Communication and Broadcast Engineering

VOL. 2 NO. 11

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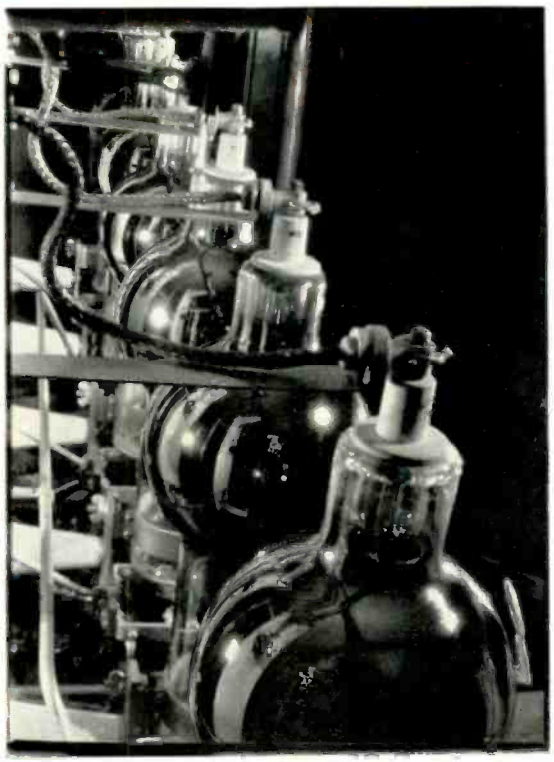

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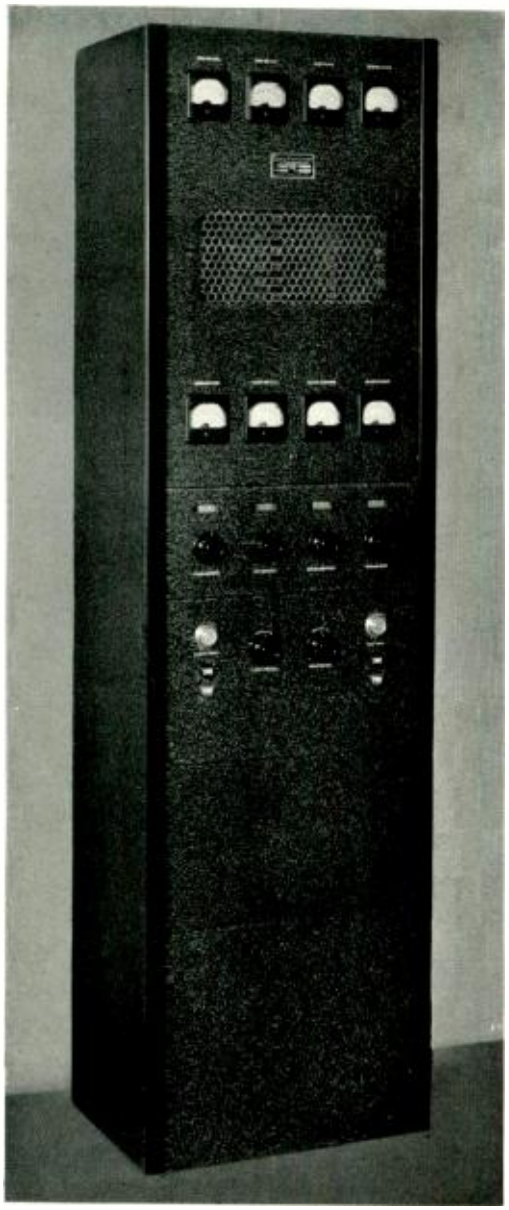
The Journal of World Communication

COLLINS TYPE 300D
100 WATT TRANSMITTER



THE NEW 300D Transmitter exactly meets the requirements of one hundred watt broadcast stations.

FIRST, the transmitter is capable of highly faithful transmission, a definite assistance in holding listener interest.

SECOND, the equipment is simple to install and maintain, and all annoyances of a technical nature are eliminated.

THIRD, the 300D is as reasonably priced as is consistent with best possible design and construction.

★ ★ ★

The 300D has remarkable performance, exceeding all of the new standards of high fidelity transmission. The frequency response at full modulation is uniform within plus or minus 1 db. from 30 to 10,000 c. p. s. The absolute hum level is 60 db. below 100% modulation. (This corresponds to a weighted value of approximately 95 db.) Total distortion components are less than 5% of the fundamental at 100% modulation. The maximum frequency deviation is less than ten cycles. Power is readily increased to 100/250 watts. The design of the transmitter is simple and straightforward so that the excellent performance obtained in the laboratory is readily duplicated day after day in actual operation.

★ ★ ★

The 300D Transmitter is illustrated at the left. An additional cabinet is furnished as standard equipment for mounting the frequency and fidelity monitors. These two units together with the Collins Type 12E Speech Input System form a complete, properly co-ordinated installation.

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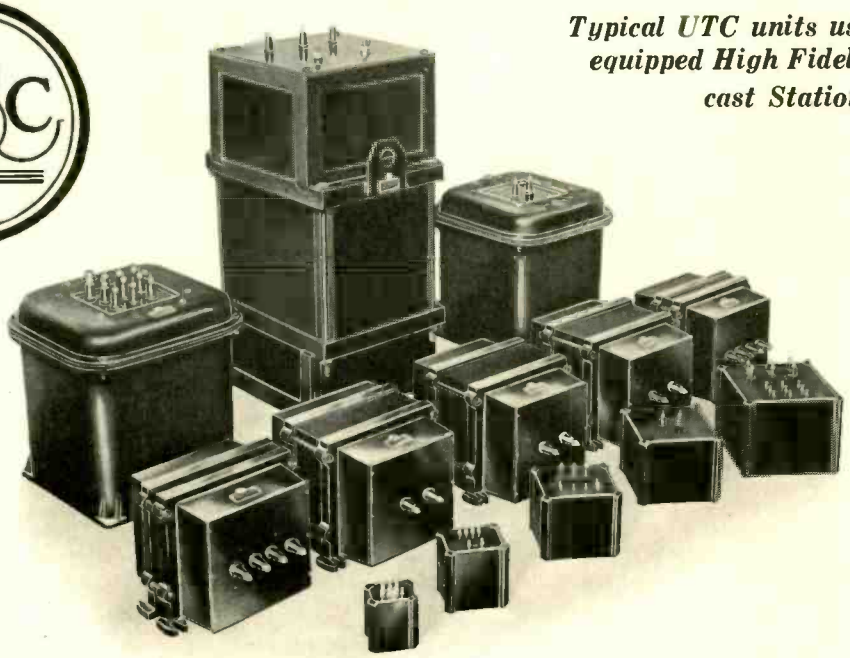


Typical UTC units used in better equipped High Fidelity Broadcast Stations

The units illustrated—top row, left to right—are: an oil-filled class B output transformer; plate transformer for output and RF stage; oil-filled modulation reactor. Second row, left to right: audio and filter reactors. Bottom row: speech and voltage amplifier audio units, etc.

UTC specializes in custom-built audio transformers in power ranges of −120 DB. to 50 KW.; power transformers to customer's specifications in dry or oil-filled types from 1 watt to 100 KVA.—up to 100,000 volts.

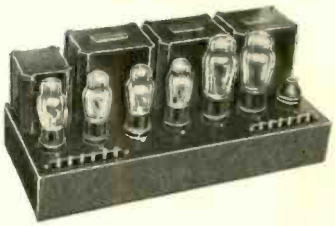
UTC has set a new precedent in matched audio units used by high fidelity broadcast and communication systems.

UTC LINEAR STANDARD and HI-PERM ALLOY audio transformers are calibrated and guaranteed to be ±1 DB. from 30 cycles to 20,000 cycles. All pertinent technical data and frequency response in DB. indelibly imprinted on outer transformer shield for customers' protection.

WIDE RANGE HIGH FIDELITY AMPLIFIER KITS

UTC LS type fixed bias 2A3 amplifier kits are designed to fulfill the most exacting requirements of Broadcast stations, recording and audio laboratories. The use of Linear Standard audio transformers calibrated and guaranteed to be plus or minus 1db. from 30 to 20,000 cycles makes possible the construction of amplifiers which do not vary more than plus or minus 1½ db. from 30 to 16,000 cycles. The amplifier illustrated has an undistorted output of 15 watts, the gain is 80 db. The amplifier kit as shown, including audio and power decks, dust covers, all transformers fully mounted, lists at.....$152.00

Complete accessory kit, nothing else required except tubes.....$23.50



2A3 Audio Amplifier with cover removed.

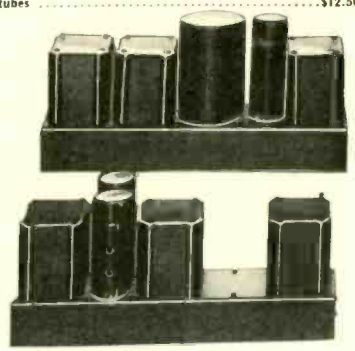
2A3 power supply with perforated protective cover fully mounted.

UTC PREAMPLIFIER KIT

The UTC AC operated 6C6 preamplifier kit is particularly adapted for use with Ribbon, Crystal or Voice Coil Microphones. The gain is 58 db. and the output plus 7 db. This preamplifier does not vary more than plus or minus 1½ db. from 30 to 16,000 cycles

The preamplifier kit as shown, including drilled audio and power decks, all transformers mounted at factory at no extra cost, lists at.....$81.00

Complete accessory kit, nothing else required except tubes.....$12.50



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EDITORIAL

HIGH-QUALITY PROGRAMS

THERE HAVE BEEN no revolutionary changes in broadcast transmitter design or technique during the past ten years. There have been many improvements, and recently such modulation schemes as Class B, Chireix, etc., have been brought forward. However, while there have been many refinements resulting in improved fidelity, lower distortion, and the like, the transmitters of today are largely the same as those of a decade ago. As a result, regulation of frequency stability, extra-band radiation, etc., have been set up and are being met. Little has been accomplished in removing one of the greatest barriers to still better fidelity, i. e., the present 10-kilocycle station assignments. The present set-up appears destined to continue for some time to come, and the present 10-kc spacing of stations appears to be one of broadcasting's most permanent limitations.

Radio receivers, on the other hand, have come through many strange and revolutionary changes but have at last emerged upon a plateau of standardization. Today the design of broadcast receivers is relegated to a slide-rule service. The limits of amplification or sensitivity have been established; selectivity and avc range depend upon the type and number of tuned circuits; tubes and their limitations are well known. Many refinements, but few radical changes, in broadcast receivers appear in the offing.

One of the most important considerations which the design engineer must face is faithful reproduction. As we have emphasized in the past, the broadcast listener is entitled to hear the program from his loudspeaker exactly as he would hear it were he in the studio. However, the present overcrowded condition of the 550-1500 kilocycle band definitely limits the frequency range that can be obtained. As a matter of fact, the present range of modulation frequencies that can be transmitted is limited to about 8,000 cycles, while 5,000 cycles is all that can be transmitted practically, unless, of course, adjacent channel interference is neglected. The latter neglect hardly seems logical in the face of present conditions.

While ultra-high-frequency assignments have so far been made only for experimental purposes, the practical possibilities of these frequencies are almost unlimited. Among the foremost experimenters in the short-wave realm is Professor E. H. Armstrong, who holds the medal of the Institute of Radio Engineers for his invention of regeneration, and who rose to fame through the development of the superheterodyne and super-regenerative circuits. Professor Armstrong in discussing his new frequency modulation system before a recent meeting of the Institute of Radio Engineers pointed out that due to "the extremely short wavelengths, it has been possible to transmit all modulation frequencies from 30 to 16,000 cycles, and to receive them with what engineers call a flat characteristic." While a wide bandwidth is only one of the major advantages to be gained from high-frequency broadcasting, it does make possible high-fidelity programs. Another major step toward better fidelity might well be the addition of auditory perspective. The large number of high-frequency channels available, together with the almost unlimited number of transmitters that may share the same channel, with only nominal geographic separation, promises much for the future of this service.

◆

TELEVISION AND ULTRA-HIGH FREQUENCIES

TELEVISION seems to have definitely rounded the famed corner, and, logically, the Federal Communications Commission is pointing the way to the higher frequencies for visual transmissions. The RCA Manufacturing Co., were recently granted a license to cover a construction permit for a 30-kilowatt visual broadcast station at Camden, N. J., to operate on 42,000-56,000, 60,000-86,000 kilocycles. Recently, also, according to a NAB report, Examiner R. H. Hyde of the Federal Communications Commission made the following statement in recommending a denial of a television application of a New York organization: "It does not appear from the evidence presented in this proceeding that the applicant's proposed use of the frequency assignment of 2000-2100 kilocycles would contribute substantially toward the progress of the radio art. . . . In this connection it appears that other frequency assignments allocated for experimental visual broadcasting, allowing substantially greater frequency spread, are better suited to the service." Inasmuch as high-definition television requires a band of frequencies of one to two megacycles, this statement takes on added significance. The FCC has shown considerable foresight in pointing the way and encouraging the use of ultra-high frequencies for visual transmissions.

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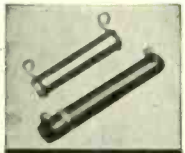

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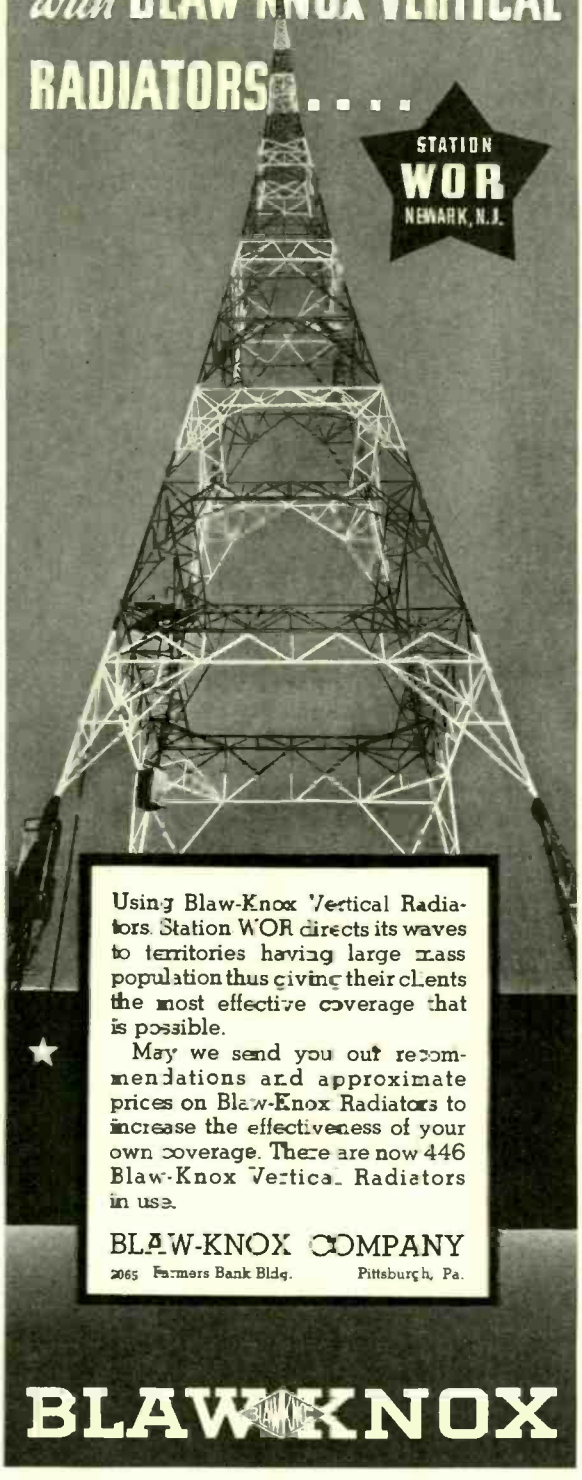

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COMMUNICATION & BROADCAST ENGINEERING

FOR NOVEMBER, 1935

U. S. C. G. AVIATION RADIO

The Equipment Aboard the Douglas Amphibian 'Dolphin-RD-4' of the U. S. Coast Guard

By HERBERT GIFFORD
Radioman, U. S. COAST GUARD

THE MAIN TRANSMITTER is known as the T-24. It is a 75-watt aircraft transmitter and has a frequency range of 275 to 600 kilocycles, and from 2600 to 8100 kilocycles. Both mcw and cw operation are provided for on the intermediate- and high-frequency bands.

TRANSMITTER CIRCUIT

The master-oscillator power-amplifier circuit forms the basis for the radio-frequency elements of the transmitter, a Colpitts type oscillator being used on both of the frequency bands. The power amplifier operates at the same frequency as the master oscillator, and is neutralized by a balanced bridge network comprised of capacitors in the master-oscillator tank circuit. Equal but opposite radio-frequency voltages are built up across the pair of capacitors in use, one voltage being applied to the grid of the power amplifier for amplification, and the other one being fed through a neutralizing capacitor for balancing the regenerative voltage across the grid-plate capacitance of the power-amplifier tube. In order that the two frequency bands may be efficiently covered, duplicate tuning circuits are provided throughout. By means of mechanical couplings, the two sets of circuits are controlled by one set of controls, resulting in appreciable simplification of operation.

Tapped variometers provide tuning for all intermediate frequencies, while tapped coils and variable condensers perform similar functions for the high frequencies.

