PICK-UPS

OCTOBER 1939

Raymond Gram Swing, WOR Mutual's Ace European News Analyst

CBS Engineering Organization — Here's How It Functions

Engineers Aim for Ideal Mobile Radio — Here's the Result

Huge Sound System at World's Fair Voices Story of Railroad's Progress

Police Radio System — St. Louis, Missouri

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

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OCTOBER, 1939

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

Western Electric COMPANY

195 Broadway : New York, N. Y.

EDGAR S. BLOOM . . . President
H. B. GILMORE . . . . Secretary
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WILL WHITMORE, Editor

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Assistant Editors

The airplane entered the last war a kite-like contraption with a dinky motor. It came out of the war an efficient, dependable machine. Four years of war had brought improvements which many years of peace-time evolutionary improvement might not have achieved.

Now radio goes to its first big war. Technological improvements have been rapid in the past, but, if the war lasts long, past achievements will seem to have come with the pace of a snail. No one can predict what war will do to radio. But of this we can be sure: Radio, in technological progress and the uses to which it will be put, will advance as it never has before. A great deal of work, study and concentration on the job in hand will be needed to keep up with the parade.

* * *

In one sense radio is not new to war. For years now it has been used in the war against crime. The nation's police have made radio a most powerful weapon against the criminal and progress in police radio equipment and usage has been swift. *Pick-Ups*, in this issue, describes the latest Western Electric Ultra-High Police Radio System. There's another police story too, describing one of the finest police radio installations in the country at St. Louis.

* * *

For a long time we have wanted to do a story about the Engineering Department of the Columbia Broadcasting System. And now we have done it. We spent a fascinating week talking to engineers, going through reports and watching the wheels go round. Enough data was collected to fill a book. But we had no book to fill so we had to pare the story down to the bare essentials and write a description of the scope and functions of the various divisions. Here it is, the lead story, with a photographic organization chart on pages 4 and 5.

* * *

If you are among the millions who have witnessed the spectacular pageant "Railroads on Parade" at the New York World's Fair you undoubtedly agree that it is one of the most breathtaking and enlightening exhibits the Fair has to offer. For more than an hour the voices of famous characters of the past and the sound of stirring music are woven into a remarkable tapestry which depicts the growth of one of America's greatest industries. And back of this moving, speaking tapestry, a huge sound system, invisible to the eyes of the audience, voices the story with perfect synchronization. How this intricate voice was designed and how it works is a fascinating story in itself—you can read all about it on page 12.

* * *

Speaking of voices, another well known Western Electric voice, "Marine Radio," sails serenely across the center pages of this issue of *Pick-Ups*. If the pictures don't make you go right out and buy a tug, ferry or ocean liner they will, at least, give you some idea of the wide range of marine radio telephone equipments which enable you to take the telephone to sea.

THIS ISSUE

Part of Engineering Staff of the Columbia Broadcasting System gathered in conference in New York, September 27-29, 1939. These men appear in the organization chart on pages 4 and 5.

CBS ENGINEERING

Here's How this Department of the World's Largest Single Network Functions

By WILL WHITMORE

Often we are told that there are no new frontiers. Obviously that is untrue because there are frontiers of knowledge as well as frontiers of geography. Radio has made its rapid progress simply because its frontiers were a challenge to everyone who came in contact with them.

When broadcasting began practically nothing was known about it. True, engineers knew how to put a signal on the air and pick it up at some remote point, but that was about all. That meagre knowledge was like a small spot of civilization in the center of a vast and unexplored continent. Once an engineer got out of the clearing he was on his own in a trackless wilderness where no one had ventured before. Whereever he went, whatever he did, resulted in discoveries — discoveries which pushed back the frontier a little farther — discoveries which advanced the art of broadcasting bit by bit.

And so it was that radio attracted to itself men whose pioneering instincts and ambitions were as great as those who built this country. Today in every radio station in the country you find just that type of man. It is this opportunity for exploration and adventure that has attracted men to broadcasting. It is this fact which explains why they are willing and glad to work harder and longer than men who hold down more prosaic posts. They love their jobs and their profession with an intensity foreign to many others.

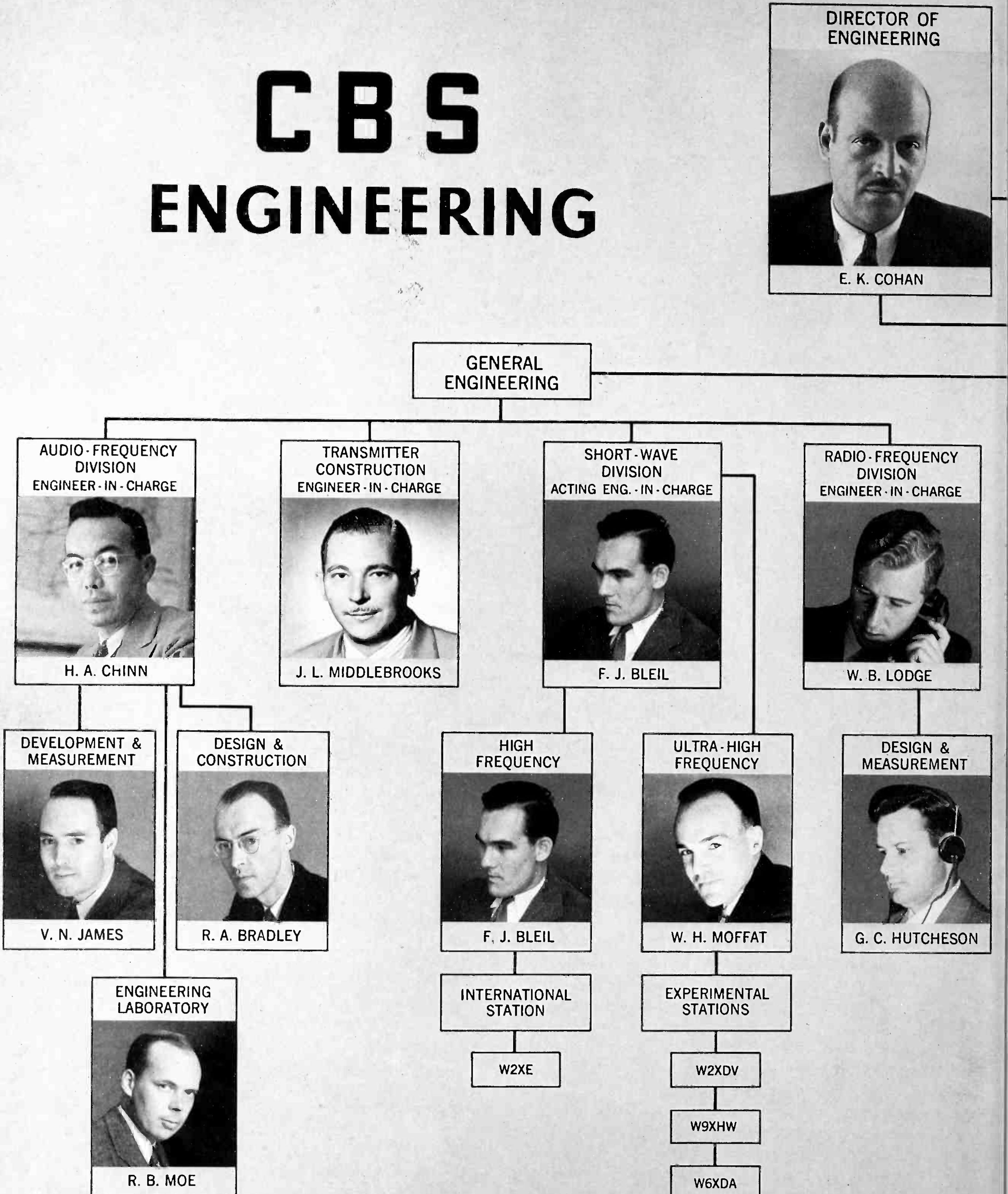
The above is preface to an understanding of any real radio engineer. Unless you recognize the truth of it and accept it as a premise you cannot understand him and his job — to be more specific, to understand the men who make up the engineering department of the Columbia Broadcasting System. They are a hard hitting group of men who scoff at regular hours and a set existence. Yes, they have regular work to perform, routine jobs to fill, but in addition they constantly have the chance for exploration and adventure in the wilderness beyond the outskirts of present-day knowledge of radio.

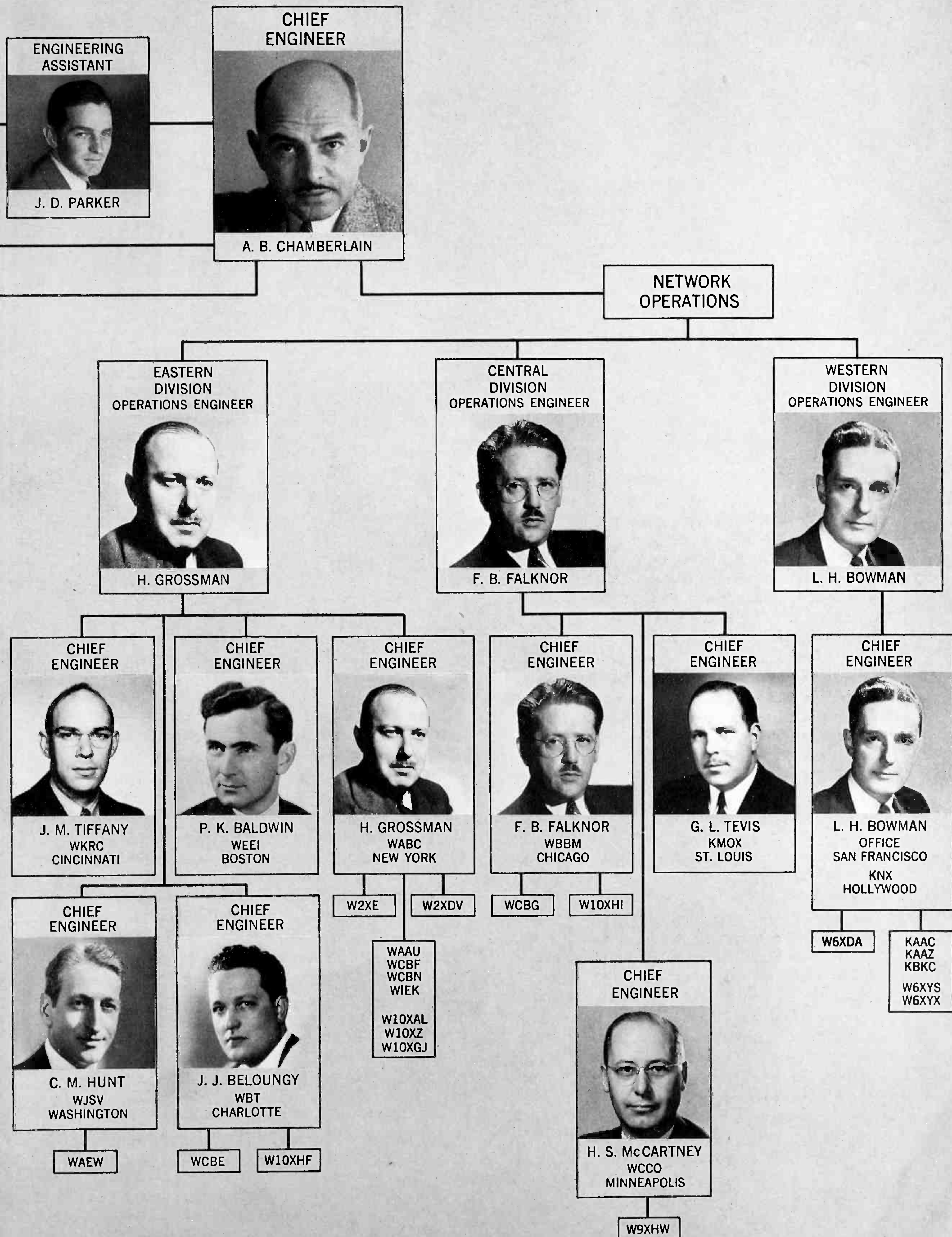
Practically every member of the group from E. K. Cohan, Engineering Director, down to the newest recruit, began as a radio amateur and served as a commercial operator. Most of them supplemented and advanced their practical knowledge and experience with engineering courses at Massachusetts Institute of Technology and other prominent engineering schools.

The Engineering Department of C.B.S. grew as the system grew, each expansion coming as the need for engineering increased. It was common-sense, practical growth, and slow enough to pick the right sort of man for each new job. Today, the Engineering Department is still smaller than you might expect it to be, but it is a close-knit group, each man of which can

(Continued on page 6)

CBS ENGINEERING

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CHIEF ENGINEER
A. B. CHAMBERLAIN
NETWORK OPERATIONS
EASTERN DIVISION OPERATIONS ENGINEER
H. GROSSMAN
CENTRAL DIVISION OPERATIONS ENGINEER
F. B. FALKNOR
WESTERN DIVISION OPERATIONS ENGINEER
L. H. BOWMAN
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WBT
CHARLOTTE
WCBE
W10XHF
CHIEF ENGINEER
H. S. McCARTNEY
WCCO
MINNEAPOLIS
W9XHW

CBS Engineering

(Continued from page 3)

double in brass. In it you will find little of the routine, red-tape and iron-clad organization channels which slow up and hinder the work of so many large company departments.

No more logical organization could be found. Any broadcasting unit, whether it be a single station or a network, has two engineering functions — providing the facilities for broadcasting, and operating those facilities to put radio programs on the air. Thus the Engineering Department is composed of two main heads, General Engineering, and Network Operations.

General Engineering is broken down into four divisions: Audio Frequency, Radio-Frequency, Short-Wave, and Transmitter Construction. The breakdown of Network Operations is naturally geographic, resulting in three divisions: Eastern, Central and Western. Internal organization of each of these divisions is more or less similar. The Eastern Division may be considered as typical and in it there are five operating groups of technicians: master control, studio and playhouse, field, maintenance and construction and transmitter.

As between General Engineering and Network Operations there is a striking difference in the work and personnel. General Engineering works by the calendar; Network Operations works by the clock. General Engineering plans and coordinates station development and expansion. It is responsible for the general engineering requirements of the system as a whole. It formulates standard practices for network operation and supervises the technical changes that are necessary in present or new stations. It is the type of job where men have time to plan, study and look ahead, and so you will find the engineers of this department more deliberate, their work generally paced to the passage of days. They move and talk with ease, deliberation and studied calculation of the research and laboratory engineer.

The personnel of Network Operations is just the opposite. Here men work by the minute. The clock is master; for their job is to put programs on the air and keep them there. They talk with fast, clipped speech, and they move with the swift, almost jerky motions of a man who hasn't a second to lose.

