COMMUNICATIONS

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RADIO ENGINEERING

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THE BROADCAST ENGINEER

MARCH
1938

startling

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Illustration exact size.

SOLAR MINICAP Dry Electrolytic Capacitors mark much more than an advance in an art. They mean that filters now occupy less space, cost less, have longer life because of permanent sealing, are used in single units to simplify both production and stock-keeping, and are "standard" parts.

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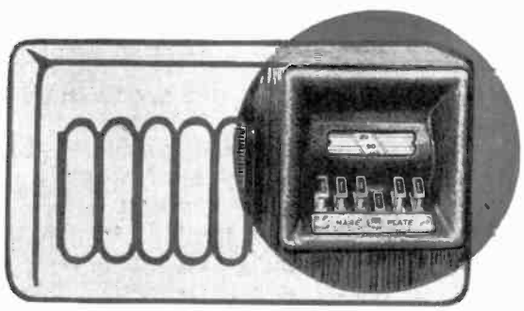
A. W. FRANKLIN MECHANICAL *Push Button* TUNER



THE Franklin Mechanical Push Button Tuner represents fourteen months of constant experimentation and development—more than a year of changes, improvements and rejections. It is an instrument that boasts no intricate assemblage of gears, racks, pinions and stuff—no complicated, trouble-making mechanisms. Here is an engineering triumph of which the radio industry will be mighty proud — a precision-built unit magnificent in its simplicity — positive in its permanent accuracy.

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COMMUNICATIONS

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RAY D. RETTENMEYER • Editors • W. W. WALTZ

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Cover Illustration: A large air-cooled transmitting tube, RCA-861, under exhaust. A power of more than 15 kilowatts is used in heating the metal parts to incandescence. Here the anode of the tube has reached a temperature of 2500°F.; it will rise higher for brief periods. Heating of the interior metal parts facilitates the vacuum pumping by releasing the hard-to-get occluded gases from the metal parts. Photo courtesy RCA Manufacturing Co., Inc.

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Western Electric's NEW 5KW has the DOHERTY CIRCUIT, too!

Final amplifier stage of the new 5KW. At right, W. H. Doherty of Bell Telephone Laboratories inspects the new transmitter.

A FEW FEATURES OF THE 5KW

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RADIO TELEPHONE BROADCASTING EQUIPMENT

WITH THE EDITORS

HIGH-POWER HEARING

IT HAS BEEN announced that the Federal Communications Commission will hold a hearing on May 16 to determine the advisability of amending the Commission's Rule 117, which provides that the authorized power of a dominant clear-channel station shall be not less than 5 kilowatts and not more than 50 kilowatts.

At this hearing all pending applications for permits which request power increases in excess of that permitted by the existing rule will be heard. Among these will be the application of WLW, which is now operating under an experimental license with 500 kilowatts power, as well as stations WHO, KFI, WGN, WSM, WSB, KDKA, KNX, KSL, WBZ, WGY, WHAS, WJR, WJZ, WOR, and WOAI.

The Commission's present regulations provide for 40 clear channels. However, under the existing arrangement there is duplication on about 12 of these channels.

As is usually the case, there are two sides to the problem. It is sincerely hoped, however, that engineering advance will not be retarded for a questionable economic gain.

A CURB ON HIGH POWER?

AND, while on the subject of increased powers, we should like to mention the so-called "Wattage Tax" bill on radio stations. This bill proposes a tax of $1 per watt for stations having powers of 1000 watts and less, $2 per watt for stations between 1000 and 10,000 watts, and $3 per watt for all stations over 10,000 watts.

Frankly, we fail to see any sound reason for imposing additional taxes upon broadcasters. But even if we go so far as to assume that additional taxes might be justified, we still fail to see any logic behind the proposed tax. In the first place, net incomes for radio stations, we believe, are somewhat less than in direct proportion to power, while the bill under consideration assumes a net income considerably greater than in direct proportion. In other words, a 100-watt station would pay a tax of $100, while a 50,000-watt broadcaster would be taxed $150,000 . . . if applications were granted for 500,000 watts, the tax on these stations would be $1,500,000!

If such a tax were to be levied, it would certainly represent a most effective curb on increased powers. As a matter of fact, the tax would probably be so heavy on a number of the present higher powered broadcasters as to render continued operation uneconomical, resulting in a deleterious effect on the entire radio industry. Everyone in the radio field should voice opposition to this proposed tax.

COMMITTEE ON INTERNATIONAL BROADCASTING

ACCORDING to Frank R. McNinch, Chairman of the Federal Communications Commission, the President has appointed an Interdepartmental Committee to study international broadcasting.

The Committee is composed of the following members: Frank R. McNinch, Chairman; Attorney General Homer S. Cummings; Harvey B. Otterman and George H. Butler, of the Department of State; Roy North, Deputy Third Assistant Postmaster General; E. K. Burlew, Administrative Assistant to the Secretary of the Interior and John Ward Studebaker, Commissioner of Education; Leslie A. Wheeler, Chief, Division of Foreign Agricultural Service, Bureau of Agricultural Economics, and E. N. Bressman, Special Adviser to the Secretary of Agriculture; Dr. Alexander V. Dye, Director, Bureau of Foreign and Domestic Commerce; and Warren Lee Pierson, President of the Export-Import Bank.

The Committee is to study and report to the President on international broadcasting problems.

IRE CONVENTION

THE TWENTY-SIXTH ANNUAL Convention of the Institute of Radio Engineers is to be held in New York City on June 16, 17 and 18. The place is the Hotel Pennsylvania. Further information on this gathering will appear in a later issue of COMMUNICATIONS.

COMMUNICATIONS

FOR MARCH, 1938

SELENIUM RECTIFIERS

A DEVELOPMENT of increasing importance in communications and other fields of electricity is the selenium rectifier. The combination of metals which makes a selenium rectifier effective was discovered during research with light-sensitive cells. Metal rectifiers have been in use for many years, and their efficiency and durability have been well established. They hold an important advantage over other types of rectifiers because they require no maintenance and no replacements. Although the rectifying property of selenium has been known for some time, it has remained for this new application to put it to its maximum use. A reliable rectifier of high efficiency and wide versatility has resulted. Present indications are that its service life is practically unlimited, and, inasmuch as there are no moving parts, no assisting agents, there is no question of maintenance. It is a particularly versatile product varying in its application from the rectification of currents as low as a few milliamperes for polarizing direct-current relays, to that of thousands of amperes in electro-plating uses.

The widespread extension throughout the world of alternating-current electrical power has, of course, increased the demand for compact apparatus which will convert the a-c into direct current silently and efficiently.

It is, in effect, an electronic switch which changes the direction of the alternating current at the instant that it passes through zero, but, unlike a mechanical switch, it has no inertia, no moving parts to wear out and require replacement. The selenium rectifier element consists of a nickel-plated iron disc to which metallic selenium is applied. This is subjected to a series of heat treatments. The selenium surface is then coated with a thin layer of special alloy which provides a uniform contact surface to distribute the current evenly over the working material. One of the outstanding features of the selenium rectifier is its uniform performance regardless of contact pressure.

Current will flow easily in the direction from the iron to the selenium, but with great difficulty from the selenium to the iron. The rectifier presents such a low resistance to current in one direction and such a very high resistance in the reverse that if a curve is drawn of current density against voltage drop in the forward and reverse directions, the reverse current is so small that it can hardly be shown on the same scale

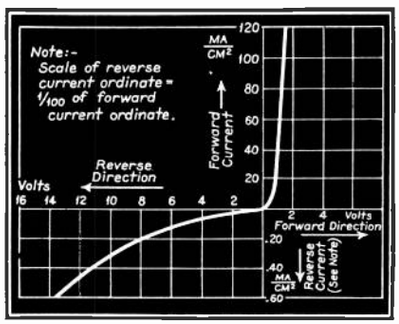


Fig. 1. Static characteristic of a selenium rectifier disc having effective surface area of 1 cm².