Included in the transmitter is an antenna tuning system for working into an extremely wide range of antennas, from one-quarter to five-quarters fundamental.

High-voltage direct current is derived from a pair of mercury-vapor rectifier tubes, especially designed for 800-cycle operation. Suitable switches and a cut-

A CLOSE-UP VIEW OF THE DIRECTION FINDER LOOP ANTENNA ON A DOUGLAS AMPHIBIAN.

Photographs courtesy Rudy Arnold

out relay enable charging of the storage battery comprising part of the emergency transmitter-receiver equipment.

ANTENNAS

Provision is made for the connection of a fixed type and a trailing antenna to a selector switch on top of the transmitter. This switch enables rapid changeover from one to the other.

When using the 275- to 600-kc band, the trailing-wire antenna is used, and let out to at least 300 feet. The fixed antenna is not used on this band as it is not feasible to resonate so small an antenna to intermediate frequencies.

Either antenna may be used on the high-frequency band, optimum range usually being obtained with the trailing wire, adjusted to such a length as requires minimum loading within the set.

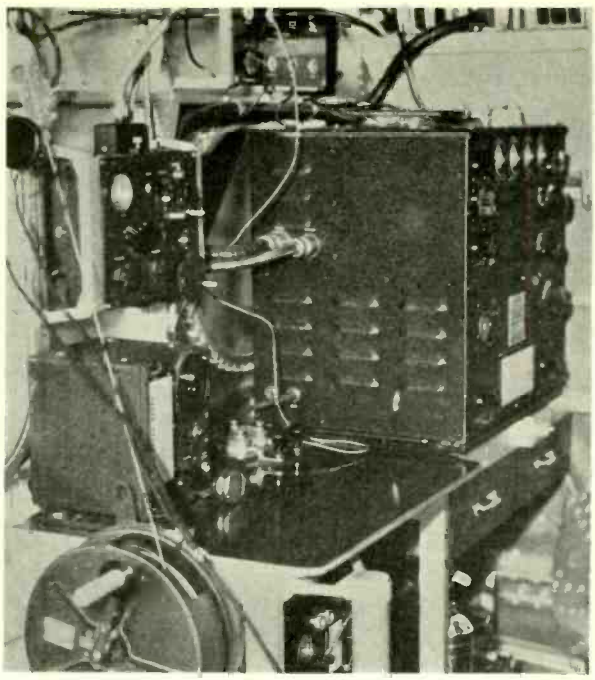
POWER SUPPLY

The alternators used in the power supply have a d-c winding, and commutator for supplying their own field excitation and for charging batteries, in conjunction with the controls of the transmitter. A 35-foot length of cable serves to connect the alternator and the set, while a 10-foot cable conducts charging power to the emergency transmitter-receiver storage battery. The transmitter is mounted on a shock-proof base.

Wherever possible, controls have been ganged to secure simplification. Thus, to change from the intermediate-frequency band to the high-frequency band, it is only necessary to throw one switch, located in the center of the panel. In either band, the M. O. and P. A. controls each consist of one tap switch and one continuously-variable control.

There are five shielded compartments in the transmitter as follows; M. O. Tuning, P. A. Tuning, Antenna Tuning. M. O. and Rectifier Tubes, and Power and Relay Section.

GENERAL VIEW OF THE EQUIPMENT IN THE RD-4. NOTE SHIELDED ANTENNA REEL IN FOREGROUND.



All controls and meters, together with the calibration chart, are located on the front panel, to facilitate rapid tuning. A removable door on the front panel provides access to all vacuum tubes, and also allows convenient adjustment of side tone value and field rheostat. The rectifier tubes are located in a compartment accessible through the above door, in order that their temperatures may be held within safe limits when ambient temperatures become extreme. A ventilator in the top is closed when the temperature is below freezing, allowing the filaments of the M. O. rectifier tubes to aid in warming the mercury vapor. At temperatures above freezing, the ventilator is opened to cool this compartment.

There are terminals provided on top of the transmitter for two antennas, ground, and connection to receiver antenna post; the latter being for the purpose of obtaining break-in operation. The break-in relay is so mounted that it may be removed for adjustment by lifting off the top shield of the transmitter, as the relay is connected by a plug-in system.

ANTENNA REEL

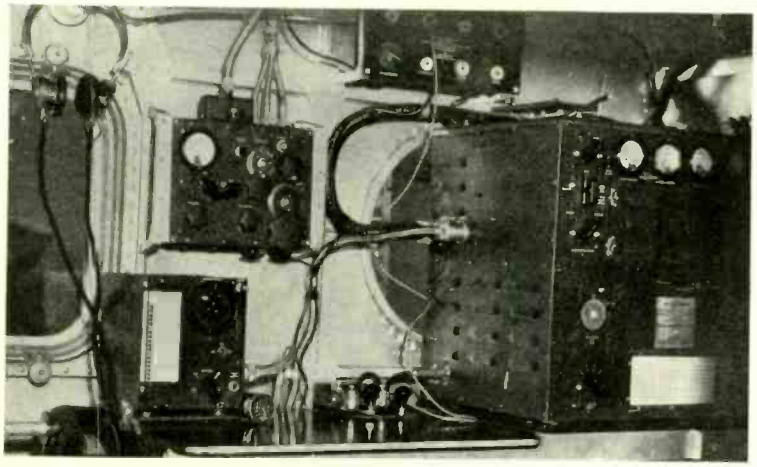
The trailing antenna is wound on a reel, capable of holding 500 feet of wire. A turn counter is installed on the reel cover to enable the operator to reel out a definite number of turns of wire; thus securing the same length of antenna each time. Although the antenna is frequently operated at relatively high radio-frequency voltages, the reel is completely covered and at ground potential, thus preventing annoying burns in case the reel is touched during operation of the transmitter, and also reducing fire hazard.

The reel is normally automatically locked, and is provided with a control lever to permit rapid paying out of wire.

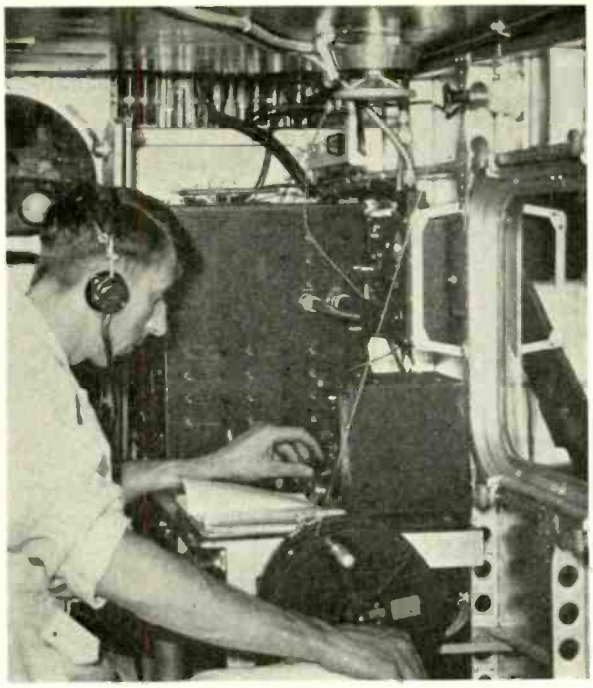
This transmitter has proved itself extremely efficient; distances of well over 1000 miles have been covered in the short time that this plane has been in use.

THE TRANSMITTER-RECEIVER

This type is known as the T-20-4, CGR-45-4. It is a combined aircraft transmitter-receiver, battery operated, and designed for the transmission and reception of cw and voice signals. Its



LEFT TO RIGHT: ANTENNA REEL, FREQUENCY INDICATOR, TRANSMITTER-RECEIVER, KEYS, MAIN TRANSMITTER.



SHOWING LOOP ANTENNA CONTROL IN CEILING OF FUSELAGE.

construction is such that the equipment will operate satisfactorily under the adverse conditions of shock, salt spray, vibration, and so forth, normally encountered in such service.

It consists of a transmitter-receiver mounted in a common cabinet, and a battery box with a flexible cable for inter-connecting the three units. It is designed to operate on a single antenna with either a counterpoise or ground. The transmitter is designed to cover the nominal frequencies of 2660-4050 kilocycles. This is accomplished in three actual frequency ranges as follows:

Range 1. 2580-3336 kc.
Range 2. 3144-4067 kc.
Range 3. 3826-5000 kc.

The desired range can be selected by means of a range switch located on the front panel. Adjustment for operation on any range is made by setting the M. O. tuning, P. A. tuning and three antenna coupling controls located on the front panel.

The transmitter delivers in excess of 5 watts, into any antenna, between 25 and 300 feet in length when the total plate current for cw operation is 55 milliamperes at 270 volts.

THE CIRCUIT

A high "C" Colpitts master-oscillator power-amplifier circuit is used. Either cw telegraph or telephone transmission may be employed. On voice, the modulation varies between 72 and 85 percent, depending on the type of microphone, and is supplied by a pair of tubes working push-pull, Class B into the plate of the Class C radio-frequency power-amplifier tube. Coupling of the P. A. output into the antenna is accomplished by a pi-impedance matching network consisting of a series tapped inductor and two shunt variable condensers.

A high order of frequency stability is attained by the high "C" oscillator circuit in connection with a low value of oscillator grid-leak, a high value power amplifier grid leak and neutralizing of the power amplifier grid to plate capacity. The resetability of the frequency is .05 percent or better with proper plate and filament supply voltages.

The transmitter-receiver is designed to operate from a single six-volt, forty ampere-hour storage battery with separate B batteries for the transmitter and receiver. The plate supply for the transmitter consists of six 45-volt batteries located in the lower compartment of the battery box.

The transmitter and receiver are shielded from one another and mounted in a common cabinet. The two units are connected together by a short length of flexible shielded cable to supply power to the receiver, and binding posts are provided on the front panel for connecting the receiver to the transmitter antenna through the "Send-Receive" switch. The transmitter or receiver may be withdrawn separately from the case and either unit is easily accessible for repair and servicing. Each chassis is fastened in its cabinet by means of four thumb screws through the front panel, and the cabinet is removable from the shook-proof mounting base by moving two levers located underneath the cabinet, one at each end. The power cable can be left attached to the receiver and transmitter for testing purposes when they are removed from the case. Panel and sub-base construction is employed. All controls, meters and antenna and ground terminals are located on the front panel and are at ground potential. Tuning equipment, tubes and transformers are mounted above the sub-base, while sockets and small parts are located below.

THE RECEIVER

The receiver is designed to cover the nominal frequency range of 2660 to 8100 kilocycles. This is accomplished in six actual frequency ranges, as follows: 2660-3205 kc; 3205-3860 kc; 3860 to 4650 kc; 4650 to 5605 kc; 5605 to 6750 kc, and 6750 to 8150 kc. The

(*Continued on page* 16)

COAST GUARD PLANE — EMPHASIZING THE DIRECTION FINDER LOOP ANTENNA.

New Communications Receiver

IN THE DESIGN of a high-frequency radio receiver there are four important qualities which must be considered. These are usable sensitivity, selectivity, frequency stability and reliability. The careful consideration given to these qualities in the design of the new RCA communications receiver, the AR-60, will be apparent from the following.

This communications receiver has been designed for commercial and amateur use. It is a single-signal 11-tube superheterodyne with continuous band spread from 1,500 to 25,000 kilocycles. The circuit is shown schematically in Fig. 1. It consists of two stages of r-f amplification, first detector, first heterodyne oscillator, three stages of i-f amplification, second detector, second heterodyne oscillator, a-f amplifier stage, output power stage and power-supply system. The power output is approximately 500 milliwatts, while the power consumption for a-c operation is 35 watts, and when battery-operated the filament current is 2.8 amperes at 6 volts, the plate current being 0.040 amperes at 135 volts. The following controls are provided: Main tuning, band-spread tuning, band-change switch, antenna coupling, antenna trimmer, volume (audio gain), sensitivity (i-f gain), beat frequency, crystal filter and selectivity control, avc switch, cw-mod. switch, audio-filter switch, and power switch.

INPUT COUPLING

The antenna coupling system is designed to provide optimum coupling from transmission lines (50 to 500 ohms) or from conventional antenna and ground systems. The coupling is variable and is controlled from the front panel. The coupling coils are electrostatically shielded from the first tuned circuit to maintain transmission line balance and to prevent voltages picked up by the transmission line from being coupled to the first tuned circuit. Since the coupling is variable, one value of inductance in the coupling coil is sufficient for a considerable range of frequencies. The two coupling coils, which cover the entire frequency range of the receiver, are in parallel. The coils have been so designed that the unused coil causes negligible loading of the coil in use. The center tap of both coupling coils is connected to a terminal which may be grounded if it is desirable to do so. The first tuned circuit is provided with a trimmer condenser adjustable from the front panel. This insures the proper tuning of this circuit with any antenna system and with any degree of coupling.

R-F AMPLIFIER

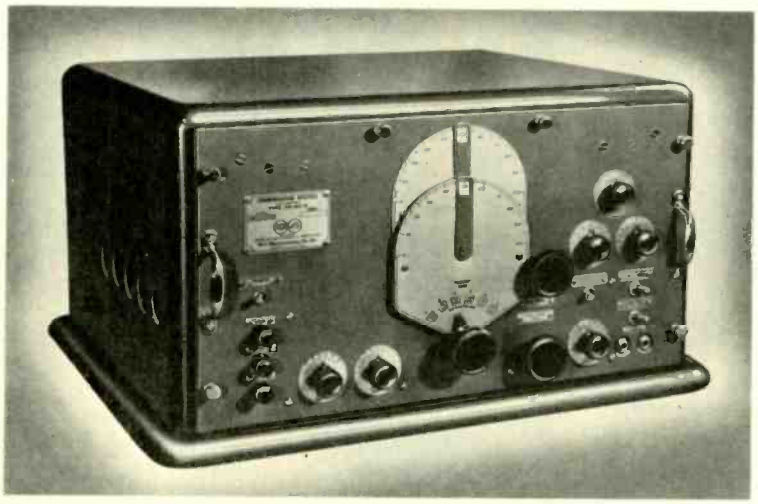
The r-f amplifier is designed to provide ample selectivity ahead of the first detector for minimizing cross-modulation and blocking effects from strong interfering signals and for obtaining a high degree of image signal suppression. The amplification is adjusted to provide optimum signal-to-noise ratio by making noise contributions of circuits following the first tube negligible in comparison with the noise contributed by the first r-f grid circuit. That is, each tuned circuit in the receiver contributes some noise voltage, but by making the gain in the first tube as high as practicable, the noise contributed by succeeding circuits is unimportant. Only one stage of r-f is used on the lower frequency bands, since sufficient gain is obtained and the image response is inherently much better on the lower frequencies because the image occurs at a frequency differing from the r-f circuit resonance by a greater amount.

BAND SPREAD

Band spreading is accomplished by means of a separate capacitor gang of suitably small capacity. This capacitor gang is connected in parallel with the main gang at all times and permits adequate band spreading at any frequency in the range of the receiver.

TUNING INDUCTANCES

The tuning-inductance system used in the first r-f grid, detector grid and oscillator grid circuits each consist of two coils wound on Isolantite forms and tapped to provide a total of six different values of inductance. The second r-f circuit utilizes one coil with three taps, this stage being used only on the three higher frequency bands. This system of inductances for band changing gives substantially the same r-f selectivity and gain as a good plug-in coil system with the added advantage of ease and speed of operation. Dead spots, or spots of low sensitivity, are avoided by shorting possible resonant



THE NEW AR-60-S COMMUNICATIONS RECEIVER.

