# Communication and Broadcast Engineering

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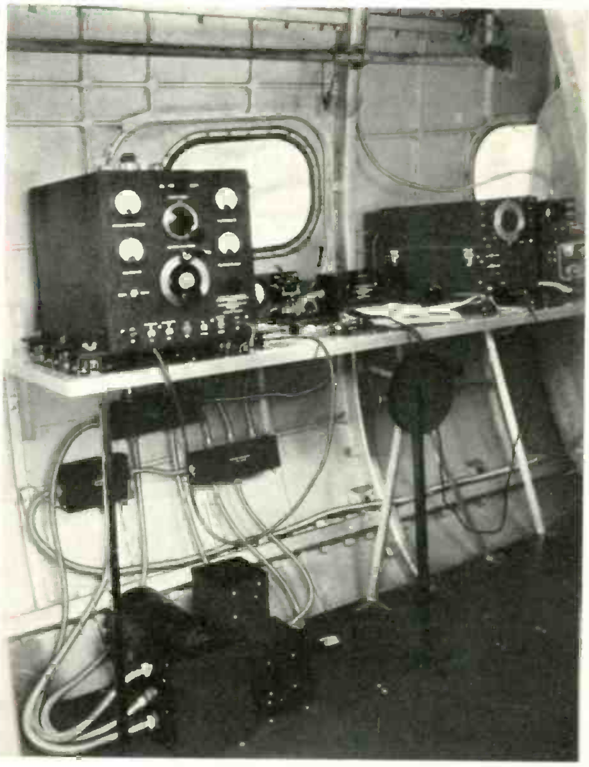
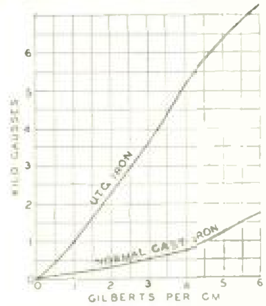


The Journal of World Communication

The UTC Engineering Laboratories Have Developed Linear Standard Audio Units Symmetrically Balanced for Your New 100 Watt A Prime Modulator

Typical Linear Standard LS 12 Broadcast line to push pull grid transformers. Fully enclosed in exclusive cast alloy shield.



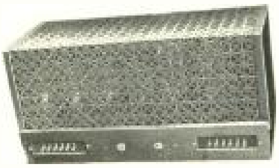

Curve showing relative shielding effect (permeability) of UTC high permeability cast iron and normal cast iron used for transformer housings. It is seen that the ratio of shielding afforded by UTC housings is 5 to 1.

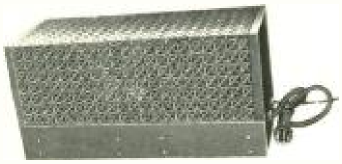
LS 845—A prime output transformer to Broadcast line.

## Amplifier and Power Components for a 100 Watt Broadcast Modulator:

| | List Price |
|---|---|
| LS-12—500, 125, 200, 50 ohm line to push-pull 57 grids | $20.00 |
| LS-22—57 triode plates to 59 grids | 22.00 |
| LS-6—59 triode plates to 845A prime grids | 22.00 |
| LS-845M—845A prime plates to RF load | 50.00 |
| LS-101—Output modulation choke | 25.00 |
| LS-77—Plate supply transformer for 845 modulation stage. Primary tapped for 100, 110, 120, 220, 230, 240 volts | 60.00 |
| LS-79AX—Grid bias transformer for 845 stage | 20.00 |
| LS-96—A prime input filter choke | 40.00 |
| LS-91—Output smoothing chokes each | 8.50 |
| LS-95—Plate isolating choke | 8.50 |
| LS-85—Filament transformer for 845's and 866's. Primary tapped for 100, 110, 120, 220, 230, 240 | 25.00 |

STANDARD DISCOUNTS ALLOWED

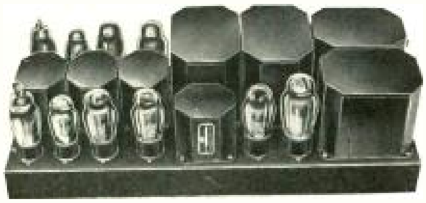




2A3 amplifier and power supply with perforated protective covers fully mounted. The undistorted Class A output is 15 watts, the gain is 80 DB. The amplifier is uniform in response from 30 to 12,000 cycles. List price of transformer kit is $152. Includes drilled decks and perforated covers—all transformers mounted at factory—standard discounts to Universities and Broadcast Stations.

## Linear Standard High Fidelity High Power A Prime and Class B Audio Transformers

for use with 204A, 849, 212D, 851, Eimac 150T, HK 354, HK 255, 270A tubes. Standard designs are now available on these units having a frequency response of ± 2 DB from 30 to 12,000 cycles.



Triple push-pull parallel 45A prime 38 watt public address amplifier. The overall gain is 90 DB. List price of complete transformer kit is $77.25—includes stamped chassis and perforated cover — all transformers mounted at factory at no extra cost. Standard discounts allowed.

Write for the new U-1100A Manual. 28 pages devoted to basic amplifier circuits, including fundamental charts on attenuation network data, decibel charts, reactance charts, rectifier constants and class B circuit constants. Kindly enclose 10c to cover mailing costs.

The output transformer illustrated is designed for 849's in A prime for a 1000 watt modulator stage. The U-1100-A manual fully describes a 1000 watt modulator circuit for Broadcast use.

# UNITED TRANSFORMER CORP.

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THE JOURNAL OF WORLD COMMUNICATION

# COMMUNICATION & BROADCAST ENGINEERING

M. L. MUHLEMAN
Editor

RAY D. RETTENMEYER
Associate Editor

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### FEATURES



### DEPARTMENTS



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and

## Happy and Successful New Year

to our readers, who have shown such a unanimous interest and appreciation of our efforts during the first three months of publication.

COMMUNICATION AND BROADCAST ENGINEERING

# EDITORIAL

## MUSICAL EXPRESSION

THERE WILL APPEAR IN THE January issue of *The Atlantic Monthly* an article titled "New Vistas in Radio," by Leopold Stokowski, the justly famous conductor of the Philadelphia Symphony Orchestra. We recommend it as a highly interesting and instructive treatise on the possible future of radio broadcasting as a medium of new modes of musical expression, by a man whose intense interest in tonal development has led him into the study of electrical sound and radio broadcasting.

Of particular interest in this article are Mr. Stokowski's remarks on the electrical production of tone. He visualizes in this highly specialized technique the possibility of breaking down the present limitations placed upon a symphony orchestra and carrying tonal expression and tonal moods into phases as yet unconceived by the composer and the conductor.

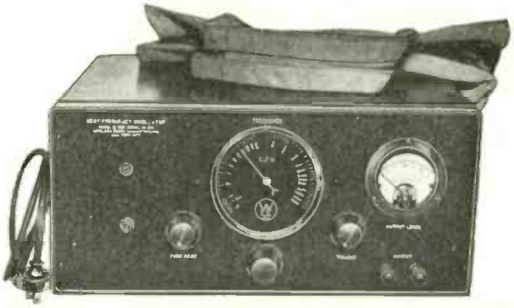
In offering a comparison between the mechanical and the electrical musical instrument, Mr. Stokowski says:

"The electrical instruments also have their mechanical side, but when they have been more fully developed they will have greater range in their powers of playing loud and soft, high and low, legato, staccato, glissando, and greater variety of tone-color. For example, on our present instruments it is difficult to play a really perfect legato because the breath becomes exhausted, or we must change the direction of the bow because of its limited length. There are no limits to the legato of the electrical instrument. All our orchestral instruments are constantly becoming 'out of tune' during the performance. Many of our wind instruments are never in tune because of their faulty structure. The only limit to playing in tune on some types of electrical instruments is the ear of the player. Others are so constructed that they never need tuning and it is impossible to play out of tune on them. These are of the 'tempered scale' type. So that in several ways the electrical instrument is not more mechanical than our present imperfect instruments. Since the development of the electrical instruments is still in a very early stage, they are not to be fairly judged by present performance. . . . Electrical production of tone may some day revolutionize the manner of composing music."

A number of the advantages of an electrical musical instrument have been appreciated for quite some time. The principal advantages, as suggested by Mr. Stokowski, are: the creation of sustained notes, extended volume range and frequency stability. These advantages alone are sufficient to offer the composer a much wider latitude of expression. The limitations imposed by the mechanical instrument quite often force the composer into musical gymnastics in order that he may at least approximate the picture or the mood he wishes to interpret. If a composer has felt the beauty of a rising sun and wishes to create a musical picture of what he has seen, he must resort to instruments capable only of discontinuous notes. On the other hand, electrical instruments producing continuous notes of slowly rising frequency, combined with other instruments having sustained tones altering in their harmonic relation for the purpose of expressing the change of the pure colors as the sun moves higher into the heavens, might well provide an audience with a new emotional experience.

There is another important advantage to the electrical production of tones; there is offered the possibility of an almost perfect simulation of the many natural sounds, such as thunder, rain and wind, with the added feature of most any conceivable form of distortion or alteration of tonal characteristics to meet the precise requirements of the composer.

Radio broadcasting has its own techniques. The radio drama is a new creation, developed to meet the special requirements of broadcasting and to provide new modes of expression. Studio technique is also a contribution to the ceaseless efforts toward more natural radio interpretations. New fields of expression will be opened up when the broadcast field takes in hand the development of improved electrical musical instruments and encourages the composition of modern symphonies based on the electrical production of tone.











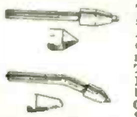










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**BRYAN DAVIS PUBLISHING CO., Inc.**
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# COMMUNICATION & BROADCAST ENGINEERING

FOR DECEMBER, 1934


# "RADIO VIENNA"

**The 100-kw station of the Austrian Broadcast Monopoly. Of particular interest are the 300-kw tubes with *indirectly-heated cathodes.***

By P. M. HONNELL

IN VIEW OF THE trend towards high-power broadcast transmitters in the United States, a description of the 100-kw station of the RAVAG—the Austrian Broadcast Monopoly—is of interest because its design incorporates several unusual features.

### TRANSMITTER LOCATION

The transmitter is located on the summit of the Bisamberg, a flat-topped 1300-foot mountain. Seven miles to the south, and at an elevation of 600 feet is the Stadt—the center of the city of Vienna—where the studios are located. From the transmitter site one has a magnificent view of Vienna to the south, with the snow-covered Alps beyond and to the west, and of the vast plains to the east and north. There is an optical transmission path to most of the city, as well as sufficient elevation to lay down a field in the mountainous country to the southwest which includes most of Austria, without obstruction from nearby mountains.

Enclosed by a high wire fence and patrolled by "Heimwehr" men with fixed bayonets is the antenna system and the very modern buildings housing the transmitter of Radio Vienna, the power plant and auxiliary equipment, and the engineering and operating staffs and their families. See Fig. 1. Once inside the iron gates one is thankful that one's credentials were adequate, for the Heimwehr guard appears to be suspicious of all visitors and in no mood to entertain any pleasantries.

### POWER PLANT

Although sources of electric power are not far from Bisamberg and the construction of transmission lines would have presented no serious difficulties, it was deemed desirable for political reasons to have the station independent of external sources of supply by employing a Diesel power plant in the station proper. The wisdom of this provision has been amply demonstrated by recent events.

Three five-cylinder solid-injection Graz Diesels, each direct connected to a 400-kva, 380-volt, 50-cps, three-phase alternator, are the primary sources of power; during operation two engines are in service, the third is in reserve. From the two generators in use the 380-volt line feeds into a motor-operated oil switch and an induction voltage regulator to the 380/15,000-volt plate-supply transformer. The regulator enables a variation in the rectified plate voltage from 4,000 to 13,000 volts to be obtained.

### THE HIGH-VOLTAGE RECTIFIERS

Two high-voltage rectifiers are provided; one a Siemens-Schuckert steel enclosed grid-controlled mercury arc for normal use; an Elin air-cooled glass bulb mercury arc is available for emergency use. Each rectifier furnishes the full 50 amperes at 13,000 volts dc required by the transmitter. The main filter consists of a 3.0-henry, 50-ampere choke and 140 microfarads of capacity.

Of particular interest is the automatic protection afforded in the event of a flash-over in the power amplifier tubes; the short-circuit current through the power tubes operates the control grids of the mercury arc, and in four ten-thousandths of a second the rectifier output drops to zero. The voltage is then automatically re-applied at 4,000 volts and then raised gradually to 13,000 volts. The complete operation from internal flash-over to full power operation interrupts the broadcast program for only ten seconds. After three repeated automatic re-applications of the plate voltage, manual re-setting is required, for more serious trouble is then indicated.

To the American engineer now accustomed to completely shielded transmitters with interlocking protective devices,

Fig. 1. A view of "Radio Vienna." The transmitter is housed in the central building. The building on the right is the home of the technical staff.

the Telefunken style of construction comes as something of a shock. Of the seven r-f stages in the transmitter only the crystal and first buffer stage and the modulating amplifier are in shielded compartments; the remaining stages are spread out "in the open" in the transmitting room, with only a railing surrounding them.

### CRYSTAL TEMPERATURE CONTROL SYSTEM

The novel temperature controlled 580-kc quartz crystal is mounted inside an evacuated glass bulb, not unlike an ordinary vacuum tube, with a heater and a control resistor. The control resistor forms one leg of an unbalanced Wheatstone bridge fed from the 50-cycle ac mains. The output of the bridge is fed to a two-stage transformer-coupled amplifier, the output tube being biased to cut-off. The rectified ac through the heating resistor is controlled by the output tube's internal resistance which is a function of the crystal temperature. A 12-watt buffer amplifier follows the crystal oscillator. Included with these two r-f stages in the shielded compartment is a two-stage resistance-coupled modulating amplifier utilizing heater-type tubes operated on dc. See Fig. 2.

### R-F AMPLIFIER LINEUP

The third r-f stage—the first of the five "in the open"—is a lightly loaded 400-watt neutralized amplifier followed by an exactly similar stage, the fourth. The modulation takes place in the fifth r-f stage, which consists of two 2.5-kw air-cooled tubes in parallel, these tubes being suitable for grid-bias modulation. The speech frequency from the modulating amplifier as well as the r-f driver are applied to the grids of this stage.

The sixth stage consists of four 10-kw water-cooled tubes in parallel push-pull. The seventh stage uses a pair of 300-kw water-cooled tubes in push-pull. Inductively coupled to this stage is a low-pass filter section which feeds into a transmission line 525 feet long consisting of a 60-ohm impedance copper concentric conductor of approximately 4 inches external diameter.

### HARMONIC RADIATION REDUCTION

The low-pass coupling section as well as the copper screening imbedded in the walls and ceiling of the transmitter room keep harmonic radiation down to required limits. The transmitter has inductive coupling between all stages; the tank and coupling condensers are of the fixed mica type. The tuning inductances are split into two paralleled sections: one, a fixed section of slightly more than the required reactance for resonance and to which the following stage or load is coupled; the second, of approximately five times greater reactance is in the form of a variometer and paralleled with the fixed inductor. This method of construction gives a useful degree of flexibility in both the electrical and mechanical design.

### WATER-COOLED RESISTORS

The grid loading resistors of the last stage are water-cooled, as is the artificial antenna located in the transmitter room, which can be switched into the output circuit in place of the transmission line. The ceramic coils used in the water-cooling system are in a room below the transmitter room: ceramic insulators with two internal water ducts are inserted between the plates of the tubes and the copper water-pipes leading to the ceramic coils below. The length of these insulators is sufficient to reduce the r-f leakage to low values, though of course the full dc plate voltage is still present. The current-limiting resistors in series with the plates of the last tubes are air-cooled and serve to limit the short-circuit current in the event of a flash-over.

### HEATER-TYPE 300-KW TUBES!

The pair of Telefunken tubes in the output stage of the transmitter are by far the most interesting equipment in the whole transmitter, and are a remarkable engineering achievement. These vacuum tubes, each of 300-kw nominal rating, have *indirectly-heated cathodes*. Thus, the 14-volt, 1,700-ampere filament current obtained from the 50-cycle ac main through a transformer and automatic voltage regulator produces a very low level of ac modulation on the carrier, as all other stages have dc generators for filament supply.

Four insulating pillars permanently mounted on the plate of each tube adjacent to the seal, support the cathode and filament assembly, since, due to their great weight, the glass seal can support only the grid structure. The external conductors supplying filament current are of copper tubing, and cooling water is fed through them to the seal. Other characteristics of the tubes are: a plate potential of 12,000 volts, plate current of 25 amperes, bias under operating conditions of 300 volts; the mutual conductance of the tubes has the enormous value of 0.25 amperes/volt, the saturation current is 200 amperes.

Due to the large size (5.5 feet high) and weight of these tubes, two spares are permanently connected in the circuit and can be switched in operation at a moment's notice.

(*Continued on page* 20)

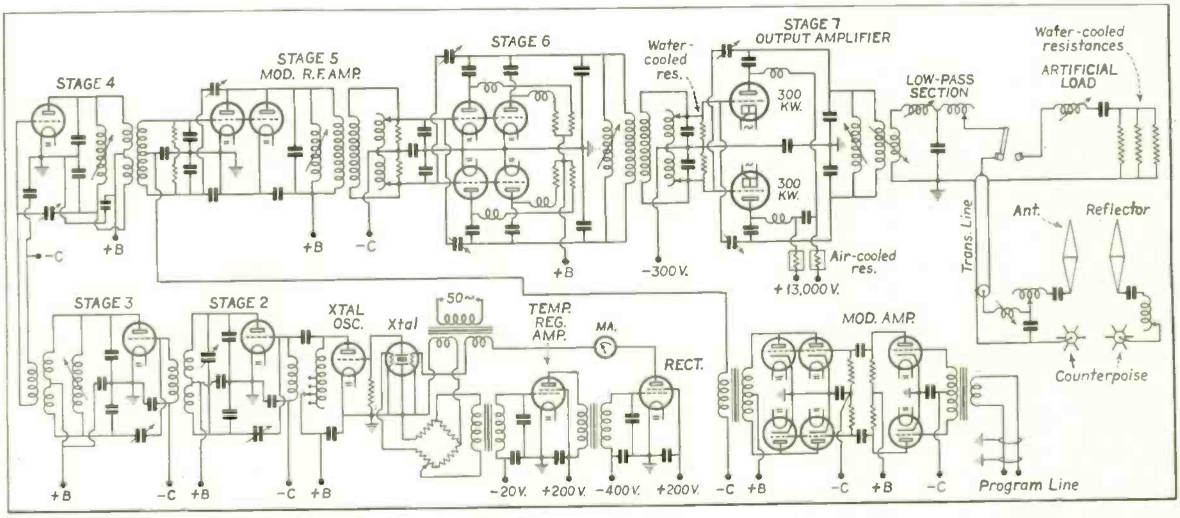



Fig. 2. Schematic diagram of the "Radio Vienna" transmitter. Note the heater-type power tubes, the water-cooled resistors, and the temperature-control system for the oscillator crystal.

# Developments in AIRCRAFT RADIO

***A description of the radio equipment used aboard Roscoe Turner's Boeing plane during the recent London to Melbourne air races, and preliminary data on a new aircraft "homing" instrument.***

By WILLIAM P. LEAR
President,
LEAR DEVELOPMENTS, INC.

Fig. 1. Front view of the 9-band transmitter which has a frequency range of 300 to 17,000 kc. There are eight crystal-controlled frequency bands and one self-controlled frequency band, tuning for the latter being controlled by the precision dial on the front panel. Note wave-changing control knob on top of the case.

AVIATION IS NO longer considered a specialized form of transportation and this changed status has in a large measure been the result of the advancement made in aviation radio communication.

The commercial air transport companies make extensive use of their radio equipment for radio range and beacon signals and for two-way radiophone communication, as well as weather reports, all of which has contributed to the present-day safety and certainty of schedule of the airlines.

### PATHS OF PROGRESS

The major contributions to the advancement of aviation in all its phases more often than not arise out of the precarious researches conducted by the aviation engineer and the test pilot alike. Since all developments must be tried out under practical flying conditions, and generally under conditions more severe than normal, the risks are great.

The recent London to Melbourne air races called for the precise preparations necessary under conditions of risk, and the development of special equipment to reduce risks to a minimum. The requirements included complete radio equipment for the purpose of communication, obtaining bearings and receiving broadcast weather reports.