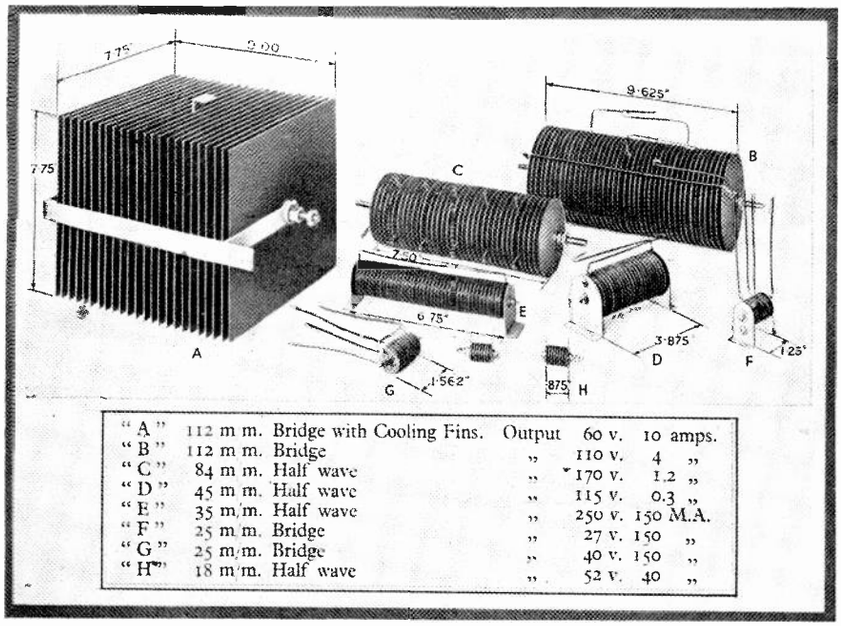
with the forward current. This is illustrated in Figs. 1 and 2 presenting the static characteristics of a selenium rectifier disc having an effective area of one square centimeter. Note should be made that the current scale of Fig. 1 in the reverse direction is magnified one hundred times.

The discs and associated parts of Fig. 3 are assembled on an insulated spindle. Connections are made from one disc to another by spring washers which make contact with the alloy layer on the face of the discs and only normal pressure is required to ensure good connection. The discs are ruggedly built, completely rigid and are not liable to accidental damage. They are unaffected by vibration and are suitable for use in installations where apparatus is subject to mechanical shocks, as exemplified by their success in train lighting sets and other mobile services.

A problem arising with the use of dry rectifiers has been the effect of the operating temperatures. In the solution of this, the use of selenium has been an important step, inasmuch as it can operate with a relatively high ambient temperature. It is obvious that no metal rectifier can operate if the temperature of the cooling air is higher than the permissible temperature of the discs. The latter, then, determines the maximum ambient temperature at which the rectifier can be used, and it is important that this working temperature be sufficiently high to permit flawless operation of rectifiers without the use of fans which means moving parts, possible noise, and increased maintenance. The new selenium rectifier has been developed to withstand relatively high temperatures and it is usually not necessary to apply any special means of cooling although, when heavy currents are used, cooling fins are added to the discs.

This high working temperature and the high permissible back voltage of the selenium discs have furthered compactness, an important factor in a rectifier assembly.

Since the current output from a selenium rectifier is not limited by emissive power but only by maximum temperature, a rectifier which is initially cold can be loaded to many times its normal carrying current for a short time. It is only necessary that the load, when the maximum temperature is reached, should be decreased to the normal value.



"A"	112 m m. Bridge with Cooling Fins.	Output	60 v.	10 amps.
"B"	112 m m. Bridge	"	110 v.	4 "
"C"	84 m m. Half wave	"	170 v.	1.2 "
"D"	45 m m. Half wave	"	115 v.	0.3 "
"E"	35 m/m. Half wave	"	250 v.	150 M.A.
"F"	25 m/m. Bridge	"	27 v.	150 "
"G"	25 m/m. Bridge	"	40 v.	150 "
"H"	18 m/m. Half wave	"	52 v.	40 "

Fig. 10. Showing various sizes, assemblies and ratings of selenium rectifiers.

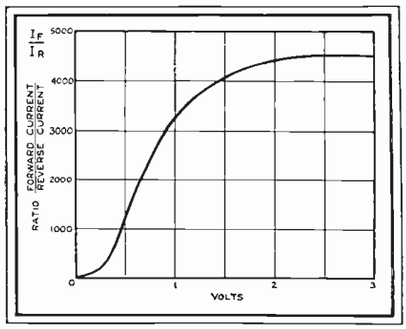


Fig. 2. Rectification ratio, or the ratio of forward to reverse current plotted against voltage.

Fig. 7. Power board for Totalisator equipment (two rectifiers, each with an output of 50 volts at 40 amperes.)

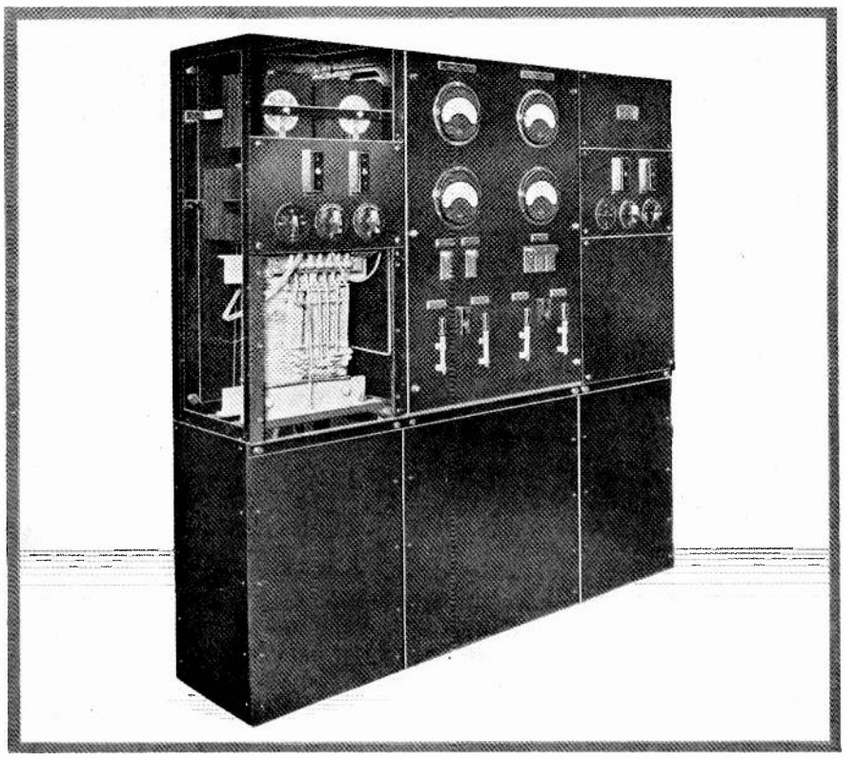


Fig. 4 shows the relation between the operating time and load rating for a temperature rise of 40 degrees C.

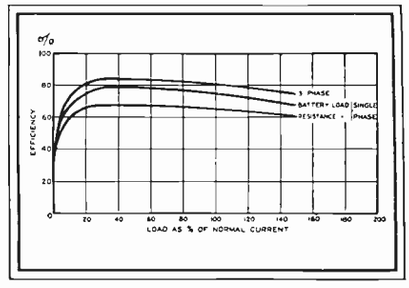
The current overload capacity indicated in Fig. 4 as a function of the operating time applies only to cases where the interval (at least half an hour) between each operation is sufficient to allow for the cooling of the rectifier. For short cooling periods, the curves of Fig. 5 apply. One curve shows the relation between percentage operating time and permissible overload of the rectifier; the other, the corresponding maximum operating time in seconds.