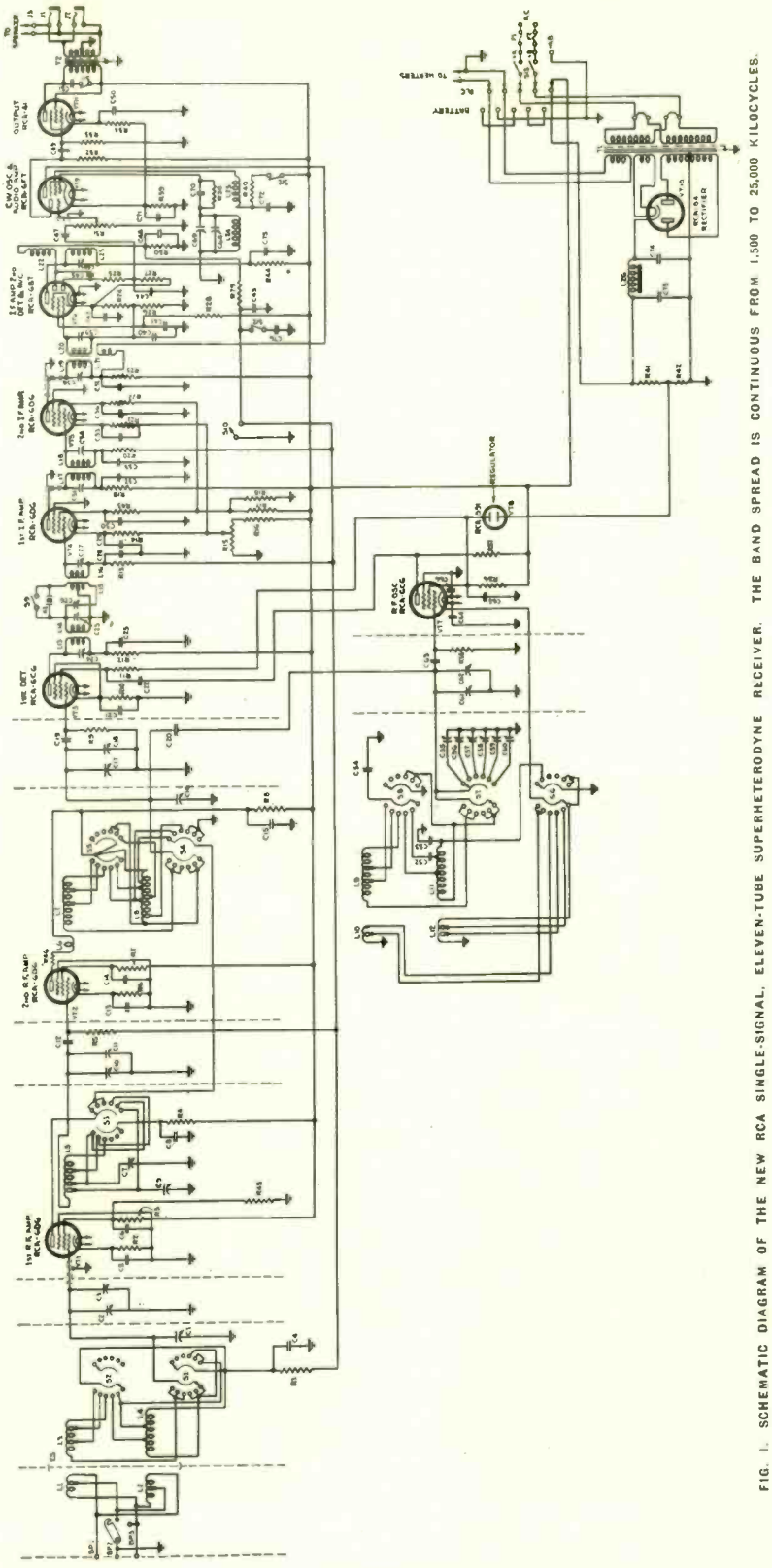


FIG. 1. SCHEMATIC DIAGRAM OF THE NEW RCA SINGLE-SIGNAL, ELEVEN-TUBE SUPERHETERODYNE RECEIVER. THE BAND SPREAD IS CONTINUOUS FROM 1,500 TO 25,000 KILOCYCLES.

circuits in the coil section which are not in use.

BAND-CHANGE SWITCH

A specially designed gang switch is used so that the necessary inductance changes for the various bands are accomplished by a single-panel control. Particular care has been taken in the design of the switch not to add undesired losses in the tuned circuit. This switch is mounted underneath the chassis with its shaft parallel to and directly beneath the capacitor shaft. It consists of eight sections, each having two poles and six positions. The sections in the front shielded compartment switch the first tuned circuits of the first r-f tube. In the second compartment from the front, another section switches the three higher frequency circuits for the r-f stage. In the third compartment are located the first detector switch sections and in the rear compartment the oscillator-circuit switches.

FIRST HETERODYNE OSCILLATOR

The first heterodyne oscillator is aligned to track with the r-f amplifier at 750 kc higher than the signal frequency, thus producing a 750-kc intermediate frequency in the first detector plate circuit, which is amplified further in the i-f stages. The oscillator voltage is regulated by the RCA-991 regulator tube to provide maximum frequency stability under conditions of variation of power-supply voltage. The maximum possible amount of coupling is used to the detector circuit which will not produce objectionable reaction with the r-f circuits. This helps to minimize cross-modulation and blocking effects, since, in general, blocking of a weak signal does not occur until the voltage from the strong signal on the first detector is about equal to the heterodyne oscillator voltage.

CRYSTAL CONTROL

For operation on a fixed frequency, crystal control for the first heterodyne oscillator can be furnished. This feature is not supplied as standard equipment but can be incorporated in the receiver assembly if desired. The arrangement consists of a low temperature coefficient crystal operating in conjunction with the first heterodyne oscillator. Temperature control, also, may be provided additionally for cases of extreme temperature variation. By use of this device, the receiver tuning can be accurately stabilized on a predetermined frequency.

INTERMEDIATE-FREQUENCY CRYSTAL FILTER

The first detector plate circuit is tuned to the intermediate frequency and a balanced link circuit is used to couple the first detector plate and the first i-f grid circuits. A 750-kc crystal is connected in one arm of the link circuit and a neutralizing capacitor, which is controlled from the front panel, is connected in the other. The impedances of the coils in this link circuit are designed so that the crystal selectivity characteristic is not impractically sharp. The band width at two times resonant input may be adjusted from approximately 125 to 700 cycles. The band width at ten times resonant input varies from approximately 600 to 2,600 cycles. A second control is the neutralizing capacitor controlled from the front panel. By variation of this control, the band width at two times resonant input remains substantially constant but the shape of the selectivity characteristic is varied in such a manner as to cause rejection of certain frequencies. Thus, without affecting the desired signal response, an interfering signal only a fraction of a kilocycle removed from the desired signal may be rejected. This is shown by the curves of Fig. 2. These

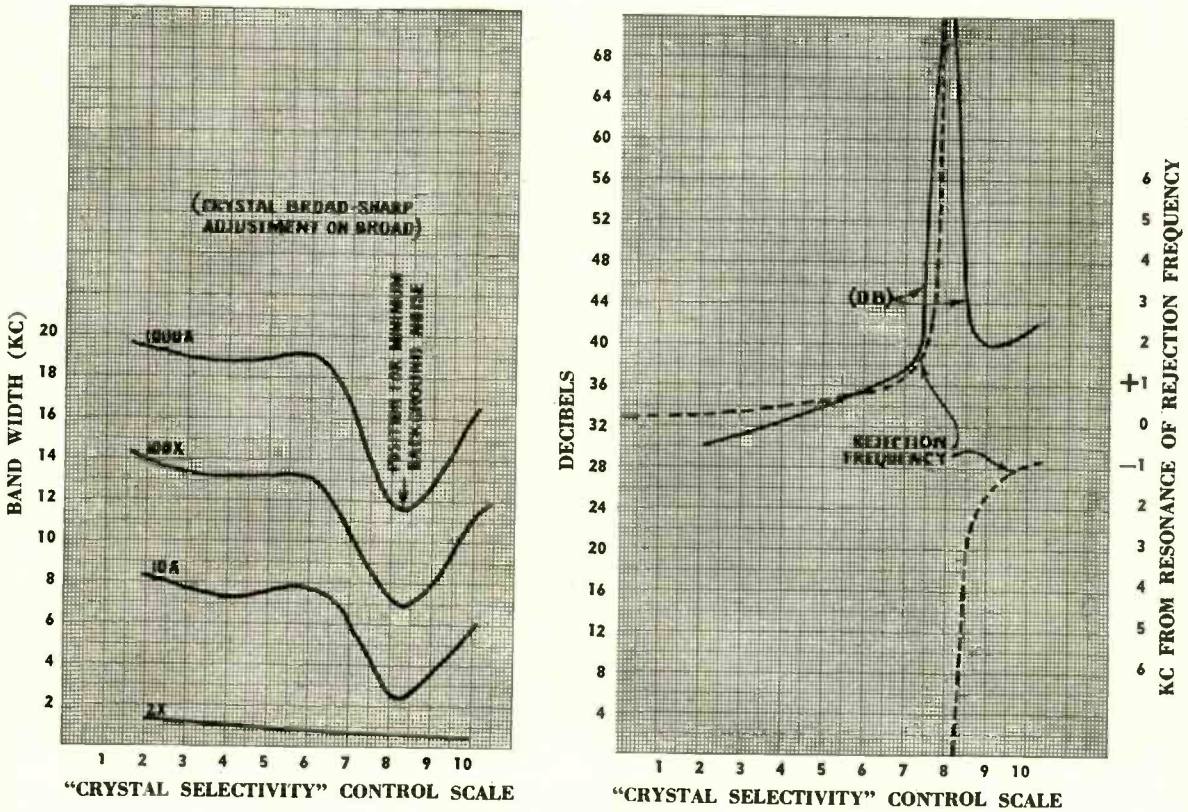


FIG. 2. CURVES SHOWING THE AMOUNT OF REJECTION IN DB OF A PARTICULAR FREQUENCY OFF RESONANCE.

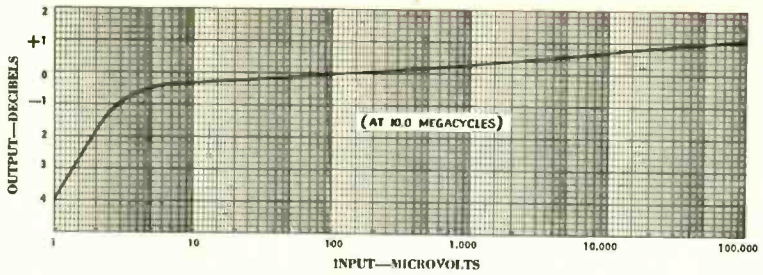


FIG. 3. THE AVC CHARACTERISTICS OF THE AR-60.

curves show the amount of rejection in db of a particular frequency off resonance. The crystal "broad-sharp" adjustment on the chassis (C-25) is in the broad position for these curves. When in the sharp position the amount of rejection is increased about 10 db. These curves also show the change in band width at 10, 100 and 1,000 times resonant input which occurs with different settings of the "Crystal Selectivity" control. The design is such that introduction of the crystal filter into the circuit produces a negligible change in gain. The use of an intermediate filter preceding the i-f amplifier has advantages as compared to an audio filter, in that chances of blocking are reduced by suppression of interfering voltages before they are amplified by the i-f system. Atmospherics and tube noises are reduced more for a given frequency bandwidth, since the audio image signal is highly attenuated.

The audio image signal appears only in cw reception. This is the signal, on the opposite side of the second heterodyne (cw) oscillator frequency from that of the desired signal, which would produce the same audio frequency in the receiver output as the desired signal. As an example, if two signals differing by 2 kc are received they would produce intermediate frequencies differing by 2 kc which would both pass through the i-f amplifier, if it had a sufficiently broad band-pass characteristic. If the cw oscillator frequency is midway between the two signals, each would produce the *same* audio signal frequency of 1,000 cycles. These two signals cannot be separated with any amount of selectivity in the audio circuits. With sufficient selectivity in the i-f circuits, either one of the signals may be received and the other rejected.

INTERMEDIATE-FREQUENCY AMPLIFIER

Three stages of i-f amplification are used. The first two stages use type 6D6 tubes and the final stage utilizes the pentode portion of a 6B7, the two diode plates being used for the second detector and avc. The first i-f transformer has its primary and secondary tuned and is coupled through the crystal filter link as has been described. The second and third transformers have primary and secondary tuned, the coupling being permanently adjusted to produce the desired frequency characteristic. The fourth transformer has a tuned primary and untuned secondary feeding the detector and avc diodes.

The third i-f stage is not connected to the avc or manual volume control; consequently a better avc characteristic with less overload distortion is obtained. This also permits the cw oscillator to be coupled to the grid circuit of this stage, giving a comparatively high detector excitation voltage with small electrical coupling to the oscillator circuit.

SECOND HETERODYNE OSCILLATOR

The second heterodyne (cw) oscillator is the pentode section of the 6F7 and is electronically coupled to the final i-f stage. A panel control is provided by means of which the frequency of the heterodyne oscillator and resultant audio beat note may be varied. Care has been taken in the design of the circuit constants to minimize oscillator harmonics. The triode section of this same tube is used as an audio-frequency amplifier.

AUTOMATIC VOLUME CONTROL

The automatic volume control system is one of the outstanding features of this receiver. The avc diode of the 6B7 is biased approximately 12 volts in order to produce delayed action. After the signal voltage reaches this value, a negative voltage is produced in the diode circuit which is fed back to bias the r-f and i-f amplifiers. The gain of the receiver is such that the avc starts to control with a signal input of the order of one microvolt. The audio-frequency gain is high enough so that maximum power output may be obtained with a 30-percent modulated signal with the avc in use. A switch is provided on the front panel to disconnect the avc.

The second heterodyne (cw) oscillator excitation voltage is just lower than the avc diode bias voltage so that it does not decrease the sensitivity of the receiver and the avc may be used on cw telegraph signals equally as well as on modulated signals. The cw switch automatically connects an additional capacitor in the avc circuit to increase the time constant, so that at normal keying speeds the avc continues to function and the background noise does not come up between characters. This also avoids introduction of irregularities in characters.

The curve, Fig. 3, shows the characteristics of the automatic volume control as taken on a sample receiver.

Two manual controls are provided; an audio gain control which is employed when the avc is in use to obtain the desired output level, and an i-f gain control for use with the avc "off."

OUTPUT TUBE

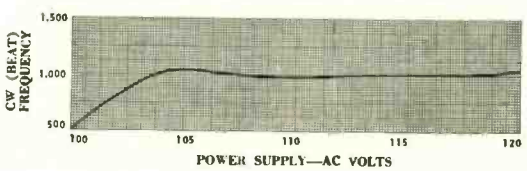
The output tube is resistance coupled from the a-f amplifier and operates into an output transformer which matches the tube to a 600-ohm line. The center tap of the output-transformer secondary is grounded and an electrostatic shield is provided to maintain balance to ground. The 600-ohm output circuit is provided to facilitate operation over long telephone connections and with the newer type low-impedance phones. Two output jacks are provided so that local monitoring may be obtained at the same time a telephone line or loudspeaker is in use.

POWER PACK

The power pack mounted on the receiver chassis consists of a power transformer, rectifier tube, and filter. By a simple wiring change the transformer is adaptable for operation from 110- or 220-volt, 40-/60-cycle supplies.

STABILITY

To secure good frequency stability, rugged construction of parts and wiring in the high-frequency heterodyne oscillator circuit has been included in the design. This together with voltage stabilization of the oscillator plate supply and proper oscillator excitation provides a high degree of stability.



AN INTERESTING CURVE SHOWING POWER-SUPPLY VOLTAGE PLOTTED AGAINST CW (BEAT) FREQUENCY.

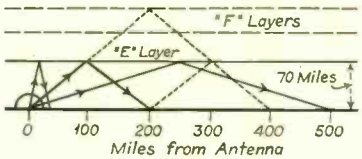


FIG. 1

(LEFT) SHOWING THE REFLECTIONS OF RADIO WAVES FROM THE IONOSPHERE. (RIGHT) THE RESULTING VERTICAL-PLANE PATTERN FOR THE 831-FOOT AND THE SUPPRESSOR ANTENNAS.

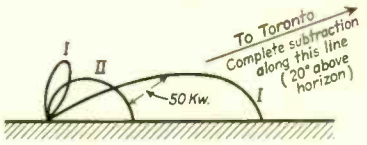


FIG. 2

THE WLW "SUPPRESSOR" ANTENNAS*

By J. C. BAILEY
Engineer
WLW, WSAI, W8XAL

THE DIRECT STUDY of antennas is about as difficult as any undertaking in the field of radio. This is probably due to the fact that antennas are so closely linked with electromagnetic radiations (which are transmitted without the use of conductors) that a mental picture of the mechanism of transmission is rather difficult.

Before taking up the WLW problem it is thought well to review here a few of the principles of antenna behavior. A more comprehensive outline has been written in a great many books and in previous issues of COMMUNICATION AND BROADCAST ENGINEERING.

* This paper is taken in part from a talk given by Mr. G. F. Leydorf, Antenna Engineer, the Crosley stations.

TRANSMISSION PATHS

The two principal paths by which radio energy reaches a given point are: (1) Along the surface of the earth; and (2) by a single reflection from the "E" layer of the ionosphere at a height of about 70 miles (night-time conditions). There are other reflections, as shown in Fig. 1, but they are relatively unimportant.

The transmission along the earth is subject to absorption, while that along the sky-path is almost free from this phenomena. In addition to losses, the intensities of both waves fall off inversely as their distance from the antenna due to diffusion or spreading. Further, studies of antennas have revealed that under most conditions ground transmission is suited to short distances while sky transmission is suited to the longer distances.