Special radio equipment was designed and manufactured for installation aboard Roscoe Turner's Boeing racing transport plane and distinguished itself by establishing a new plane-to-ground, two-way communication record, when, in the air some two hundred miles from Melbourne, Turner and Pangborne carried on an extensive contact direct with the Mackay radio station at San Francisco, a distance of about 9,000 miles. This was accomplished with a 28-pound, 9-band aircraft transmitter and a special 5-band superheterodyne receiver.

An illustration of the complete radio equipment aboard the Turner plane is shown on the front cover of this issue.

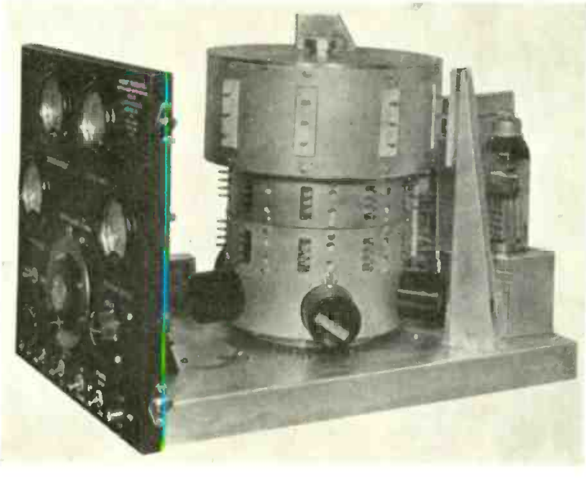
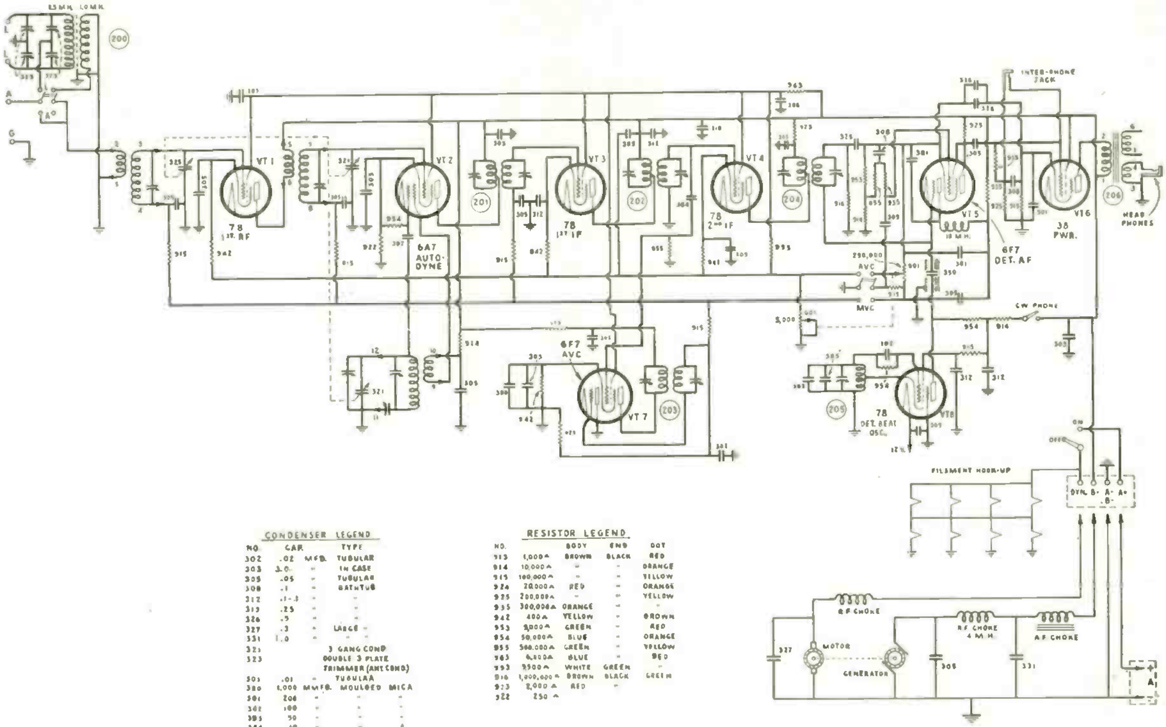


Fig. 2. Open view of the 9-band transmitter, showing the large rotating drum switch. The coil contact lugs can be seen, as well as the row of crystal holders along the bottom. The r-f power amplifier pentode can also be seen. Note the shielding around the lower portion of this tube.

### THE 9-BAND TRANSMITTER

A front view of the 9-band transmitter of the type used by Roscoe Turner in his London to Melbourne flight, is shown in Fig. 1, while an open view of the same unit is shown in Fig. 2.

The transmitter proper weighs 28 pounds and measures 12" x 12" x 14". It transmits either voice, cw or icw on carrier frequencies ranging from 300 to 17,000 kc. The weight of the two asso-



**CONDENSER LEGEND**

| NO. | CAP. | | TYPE | |
|---|---|---|---|---|
| 302 | .02 | MFD. | TUBULAR | |
| 303 | 3.0 | " | IN CASE | |
| 305 | .05 | " | TUBULAR | |
| 308 | .1 | " | BATHTUB | |
| 312 | .1-.1 | " | " | |
| 313 | .25 | " | " | |
| 326 | .5 | " | " | |
| 327 | .3 | " | LARGE " | |
| 331 | 1.0 | " | " " | |
| 321 | | | 3 GANG COND | |
| 323 | | | DOUBLE 3 PLATE TRIMMER (ANT COND) | |
| 301 | .01 | " | TUBULAR | |
| 380 | 1,000 | MMFD. | MOULDED | MICA |
| 381 | 200 | " | " | " |
| 382 | 100 | " | " | " |
| 383 | 50 | " | " | " |
| 384 | 10 | " | " | " |
| 385 | 15 | " | " | " |

**RESISTOR LEGEND**

| NO. | | BODY | END | DOT |
|---|---|---|---|---|
| 913 | 1,000Ω | BROWN | BLACK | RED |
| 914 | 10,000Ω | " | " | ORANGE |
| 915 | 100,000Ω | " | " | YELLOW |
| 924 | 20,000Ω | RED | " | ORANGE |
| 925 | 200,000Ω | " | " | YELLOW |
| 935 | 300,000Ω | ORANGE | " | " |
| 942 | 400Ω | YELLOW | " | BROWN |
| 953 | 5,000Ω | GREEN | " | RED |
| 954 | 50,000Ω | BLUE | " | ORANGE |
| 955 | 500,000Ω | GREEN | " | YELLOW |
| 963 | 6,000Ω | BLUE | " | RED |
| 993 | 9500Ω | WHITE | GREEN | " |
| 916 | 1,000,000Ω | BROWN | BLACK | GREEN |
| 923 | 2,000Ω | RED | " | |
| 922 | 250Ω | | | |

Fig. 5. Circuit diagram of the five-band superheterodyne receiver.

ciated dynamotors is also 28 pounds, making a total of but 56 pounds for the complete transmitter installation.

The transmitter develops over 160 watts of cw carrier into a trailing wire antenna and 35 watts when used for icw, or phone with 100 percent modulation.

### THE BAND CHANGER

The outstanding feature of this transmitter, in addition to the high power output with a small, light-weight unit, is the method provided for quickly changing from one transmitting frequency to another. The photo of Fig. 2 clearly illustrates this mechanism. It will be seen that a composite drum or "turret" rotates about a central shaft. This drum contains all of the various tuned circuits, each circuit being complete within its own shielded compartment. As the large knob at the top is turned so as to cause the drum to rotate, contact fingers engage, one at a time, just the correct inductance and capacity for each circuit and frequency band.

In addition to rapidly switching the various tuned circuits, this same drum is used to switch the various crystals and their heaters, which will be noted in the lower drum sector. Thus, by the simple procedure of moving the shaft knob 40 degrees, the frequency-controlling crystal together with all of the oscillator, tank and output circuits are changed and placed in circuit for immediate operation without requiring a preliminary adjustment of circuit values.

The transmitter in the Turner-Boeing plane employed eight crystal-controlled frequencies and a ninth band using a self-controlled oscillator which is manually tuneable from 300 to 500 kc. Five crystals are used, the particular frequencies in this case being 3105 kc, 4140 kc, 5520 kc, 6210 kc and 8280 kc, all being the fundamental frequencies of the crystals used. The three remaining frequencies, also crystal controlled, are the second harmonics of the 5520, 6210 and 8280 crystals, thus providing three extra bands at 11,040 kc, 12,420 kc and 16,560 kc—a total of eight crystal-controlled channels.

### TRANSMITTER CONTROLS

Aside from the frequency band control just described, the transmitter also has switches on the front panel which provide high or low power, for changing from cw to icw or voice, and for turning on the entire equipment and the crystal heaters. The microphone plugs into the panel and a switch button on the hand microphone operates a relay within the chassis which auto-

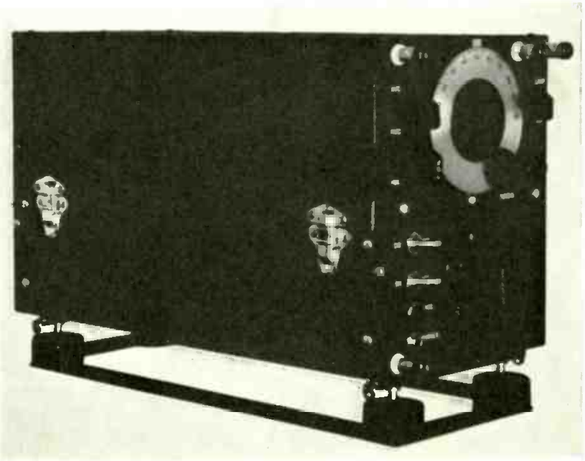


Fig. 4. A view of the combination compass and communications receiver. This is a superheterodyne with a tuning range of 200 to 16,000 kc. There are five bands. The receiver dynamotor obtains its operating supply from the 12-volt storage battery on the plane.

matically applies the plate voltages and transfers the antenna from "receive" to "send" only when the pilot is ready to speak.

The dynamotor unit obtains its power from the plane's 12-volt storage battery and provides 1,500 volts to the plate of the power tube and 400 volts to the screen.

### THE TRANSMITTER CIRCUIT

The schematic diagram of the transmitter is shown in Fig. 3. A type 47 pentode tube is used as the oscillator and is so arranged in the circuit that the control grid may be connected to any one of the five temperature-controlled crystals, or to a manually-tuned circuit when the tube is used as a self-controlled oscillator. Similarly, the plate circuit is so arranged that any one of five pre-tuned tanks may be thrown in with the proper crystal, or again connected to the manually-tuned circuit, in which case the 175-mmfd variable condenser is shunted across a grid coil in inductive relation to the plate coil. These are all functions of the drum-type band changer previously described and it is evident from the diagram that individual output coils are selected in the same manner.

The type 47 oscillator is coupled directly to the r-f power amplifier tube through a capacity of 100 mmfd. The r-f amplifier is a Raytheon RK-20 power pentode. This tube requires very little excitation—in the vicinity of 1 or 2 watts—and provides about 120 to 160 watts cw and 35 watts on phone or icw. Because of its low excitation requirements and its inherent characteristics, it places only a small unvarying

Fig. 6. The aircraft beacon receiver which tunes from 195 to 415 kc, through the airway beacon channels. Upper part of receiver shows a special loop tuning unit which does not ordinarily accompany this set.

load on the oscillator tube, thus assurring frequency stability. The tube is particularly adaptable to suppressor-grid modulation and when used in this way requires only about 3 to 5 watts of audio excitation for 100 percent modulation. It was therefore possible to use but a single tube in the speech amplifier. This is a type 2A5 heater-type pentode the output of which is fed to the suppressor grid of the RK-20 through a suitable transformer.

The small insert in the diagram shows the 0-50 ma milliammeter and switch which is used to check the current in the grid and screen circuits of the RK-20 power pentode for proper operation.

A later, screen-grid, power pentode, developed by RCA-Radiotron, shows the possibility of outputs of 250 to 400 watts with the same ease of excitation and modulation.

### THE AIRCRAFT RECEIVER

There are two receivers in Turner's plane. The larger receiver is a 5-band superheterodyne, combined compass and communication receiver which tunes from 200 kc to 15,000 kc. Frequency bands are selected by a drum arrangement smaller, but similar to the transmitter mechanism. A front view of the receiver is shown in Fig. 4. The front panel contains the main tuning dial, a switch to cut in and out automatic volume control, the band selector knob, an "on-off" toggle switch, another toggle switch to throw in a beat oscillator for cw reception, a switch to change from antenna to loop, and a jack for headphones, as well as one for the intercommunication microphone. The receiver is entirely enclosed in a metal case which provides complete shielding, and is mounted on a frame with shock absorbers.

When the receiver is used for compass work with a loop antenna, a special shielded transformer couples the antenna to the input circuit to provide an accurate nul point.

### THE RECEIVER CIRCUIT

The circuit diagram of the receiver is shown in Fig. 5. There is an r-f preselector stage feeding a 6A7 mixer-oscillator, two stages of intermediate-frequency amplification using type 78 tubes, and a 6F7 second detector and a-f tube feeding a type 38 power pentode. A second 6F7 tube with pentode control grid capacity-coupled to the grid

(*Continued on page 20*)

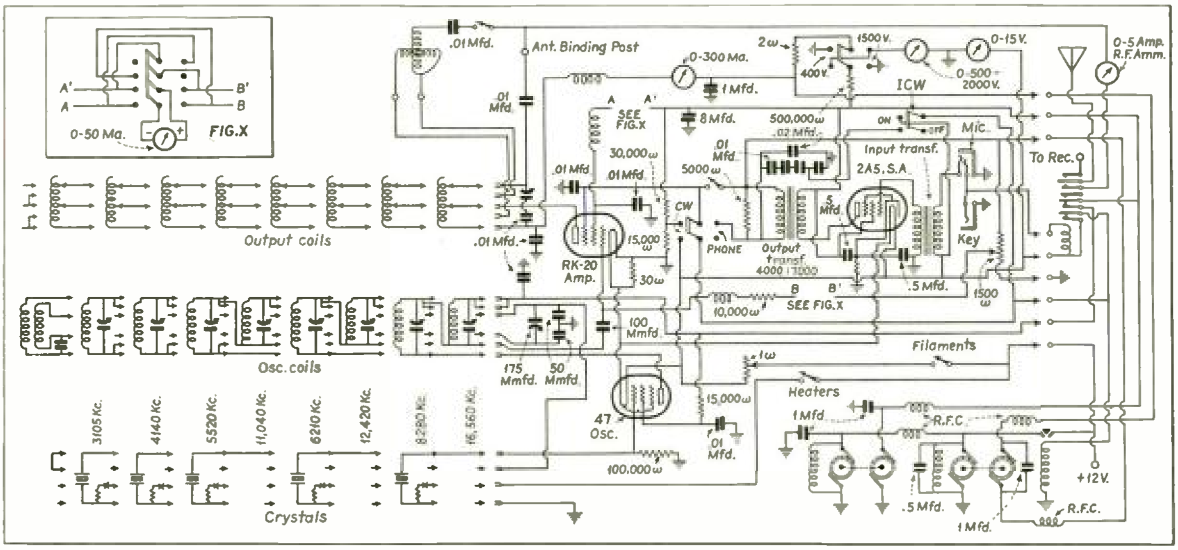



Fig. 3. Complete circuit diagram of the 5-band transmitter. Note that there are three tubes, a 47 as oscillator, an RK-20 as r-f amplifier and a 2A5 as modulator. Suppressor-grid modulation is employed.

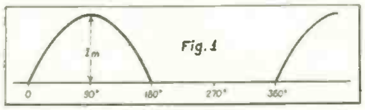
# Class B Radio-

● ***Fundamental pointers relative to the characteristics of Class B amplifiers for transmitters and notes on their proper design. The article includes a typical design example based on simple mathematics.***

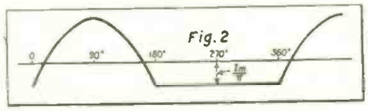
A LARGE PROPORTION OF RADIO transmitters use in some part of their circuit a Class B amplifier. A Class B amplifier is of considerable commercial importance because the conversion efficiency is the highest that can be obtained with the output power remaining proportional to the square of the input voltage or, in other words, the alternating-current output in amperes is a linear function of the alternating grid-voltage excitation. A Class B amplifier is one which is so biased that the plate current is nearly zero without grid excitation.

## CIRCUIT CHARACTERISTICS

With a sine wave of grid excitation the plate current will be of the form of Fig. 1, while the alternating current into the load will be of the form shown in Fig. 2.




Class B amplifier plate current with sine-wave grid excitation.




Resultant alternating current into the load.

Fig. 3 is an oscillogram of a modified Class B amplifier operated at 60 cycles in order that a standard oscillograph could be used. Curve (a) is the grid excitation, (b) the alternating current into load (which was a pure resistance), and (c) the dc plate current supplied by the plate supply.

It can be seen that the current supplied to the load by a Class B amplifier is far from a sine wave, containing as it does a large number of harmonics. If the alternating-current output is analyzed in terms of *Idc* (which is easily measured by one of several methods), it is found to be equal to the following:

$$i = 1.57\ \text{idc}\cos\omega t + .85\ \text{Idc}\cos 2\omega t + .23\ \text{Idc}\cos 3\omega t + .18\ \text{Idc}\cos 4\omega t \quad \ldots\ldots\ldots (1)$$

where *Idc* is the direct plate current of the tube and is measured by means of a direct-current ammeter.

If this complex wave of current represented by equation (1) is applied to a tank circuit of parallel capacitance and inductance, it would seem that the resultant tank voltage would contain a large number of harmonic voltages. However, such is not the case as will be shown. At resonance the tank circuit offers a pure resistance load to the tube the value of which is equal to:

$$\frac{\omega^2 L^2}{r} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

where *r* is the ohmic resistance in the tank circuit and *L* is the inductance. At frequencies above resonance frequency the circuit offers a capacity load to the tank circuit whose value is approximately equal to:

$$Z = \frac{n\, X_c\, X_L}{n^2 X_L + X_c} \quad \ldots\ldots\ldots (3)$$

where $X_c$ *and* $X_L$ are the reactances at resonance frequency and *n* is the harmonic of the fundamental frequency.

## CALCULATION OF TANK VOLTAGE

The voltage developed across a tank circuit by this complex wave can easily be calculated by the following approximate method: Let us consider a tank circuit which has a reactance of 160 ohms and enough resistance inserted in the inductive branch to give a resistance of 4000 ohms at resonance frequency. The reactance at 2nd, 3rd and 4th harmonic is approximately 62, 48 and 38 ohms respectively. The voltage drop across the tank circuit will be the sum of the voltage drops due to the fundamental and all harmonics and is equal to the following:

$$Et = \Sigma\ \text{Idc}\ KZ \cos(n\,\omega t - 90) \quad \ldots\ldots\ldots (4)$$

where *K* is the coefficient of each frequency given by equation (1), *Z* is the impedance of the tank circuit to the corresponding frequency and is given by equation (3) and *n* is the harmonic of the fundamental under consideration. At the fundamental frequency *Z* is a pure resistance equal to that value given by equation (2), and 90 is not used in the cosine terms.

At the fundamental frequency the voltage will be:

$$1.57 \times .317 \times 4000 \times \cos\omega t = 2000 \cos\omega t \text{ volts.}$$

For the second harmonic it will be:

$$.85 \times .318 \times 62 \cos(2\omega t - 90^\circ) \text{ volts} = 16.7 \cos(2\omega t - 90^\circ) \text{ volts.}$$

The third harmonic voltage will be:

$$.23 \times .318 \times 48 \cos(3\omega t - 90^\circ) \text{ volts} = 3.54 \cos(3\omega t - 90^\circ) \text{ volts.}$$

While the fourth harmonic voltage will be:

$$.18 \times .318 \times 38 \cos(4\omega t - 90^\circ) \text{ volts} = 2.2 \cos(4\omega t - 90^\circ) \text{ volts.}$$

The 90° appears in the above expression since at the

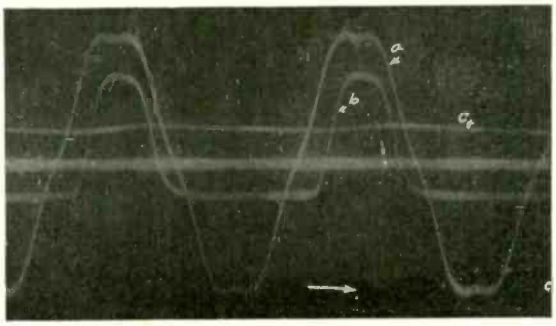


Fig. 3. Oscillogram of a modified Class B amplifier operated at 60 cycles in order that a standard oscillograph could be used.