The efficiency of the selenium rectifier varies from 65% to 85% according to the method used for measuring it. It is highly uniform varying little from 15% to 150% of full load. This is due to the fact that the internal resistance falls as the current increases. This is an important factor on a fluctuating load, since the efficiency stays high when the load is reduced. In this respect this rectifier differs from most other electrical apparatus where maximum efficiency is attained only in the neighborhood of full load. To illustrate the efficiency with various types of loads, Fig. 6 shows efficiency as a function of load current for 3-phase currents and single-phase currents of both battery and resistance loads.

A distinction must be drawn between the efficiency calculated as the ratio of the output to the input, when both are measured with a wattmeter, and the efficiency obtained when the output is measured with voltmeter and ammeter of the moving-coil type. The figure in the case, the watt efficiency, is about 85% at full load for all sizes of discs, types of load, and rectifier circuits because the current ratings are determined so that the same final temperature is reached in each case by the rectifier. The volt-ampere efficiency, on the other hand, depends on the form factors of the output voltage and current, and these factors vary considerably for different loads and rectifier circuit arrangements.

As mentioned previously the life of a metal rectifier is practically unlimited, and the selenium rectifier has proved that it is no exception in this respect.

Fig. 6. Efficiency of selenium rectifier operating at full-load voltage.



It has been in use for about seven years. The experience gained shows that, in common with other metal rectifiers, it "ages" slightly—what is, the forward resistance increases—during the first 10,000 hours and then tends toward a constant final value. The resulting drop in output voltage is slight and is frequently compensated for by a 5% tapping on the transformer when it is necessary to maintain output voltage at original value.

Selenium rectifiers are being applied in communications operations as follows: *Telephone and telegraph*—rectifier for operating d-c relays from a-c source, employment of its voltage-resistance characteristic (for relay break delay and for contact spark quenching), polarization of d-c relays, power supply for small telephone exchange, P.B.X.'s and signalling installations (with reserve engine generator), floating battery chargers in signal circuits, in voltage protection circuits, as meter rectifiers; *Radio*—rectifiers for filament or anode supply, avc and detectors in receivers, loudspeaker field supply. Different European designs of rectifier equipment are shown from the large installation in Fig. 7 to the water tight special installation in Fig. 8 and the garage battery-charging equipment in Fig. 9. A view of the various sizes, assemblies and ratings are given in Fig. 10.

This product is of increasing commercial importance among the many communication items manufactured and distributed by associated companies of the International Telephone and Telegraph Corporation throughout the world. It is being used extensively in Europe. Selenium rectifiers are being purchased also in North and South America, Australia, and other parts of the world.

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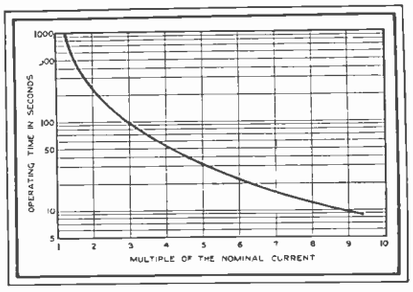
RADIO-EQUIPPED AMBULANCE

A STREAMLINED AMBULANCE, equipped with a General Electric radio receiving set, was recently purchased and put into operation by the New York City Fire Department.

The radio equipment is capable of being tuned to either police or fire department frequencies.

Fig. 4. Short period current-overload capacity of a selenium rectifier.



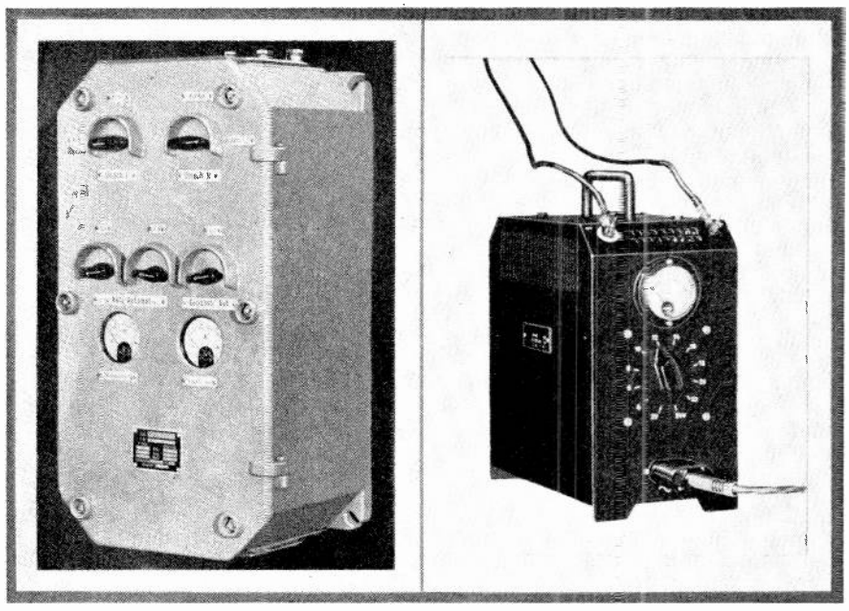


Fig. 8. Left: Battery-charging equipment in water-tight container. Fig. 9. Right: Portable charging equipment.

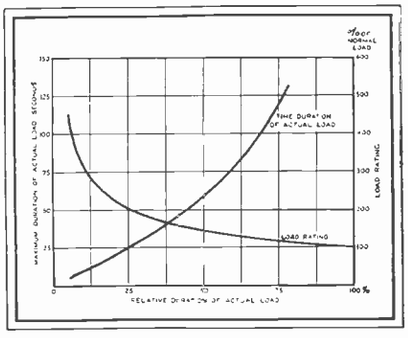
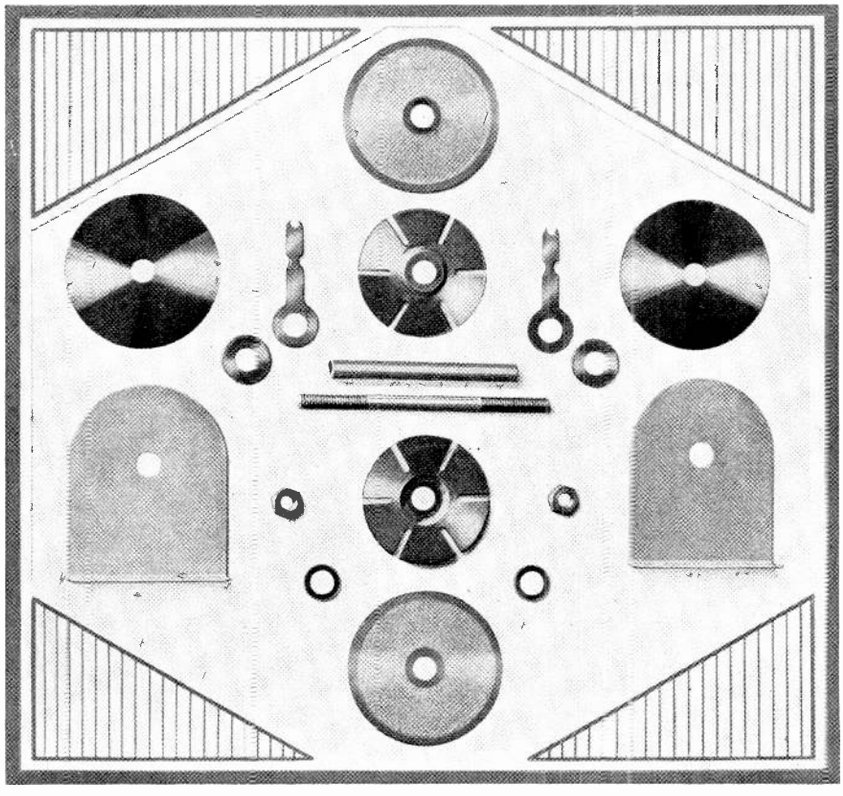


Fig. 5. Overload rating and operating time for a selenium rectifier on intermittent operation.

Fig. 3. Component parts of a Standard selenium rectifier.