Also, with most antennas there will be a point where the ground wave and the sky wave will have nearly equal intensities and at this point the two waves will subtract so that their difference is nearly zero. Under these conditions severe fading will be noticed. Of course, fading, even for short periods, is very undesirable. Two methods are suggested

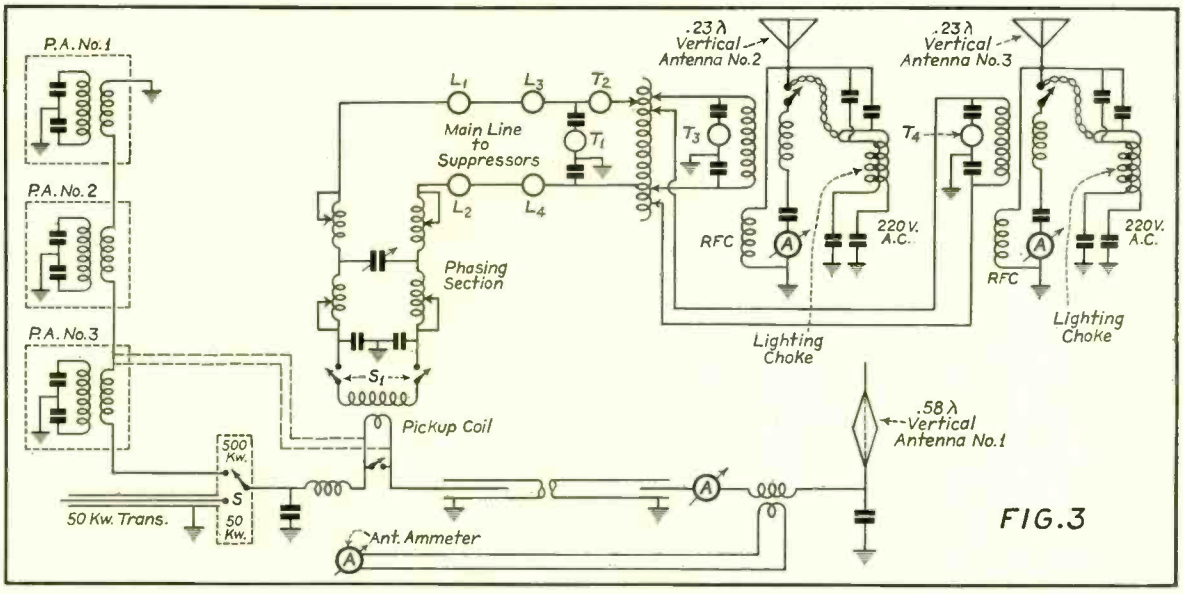
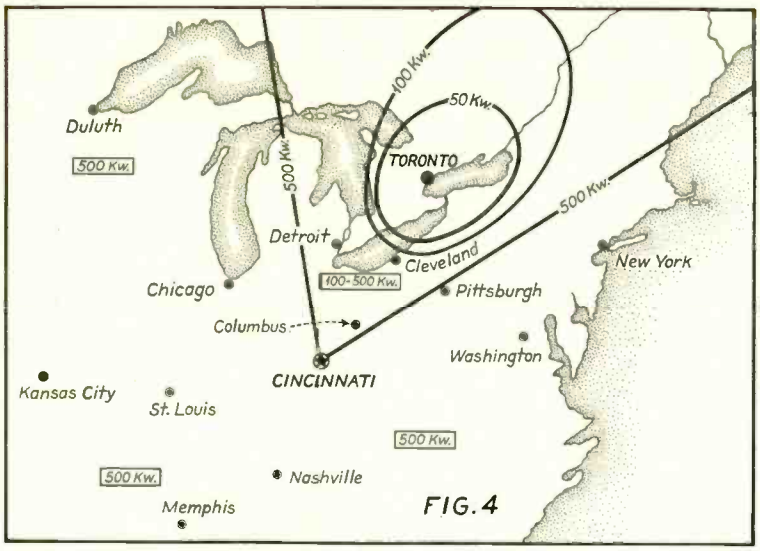


FIG. 3

SCHEMATIC OF CIRCUITS FOR WLW SUPPRESSOR ARRAY NO. 20.



DISTRIBUTION OF POWER WITH 500-KW INPUT TO SUPPRESSOR ARRAY.

for its elimination. First, to use a receiving system to discriminate against one or the other. Second to eliminate one or the other at the transmitting antenna. At present little is being done about the first, while every effort is bent towards accomplishing the second.

WLW GOES VERTICAL

There has been a great difference of opinion as to how this fading menace should be eliminated at the antenna. Obviously a high-powered station such as WLW cannot afford to send all its energy along the earth, even if this were possible. Already, the area which can be covered efficiently by ground transmission is taken care of adequately by the use of high power. To eliminate all the sky transmission would destroy the most valuable long-distance reception; that is, good reception at distances of the order of two to five hundred miles or more.

One fact is certainly evident. As one moves away from a station, a point is finally reached where the ground transmission should be abandoned, substituting sky transmission. Further, this point is reached long before the ground wave has entirely disappeared. Hence, to restrict the area of fading, the sky wave must be almost negligible up to a certain point and then rapidly increase in intensity above the ground wave. A short vertical antenna goes a long way towards accomplishing this rapid increase in the sky wave after a certain point, the reason being that the energy is more equally distributed in the vertical plane.

The 831-foot Blaw Knox antenna, in use at the present time with WLW, was first put into service with the 50,000-watt transmitter and then when power increase was granted it was automatically used to radiate with 500,000 watts. The antenna has been checked quite thoroughly, with field-strength measurements, and found to very closely follow the predicted theoretical calculations. There is a small amount of fading at approximately 150 miles which does not seriously impair the service of WLW because of a slight absorption in the sky wave. Even this could be reduced by shortening the antenna somewhat. The area between 150 and 200 miles has been checked and the ground wave is not interfered with for periods of an hour or more at a time.

WLW vs CFRB

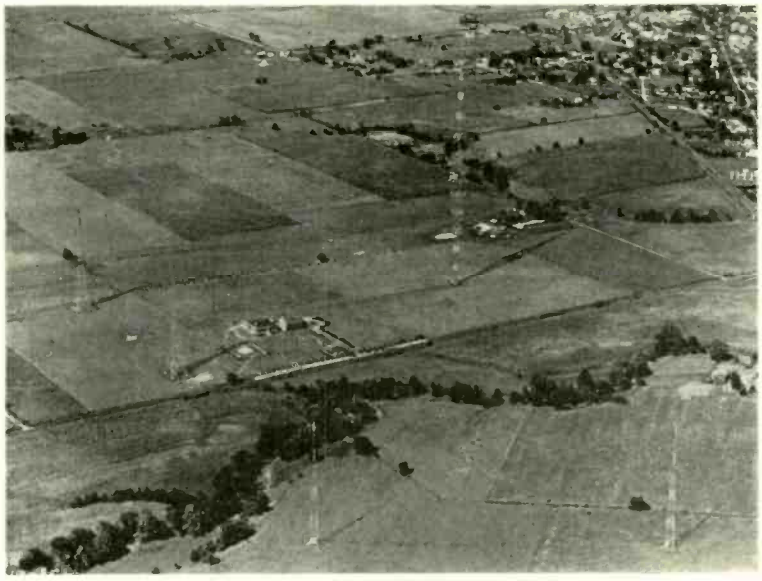
Everything was going along nicely with this antenna on 500 kw until the Canadian station CFRB, about 400 miles from Cincinnati, complained of interference on their frequency of 690 kc. Several methods of solving this problem were available, but the one ultimately decided upon was to use "suppressor"* antennas on WLW.

Obviously it was necessary to avoid, as much as possible, any unnecessary restriction of the large area served by WLW with the vertical radiator. The directional antenna schemes so far used in problems of this sort could not be tolerated because they would destroy too much of the service rendered by the station. There were two principal faults with systems thus far developed: First, the signal intensity would be decreased over a wide area; and, second, fading would appear much nearer the station and over a much broader area.

During some of the preliminary calculations it was noticed that with the vertical antenna, practically all the radiation arriving at a point 400 miles away consisted of sky wave. Further, the radiation left the antenna at an angle of 20° from the horizontal. The ideal solution then would be one which would eliminate a part of the radiation in the direction of Toronto at or near an angle of 20°, and at the same time not disturb the radiation at any other angle or di-

(*Continued on page* 16)

* The word "suppressor" when used in connection with antennas designates an array which suppresses the energy in a given area instead of in a given direction, as the word "directional" indicates.



(CENTER) THE 831-FOOT VERTICAL RADIATOR. (FRONT) THE "SUPPRESSOR" ANTENNAS. AND (LEFT) WSAI TOWERS AND TRANSMITTER BUILDING.

THE WLW "SUPPRESSOR" ANTENNAS

(*Continued from page* 15)

rection. Though this sort of a system is possible it is too expensive and would take far too much time to design and construct. In the course of the investigation many systems were examined, twenty of them quite thoroughly, the result being that the present system was chosen. It happened to be number twenty on the list, hence the title "WLW Suppressor Antenna No. 20."

"SUPPRESSOR" ANTENNA THEORY

A "suppressor" antenna utilizes the same fundamental principle as is exhibited in fading; that is, as the difference in length of two transmission paths is changed, the waves arriving at a given point by way of one path may add or subtract from those arriving at the same point by another path, depending on their phase difference.

If two antennas are radiating at the same frequency, but are separated from each other on the ground, the length of the path for one antenna will in general be different from that of the other. This difference in path length will increase with the spacing between antennas. Also, as one moves around the antennas to a different direction the difference in the lengths of the paths will change. Thus by suitable choice of spacing, the waves of two similar antennas equally excited could be made to add in one direction and completely subtract in the other. Between these two directions there would be successive changes as follows: Addition, partial addition, partial subtraction and then complete subtraction. A good example of this is the two suppressor antennas used as part of WLW's suppressor system. For this system the composite wave is zero in two directions while full addition takes place in two other directions.

A summary of the intensity arriving at a given point by a certain path is seen to depend upon several things:

1. The number of antennas.
2. The length of these antennas. (Assuming that all antennas are vertical, all that is required is their length.)
3. The relative intensity leaving each antenna.
4. The times at which a given wave leaves each of the antennas. (Time phase.)
5. The spacing between the antennas. (Space phase.)

The correct application of the above five points gave Fig. 2, the resulting vertical-plane pattern for the 831-foot antenna and the suppressor antennas, and is self-explanatory. All antennas must be excited.

THE CIRCUIT

The circuit of Fig. 3 illustrates the manner in which the two suppressors and the vertical antenna are connected in to the transmitter. This arrangement gives control over the time phase of the current in the suppressor antennas, the space phasing having been accomplished by the placement of the towers on the ground. Though the currents are only mentioned in passing, their design and adjustment is by far the most difficult part of the job; in fact, to explain completely how such a system was first discovered would require much more space than is available here.

RESULTS

Finally, the map of Fig. 4 shows approximately the intensity received at various points using the suppressor antennas at night. It will be noted that the area over which a 50-kw signal is received is restricted to a relatively small territory. In all other directions the intensity is 500 kw, or so slightly higher that the difference is not noticeable when the suppressors are connected in to the vertical. The eastern section of the map has been thoroughly checked by field-strength measurements.

Contributing to the success of this "suppressor" array were Mr. J. A. Chambers, Technical Supervisor of the Crosley stations; Mr. J. Whitehouse, Chief Transmitter Engineer, and Mr. G. F. Leydorf, Antenna Engineer of the Crosley stations.

U. S. C. G. AVIATION RADIO

(*Continued from page* 9)

desired range can be selected by means of a range switch located on the front panel, and adjustment of a single tuning control is sufficient to select the exact frequency.

The receiver uses three type 78 screen-grid tubes and one 38 type tube. The sensitivity is better than 100 microvolts throughout the entire range when adjusted for icw signals.

The circuit consists of one radio-frequency aperiodic coupling stage, one stage of tuned r-f amplification, a tuned regenerative detector, and one stage of impedance-coupled audio frequency. A band-pass switch is provided. In the On position, the receiver has an audio response characteristic peaked at 1000 cycles providing additional selectivity for cw reception. In the Off position, for phone reception, the receiver has an essentially flat audio response between 150 and 3000 cycles. The output transformer has a built-in low-pass filter which cuts off frequencies above 3000 cycles to reduce unnecessary background noise. It also has two output windings which may be connected for operating either into 20,000-ohm or 6,000-ohm headsets. The receiver is connected through terminals on the front panel to the main Send-Receive switch. The antenna is then connected to the Ant terminal on the transmitter for common use by both transmitter and receiver.

RECEIVER POWER SUPPLY

The receiver power is supplied through a cable connection to the power plug on the transmitter and is controlled by the Send-Receive switch. Both the filament circuit and the plate circuit are open when this switch is in the Off position. The receiver is in operation when this switch is either in the Receive or Send position and break-in operation is possible. The plate-supply switch on the receiver panel opens the B circuit to the receiver and, if desired, the receiver can be made inoperative during transmission. However, filament current is supplied to the tubes so that the receiver is ready for immediate operation.

The receiver uses a storage battery in common with the transmitter and draws a total of 1.2 amperes for the filaments. Its plate supply is furnished by a separate 90-volt B battery in the upper section of the battery box. The total plate current of the receiver is less than 12 milliamperes. No C battery is needed. The voltmeter on the receiver panel indicates continuously the filament voltage applied to the tubes. When the button on the face of the meter is pressed, it indicates the receiver plate voltage.

This transmitter-receiver has proven

(*Continued on page* 18)

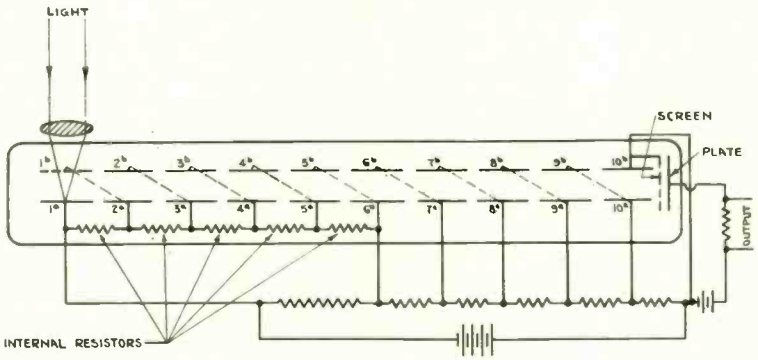
New High-Gain Low-Noise Tube

A SMALL RADIO TUBE, which catches an energizing light or radio impulse and multiplies it millions of times was recently described and demonstrated before the Institute of Radio Engineers at 330 West 42nd Street, New York, by Dr. V. K. Zworykin, Dr. George A. Morton and Mr. Louis Malter of the RCA Laboratories.

Tests made indicate application of the tube to any problem of electrical amplification requiring exceedingly high "gain" at noise levels far below the present types of amplifying tubes, including television scanning.

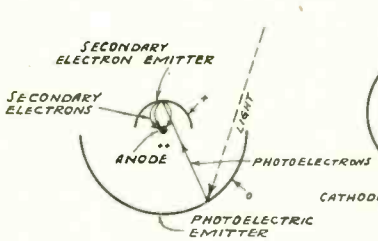
The device is suitable for amplifying either direct current, or alternating current of any frequency, and the circuit in which it operates is one of extreme simplicity. The tube marks a distinct advance in the utilization of what technicians refer to as "secondary emission," a principle by which the impact of electrons emitted by a cathode release other electrons from a series of succeeding electrodes in ever increasing volume.

The new tube may be provided with either a photoelectric cathode or the usual thermionic cathode, such as that used in the radio tubes of home receivers. In a demonstration of the new device, the RCA scientists employed a tube with photoelectric cathode. The energizing impulses were provided by a neon glow tube, connected to the magnetic pickup of an electric phonograph. The dull light thus generated, fluctuating in accordance with the music of the record, was focused on the photoelectric element of the new tube, which converted it into electrical energy and amplified it enormously. It produced an output of two to three watts for the direct operation of a loudspeaker, through which the recorded music was reproduced.

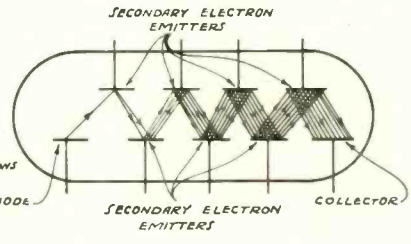


SHOWING THE SIMPLE CIRCUIT IN WHICH THE NEW HIGH-GAIN TUBE OPERATES.

THE NEW AMPLIFIER TUBE UTILIZES "SECONDARY EMISSION," A PRINCIPLE BY WHICH THE IMPACT OF ELECTRONS EMITTED BY A CATHODE RELEASES OTHER ELECTRONS FROM A SERIES OF SUCCEEDING ELECTRODES IN EVER INCREASING VOLUME.



SECONDARY EMISSION PHOTOCELL



SIMPLIFIED SECONDARY EMISSION MULTIPLIER

U. S. C. G. AVIATION RADIO

(*Continued from page* 16)

itself extremely efficient. Distances of over 1500 miles have been consistently worked with this equipment.

THE FREQUENCY INDICATOR

This equipment comprises a master oscillator operating in a limited frequency range of 1000 to 2023 kilocycles which by harmonic combinations, is capable of checking transmitters in the frequency range of 250 to 8100 kilocycles. Calibration may be corrected to harmonics of a 200-kilocycle crystal oscillator, also contained in the equipment. The apparatus is so constructed that corrections may be made on the master oscillator dial for effects of temperature on the crystal. No antenna, in the usual sense of the word, is required. However, in some cases, depending on the power, shielding and location of the transmitter antenna lead-in, a short pickup lead may be required. This usually takes the form of a short antenna run near the transmitter antenna lead-in. An input r-f voltage of approximately 8 volts is used for normal operation.

THE DIRECTION FINDER

The frequency range covered by this receiver is from 200 to 750 kilocycles, and from 2000 to 5000 kilocycles. The receiver itself, together with the battery box, is mounted in the tail section of the plane, out of the way, with remote control cable running forward to the operator's position in the plane. A remote-control panel is installed over the operator's table enabling him to turn the receiver on and off, regulate the filament voltage, balance, etc., and turn the loop.

This equipment has proven itself extremely valuable during the past few months in connection with medical relief work, in locating vessels at sea having sick or injured men aboard. The usual procedure is to have vessels in distress transmit signals which are picked up by the plane, bearings being taken, and the pilot furnished with these bearings, enabling the plane to head directly for the vessel transmitting the signals. In thick, foggy weather with poor visibility, this equipment has been of inestimable value where the saving of minutes in getting a patient to a hospital has meant the difference between life and death.