You aren't around Columbia long, or for that matter any place where radio men meet, without hearing references to "E. K.," which of course stands for Edwin King Cohan, Director of Engineering. Cohan, tall, slender, complacent and always at ease, has the job of directing and coordinating the work of the two engineering departments. Coming to Columbia in 1930 as chief engineer and technical supervisor of CBS, he calls the almost ten years he has been there the happiest years of his life. "Radio," he says, "is the most satisfactory and satisfying job a man could have." The "screwy hours" appeal to him, and a job which never gives any hint of what tomorrow may bring is exactly what he likes. Yet, his second choice for a profession would be the law with all its rules, regulation and foundation in precedent. His own feeling that he would have made a good lawyer is seconded by any number of lawyers who have met him at FCC hearings.

Cohan has aimed to make the Engineering Department as self-operating as possible and has succeeded to a surprising degree. "We don't want men who have to be told what to do and how to do it," he says. His ideal engineer is a man who has a solid foundation in engineering knowledge acquired in a good engineering school backed by practical experience and coupled with ambition, imagination and resourcefulness. That's a large order, but he has been successful in surrounding himself with just such men.

Having a self-operating department has given Cohan the opportunity to remove his job far away from official routine work, enabling him to plan far ahead of the immediate needs of the network. For a good many years his interests have been centered in international broadcasting and he is known personally to practically every first rank chief engineer in the world. His interests in this field have carried him abroad on extensive trips for four successive years. He has flown on every airline in this country, Europe and northern Africa. Today, the stamps on his incoming mail would gladden the heart of any philatelist.

Wheel-horse and next in command is A. B. Chamberlain, Chief Engineer, who came to CBS in 1931. The two departments, General Engineering and Network Operations report directly to him and his job is to supervise and coordinate the work of each. Chamberlain is ideally suited to the job because of his experience, background, and personal characteristics. He talks the language and knows the operations of each department. Apparently he can take on the characteristics and meet the requirements of either. He can be quick, alert, ready to move at a moment's notice, or calm, deliberate and serene. In experience and training, he has served in almost every radio engineering capacity, having been chief engineer, director of technical operations of radio stations, and general manager. He is a graduate of the U. S. Naval Radio School and the Submarine School, New London. Following graduation, he acted as instructor at the U. S. Naval Radio School. For more than a year he was engaged in electrical radio construction and radio operation, 8th Submarine Division.

Engineering as such is merely a portion of "A.B.'s" job and since this plays such an important part in the operations of a big network, his broader responsibility becomes one of cooperation with practically every other department in the system. There are endless details to be worked out between such depart-

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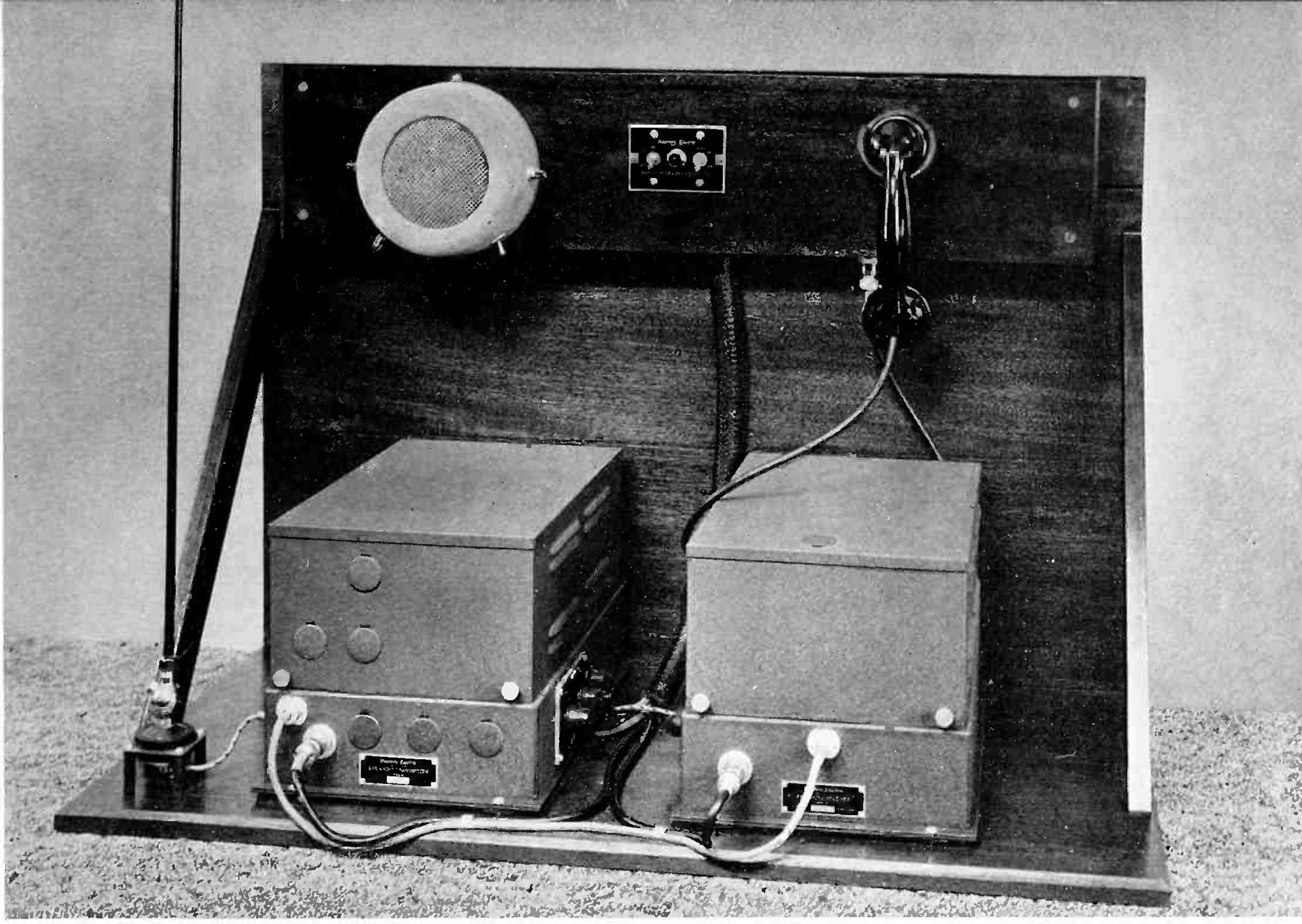

Engineers Aim for Ideal Mobile Radio. Here's the Result—And How!

Intensive Field Study Contributes to Design of 228A Radio Telephone Equipment

By ARNOLD B. BAILEY

Commercial Products Development, Bell Telephone Laboratories

In the design of the 228A Radio Telephone Equipment, intended primarily for police car two-way communication in the band 30 to 40 mc., the engineers of Western Electric and Bell Telephone Laboratories held constantly in mind the importance of so designing the apparatus that it would meet even the most stringent of service requirements without requiring undue attention on the part of the customer to make it function properly.

The design of this equipment as a whole as well as its smallest detail has been the result of a thorough study of scores of police radio systems now in use throughout the country. The design engineers visited these installations with one predominant thought in mind: to select desirable design objectives, and then to determine for each of these objectives its reasonable ideal. These ideals were determined, and, expressed in finite terms, formed the backbone of the entire development of the new police car equipment. Some of these ideal objectives, relative to the equipment as a whole, were:

1. The cost should be as low as possible.
2. The equipment should be the essence of simplicity, thus reducing possible failure to a minimum.
3. It should be flexible, so that the receiver can be used alone in one-way systems, or either unit used with any car radio equipment in current use.
4. The equipment should be delivered complete in every detail, so that installation can be made with minimum effort, thus reducing installation cost.
5. All units must be easily installed and removed from the car, making replacement easy and reducing the time any car is out of service.
6. Installation must be done without marring the instrument panel or other visible parts, thus improving the resale value of the car.
7. Equipment and tubes must have long life.
8. Maximum coverage must be attained under all conditions.
9. The transmitter must have full 100 percent modu-

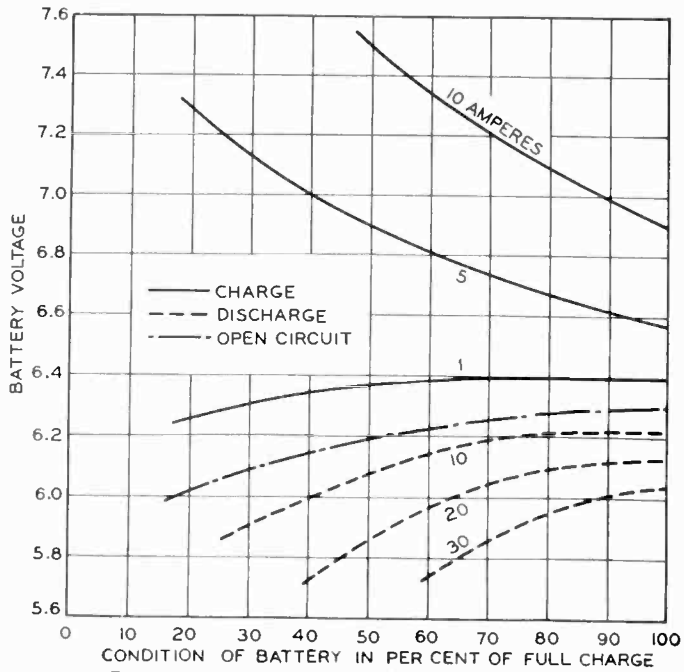

Fig. 1—Battery Terminal Voltage Under Load.

lation.

10. No further tuning should have to be made once the equipment is installed.
11. The equipment must be quiet in operation and yet have a CODAN sensitivity of at least two microvolts.
12. No tricky CODAN circuit adjustments or noise gate adjustments should be required at the time of installation or later.
13. Operation of the equipment by the radio man in the car should not include ANY tuning adjustments, but require only normal operation of the transmit switch and adjustment of loudspeaker volume.
14. The equipment must operate reliably and retain frequency stability under all conditions, not only to maintain communication but equally important to stay within channel assignments so that other services will not be subjected to interference.
15. The radio equipment should be designed to work best with the impedance of the car antenna systems including the antenna connections as used in the field.
16. Due consideration must be given to the car battery, car generator, car equipment other than radio apparatus, and radio cable lengths in establishing proper and consistent design voltage of the receiver and the transmitter.

An example of the study and thought that was given to these ideals prior to incorporating them in the design of the new equipment, is furnished by the item just above concerning the determination of the proper design value for the transmitter and receiver terminal voltages. A study was made with the cooperation of battery manufacturers over a period of several months to determine exactly what variations are to be expected in the 6 volt supply voltage in an average police cruiser. Some of the results of this study are given in Figures 1 and 2.

Figure 1 shows the terminal voltage of a 120 amp.-hr. battery under specified charge and discharges current values, in terms of the battery condition. These values are necessarily of an approximate nature, as they become modified by the length of time and the magnitude of the load applied. The curve is reasonably good for loads applied for a short period of a minute or two, though initial and final voltage readings in such a period are never quite equal. This error is small for a fairly well charged battery under reasonable load conditions and fortunately it was found that police cruisers with radio system loads which are balanced with good high current charging generators and voltage regulators seldom allow the batteries to reach conditions much below 70 percent of full charge.

Figure 2 shows a 24 hour wintertime duty cycle of a car electrical system simulating police cruising with a two-way UHF car radio system in addition to normal car loads including ignition, lights, starter, siren, heater and other accessories which in a modern car reach an unexpected number.

The corrections required to take into account the voltage drop along the radio cable and the system drops are indicated in Figure 3, which shows the net voltage across the terminals of the radio transmitter and receiver. The final design value is necessarily somewhat of a compromise between the lowest and highest voltages expected, and must be separately specified for the two cases of the transmitter and receiver. The value decided upon for the 228A equipment is 5.8 volts for the transmitter and 6.3 volts for the receiver.

Of equal importance to this supply voltage problem, was the problem of matching the transmitter and receiver to the radio impedance of the car antenna system. This determines the efficiency of transfer of the signal energy from antenna to receiver, and the transfer of power from the transmitter to the an-

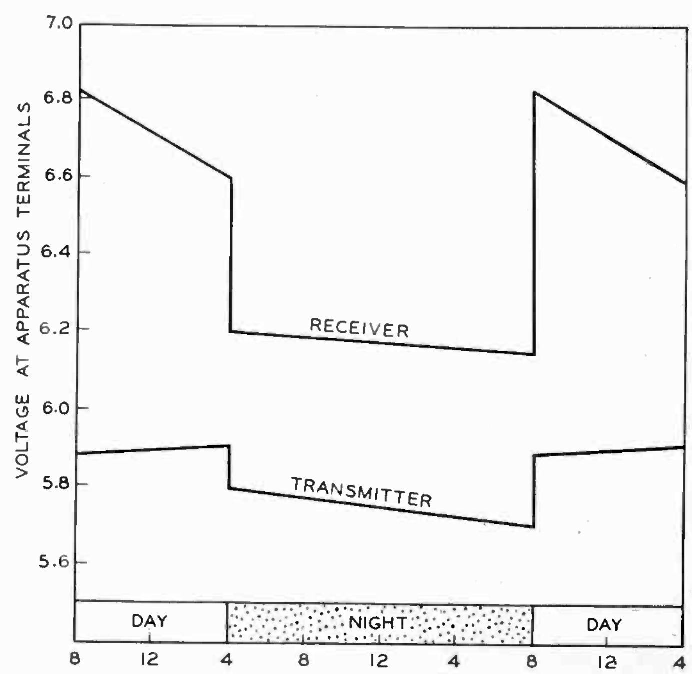

Fig. 2—Apparatus Terminal Voltage—Daily Cycle.

tenna. A typical impedance characteristic of a vertical rod type car antenna is given in Figure 4 on a generalized basis as experience indicated that one characteristic will adequately cover all types of cars. Again, it can be seen that lower and upper limits, based on measurements of many car antenna systems, are required, and throughout this range the car transmitter and car receiver must be designed to meet these impedance conditions efficiently. A good mean value for this impedance is shown in Figure 4.

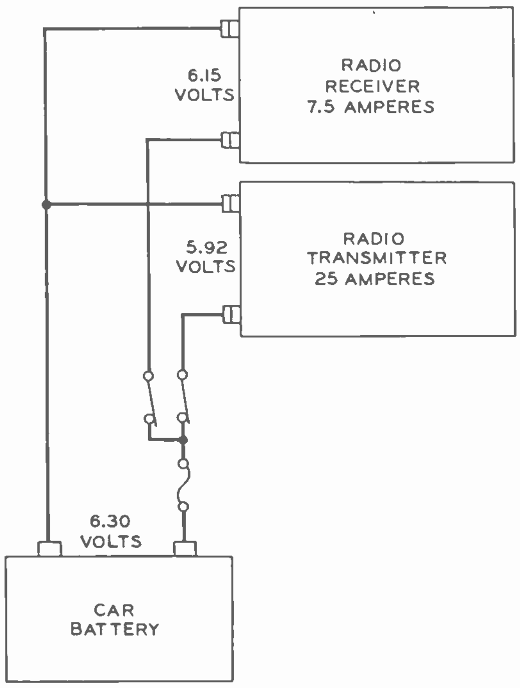

Fig. 3—Voltage Drop in 228A Radio Telephone System.