CATHODE-RAY ELECTRON BALLISTICS

By F. MALCOLM GAGER

Department of Physics
BOSTON COLLEGE

HOLLMANN[1] and subsequently Libby[2] have indicated that high-frequency cathode-ray deflections as a function of frequency for sinusoidal charge forces on the electron stream are accounted for by a single correction factor and constants. The substance of this paper reveals a generalized correction chart for any cathode-ray tube of known geometry and applied potentials when deflected magnetically or electrostatically by sinusoidal or non-sinusoidal forces. In addition, the treatment calls for a recognition of two dissimilar constants and a more logical reference point for deflection expressions which is more in line with recognized differences between theoretical and experimental deflections.

Let the following represent the quantities:

E_p —The peak value of the deflecting voltage
E_v —The electron-gun velocity voltage giving rise to the horizontal component of particle velocity from the expression $(1/2)\ mv^2 = E_v e$
v —Horizontal electron-gun velocity $5.97 \times 10^7 \sqrt{E_v}$
T —Time of electron flight under the deflecting plates
t —The period 1/f
f —The frequency of the deflecting force
l —The physical length of the deflecting plates
l_ε —The effective length of the deflecting plates
y —The distance of electron fall at the effective tip of the deflecting plates l_ε
dy/dl_ε—The derivative at the point of entrance of the stream electrons into a field of "no force"
D_e —The maximum ray deflection from the neutral axis A-A, Fig. 1, on the screen S due to electrostatic forces

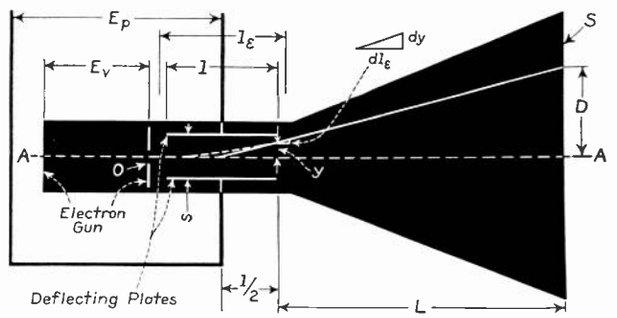
deflecting plates of length l, the effective length l_ε is much larger than the physical length[3]. When the electron stream's particle acceleration is constant during the flight time T, the deflection sensitivity is straight forward and given by

$$\frac{D_e}{E_p} = \frac{L' l_\varepsilon}{2 s E_v} = \frac{l_\varepsilon}{2 s E_v}(L + l_\varepsilon/2) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

and

$$\frac{D_m}{H} = \frac{v L' l_\varepsilon}{2 E_v} = \frac{v l_\varepsilon}{2 E_v}(L + l_\varepsilon/2) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Fig. 1. Skeleton structure of cathode-ray device.



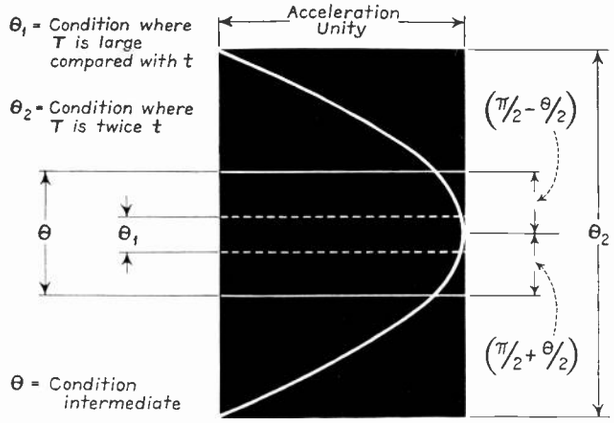


Fig. 2. Half sine wave with superimposed angles of flight.

D_m—The maximum ray deflection due to magnetic forces on the charge stream
L —The distance from the screen S to the effective tip of the deflecting plates l_ε
L' —The distance $(L + l_\varepsilon/2)$
s —The deflecting plate spacing
H —The magnetic intensity.

Fig. 1 indicates a cathode-ray tube with one set of deflecting plates for the purposes of analysis. Due to the fringing of the electrostatic flux at the edges of the

[1]Hollmann—*W.E.&E.W.*, No. 10—1933.
[2]Libby—*Electronics*, Sept.—1936.

These expressions are similar to those idealized in the textbooks by making l_ε equal to l.

THE GENERAL DEFLECTION

When frequency and waveform are considered, there is a definite need for more valid expressions than (1) and (2), and furthermore they cannot be corrected by a single constant. To this end the problem is considered one of particle mechanics and before revealing the results of such an investigation, it is timely to consider particle conditions. First, no matter what path the electron takes to arrive at the effective tip of the deflecting plates, it is clear that the velocity at this point will be determined by the derivative dy/dl_ε at the point. The latter is definitely a function of the waveform of the applied E_p (or the current which produces H) and the time of flight T when E_p is a function of time. Secondly, the distance y at the effective tips of the deflecting plates is not only dependent upon the latter considerations but in addition the full time of flight is not always effective in producing electron fall from the neutral axis A-A.

With the above physical conditions in mind, one can refer to Fig. 1 and write the general deflection expression without immediate regard for the character of the forces on the electron stream. Accordingly the maximum de

(*Continued on page* 15)

[3]R.C.A. 906 and 911 have l = 1.5 cm whereas l_ε = 1.9 cm.

General Cathode-Ray Deflection Sensitivity Corrections

$T = l_\varepsilon / v$, $v = 5.97 \times 10^7 \sqrt{E_V}$

K for all waveforms — No. 2
K = sine wave — No. 1
K = square wave — No. 2
K = triangular wave — No. 3

Electrostatic deflection –

$$D_E = \frac{E_p K l_\varepsilon}{2 s E_V}\left(L + \frac{k l_\varepsilon}{2}\right), \text{ from neutral axis.}$$