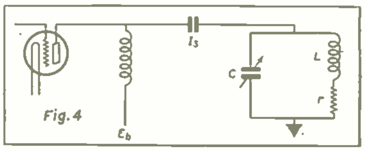
# FREQUENCY AMPLIFIERS

By CLYDE L. FARRAR

Associate Professor of Electrical Engineering

UNIVERSITY OF OKLAHOMA

fundamental frequency the circuit acts as a resistance, while at the harmonic frequencies it acts as a capacitance. It can thus be seen that the harmonics are small in proportion to the fundamental voltage, and it is not im-




Class B amplifier in which the load is a tuned circuit.

possible to reduce them to values which cause no interference from existing high-frequency stations.

These harmonics can be reduced by the use of a high-C circuit, and in general sufficient capacitance should be used so that the tank current should be 25-30 times the fundamental frequency plate current.

## FUNDAMENTAL POWER CONSIDERATIONS

The rest of the discussion will be concerned with the fundamental power only.

Fig. 4 shows a typical Class B amplifier in which the load is a tuned circuit and at resonance the resistance is given by the following:

$$R = \frac{\omega^2 L^2}{r} = \frac{L}{rc} \quad \text{where } \omega = 2\pi f \quad \ldots\ldots\ldots (2)$$

$L$ is the inductance of the tank circuit, $C$ the capacitance of the tank circuit, and $r$ the ohmic resistance. If the radio-frequency power is to be completely modulated $I_1 \omega L$ should be 40% of $Eb$. The reason for this is that the output of a linear power amplifier is limited to one-fourth the peak undistorted output if 100% modulation is to be obtained. This is true since at complete modulation the tank voltage and current both double and hence the power increases four times. The plate voltage decreases as the load current increases due to the voltage drop in the load resistance

$$Ep = Eb - i\,R = Eb - I'\,X_L \ldots\ldots\ldots (5)$$

where $i$ is the fundamental component of the plate current, and $I'$ the tank current and $X_L$ the tank inductive reactance. The output of a tube is linear until the minimum plate voltage is approximately 20% of the maximum plate voltage as shown by Fig. 5. This large reduction of plate voltage should take place only during full modulation (100%), while during periods of no modulation the minimum plate voltage must be held to 60% normal plate voltage so that the load voltage can be doubled without the minimum plate voltage being less than 20% full plate voltage. This is illustrated by Fig. 5, which is a typical output characteristic curve of a Class B amplifier. As the grid excitation is increased, the minimum plate voltage decreases, the ac current $I'$ increases and the efficiency increases linearly up to a grid excitation corresponding to a minimum plate voltage of 20% $Eb$. This then represents the upper limit to which the grid excitation should be carried. e'g then represents the proper grid excitation for 100% modulation and e"g represents the maximum grid excitation. And, for 100% modulation e"g = 2 e'g.

## OBTAINING GOOD WAVEFORM

To obtain a good waveform, since the alternating current supplied to the tank circuit contains a large number of harmonics, the circulating tank current should be made equal to about 20-30 times the fundamental component of plate current. The efficiency of a Class B amplifier is given by the following equation

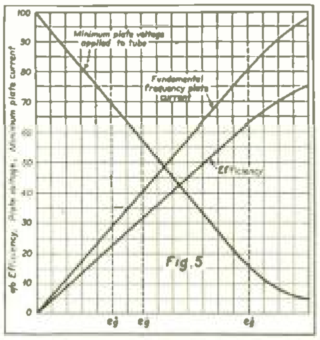
$$\text{eff.} = 78.5 \left(1 - \frac{e\ \text{min}}{Eb}\right) \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

For maximum load (100% modulation) the efficiency is equal to 78.5 (1 — .2) = 63%, while the efficiency without modulation is 78.5 (1 — .6) = 31.5%.

When a Class B amplifier is amplifying a modulated signal, the average dc input power remains constant and the efficiency changes for the increased output required for a modulated signal. Since the dc power change can be noted from the plate current change, a good check, in so far as correct operation is concerned, can be made by noting the change in the plate current. The amplifier plate current should not change by a large amount from 0 to 100% modulation.

## TYPICAL DESIGN EXAMPLE

In order to make the above relation clear, a typical Class B amplifier will be designed. After the power output, plate voltage and degree modulation have been selected, the procedure for the design may be carried forward as follows: Consider the design of a 500-watt




The output of a tube is linear until the minimum plate voltage is about 20 percent of the maximum plate voltage, as indicated.

Class B linear amplifier, using a plate voltage of 5000 volts and 100% modulation. The plate current can be found by dividing the power by efficiency and voltage;

$$Ip = \frac{500 \times 1000}{.315 \times 5000} = 318 \text{ ma.}$$

The peak value of the fundamental component of tank current will be 318 ma. × 1.57 ma. Assume the peak tank current as 25 times the peak current of fundamental frequency. The peak tank current should then be equal to 500 × 25 = 12500 ma, or 12.5 amps. For 100% modulation this current must increase to twice its normal value or 25 amperes. Now this 25 amperes flowing through the tank inductance should develop a voltage not to exceed 80% of the plate voltage, or 4000 volts. Hence:

$$X_L = \frac{4000}{25} = 160 \text{ ohms.}$$

Now the inductance of the tank circuit may be computed from the well-known expression $X_L = 2\pi fL$, where $f$ is the frequency of the carrier. Also $X_c$ is nearly equal to $X_L$; hence the tuning condenser can be found by means of the expression

$$c = \frac{1}{2\pi f X_c} = \frac{1}{2\pi f X_L}$$

Now the impedance of the tank circuit at resonance is a pure resistance equal to $R$, and given by the expression

$$R = \frac{L}{rc}$$

where $L$ is equal to the tank inductance, $c$ the tank capacitance, and $r$ the tank resistance, or the reflected resistance of the antenna if the output stage, and the inserted resistance if an intermediate linear amplifier.

$R$ may be calculated by the following:

$$R = \frac{Z\,P}{(I_1)^2} = \frac{500 \times 2}{(I_1)^2} = \frac{1000}{(.5)^2} = 4000 \text{ or } R = \frac{E'}{I}$$

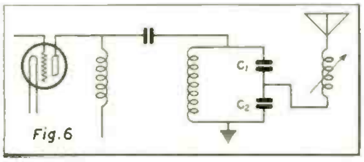
where $E'$ is the peak ac voltage at maximum modulation and $I$ is the peak fundamental current at maximum modulation and in this case would be

$$\frac{4000}{1} = 4000 \text{ ohms.}$$

This is commonly called the tank-circuit impedance. Now if an antenna is to be coupled into the tank circuit, some special coupling system is generally required, since in general the antenna resistance is less than 100 ohms and the tank circuit is several thousand ohms.

## CAPACITY COUPLING SYSTEM

A very simple and effective coupling system is a so-called capacity coupling and is illustrated in Fig. 6.




A simple and effective capacity coupling system between tank and radiator.

In this case let $C$ equal the tuning capacity across the tank inductance. It is numerically equal to the following:

$$\frac{C_1 C_2}{C_1 + C_2} = C \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

The value of the coupling condenser is found as follows:

$$\frac{C_2}{C} = \sqrt{\frac{R}{R\,ant.}} \quad \ldots\ldots\ldots\ldots\ldots (8)$$

where $R$ is tank-circuit impedance at resonance and $R$ *ant.* is the antenna resistance. Consider the above tank circuit to be operated at 1000 kc. Then C = .001 mfd. Assume an antenna resistance of 40 ohms. Then

$$C_2 = .001\sqrt{\frac{4000}{40}} = 0.1 \text{ mfd.}$$

C would then be equal to .0011 mfd. Now the antenna inductance is used to tune the antenna circuit. When the circuit is properly tuned the tank-inductance current should always exceed that of the tank-capacity circuit, the relation being

$$\frac{I_L}{I_c} = \frac{X_L}{\sqrt{X_L^2 + r^2}} \quad \ldots\ldots (9)$$

It should be noted that the efficiency of a Class B amplifier on the above assumption is 31.5% somewhat less than allowed by the late Federal Radio Commission. However, their efficiency allows somewhat higher distortion than that which will result from the above.

If the station is to operate on reduced power the above calculations should be made on the highest power; then at reduced power the efficiency will be much less than 31.5%. The operating point will then be at $e^{\circ}g$ of Fig. 5. For example, if the transmitter was to be operated at 1000 watts the tank circuit should be 2000 ohms, the efficiency at 1000 watts no modulation would be 31.5%, while at 500 watts with no modulation the efficiency would be approximately 22%; hence the power should be measured by the antenna method under this condition. If the transmitter is adjusted to an efficiency of 33% at 500 watts, severe distortion will take place. It is noted that the power output of a Class B amplifier is a function of the tank-circuit resistance, the resistance being found by equation (2). This tank-circuit resistance can be changed either by varying $C$ and $L$ or by varying $R$, and in case the antenna is inductively coupled to the tank circuits this $R$ at resonance is equal to

$$r' = r + \left(\frac{\omega M}{Z_2}\right) r_2$$

where $\omega M$ is the mutual reactance which can be varied and $r_2$ and $Z_2$ are the antenna resistance and impedance including the tuning units. And within limits either $L$ and $C$ or $R$ may be varied; however, $L$ and $C$ should be varied until the tank current is equal to 20-30 times the fundamental frequency plate current, and the final adjustment be made by varying the coupling. This also applies to the capacity coupling of Fig. 6.

## SUMMARY OF DESIGN

The following table is a summary of the design for a 500-watt Class B amplifier outlined above:

*Plate current* = 318 *ma.*
*Peak fundamental plate current* = 500 *ma.*
*Effective fundamental current* = .353 *ma.*
*Peak tank current* = 12.5 *amperes*
*Effective tank current* = 8.85 *amperes*
*Peak tank voltage* = 2000 *volts*
*Effective tank voltage* = 1414 *volts*
*Minimum plate voltage* = 3000 *volts*
*Efficiency* = 31.5%
*Total tube capacity* = 2000 *volts.*

# A Portable All-Wave SIGNAL RECORDER

By S. R. WINTERS

A CONTINUOUS RECORDER of radio field intensities has been developed at the Radio Laboratory of the Bureau of Standards by K. A. Norton and S. E. Reymer. It is a self-operating instrument for measuring the strength of amateur, short-wave and broadcasting stations. It will make continuous records for periods of at least twenty-four hours without attention from the operator. This device has several outstanding characteristics, among them being:

(a) It will operate over a wide range of frequencies, from 540 to 20,000 kilocycles per second; (b) it is adapted for use with the commercial operating supply; that is, the regular house lighting circuit; (c) it will measure anything from a small 2-watt amateur station to the 500,000-watt super station of WLW, Cincinnati; (d) the logarithmic nature of its scale insures a uniform percentage accuracy for all portions of the range measured, a feature of great importance in measuring intensities because of the fact that the daily variation of radio field intensities may be as much as 100,000 to 1 for a distant station; (e) its indications are not affected by slight variations in the power supply and temperature; (f) its cost is low, as it is constructed of parts already on the market for other uses; (g) it is portable and transportable.

## MANNER OF RECORDING

Recording with this instrument is done as follows: A potentiometer recorder, such as is employed in recording temperature and humidity, is used to record the plate resistance of a vacuum tube adapted as the first intermediate-frequency amplifier in a superheterodyne receiving set. A well shielded broadcast receiving set gives an automatic volume control, and to cover the frequency band from 1,500 to 20,000 kilocycles, a high-frequency converter was hooked up with the set.

Fig. 1 shows the circuit arrangement of the potentiometer recorder, from which it may be seen that it is a Wheatstone bridge which permits the operation of the recorder in such a way as to automatically adjust the slide wire "S" (the maximum resistance of which is 50 ohms) for zero current in the galvanometer "G." The 250-volt direct current comes from the power supply of the receiving set, and $R_s$ is sufficiently large (about 250,000 ohms) to make the voltage across the slide wire in the recorder about 50 mv. The plate resistance of the vacuum tube used for measurement is indicated by $R_p$. The intensity range may be made to vary by $R_1$ and $R_2$, which resistors are variable between 0 to 50 and 0 to 175 ohms, respectively. It has been found by experiment that the approximate relation between $R_p$ and the radio-frequency voltage E may be expressed by:

$$R_p \simeq C \log E \qquad (1)$$

## ELIMINATION OF VARIATIONS IN RECORDED VALUES

Experiments indicate that $R_p$ is very sensitive to slight variations in the voltage of the power supply, and that a 5 percent change will cause an apparent 100 percent difference in the recorded value of E. To eliminate such variations, the plate resistance of a tube similar to that used for $R_p$ was substituted for $R_s$ at the suggestion of L. V. Berkner, who was a radio-man on one of Admiral Byrd's former Antarctic

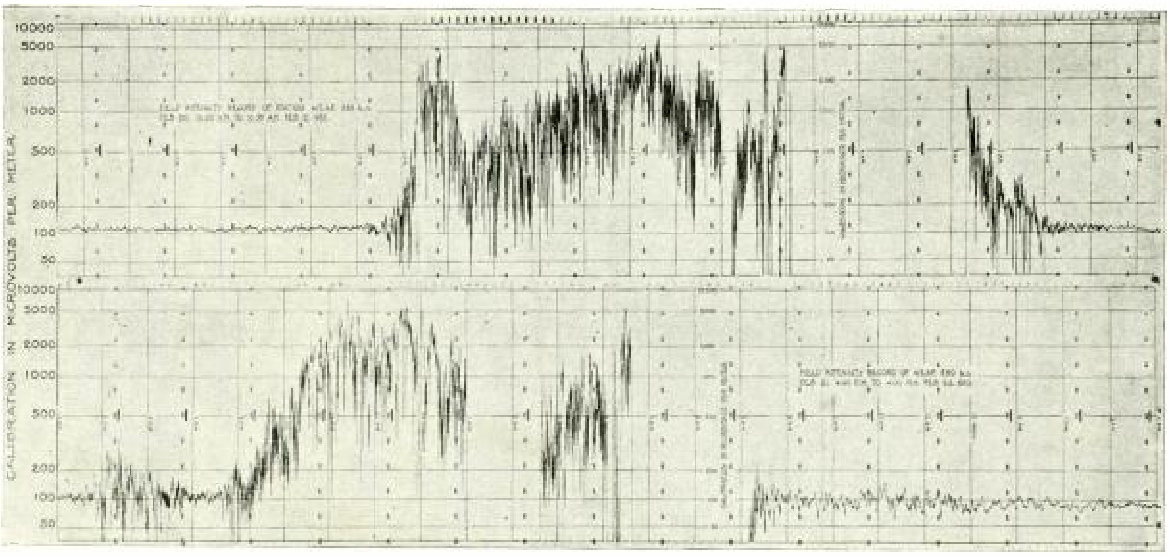



Fig. 3. Field-intensity records of WEAF, New York: frequency 660 kc; power, 50 kw; distance 353 km.

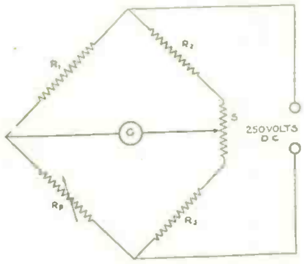



Fig. 1. Circuit arrangement of potentiometer recorder.

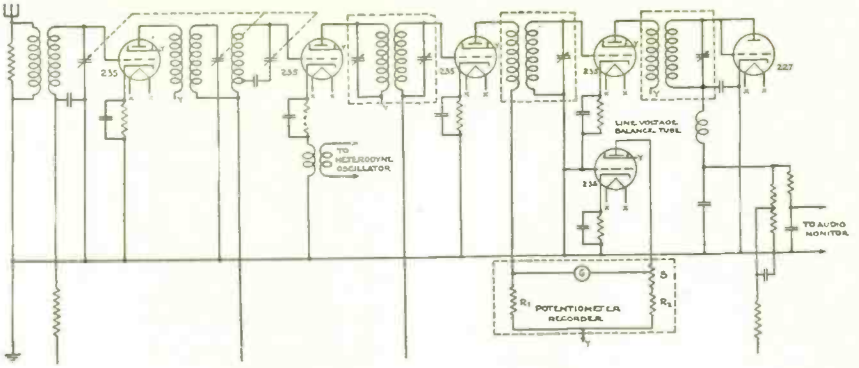



Fig. 2. Circuit of the combined receiver and recorder.

expeditions and now associated with the Radio Laboratory of the Bureau of Standards. The power supply voltage variations were thereby effectively excluded, as the ratio $R_p/R_s$ is independent of line voltage. To obtain this independence of line voltage for this ratio of plate resistances it is not necessary that the tubes exactly match. Five percent variations in the supply voltage did not materially change the sensitivity of the receiving set, and the function as shown in (1) is independent of such variations. Fig. 2 shows the final circuit arrangement of the receiving set and recorder.

### CALIBRATION OF RECORDER

To calibrate the recorder, the antenna is removed, and a local voltage from a standard radio-frequency generator is applied across the antenna and ground terminals of the receiving set. In the case of higher frequencies a converter is employed. Now and then a measurement is taken of the ratio of the voltage across the input terminals as brought in by the standard generator and that made by a known field intensity acting on the antenna; the exact value of the field strength is measured by a field-intensity set. For an ordinary calibration of the recorder the standard radio-frequency generator need only be accurate for relative values, since the absolute value of the field intensity is occasionally checked. The designers of this instrument offer one precaution in the use of this method, and that is to be sure that the internal impedance of the standard generator is small compared to the input impedance of the receiving set. Otherwise, to retain correct relative values of the local voltage it will be necessary to make corrections for the resultant shunting impedance.

Experiments showed it necessary to increase the range for the higher frequencies for two reasons: First, because the intensities on higher frequencies vary over a wide range, and, second, the fading is so rapid that the recorder (changing its balance point only once every three seconds) can not follow the variations when the intensity range is decreased. The maximum amount of balancing each three seconds is approximately 8 percent of the total scale value. While the instrument usually records at the rate of 2 inches of record paper per hour, it may be operated at rates of from 1 to 6 inches per hour. To resolve the rapid fading characteristic of frequencies above 2,000 kc it is necessary to run the recorder at a rate of 6 inches per hour.