Referring to the headpiece and to Figures 5 and 6, the equipment as a whole consists of six main parts: transmitter, receiver, antenna, loudspeaker, hand set, and control unit. Each part has been simplified to perform its essential function and do the job well and efficiently.

The radio transmitter, schematically shown in Figure 7, has a carrier power of 15 watts and is completely modulated. Three radio stages and two audio stages are employed. The crystal oscillator stage employs a new circuit which allows fundamental oscillation at the crystal frequency (one-sixth the carrier frequency) using the grid, the filament, and the screen of a 1619 beam power filamentary tube as the triode elements of the oscillator. The screen, however, is at RF ground potential and the filament of the tube is at high RF potential. The filament is connected to RF ground through an inductance consisting of two parallel wound conductors which carry the DC filament current for the respective legs of the filament. No tuning of the crystal fundamental circuit is required. The plate of this crystal tube is tuned to the second harmonic of the crystal and drives the succeeding tripler stage using a 46 filamentary screen grid tube. The plate circuit of the tripler is tuned to six times crystal frequency (the carrier frequency) and in turn drives the grid of the output stage. The RF output stage is a beam power amplifier employing a 1624 filamentary beam power tube and is modulated on both screen and plate. Coupling of this stage to the car antenna system is obtained by variable capacitive coupling, thus matching a very wide range of antenna impedances.

The transmitter includes an antenna series-resonating circuit which ensures that optimum antenna coupling is attained. This is accomplished by tuning the antenna circuit to unity power factor with a fixed load coil and small series antenna condenser either or both of which may be used depending upon the reactance characteristic of the particular antenna system used. The full power of the transmitter is hence delivered to the antenna with minimum loss. An antenna relay connects the transmitter to the antenna during the transmit intervals, places plate voltage on the transmitter and silences the radio receiver by shorting its audio output. The relay also disconnects the antenna from the receiver.

The simple audio system in the transmitter consists of a single 46 speech amplifier driving a push-pull Class B audio output stage using two 46 filament type vacuum tubes. The microphone supply is taken from the 6 volt supply after being adequately filtered to eliminate any ripple.

High voltage is supplied by a compact and efficient dynamotor which is located on the chassis of the transmitter and is well filtered both in respect to its commutator ripple as well as possible RF noise from commutation.

Tuning and maintenance of the trans-

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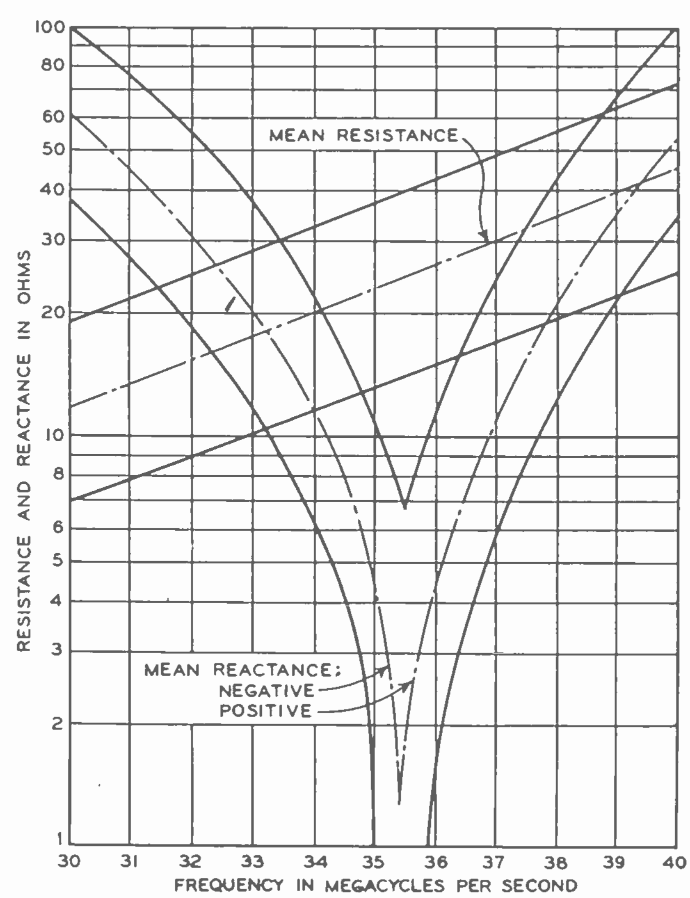


Fig. 4—Car Antenna Impedance.

WIBW's New Transmitter Boosts Listening Area 33 Per Cent

Typical of chief engineers throughout the country, Karl Troeglen of WIBW, Topeka, Kansas, has his own ideas of what constitutes a good transmitter. Backed by Manager Ben Ludy's progressive policy, Troeglen's ideas recently materialized in the form of a $70,000 transmitter plant to broadcast the "Voice of Kansas."

WIBW's new plant is located seven miles west of Topeka on a 138 acre tract of river-bed farm land. The one story brick transmitter building, 67 by 35 feet, stands 550 feet from the tower. The floor of the building is elevated to a point five-feet above any previous flood stage.

The spacious control room which houses the Western Electric 5000 watt transmitter is located in the center of the building. Flooring for this room is made of cork to prevent foot-slipping and to aid acoustics. The ceiling consists of sound-absorbent celotex. Because of its ceiling and floor design this room may be used as an emergency studio if necessary. To provide further for this emergency measure a special compartment has been built in the control panel which houses an emergency turn-table and a number of recordings.

High-voltage power equipment and cooling apparatus is located at the left of the control room. For future expansion a room of similar size is provided at the right. Back of the control room a small space enclosed in copper has been partitioned off for short wave reception and re-broadcasts. Other appointments of the building include an automatic emergency power plant, sleeping quarters, bathroom, engineer's office, automatic heating and air conditioning and, in the basement, a double garage and work shop.

Safety and efficiency are the twin watchwords around the new transmitting equipment. The safety lies in the FCC-sealed locking system which makes access to any high voltage apparatus physically impossible during broadcasting. The efficiency lies in the selection of the finest equipment to assure the utmost in mechanical perfection for broadcasting WIBW's messages.

The great tubular mast is 445 feet high. Heavy guide wires, each one inch thick and firmly anchored in concrete, hold this big needle erect.

The tower which is 12 inches in diameter at the bottom and four inches at the top is pivoted on a 16 inch diameter tubular base. The total static load on the pivot insulator, comprising the weight of both mast and the guy wire assembly, is approximately 42 tons. The mast itself is in eight separate sections.

WIBW's new radiator has one of the finest ground systems in the country. Land on which the transmitter stands is the old bed of the Kansas River. The soil itself — a rich sandy loam — is always damp with normal water level only 20 feet below ground surface. The transmitter grounds, but not the transmitter house, are subject to overflow at high river stages.

This famous Kansas soil is well known for its unusually high conductivity of radio waves. And buried in this rich, wet soil is the ground system of the new transmitter. From the tower itself extending out like the spokes of a wheel are 120 radials of Number 10 bare copper wire each 825 feet long. These lengths of wire are completely buried in shallow graves eight to ten inches deep.

Thus the new plant, according to Troeglen, boasts the finest in towers, in ground systems and in soil conductivity, all of which make WIBW's 5000 watt regional channel at 580 kilocycles easily equivalent to several times that wattage in some parts of the country.

WIBW's primary area has always been outstandingly large. With the old transmitter this area has field tested one half millivolt at a radius of 187 miles. But with the new transmitter, the primary area radius is currently showing field test results at approximately one half millivolt at 250 miles.

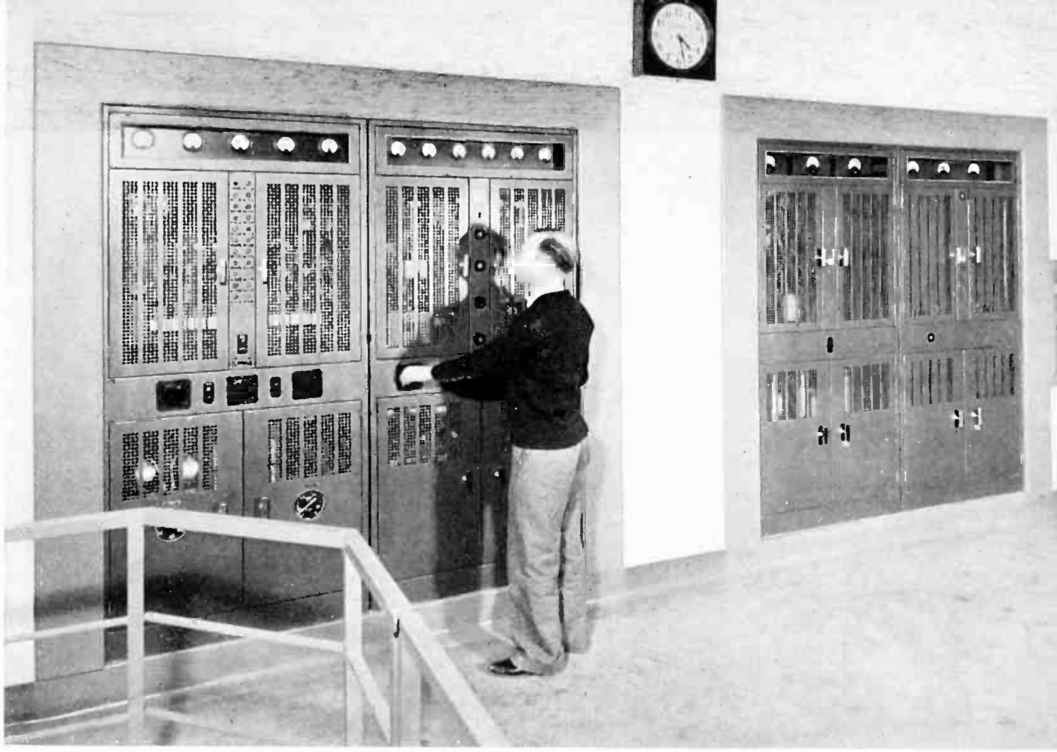
This means that the station's primary and secondary areas are now about 33.6 per cent greater than they were before the new plant went into operation. If listeners in these areas increase in the same proportion WIBW's broadcasts will reach 7,977,880 people instead of the previous number of 5,983,410.

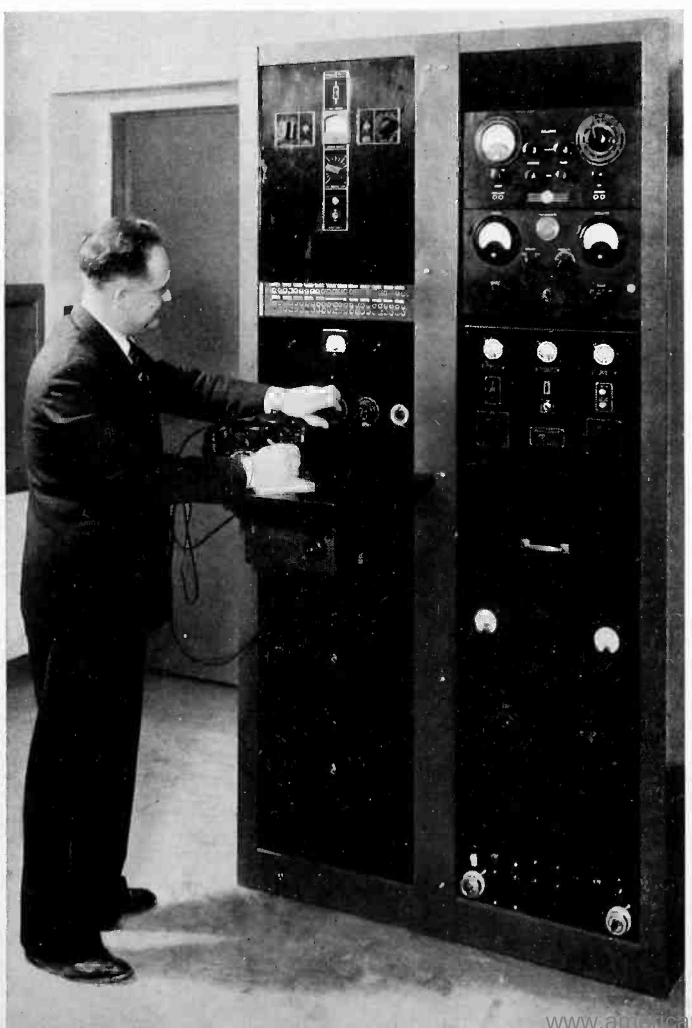
This eight-ball microphone was accidentally dragged over a concrete road for a distance of one mile and a half behind a speeding noise measuring truck operated by General Motors. When recalibrated it was found to be in perfect working condition except for a slight decrease in level at the high frequency end.

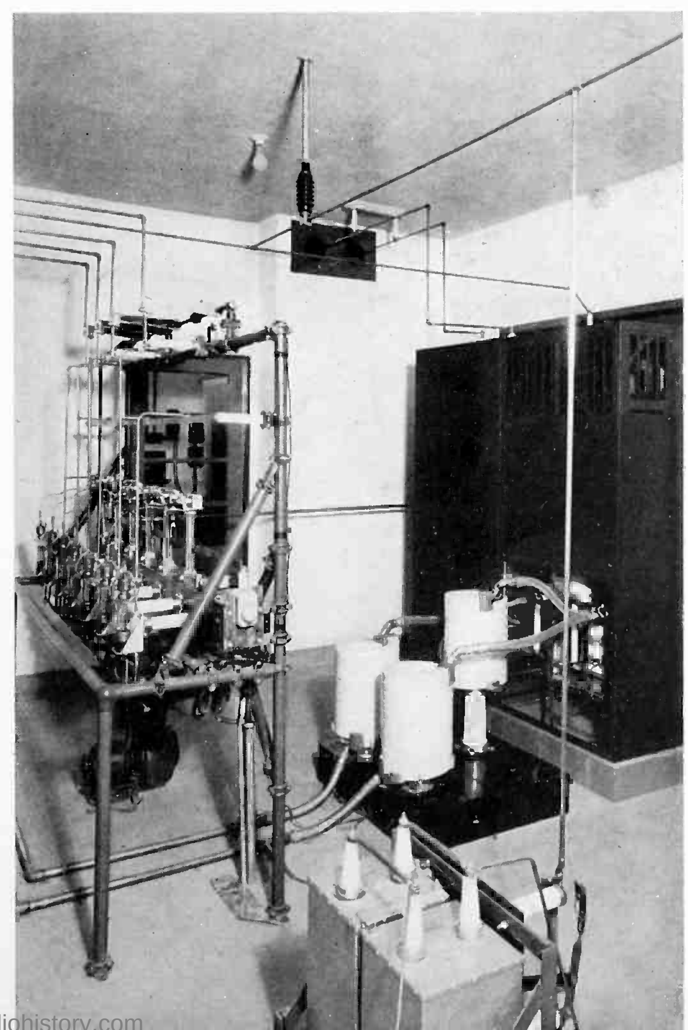
WIBW

Topeka, Kansas

The new "Voice of Kansas" reaches WIBW listeners through the medium of this Western Electric 5000 watt transmitter. Increased coverage and higher fidelity are responsible for that satisfied expression on Manager Ben Ludy's face. Chief Engineer Karl Troeglen (lower left) chose the equipment. High voltage unit shown in lower right picture.