This equipment is also used as a homing device, consecutive bearings being taken on the home station and the pilot following the "null" until the destination is reached.

CORRECTION

ON PAGE 18 of the September, 1935, issue of COMMUNICATION AND BROADCAST ENGINEERING, equation (1), in the article *Impedance Matching at Audio Frequencies*, by T. W. Kilmer, Jr., is given as

$$I^2 R_L = \frac{E R_L}{(R_0 + R_L)^2}.$$

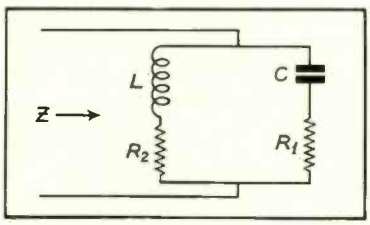
The E in the numerator of the second part of this equation should be squared, making the correct equation read as follows:

$$I^2 R_L = \frac{E^2 R_L}{(R_0 + R_L)^2}.$$

•

PARALLEL RESONANT CIRCUIT HAVING IMPEDANCE INDEPENDENT OF FREQUENCY

A PARALLEL RESONANT CIRCUIT whose impedance is independent of frequency over wide bands of frequencies presents interesting possibilities for use in radio transmitters. Such a circuit has been used to a limited extent.



$$Z = \frac{(R_2 + j\omega L)\left(R_1 - \frac{j}{\omega C}\right)}{(R_1 + R_2) + j\left(\omega L - \frac{1}{\omega C}\right)}.$$

$$= \frac{\left(R_1 R_2 + \frac{L}{C}\right) + j\left(\omega L R_1 - \frac{R_2}{\omega C}\right)}{(R_1 + R_2) + j\left(\omega L - \frac{1}{\omega C}\right)}.$$

$$\text{If} \quad \frac{R_1 R_2 + \frac{L}{C}}{R_1 + R_2} = \frac{R_1 L}{L} = \frac{\frac{R_2}{C}}{\frac{1}{C}}. \quad (1)$$

$$\text{or} \quad R_1 = R_2 \quad \text{and} \quad R_1 R_2 = \frac{L}{C}$$

$$\text{then} \quad Z = R_1 = R_2$$

which is independent of frequency so long as (1) is true.

NEW ENGINEERING EXPERIMENT STATION BULLETIN

Bulletin No. 278, "Oscillations Due to Corona Discharges on Wires Subjected to Alternating Potentials," by J. T. Tykociner, R. E. Tarpley, and E. B. Payne, has been issued by the Engineering Experiment Station of the University of Illinois.

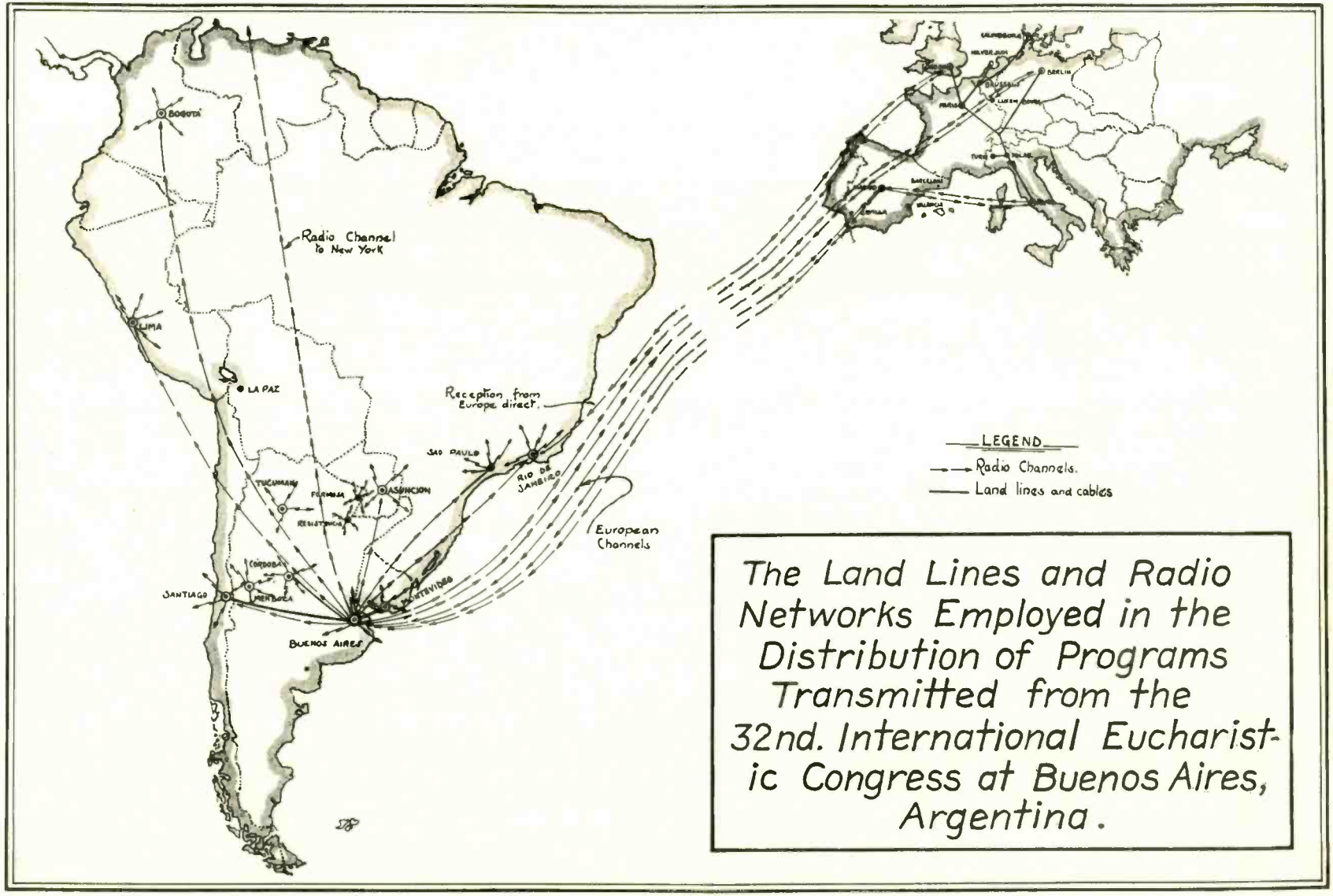
Oscillations due to corona discharges have been applied extensively for the detection of ionization in cables. The results of an investigation on this subject have been published in two bulletins, Nos. 259 and 260, of the Engineering Experiment Station.

It was found generally that these oscillatory currents set in with ionization. They started in cables at certain values of applied alternating potentials characteristic for each kind of cable and increased in intensity with applied voltage. The oscillograms obtained showed very complex trains of waves, superimposed on the charging current and distributed within definite regions of the applied voltage waves.

It was not possible to interpret the rugged character of the waveforms, the variations in amplitude, and the indefiniteness of the frequency of the oscillations; nor was it possible to determine what was the actual functional relation between the effective values of the oscillatory currents and the ionization in the dielectric which produced oscillation.

As a first step towards the solution of this problem and for the purpose of further improvements in the methods of testing cables, it was necessary to find out experimentally what are the particular ionic and electrodynamic processes connected with the oscillations due to ionization. A study of cables from this point of view could not be expected to yield satisfactory results; first, because a cable with its composite dielectric and comparatively large dimensions did not present sufficiently simple conditions which could be independently controlled, and, secondly, because the opaqueness of the dielectric and its lead sheath excluded any possibility of direct observation of the various discharges produced by ionization. Recourse was therefore had to models, in which at least qualitatively, if not quantitatively, all the essential functional elements would be embodied. Corona tubes with a cylindrical electrode and a coaxial wire fixed on insulators or within a glass envelope were chosen for this purpose.

Until April 1, 1936, or until the supply available for free distribution is exhausted, copies of Bulletin No. 278 may be obtained without charge upon application to Engineering Experiment Station, Urbana, Illinois.



The Land Lines and Radio Networks Employed in the Distribution of Programs Transmitted from the 32nd. International Eucharistic Congress at Buenos Aires, Argentina.

MAP No. 12--I. T. & T. Program Distribution System, 32nd Int'l. Eucharistic Congress.

TELECOMMUNICATION

PANORAMA OF PROGRESS IN THE FIELDS OF COMMUNICATION AND BROADCASTING

MINIMUM ANTENNA HEIGHTS REQUIRED FOR BROADCAST STATIONS

A REVIEW of the antenna systems employed by broadcast stations reveals that there are now many antennas in use having radiating efficiencies that do not comply with the requirements of good engineering practice. In many cases a material improvement in the coverage of the station could be accomplished by erecting an efficient radiating system. This increase in coverage may be more than could be accomplished by doubling the power.

The Federal Communications Commission feels that it is the obligation of the licensee of every station to make efficient usage of the assignment granted to them. At this time, however, it is not the intention of the Commission to require all the stations with questionable radiating systems to install antennas having the required efficiency, but, according to a recent release, it is their intention not to grant additional facilities to licensees of broadcast stations unless they are making efficient usage of the assignments already granted. That is, the licensee of a broadcast station requesting more power, change in time of operation, different frequency, or move of the transmitter, must have an antenna for the assignment requested that meets with the minimum requirements before favorable consideration will be given.

The accompanying graph shows the minimum physical height of antenna proper or minimum effective field intensity that stations must have before additional facilities will be granted.

These minimum actual physical vertical heights of antenna permitted to be installed are shown by the curves A, B, C, and D as follows:

A—Local Channel Stations, 100 watts night and day or 100 watts night and 250 watts day, or a minimum effective field intensity at one mile of 40 mv/m for 100 watts.

B—Regional Channel, limited time, day, etc., stations 250 watts to 1000 watts night and day, or a minimum effective field intensity at one mile of 150 mv/m for 1 kilowatt.

C—All stations other than Dominant Clear Channel Stations having an operating power night or day greater than 1 kilowatt and less than 25 kilowatts, or a minimum effective field intensity at one mile of 175 mv/m for 1 kilowatt.

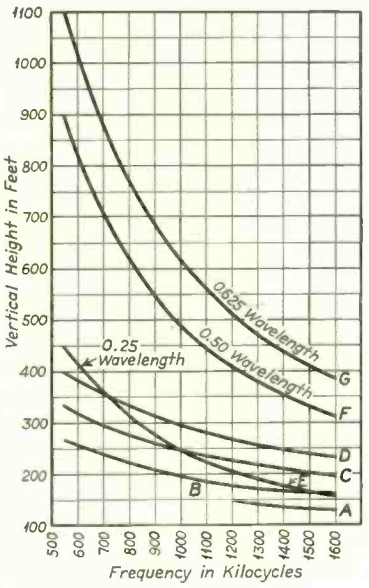
D—All Dominant Clear Channel Stations and all other stations having a maximum operating power night or day of over 10 kilowatts, or a minimum effective field intensity at one mile of 200 mv/m for 1 kilowatt.

The heights given on the graph for the antenna apply regardless of whether the antenna is located on the ground or on a building. Except for the reduction of shadows locating the antenna on a building does not necessarily increase the efficiency. In applying these curves the maximum operating power shall determine which curve is applicable.

In case it is contended that the required antenna efficiency can be obtained without antenna of the height specified, a complete field-intensity survey must be supplied to the Commission showing that the field intensity at a mile without attenuation fulfills at least the minimum requirements. This field survey must be made by a qualified engineer using equipment of acceptable accuracy.

To obtain the maximum efficiency of which any antenna is capable, a good ground or counterpoise system must be employed.

At the present state of the art, it appears that where a vertical radiator is employed the ground system should consist of radial wires at least ¼ wavelength long. There should be as many of these radials as practicable and in no event less than 70. These wires should be buried only deep enough to provide mechanical protection (not greater than 12 inches). However, they should not be permitted to rest on the surface.



In many cases a counterpoise or combination counterpoise and ground system may be superior to a ground, especially where a good ground cannot be obtained.

It should be borne in mind that the above specifications are the minimum and where possible better antenna and ground systems should be installed.

Before any change is made in the antenna, however, details should be submitted to the Commission for approval in order that it may be definitely determined that the installation will meet the requirements of Rule 131 and that it does not constitute an objectionable hazard to air commerce.

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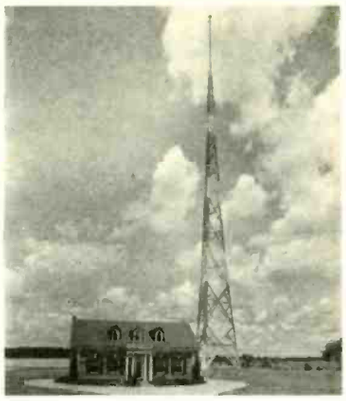
INCREASED SERVICE AREA FOR WRVA

THE PERFORMANCE of the first wood radio tower in the country, designed to increase broadcast effectiveness, stands out as an interesting experiment in radio transmission. Field surveys and listener comments have shown that the advantages predicted for the wood tower have been fully accomplished, according to Larus and Brother, Inc., of Richmond, Va., owners of station WRVA.

Wood, being a non-conductor of electrical energy, has for some time been considered as a material for transmitter towers, but former structural limitations have made its use impractical, because of the expense of the massive construction which was necessary to assure proper support and wind resistance, in towers of such great height. The structural limitations have been eliminated by the availability of modern timber connectors, which do away with the necessity for heavy cross-beams and other such materials.

Since the start of operation of the new transmitter, intensive field tests, carried on to check its efficiency, are said to have demonstrated the increase



in signal strength, reduction of fading and extension of the service area. Paul F. Godley, prominent radio consulting engineer of Upper Montclair, N. J., who designed the antenna, reports: "The use of the 'low-velocity' antenna system on WRVA's new 326-foot wood tower has effected a very material increase in the service area of the station. Since WRVA operates on a cleared channel, most important gain is found in the extension of the primary nighttime service. The so-called fading zone of the station has been pushed out to such an extent that dependable nighttime service area shows an increase of approximately 400 percent. Although surveys have not yet been completed, it can be said that the effect upon daytime service is the approximate equivalent of a three-fold increase in power over the old WRVA antenna."

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"CENTENNIAL SPEAKING . . ."

AN INDEX to the size of the Texas Centennial Exposition in Dallas in 1936 and the precautions to be taken for the entertainment and safety of its visitors can be found in plans of the communications department, which will install, and operate the telephone, telegraph, radio, public-address, and police and fire-alarm systems at the southwest's first World's Fair.

More than five hundred telephones will be required to serve the buildings and grounds. Two hundred of these will serve the administrative offices and three hundred will be distributed over the grounds for the convenience of employees and the public. Twelve to fifteen information stations will house telegraph and special messenger services, in addition to the special teletype bureau in the administrative offices.

Public-address systems will be installed in the stadium, the auditorium, and the arena to amplify speeches, announcements at athletic events, and the presentation of plays and pageants. A loudspeaker system will cover the grounds, to serve in locating lost persons, in relaying messages to exposition employees away from the office, and in providing entertainment from radio and the exposition's own artists to visitors over the grounds.

Protection of the public from fire, robbery, and accidents will also come under the jurisdiction of the communications department. More than two hundred policemen and special officers, especially trained for their duties, will patrol the grounds night and day. Police call boxes will be placed every three hundred feet over the two-hundred-acre park to guarantee close watch over property. Fire-alarm boxes will simultaneously notify the Exposition's own fire station and the Dallas central fire station. Hundreds of fire extinguishers will be placed at advantageous points. As a further precautionary measure, flags, bunting, decorations, and all other inflammable materials will be treated with special fire-retardant solutions.

An emergency hospital, manned by a staff of expert doctors and nurses, will also be maintained for the safety of visitors.

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ARMSTRONG DEMONSTRATES FREQUENCY MODULATION SYSTEM

IN A DRAMATIC DEMONSTRATION before the Institute of Radio Engineers at the Engineering Societies Building on November 6, Major Edwin H. Armstrong, professor of electrical engineering in Columbia University, revealed the workings of a staticless radio system which, it was declared, ushers in a new era of broadcasting.

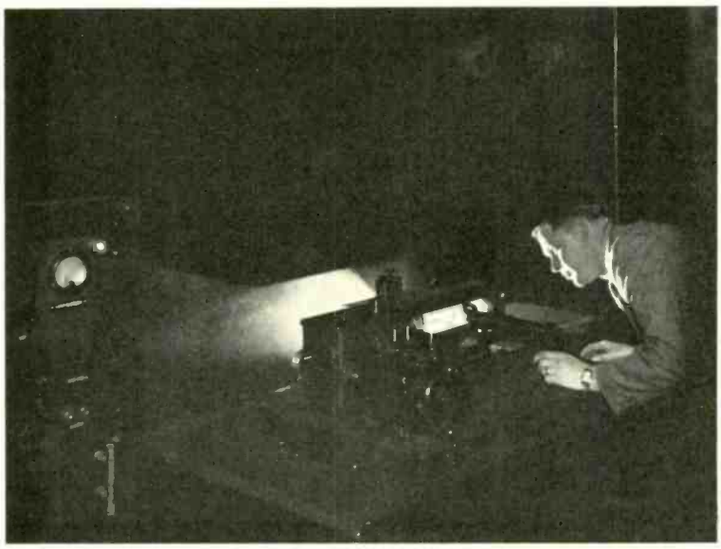
It was the first public disclosure ot the successful outcome of exhaustive tests which have been carried on for more than a year between the National Broadcasting Company station located on top of the Empire State Building and Haddonfield, N. J., eighty-five miles away.

