new 343 AA tube cooled by air. It is designed for operation in new 5 KW. transmitters offered by Western Electric. Making use of modern aerodynamic and thermal engineering, it marks the culmination of much research to produce an air cooled tube having all the desirable characteristics of similar water cooled tubes with none of the objections to previous air cooled types.



"Boy! Did we stick our necks out— trying to adjust our field pattern without a Western Electric 2A Phase Monitor!"