Huge Sound System at World's Fair Voices Story of Railroad's Progress

By R. V. FINGERHUT

Railroads on Parade! Well named in this pageant of rail transportation which, four times a day, portrays to an enthusiastic audience at the New York World's Fair the history and growth of one of America's greatest industries. On a huge outdoor stage, great revolving turntables enable unseen hands to transfer the scene, in a moment's time, from New York to Baltimore, to change a country railroad siding of 1839 into a modern depot of a century later. Two sets of track run across in front of the stage and on these the largest "props" in the history of show business enter and leave the scene of action. The blase show-goer of today is no longer surprised when horses and even elephants tread across the boards or automobiles scoot about among the scenery. But this outdoes them all, for here is a show in which the main characters are railroad trains.

And these characters are just as real, just as alive as any the stage has seen. They breathe with snorts of live steam and talk in tones of shrill whistles. And, though confined to rails, they move faster than mere man can follow. They have their quaint names or their famous numbers. There is the doughty *Stourbridge Lion,* the first locomotive in America, brought over from England to haul coal from the hills of Pennsylvania to the sea. Then there's the *Best Friend of Charleston,* and the well known *DeWitt Clinton.* The *119* of the Union Pacific returns to life during the scene in which the builders of the first transcontinental railroad drive home that famous last spike of gold.

Assisting these main characters of steel and iron is a supporting cast of 250 people and 40 horses, in addition to a 30-piece orchestra, a chorus of 20, and eight dialogue actors and narrators.

For more than an hour the audience of up to 4,000 persons watches and listens while the action of the pageant, the sound of glorious music and the voices of famous characters of the past are woven into a fascinating tapestry which depicts, in an unforgettable manner, the growth of American Railroads. Though no orchestra is visible music flows and stops. Though microphones and loudspeakers are unseen, all of the dialogue travels clearly and distinctly to the farthest seats in the grandstand. Though the characters on the stage move their lips and seem to do the talking, the dialogue comes, not from the costumed actors, but from a group of shirt-sleeved readers in a sound room beneath the audience.

There are three of these rooms, located under the front edge of the grandstand. One is for the dialogue "readers" and the choir, another for the orchestra. The third is the control room. In this latter is located the maze of equipment necessary for the operation of the elaborate sound system. And elaborate

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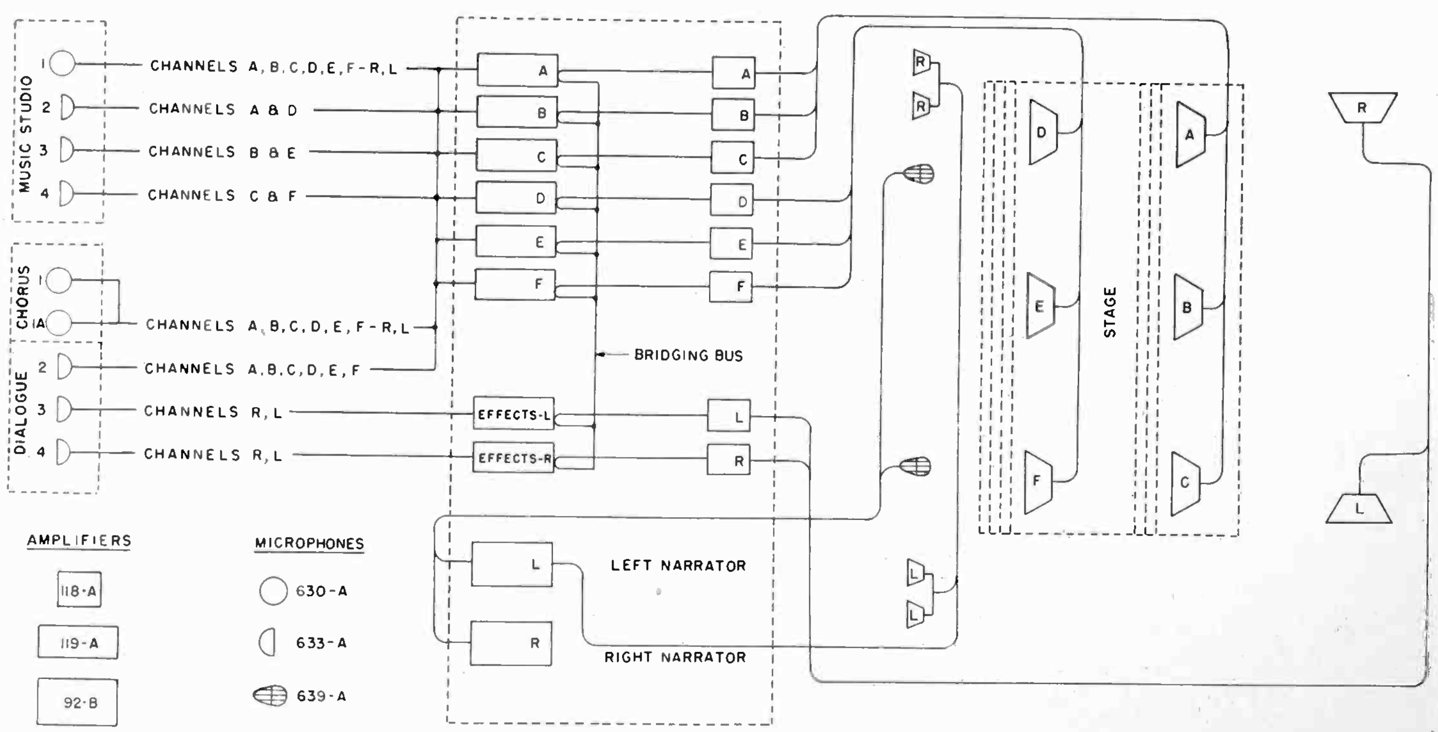
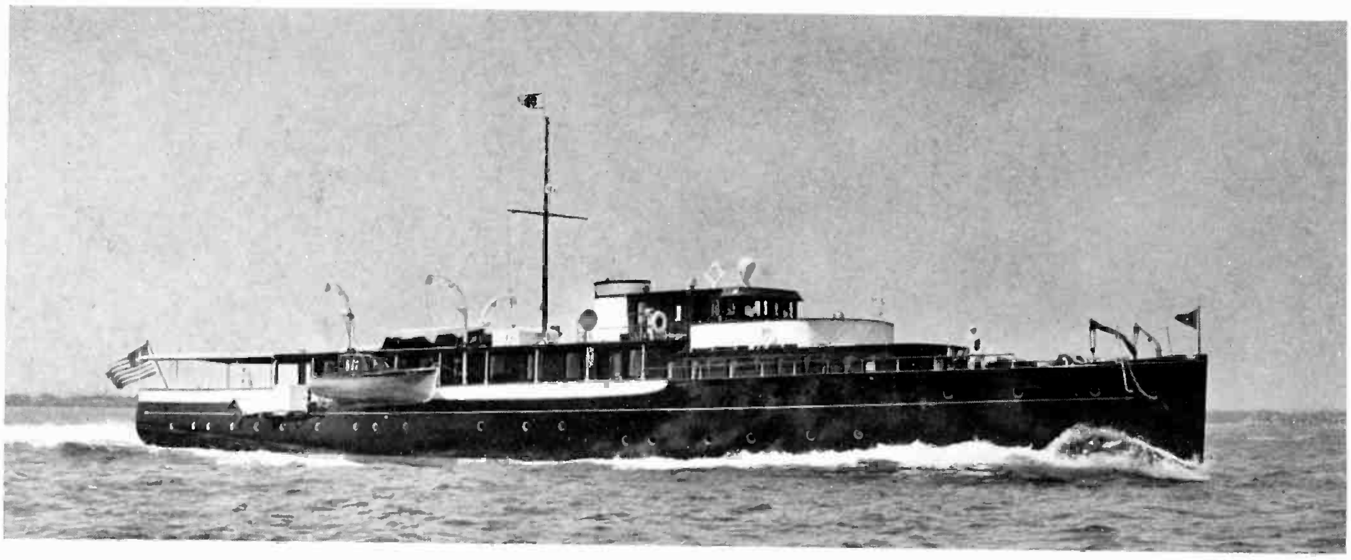


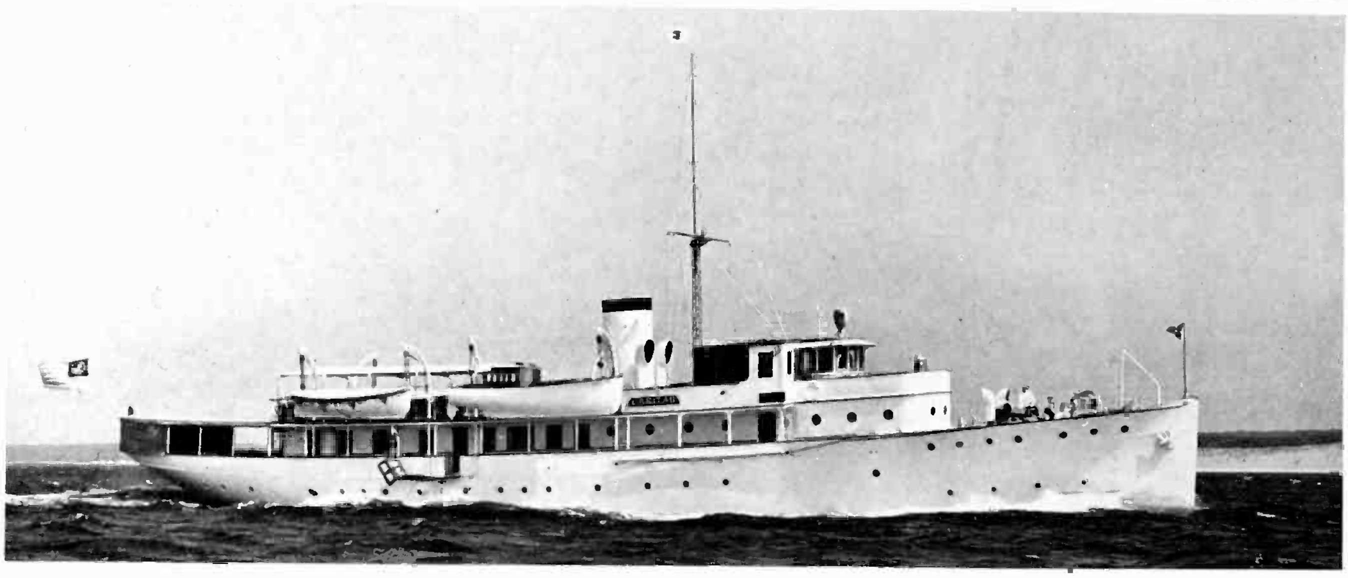
Schematic of the sound system for "Railroads on Parade," the great pageant of the "The Iron Horse" at the New York World's Fair.

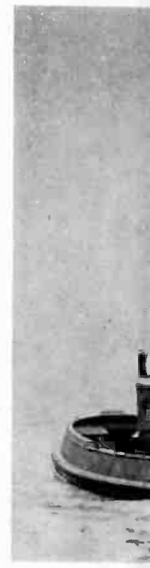
RAILROADS ON PARADE

Among the most popular exhibits at the New York World's Fair is the spectacular pageant "Railroads on Parade." The great triple-stage is shown at top where all sound emanates from loudspeakers indicated by circles. The only microphones visible to the audience are used by narrators (squares).

The two colorful scenes pictured above are (left) the completion of the first transcontinental railroad and (right) the first trip of the "De Witt Clinton." The choir (lower left) follows the guiding hand of the music director in the doorway to orchestra room. Below: Amplifier racks and control operators.







West

MARIN

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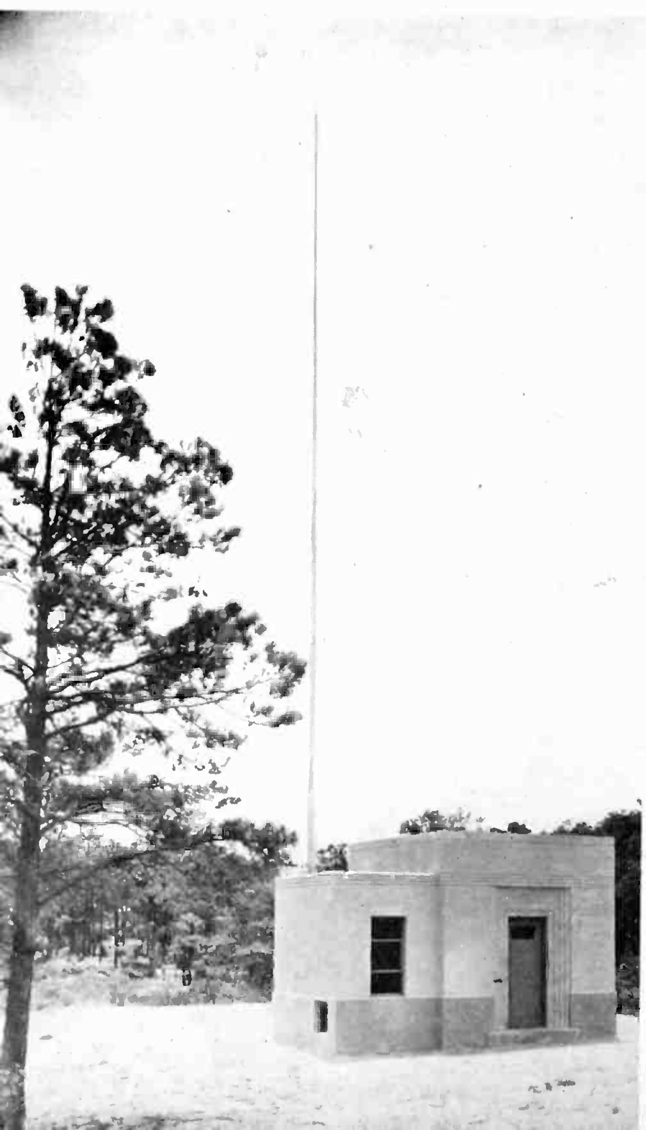
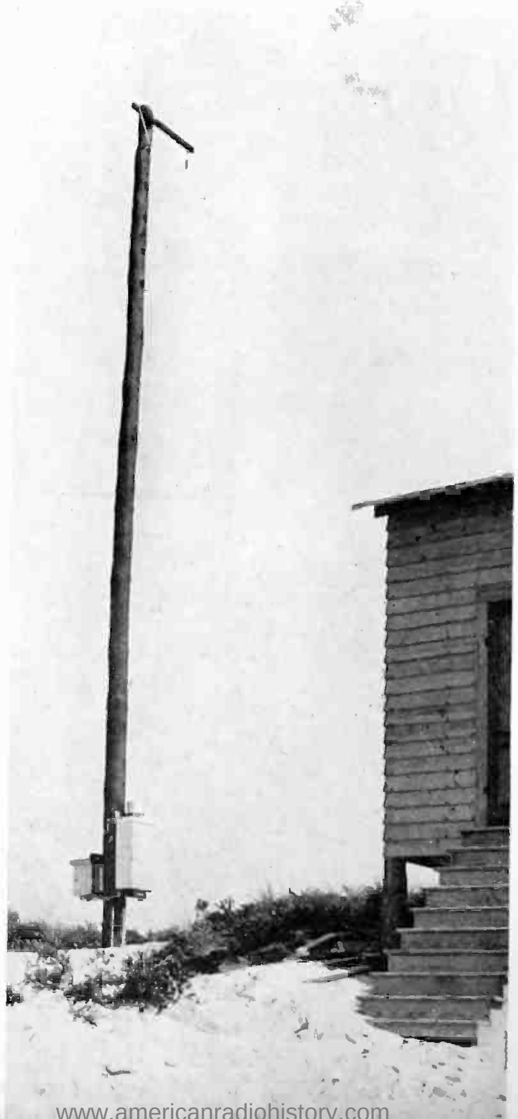