The invention, announced in April, embodies new and revolutionary principles of transmission and reception. The system is principally applicable to ultra-short-wave broadcasting.

It eliminates static, tube noises, and the distortion of reception due to fading. The whole range of musical vibrations can be transmitted, because the limitation on higher frequencies existing in present-day broadcasting is removed. Reception of programs with highest "fidelity" is thereby made possible.

The theory of the invention, developed in the Marcellus Hartley Research Laboratory of Columbia University, is diametrically opposed to the principle upon which the art has been proceeding for twenty years, and which, Prof. Armstrong, asserted, are fallacious.

The system is based upon "the modulation of the frequency of the transmitted wave" and employs "a new method of reducing interference in radio signaling," resulting in "a very great reduction in the effects of the various disturbances to which radio signaling is subject." It is capable of multiplex operation, and as many as four programs have been simultaneously transmitted and received using a single transmitter and a single receiver.



RECEIVING A RADIO FACSIMILE PICTURE BY PHOTOGRAPHIC METHOD AT CENTRAL OPERATING OFFICE, RCA COMMUNICATIONS, BROAD STREET, NEW YORK CITY.

aforesaid applications be dismissed.

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APPLICATIONS GRANTED FOR NEW STATIONS

Telegraph Division

August 27, 1935.

CITY OF EL PASO, Texas, granted construction permit, portable-mobile, general experimental, 30,100, 33,100, 37,100, 40,100 kc, 25 watts.

CITY OF PETALUMA, California, granted construction permit, general experimental, 33,100, 37,100 kc, 10 watts. Similar permit granted for mobile equipment, 5 watts.

BOEING SCHOOL OF AERONAUTICS, Oakland, California, granted construction permit, portable-mobile, special experimental, 62,000, 66,000 kc, 50 watts. Also granted license covering same.

ELWIN B. DELL, Hooper Bay, Alaska, granted construction permit, fixed point-to-point telegraph service, 3092.5 kc, 25 watts.

THE CITY COUNCIL OF AUGUSTA, Georgia, granted construction permit, emergency police, 2414 kc, 250 watts.

mit (3 applications) for similar portable-mobile equipment.

INTERSTATE GEOPHYSICAL EXPLORATION CO., St. Louis, Missouri, granted construction permit (2 applications), mobile, geophysical service, 1602, 1652, 1700 kc, 15 watts.

September 24, 1935.

STANDARD CAHILL CO., Inc., New York, granted construction permit, general experimental, to be used for general research purposes only, 1614, 2398, 3492.5, 4797.5, 6425, 12,862.5, 31,600, 35,600, 38,600, 41,000 kc, 25 watts.

STATE OF RHODE ISLAND, Department of Agriculture and Conservation, Providence, granted license to cover construction permit (3 applications), portable-mobile, general experimental, 35,600, 41,000 kc, 50 watts.

GULF RESEARCH AND DEVELOPMENT CORP., Pittsburgh, Pennsylvania, granted construction permits for three geophysical stations, portable, 1602, 1628, 1652, 1676, 1700 kc, 10 watts.

STATE OF WASHINGTON, Highway and Police Department, granted construction permit, portable-mobile (Snow Plow),

CITY OF MANSFIELD, Ohio, granted construction permit, 2474 kc, 50 watts.

STATE OF ILLINOIS, Department of Public Works and Buildings, Bureau of Police, DeQuoin, Chicago, Effingham, Macomb, Sterling, Pontiac, granted construction permits, 1610 kc, 1 kw.

TERRITORY OF ALASKA, Kenai, granted special authority to operate on 2986, 2616 kc, 40 watts, for a period of three months subject to receipt and action on formal application.

October 8, 1935.

CITY OF VALLEJO, California, granted construction permit (4 applications), mobile, general experimental, 33,100 kc, 8 watts.

CITY OF PROVIDENCE, Rhode Island, granted construction permit, portable-mobile, general experimental, also authority to communicate as municipal police, 30,100, 33,100, 37,100, 40,100, 86,000-400,000 kc, 7.5 watts.

LA SALLE COUNTY, Ottawa, Illinois, granted construction permit, police service, 2458 kc, 250 watts.

FEDERAL COMMUNICATIONS COMMISSION REPORTS

AUTO-ALARM RECEIVERS

IN THE INTEREST of safety of life and property at sea, the Telegraph Division in a meeting on October 1 approved requirements and type tests for an auto-alarm receiver for use aboard ships of the United States.

Article 22, paragraph 21 (1) of the General Radio Regulations annexed to the International Telecommunication Convention, Madrid, 1932, provides for an automatic alarm signal to consist of twelve dashes sent in one minute, the duration of each dash being four seconds and the duration of interval between two dashes one second. The purpose of this special signal is to set into operation the auto-alarm apparatus on a ship to give the alarm. Paragraph 5 of the same article provides that this alarm signal shall, as a general rule, immediately precede the distress call sent by radiotelegraphy on 500 kilocycles. Paragraph 21 (4) also prescribes the conditions which this automatic device must satisfy and these conditions are the basis for the specifications.

At the present time there are about

Assistant Professor of Law at the School of Law, Tulane University, New Orleans.

From 1927 to 1931 Mr. Becker practiced law in Milwaukee, after which he was appointed Executive Counsel to Governor LaFollette during the term of 1931 and 1932. During that period he was also Special Counsel for the State of Wisconsin in several important cases, and also assisted the Public Service Commission in its investigation of the telephone company's rates.

Mr. Becker returned to the practice of law until September, 1933, when he was employed as Counsel in the Public Works Administration. In 1934 he returned to Wisconsin and was employed by the Public Works Administration as Counsel for Wisconsin, and on August 5, 1935, he was appointed General Counsel to the Power Division of the Public Works Administration.

Mr. Becker is the author of several articles printed in standard legal journals and is considered an authority in his special field.

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vice Commission, for due to the increasing work of the Federal Communications Commission it will be necessary to add to its legal personnel.

"The ten attorneys appointed on a permanent basis by virtue of the Executive Order are the following:

Walter D. Humphrey	James L. McDowell
James A. Kennedy	Annie Perry Neal
Geo. M. Harrington	Robert M. Fenton
Abe L. Stein	Frank U. Fletcher
Basil P. Cooper	Melvin H. Dalberg"

This order was made effective October 1, 1935.

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RULE 30 MODIFIED

AT THE GENERAL SESSION of the Federal Communications Commission, held on September 26, 1935, Rule 30 of the Rules and Regulations was modified to relocate the boundary between Radio Districts 11 and 12 in the State of California. The counties of Monterey, Kings and Tulare were transferred from the 11th to the 12th Radio District with headquarters at 328 Custom-house, San Francisco, California, and the

October 15, 1935.

AERONAUTICAL RADIO, Inc., Robertson, Missouri, Memphis, Tennessee, granted construction permits, aviation aeronautical, 3485, 5692.5 kc, 400 watts.

AERONAUTICAL RADIO, Inc., Wilmington, Delaware, granted construction permit, aviation aeronautical, 2906, 3072.5, 3088, 4937.5, 4952.5, 4967.5, 5672.5, 5692.5 kc, 25 watts.

AERONAUTICAL RADIO, Inc., Jackson, Mississippi, granted construction permit, aeronautical and aeronautical point-to-point, 3485, 5682.5, 2854 kc; 5707.5 kc day only; 2608 kc day only; power 400 watts on first 4 frequencies, and 1 kw on 2608 kc.

CITY OF MONROE, Michigan, granted construction permit, general experimental, 33,100 kc, 35 watts; authority to communicate as municipal police in emergency service. Also granted similar construction permits (2 applications), mobile, 10 watts.

VILLAGE OF FOREST PARK, Illinois, granted construction permit, general experimental, authority to communicate as municipal police in emergency service, 40,100 kc, 35 watts. Also granted similar construction permits (2 applications), mobile, 10 watts.

CITY OF MACON, Georgia, granted construction permit, portable-mobile, general experimental, 30,100, 33,100, 37,100, 40,100 kc, 15 watts. Also granted authority to communicate as municipal police in emergency service.

CITY OF BAY CITY, Michigan, granted construction permits (2 applications), mobile, general experimental, 30,100 kc, 15 watts.

ENGINEERING LABORATORIES, Inc., Tulsa, Oklahoma, granted construction permits (2 applications), portable, geophysical, 1602, 1628, 1652, 1676, 1700 kc, 10 watts.

VIRGIL L. KIRKENDALL, San Francisco, California, granted construction permit, portable, geophysical, 1602 kc, 0.3 w.

HOWARD H. BURKHER, Igloo, Alaska, granted construction permit, point-to-point telephone in fixed public service, 2616 kc, 50 watts.

TERRITORY OF ALASKA, Hoonah, Alaska, granted 90-day telegraphic authority, point-to-point telephone and telegraph, 3092.5 kc, 40 watts.

CITY OF OTTAWA, Illinois, police department, granted construction permit, general experimental, 30,100, 33,100, 37,100, 40,100 kc, 100 watts.

CITY OF STREATOR, Illinois, Police Building, granted construction permit, general experimental, 30,100, 33,100, 37,100, 40,100 kc, 100 watts.

CITY OF MENDOTA, Illinois, granted construction permit, general experimental, 30,100, 33,100, 37,100, 40,100 kc, 100 watts.

CITY OF MARSEILLES, Illinois, Police Department, granted construction permit, general experimental, 30,100, 33,100, 37,100, 40,100 kc, 100 watts.

CITY OF OGLESBY, Illinois, Police Department, granted construction permit, general experimental, 30,100, 33,100, 37,100, 40,100 kc, 100 watts.

TOWNSHIP OF WOODBRIDGE, New Jersey, granted construction permit (3 applications), mobile, general experimental, 30,100, 33,100, 37,100, 40,100 kc, 25 watts.

October 22, 1935.

KOYUKUK COMMUNITY RADIO SERVICE, Wiseman, Alaska, granted construction permit, fixed point-to-point telegraph service, 252 kc, 50 watts. Also granted license covering same.

ARTHUR WILSON, granted construction permit, portable (Illinois), general experimental, 31,600, 35,600, 38,600, 41,000 kc, 2 watts.

MESTA MACHINE COMPANY, NC-14947, granted aviation aircraft license for itinerant aircraft, 3105, 3072.5, 3088, 4937.5, 4967.5, 2922, 4122.5, 3232.5, 3127.5, 3257.5, 5602.5, 5632.5, 4917.5, 5612.5 kc, 50 watts.

CITY OF ATCHISON, Kansas, granted construction permit, emergency police, 2422 kc, 50 watts.

AERONAUTICAL RADIO, Inc., Birmingham, Alabama, granted construction permit, aeronautical point-to-point, 2854 kc unlimited, 5707.5 kc day only not to be used within 400 miles of Canada, 2608 kc, 100 watts.

October 29, 1935.

CITY OF BURLINGAME, California, granted construction permit, portable, general experimental, 30,100, 33,100, 37,100, 40,100 kc, 5 watts, unlimited time. Also granted similar construction permit, mobile.

CITY OF WYANDOTTE, Michigan, granted construction permit, 33,100 kc, 25 watts.

CITY OF MARYSVILLE, California, granted construction permit, general experimental, 30,100, 33,100, 37,100 kc, 15 watts.

Broadcast Division

August 27, 1935.

SOUTHERN OREGON PUBLISHING CO., Roseburg, Oregon, granted construction permit, 1500 kc, 100 watts, daytime.

DR. WM. J. REYNOLDS AND WM. J. REYNOLDS, Jr., Selma, Alabama, granted construction permit, 1500 kc, 100 watts, daytime.

September 10, 1935.

ROY L. ALBERTSON, Buffalo, New York, granted construction permit, 1370 kc, 100 watts night, 250 watts day, share WSVS.

GENERAL ELECTRIC CO., Schenectady, New York, granted construction permit (2 applications), portable-mobile, broadcast pickup, 31,100, 34,600, 37,600, 40,600 kc, 2 watts.

WDSU, Inc., New Orleans, Louisiana, granted construction permit, portable-mobile, broadcast pickup in temporary service, 1646, 2090, 2190, 2830 kc, 3 watts.

September 17, 1935.

STANDARD CAHILL CO., Inc., New York, granted construction permit, portable-mobile, general experimental, 31,100, 34,600, 37,600, 40,600 kc, 5 watts.

WILTON E. HALL, Anderson, South Carolina, granted construction permit, portable-mobile, experimental, broadcast pickup in temporary service, 31,100, 34,600, 37,600, 40,600 kc, 0.5 watt.

DONALD A. BURTON, Muncie, Indiana, granted construction permit, portable-mobile, general experimental, 31,100, 34,600, 37,600, 40,600 kc, 2 watts. unlimited time.

THE STAR-CHRONICLE PUBLISHING CO., St. Louis, Missouri, granted construction permit, general experimental, 31,600, 35,600. 38,600, 41,000 kc, 100 watts.

September 24, 1935.

CLARENCE SCHARBAUER, Midland, Texas, granted construction permit, 1420 kc, 100 watts, daytime.

SOUTHWEST BROADCASTING COMPANY, Ft. Worth, Texas, granted construction permit, mobile, temporary broadcast pickup, 1646, 2090, 2190, 2830 kc, 75 watts.

DON LEE BROADCASTING SYSTEM, San Francisco, California, granted construction permit, portable-mobile, temporary broadcast pickup service, 1646, 2090, 2190, 2830 kc, 100 watts.

WPTF RADIO COMPANY, Raleigh, North Carolina, granted construction permit, portable-mobile, general experimental, 31,100, 34,600, 37,600, 40,600, 86,000-400,000 kc, 15 watts, unlimited.

NATIONAL BROADCASTING COMPANY, Inc., Washington, D. C., granted construction permit and license, general experimental, broadcast pickup, 31,100, 34,600, 37,600, 40,600 kc, 100 watts.

October 1, 1935.

BROWN RADIO SERVICE AND LABORATORY, Gordon P. Brown, Owner, Rochester, New York, granted construction permit, 1210 kc, 100 watts, daytime.

DON LEE BROADCASTING SYSTEM, Los Angeles, California, granted construction permit, portable-mobile, temporary broadcast pickup, 1646, 2090, 2190, 2830 kc, 100 watts.

BROOKLYN DAILY EAGLE BROADCASTING CO., Inc., Brooklyn, New York, granted construction permit, 1400 kc, 500 watts, share time equally with WBBC.

October 8, 1935.

MIAMI VALLEY BROADCASTING CORP., Miami, Florida, granted construction permit (2 applications), portable-mobile, 31,100. 34,600, 37,600, 40,600 kc, 2.5 watts, unlimited time.

HAVENS AND MARTIN, Inc., Richmond, Virginia, granted construction permit, portable-mobile, 31,100. 34,600, 37,600 40,600 kc, 20 watts, unlimited time.

HONOLULU BROADCAST COMPANY, Inc., Honolulu, T. H., granted construction permit, portable-mobile, 31,100, 34,600, 37,600, 40,600 kc, 20 watts, unlimited time.

October 15, 1935.

J. B. ROBERTS, Gastonia, North Carolina, granted construction permit, 1420 kc, 100 watts, unlimited time.

SHENANDOAH VALLEY BROADCASTING CORP., Harrisonburg, Virginia, granted construction permit (B/C Temp.), portable-mobile, 1622, 2060, 2150, 2790 kc, 60 watts.

WCAU BROADCASTING CO., Philadelphia, Pennsylvania, granted construction permit, portable-mobile, general experimental, 31,100, 34,600, 37,600, 40,600 kc, 50 watts.

WKY RADIOPHONE CO., Oklahoma City, Oklahoma, granted construction permit, general experimental, 31,600, 35,600, 38,600, 41,000 kc, 100 watts.

BEN S. McGLASHAN, Los Angeles, California, granted construction permit, portable-mobile, general experimental, broadcast pickup, 31,100. 34,600, 37,600, 40,600 kc, 100 watts. Also granted construction permit, general experimental, 31,600, 35,600, 38,600, 41,000 kc, 100 watts.

HEAD OF THE LAKES BROADCASTING CO., Virginia, Minnesota, granted construction permit, 1370 kc, 100 watts, unlimited time.

WFIL BROADCASTING CO., granted construction permits (2 applications), portable-mobile, 31,100, 34,600, 37,600, 40,600 kc, 1 watt. Also granted license covering same for period ending October 1, 1936.

Telephone Division

October 9, 1935.

AMERICAN TELEPHONE AND TELEGRAPH CO., vicinity of Big Pine Key, Florida, granted construction permits and licenses (4 applications), portable, special experimental service; two to operate near Big Pine Key on 5077.5 and 5197.5 kc, and two to operate near Tavernier on 4177.5 and 4242.5 kc; power 5 watts.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGonigle, Secretary, 112 Willoughby Avenue, Brooklyn, N. Y.