### OSCILLATOR DRIFT COMPENSATION

A temperature change of ± 3° C. has a slight effect on the recording ac-

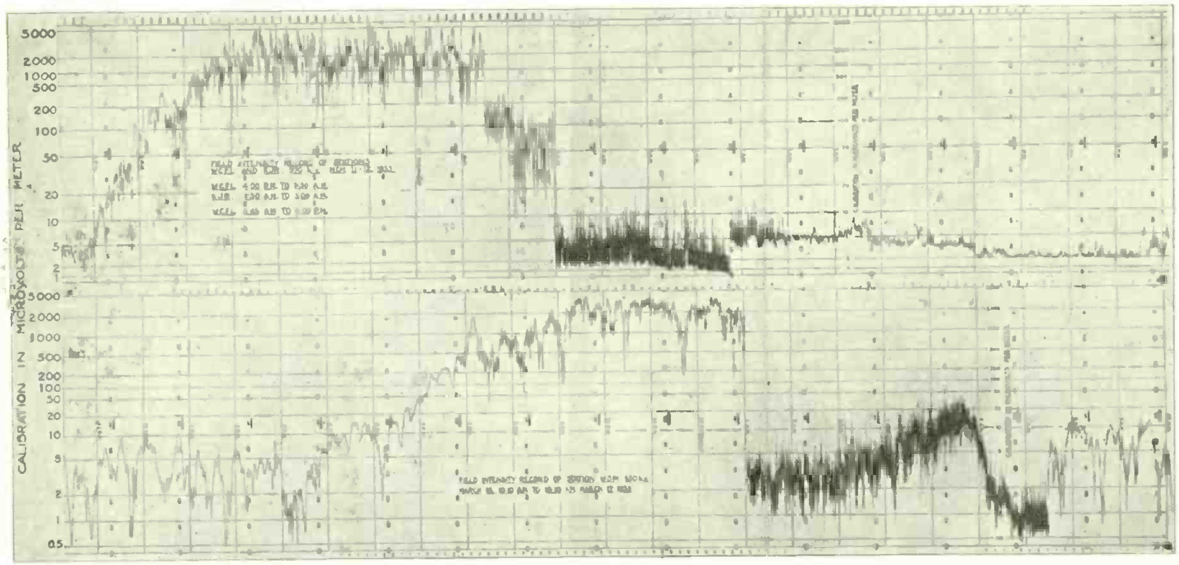
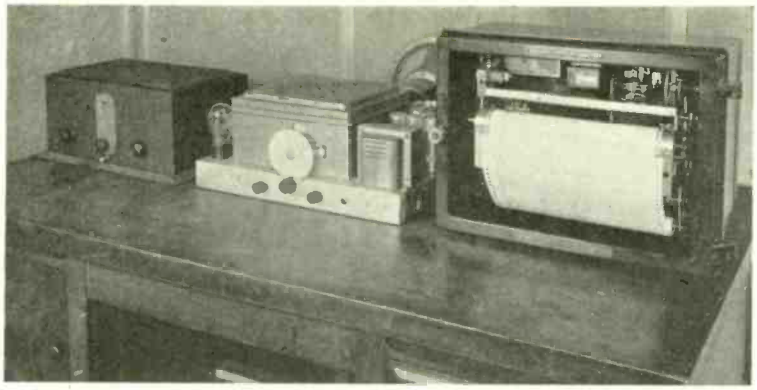



Fig. 4. Field-intensity records of WCFL, Chicago: frequency, 970 kc; power 1.5 kw; distance, 988 km. Of KJR, Seattle: frequency, 970 kc; power 5 kw; distance, 3,750 km. Of WSM, Nashville: frequency, 650 kc; power, 50 kw; distance, 928 km.



The all-wave signal recorder. From left to right are: the short-wave converter, the broadcast-wave superheterodyne receiver, and the potentiometer recorder.

curacy, particularly on the higher broadcast frequencies (1,100 to 1,500 kc), chiefly due to a drift of the heterodyne oscillator. To hold this effect as low as possible, the intermediate-frequency band-pass may be broadened, provided the overall selectivity of the receiving set will permit this for the particular existing conditions of interference on nearby frequencies. A temperature change of 6° C. does not appreciably affect the recording on the lower broadcast frequencies (540 to 1,100 kc). A frequency of 575 kc for the intermediate frequency for the converter will eliminate effects of temperature variations in the higher frequencies. Temperature fluctuation in the building in which the apparatus is housed is eliminated by a thermostat control which is set at about ± 3° C.

### EXAMPLES OF RECORDING

Examples of the records obtained from experiments with this instrument are shown by Figs. 3 and 4. The field-intensity scales are indicated by the numbers at the left and by the horizontal lines. Time is given in eastern standard time for hourly intervals along the middle of the records. It will be noted that the apparatus used recorded the ground wave as a substantially straight line, indicating independence from line voltage and temperature fluctuations. As the scale of the recorder is approximately logarithmic, an equal percentage accuracy for all parts of the range may be obtained. Over a period of several months no field intensities greater than 10 microvolts per meter have been received for station WEAF located on Long Island. At 7:30 p.m. there is a decrease in the field intensity following the rise shown. The dip appears on most of the records of this station, which extend over a period of about 6 months. Severe fading at night is characteristic of this particular distance and frequency.

### SIMULTANEOUS RECORDINGS

In Fig. 4 the upper record is of WCFL, Chicago, Illinois, and KJR, Seattle, Washington, which operate simultaneously on a frequency of 970 kilocycles. The record of KJR may only be seen when WCFL is not broadcasting. The daytime fields are from another station on an adjacent wavelength, and appear in the record because the receiving set is not selective enough to discard them. Static and other air disturbances are the source of the incoming intensities indicated between 3:00 and 6:45 in the morning.

The lower record on Fig. 4 is of WSM, Nashville, Tennessee, on a wavelength of 650 kilocycles. The incoming measured signal strength is due to the skywave both day and night, the fluctuations being in a ratio of 20 to 1 at mid-day. For this wavelength and distance, 930 kilometers, fading is less pronounced than for less distances.

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## NEW FACSIMILE RECORDER

A NEW RADIO FACSIMILE system which reproduces entire messages, maps and pictures directly on ordinary paper at the rate of a full letter-sized sheet every eight minutes, was described by Charles J. Young, research engineer of the RCA Victor Company, to members of the Institute of Radio Engineers, who met recently in Houston Hall of the Moore School of Electrical Engineering.

### FIELDS OF APPLICATION

While Mr. Young emphasized that it is premature to attempt to evaluate all of the practical uses to which the new development might be put, he suggested that such a simplified system could be used to flash messages in their entirety, from city to city, exactly as written by the sender, to supplant the present method of sending such messages, letter by letter, in the comparatively laborious Morse code. He pointed out that the new facsimile system should prove useful in police and crime detection work. Fingerprints, identifying photographs and other useful information could be exchanged by police departments to aid in the apprehension of criminals. He also described a series of successful experiments conducted between the shore and ships at sea, in which complete weather maps were prepared by observers and sent to the vessels at frequent intervals to aid navigation.

C. J. Young with simplified facsimile recorder.

### HOW IT WORKS

The recorder system developed by Mr. Young in the RCA Victor laboratories dispenses with the cumbersome processing, or photo developing required by other facsimile systems, by utilizing ordinary carbon paper to print directly on ordinary white paper. Continuously feeding rolls of both the carbon and the paper are led past a metal cylinder, on which a single spiral of wire projects slightly above the surface. The fluctuations in the intensity of the incoming signals press the paper and carbon together against this spiral to make marks corresponding to the light and shade of the original at the transmitter. Since the receiver and the transmitter are synchronized, an exact reproduction results. The facsimile recorder described by Mr. Young traverses a standard width letter size page, measuring 8½ by 11 inches, at the rate of 1.2 inches per minute. Thus, a full-sized page filled with single spaced typing is completed in eight minutes, or at the rate of 100 words per minute.

# APPLICATION OF A PRIME AMPLIFICATION TO A 100-WATT BROADCAST TRANSMITTER

By I. A. MITCHELL
Chief Engineer
United Transformer Corp.

THE FEDERAL COMMUNICATIONS Commission has effected one radical change in radio law since its inception. Radio law limits the number of broadcasting stations in any state as related to the total number of stations in the United States in the same ratio as the state's population to the nation's population. However, this has been modified by the FCC so that it does not apply to the low-power stations of 100 watts and less. The importance of this modification is well attested to by the large number of license applications already received by the FCC. The 100-watt transmitter is ideal for small area coverage. It can readily be located in a commercial area where the largest possible number of listeners can be included.

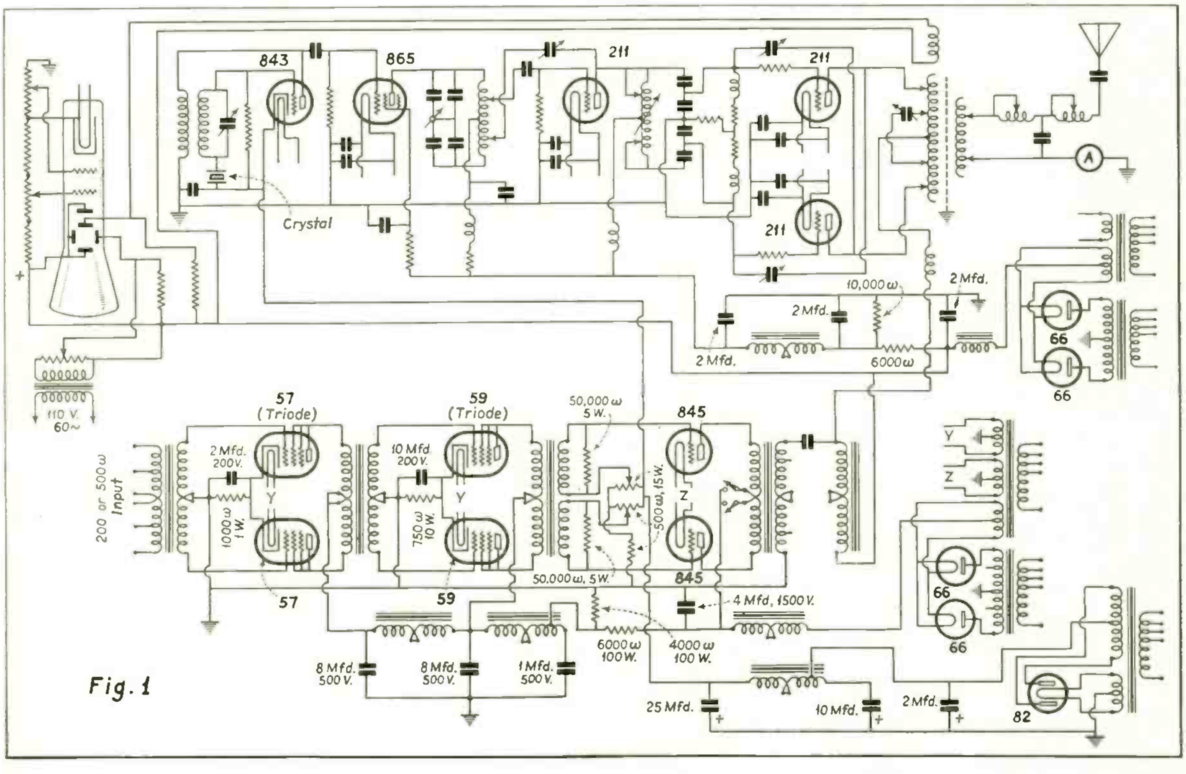
The 100-watt transmitter lends itself very well to the use of high-level plate modulation and an A Prime modulator. Similar to Class B, in Class A Prime amplification, much higher output can be obtained from a given pair of tubes than in a Class A amplifier using the same tubes; and with considerable increase in plate efficiency.

### CLASS A AMPLIFIERS

In a Class A amplifier, the bias voltage is normally chosen approximately midway between zero bias and the bias required for plate current cut-off, so that the grid voltage is permitted to swing the plate current over the linear portion of the tube characteristic. This normally results in a condition such that the dc plate current does not change appreciably when full signal voltage is applied to the grid, and the plate current is not cut off during any portion of the cycle. For undistorted output from a single output tube, these conditions must be met fully. If the tube is operated above the substantially linear portion of its characteristic, considerable distortion will be present in the output. However, when two tubes are operated in push-pull, the nonlinear sections are made to complement each other and thus effect a comparatively linear overall characteristic. In a perfectly balanced push-pull circuit, this results in the complete elimination of second harmonics. Inasmuch as the grid is never driven into the positive region in Class A amplification, the grid current is negligible and the input grid impedance practically infinite.

### CLASS B—CLASS A PRIME

In normal Class B operation, the tube is biased almost to cut-off. Consequently, as the signal voltage is increased, the average plate current increases. The fact that the tubes operate over a much greater portion of the characteristic makes it possible to obtain greater power and efficiency than from a similar Class A setup. In Class A Prime, the bias is adjusted between the




Schematic of 100-watt broadcast transmitter with A Prime modulator and cathode-ray tube as visual distortion indicator. The switches in the plate-supply circuits of the 845 modulators may be used for providing individual plate-current readings. A milliammeter should be connected in the common plate-supply lead.

Class A and Class B values. The normal plate current with no signal lies between the Class A and Class B values and the plate current is substantially constant for low applied signal. However, as the signal is increased, the plate swings over a larger portion of the characteristic, similar to Class B, and the average plate current rises. The high bias applied to the tube in A Prime operation allows a large swing in applied signal before the grid is driven positive. In other words, at low and medium levels, a Class A Prime amplifier is substantially an ordinary Class A amplifier somewhat over-biased. No grid power is required and the grid impedance is high. For maximum power, however, the grid is driven positive. The action of a vacuum tube amplifier is such that the instantaneous grid voltage affects a corresponding voltage in the plate circuit which is in turn coupled to the output load. It is apparent that for undistorted output from the plate circuit, the grid voltage must not be distorted. In a Class A circuit, where the grid impedance is uniformly high, this condition is met easily. In Class A Prime or Class B, considerable care must be taken to meet this condition.

As a general design consideration, the input impedance to the grids of Class A Prime or Class B tubes should be approximately 20% of the minimum instantaneous grid resistance. This is particularly important in those tubes which have negative grid resistance, as a source impedance higher than the negative grid resistance will tend to produce parasitic oscillations which, besides distorting the signal, may break down the output transformer insulation.

## DESIGN FACTORS

The various design factors embodied in the construction of an A Prime amplifier are well exemplified by that of the 100-watt transmitter using 845 tubes in the output audio stage. The schematic diagram for such a transmitter is illustrated in Fig. 1. While the exact values of components are shown in the audio section, only general detail is shown in the r-f sections. The use of inexpensive low power tubes and the simplicity of the circuit shown make this an excellent transmitter from the angle of ease of construction and cost. The use of high-level plate modulation effects low power consumption and maintenance costs. While the general electrical details of this transmitter are standard, a number of unusual factors must be considered in connection with the A Prime amplifier.

The design of the input transformer is easily generalized. After the type of output tube and its operating conditions are chosen, the peak grid swing for maximum output must be determined. We then determine the peak plate swing of the driver tube or tubes. The ratio of the input transformer (total primary to ½ secondary) should be equal to the ratio of driver peak plate swing to output peak grid swing. In the circuit shown, the peak grid swing is approximately 300 volts. The peak plate swing of the 59 tubes is about 180 volts with 275 volts on the plates and slight overbias. As the 59's are connected in push-pull, the plate-to-plate swing is 360 volts. The ratio of peak plate swing to peak grid swing is therefore

$$\frac{360}{300} \text{ or about } 1.2$$

and consequently the input transformer turns ratio is approximately 1.2:1 from total primary to ½ the secondary. Since the impedance ratio of a transformer varies as the square of the turns, $1.2^2$ or 1.44 is the ratio of impedance from driver to each grid. The 59 plate resistance is 2300 ohms, or 4600 ohms for push-pull tubes. Therefore,

$$\frac{4600}{1.44} = 3200 \text{ ohms}$$

as the reflected load in series with each grid.

## LOAD IMPEDANCE

The best load impedance for Class A Prime tubes is somewhat difficult to calculate accurately. As in Class B, for a limited grid voltage the output power will be greatest when a plate load is chosen such that the product of plate voltage swing and plate current swing is a maximum. For maximum power with minimum distortion, the load resistance will decrease as the driver power is increased. In other words, with greater driving power, the plate current swing on the output tube can be increased and greater power output will consequently be developed across a smaller resistor. This again is governed by the peak current which the plate supply can deliver. It is also not desirable to use a low load resistance if the plate supply regulation is bad. All these factors are of more or less importance, depending upon the magnitude of values in the particular design. However, a general method of determining load impedance for push-pull tubes can be used where the grids are not driven very far positive. Fig. 2 shows this as applied to the 845 tubes. The published plate characteristic curve must be obtained and an operating voltage E selected. A vertical is erected at $.6E_b$ and the $E_c$ = E line is extended to meet it. A line is then drawn from this point of intersection to our point $E_b$. The slope of this line multiplied by 4 is the proper plate-to-plate load.

If the grids are driven sufficiently positive to make the normal output about

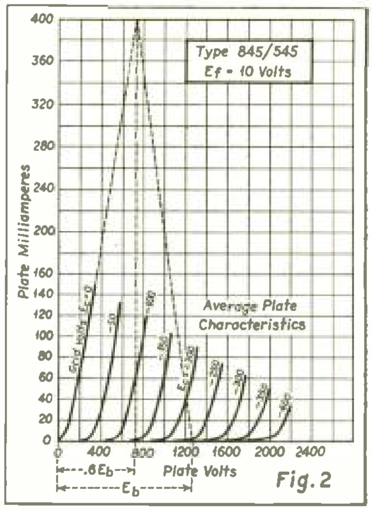



Fig. 2

Chart for computing load impedance.

four times that of a single-sided Class A amplifier using the same tube, this value of load impedance should be reduced by about 20%. If the plate supply regulation is better than 10%, this load impedance can be reduced another 5%. In the case shown, this would mean an effective plate load of 3750 ohms. The recommended RCA value is approximately this value.

The calculation of maximum power output is also not difficult. The output is equal to

$$\text{Power} = \frac{\text{Max. plate current} \times \text{Plate voltage}}{5}$$

as shown in Fig. 2. This gives

$$\frac{.40 \times 1250}{5} = 100 \text{ watts}$$

## TRANSMITTER DATA

The salient features in this transmitter are readily seen from the circuit. Push-pull coupling is used throughout all the audio stages. Push-pull tube operation effects a cancellation of even harmonics and also of plate-supply and filament-supply hum. The use of 57 tubes as triodes in the first audio stage effects high gain. These are transformer-coupled to the 59 driver tubes which are operated slightly A Prime, which are in turn coupled to the audio output tubes through the stepdown transformer previously described. The 845 audio output tubes are coupled to the Class C load with a special matching transformer and a modulation choke.

An 843 tube is used in the crystal oscillator due to the heater-type cathode which minimizes the tendency for hum or frequency modulation. The 843 is coupled to an 865 buffer which is in turn coupled to a 211. This 211 drives the output stage consisting of two 211's in push-pull Class C. Though this push-pull coupling tends to reduce harmonics, electrostatic shielding and a harmonic suppression network are necessary to effectively eliminate the radio-frequency harmonics. For simplicity of construction and dependability, all r-f stages are self-biased. The plate supply for the 843 tube is taken from the 845 bias supply which uses an 82 rectifier. 866 tubes are used in the full-wave plate supply for all audio stages. Self bias is used on the first two audio stages. A separate 866 plate supply is used for the r-f stages.

### VISUAL DISTORTION INDICATOR

For maximum efficiency in a broadcast transmitter it is desirable to maintain the gain control setting at a point where the average percent modulation is as high as possible. This is particularly necessary in a low-power transmitter where the signal intensity is low even at full modulation. However, if this setting is determined solely by audio monitoring, the modulation may exceed 100% and the consequent distortion would spoil the program fidelity. While the deflection of plate meters has been used in the past as a visual distortion indicator, this method has an unfortunate limitation in the fact that the deflection does not take place until actual distortion is present. The use of a cathode-ray tube for checking modulation seems to be the solution to this problem. The method of connecting an RCA 906 (3") cathode-ray tube for modulation checking is shown in Fig. 1. Anode, focusing and grid voltages are obtained from a voltage divider bridging the 845 plate supply. Sixty cycles is used for the sweep. The voltage for the deflecting plates is obtained from a coil coupled to the antenna output circuit. Due to the highly sensitive operation of this tube, full magnetic and electrostatic shielding should be provided.

### FREQUENCY CHARACTERISTICS

The importance of high fidelity in broadcast transmission is coming more to the fore every day. Radio receiver fidelity has been increased to the point where harmonic distortion and frequency transmission are becoming increasingly more noticeable and objectionable. The user of broadcast facilities is beginning to appreciate that not only fine studios and artists, but also low distortion, hold listener interest. Using high-fidelity audio transformers, the frequency characteristic of the transmitter described is uniform from 30 to 12,000 cycles. The hum level is 65 db below the output at 100% modulation. Harmonic distortion at 95% modulation is under 6% total.

The three-stage audio amplifier has an overall gain of 65 db. This makes it possible to eliminate the use of an intermediate amplifier and couple the studio pre-amplifiers directly to the input to the 57's. An excellent ac-operated pre-amplifier was described by the writer in the October 1934 issue of RADIO ENGINEERING.

Everything considered, it is apparent that this 100-watt transmitter, while designed for the small station with reference to simplicity of operation, cost, and ease of construction, is equal in all respects to its bigger brothers. From the standpoint of economy and program fidelity, this transmitter, carefully constructed, should meet the highest broadcast standards.