n Electric

RADIO

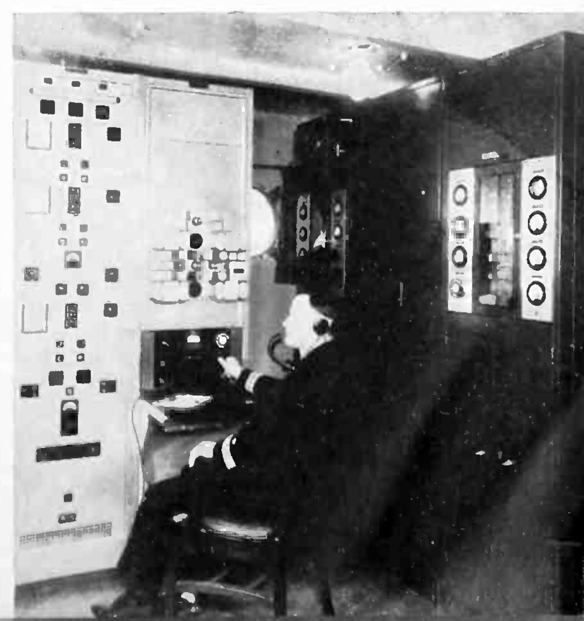
of the Sea

Ocean liners, coastwise vessels, private yachts, trawlers, tugs and even a de luxe ferry safeguard their travels along the great water lanes with Western Electric marine radio telephone equipment. How would you like to telephone shore from the beautiful yacht Wakiva (above)? She was built for Harkness Edwards in 1938.

A 50 watt installation sails aboard the Elka (upper left) whose proud owner is Arthur V. Davis. The Caritas (below) boasts of one of the most powerful marine telephone installations manufactured by Western Electric. First ferry equipped is Princess Ann operating between Cape Charles and Little Creek, Virginia.

That tenacious tug is the latest addition to Russell Brothers Towing Company. The trim transmitter station (lower left) at Virginia Beach and the receiving station, overlooking Chesapeake Bay, are typical of the growing chain of marine radio telephone shore stations which are dotting the East and West coast lines.

The panel below depicts the wide range of marine radio telephone equipments now available. The smallest, aboard the Martha E, speed boat commuter—the Wakiva's compact voice installed in the grand salon—the still more powerful voice of the Caritas and the elaborate system installed on the United States liner, the Washington.



CBS Engineering

(Continued from page 6)

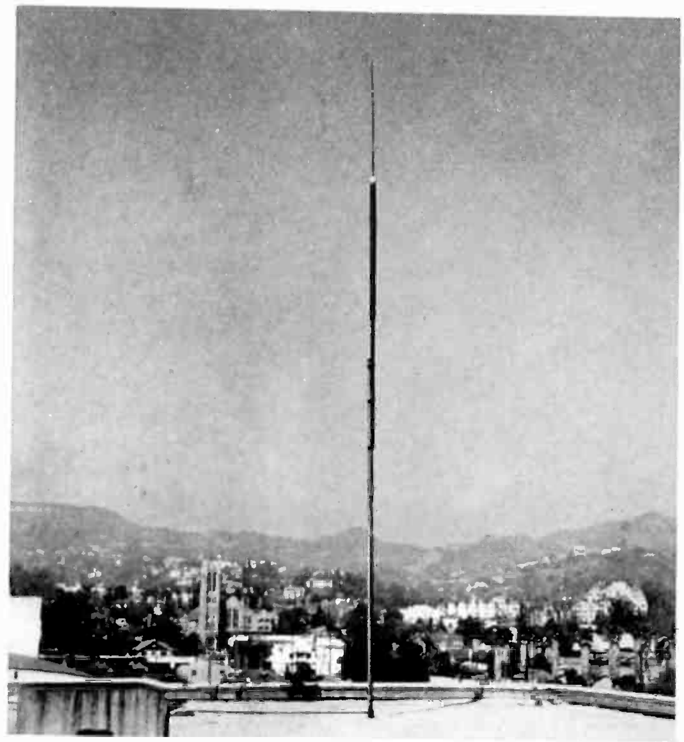
ments as Traffic, Sales Promotion, Special Events, and Publicity.

Special Events cooks up some novel broadcast which may call for broadcasts and special transmission from land, sea, and air, from every sort of location and from any sort of moving vehicle ranging from donkey cart to submarine. They come to Chamberlain. Can he do it? What will it cost? What are the chances for failure? And of course it all has to be done day before yesterday. To get away with it a man has to be a combination radio engineer, cost accountant, showman, prophet, magician, and advertising man.

Publicity wants a field transmitter that will have the sex appeal of a chorus girl, the size of a pocketbook, and the power of a broadcast transmitter. Sales Promotion wants coverage maps of every radio station in the country in time to meet next Tuesday's trade paper deadline. An affiliated station wants a five element antenna design and a member station wants a new technician. No wonder Chamberlain says they want men who can come up with the right answer and in a hurry. "Theory alone is no good," he explains. "Our engineers must be good engineers, but they must be good practical men, with lots of imagination to tackle jobs that have never been done before."

Seeing ahead, and effecting the correlation of present equipment and techniques with future needs play a big part in engineering. In the daily operation of a great network, much of the work is concerned with future requirements and it is only natural that out of daily operations should come developments which further the art of broadcasting. The Columbia Engineering Department is proud of the many that it

V. N. James operating the CBS portable automatic audio measuring assembly developed by him for Columbia Broadcasting System. It is recording the reverberation vs. frequency characteristic of one of the CBS New York studios. The equipment also automatically traces a graph of response vs. frequency characteristics of complete systems as well as amplifiers, filters, program lines. Acoustical measurements such as reverberation decay, noise-level surveys, sound isolation and determination of microphone and loudspeaker characteristics, and dynamic range, are readily accomplished by this assembly.



The Bailey Antenna of CBS's experimental station W6XDA, Hollywood.

has already fostered.

Probably no industry is backed by greater research than is carried on in broadcasting. One of Chamberlain's jobs is to consult with and advise the large research and manufacturing organizations in order to guide their research work along the lines most beneficial to broadcasting and to help them to provide the proper equipment.

Another tremendous job is that of keeping abreast of new developments. A thorough knowledge of all equipment offered by competing manufacturers is essential to a network which makes large purchases every year.

At any one time there is a score of new engineering jobs underway. On his desk, Chamberlain keeps a great leather folder which contains a record of every current engineering project. At a moment's notice he can refer to and check up on their status. A reference code in the file refers to complete engineering records of the entire job.

All owned stations of the system make detailed monthly operating reports to Chamberlain. From these detailed reports, he keeps an accurate record of every man and every piece of equipment in every station. If you want to know the life of a final amplifier tube in any CBS station, Chamberlain can tell you. From such reports accurate life records of all tubes and other equipment are used to guide future purchases. Costs of operating each station are minutely checked. Should a power bill from any station seem too big for a month, somebody will have to explain why. Yes, it's quite a job, and it takes a man like "A.B." to run it.

Each of the four divisions in General Engineering under Chamberlain has an Engineer-in-Charge. In the Audio Division it's Howard A. Chinn, graduate of M.I.T. From the day he joined CBS the calibre of his work was so good, Cohan sent down word that he wanted more men like Chinn. So it is that there are mostly M.I.T. graduates in Columbia.

Chinn's department is concerned with everything that happens to a sound wave from the time it leaves a performer's mouth until it reaches the transmitter in the form of electrical pulsations. His department is split three ways into Development and Measurement under Vir N. James; Design and Construction under Robert A. Bradley; and Engineering Laboratory under Robert B. Moe.

These three groups, individually and collectively, turn out an amazing amount of work. Chief among the jobs is the design and construction of studios and all audio facilities for the CBS owned stations, but the work is far greater than that because they are constantly being called upon to render similar services for affiliated stations, a service which is given free of charge or at actual cost depending upon the nature and scope of the work. Typical of such work are the studios and audio facilities at Columbia's West Coast Outlet, KNX, Hollywood; the entire design and construction of which was done by Chinn's department. Bradley was on the job there for more than six months, and regularly spends half of his time in the field supervising construction of studios and installation of speech input equipment in owned and affiliated stations.

Acoustic measurement, and treatment, where needed, of every studio in each of the nine owned CBS stations plus any number of affiliated stations is just one job of this department. It is handled by James as a function of Development and Measurement. To do this work, James had under development for several years the CBS Transmission Panel, and the CBS Automatic Audio Measuring Assembly, special instruments for making complete electrical and acoustical measurements of studios and audio equipment. They are considered distinct contributions to the industry.

Realizing a life-long ambition, E. K. Cohan, CBS Director of Engineering, this year launched his own boat, the Electron. A Western Electric Marine Radio Set features one of the finest radio installations afloat. The station's call letters stand for the Master's name.

J. D. Parker and the CBS two-element directional array graphical calculator, which he developed. This calculator enables the radiation along the horizontal plane, or in any direction in space, of a two-element directional antenna array to be estimated rapidly and accurately in terms of field strength units for any given operating conditions of the array.

Another job of Chinn's department is to make comparative tests of all competitive equipment. This work is carried on extensively and continuously. It enables the System to keep up to date on all developments and places it in the position of knowing the best equipment offered on the market.

Development of new equipment, research work investigations and general all around engineering is carried on by Moe who is in charge of the CBS laboratory.

William B. Lodge, another M.I.T. graduate is Engineer-in-Charge of the Radio-Frequency Division. This department comprises the chief transmission data collecting agency of the entire CBS system. Under Lodge the first conductivity map of the United States was prepared and published. Later he cooperated with the Canadian Broadcasting Company and introduced the first conductivity map of Canada. Coverage maps of the country have been presented before the FCC representing more than 8,000 man hours of work simply to assemble the material and in addition to the years of work of many men in making the actual surveys.

Making coverage surveys and signal strength maps for affiliated and owned stations is an all-the-year-round job of Lodge's Division. One of the things he likes best to do is selecting new station sites, and he has done this more than 25 times since he came to Columbia in 1931. To the laymen this may not sound like an unusual job but it requires not only skill and diplomacy but also a great deal of hard work. Making a survey may require weeks plus the juggling of such factors as land costs, FCC requirements, Department of Commerce rulings and regulations, local zoning ordinances, soil conductivity, topography, and directional characteristics.

Coupled to this is the work of designing antennas for owned and affiliated stations. More than 200 have been designed by Lodge and J. D. Parker, antenna expert, and assistant to Cohan and Chamberlain. Indicative of the scope of Lodge's Division is the operation of the Columbia Field Intensity Automobile. In three years this car traveled more than 53,000 miles, was engaged in more than 9,000 field intensity measurements in the course of making surveys for more than 50 stations in the Eastern half of the country. This car has been retired and replaced by a new Chrysler with the most modern of survey equipment. It is operated by G. C. Hutcheson. Surveys for Western stations are made by cars operating out of Chicago and Los Angeles.

Another phase of Lodge's work is testifying before FCC hearings. To date he has made perhaps a score of appearances. He spends several days each month in Washington.

The Short-Wave Division comprises two sections, High-Frequency and Ultra-High-Frequency. F. J. Bleil is Acting Engineer-in-Charge of the Division and head of the High-Frequency end. W. H. Moffat heads the Ultra-High-Frequency end.

Bleil, graduate of M.I.T., has charge of all intermediate and short wave transmitters used by Columbia for relay broadcasting as well as the 10 KW. international station W2XE, located at WABC, and now known as WCBX. Most relay transmitters are bought from outside suppliers, although often they are built to CBS specifications resulting from designs developed by Bleil.

An interesting and valuable part of Bleil's work is the scheduling of operating frequencies for the international station. These schedules must be made up four months in advance and are based on predicted propagation characteristics of the heavi-side layer and countless other factors including sunspots. So accurate has the science of propagation predictions become that it is rarely necessary to change schedules even though they are prepared far in advance. Much help is obtained in this work from the daily reports of the monitoring of the station's signals by the British Broadcasting Company, and also through commercial radio operations in South America.

Columbia's new Field Intensity Measuring Car, which this year replaced one that had made more than 9,000 measurements in 53,000 miles of travel.

W. H. Moffat, Georgia Tech, is in charge of Columbia's three experimental ultra-high-frequency stations, W2XDV, New York; W9XHW, Minneapolis; and W6XDA, Los Angeles. Much of his time is spent in making coverage surveys, noise level surveys, and level variations. At present he is making an elaborate study and comparative tests of vertical and horizontal polarization of ultra-high antennas.

The fourth Division of General Engineering operates under J. L. Middlebrooks, architectural graduate of Alabama Polytechnic Institute and engineering graduate of Georgia Tech. It is his job to plan and supervise the construction of new Columbia stations. Right now he is down in Washington busily putting Columbia's new Western Electric 50 KW. transmitter on the air at WJSV. He supervised the construction of WKRC and WEEI at the same time by commuting via airplane between the two jobs.