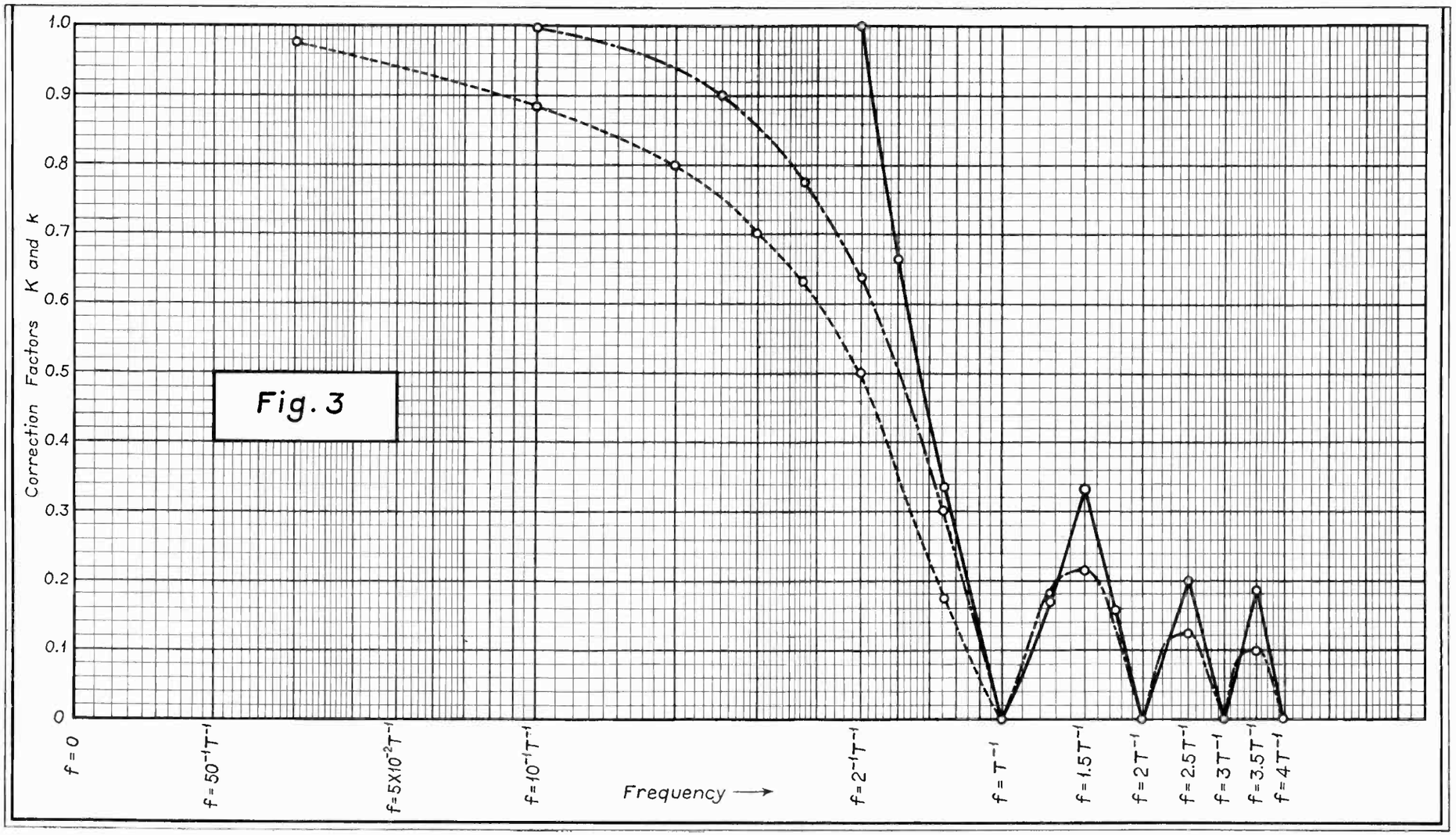
Magnetic deflection –

$$D_M = \frac{v H K l_\varepsilon}{2 E_V}\left(L + \frac{k l_\varepsilon}{2}\right), \text{ from neutral axis.}$$

$$l_\varepsilon = \frac{2 s E_V}{L'}\left(\frac{D_E}{E_p}\right)$$

v – Electron gun velocity

E_V – Electron gun voltage.
L – Distance from screen to tip of deflecting plate l_ε.
l_ε – Effective length of deflecting plates with fringing, and spacing s.



A group photo of those in attendance at the Conference.

THE BROADCAST ENGINEERING CONFERENCE

THE FIRST Annual Broadcast Engineering Conference, held at Ohio State University, Columbus, Ohio, from February 7-18, was a distinct success. The Conference had ninety-six registrations, coming from twenty-five states and three Canadian provinces. These registrations included a large number of operating broadcast engineers, representatives of industry, teachers, and a number of governmental representatives. As a matter of fact, the gathering was so successful that plans are under way to hold it annually in Columbus.

The excellent program of the conference included three timely topics each day, a period of two hours being assigned to each topic. Logically, the first hour was devoted to a formal lecture, while the second hour was given over to a round-table discussion.

Briefly, the speakers and their subjects were as follows: "Field Strength Surveys," by J. F. Byrne, Collins Radio Company; "Coupling Networks," by W. L. Everitt, Ohio State University; "Studio Acoustics," George M. Nixon, National Broadcasting Company; "Ultra-High-Frequency Propagation," by H. H. Beverage, RCA Communications; "Propagation of Broadcast Frequencies at Night," by J. H. Dellinger, Bureau of Standards; "Broadcast Antenna Design," by George H. Brown, Consulting Engineer; "High-Power Radio-Frequency Amplifiers," by W. H. Doherty, Bell Telephone Laboratories; "Modulation and Distortion Measurements," by A. E. Thiessen, General Radio Company; "Indicating Instruments," by H. L. Oleson, Weston Elec. Inst. Co.;

(*Continued on page* 35)

Left: Candid shot of John Morrison (with pipe) talking to Dr. Brown.

Right: Dr. Geo. H. Brown the center of interest at an informal discussion.

HIGH-FREQUENCY TRIODE OSCILLATORS

By GROTE REBER

TRANSIT TIME EFFECTS

RECENTLY considerable work has been done on electron transit-time effects in triode amplifiers and diode rectifiers. These same principles apply to negative-grid triode oscillators. Ferris[1] gives

$$\tau_1 = \frac{K\ (r_G - r_K)}{5.95 \cdot 10^7 \sqrt{V_g}} \quad \text{seconds} \quad (1)$$

$$\tau_2 = \frac{2r_P}{5.95 \cdot 10\sqrt{E'}} \cdot \frac{1}{E_B/E'} \int_{\sqrt{E_B/E'}}^{\infty} \frac{dx}{e^{x^2}} \quad \text{seconds} \quad (2)$$

where

τ_1 cathode-to-grid transit time
τ_2 grid-to-plate transit time
K a function of r_G/r_K
r_K cathode radius in centimeters
r_G grid radius in centimeters
r_P plate radius in centimeters
E_B plate potential in volts with respect to cathode

$$V_g = \left(\frac{3\ I_B}{2\ S_m}\right)\left(\frac{1}{1 + \frac{1}{\mu} + \frac{2}{3\mu}\log r_P/r_G}\right)$$

$$E' = \frac{E_B - V_G}{\log r_P/r_G}$$

and

I_B plate current in amperes
S_m transconductance in mhos
μ amplification factor

[1] "Input Resistance of Vacuum Tubes as Ultra-High-Frequency Amplifiers," by W. R. Ferris, *PIRE*, p. 82, January, 1936.

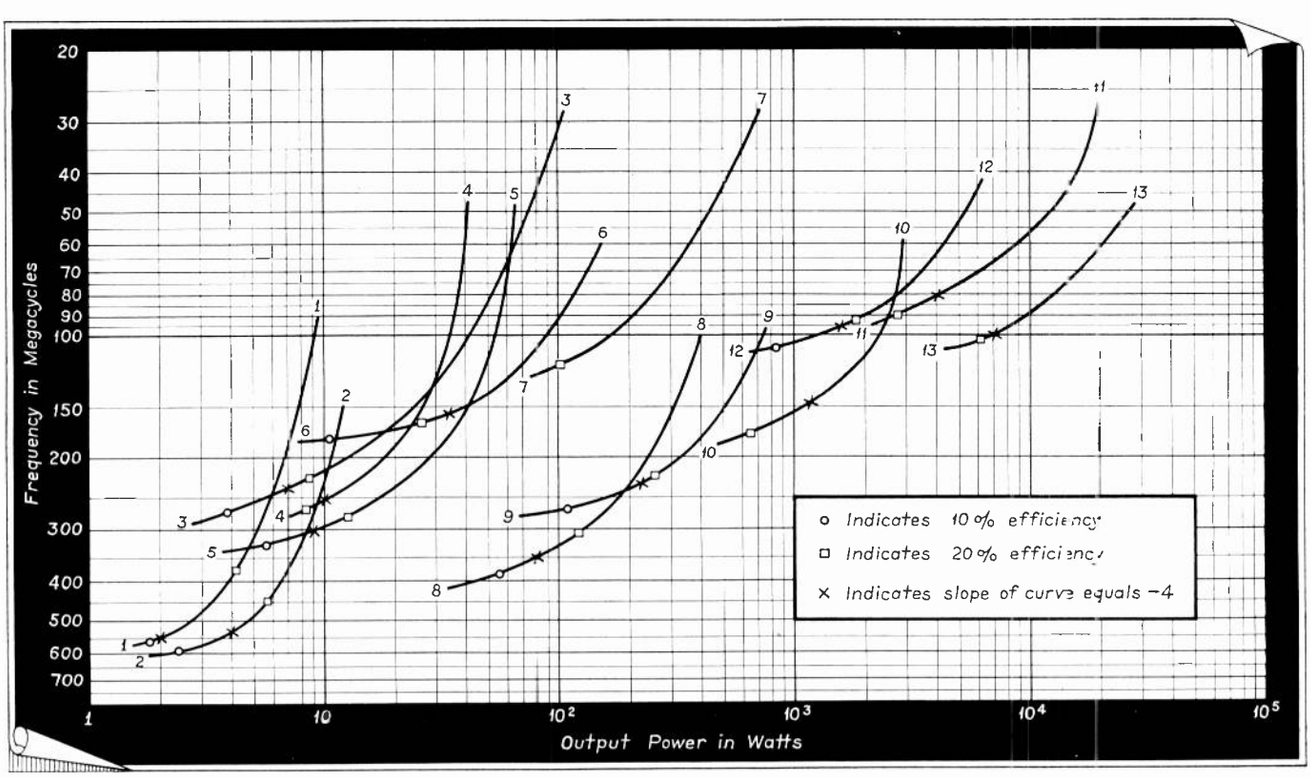
Table I gives a summary of data taken from current literature as a basis for computation. The results are shown in Fig. 1.