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## "RADIO VIENNA"

(*Continued from page* 8)

### OUTPUT POWER

The 600-kw input to the last stage may seem high at first glance, for a 100-kw output. However, it must be remembered that the rating is the actual power in the antenna and therefore considerably more than 100-kw output must be obtained from the tubes to compensate for circuit losses. Furthermore, as is now recognized, Class B r-f amplifiers which can truly be classed as high-quality—i. e., which produce small distortion in the modulated envelope—have efficiencies nearer 23.% and 33.%.

### THE ANTENNA SYSTEM

The antenna consists of a $\lambda/4$ mast radiator 460 feet high with a duplicate mast spaced $\lambda/4$ as a reflector so as to give better coverage of the whole of Austria. The base of the masts are supported by three insulators in a sort of tripod arrangement, in contrast to the single insulator as used on the WLW and similar masts. The steel masts have no copper bonding conductors to increase their conductivity, as extensive tests by the Technical Director of the RAVAG indicated that these were unnecessary. The tests were made on a special steel mast $\lambda/4$ high. A constant power input gave the same field intensities for the mast with the copper bonding conductors, for the mast without the copper conductors, and for the copper conductors alone when supported by a balloon.

### HEATED COUNTERPOISE

Due to the rocky ground and wide seasonal variation in ground moisture, counterpoises are used, each antenna having its individual counterpoise. Heating of the counterpoise wires by 50-cycle ac is required to prevent ice formations during the winter months, at which time the station is exposed to very severe weather.

A specially designed program cable connects the studios in the Stadt with the station at Bisamberg, and furnishes both order wire and program service.

Austria is justly proud of this modern high-power broadcast station, which represents the best in Germanic technical progress.

## DEVELOPMENTS IN AIRCRAFT RADIO

(*Continued from page* 11)

of the second i-f amplifier tube, provides amplified automatic volume control. The avc voltage is developed in the load circuit of the triode section of the 6F7 and this voltage is filtered and fed to the grid circuits of the r-f stage, the mixer and the first i-f stage. A switch is provided for grounding the avc voltage-feed circuit when the receiver is used for code reception. With the switch in this position the manual volume control is thrown into circuit. It is seen to consist of a combination r-f sensitivity control (grid-bias adjustment) and a-f gain control, the two variable resistors (601-601) being connected in tandem.

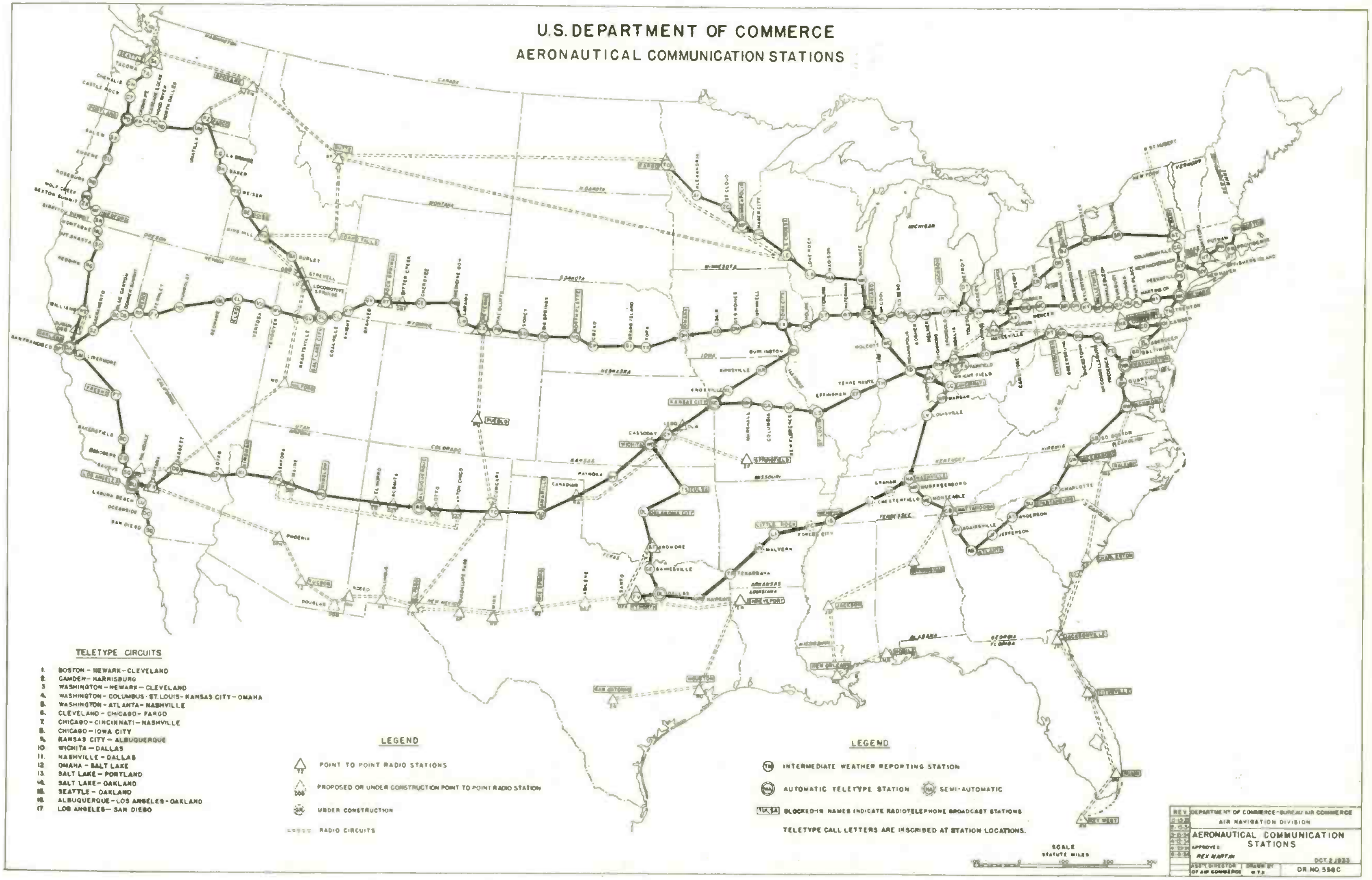
A separate type 78 tube is used as i-f oscillator to beat with the signal in the second detector circuit when receiving cw. A switch is provided for removing the voltage from the plate of the i-f oscillator when receiving phone.

The eight tubes in the receiver have their heaters connected in series-parallel, as indicated, and are energized directly from the 12-volt storage battery in the plane. A dynamotor, with filtered output, supplies all plate and screen voltages.

### THE BEACON RECEIVER

The second plane receiver, shown in Fig. 6, is used for the airway beacon signals in the frequency range from 200 to 600 kc. This receiver is equipped with a remote control unit and a dynamotor to operate from the 12-volt storage battery. This receiver also served as an auxiliary intermediate frequency receiver in the flight. The cw signals were picked up by throwing the detector circuit into oscillation.

There has been developed a new comcombined radio receiver and "homing" device. This is essentially the receiver proper shown in Fig. 5 to which has been added a special modulator unit and a loop antenna. By a clever method of comparing the phase relationship of the currents in the loop antenna and that in the vertical antenna, it is possible to use any broadcast station as a perfect aircraft beacon. The pilot merely tunes in the particular broadcast station toward which he would like to direct his course and then, by orienting his plane to keep the needle of the visual indicator always in the center, oncourse position, he will bring his plane right to the broadcast station tower. By the additional use of a landing field boundary marker it becomes possible to land a plane flying blind.




# MAP NO. 1--*Aeronautical Communication Stations*

THE FIRST OF A SERIES OF MAPS TO BE PUBLISHED EACH MONTH, PROVIDING COMPLETE DATA ON THE VARIOUS CLASSES OF U. S. COMMUNICATION AND BROADCAST NETWORKS. THE ABOVE MAP, WORKED UP BY THE U. S. DEPARTMENT OF COMMERCE, CONTAINS ALL REVISIONS UP TO SEPTEMBER 6, 1934. FURTHER REVISIONS IN TABULATION FORM ARE PROVIDED AT REGULAR WEEKLY INTERVALS TO AIRPORTS.

# BOOK REVIEWS

PHOTOELECTRIC CELLS, *by N. R. Campbell and D. Ritchie, published by Sir Isaac Pitman & Sons, Ltd., London, England (U. S. Representative, Pitman Publishing Corp., N. Y.), third edition, 223 pages, cloth covers, list price* $3.75.

Many readers will remember the first and second editions of this book, it being one of a very few texts on this subject which was then sadly lacking in literature. Since the first edition was published in 1929, there have been a number of excellent books both on the theory and applications of photoelectric cells as well as a great many excellent articles on various phases of the subject. The authors are to be commended on their frank recognition of this fact and their consequent complete revision of the original text. This book is therefore much more than an attempt to bring the earlier editions up to date, it is essentially a new book. As the authors state in their preface, the gap that the first and second editions were intended to fill no longer exists. Whereas the original editions emphasized practice instead of theory, this edition reverses the process. While there are a number of excellent books available on the subject of photoelectric cells, none of them that have come to this reviewer's attention have been concerned primarily with the principles of operation as subsidiary to operating practices and applications. It would, therefore, appear that this book fills a distinct need in this field.

This book contains 13 chapters dealing with such concepts as Colorimetry, Photometry, Valve Amplification, as well as a complete discussion of vacuum, gas filled, rectifier and conductivity cells. The book is divided into three sections. The first is entitled Properties of Photoelectric Cells; the second, Use of Photoelectric Cells; and the third, Some Applications of Photoelectric Cells. On the whole, the book is readable even for the non-mathematical reader. While mathematics is not dispensed with, where it can serve a useful purpose, the arrangement is such that the results of each analysis can be visualized without following through the mathematics. The reader may in some cases be confused by the fact that the authors deliberately ignore the distinction between emf and potential difference and by such statements as $\frac{dx}{dy}$ as positive instead of x increases with y. However, this will present no difficulty to the careful reader since the authors state their position at the beginning and follow it rigorously throughout the book. The authors are especially to be commended on the inclusion of a wholly adequate discussion of the little used and nearly forgotten conductivity cells. It appears to this reviewer that no text on this subject would be complete without at least a mention of this type of cell which has played so important a part in the early development of photoelectricity.

The book is thoroughly up to date, the main body of the material dealing largely with information which has come to light within the past few years. It is replete with references, over 100 separate citations being given. The typography and illustrations are of a high class and, so far as this reviewer could determine, very few errors are present.

While this book is intended primarily as a text for the student of photoelectricity, it appears that it is likely to be even more valuable as a handy reference volume both for the worker in the field of photoelectricity and for the engineer who has occasion to refer to standard texts on the subject in connection with the design and operation of photoelectric and allied apparatus. To this field, this book is highly recommended.

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ELECTROMAGNETISM, *by H. M. MacDonald, published by G. Bell & Sons, Ltd., London, England, 178 pages, cloth covers.*

To attempt to do justice to the subject of electromagnetism in less than 200 pages is indeed an ambitious undertaking. It follows that if the subject is to be treated without slighting many of its ramifications, it is necessary to make a selection of the particular problems to be treated. While this book is far from a complete compendium of information on the subject, it does treat many of the most important problems in considerable detail.

The author states at the beginning that his object is the development of a consistent scheme for the representation of electrical phenomena and the derivation of the more immediate consequences of the fundamental laws from the fundamentals of electromagnetism. The book includes a discussion of the general equations of electrodynamics, application to material media and to conducting media, diffraction, radiation, resonance, and moving electrical systems. The relations developed rest on the hypothesis that electrical effects in free space are propagated in accordance with the laws of Ampere, Fresnel and Faraday. The author starts by setting up the field equations for electric and magnetic force in free space as originated by Faraday and leads naturally to a mathematical representation of the results of the Fresnel-Arago experiment performed in 1816 which indicated that electromagnetic waves polarized in perpendicular directions did not interfere in free space. The analogue of Green's theorem that the potential at points outside a closed surface due to fields inside the surface can be expressed in terms of the electric and magnetic fields tangential to the surface is developed.

Such a treatise is necessarily highly mathematical, and while the author seldom departs from the standard methods of differential equations, the going does become heavy and somewhat involved in spots. However, for the reader who can "take his mathematics or leave it alone" this book should prove highly interesting. The author covers all the more important problems of electromagnetics in considerable detail and with admirable clarity, once the reader becomes familiar with his methods of analysis.

The chapter on radiation and resonance is of particular interest to the radio engineer. For example, the derivation of the resultant radiated field from a number of simple sources of like frequency and varying phases is the basis of most calculations of the resultant fields of synchronized radio transmitters. Most antenna problems could be solved by starting with the equations developed for the radiation from the ends of free and terminated conductors in which electrical oscillations exist.

The book is replete with references for the reader who desires to follow further some of the more detailed ramifications of electromagnetic theory. The book is intended for the advanced student and should be an excellent text. It can also be recommended to the physicist who is interested primarily in theoretical considerations rather than applications of the theory of electromagnetism.

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*KRUSE'S RADIOPHONE GUIDE (2nd Edition), by R. S. Kruse, published by Robert S. Kruse, Guilford, Conn.*, 82 *pages, well illustrated, paper cover. Price,* 50 *cents.*

The latest edition of "Kruse's Radiophone Guide" contains a group of "Radiographs" worked up by Ralph

Batcher, covering the determination of pad design, resultant values of equal and unequal resistors in parallel, condensers of unequal value in series, etc. There are also graphs dealing with coil calculations for wavelengths below 200 meters, with Ohm's law, and two charts relative to wire weight and wire winding.

The book opens with an article on the use of the cathode-ray tube in the testing of radiophone transmitters. This is followed by data on tank circuits, the construction of an inexpensive oscilloscope, pre-amplifiers and modulators, means of checking plate modulation without an oscilloscope, precision frequency meters, grid modulators, a chart on the operation of tubes in Class C modulated r-f amplifiers using grid leak bias, etc.

Though the book is written principally for the amateur, it should be of interest to engineers concerned with low-power transmitter design.

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*BROADCAST-RECEIVER DESIGN, by G. S. Granger,* 36 *pages, paper covers, price* 50 *cents.*

*ALL-WAVE RECEIVER DESIGN, by G. S. Granger,* 30 *pages, paper covers, price* 50 *cents.*

*HIGH-FIDELITY RECEIVER DESIGN, by G. S. Granger,* 32 *pages, paper covers, price* 50 *cents.*

Published by Manson Publishing Company, 521 Fifth Ave., New York, N. Y.

This set of three books on receiver design were written for the radio service man with the intention of assisting him in making independent analysis of receiver circuits. Complete explanations are given of modern circuit functions, with an occasional mathematical interpretation where it is deemed necessary.

*Broadcast-Reveiver Design* opens with a chapter on antennae and antenna coupling circuits, with an interesting portrayal of subsequent engineering developments and the reasons for them. Later chapters, each handled in the same interesting manner, cover audio amplifier systems, bandpass filters, image-suppression circuits, i-f amplifiers, coupling systems, oscillators and oscillator tracing, avc and qavc circuits, circuit noise, etc.

*All-Wave Receiver Design* deals with special antenna systems developed for wide frequency coverage, avc circuits as applied to all-wave receivers, beating oscillators, choice of intermediate frequency, oscillators and oscillator tracking, shielding, and waveband switching systems.

*High-Fidelity Receiver Design* opens with a chapter on acoustic considerations, and follows through with an explanation as to what constitutes an authentic high-fidelity receiver, special audio amplifiers, automatic tone control, bandpass filters, high-fidelity requirements, special i-f amplifiers and band-width control, oscillator problems, thermal noise, etc.

Though there are duplications of chapter heads in the three books, there is actually no duplication of material.

The data is well presented and parts appear decidedly original. For this reason the books should be of interest to engineers as well as service men.

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*HANDBOOK OF CHEMISTRY AND PHYSICS, nineteenth edition, edited by Charles D. Hodgman; published by the Chemical Rubber Publishing Co., Cleveland, Ohio,* 4 *x* 6½ *inches; leatherette cover;* 1,934 *pages; price,* $6.00.

As the name implies, the handbook is a compilation of physical and chemical data of importance to the development engineer or research engineer. For convenience in reference, it is divided into five sections: 278 pages of mathematical tables, 485 pages of data on properties and physical constants, 391 pages of general chemical tables, 425 pages of heat and hygrometry, and 354 pages of quantities and units and miscellaneous.

The mathematical tables are exceptionally complete. Although the table of integrals is not as complete as one might find in a book devoted exclusively to this subject, the most important ones are included, as are many definite integrals used in engineering work. The formulas for the solution of certain cubic equations, trigonometric identities, permutations and combinations, probability tables, and logarithmic and trigonometric tables, are in handy form, close together, which makes them suitable for easy reference.

The second section of the handbook is devoted to the chemical elements and their characteristics. While this chapter is not very useful to the radio engineer, the data are valuable to those interested in the quantitative solution of certain photoelectric problems.

The selection on sound and light are of importance to the radio engineer. The velocity of sound in various media, the frequencies of the same notes for various musical scales, the absorption coefficients of different materials, the wavelength and specific inductive capacity of different materials, contact potentials, a complete table of resistivity of different materials, constants of iron, and numerous additional data make this one of the most useful tables for the engineer and physicist.

The last section of the handbook is devoted to numerous radio tables and data that are valuable to anyone in the radio field. A complete list of the characteristics of receiver, telephone, and transmitting tubes is included.

The usefulness of this book lies in the fact that the material most used by engineers is contained in a single volume, which obviates the necessity for extended research to obtain some constant that may be required at a momnt's notice. There are enough explanatory text books for the radio man available now, in the opinion of your reviewer; the handbook is a compilation of data without the explanations.

Those familiar with previous issues of the bandbook will be interested to know that the present nineteenth edition has two hundred pages more than the previous edition, and that the material has been re-arranged for more handy reference, as outlined her. There should be room for this book on the desk, not in the bookcase.—*L. M.*

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*RCA HANDBOOK SERIES*

THE RCA Handbook Series are divided into three parts namely, the HB-1, HB-2, and the HB-3.

The "All Types" RCA Tube Handbook, HB-3, combines in one volume the material of the RCA Receiving Tube Handbook (forming the first section) and the material of the RCA Transmitting Tube Handbook (forming the second section). Provision is made for the inclusion of a third section to contain data on cathode-ray tubes and other miscellaneous special-purpose types. Sheets for this miscellaneous section will be issued in the near future.

The respective sheets show not only the main use for which the particular type was designed, but also its rating. typical operating conditions, characteristics, interelectrode capacities, base connections and overall mechanical dimensions. In addition, full size sheets showing the more commonly used families of static and dynamic characteristics curves have been included. All curves have been plotted to easily readable scales and are sufficiently large to be useful for engineering design purposes.

The Transmitting Tube Handbook (HB-2) consists of the second section of HB-3, while the RCA Receiving Tube Handbook (HB-1) is made up of the first section of HB-3.

The handbooks have been placed on a subscription basis to partially cover costs and to limit its distribution to those who have real need for the data it contains.

# TELECOMMUNICATION

PANORAMA OF PROGRESS IN THE FIELDS OF COMMUNICATION AND BROADCASTING

### RADIO MARKER BEACON

IT IS FELT that high radio towers, some of which exceed 800 feet in height, used for transoceanic communication and some commercial broadcast stations, monuments, suspension bridges and the like, present distinct hazards to airplanes in periods of poor visibility. It is also felt that with the increasing headway being made in the art of blind flying that it is desirable to have some form of marking that is independent of visibility. As a result the Bureau of Air Commerce has attacked this problem with radio marker beacons, the project being carried out by their principal radio electrician, R. P. Battle.

Two experimental installations* were designed and tested in conjunction with two commercial radio stations. One installation was made at WOR's new broadcast station at Carteret, N. J., and the other at station WJR, Wyandotte, Michigan. The two installations differed, for the most part, only in the power used in the transmitter, that of the WJR set-up being the lower.

From the aviator's standpoint the system works quite simply. The pilot following the radio range beacon course would, upon approaching the obstruction, hear the signal of, say, five dashes superimposed upon the monotone of the radio course, but modulated at a different audio frequency. An altitude check would point out whether or not a change in the height of the plane above the ground was necessary. Once having passed the obstruction the warning signal would gradually die out, indicating to the pilot that the hazard had been safely overcome.