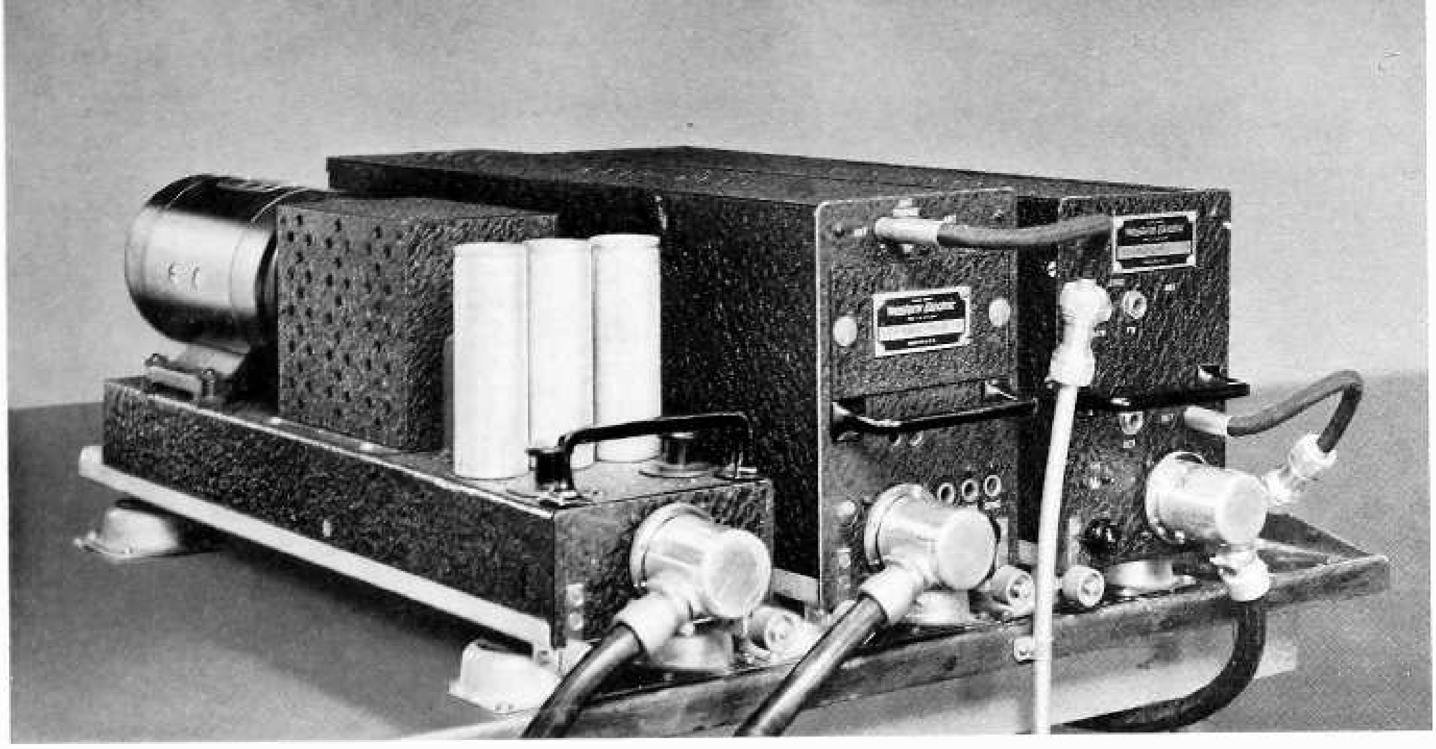
Such is the General Engineering Department. In man power, Network Operations is a much larger organization. In each division, the chief engineer of the key station of the division serves also as Division Operations Engineer. Thus, Henry Grossman is Chief Engineer of WABC, New York and Operations Engineer for the Eastern Division; F. B. Falknor, Chief Engineer of WBBM, Chicago, is Central Operations Engineer; and L. H. Bowman, Chief Engineer of KNX, Hollywood, is Western Operations Engineer.

In all there are 290 persons in the CBS Engineering Department. The System owns and operates nine broadcasting stations, and has 106 affiliated stations which comprise the network stations, one international short-wave station, three experimental stations, and 16 relay and experimental relay stations.

Besides operating the largest single network in the world CBS Engineering has made innumerable important contributions to the entire field of radio broadcasting. This includes new equipment, new techniques and new operating procedures. Its scope and influence has helped tremendously to speed engineering research and direct it along lines productive of better and more efficient operations. Scores of technical papers have been presented before scientific organizations such as the Institute of Radio Engineers, and many CBS engineers take active part in such engineering bodies.

In the words of E. K. Cohan, "the Engineering Department, man for man, constantly strives for that happy balance between engineering perfection and economic justification."

Radio as a whole had its acid test this fall when the nations of Europe hung for days between war and peace. If ever an industry, its organization, personnel, and facilities had a supreme test of its fitness, radio had it then. CBS Engineering came through with flying colors.



The main components of the 1A Radio Altimeter — modulator, transmitter and receiver.

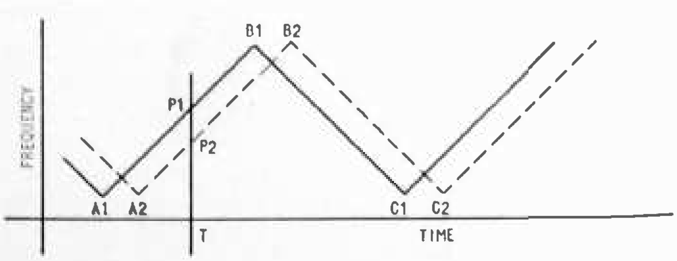
New Radio Altimeter Safeguards Air Travel

The commercial model of the terrain clearance indicator developed by Bell Telephone Laboratories has just been announced by the Western Electric Company. This instrument, known as the 1A Radio Altimeter, is designed to provide airplane pilots with a constant indication of their height above the ground. It is an outgrowth of the experimental model which was first demonstrated in October 1938.

At that time the terrain clearance indicator was welcomed by all branches of the aviation industry as a major contribution to air navigation. Despite darkness or fog, a pilot using this instrument is always aware of his height, not above sea level, but above the ground beneath him. By keeping at a safe predetermined terrain clearance, or height above the ground, the danger of crashing due to lack of visibility or ignorance of the terrain becomes practically nonexistent.

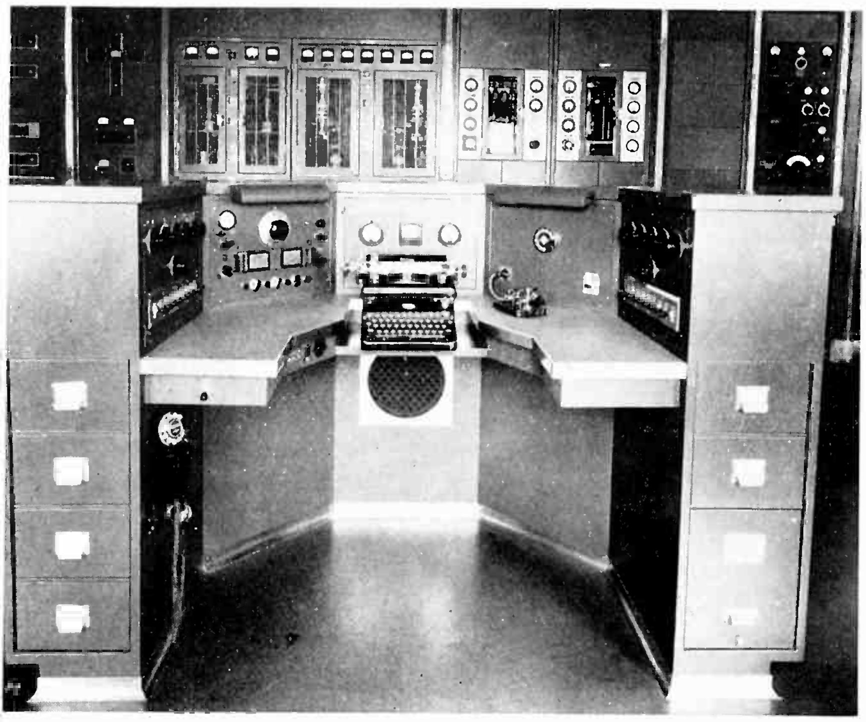
The 1A Altimeter employs a principle involving transmission of a radio signal from an airplane, reception of the signal as reflected from the earth, measurement of the elapsed time between transmission and reception, and the translation of this time interval into a direct reading of the plane's altitude in feet as shown on a meter. Due to its use of ultra high frequency the new instrument is entirely free from static interference.

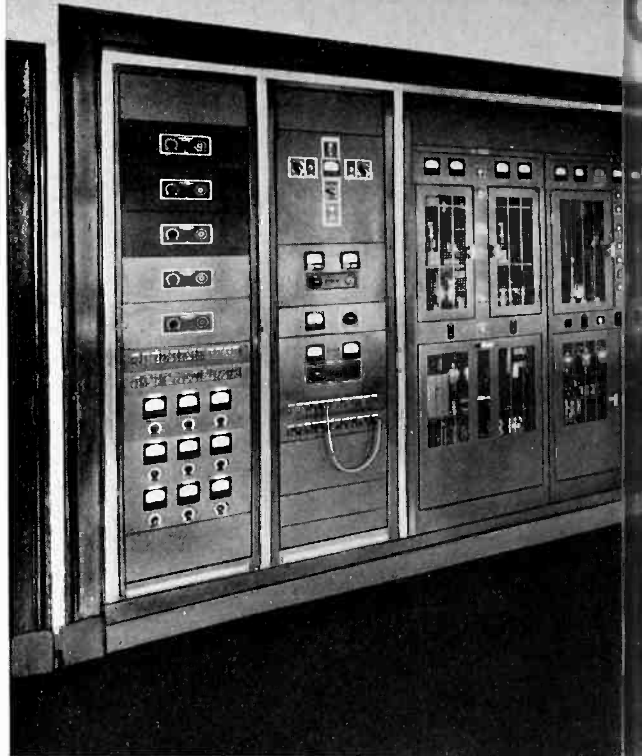
Since the speed of radio waves is constant, the elapsed time is proportional to the distance. If an airplane is equipped with a radio oscillator whose frequency can be "wobbled" according to the sawtooth curve A_1 B_1 C_1, and if a corresponding wave is radiated toward the ground, some of the energy will be reflected back to the plane where it will set up a current in an antenna. The frequency of that current will have a similar wobble, but displaced in time to the position A_2 B_2 C_2 by reason of the delay in travel to the ground and back. At any instant the frequency of the received wave will differ from that sent out by a constant amount equal to P_1 P_2. If the ground falls away or the plane rises, the travel time will be increased and the received current will be displaced still further; consequently the frequency difference at any time will increase in proportion to the change in clearance.



The difference in frequency between two currents can be measured by passing them through a modulator tube and measuring the frequency of the "difference" component in a frequency meter. The scale of this meter, graduated in feet, will indicate directly the clearance over the terrain.

The Western Electric 1A Altimeter consists of a transmitter, modulator or "wobbler," receiver, meter and two dipole antennas. The transmitter, modulator and receiver can be installed in the baggage compartment of the plane with cable connections to the airplane battery and to the meter on the instrument board. The two antennas are mounted on the undersurface of the wings on either side of the plane body and connected to the transmitter and receiver by coaxial transmission lines. Each of these antennas extends downward only seven inches and has a spread of approximately 14 inches. The total weight of the entire apparatus is less than 50 pounds.





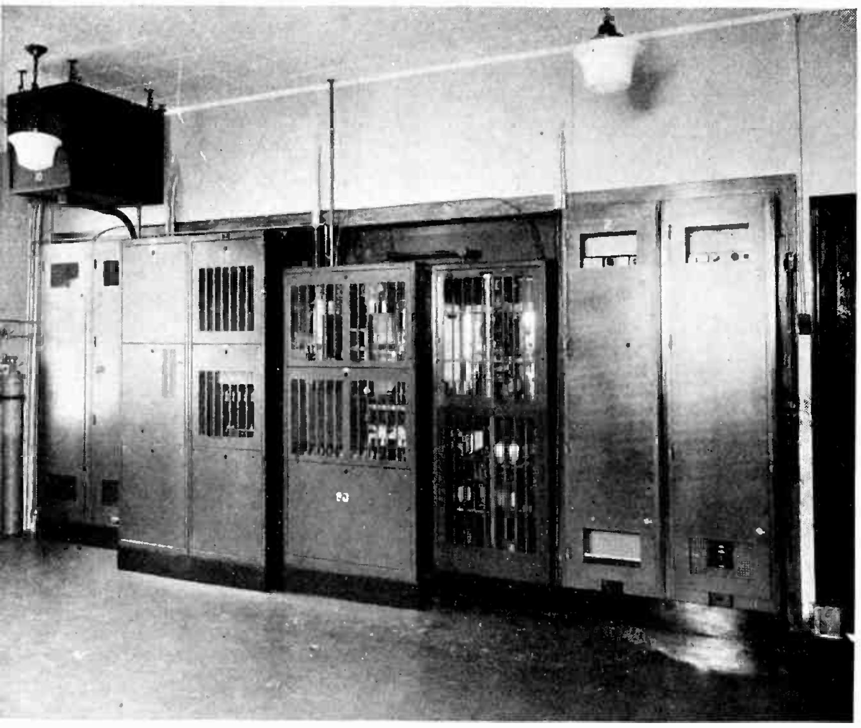
POLICE

St. Louis

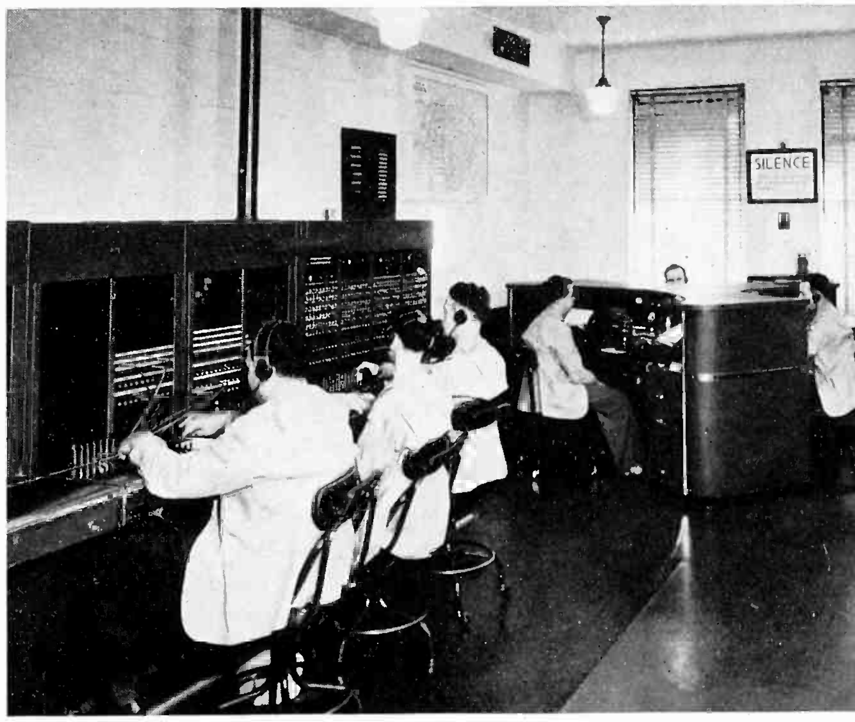
The latest interzone police radio station to join the ranks of those equipped with modern high quality apparatus is KGCP, St. Louis, Missouri. A new, complete Western Electric radio telephone and radio telegraph system, which puts the St. Louis Radio Division on a par with the finest police radio stations in the country, "went on the air" June 23, 1939.