These results show that efficiency is primarily dependent upon the ratio τ_1/T (where $T = 1/f$) as indicated by the mean heavy line and independent of absolute frequency. τ_2 appears to have little or no effect on efficiency since all points fell below a tenth of a period and 75% fell below a twenty-fifth of a period. Since the loading conductance is proportional to τ^2 the grid-cathode conductance will be over 50 times the grid-plate conductance so that even though in the average feedback oscillator where the grid-plate voltage will average twice the cathode-grid voltage τ_1 will still be the controlling factor.

THE PRINCIPLE OF SIMILITUDE

If a series of tubes are built exactly similar and having linear dimensions of U. U/2, U/3, ... , U/n, from the

Fig. 2. Performance curves of triode oscillators when operated at constant plate dissipation and constant plate current.



Model theorem[2] the μ, S_m, R_p will be substantially the same. When $E_b, E_b/2, E_b/3, \ldots, E_b/n$ are applied with the same load resistances, a series of plate currents $I_b, I_b/2, I_b/3, \ldots, I_b/n$ will result. The power inputs will be $P_i, P_i/4, P_i/9, \ldots, P_i/n^2$. Since τ_1 is proportional to $(r_g - r_k)/\sqrt{I_b}$ the series of τ_1 will be $\tau_1, \tau_1/\sqrt{2}, \tau_1/\sqrt{3}, \ldots, \tau_1/\sqrt{n}$. From the results of Table I and Fig. 1 the ratio τ_1/T will produce a given ε independent of f. Therefore for any given ε the series of frequencies obtained will be f, $\sqrt{2}f$, $\sqrt{3}f$, $\ldots$, $\sqrt{n}f$. With fixed efficiency the power outputs will be $P_o, P_o/4, P_o/9, \ldots, P_o/n^2$. D will remain constant and the dissipating areas will be A, A/4, A/9, $\ldots$, A/n^2. When power output versus frequency is plotted on log-log paper and points of equal efficiency are connected together a line of slope — 4 will result. Similarly the line drawn tangent to all the curves will have a slope — 4. The equation of this line is

$$\log P_o = s \log f + \log B \quad \ldots\ldots (3)$$

where s is the slope and B the intercept value. This intercept value is important as it is the figure of merit of that design and operating condition.

POWER OUTPUT

Table II gives a summary of data plotted in Fig. 2. The intercept values for these curves have been computed as follows. Equation (3) is transformed to

$$B = Pf^4 \quad \ldots\ldots (4)$$

by taking the antilog and inserting the value — 4 for s obtained from the above discussion.

The parameters of which B is a function are not obvious. If, however, the following empirical relation is set up

$$B = J\, P_{loss}^{3/2}/\text{Volume} \quad \ldots\ldots (5)$$

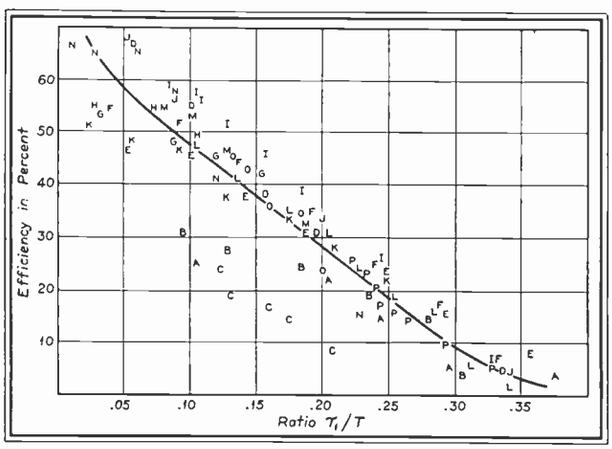
where J is a constant to be determined

P_{loss} is plate dissipation in watts
Volume is $\pi(r_g^2 - r_k^2)l$ in cubic centimeters

and J is computed for various efficiencies; the results plotted in Fig. 3 are obtained. The radius of the circles is equal to the probable error of the point in question. The numbers in circles indicate number of readings used to compute value of J at point indicated. The fact that maximum J is obtained for ε between 10% and 20% can be checked qualitatively by noting on Fig. 2 that lines of slope — 4 become tangent to curves 1, 2, 3, 5, 8, 9, 12 between points $\varepsilon = 10\%$ and $\varepsilon = 20\%$ and tangent to the others near 20%. At ε below this tangent point of slope — 4 the output decreases very fast and as B approaches zero so does J with the result that the curve of Fig. 3 will turn back below 15% and end at zero-zero.

[2] "Recent Developments in Miniature Tubes," by Bernard Salzberg and D. G. Burnside, *PIRE*, p. 1142, October, 1935.

Fig. 1. Values of cathode-grid transit time in fractions of a period versus efficiency.



GRID TEMPERATURE

Application of the Stefan-Boltzmann law to the triode structure involves the following additional notation.

- U energy dissipated at the cathode
- V energy dissipated at the grid
- R ratio of grid-mesh hole area to grid cylinder area (always less than one)
- M radiated cathode energy intercepted by grid
- N radiated cathode energy through grid
- l length of elements in centimeters
- T_k cathode temperature Kelvin
- T_g grid temperature Kelvin
- T_p plate temperature Kelvin
- C a constant for radiated energy per square centimeter per degree Kelvin

Then

$$M = (1 - R)\,(T_K^4 - T_G^4)\, 2\pi l C r_K \quad \ldots\ldots (6)$$
$$N = R\,(T_K^4 - T_P^4)\, 2\pi l C r_K \quad \ldots\ldots (7)$$
$$M + N = U \quad \ldots\ldots (8)$$

TABLE I

TUBE NUMBER	CURVE	FREQUENCY RANGE IN MEGACYCLES	PLATE VOLTAGE RANGE IN KILOVOLTS	PLATE CURRENT RANGE IN AMPERES	TRANS-CONDUCTANCE RANGE IN MHOS
149Y	A	200 - 700	.30	.067 - .081	.0026
	B	200 - 650	.40	.070 - .077	.0021
	C	484	.24 - .48	.070 - .078	.0020 - .0029
800	D	60 - 300	1.25 - .44	.080	.0020 - .0023
304A	E	50 - 350	.50	.100 - .106	.0028
	F	50 - 350	.75	.099 - .102	.0024
	G	50 - 200	1.00	.104 - .084	.0020 - .0014
	H	50 - 150	1.25	.089 - .078	.0016 - .0012
852	I	60 - 187	2.48 - .90	.100 - .121	.0013 - .0020
831	J	26 - 150	3.50 - 1.22	.343	.0018 - .0021
FP94	K	30 - 300	4.00 - 2.54	.250	.0042 - .0030
A217	L	100 - 300	4.38 - 2.51	.400	.0060
846	M	60 - 150	6.95 - 2.15	.75 - 1.60	.0030 - .0050
858	N	1.5 - 65	20.0 - 5.0	2.0 - .80	.0050 - .0090
AW200	O	54.5	2.37 - 10.0	.97 - 4.69	.0060 - .0125
	P	107	4.0 - 12.0	2.03 - 5.50	.0080 - .0120

$$M + V = (1 - R)\,(T_G^4 - T_P^4)\, 2\pi l C r_G \quad \ldots\ldots (9)$$
$$U + V = [(1 - R)\,(T_G^4 - T_P^4) + R\,(T_K^4 - T_P^4)]\, 2\pi l C r_P \quad \ldots\ldots (10)$$

from these we may eliminate M, N, 2π, l and C which give

$$r_G = \frac{r_K\,[VR\,(T_K^4 - T_P^4) + (1 - R)\,(T_K^4 - T_G^4)\,(U + V)]}{U\,(1 - R)\,(T_G^4 - T_P^4)} \quad (11)$$

and

$$T_G = \left(\frac{r_K\, VR\,(T_K^4 - T_P^4) + (1 - R)\,[(U + V) r_K T_K^4 + U r_G T_P^4]}{(1 - R)\,[U r_G + (U + V) r_K]} \right)^{1/4} \quad \ldots (12)$$

Using R from 0.6 to 0.9, V will be the controlling factor above V = .25U. This is important because high efficiency demands that r_g be small.