The antenna system used for the WOR marker beacon was of the single-wire L-type having a horizontal length of 150 feet and an average height above ground of about 16 feet, the overall height being in the vicinity of 18 feet. Tests at this installation indicated that 25 to 30 watts was sufficient antenna power, powers in the vicinity of 50 watts and above proving undesirable. Tuning the marker to zero beat with the range was also found to be undesirable, producing a "wobbling" effect on the range due to beating between the carriers. Most efficient results were obtained when the carrier frequencies of the range and marker had a 1,200-cycle separation. This separation was obtained for the marker by using a crystal-controlled oscillator.

Results also indicated that an audio frequency of about 120 cycles was desirable, using a broken signal. The broken signal did less to impair the "On Course" signal when flying closest to the marker.

A radio marker beacon having a visual or aural method of helping the pilot in orienting himself with respect to a near airport has also been suggested.

*November 15, 1934, *Air Commerce Bulletin*, page 119.

### STATIC SHIELD PREVENTS HARMONIC RADIATION

THE ACCOMPANYING illustration shows the lattice-work wire shield suspended between the coils of the antenna transformer in the new Westinghouse station, KYW, in Philadelphia. This electrostatic shield is used to reduce the radiation of harmonics to a minimum.

Legislation under the Federal Communications Commission has required strict observance of the percentage of harmonic radiation of all broadcast stations, so serious is the effect of these stray signals from super-power stations. With the aid of the new static shield, it is estimated that the reduction of harmonics will be hundreds of times better than the law requires.

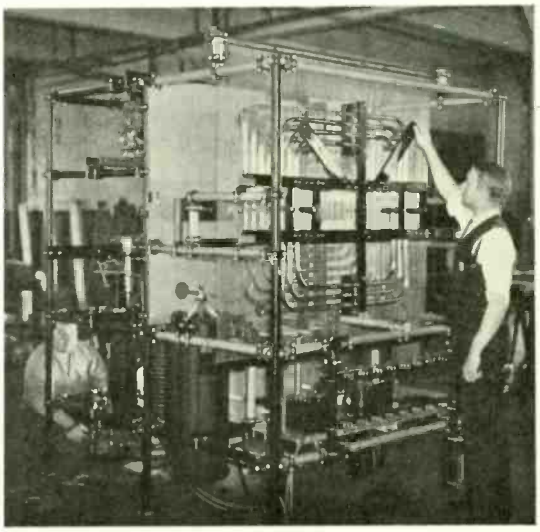
The simplicity and effectiveness of the static shield and its coming popularity are evidenced by the fact that a miniature one is built into the new Westinghouse 50-watt Police Transmitter installed last month in Charleston, West Virginia.

### ULTRA-SHORT-WAVE POLICE TRANSMITTER

THE TIP OF A flag pole serving as an antenna, hollow wires which like water pipes carry electricity without leaking, and a quartz crystal scarcely thicker than a hair which acts as a control by vibrating 5,000,000 times a second, are among the features of the radio system just placed in operation by the Police Department of the City of Newark.

The system jointly produced by the Western Electric Company and Bell Telephone Laboratories uses an ultra-high frequency, 30,100 kilocycles.

A "concentric" transmission line composed of one copper tube within another runs to the roof, the outer tube preventing the escape of any current and thus making the line "water tight." The line runs up the inside of a 100-foot flag pole topped by a 22-foot brass tube which acts as the antenna 600 feet above street level.



The static shield in this power amplifier assembly materially improves the signal from the new KYW station in Philadelphia by reducing harmonic radiation to a minimum.

# TELEGRAPH UNIFICATION RECOMMENDED

**Company officials unanimous in voicing approval of mergers satisfactory to the interests of the industry and the public.**

RECOMMENDATIONS MADE to the Telegraph Division of the Federal Communications Commission by officials of the Postal Telegraph Company, the International Telephone and Telegraph Corporation, Commercial Cables, Mackay Radio, All-American Cables, the Western Union Telegraph Company, the Radio Corporation of America, and the American Telephone and Telegraph Company, express approval of operating inter-relations between present competitive interests for the purpose of eliminating duplication of services and permitting an extension of development into territories not served by communication facilities.

Colonel Behn, president of I. T. & T., and Colonel Griswold, executive vice-president of Postal, advocated the merging of telegraph services as a means toward the elimination of waste through duplication. Colonel Griswold pointed out that the domestic telegraph companies have never been able to extend their services in this country due to the direction of efforts toward the meeting competition, and added that no real development work worth talking about is going on today or can go on unless there is a substantial improvement in the financial condition of the industry. Colonel Griswold expressed the opinion that not until the industry is free from competitive efforts of domestic companies could improvement of services and reduction of costs be brought about.

Mr. Pitkin, vice-president of I. T. & T., held a similar opinion and expressed his belief that the telegraph companies should be free of competition in order to meet the business of the telephone and radio companies. Mr. Pitkin pointed out to the Commission that the growth of the air mail has also served to substantially reduce the revenue normally reverting to the telegraph companies.

Mr. Chinlund, comptroller of the I. T. & T., said, "With unification under governmental supervision a new scientific rate structure which would be fair to all classes of telegraph users could result promptly. Service would be extended to places not served and services would be improved principally because the industry could devote its attention to such improvement with confidence in the future."

J. C. Willever, vice-president of Western Union, expressed the opinion that a consolidation of the telegraph industry would prove the salvation of telegraphy. He was of the opinion, however, that the economies resulting from such a merger would come largely from a reduction in personnel with the result that such a merger might not be to the best of public interest. He indicated that a unified system might be more satisfactory since attention would be directed toward new business rather than to the holding of existing business in the face of competition. It is his opinion that any method of unification should include Western Union, Postal Telegraph and Cable Co., the Radio Corporation of America and the Mackay Radio System.

C. P. Cooper, vice-president of A. T. & T., stated that his company favored unification as a means of extending advantages to the telegraph industry. He is of the opinion that leased wire services and teletypewriter services should not be considered as part of the telegraph industry.

Mr. David Sarnoff, President of the Radio Corporation of America, who appeared before the Telegraph Division of the Federal Communications Commission on December 4th, brought up the subject of foreign competition and its effect on American communication services. He said:

"Your Telegraph Division Order No. 11 states that the purpose of this hearing is to assist the Commission, (1) in determining whether it should recommend to Congress the enactment of laws authorizing consolidation or merger of communication companies, and (2) in the event that such recommendation is to be made, in determining what safeguards and conditions should be included.

"Let me make it clear at this point that neither the Radio Corporation of America nor any of its subsidiaries has any plan or program for consolidation or merger with any other communication company, in the event legislation be enacted permitting this to be done.

"A definite American communications policy is needed to enable the telegraph services of our country adequately to develop and to render a fuller public service. The Roper Interdepartmental Committee (1933), of which the Chairman of the Telegraph Division of this Commission was a member, was correct when it said in its report:

" 'Under the existing unrestricted competitive system the United States does not have an adequate telegraph service.'

"The enactment of the Communications Act of 1934 and the establishment of this Commission, in which have been centralized for the first time the hitherto scattered regulatory powers of the Government, was an important step toward the adoption of a national communications policy.

"The next step would properly be the enactment of legislation necessary to enable the Commission to evolve a comprehensive communications policy, and to put it into effect. A national communications policy will not likely result from the work of a single man or the suggestions of a single company. It will evolve from the requirements of public service, from the experience, the plans and the proposals of the several communication companies, and from the decisions of this Commission, as to how the public interests in respect of communications can best be advanced.

"In considering such a policy, your Commission will speedily find that the United States does not have an adequate telegraph service in the domestic field, and that in the international field, Americans are working at cross purposes with each other. . . .

"In the domestic telegraph field, there is needless duplication of investment, overhead and operating expenses. There has been great waste without compensating advantage to the public. The teletypewriter exchange service, recently introduced, has added further complications. The development of domestic radio telegraph services would have been greatly accelerated had there been a definite communications policy.

"The absence of such a policy is even a greater menace to American communications, in the international field. Foreign communications systems, each unified in its own country, can and increasingly will benefit from the keen competition of American companies to do business with them. In Germany, Norway, Sweden, Denmark, Finland, Czechoslovakia, Hungary, Jugoslavia, Roumania, Holland, Belgium, Russia, Poland, Japan and China, domestic and international telegraph services are operated under the control of the same administration. In Great Britain international cable and radio telegraph facilities were recently consolidated. The foreigner has the advantage in every negotiation. A definite national policy is essential if the independence and security of America in world communications are to be preserved.

"There can be no effective remedy so long as American laws forbid unification of telegraph services in this country thereby preventing them from meeting on even terms and dealing effectively with unified systems in foreign countries with which American communication companies must necessarily meet and deal. We should not permit foreign communication agencies to apply a policy of 'divide and rule' in their relations with Americans—neither in traffic arrangements nor in other dealings."

# Federal Communications Commission Reports

## NON-PROFIT PROGRAM ALLOCATION

CHAIRMAN HAMPSON GARY of the Broadcast Division announced on November 13 that the hearings which had been in progress for weeks before the Communications Commission, on the proposal to allocate fixed percentages of broadcasting facilities to non-profit programs or agencies, were concluded.

Great interest was manifested in these hearings. More than one hundred and fifty witnesses from all parts of the country were heard, and twenty thousand pages of testimony taken. Under the law, the Communications Commission is to prepare a comprehensive report, and submit recommendations to Congress for its consideration at the next session.

## SHIP TELEGRAPH STATIONS

On December 1, the Telegraph Division issued a statement to the Licensees of Ship Telegraph Stations. Under the terms of the Ship Act, the equipment installed on a compulsorily equipped vessel must be in charge of *"two or more persons skilled in the use of such apparatus, one or the other of whom shall be on duty at all times while the vessel is being navigated."* Under the terms of paragraph 2 (1) of Article 19 of the General Radio Regulations annexed to the International Telecommunication Convention of Madrid, 1932, all ships operating on the frequencies 365 to 515 kilocycles must make provision for the maintenance of watch on 500 kilocycles during the silent period throughout their working hours.

It is entirely practicable for auxiliary receiving antennas to be installed on the majority of ships equipped with direction-finding apparatus by means of which the radio operator may continue reception on the distress frequency (500 kilocycles, or 410 kilocycles on the Great Lakes), during the periods in which bearings are being obtained, and it is expected that such antennas will be adopted in the future.

### Telegraph Division

*October* 10, 1934.

CITY OF SACRAMENTO, Calif., was granted construction permit for portable equipment to be used for special experimental service at a power of 25 watts and to be operated on a frequency of 2422 kc.

MACKAY RADIO AND TELEGRAPH CO., INC., Brentwood, N. Y., was granted a construction permit for fixed public point-to-point telegraph use to Buenos Aires, Prague, and Kansas City, Mo. The power is 10 kw at frequencies of 5250, 7752.5, and 10,830 kc.

*October 31, 1934*

G. W. McCAULEY, doing business as Aeronautical Radio, Inc., Roosevelt Field, Garden City, New York, was granted a construction permit and license. The equipment to be used at a frequency of 278 kc with a power of 15 watts.

AERONAUTICAL RADIO, INC., was also granted construction permits for Raleigh Airport, Raleigh, N. C., and Savannah Airport, Savannah, Ga. The power used to be 20 watts and equipment to be operated at frequencies of 2922, 2946, 2986, 4122.5, and 5652.5 kc. Also granted were (No. 1, No. 2) construction permits and licenses for portable-mobile equipment as follows: (1) 2930 and 6615 kc aeronautical; (2) 2930 and 6615 kc aeronautical point-to-point, with power of 400 watts; (1) A1, A2, A3, aeronautical; (2) A1, aeronautical point-to-point. Portable-mobile, No. 1, was granted aeronautical license for frequencies of 2930 and 6615 at 400 watts.

DR. SAMUEL SPITZ, Hangar No. 5, Burbank, Calif., was granted construction permit, the frequencies being 1614, 2398, 3492.5, 4797.5, 6425, 8655, 12,862.5, and 17,310 kc. The power is 600 watts.

CITY OF SALISBURY, N. C., was granted construction permit using frequencies of 30,100, 33,100, 37,100, and 40,100 kc, the power being 20 watts.

CITY OF CLAIRTON, Pa., was granted construction permit. The frequencies are 30,100, 33,100 and 37,100 kc, and the power 15 watts.

ATLANTIC CITY, N. J., was granted construction permit for portable-mobile equipment. The frequencies are 30,100, 33,100, 37,100, 40,100, 86,000-400,000, 401,000 kc and above. The power is 9 watts.

POLICE DEPARTMENT, Borough of Sharon Hill, Pa., was granted construction permit as follows: frequencies of 30,100, 33,100, and 37,100 kc; power 15 watts.

CITY OF PARKERSBURG, W. Va., was granted construction permit using a frequency of 2490 kc and a power of 50 watts.

CITY OF WILMINGTON, Del., was granted construction permit using frequencies of 30,100, 33,100 and 37,100 kc, 15 watts power, and with an experimental clause in regards to operation as municipal police station in emergency service.

*November* 7, 1934.

WILLIAM P. LEAR, NC-13402, granted license for 3105 kc, 150 watts.

CITY OF VENTNOR, N. J., granted construction permit for portable-mobile equipment using frequencies of 30,100, 33,100, 37,100, 40,100, 86,000-400,000, 401,000 kc and above. Power 4.5 watts.

UNIVERSITY OF FLORIDA, Gainesville, Fla., granted construction permit using power of 600 watts and frequencies of 2398, 6425, 12,862.5 kc.

C. ALBIN ANDERSON, Kane County, Ill., granted construction permit for mobile equipment using frequency of 30,100 kc, 5 watts power.

STATE OF NEW JERSEY, Dept. of Conservation & Development Forest Fire Service, Trenton, N. J., granted construction permit; frequencies 33,300, 33,850, 35,400, 35,800, 36,000, 36,500, 38,000, 39,000, 54,000 kc; 100 watts. Budd Lake and Butler, N. J., granted construction permit same as above, except with additional frequencies of 38,800, 40,800 kc. Mt. Holly and Blue Anchor, same as above except additional frequencies 37,800, 39,800 kc.

STATE OF NEW JERSEY, Dept. of Conservation & Development Forest Service, Bridgeton, N. J., granted construction permit; frequenies 33.300, 33,850, 35.400, 35,800, 36,000, 36,500, 38,000, 39,000, 54.000, 38,800, 39,800, 40,800 kc, 100 watts. Also, same dept. Windbeam, Beaufort, Culver Lake, Catfish, Millville, Belle Plains (all N. J.), granted construction permit, frequencies 38,800, 40,800 kc, 5 watts; Retreat, Cedar Bridge, Batso, McKeetown (all N. J.), granted construction permit, frequencies 37,800, 38,800, 39,800, 40,800 kc, 5 watts; Farmingdale, N. J., granted construction permit, frequencies 37,800, 39,800 kc, 5 watts; portable-mobile equipment (N. J.), granted two construction permits same as above except additional frequency, 54,000 kc; portable-mobile (4 applications), granted construction permit, frequencies 38,800, 40,800, 54,000 kc, 5 watts; granted construction permit for portable-mobile equipment on any Aircraft, frequencies 37,800, 38,800, 39,800, 40,800, 54,000 kc, 5 watts; Airplane Hangar, Mercer County, N. J., and Mizpah, N. J., same; Edison, Lake Hurst, Maple Shade, N. J., granted construction permit, frequencies 33,300, 33,850, 35,400, 35,800, 36,000, 36,500, 38,000, 39,000, 37,800, 38,800, 39,800, 40,800, 54,000 kc, 5 watts.

STANDARD OIL COMPANY of Calif., NC-14285, granted authority to operate itinerant aircraft station on 3105 kc, 50 watts.

WESTCHESTER COUNTY, Emergency Work Bureau, granted 6 construction permits, portable-mobile, frequencies 31,600, 35,600, 38,600, 41,000 kc, 2 watts, with authority to communicate on an experimental basis in connection with triangulation project being conducted in collaboration with U. S. Coast and Geodetic Survey.

*November* 14, 1934.

A. R. BRUEGER, Wrangell, Alaska, granted construction permit (Public Coastal) 2538 kc, 50 watts.

COMMONWEALTH OF MASS., Dept. of Public Safety, Division of State Police, granted construction permit (5 applications), portable-mobile equipment, general experimental purposes, frequencies 30,100, 33,100, 37,100, 40,100 kc, 2 watts.

STATE OF WASHINGTON, Highway Dept., Skykomish, granted construction permit, Emergency State Police, 2490 kc, 10 watts.

STATE OF WASHINGTON, Highway and Police Dept., granted construction permit, mobile equipment (Rotary Snow Plow), 2490 kc, 10 watts.

CITY OF BERKELEY, Calif., granted special temporary authorization (portable-mobile) to operate 3 general experimental stations communicating as Municipal Police Stations, frequencies 33,100, 5 watts.

PACIFIC ALASKA AIRWAYS, Inc., Koyuk, Alaska, granted construction permit for new station, frequencies 3082.5, 5692.5, 8220 kc, (2) 2648, 4125, 6570 (day only), 8015 kc, 15 watts.

*November* 21, 1934.

TEXACO DEVELOPMENT CORP., granted construction permit, portable equipment (La., Calif., Texas, and Okla.) (10 applications), frequencies 1602, 1628, 1652, 1676, 1700 kc, 10 watts.

CITY OF MARCED, Calif., Police Dept., granted construction permit, portable-mobile equipment, 40,100 kc, 5 watts; also granted construction permit for 37,100 kc, 15 watts, to communicate as Municipal Police Station in emergency service.

*November* 28, 1934.

CITY OF NEWARK, N. J., granted construction permit and license Aviation-Airport, frequency 278 kc, 15 watts.

ADAM W. LIPKE, Seldovia, Alaska, granted construction permit, frequency 3265 kc, 25 watts.

GEO. D. PRESTON, VIOLA D. PRESTON, doing business as Preston Radio Service, granted construction permit (2 applications), portable-mobile equipment (Maine), frequencies 2398, 4797.5, 8655, 31,600, 35,600 kc, 10 watts.

ST. LOUIS METROPOLITAN POLICE DEPT., Mo., granted construction permit, portable-mobile equipment, 30,100 kc, 15 watts.

HENRY E. GOLDENBERG, granted construction permit, portable-mobile (Mo.), frequencies 31,600, 35,600, 38,600, 41,000, 86,000-400,000 kc, 10 watts. Also granted a similar construction permit except for 2 watts power.

CITY OF CLEBURNE, Texas, granted construction permit, 1712 kc, 50 watts.

CITY OF SACRAMENTO, Calif., granted construction permit, 2422 kc, 500 watts.

ARIZONA STATE HIGHWAY DEPT., Phoenix, Arizona, granted construction permit, 1698 kc, 1 kw.

I. McGEE, Anchorage, Alaska, granted construction permit, 2922 kc, 2946 kc, 25 watts.

SUPERIOR OIL COMPANY, NC-13774, granted aircraft station license for frequency 3105 kc, 50 watts, emission A1, A2, A3.

HERBERT G. FALES, NC-625-E, granted aircraft station license for frequency 3105 kc, 15 watts, A3 emission.

*December* 5, 1034.

COLLINS RADIO COMPANY, NC-570-W, granted Aviation-Aircraft license, 3105 kc, 50 watts.

*December* 11, 1934.

NATIONAL BROADCASTING CO., Inc., Bound Brook, N. J., granted license (temporary . . . broadcast pick-up), frequencies 2020, 2102, 2760 kc, 10 kw.

PERKINS BROS. CO., Sioux City, Iowa, portable-mobile, granted construction permit for general experimental station to operate as a broadcast pick-up, frequencies 31,100, 34,600, 37,600, 40,600 kc; 2.7 watts unlimited time.

### Broadcast Division

*October* 10, 1934.

ABERDEEN BROADCAST CO., Aberdeen, S. Dak., was granted construction permit for a new station to operate on 1420 kc, 100 watts and for full daytime hours.

RICHARD AUSTIN DUNLES, Wilmington, N. C., was granted construction permit for a station to operate daytime on 1370 kc, 100 watts.

E. J. REGAN AND F. ARTHUR BOSTWICK, doing business as Regan and Bostwick, St. Albans, Vt., were granted construction permit for experimental purposes to operate on 406,000 kc at 5 watts.