The main components of the St. Louis system are two Western Electric transmitters — a 500 watt 309B which is used for telephone communication with the roving police cars and a 400 watt ten-channel 14C. Nine of the 14C's channels are used for telegraph communication, the tenth being arranged for emergency telephone communication on the same frequency as that used in the 309B transmitter.

The entire system, located on the top floor of the Police Headquarters Building, occupies three rooms, each of which is acoustically treated and air conditioned. These are the dispatching room, in which the telephone switchboard is also located, the main transmitter room, and the service room in back of the wall mounted transmitters. In the latter room are located spare parts cabinets and a completely equipped workshop for servicing all radio apparatus including the mobile transmitters and receivers. Since the rear of the wall mounted equipment opens into this service



Above: A general view of the main transmitter room. At left—top: The control console. Center: A view of the rear of the transmitting equipment in the service room and, at bottom: The Headquarters building with its twin towers.



RADIO

Missouri

room all parts of the units are easily accessible for replacement or repair.

In the transmitter room, the flush mounted transmitting and speech input equipment occupies almost an entire wall. This equipment consists of the 14C and 309B transmitters and four bays of amplifying and control units. The left bay contains five 109B amplifiers, two jack strips for testing and emergency patching and nine decibel meters for the branch loudspeaker circuits throughout the building. Mounted in the second bay are the 110A program amplifier, two 105A speech input amplifiers, a volume indicator panel and two jack strips. Next is the 309B transmitter and then the 14C transmitter and rectifier. Of the two bays on the right, the first is as yet unused while the last contains the modulation monitor, frequency monitor, frequency deviation meter and the heterodyne frequency meter and calibrator.

The control console, in the center of the transmitter room, faces the transmitter layout and is low enough to give the control engineer easy observation of the entire equipment. All controls and meters mounted on the five panels of the console are arranged for simplified operation. The left panel of the control console is a five channel microphone mixing panel with

(Continued on page 25)

Upper right: A general view of the dispatching room showing the telephone switchboard and the three position dispatching console. In the center is a view of the main dispatching position and at the bottom the clerk's position.

228A Radio Telephone Equipment

(*Continued from page 9*)

mitter is extremely simple. The crystal is plugged in, and the crystal-doubler and tripler circuits are tuned to give maximum plate current in the output circuit as evidenced by a meter plugged in to conveniently located jacks. The output circuit is trimmed to minimum plate current and the antenna circuit is tuned to resonance as noted by an antenna current maximum. Further trimming of the antenna coupling condenser allows adjustment of the plate current of the RF output stage to its proper finite specified value for 15 watts carrier output. Final trimming of the controls with modulation on allows further maximizing of modulated antenna current as the final step. No adjustment of the audio circuits is required.

If the transmitter is installed in a car having reversed polarity a simple interchange of the primary dynamotor leads is all that is required. No current is taken in the standby position except for temperatures under freezing when 0.2 ampere is drawn intermittently by the crystal heater. The vacuum tubes in this transmitter receive exceptionally light service since in a normal year (assuming transmission periods at 5 minutes per hour) the tubes would be used only a total of 730 hours.

The car transmitter is housed in a steel cabinet with a removable top. All tuning controls are accessible from the front with the top on, and these controls are tunable with a small screwdriver and may

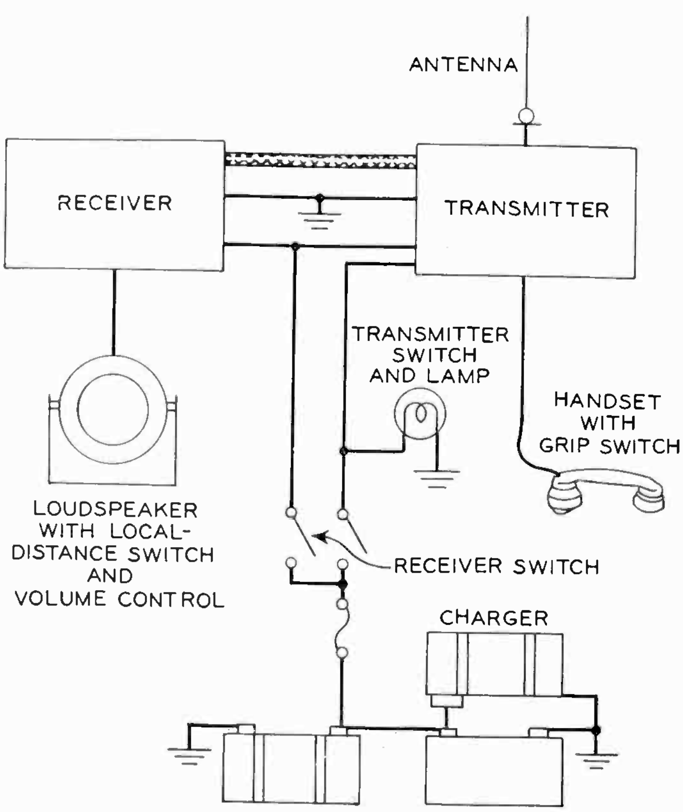


Fig. 5—228A Radio Telephone Equipment—Block Diagram.

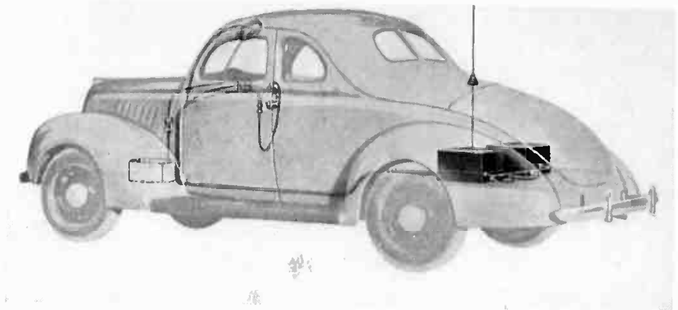


Fig. 6—Typical 228A Radio Telephone Equipment Installation

be locked with a socket wrench. A mounting bed plate is permanently fastened to the metal floor of the luggage compartment of the car and allows the transmitter to be slid in place and fastened by two machine screws. Six-volt connections are made by means of large cable lugs which are solidly fastened to appropriate studs with large elastic stop nuts. The hand set cable socket on the transmitter chassis may be employed for tuning by removing the hand set from up front in the car and reinserting it in the transmitter chassis.

The car antenna connection is plugged into a small socket as well as the receiver transmission line connection which is similarly arranged. No separate audio connection for feeding receiver output to the hand set phone is required between the transmitter and receiver as this audio energy is carried by the receiver RF transmission line.

The 28A Receiver is a high gain superheterodyne car receiver with a circuit shown schematically in Figure 8. It is built almost identically in size and appearance to the car transmitter and is a most suitable companion for it in the two-way radio system since all interconnection facilities are arranged for short symmetrical strapping to the transmitter. The receiver may, however, be used alone in a one-way receiving system for car use.

The receiver contains an 1851 radio frequency amplifier stage for feeding the first detector (a 6L7) in which is injected a beating oscillator voltage from a 6C8G. The generated I.F. signal at 2.7 mc is amplified by two 6K7 stages with doubled tuned I.F. transformers which feed the second detector, a 6Q7. Three audio amplifier stages are used, one of which is also a DC amplifier for the amplified AVC circuit controlling bias on the RF amplifier, first detector and the two I.F. stages. The succeeding two audio stages are a 6C8G and a 6V6, the latter feeding 3 watts of audio energy to the loud speaker. An audio volume adjustment is provided in the grid circuit of the audio output stage which is supplemented by another volume control located on the separate loud speaker. Audio output is also fed back over the receiver transmission line through an RF filter to the radio transmitter where it may be short-circuited during transmit intervals and where it may also be fed to the hand set phone during receiving intervals.

In order to obtain quiet operation of the receiver when no carrier is received, a triode noise gate is inserted between the second detector output and the first audio amplifier. This triode noise gate tube operates in the following manner. With no carrier present, the cathode and plate are at a positive potential with respect to ground and the grid is at ground potential hence the triode is biased below cut-off and cannot conduct energy to the audio tube even though a difference in potential of proper polarity exists between plate and cathode. As soon as a carrier is received, the plate and cathode swing from a positive potential with respect to ground to a negative potential with respect to ground by means of the voltage developed in the DC amplifier. The noise gate grid, however, is still at ground potential and hence allows the noise gate triode to conduct energy to the audio stage. As can be seen from the receiver schematic (Figure 8) the noise gate plate and cathode are so connected across the output of the second detector that signal voltages will freely pass through these noise gate elements to the audio stage, since the noise gate plate is at a positive potential with respect to the noise gate cathode when signal voltages are present.

The above effect is to act as a valve which allows energy to pass only when carrier is present. Entirely aside from this effect is a further noise suppression function obtained in this noise gate circuit. With a carrier present and the noise gate conducting, the DC and AC components of the modulation envelope are allowed free passage to the audio stage. However, as is prevalent in the UHF spectrum, high ignition noise that degrades the transmission is generally present. These high noise transients are frequently higher in voltage than the carrier modulation envelope peak voltages. This noise gate circuit prevents these high noise peaks from being conducted. By reference to the schematic, it can be seen that the plate of the noise gate goes momentarily negative in respect to the noise gate cathode when transient voltages are developed in the second detector. The noise gate cathode is prevented from rapid changes in potential by means of the 0.1 MF condenser and its voltage remains practically constant. Under this condition, the noise gate becomes non-conductive for very short transient periods and effectively reduces the noise peaks to values comparable with the modulation envelope voltages. The signal-to-noise ratio is consequently considerably improved.

Additional audio suppression during off-carrier periods is effected by a neon tube short across the output audio stage grid. This neon tube is extinguished whenever carrier is received by the use of a triode operating as a DC amplifier. The grid of this triode is negatively biased whenever carrier is received and plate current of this triode which activates the neon tube drops to a low value and extinguishes the neon tube.

Two rectifier tubes, an 0Z4 and a 6ZY5G are used, each supplied from the same non-synchronous vibrator circuit, the first for positive plate and screen voltages and the second for negative biasing voltages.

Tuning the receiver is accomplished by trimming three RF circuits and the beating oscillator circuit. A codan sensitivity adjustment is provided to allow adjusting the receiver gain for specific noise conditions. The beating oscillator may be crystal-controlled

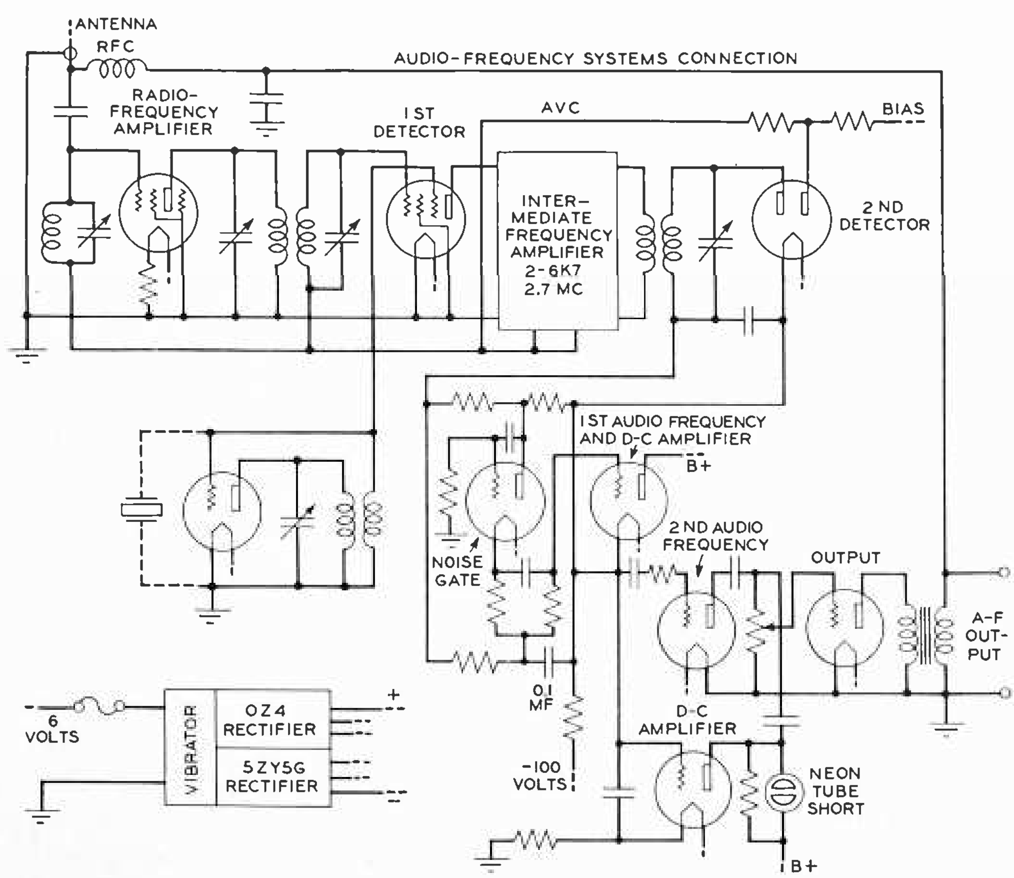


Fig. 7—
Schematic
Diagram of
28A Transmitter

if desired, but tests indicate the use of a crystal is not at all imperative, since the electric oscillator is exceptionally stable requiring no adjustment or trimming for temperature variations of about 40 degrees Fahrenheit. Under these variations the sensitivity of the receiver will not change more than 6 db when receiving signals from a transmitter having a carrier stability of .02 percent provided that the beating oscillator is adjusted at the mean of the temperature cycle. This electric oscillator includes an exceptionally good temperature compensating circuit thus allowing the attainment of such good stability.

The loud speaker is a 5 inch permanent magnet dash-mounted unit so arranged with a bracket that it can be swung to face the operator for optimum acoustical performance. On it are located an audio volume control and a local-distance switch. When the switch is in the local position the receiver operates at a pre-set sensitivity for quiet off-carrier operation under the noise conditions prevailing in a given cruising area. For emergency use on weak signals the distance position is used thus giving maximum codan sensitivity.

The hand set is equipped with the familiar F1 Transmitter Unit which has an established reputation for simplicity, reliability and fine voice quality. A sturdy phone is used for ear reception as well as sidetone during transmission. A light pressure grip switch in the handle operates the transmitter carrier whenever the main transmitter switch is on. The hand set is supplied with a cord and cord plug so that it can be used interchangeably for normal operation up front in the car or for maintenance checks in the rear luggage compartment. A small rubber hand set holder is used on the instrument panel scarcely larger than the phone end of the hand set.