EFFICIENCY

Power output can be expressed as

$$P_o = DA\epsilon/(1-\epsilon) \quad \ldots\ldots (13)$$

where P_o is power output

D is dissipation per unit area
A is units of area
ϵ is efficiency

Using existing materials D cannot be increased very many times over present values. Since the fundamental

TABLE II

TUBE NUMBER	CURVE	PLATE VOLTAGE RANGE IN KILOVOLTS	PLATE CURRENT IN AMPERES	PLATE DISSIPATION IN WATTS
149Y	1	.40 - .20	.070	16.9
	2	.45 - .25	.077	21.6
800	3	1.25 - .44	.080	35.0
304A	4	.75 - .25	.103	34.0
	5	1.25 - .50	.092	50.0
852	6	2.48 - .90	.105	100
831	7	3.50 - 1.22	.343	400
FP94	8	4.00 - 2.54	.250	500
A217	9	4.32 - 2.51	.400	1000
846	10	6.95 - 2.51	.900	2500
858	11	15.00 - 6.25	2.00	10,000
AW200	12	5.50 - 4.00	2.25	7500
	13	10.00 - 7.00	4.50	25,000

alternating-current generator is limited to one wavelength in size A will be proportional to the square of the wavelength and P_o will be inversely proportional to f. The only way (outside of cascading many generators) to obtain high power output is to increase ϵ. Inspection of (13) shows the nearer it approaches unity the more profitable it is to increase it.

CONCLUSIONS

(a) Efficiency is determined by ratio τ_1/T as shown in Fig. 1. Its importance increases approximately as the square of the frequency.

(b) Absolute power output is dependent upon relations of (4) and (5) and Fig. 3.

(c) Grid temperature may be important as determined from equations (11) and (12).

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CATHODE-RAY BALLISTICS

(*Continued from page* 10)

flection from the neutral axis is given by $(D-y)/L = dy/dl_\epsilon$ or

$$D = Ldy/dl\varepsilon + y \quad \ldots\ldots (3)$$

This expression is as expected. The first term involves the derivative and the second the distance of fall y.

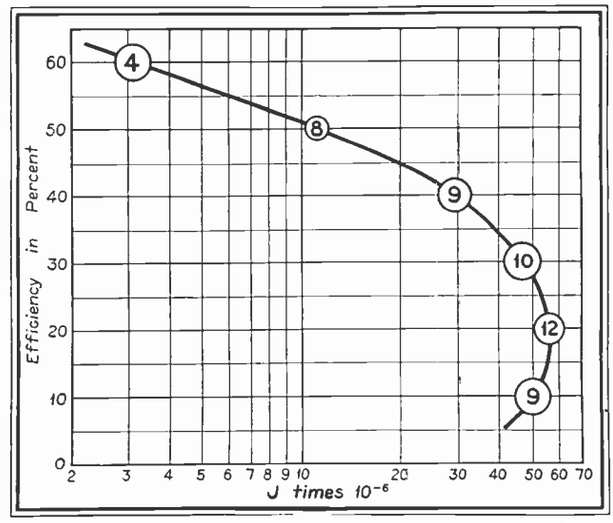


Fig. 3. Variation of empirical constant J with efficiency.

WAVEFORM AND FLIGHT-TIME CONSIDERATIONS

When the period t of the deflecting voltage E_p (or the current producing H) is comparable with the electron's flight time under the deflecting plates l_s the force on the electron's charge (e) is not constant. In support consider Fig. 2 where a half sine wave of unit amplitude represents charge acceleration as a function of electrical angle or time, along with the constant upper line indicative of constant acceleration. Superimposed upon these two is a slot suitably representing the electron flight time. If θ_1 represents a width of slot where t is large compared with T, the acceleration force on the charges which produce maximum deflection is substantially constant during the time T, because the areas under the constant curve and that under the sine curve are substantially equal[4]. The latter is to be expected over a considerable range of frequency from zero (d-c) to some high frequency. The integrated curve area, or the terminal velocity in the vertical direction at the tip of the deflecting plates l_ϵ when made a definite integral over the time $T = l_\epsilon/v$, when expressed as a ratio for that of a constant force is the correction factor altering the terminal velocity which would be expected for a constant force.

Let the acceleration be a function of α. The ratio between the two terminal velocities in the vertical direction is given by

$$K = \int_{\beta_1}^{\beta_2} f(\alpha)\, d\alpha/\theta \quad \ldots\ldots (4)$$

where $\beta_1 = (\beta - \theta/2)$, $\beta_2 = (\beta + \theta/2)$ and β[5] the reference angle or time. When (4) is evaluated for a sine-wave accelerating force the expression for K becomes

$$K = 2\sin(\theta/2)/\theta \quad \ldots\ldots (5)$$

The derivative dy/dl_ϵ involves a ratio between the terminal velocity in the vertical direction and the gun velocity, thus $K\, dy/dl_\epsilon$ is said velocity corrected for any K evaluated. In order that (4) and (5) be made experimentally useful for any tube K, from (4), was evaluated for three specific waveforms and plotted—curves 1, 2, and 3, Fig. 3—as a function of frequency on a general frequency axis applicable to any tube

(*Continued on page* 28)

[4]Considering high frequencies increase the slot width Θ because the effect is the same if the slot width is fixed and the frequency increased.
[5]β is chosen to produce maximum deflection over the flight-time angle Θ.

Mark Ethridge, WHAS.

REPORT OF THE

HELD

AT THE HOTEL

WILLARD, WASHINGTON, D. C.,

FEB. 14-16

Elliott Roosevelt, Hearst Radio.

Harold Hough, WBAP.

THE SIXTEENTH ANNUAL convention of the National Association of Broadcasters, which was held at the Hotel Willard, Washington, D. C., from February 14 to 16, was well attended, about 350 broadcasters being present. As expected, the business sessions were primarily concerned with reorganization. There was even less opposition to the proposed plan than had been anticipated.

BOARD OF DIRECTORS

The new Board of Directors is composed of twenty-three members, seventeen district representatives and six directors at large representing the clear, regional and local channels.

The district representatives are as follows: John Shepard, 3rd, Yankee Network, for District 1; Harry C. Wilder, WSYR, Syracuse, New York District 2; Clair McCollough, WDEL, Wilmington, Delaware, District 3; John A. Kennedy, WCHS, Charleston, West Virginia, District 4; W. Walter Tison, WFLA, Tampa, Florida, District 5; Edwin W. Craig, WSM, Nashville, Tennessee, District 6; Mark Ethridge, WHAS, Louisville, Kentucky, District 7; John E. Fetzer, WKZO, Kalamazoo, Michigan, District 8; Walter J. Damm, WTMJ, Milwaukee, Wisconsin, District 9; John J. Gillin, Jr., WOW, Omaha, Nebraska, District 10; Earl H. Gammons, WCCO, Minneapolis, Minnesota, District 11; Herb Hollister, KANS, Wichita, Kansas, District 12; O. L. Taylor, KGNC, Amarillo, Texas, District 13; Gene O'Fallon, KFEL, Denver, Colorado, District 14; Ralph R. Brunton, KJBS, San Francisco, California, District 15; Donald W. Thornburgh, KNX, Hollywood, California, District 16; C. W. Myers, KOIN, Portland, Oregon, District 17.