NATIONAL BROADCASTING CO., INC., New York City, was granted construction permit for portable-mobile equipment to be used for general experimental purposes at 15 watts power. The frequencies are 17,310; 23,100; 25,700; 26,000; 27,100; 31,100; 34,600; 37,600; 40,600; 86,000-400,000 and 401,000 kc. A license covering the same was also granted.

CLARION BROADCASTING CO., INC., Clarion, Pa., was granted its application for a station to operate on 850 kc with 250 watts, daytime hours.

*October* 16, 1934.

WILLIAM J. SANDERS, New Britain, Conn., was granted construction permit for station to operate daytime on 1380 kc at 250 watts.

HEAD OF THE LAKES BROADCASTING CO., Hibbing, Minn., was granted construction permit for a station to operate unlimited time on 1210 kc with 100 watts power.

PLATTSBURGH BROADCASTING CORP., Plattsburg, N. Y., was granted construction permit for a station to operate daytime on 1310 kc with 100 watts. The site of the transmitter is to be determined.

A. M. ROWE, INC., Fairmont, W. Va., was granted construction permit on portable-mobile equipment to be used for general experimental purposes to operate on 31,100; 34,600; 37,600 and 40,600 kc with 10 watts power.

*November* 13, 1934.

J. H. SPECK, Santa Fe, New Mex., granted construction permit for station to operate on 1310 kc, 100 watts. Unlimited time.

JOSEPH M. KIRBY, Boston, Mass., reconsidered and granted in part application for construction permit for radio station to operate daytime only on 1120 kc, 500 watts. The part requesting 250 watts night was left on the hearing docket.

PATRICK H. GOODE, New Haven, Conn., granted amended application to erect broadcasting station to operate on 900 kc, 500 watts, daytime only.

GEORGIA SCHOOL OF TECHNOLOGY, granted construction permit, portable, 1622, 2190 kc, 5 watts, with special high-quality telephony-communication band width 10 kc. Also granted similar permit, except power 10 watts.

*November* 27, 1934.

W. WRIGHT ESCH, Daytona Beach, Florida, granted construction permit for station to operate on 1420 kc, 100 watts, unlimited time.

BAMBERGER BROADCASTING SERVICE Inc., Newark, N. J., granted general experimental construction permit for special facsimile communication, frequencies 31,600, 35,600, 38,600, 41,000 kc, 1000 watts, location to be determined.

### Telephone Division

*November* 8, 1934.

MUTUAL TELEPHONE CO., Honolulu, T. H., granted general experimental construction permit (2 applications) portable, frequencies 86,000-400,000, 401,000 kc and above, power 100 watts.

*December* 12, 1934.

PAN AMERICAN AIRWAYS, Inc., granted construction permit for portable equipment to be operated near Baltimore, frequencies 3082.5, 5375, 5692.5, 8220 kc, 25 watts.

CITY OF CHICAGO, Bureau of Parks, Recreation and Aviation, granted construction permit for portable-mobile equipment to be used for general experimental purposes on 31.600, 41,000 kc, 5 watts.

### MEMORANDUM TO PARTIES OF RECORD

In a regular meeting of the Telephone Division of the Federal Communications Commission, December 13, 1934, the Telephone Division having under consideration the matters presented by briefs and oral argument pursuant to Telephone Division Orders No. 7 and 7-A authorized the following statement:

The Division has considered the matters and things presented, including the question of notice or time necessary under the law prior to the effective date of changes in accounting rules.

The Division is of the opinion, considering all of the facts and circumstances, including the other emergency duties before the Commission, that it will not be practicable to promulgate changes in Accounting Rules for Telephone Companies effective for the year beginning January 1, 1935.

The Division is assured of the fullest cooperation of the State Commissions, and will expect to arrange for a series of conferences with the State Commissions, in ample time for the issuance of an order on changes in the Uniform System of Accounts for Telephone Companies prior to July 1, 1935, to become effective January 1, 1936.

### ORDER NO. 10-A—DOCKET NO. 2552

In a regular meeting of the Telephone Division of the Federal Communications Commission, December 13, 1934, the Telephone Division having under consideration the orders and memoranda heretofore issued by the Interstate Commerce Commission in its Docket No. 14700, Depreciation Charges of Telephone Companies, effective January 1, 1935, and the hearing and argument thereon:

*IT IS ORDERED*, That the said orders of the Interstate Commerce Commission be, and they are hereby, amended as follows:

(a) By changing the effective dates of said order of July 28, 1931, applicable to Class A telephone companies, from January 1, 1935, to January 1, 1936.

(b) By extending to May 1, 1935, the time within which the State Commissions, if they so desire, may submit original recommendations to this Commission for its consideration in issuing any orders specifying the composite annual percentage rates to be used by Class A telephone Companies.

*Provided*, that the estimates of composite percentage rates submitted by telephone companies to the State Commissions and to this Commission are for the information of the several Commissions, but shall not be deemed to be prima facie correct.

*Provided further*, that nothing in the foregoing shall be construed as relieving telephone companies from accounting for depreciation by the application to the primary plant account of composite annual percentage rates based upon the best estimates available of service lives and salvage values, as required by the Uniform System of Accounts for Telephone Companies, (First Revised Issue, 1933), unless and until further ordered by this Commission in accordance with the foregoing order.

### COMMISSION ORDER NO. 8

At a general session of the Federal Communications Commission held at its office in Washington, D. C., on the 7th day of December, 1934, the Commission having under further consideration the matter of regulations governing authorizations of persons, under Section 212 of the Communications Act of 1934, to hold the positions of officer or director of more than one carrier:

*It is ordered*, that the regulations prescribed in Commission Order No. 4 adopted on October 9, 1934, as amended in Commission Order No. 7 on November 2, 1934, apply to any person authorized by or undertaking for each of two or more carriers to perform the duties, or any of the duties, ordinarily performed by a director, president, vice president, secretary, treasurer, general counsel, general solicitor, general attorney, comptroller, general auditor, general manager, general commercial manager, chief engineer, general superintendent, general land and tax agent, or chief purchasing agent.

# VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

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

## LEE L. MANLEY

THE STORY OF HOW Lee L. Manley qualified for membership in the Veteran Wireless Operators Association may have been told. Even so, it is worthy of repetition.

Years ago while Mr. Manley was a marine radio construction man, an inventor designed what he claimed to be an unsinkable lifeboat, the qualities of which he wished to demonstrate by making a trip across the Atlantic.

A wise man, this inventor, he wanted "wireless" in his boat. Manley, then with the Marconi Company, was assigned to make the installation. When the question of an operator came up, Manley volunteered. This, it must be said, was before there was a Mrs. Manley or a pretty daughter, "Bubbles."

The boat started on its voyage and after passing out of New York's lower harbor met an ocean swell so heavy that the boat capsized. A convoy tug was just about to make its turn back but, luckily, was near enough for the inventor-captain and his wireless man to be rescued.

So the fact cannot be disputed but what Manley went to sea—even if only for a few inches. At any rate he went into the sea as wireless operator. And, of course, his upholding the tradition of bravery counts a bit as well.

However, he did go to sea later, as a passenger, when he traveled half-way across the Pacific and back as one of the engineer crew which constructed the transoceanic radio transmitting station on the Hawaiian Islands. Furthermore, he has been a radio expert from back into his school days.

As a boy, though, he aspired to chemistry. He had a chemical laboratory in the basement of his home. Boyish endeavors to concoct a chemical compound as a substitute for TNT made it compulsory to change to another pursuit. His laboratory was transformed into a workshop and from that time his chief hobby has been mechanics.

You would not exactly call him a mechanic, rather an executive type, as has been shown by the responsible executive posts he has held. Still, whether it is the construction of radio manufacturing machinery, the repair of an automobile, an airplane, or the intricacies of a household gadget, you are assured that he knows as much about how the work should be done as the mechanic doing the job.

And, most assuredly, he knows radio equipment—inside and out. Radio practically was still in its infancy—and Manley not far removed from that stage of his own life—when radio entered his workshop and home laboratory. And let us record here that . . . .

Lee L. Manley is credited with having given the first lecture on, and demonstration of, radio in an Ameriacn public school. His classmates in that Brooklyn school thought him a wizard. Incidently, that talent for orignial ideas is still with him—a sort of second nature, his associates say.

After school came radio in earnest and it was then that we find him as a construction man on ships along New York's West Street piers. Not many years later—for Mr. Manley is still a young man, it must be remembered—he had worked his way to the top as superintendent over a large marine radio maintenance, repair and inspection force.

LEE L. MANLEY

In the meantime, however, he had performed some important services. In addition to his engineering work on the station in Hawaii, he took part in the construction of the high-powered transoceanic station at New Brunswick. He was also, for a time, a marine district manager at Philadelphia.

Perhaps Mr. Manley's greatest achievement was as organizer and manager of RCA's national service division. Many of the present-day policies, particularly that of the issuance of comprehensive service data, originated with his pioneer work at a time when there were no set standards of procedure.

Today Lee L. Manley is head of engineering and production at the Hugh H. Eby, Inc. manufacturing plant in Philadelphia. In recalling his accomplishments, the radio world, in which he enjoys unusual popularity, will say that he is the right man in the right place in the production of the famous Eby products.

Mr. Manley is a member of the board of directors of the Veteran Wireless Operators Association. His prominence in radio once prompted his selection as a nominee for the organization's presidency but, using the words of another great character, he did not "choose to run."

## CHRISTMASTIDE

By C. S. A.

THE SEASON OF SOLEMNITY is with us once more and casting about in revery of the significance of Christmas in its relationship to the birth of things new, the present portends a new culture of human values and the use of man-made things for a more abundant life, both physical and spiritual. In the dawn of the new day will be dispelled the depression of the past and good will radiate in ever increasing frequency to those attuned to the motif of Christmastide.

The Officers and Directors of our Association extend to our membership the season's greetings for a Merry Christmas and a Happy and Prosperous New Year.

## "FLASHES"

By W. S. F.

THE FIRST SHIP! . . . The first message! . . . Georgia . . . The Galveston sea wall . . . . The New Orleans Mardi Gras . . . The delicious Pina Fria at Havana . . . Riding through the Panama Canal before the water was let in . . . War! . . . The sight of the glittering sun on a German submarine rising to the surface for attack within a stone's throw of the ship and the exciting zig-zag chase which followed . . . The lead-covered code books . . . London! . . . Comparing the Underground Tubes with the subways of Paris, New York, Philadelphia and Boston . . . Walking along Baker Street thinking of Sherlock Holmes . . . The fearful daze in alighting from moving left-hand buses in left-side traffic . . . Standing on Longitude 0 at Greenwich, with one foot on the East side of the world and the other on the West . . . Sitting for and obtaining an English radio license and being told it was one of the only three ever issued to other than British subjects.

## PERSONALS

GEORGE H. CLARK returned recently from the Chicago World's Fair looking hale and hearty. Glad to see you George . . . McIlvain Ross, Radio Officer aboard the S. S. Algonquin of the Standard Vacuum Company remits M. O. for 1935 dues . . . Ye Sec'y will be glad to mail 1935 membership cards to all members who do likewise . . . Many thanks to Fred Meinholtz, Director of Communications for the New York *Times*, for information re the Morro Castle disaster . . . Karl Baarslag sailed south aboard the Yacht Vagabondia to bask in the actinic rays of Miami's warm winter sun . . . Interesting inquiry from Gordon de B. Brown of Menlo Park, Calif., re membership in V. W. O. A. . . . P. C. Ringgold now at the Radiomarine offices at 75 Varick Street . . . A. J. Costigan back from the Lisbon Radio Conference . . . Federal Communications Commission offices at 641 Washington Street (Federal Building). Nice arrangement. Moved from Sub-Treasury Building. In the words of O. O. McIntyre—"one of the nicest persons we know"—Mr. Manning of the F. C. C. office in New York . . . E. W. Dannals who designed station WEVD in New York City, formerly associated with Wired Radio Company is at present connected with the Premier Crystal Laboratories. E. W. D. was at the last meeting. Glad to see you again OM. . . .

## IN MEMORIAM

WE REGRET TO learn of the untimely decease of two truly veteran radiomen—"Jerry" Simpson, 30 year retired U. S. Navy Chief Radioman more recently associated with RCA Institutes in New York as Instructor, and Charles Stellmach to whom Gilson V. Willets, Charter Member of our Association paid a beautiful tribute in a newspaper article appearing in the Los Angeles *Examiner* under date of October fifth. We extend, on behalf of the Association membership, sincerest sympathies and condolences to the families of "Jerry" Simpson and Charles Stellmach in their bereavement.

# OVER THE TAPE . . .

NEWS OF THE RADIO, TELEGRAPH AND TELEPHONE INDUSTRIES

### DR. LANGMUIR HONORED BY JAPAN

Dr. Irving Langmuir, Associate Director of the General Electric Research Laboratory at Schenectady, has been awarded the Fourth Order of the Rising Sun by the government of Japan, where he has been delivering a series of lectures for the Iwadare Foundation, which is operated by the Japanese Institute of Electrical Engineers. The decoration is bestowed by Japan in recognition of distinguished service.

Subjects upon which Dr. Langmuir, recent Nobel prize winner in chemistry, addressed the Japanese scientists included: "Fundamental Industrial Research," "Surface Chemistry," and "Electric Discharges in Vacuum and Gases at Low Pressures." The series of six talks included two on each of the three topics.

### RCA CAPITAL STRUCTURE

General J. G. Harbord and Mr. David Sarnoff, Chairman and President, respecspectively, of the Radio Corporation of America, recently stated that a readjustment of the capital structure of the Radio Corporation has from time to time been discussed informally with the Board of Directors. At their request a Committee of the Board has recently been studying the subject more actively. A plan is expected to be presented to the Board for early consideration. Any proposal would, of course, be submitted to the stockholders for their approval.

### NEW BRUSH REPRESENTATIVE

Arthur H. Baier, Manufacturer's Representative, 2015 East 65th Street, Cleveland, Ohio, has been appointed Ohio Representative for the Brush Development Co., Cleveland, Ohio, whose line comprises Sound-Cell Microphones, Phonograph Pick-ups, Tweeters, Loudspeakers, and the like.

### CHANGE OF ADDRESS

The New York City sales office of the American Transformer Company has been moved from 11 E. 41st St. to 30 Rockefeller Plaza. The new telephone number is Columbus 5-4767.

Mr. Ivor B. Watts is in charge of Amer-Tran's audio transformer sales in New York City. Mr. Watts has been connected with American Transformer Company since 1927 and has been engaged in sales work for the past five years. Previous to February, 1934, Mr. Watts was employed at the Company's main office at 178 Emmet St., Newark, N. J.

### RCA VICTOR BULLETIN 45

The RCA Victor Company, Camden, N. J., recently released Bulletin 45 on Remote Pickup Equipment, Type OP-4. This 8-page bulletin is profusely illustrated and contains information on their Type OP-4 portable speech-input system. Briefly, some of the information included is on the importance of outside pickups, quality, the complete and self-contained features, the portability of the equipment, assembly and housing, electrical design, three-position studio-type mixer, non-microphonic high-gain amplifier, interstage volume control, adjustable-level volume indicator, metering, monitoring, and their inductor microphone (including specifications).

Further information may be obtained by addressing the Transmitter Section of the RCA Victor Company.

### NEW QUARTERS FOR CURTIS

The Curtis Condenser Corp., of Cleveland, Ohio, manufacturers of Electrolytic Condensers, have moved their factory into larger quarters at 3088 W. 106th St. This move was necessitated by the fact that they were unable to increase production in their old plant to keep abreast of orders. The new plant will allow for much larger production which enables them to meet all requirements for Curtis Electrolytic Condensers.

### MACKAY OPENS RADIO-TELEGRAPH SERVICE TO JAPAN

Direct high-speed radio-telegraph service between the United States and Japan was opened on November 14, by the Mackay Radio and Telegraph Company, a subsidiary of the International Telephone and Telegraph Corporation, and the Japanese Government radio administration.

This new service with Japan is available to all parts of the United States through the facilities of Postal Telegraph. In Japan, direct communication is provided to all points through the Japanese Government telegraph system which connects with the radio station at Tokio.

From New York and the eleven other principal cities in which Mackay Radio operates, the circuit with Japan is radio all the way.

### "THE TRADING POST"

A recently announced department of the Harrison Radio Company, New York City, may prove of interest to the smaller stations and the new 100-watt broadcasters. It is known as the "The Trading Post" and, it is stated, deals in used apparatus that is in good operating condition.

Cash or apparatus that you need may be obtained in exchange, and it is further stated that every item is carefully and accurately tested in the laboratory of the Harrison Radio Company to insure its perfect condition and accuracy of description.

### NEW AMERTRAN CATALOG

The American Transformer Co., 178 Emmet Street, Newark, N. J., have recently issued a new catalog on Transformers for Audio Amplification and Transmission. This 32-page catalog is well illustrated and contains a great deal of helpful and interesting information and technical data on the AmerTran line of transformers.

Included in this AmerTran catalog are: Mixing transformers, line-to-grid transformers, interstage transformers, interstage driver transformers, plate-to-line transformers, output transformers, line-to-speaker transformers, bridging transformers, audio reactors, equalizers, plate-filament transformers, filter reactors, filament transformers, plate transformers, rectifier circuits, power-supply units.

Copies of this catalog, Bulletin No. 1002, will be sent on request to the above company.

Also available is a De Luxe Edition of this catalog which is 8½ x 11 inches and printed by letterpress on 80 lb. coated stock. There is a minimum charge of 10c on this latter catalog to cover the costs of postage and mailing.

### NEW KYW OPERATING STAFF

Mr. E. H. Gager has been appointed Plant Manager of Westinghouse KYW in Philadelphia. For the past several months he has been in charge of the construction of the new station. Mr. Gager at one time was Assistant Superintendent of the Commonwealth Edison Company in Chicago, serving in this capacity for 19 years. From 1922 to 1925, he was associated with KYW in Chicago. For four years, he was Chief Engineer of WEMR in Chicago, later becoming Staff Engineer with the National Broadcasting Company for two years. Mr. Gager's duties will include complete technical supervision of the studio and station of KYW in Philadelphia.

Mr. A. C. Goodnow, formerly Studio Supervisor at KDKA, will hold the same position at KYW. The Control Operators will include F. M. Sloan from KDKA, I. N. Eney and C. E. Donaldson from WBZ.

Mr. J. J. Michaels, formerly Chief Operator of KYW in Chicago, will be Chief Operator at the Philadelphia transmitter, and his operating staff will include Bryan Cole, Bernard Clark and W. C. Ellsworth. Mr. Clark was formerly of the Radio Broadcasting Headquarters Staff and Mr. Ellsworth of the Radio Engineering Department of the Radio Division of Westinghouse in Chicopee Falls.

### ROLLER-SMITH CATALOG

The Roller-Smith Company, 233 Broadway, New York, N. Y., have recently made available Catalog No. 10 covering the Kathetron Out-Voltage Regulator. Oscillograms, curves, and technical data are included in the catalog on this regulator, which is a device that may be used for customers' premises and industrial applications where the input line voltage is reasonably constant but where objectionable delivered voltage drop is caused by relatively heavy sudden demands.

## G-E RADIO PROGRAM APPOINTMENTS

Following the recent announcement by C. E. Wilson, Vice President of the General Electric Company, that General Electric radio receiving sets will be manufactured at the Bridgeport, Conn., works, beginning with the new line to be introduced in the late summer of 1935, comes the announcement of the names and functions of the executives who are to direct this new manufacturing and merchandising program.

Mr. Wilson has announced the appointment of J. A. Proctor as Assistant to the Vice President, with the responsibility of acting for him in the general co-ordination of radio engineering, manufacturing sales activities.

W. Stewart Clark, Works Manager at Bridgeport, has announced that the Design Engineer in charge of the Radio Engineering Section will be I. J. Kaar. The position of Superintendent of Radio Manufacture, it was also announced by Mr. Clark, will be held by R. J. Jenkins.

J. L. Busey, Manager of Sales, Appliance Division, has announced that R. J. Cordiner, formerly Manager of the Heating-Device Sales Section at Bridgeport, has been appointed Assistant Manager of Appliance Sales in general charge of sales development for G-E radio.

B. C. Bowe, it was announced, will continue as Manager of Sales in the Radio Sales Section, a position he has held ever since the section was established in 1930.