The car antenna system consists of an 87 inch steel whip which may be mounted through the luggage compartment with its base near the transmitter in which case a small rubber exit bushing it attached to the car body surface in a weatherproof manner. Alternatively, this same whip may be mounted on the exterior of the car body on an adjustable bracket as a single point support. The connection to the transmitter in either case may be made with an unshielded conductor about one foot long.

The fused cabling system is made up of two No. 6 B&S unshielded conductors, and two unshielded four conductor cables all of which are run through loom from the dash to the luggage compartment. The control unit is fed from the battery system by a single conductor (No. 6 B&S) which is connected to the car starter switch, freeing the battery itself from extra bothersome leads. This conductor contains a fuse which with its machine screw clamp mounting was selected because of the low voltage drop and sturdy construction.

The control unit is a small plate containing two 6 volt switches, one for the receiver supply and one for the transmitter supply. In order to further reduce voltage drop in the system, these switches were selected after considerable investigation was made to obtain a switch having a very low resistance. Conventional switches have about 10 times the voltage drop of the one selected. A small indicating lamp is located on the control unit to indicate when the transmitter is on.

The 6 volt ground return circuit and radio frequency ground for the receiver and transmitter are obtained by metallic contact of the base of each unit with the metal floor of the luggage compartment, and in addition, a heavy short ground lead is fastened to the car body. With proper car bonding, this ensures the lowest resistance ground and tests have adequately borne this out.

Now a natural question arises. Just how well does this equipment perform and has all this detailed study resulted in a product that shows immediate improvement over that of older equipment? The 228A equipment was installed at Kansas City, Missouri and New York City under three separate sets of conditions

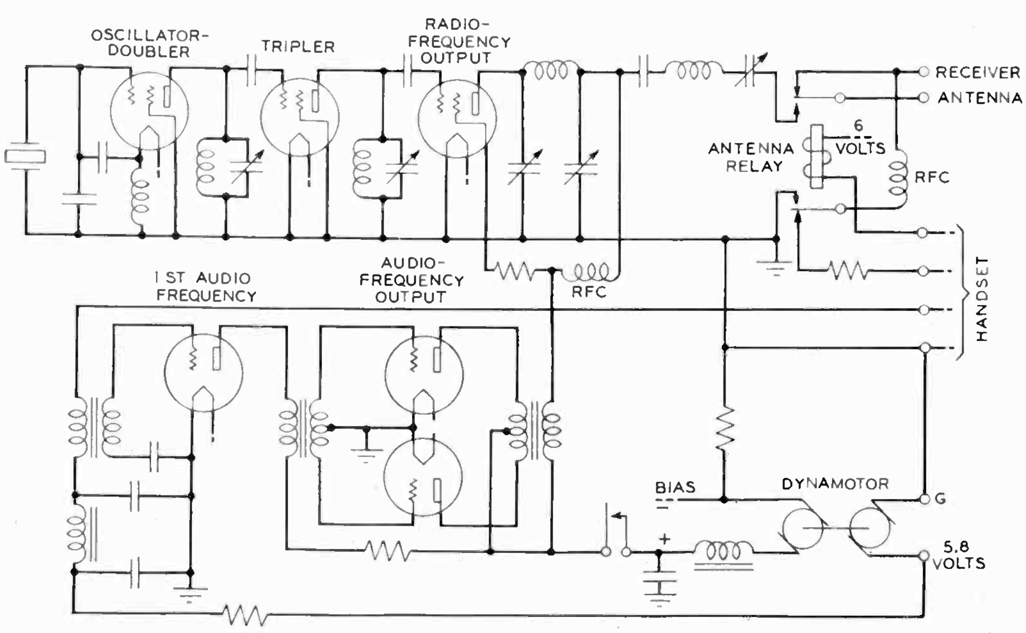


Fig. 8—
Schematic
Diagram of
28A Receiver

and in all cases coverage was considerably improved over existing equipment. The improved operation of the new receiver is perhaps most striking. Its improved audio quality was immediately noticeable. Most important, its ability to discriminate better against man-made noise in the center of the city allowed the codan circuit to be operated at a more sensitive setting so that more receiver sensitivity was realized.

The 15 watt car transmitter with a completely modulated carrier unquestionably out-performed lower powered units, although it is only fair to state that perhaps the chief reasons were that the carrier power is actually delivered to the whip antenna in an efficient manner and the carrier was really modulated to its fullest extent. It is well known that simple ratios of power increases alone are not of substantial benefit, but there is a great deal of satisfaction in knowing that a full 15 watts of 100 percent modulated carrier are being radiated. As for installation simplicity, a glance at Figure 5 is most convincing and experience in its installation has fortified this conviction.

Police Radio, St. Louis, Mo.

(Continued from page 21)

a master gain control. The next contains an ultra high frequency telegraph receiver and R. F. gain controls for three additional UHF receivers inside the console.

On the center panel is mounted the remote modulation meter, the remote over-modulation indicator and the channel indicator meter for the 14C transmitter. On the right center panel are the remote frequency switching dial for the 14C, a double jack for the telegraph key and the microphone on the emergency voice channel and a switch for selecting either microphone or key. The panel on the right contains the "T" pad mixers and master gain control for the five incoming remote ultra high frequency receivers located in various parts of the city for the car talk-back. Behind the mixers and inside the cabinet are the amplifier and compressor for the mixed circuits.

In order to attain the speed and smoothness necessary for efficient communication with the patrol cars, a three-position console has been designed and installed in the dispatching room. The telephone and microphone facilities are identical and in multiple at all three positions. In addition, the Dispatcher No. 1 position has a control panel for a large wall map of the city, equipped with light signals for designating the radio equipped cars in and out of service. The Dispatcher No. 2 position assists dispatcher No. 1 and the No. 3 position is for the Clerk, who at times assists the two dispatchers in receiving and broadcasting calls.

Each dispatcher's position has a transmitter on-off switch, decibel meter, loudspeaker and a microphone jack into which is plugged a 639A microphone. Since the clerk acts as substitute announcer, his position is similarly equipped, with the addition of two noiseless typewriters for keeping a log and making a record of all calls.

The antenna system, consisting of two separate vertical insulated radiators, is mounted on the roof of the Headquarters Building. These radiators are 100 feet high and placed 165 feet apart on a line approximately 45 degrees West of North. The Southeast tower is used with the 14C equipment for transmission on nine radio telegraph interzone frequencies and in emergency on the radio telephone frequency. The Northwest tower is used with the 309B for transmission on the radio telephone frequency.

A ground system consisting of two-inch copper strips spaced 30 inches apart covers the roof area. All joints are bonded to the building ground by either soldering or brazing. All conduits, cells, ventilating ducts and other accessories are also bonded to the building ground system. The Northwest tower and its associated antenna coupling unit are connected to the output of the 309B transmitter with approximately 135 feet of 7/8 inch concentric transmission line. The Southeast tower is connected to the output of the 10B tuning unit associated with the 14C equipment with approximately 58 feet of one-inch concentric line.

The 309B transmitter is used for radio telephone communication over a radius of 25 miles, including the metropolitan area of St. Louis and 22 outlying communities. To cover this territory, the police department operates 203 receiver equipped patrol cars, 19 motorcycles equipped with mobile receivers and 17 station-house receivers. All of the officials of the St. Louis Police Department are, to quote a letter from Chief of Police John H. Glassco, "well pleased with the performance of the new system."

Sound System at New York World's Fair

(Continued from page 12)

it had to be for its requirements were most complex. It had to be powerful, for the sound must cover 4,000 seats and be heard clearly over the noise of moving trains. No equipment was to be visible except the microphones used by two narrators who, speaking from a dais at either side of the stage, help the audience follow the quickly moving story.

All action and sound had to be perfectly synchronized and means provided to give the proper cuing to musical director and narrators. To preserve absolute realism all sound must move with its apparent source. When the actors move about, their voices must move with them, and when a group of street musicians, playing on silent strings and noiseless drums, swings across the stage, the music from its hidden counterpart must follow the wandering feet.

To obtain these results The Langevin Company designed a unique sound system, (part of which is stereophonic). Ten channels are used with 12 loudspeakers. Eight of these channels are capable of delivering a total of 400 watts of audio power, while the two narrator channels, each of which uses a pair of smaller loudspeakers, can deliver 20 watts each. The mixer is of the electronic type and consists of 34 input positions, arranged in groups for easy control by the two mixer operators and the stage and music directors. Each position controls a Western Electric 116A pre-amplifier coupled to a 119A voltage amplifier which drives a 118A power amplifier.

Each of the eight large speakers consists of a high and low frequency unit capable of handling 50 watts of power. As indicated on the schematic, six of these speakers are placed beneath the stage behind the two sets of steps. Two more in the wings on either side are used for off-stage sound effects. The other four, which carry only the voices of the narrators, are located in the flats just above their positions.

Three Western Electric 630A, six 633A and two 639A microphones are used as indicated in the schematic. Four of these are located in the music studio: one 630A which can be switched to any or all of eight loudspeakers, and three 633A's which, properly distributed among the 30-piece orchestra, feed into a three-channel stereophonic system. Two 630A microphones pick up the voices of the chorus and three 633A's are used by the dialogue readers. The 639A cardioid microphones are used by the two narrators.

To obtain the perfect synchronization of sound and action necessary for this production a unique cuing system was devised. Since the narrators cannot watch the action on the stage and, due to the directional effect, often cannot hear the dialogue, small loudspeakers are hidden in the wall directly behind them. These speakers, which are bridged across all of the other lines, enable them to pick up their cues easily. The readers in the sound room stand before double-glass windows and watch the action on the stage. In the orchestra room the leader uses a set of headphones, bridged across all 10 channels, to pick up his cues. The two operators at the mixer in the control room face open windows looking out at the stage and monitor directly from the loudspeakers.

The result is perfect coordination. Carl Langevin has always maintained that a good sound installation is one in which the audience hears clearly but does not realize that there is a sound system in operation. It may seem far-fetched to say that a system of this size should go unnoticed but the illusion that those on the stage are actually speaking is so well carried out, the synchronization of sound and action is so perfect, the music is reproduced so naturally, that this easily qualifies as a *good* sound installation.

Arnold B. Bailey

Arnold B. Bailey's radio career began at Providence, Rhode Island, in 1911, as a junior operator for his brother's wireless station "WB" which managed to communicate 20 miles if all went well with the spark coil and galena detector. Since this early start his activities have always been centered in radio.


Arnold B. Bailey

During his senior year at M.I.T. in 1925 Bailey investigated and analyzed methods of manufacturing mica radio condensers for a thesis on this subject.

After graduation the Institute appointed him to the position of assistant in the Department of Engineering Administration. During this period he conducted a course of instruction in engineering cost accounting and in addition, studied the theory of wave filters under Professor Dellenbaugh.

In 1926 Bailey joined Bell Telephone Laboratories as a member of the Radio Development Department and specialized in radio transmitter design under F. M. Ryan. A year later he participated in radio communication tests for the Great Northern Railroad at Glacier Park, Montana. He also experimented with the use of radio as a means of communication with moving trains, in cooperation with the New York, New Haven and Hartford Railroad.

In 1928 Bailey devoted his time to the development of a universal radio beacon. A year later he went into the field for the Laboratories supervising broadcast field intensity surveys and transmitter location projects for stations WEEI, WABC, WCAR, WHN, WOR and WSB.

Returning to development work in 1933, Bailey engaged in ultra-high frequency transmitter and antenna design as applied particularly to police radio systems. Since 1937 he has been in charge of a group specializing in ultra-high frequency transmitter design.

The coaxial antenna, described in the September, 1938, issue of *Pick-Ups,* and now used in practically all recent police radio installations, is a personal achievement of Bailey's and represents a major step in his efforts to improve ultra-high frequency transmitting equipment. The 228A Mobile Radio Telephone Equipment described in this issue concludes another forward step in this directon.

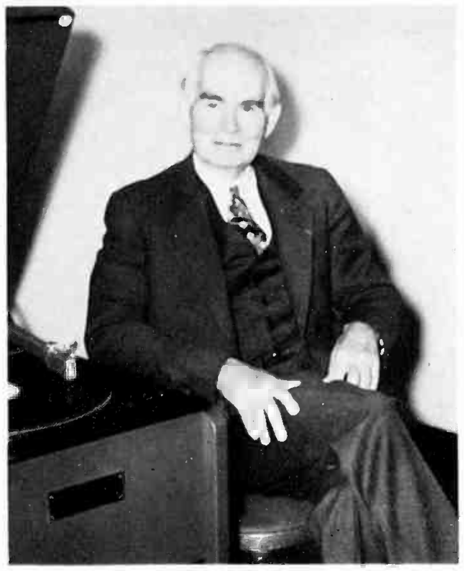
Mr. Bailey's hobby is photography. He is an active member of the Circle of Confusion, and president of the Miniature Camera Club of New York.

FACES the camera CAUGHT at the

Institute of Radio Engineers' Convention
Pennsylvania Hotel, New York, Sept. 20, 1939

Dan W. Gellerup (WTMJ) and a portion of another conferee.

Dr. Lee De Forest, famous radio pioneer and honor guest at the convention.

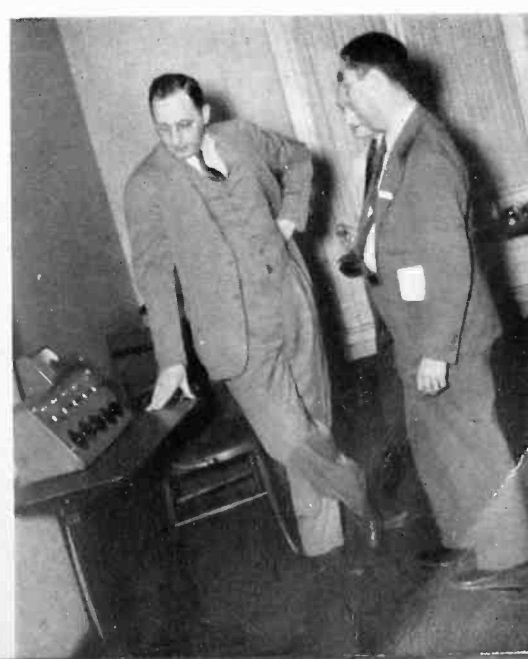


G. L. Thomas and Thomas M. Gluyas both from KMBC.

Stewart H. Chamberlain, H. F. Scarr (W.E.), Jim Everett, W. O. Sharp.

M. Pierce (WGAR), I. Martino (WDRC), R. E. Duncan, A. S. Wise (Graybar)

Left: Paul DeMars (Yankee Network); Below: W. E. McDowell (WHDL); and at right: I. B. Robinson (Yankee Network), H. F. Scarr and E. J. Content (WOR).



"Maybe I'm crazy – but everybody else thinks this new Western Electric Mike is a bird!"

PICK-UPS

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