CRUISE DEVELOPMENTS

THE ELEVENTH Annual Dinner Cruise of the Veteran Wireless Operators Association announced last month to take place on the 11th of February, 1936, simultaneously in various cities of the United States, now bids for greater scope. In addition to the cruises in New York, Boston, Chicago, San Francisco, Miami and New Orleans, it seems feasible at this stage of developments to hold a cruise in Honolulu with George Street of RCA Communications in that city, assisted by Arthur Enderlin of the Mackay Company, in Honolulu, acting as Chairman and Secretary, respectively, of the Honolulu Chapter.

To L. A. Briggs of RCA Communications, Electra House, Victoria Embankment, London, England, we suggest the possibility of inaugurating the First International Cruise in his city. There are many of our British cousins who are interested in our Association, some of whom in the past have been members, but because of distance and lack of a suitable organ, which is now admirably taken care of here, COMMUNICATION AND BROADCAST ENGINEERING, the official news disseminating agency of our Association, have become inactive members. We hope that LAB may find it possible to gather together many of these former members and the numerous friends of the Association in London on the evening of Tuesday, February 11, 1936, and drink a toast with the other chapters in the United States and Hawaii.

A recent visit of the Secretary to Boston and a pleasant conversation with Harry Chetham, Boston Chapter Secretary, we are pleased to report that the Boston Chapter is one of the most active in the Association. Many applications were passed out at the meeting in October and we expect a large number of returns in the very near future. Plans for their coming cruise on February 11th are being formulated and all interested in attending the Boston Cruise are invited to correspond with Harry Chetham, at 98 School Street, Somerville, Mass.

AWARDS

THE AWARDS COMMITTEE of the Veteran Wireless Operators Association are desirous of receiving reports of heroic deeds performed by wireless operators during the past year. It is important that all cases be made known to the committee so that the awards may be equitably distributed. We, therefore, urge all in a position to know of such activities to correspond with Mr. W. S. Fitzpatrick, Chairman of our Awards Committee.

The Annual Awards of the Association are a highlight of our Annual Cruises and on numerous occasions the distribution of awards has been broadcast from the scene of the Cruise.

THE OLD DAYS

C. D. GUTHRIE supplies us with the following list of radio stations well known in their day but long since out of existence. Undoubtedly mention of the call letters will bring many fond memories to the minds of our many veteran members.

Isle of Shoals, off Portsmouth, N. H., small portable set—Call "AA." (And we always thought portables were a product of the late 20's!)

Manhattan Beach, Call—DF, De Forest. Power—35 kw, later reduced to 2 kw. Fine for press news as it could be heard all over creation.

Fortress Monroe, Call—FM, Fessenden equipment.

Brant Rock, Mass., Call—BO, Fessenden equipment.

Block Island, Call—BI, Massie equipment.

Wilson's Point, Conn., Call—WN, Massie equipment.

Lynn, Mass., Call—CN, Fessenden equipment.

Jamestown Exposition, Va., Call—JE, U. S. Navy, Shoemaker 10 kw equipment.

South Wellfleet, Mass., Call—CC, equipment 35 kw Marconi, about 25 cycle, fine for press but hard to read at any distance if static was bad.

North Post, Trinidad, B. W. I., 2 kw Lodge Murhead, fine for press but no carrying power. Good only in the immediate vicinity of Trinidad.

Station BF heard near Trinidad, at least 10 kw, sending French and Spanish to another station KR in American and Continental Morse. Location never ascertained.

DECEMBER MEETING

AT THE DECEMBER MEETING of the Association, notices of which will be mailed in the very near future, a list of nominees for officers and directors for the year 1936 will be presented by the Board of Directors. Petitions signed by 30 or more members placing names in nomination for any of the offices or for directors are now in order, if members desire, and should be mailed to the Secretary for reference to the Board and to be included by them in the list of nominees. Ballots will be mailed to the membership immediately following the December meeting and should be returned to the Secretary in time to be counted at the January or Annual Meeting of the Association.

PERSONALS

H. T. HAYDEN continues to send in names of prospective members of the Association. Thanks HTH. Keep up the good work. . . . What is V. P. Villandre doing? Haven't heard from him lately. . . . An interesting letter from Geo. Street, now in Honolulu, inviting his many friends to patronize the airline and visit him in the "Garden Spot of the Pacific." He sends 74 (73 plus 1) to all. . . . The following members visited the Camden Plant of the RCA Manufacturing Co., in Camden, to witness a demonstration of the latest developments in television: A. J. Costigan, Traffic Supt. of Radiomarine; Harvey R. Butt, also of Radiomarine; W. F. Aufenanger and W. S. Fitzpatrick, both of RCA Institutes; and George Clark, Association President, of the Radio Corporation of America. . . . We understand the sales of Karl Baarslag's book—*S O S To The Rescue*, published by Oxford University Press—have come up to expectations. We highly recommend Karl's tome as an excellent factual treatise on the part radio has played in marine disasters. Karl recently gave an interesting talk on the book and his experience on Pitcairn, Easter and other islands of the South Pacific, before the Telcoli Radio Club. . . . Charles J. Pannill, Association Life Member, and President of the Radiomarine Corporation of America, was recently elected Executive Vice-President of the Comite International Radio Maritime, to which practically all the large marine communication companies of the world belong.

COOPERATION

YES, WE'RE ASKING IT AGAIN. Suggestions concerning the nature of the coming Cruise possible highlights—features for the evening—methods of publicizing its occurrences—assistance in getting the tickets into the hands of those desiring to participate—suggestions for other Association activities—items for this page—names of prospective members—interesting anecdotes—news of our members—in fact anything that will in any way forward the aims and purposes of the Association are hereby requested. Your interest in these matters will be sincerely appreciated.

REMEMBER—TUESDAY, FEBRUARY 11TH, 1936, ELEVENTH ANNUAL V. W. O. A. CRUISE.

TECHNICAL SERIES TS-2

Cathode-Ray Tubes and Allied Types is the title of Technical Series TS-2, a 120-page booklet issued by the RCA Radiotron Division, RCA Manufacturing Company, Inc., Harrison, New Jersey. This booklet provides technical information on the features and applications of RCA cathode-ray tubes and allied types. In convenient reference size, it will be found helpful by everyone interested in the application of cathode-ray tubes.

The following chapter titles give a good indication as to the contents of the booklet: "General Theory," "General Features of RCA Cathode-Ray Tubes," "Cathode-Ray Tube Installation," "Cathode-Ray Tube Application," "Technical Description by Tube Type," "Voltage Supplies to Provide 1,000 or 2,000 Volts for Cathode-Ray Tubes (also, description of a simple, portable oscillograph)," "Lissajous Figures," "Photography of Cathode-Ray Tube Patterns," "Typical Oscillograms," "The Use of the Cathode-Ray Oscillograph for Checking Modulated R-F Waves," "Cathode-Ray Curve Tracing Apparatus for Aligning Tuned Circuits," "A Deflecting-Magnet Current Amplifier for Use With Cathode-Ray Tubes Employing Electromagnetic Deflection," "Cathode-Ray Tube Terminology" and a "Reading List."

Technical Series TS-2 may be obtained from the above organization for the sum of twenty-five cents.

OVER THE TAPE...

NEWS OF THE RADIO, TELEGRAPH AND TELEPHONE INDUSTRIES

"PICK-UPS"

The first issue of a new magazine named "Pick-Ups" has been issued by the Western Electric Company. The introductory editorial states that the magazine will be devoted to "news of developments in the field of sound, and of the organizations and men who use the equipment designed by Bell Telephone Laboratories, manufactured by Western Electric and distributed by Graybar".

In this initial number there are 26 pages with a two-color cover depicting the new non-directional dynamic microphone. Leading stories deal with the microphone, WTCN's new 5,000-watt station at Minneapolis, new radiophone equipment for aviators, the work of Bell Laboratories, a two-way ultra-high-frequency police-radio installation at Evansville, Indiana, and the wide-range public-address system at the California Pacific International Exposition. The entire issue is copiously illustrated.

The publication will be issued several times a year and will be circulated chiefly to users of Western Electric equipment, such as broadcasting stations, police departments and air transport companies, as well as to prospective users. The editor is Will Whitmore, and the assistant editor is M. M. Beard, both of the Company's headquarters staff at 195 Broadway, New York City. The editors are to be congratulated on an excellent first issue.

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UTC BULLETIN 1100

"Controlled Carrier Modulation" is the title of the latest United Transformer Corporation Bulletin, No. 1100. The first half of the bulletin covers voice-actuated sub-audible carrier control for increasing power output from a given tube capacity in the final amplifier. The second part is a description of "A Controlled Carrier Transmitter", the summary of an article that recently appeared in "Radio". Write to the United Transformer Corp., 72 Spring Street, New York City.

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CHANGE IN NAME

The Communications Engineering Company has expressed its appreciation for the support the radio industry has given them during the past year. This organization has now incorporated under the name of Electronic Mechanics, Inc., and their new address is 201-203 East 12th Street, New York City, Telephone ALgonquin 4-2088. Their expanded facilities will enable them to serve the industry better in the future.

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ELECTRAD CATALOG

Electrad Incorporated, 175 Varick Street, New York City, recently released their 1936 catalog. This attractive 18-page catalog gives complete descriptions of the various Electrad products. It may be obtained by writing to the above organization.

LIFE BOAT RADIO INSTALLATION

The first motor life boat radio installation in anticipation of the new sea-safety regulations of the Department of Commerce has been completed and given its official test on the Hudson River, Charles J. Pannill, President of the Radiomarine Corporation of America, announced. The installation is on the SS. *Pennsylvania* of the Panama Pacific Line.

When the new Department of Commerce rules go into effect next January 1 all ocean-going passenger vessels of 2,500 gross tons will have the added safeguard of motor life boats with radio-telegraph equipment capable of communicating at least fifty miles on the international distress frequency.

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"ADVANCED DISC RECORDING"

Universal Microphone Co., Inglewood, Calif., in November issued its 1936 edition of "Advance Disc Recording," written by E. E. Griffin, chief engineer. The 16-page booklet is profusely illustrated with line drawings and photographs.

One section is devoted entirely to 33-1/3 recording. The information is said to be new and valuable inasmuch as, at this lower speed, considerable difficulty is often experienced in securing satisfactory reproduction.

All methods are described in detail and there are separate pages on recording on aluminum, silveroid or acetate. Other headings discussed include the cutting head, recording amplifiers and other topics.

A minimum price of 10 cents has been placed on the booklet. However, no charge has been placed on the new instruction sheet which Universal has issued with its professional recording machine.

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FERRANTI BULLETINS

Ferranti Electric, Inc., 130 West 42 Street, New York City, have recently released two interesting bulletins. One bulletin covers the New Ferranti electrostatic voltmeters for a-c and d-c measurements; while the other one deals with a clip-on ammeter, a split-core current transformer, the primary of which is formed by the conductor whose current is to be measured, the secondary being connected to a milliammeter.

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OLESEN APPOINTMENTS

Art Davis, formerly with Western Electric in Hollywood, has joined the recording manufacturing division of Otto K. Olesen sound studios. C. C. McDonald continues as chief engineer and Sam Bartlett becomes production manager for the transcription activities.

This organization has started to market parts and kits for their recording machines, both portable and bench mount models. It has also started to manufacture a heartbeat amplifier for use by hospitals and medical laboratories.

WOR OFFICIALS APPOINTED ADVISERS FOR POLICE-RADIO SURVEY

Two WOR officials have been appointed advisers to the Police-Radio Survey Commission of New Jersey. They are G. W. Johnston, director of public relations, and J. R. Poppele, chief engineer of the station. The commission, authorized by the State Legislature and appointed by Governor Harold G. Hoffman, has been created to combat crime in New Jersey.

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NATIONAL BULLETIN NO. 250

Bulletin No. 250 is a descriptive price list of the various radio products of the National Company, Incorporated, 61 Sherman Street, Malden, Massachusetts. This 20-page bulletin covers condensers of all types, dials, transformers, coil forms, sockets, crystal holders and other radio products too numerous to mention.

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BRUNO APPOINTMENTS

William A. Bruno, President of the Bruno Laboratories, recently announced a complete reorganization in the executive staff. Mr. P. Fernald, widely known sales executive who was formerly connected in this capacity with the Kenyon Co., and Operadio, has been appointed as sales manager. Mr. Fernald takes up the position vacated by Mr. John Koppie, who is no longer associated with the organization.

Mr. Paul von Kunits, formerly chief engineer of The General Broadcasting System and later connected with the American Radio News Co., and Hearst Radio Inc., has been appointed as chief engineer of the radio division of the laboratories. Mr. Fernald and Mr. von Kunits will be in direct charge of the New York office. This will allow Mr. Bruno to devote more of his time to the increasingly important Aviation Division of the Laboratories, in Washington, D. C.

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NEW WGN STUDIOS

"A Word Picture of the New WGN Radio Building and Studios", by James O'Donnell Bennett, is the title of a 28-page reprint of an article which appeared in the Chicago Sunday Tribune, September 22, 1935. This attractive booklet gives an interesting description of the new WGN building and studios.

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"AIRPORTS"

An attractive 4-page bulletin entitled "Airports" has recently been released by Western Electric. This bulletin covers the Western Electric 10-A Radio Transmitter which has been designed expressly for airport service. This bulletin may be obtained from the Aviation Radio Department of the Western Electric Company, 195 Broadway, New York City.

THE MARKET PLACE

NEW PRODUCTS FOR THE COMMUNICATION AND BROADCAST FIELDS

MAGNETIC CHUCK RECTIFIER

Ward Leonard Electric Co., Mount Vernon, New York, announces the development of a rectifier for use with magnetic chucks.

This device provides an economical means for obtaining rectified alternating current from 110-volt, 60-cycle service.

Standard full-wave rectifier tubes are used in each of the four sizes that comprise the present line covering a range up to 1800 watts.

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DURALOTONE DISCS

The Sound Apparatus Co., 150 W. 46th Street, New York City, announce the new Duralotone Disc for direct recording. The Duralotone disc has a soft, black, wax-like composition impregnated on a metal base. After being processed it is said to have the looks and features of the regular commercial disc. It can be played with any steel needle, is safe in operation, does not skip grooves, and has a long life. The composition permits easy cutting with steel needles and warrants the inscribing of a wide frequency and volume range, it is said.

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NEW DU MONT CATHODE-RAY OSCILLOGRAPH

The Allen B. Du Mont Laboratories, Upper Montclair, New Jersey, recently announced their new Type 148 Cathode-Ray Oscillograph. This new oscillograph incorporates many advanced features, and no effort has been spared to make the unit as flexible as possible, it is stated.

The sweep circuit of this unit is said to be basically new and allows waves of from 10 to 500,000 cycles per second to be observed with good linearity. The return trace has been speeded up and does not interfere with the pattern at high frequencies. The sweep can easily be synchronized with fractions of the wave as well as with multiples of the wave.

The amplifiers in this unit are arranged so that they may either be used as single-stage units for each set of deflection plates or else as a two-stage amplifier for the vertical deflection plates.

The method of applying the signal and sweep voltages in various combinations to the deflection plates is controlled by one knob. A calibrated scale is supplied with this unit when used with a five-inch cathode-ray tube. The scale and large viewing screen of the tube makes for more accurate determinations, it is said.

A uniform focus is obtained over the entire screen due to a new coupling circuit which applies the input signal without having it affect the accelerating potential. The unit is applicable for checking percentage modulation, phase shift, distortion in amplifiers, frequency, fidelity, overloading, and the like.

Complete information may be obtained from the above company.

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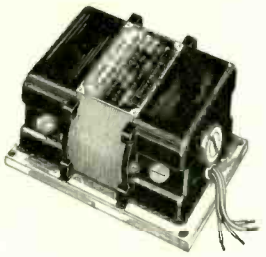
NEW CARTER POWER PLANTS

The new Carter power plants, one of which is shown in the accompanying illustration, are for use with sound trucks and transmitters, two-way police radio and test equipment. These units are said to be reliable and economical B power supplies for operating Class A or B portable amplifiers from 6- or 12-volt batteries. The



motor is specially designed for high-voltage output and the filter is unusually large. It is supplied with quiet running ball bearings that require no oiling. The brushes are extra heavy.

For further information write to the Carter Motor Company, 361-399 W. Superior Street, Chicago, Illinois.

AMERTRAN AMPLIFIER KITS

AmerTran Series "400" Sound-System kits have been developed to provide high-quality amplifier equipment at moderate cost. By following carefully circuits and detailed wiring instructions, these kits may be assembled without difficulty on a standard AmerTran chassis. They are well suited for the following: Station amplifiers, recording amplifiers, audition amplifiers, monitoring amplifiers, public-address amplifiers, and amplifiers for the home.

Series "400" kits have a frequency range of 30 to 12,000 cycles with response uniform within either ±1½ db or ±3db, depending upon whether transformers in the audio system are AmerTran Precision De Luxe or Standard De Luxe, it is stated. The former represents the higher fidelity equipment.

Standard kits will deliver either + 33 db (12.3 watts) or + 36 db (25 watts), depending upon whether push-pull or parallel-push-pull tubes are used in the output stage. Special kits using different tube and transformer combinations may be obtained to satisfy unusual power requirements.