The general administration of the radio department will be in the hands of a Radio Management Committee of three, with R. J. Cordiner as Chairman and Messrs. Jenkins and Kaar as the other two members. Mr. Proctor will also be a member of this committee, ex-officio.

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## UNIVERSAL APPOINTMENTS

The Board of Directors of the Universal Microphone Co., Inglewood, Calif., has appointed a Consulting Advisory Committee to aid in the research laboratory development and distribution of new products.

The list includes K. G. Ormiston, Chief Engineer at KNX, in broadcast problems; Jack Adams, in Charge of Communications at the Hearst Ranch in San Simeon, for public-address systems; H. A. Waggoner, M. D., Hollywood Physician and Surgeon, for hearing-aid devices; Albert R. Rethery, Construction Engineer, Consolidated Steel Corporation, for laboratory research and Ralph L. Power, Ph. D., Public Relations Consultant, for marketing and distribution.

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## GENERAL ELECTRIC BULLETIN

The General Electric Company, Schenectady, N. Y., have recently relased literature on Cutouts, in the form of a sheet, GEA-2030. These Cutouts, it is stated, have the following operating advantages: They will open the circuit faster than any other device (clear in one-half cycle); fuses are quickly and easily replaced; durability and quietness are provided by the housing, which protects all electric parts and effectively muffles noise, even when opening heavy short circuits; heavy self-aligning contacts make possible repeated opening under load; and they afford a wide range of protection, since they may be fused closely to the load.

Further information may be obtained from Bulletin GEA-732D, and all requests should be addressed to Dept. 6-201.

## RCA VICTOR BULLETINS

Bulletin-50 on Air-Cooled Radiotrons for Broadcast Stations has been released by the Engineering Products Division of the RCA Victor Company, Inc., Camden, N. J. This 60-page bulletin is shown in the accompanying illustration, and gives a great deal


of exceptionally valuable and interesting material on air-cooled radio tubes.

Included in this bulletin are: The characteristics, maximum ratings and typical operating conditions of the 203-A/503-A as a-f power amplifier and modulator


(Class B), as r-f power amplifier—Class B (Telephony), as plate-modulated r-f power amplifier—Class C (Telephony), and as r-f amplifier and oscillator—Class C (Telegraphy); installation data; application data; overall dimensions; tube symbols and top view of socket connections; plate characteristic curves; schematic diagram of r-f power amplifier with a nominal output of 100 watts; and the like. Similar information, and in many cases considerably more, is included for the 204-A/504-A (r-f power amplifier, oscillator, Class B modulator), 211/511 (oscillator, r-f and a-f power amplifier, modulator), 800 (r-f amplifier, oscillator, Class B modulator), 841 (r-f power amplifier, oscillator, a-f voltage amplifier), 842 (a-f power amplifier, modulator), 845/545 (modulator and a-f power amplifier), 849/549 (modulator, a-f and r-f power amplifier, oscillator), 852/552 (r-f power amplifier, oscillator), 860/560 (screen grid r-f power amplifier), 865/565 (screen grid r-f power amplifier), 866-A (half-wave mercury-vapor rectifier), and 872/572 and 872-A (half wave mercury-vapor rectifiers).

Also available is Bulletin 51. This booklet, also shown, presents technical information on water-cooled transmitting types of RCA Radiotrons as well as on some air-cooled types frequently used in transmitting equipment.

For each of the various types arranged in sequence, recommended maximum conditions of operation and also typical operating conditions are given. In most cases, this information is supplemented by a dimensional outline drawing of the type and a curve family.

Included among these tubes are the following types: 10-special, 206, 207, 214, 217-A, 217-C, 218, 219, 801, 831, 843, 844, 846, 848, 850, 851, 857, 858, 861, 862, 863, 864, 866, 869-A, 870, 871, 1651, and 1652.

Bulletin 51 in combination with Bulletin 50 should be found quite useful by all engineers interested in transmitting tubes.

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## NEW WESTON BULLETIN

"Weston Relays" is the title of a new, twelve-page bulletin now being distributed by the Weston Electrical Instrument Corporation of Newark, N. J.

On its pages are grouped comprehensive lines of sensitive, toggle, polarized, power and time-delay relays. The bulletin might well be termed a complete summary of over thirty years' experience in the development and manufacture of relays.

Copies are available by writing the Weston Corporation at Newark, N. J.

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## ZIMMER APPOINTED MANUFACTURING MANAGER FOR SYLVANIA TUBES

Hygrade Sylvania Corporation announces the appointment of H. W. Zimmer as Manufacturing Manager of the Sylvania Tube plant at Emporium, Pa. This position was formerly held by R. W. Roloff, who in January, 1934, was appointed General Manufacturing Manager of Sylvania Receiving Tubes for both the Salem, Mass., and the Emporium plants.

During 1934, until the appointment of Mr. Zimmer, Mr. Roloff has also continued to act as Manufacturing Manager at the Emporium plant. Relief from these duties will permit him to give his entire attention to supervision of receiving tube production in Salem and Emporium.

F. J. Healy remains Manufacturing Manager of receiving tubes at the Salem plant.

All three have had a long connection with the company. Mr. Zimmer was formerly General Purchasing Agent at Emporium and has recently been acting as General Manager of the Hygrade Sylvania Electronics Department plant at Clifton, N. J.

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## TUNGSTEN PRODUCTS

The Cleveland Tungsten Manufacturing Company, Cleveland, Ohio, are exclusively manufacturers of tungsten products. Among their products are the following items: Tungsten carbides, powder, rod, wire, ribbons for heating elements and high-temperature, protected atmosphere furnaces.

# THE MARKET PLACE

NEW PRODUCTS FOR THE COMMUNICATION AND BROADCAST FIELDS

### GEN-E-MOTORS FOR POLICE CAR RECEIVERS

A complete line of motor-generator units designed to replace "B" batteries and vibrator-type power systems in police-car radio receivers is being featured by the Pioneer Gen-E-Motor Corp., 466 W. Superior Street, Chicago, Ill.

The four models comprising the line are compact and cover all police-work applications, being suitable for use in any make of receiver, it is stated.

Employing full annular-ball bearings of the "sealed-in lubrication" type, these Gen-E-Motors are said to operate indefinitely without oiling or attention. Any of the four types can be furnished to operate from a 6-, 12- or 32-volt battery system, with output potentials up to 300 volts. Two of the models are supplied with built-in filter units for noiseless operation.

A bulletin covering the use of Pioneer Gen-E-Motors for police work is now available to dealers and police departments.

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### R-F TRANSMITTING CHOKE

The Coto CI-20, r-f choke, shown in the accompanying illustration, is a transmitting unit designed for the high-power stage. This choke is manufactured by the Coto-Coil Company (subsidiary of Coils, Incorporated), 229 Chapman Street, Providence, R. I.

This unit is wound with five continuous universal tapered pies on a one-half inch

Isolantite core, three inches long. Non-resonant throughout the amateur bands, the effective impedance is said to be high enough to make practical, parallel plate feed.

The CI-20, which is 3⅝ inches by 1⅜ inches in size, has the following electrical characteristics: Inductance, 4.5 mh; current-carrying capacity, .6 to .8 ampere; and dc resistance, 12.5 ohms.

Further information is contained in a catalog which will be sent on requests addressed to the Coto-Coil Company.

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### NEW RADIO-TELEPHONE EQUIPMENT

A new type of radio-telephone equipment which enables captains of fishing vessels, harbor craft and yachts to have telephone service at sea comparable with that on land was shown for the first time at the Marine Exhibit, 80 Broad Street, New York.

When within range of a coastal-harbor radio-telephone station providing this service, captains are able by means of this equipment to talk to their offices, their homes and in fact to almost any destination as easily as though they were on land. They merely pick up a telephone, located for example in the pilot house, press a button on the instrument and say "Marine Operator." Promptly a voice replies with the familiar "Number Please" and the call goes through as do millions of land calls daily. When the ship itself is called, a selective device rings its bell but not that of any other ship.

The equipment designed by Bell Telephone Laboratories for the Western Electric Company consists of a telephone and a control unit, a cabinet about the size of a trunk which contains a 50-watt transmitter and a superheterodyne receiver, and lastly a power unit. Crystal control keeps both transmitter and receiver on frequency at all times, eliminating tuning. One antenna serves for both sending and receiving.

A radio direction finder newly developed for use with this equipment gives bearings to within one percent accuracy even at distances of several hundred miles. The direction of the incoming beam is registered directly on a scale in the pilot house.

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### CELLULOID DISC SHIPMENTS

Paul K. Trautwein of the Recording Supply Company, 58 West 25th Street, New York, announces that effective January 2, 1935, they will be able to make shipments of the Celluloid Disc for recording purposes. Shipments will be made the same day that the order is received. Price schedules will be furnished upon request to the Recording Supply Company at the above address.

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### NEW ALUMINUM ALLOY

Paul K. Trautwein, President of Mirror Record Corporation, 58 West 25th Street, New York, manufacturers of legitimate blank aluminum discs for recording purposes, announces that they are now supplying a new alloy of aluminum which is far superior to what has heretofore produced. This new disc is also processed by their improved method of lubrication.

While this new alloy material costs considerably more than the previous stock, at the present time there will be no increase in the price and in some cases a reduction, it is stated.

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### MOVING-COIL MICROPHONE

Audio Research, Inc., 105-107 East 16 Street, New York City, have a moving-coil microphone designed to meet the requirements of ease of operation, ruggedness, maintenance cost, and high tonal fidelity necessary for use in recording, broadcasting, and public-address services. The unit is shown in the accompanying diagram.

Connections are made to three terminals at the back. The case diameter of the unit is 3⅜" and the depth 1¾" . . . the weight is 2¼ pounds.

This microphone has a voice-coil impedance of 30 ohms. The output level is minus 55 db for normal speech at a distance of two feet. While this is about 20 db less sensitive than the conventional carbon-type microphone, it is substantially more sensitive than the other types, it is stated.

The response of this unit is substantially constant from 30 to 9000 cycles. For further information address the above company.

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### S-W PRE-SELECTOR PRE-AMPLIFIER

The new Peak Model P-11 pre-selector pre-amplifier, manufactured by the Eastern Radio Specialty Co., 1845 Broadway, New York, N. Y., is to be used with any type receiver covering from 14 to 200 meters. The following results are said to be obtained by use of this instrument: Increase in signal strength, increase in sensitivity,

absolute rejection of image, increase in selectivity, and decrease of signal-to-noise ratio.

High gain is obtained through the use of electron-coupled regeneration in conjunction with two tuned stages of r-f, it is stated. No plug-in coils are used, the entire set of coils being incorporated in the unit. Band changes are made by means of a selector switch having silver-plated arms and contacts.

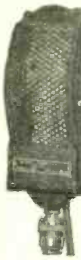
This unit, which is shown in the accompanying illustration, has a self-contained filament supply. The overall dimensions of the cabinet and chassis are 7 x 9 x 10 inches.

The Peak pre-selector pre-amplifier is said to be not a short-wave converter, but an auxiliary equipment which gives astonishing improvement to any all-wave or short-wave receiver in the 14-200 meter bands.

### MODEL "M" VELOCITY MIKE

The new De Luxe Model "M" Velocity Microphone, shown in the accompanying illustration, has been designed to meet the requirements of broadcasting studios, recording studios, sound-equipment companies and public-address users, states their manufacturer, the Bruno Laboratories, 22 W. 22nd St., New York City.

Two cobalt magnets are used to produce the magnetic field in which is suspended



the aluminum alloy ribbon. These magnets are placed vertically, end to end, and the ribbon suspended in the dense portion of the magnetic field. A sound wave striking the ribbon will then continue to travel without impediment and will not be reflected back by the inner portion of the horseshoe magnets as is the case of poorly designed velocity microphones, it is said.

These units are said to possess a rugged construction, a flat frequency-response curve from 30 to 14 cps, a directional characteristic enabling the reduction of acoustic feedback, and are said to not be subject to variations of humidity and temperature. The matching transformer used in these mikes are wound on permalloy cores with an impedance output of either 200 or 500 ohms, although other ohmages can be supplied.

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### WRIGHT-DeCOSTER REPRODUCER

The Model S. W. 429, Wright-DeCoster reproducer has been designed by Wright-DeCoster, Inc., St. Paul, Minn., for use in shortwave reception. Its power handling capacity and its sensitivity makes the Model S. W. 429 suitable for the smallest laboratory or for a really good-sized room or small hall, it is stated.

This unit has a 10-inch cone, the outside measurement of cone bracket being 12⅛ inches, the depth 8¾ inches, the height 14 inches and the width 14 inches. The standard voice-coil transformer has an impedance of 4000 ohms, the voice-coil impedance being 10 ohms at 400 cycles. A 25Z5 rectifier tube is included.

The speaker operates on 110- to 115-volt, 50/60 cycle, alternating current.

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### NEW CIRCUIT BREAKER

Westinghouse announces a new low-voltage "De-ion" breaker, similar in general to the standard 600-ampere, 600-volt AB breaker brought out several years ago, with the major exception that the new breaker has an interrupting capacity of 20,000 amperes. The new AB-20 is totally enclosed, being mounted in the standard 600-ampere molded case. It is available in all ratings from 50 to 600 amperes, complete with standard tripping accessories and motor mechanism.

To secure a heavy-duty AB-20 breaker it was necessary to double the interrupting capacity of the standard AB breaker. This was accomplished by a complete redesign of the contact structure and major modifications in the "De-ion" chambers and operating mechanism. The cold-cathode principle of arc extinction, which has been successfully used in the standard duty breakers, has been retained.

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### NEW PIONEER GEN-E-MOTOR

The Model JW-F Gen-E-Motor, a motor generator designed to replace vibrator-type power supplies in Ford-Majestic auto radios, has just been announced by the Pioneer Gen-E-Motor Corp., 466 West Superior Street, Chicago.

This new unit, which supplies all plate voltages from a six-volt storage battery, furnishes the exact output voltage required by the Ford-Majestic set, it is stated. It is compact, fitting easily into the space occupied by the vibrator system which it replaces. A single plug-in connection is the only hook-up required.

Complete descriptive literature covering the Model JW-F is now available.

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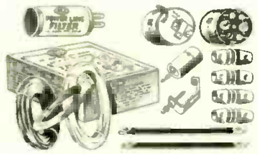
### ALL-WAVE FILTERIZER KIT

Two models of the All-Wave Aerial Filterizer Systems have recently been developed by the Tobe Deutschmann Corporation of Canton, Massachusetts.

Features of the Tobe Filterizer Systems are: Practical and inexpensive installation requirements, true all-wave band efficiency, and great reduction in radio noise and interference pick-up, it is stated.

These all-wave aerial kits are readily adapted to one-quarter wave Marconi or one-half wave Hertz aerials.

One model used is a small line filter



for by-passing noise present on the whole wiring to ground. Model 34 contains one aerial transformer, 50 ft. twisted-pair weather-proof transmission line, one receiver transformer, complete aerial and ground equipment, and power-line filter.

Model 35, is the same as Model 34 except that it is without aerial and ground equipment and power-line filter.

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### SYLVANIA CATHODE-RAY TUBE

The H7-2 cathode-ray tube of the Hygrade Sylvania Corporation, Emporium, Pa., is a general-purpose oscillograph tube equipped with two sets of deflecting plates. It may be used for observation and photography of many transient and recurrent electrical phenomena.

The essential parts of the H7-2 are as follows: A substantial cathode, used as a source of electrons; a control electrode (grid), used for varying the intensity and size of the focused electron beam; two anodes, which accomplish the acceleration and focusing of the electron beam; a fluorescent viewing screen, three inches in diameter, upon which the electron beam is brought to a focus; and two sets of deflecting plates for deflecting the electron beam in two mutually perpendicular directions.

The high-voltage electrode (anode No. 2) voltage is designed for a maximum of 1,200 volts, and the maximum focusing electrode (anode No. 1) voltage is 250 volts. The grid voltage is never positive, the grid voltage for current cut-off with approximately 200 volts on anode No. 1 being nearly —35 volts. The H7-2 heater voltage (ac or dc) is 2.5 volts, while the heater current is 2.1 amperes. Heating time is around 0.5 minute.

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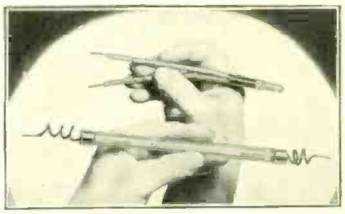
### "TATTELITES"

The Littelfuse Laboratories, 1772 Wilson Ave., Chicago, Ill., have announced Tattelites, their addition.

Tattelites are a line of neon discharge tubes having breakdown potentials of 100, 250, 500, 1,000, and 2,000 volts. They are really voltage fuses, protecting equipment against excessive voltages, whereas regular fuses protect against excessive currents. They operate by shunting out the overload.



This line of fuses prevent insulation breakdowns; protect voltmeters, ammeters, transformers, condensers, and gaseous rectifiers against voltage surges; make radio lightning arresters, and leak off static charges from machinery; test for blown fuses, defective resistors, and condensers; indicate radio frequency, resonance peaks, high tension lines; and are used in making saw-tooth oscillators, trigger circuits, bleeders for dc power supplies and stroboscope effects.

Tattelites are described in the new Littelfuse Catalog No. 6, available upon request.

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### NEW CATHODE-RAY TUBE

The Allen B. DuMont Laboratories of 542 Valley Road, Upper Monclair, New Jersey, announce a new cathode-ray tube known as the 54-8-C or 94-8-C, being made in two sizes, respectively, 5" and 9".

The type 54-8-C or 94-8-C is designed to eliminate a number of the defects which occur in the ordinary cathode-ray tubes. By a special design of the elements, the threshold effect is eliminated, a more uniform pattern is obtained and the tube has a constant and higher impedance across the deflection plates as the voltage supplied to them varies, it is stated.

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### NEW "UNIVERSAL" RECORDS

"High-Fidelity Silveroid Records" becomes the trade name for a new development in cellulose coated aluminum discs to be put on the market early in December from the Inglewood, Cal., factory of the Universal Microphone Co.

The manufacturers' claim for the discs is that they have a lower background level than anything yet produced in the line of instantaneous recordings.

The records can be cut with the regular sapphire points exactly as in the usual wax transcription recording. They play back with any needle, though best results are said to result from the use of a trailing needle, known to the trade as a "phony." But any type of non-metallic needle now on the market can also be used.

In appearance the Hi-Fidelity Silveroid Records are of a brilliant silvery finish in 12-inch size.

# Yes!

Subscribers may date back their subscriptions to include the first number (October) of Communication and Broadcast Engineering.

A limited number of extra copies have been printed so that files may be kept complete.

The subscription rate is $3.00 yearly. Foreign and Canada $4.00 yearly.

**Bryan Davis Publishing Co., Inc.**
19 East 47th Street
New York City

# Another Station goes HIGH FIDELITY

WITH RCA VICTOR'S MODERN
1 K.W., TYPE 1-D EQUIPMENT


**J. L. GRETHER, Technical Director and Chief Engineer of WTAR, Norfolk, Va., says:**

"With the incentive which the excellent frequency characteristic of the 1-D Transmitter is bound to give the Engineering Department of any station, the broadcasting art as a whole will greatly benefit."

RCA Victor is the *only* organization which designs and manufactures *everything* from the microphone at the broadcast station to the loudspeaker in the home. Only perfect coordination and proper attention to *every* link in this chain can deliver genuine HIGH FIDELITY programs at their destinations.

Why struggle with "patch-work" when a well ordered *system* is available?

## RCA Victor Company, Inc.

ENGINEERING PRODUCTS DIVISION, CAMDEN, N. J.

NEW YORK: 153 E. 24th St. CHICAGO: 111 N. Canal St. ATLANTA: 144 Walton St., N. W.
DALLAS: Santa Fe Building SAN FRANCISCO: 235 Montgomery St.

RCA VICTOR CO., Inc., ONE UNIT OF RADIO CORPORATION OF AMERICA . . . THE WORLD'S LARGEST RADIO ORGANIZATION.
OTHER UNITS: NATIONAL BROADCASTING CO., INC. . . . R. C. A. COMMUNICATIONS, INC.
RCA RADIOTRON CO., INC. . . . RADIOMARINE CORPORATION OF AMERICA