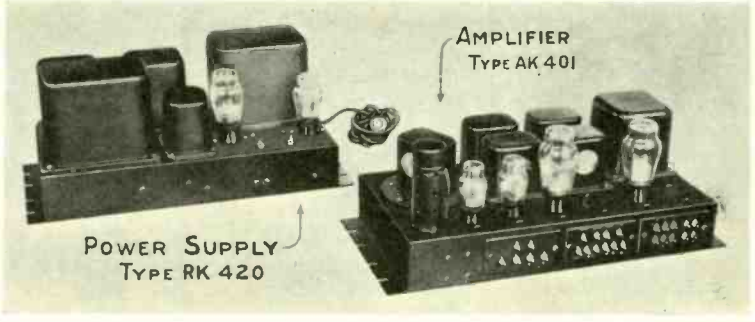
Overall gain in Series 400 kits ranges from 76 db to 85 db, depending upon the amplification factor of the tubes used and the turns ratios of the interstage transformers.

Input circuits on all standard kits will match an input source of 500, 200, 125, or 50 ohms impedance and the output circuit will deliver full power into a load of 500, 125, 15, 7½, 5, 3¾, or 1¼ ohms. There is also a wide assortment of transformers which may be substituted if it is necessary to match special impedances.

Standard and special kits use the same basic amplifier circuit consisting of three a-f stages—the first a 57 connected as a triode; the second, two 56's in push-pull; the third, either push-pull or parallel-push-pull 45's, 2A3's or 50's.

The amplifier circuit is so arranged that it may be operated either with batteries or from an a-c supply. A special power supply has been designed for use with the Series 400.

Further information may be obtained from The American Transformer Co., 178 Emmett Street, Newark, N. J.



PROCTOR TRANSCRIPTION EQUIPMENT

The Proctor Transcription Equipment is now available with the new wide-range Proctor Piezo Phonograph Reproducer insuring good reproduction of lateral-cut records. It employs a General Electric self-starting, constant-speed, synchronous motor incorporating a ball-bearing speed-reduction mechanism providing reproduction at 33-1/3 or 78 rpm. Also, it is designed to operate from a 105/125-volt, 60-cycle power supply,

A novel feature of the equipment is the new non-warping, non-resonant Proctor Turntable Platen which is 16 inches in diameter and furnishes a foundation for all types of records.

The output of the pickup is fed through a specially designed transformer and by means of a 7-position tone-equalizing switch, mounted on the motor board, it is possible to compensate for variations in the frequency characteristics of individual records so that the overall reproduction characteristic is substantially flat, it is said.

Connections to the output are made by means of a jack and plug arrangement and two output impedances are available, 200 and 500 ohms.

The Proctor Transcription Equipment is mounted in an attractive plywood cabinet, covered with black leatherette and is provided with a removable lid which forms a convenient dust cover.

For further information write to the B. A. Proctor Company, Inc., 17 West 60 Street, New York City, for Bulletin 2.

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NEW REMLER REMOTE AMPLIFIER

Unfortunately the illustration used with the description of the New Remler Portable Remote Amplifier, page 28, Sept., 1935, COMMUNICATION AND BROADCAST ENGINEERING was that of a portable p-a system. The remote amplifier described in that issue is shown below.

NEW ULTRA-SHORT-WAVE POWER TUBE

An ultra-short-wave power tube with a filament of pure tungsten assuring uniform performance and long life is announced by the Westinghouse Lamp Company. The new short-wave power tube is particularly suitable as an oscillator for 6-meter diathermy machines, featuring a tungsten filament, with complete insulation of the plate assembly from the filament stem and with plate and grid connections brought out of the top of the bulb to facilitate simpler wiring in short-wave circuits.

Designated as the WL-455, the tube is modeled after the 100-watt WL-680 general-purpose transmitting tube. The chief difference lies in the grid and plate connections, which are brought out near the top of the bulb, eliminating the need of long connections through the base. Simpler wiring is therefore possible in the short-wave circuits of diathermy machines.

Another advantage of the WL-455 is the complete insulation of the plate assembly from the filament stem, a feature which eliminates punctures at this point and contributes to longer life. In addition, the

tungsten filament makes it possible to control the output of diathermy machines merely by varying the filament voltage.

Typical high-frequency ratings of the WL-455 are as follows:

Frequency Megacycles	*DC Plate Amperes*	*DC Grid Amperes*	*Output Watts*
6	0.200	0.020	200
15	0.200	0.020	175
30	0.200	0.015	150
50	0.175	0.010	125
75	0.175	0.010	75

The above values are for a plate voltage of 1500 volts.

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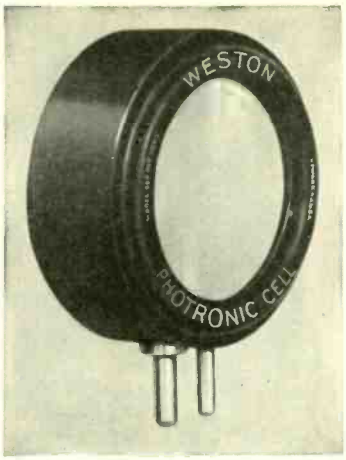
HIGH-OUTPUT PHOTRONIC CELL

A photoelectric cell of the "dry-plate" type which provides an increased current output may now be obtained from the Weston Electrical Instrument Corporation. Newark, N. J. Known as the Type 2 Photronic Cell, it is intended primarily for use at levels of illumination so low that the regular Photronic Cell will not provide sufficient output for the purpose intended.

Current output of the new cell is approximately three times that of the regular Photronic Cell for the same illumination. Its spectral sensitivity is slightly greater in the blue end of the spectrum than that of the regular cell. In size, speed of response and most of the other



general characteristics, the high-output cell is similar to the regular type.

However, in common with all known supersensitized photoelectric cells, the Type 2 cell is not quite so stable as the regular type, but it will be found suitable where high output is more essential than strict permanence, especially for use in relatively low illumination.

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QUARTER-MILLION-VOLT CONDENSER

Cornell-Dubilier Corporation, a pioneer in the condenser industry, is keeping pace with the latest developments of the industry as well as initiating future courses. Many special problems are addressed to it by different interests for new applications of the electric condenser.

Illustrative of this service is the new unit developed for X-ray power purposes. In this particular instance, a condenser was required that was capable of withstanding a potential of one-quarter of a million volts. The condenser consists of four units in series and of the design to be found in broadcast stations. These units comprise oil-filled paper condensers assembled within an insulating housing with metal ends, allowing easy series connection. The individual ratings of these units of 0.25 microfarad and 60,000 volts provides a complete assembly of about 0.06 microfarad and 240,000 volts when connected in series.

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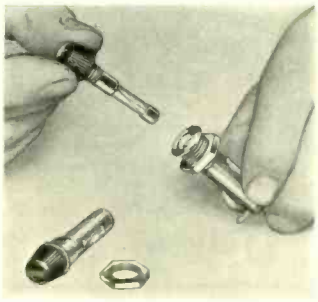
NEW FUSE MOUNTING

The new No. 1069 Extractor Fuse Post takes the standard 3 AG type fuse and is not only insulated to make it shockproof, but it extracts the blown fuse when the knob is unscrewed. It is of the panel-mounting type; requires a ½-inch mounting hole; and the overall length is 2¼ inches. It is especially suited for loads of less than 5 amperes and 110 volts, in the primary circuits of power supplies to radio receivers and power amplifiers.



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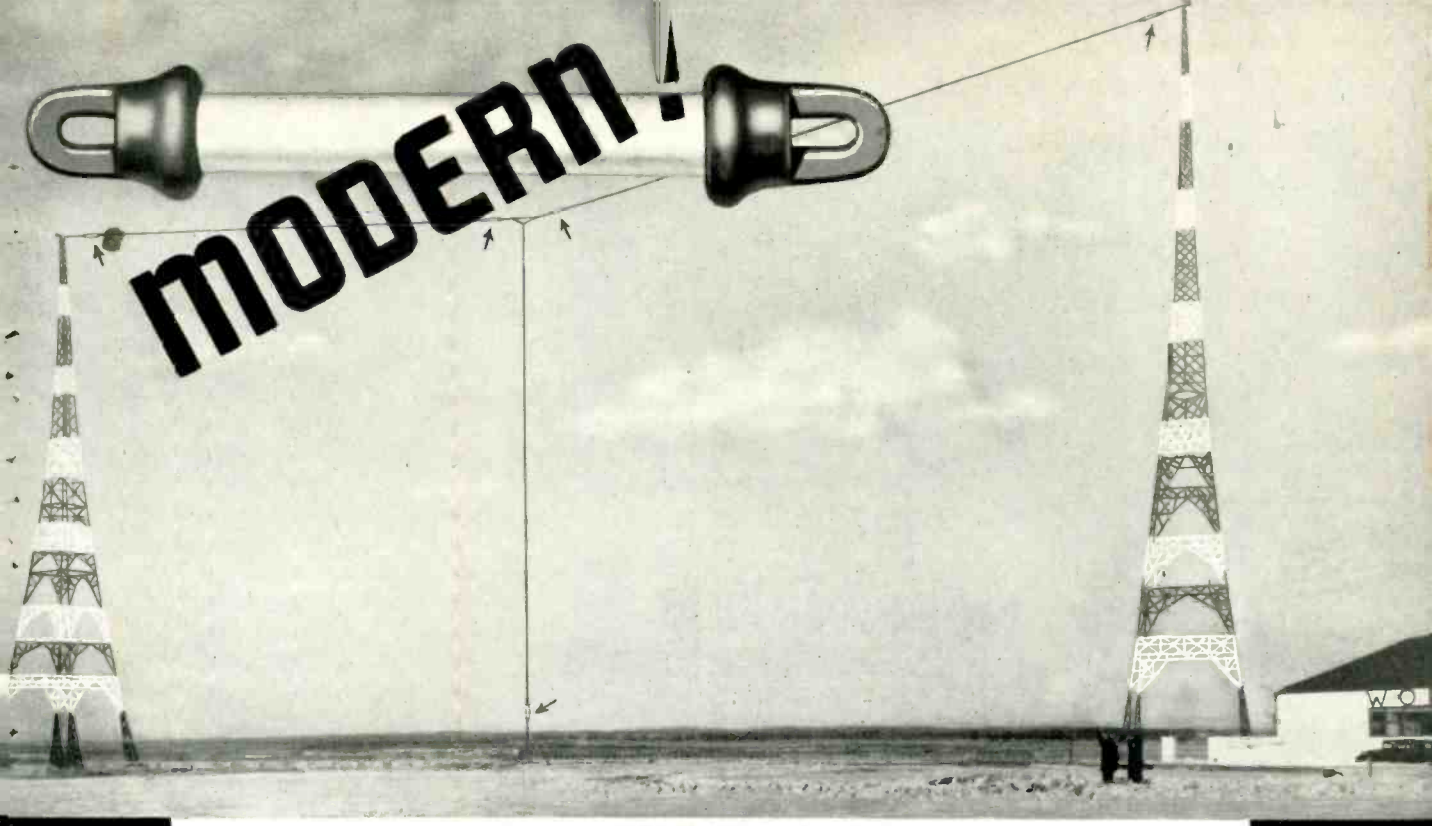


Panorama of WOR 50 K.W. Broadcast Station

ISOLANTITE PLAYS AN IMPORTANT ROLE IN THE MODERN BROADCAST TRANSMITTER.

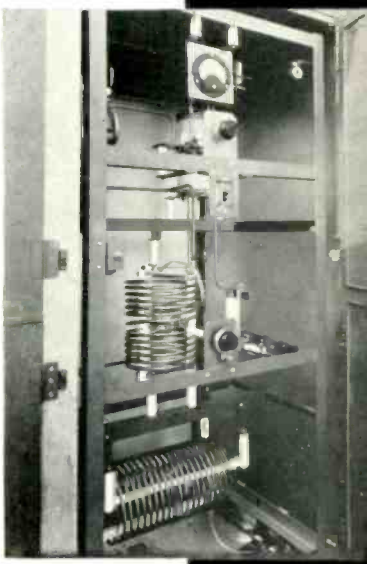
The 50 K.W. Transmitter recently built by Western Electric for Station WOR employs ISOLANTITE liberally.

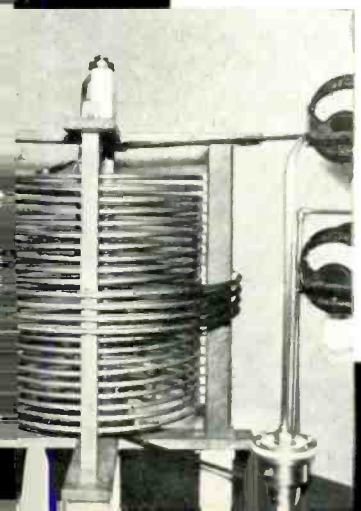
In this up-to-date station are strain insulators, concentric transmission line spacers and end seals, stand-offs, switches, shafts, inductance supports, power and rectifier tube supports, condenser cases, pedestals and many other parts of ISOLANTITE.

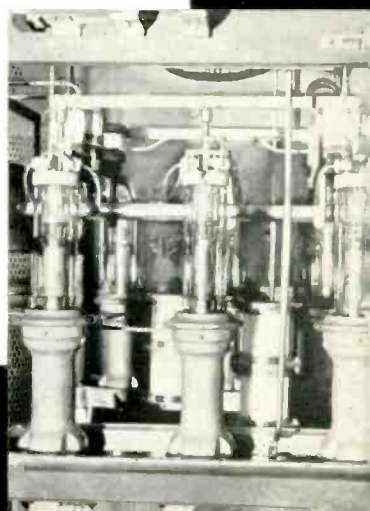
To improve your equipment, specify ISOLANTITE insulation. *Isolantite, Inc., 233 Broadway, New York, N. Y. Factory at Belleville, N. J.*

Represented by GRAYBAR ELECTRIC CO.

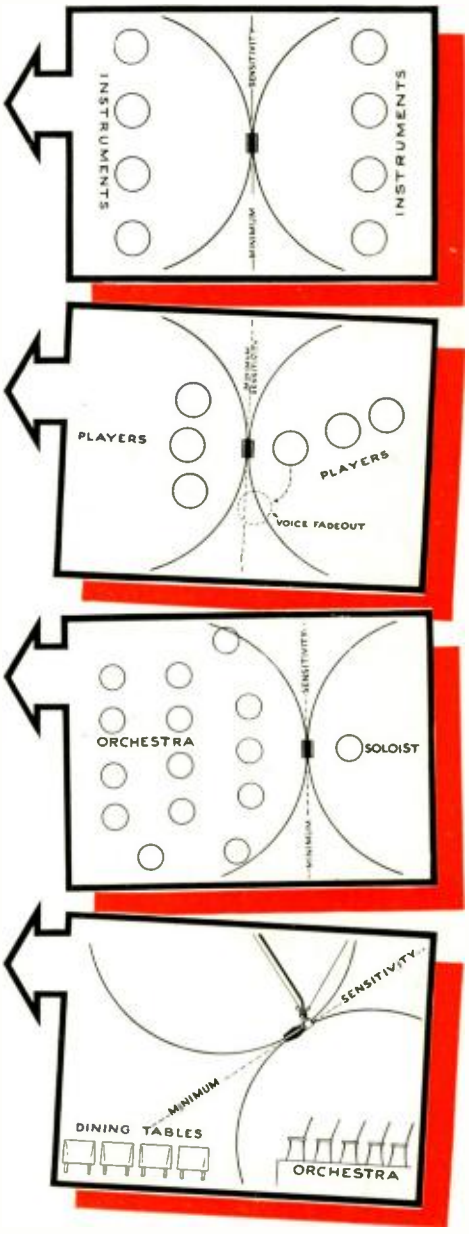
Isolantite
CERAMIC INSULATORS







THE VELOCITY MICROPHONE FOR *VERSATILITY!*



IN THE SMALL STUDIO . . . Where space limitations might otherwise necessitate the crowding of instruments and artists, the Velocity Microphone offers an ideal solution for a pressing problem. Both sides being "live," the members of the orchestra may be arranged in the manner shown in the diagram with the resulting assurance of perfect pickup and balance. In effect, it enlarges the studio.

FOR RADIO DRAMA . . . Modern broadcast plays often require large casts. Here again the ability to use both sides of the microphone is an important asset. An additional feature is the fade-out obtained when actors move into the side areas of minimum sensitivity, producing the illusion of moving about the scene.

FOR SOLOISTS . . . Proper relative values for soloist and accompaniment are easily obtained by placing the artist on one side, and the orchestra, chorus, etc., on the other. Crowding is avoided, with its accompanying unbalance, and proper relative values are easily obtained.

IN PUBLIC . . . The Velocity Microphone is particularly effective in pickup work where sensitivity to the program is of paramount importance, and the ability to suppress extraneous sounds is essential—as, for example, in broadcasts from restaurants and night clubs. As indicated in the diagram, the area of minimum sensitivity turned towards the diners prevents any audible interference with the clear, balanced transmission of the program. Not only the usual, but the very unusual microphone problems which present themselves, may be solved quickly and satisfactorily through the inherent element of flexibility in the Velocity Microphone.

These are but four examples of the surprising versatility of the RCA Velocity Microphone, a feature that joins with High Fidelity in making it a supreme instrument.

PROGRAM TYPE 44-AP ANNOUNCE TYPE 44-AA SUSPENSION TYPE 44-AS

Get in touch with one of these offices:

New York, 1270 Sixth Ave.; Chicago, 111 No. Canal St.; San Francisco, 170 Ninth St.; Dallas, Santa Fe Building; Atlanta, 144 Walter St., N. W.

RCA Manufacturing Co., Inc., Camden, N. J. • A subsidiary of the

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