DIRECTORS AT LARGE

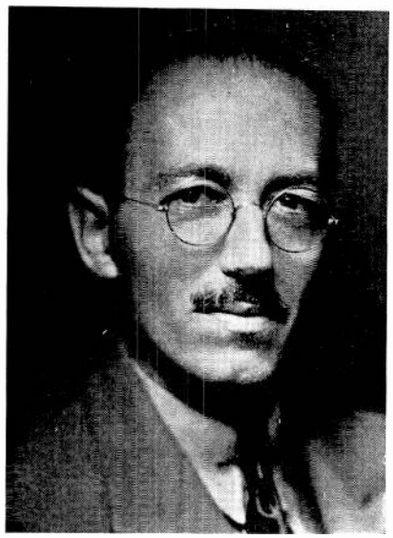
The six Directors at Large are: Clear Channels — Harold Hough, WBAP, Fort Worth, Texas, and Lambdin Kay, WSB, Atlanta, Georgia; Regional Channels—Frank M. Russell, WRC, Washington, D. C., and Elliott Roosevelt, Hearst Radio, Incorporated; Local Channels—John Elmer, WCBM,

Edward A. Allen, WLVA.

NAB CONVENTION

Edwin W. Craig, WSM.

Herb Hollister, KANS.



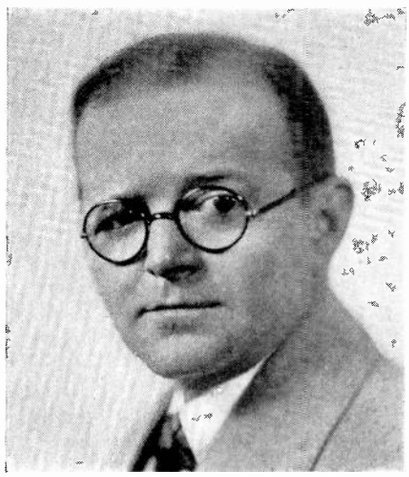
John Elmer, WCBM.

Frank Russell, WRC.

Baltimore, Maryland, and Edward A. Allen, WLVA, Lynchburg, Virginia.

EXECUTIVE COMMITTEE

From the above Board of Directors the following men were named to act on the Executive Committee: Mark Ethridge, Edwin W. Craig, Herb Hollister, John Elmer, Frank M. Russell and Walter J. Damm. Philip G. Loucks,



Lambdin Kay, WSB.

former Managing Director of the NAB, has been retained as special counsel for the organization.

It was announced that the Board of Directors will meet again in Washington on March 21. It is expected that the matter of a paid President for the association will receive attention at that time.

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REBUILDING TRANSMITTER TUBES

ONE OF the most interesting phases of radio is the rebuilding of power tubes. No one can imagine the difficulties encountered in rebuilding practically any kind of tube that may come in for repairs of some kind of other, unless he has been associated with this kind of work for many years.

When a tube is received, it is tested for vacuum with a high-frequency coil to determine if there is a slow leak or crack somewhere in the tube—also as to whether or not there is any vacuum in it.

Next is to determine whether the gas is air or if it is gas that has been liberated from the electrodes. If the gas is air, new stems are needed. If the job is a water-cooled tube, the metal-to-glass seal may be cracked or leaky which can generally be repaired if it is hard glass. If it is soft glass, it will probably require a new bulb and a glass-to-copper seal.

We are now ready to break the vacuum at the tip off and open the tube with a hot wire. The grid and plate are examined for defects. Then the filament is measured with a micrometer to determine the diameter. A new filament is formed of the same diameter and spot welded to the leads. The grid

(Continued on page 26)

RECENT DEVELOPMENTS

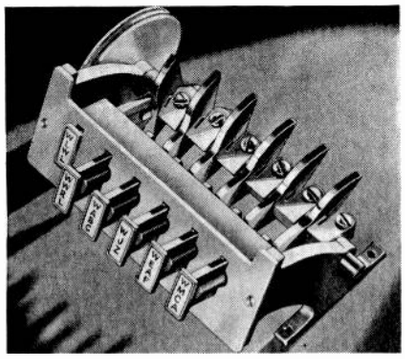


Fig. 1. The Franklin push-button tuner.

PUSH-BUTTON TUNING has received a great deal of attention during the past year. While automatic tuning was at first confined to the higher priced receivers, push-button tuned sets selling for less than twenty dollars are now available. Additional interest will no doubt be evidenced in the subject during 1938. Hence, it is the purpose of this article to briefly review some of the most recent developments in this field.

The push-button tuner mechanism shown in Fig. 1 is a mechanical system

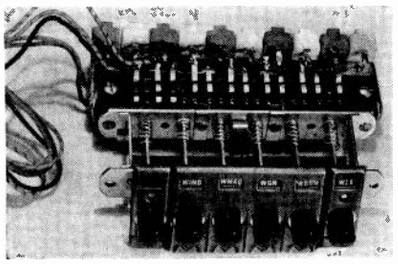
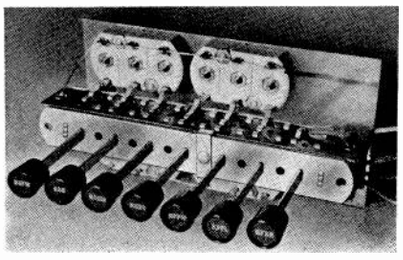


Fig. 7. The Harbray tuning unit.

recently announced by A. W. Franklin Mfg. Co. The mechanism essentially consists of six or more station selector buttons mounted on a suitable frame, with a corresponding number of cams on a common drive shaft assembled on two pedestals. The action is transmitted from the cam shaft to the variable condenser by means of two pulleys and a connecting wire cable. A dial is also attached to the condenser by the pulley and drive cable arrangement.

Adjustments for desired station frequencies are made from the front of the radio by removing a snap-in name

Fig. 6. Meissner's push-button system.



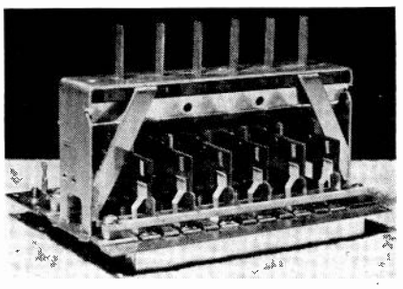


Fig. 3. Sprague's back-adjusted unit.

plate on the face of the escutcheon. The set screws for adjusting the cams are thus made easily accessible. The desired station is tuned in by the tuning knob, then the proper selector button is depressed and the corresponding cam is set using a screw driver. The selection of station frequencies may be made in any desired sequence. When any button is pushed in, a latching bar automatically locks it to tune-in position and releases all other buttons. Manual tuning is accomplished by pressing a tuning knob and adjusting the variable condenser to the desired station frequency. The change from manual to push-button tuning requires no additional button.

Fig. 8. Automatic Devices B-6 tuner.

The principle of operation is simple —the mechanism utilizes the downward stroke of a sliding member to rotate a cam to a pre-set adjustment. At the point of adjustment, the radius-edge of the push button meshes with the face of an inverted V-shaped cam. A stroke of five-eighths of an inch rotates the cam through a maximum arc of 60°. This rotary motion is transmitted to the shaft of a variable condenser by a system of two pulleys (ratio of 3 to 1) connected by a drive cable of stainless steel. All push-buttons, cams, pedestals, and the button bearing plate are of one piece die castings. The individual parts are solidly assembled and the bearing surfaces of all moving parts are kept to close tolerances. The arrangement and dimensions are given in Fig. 2.

An automatic tuning system employing trimmer condensers has been announced by Sprague Specialties Co.

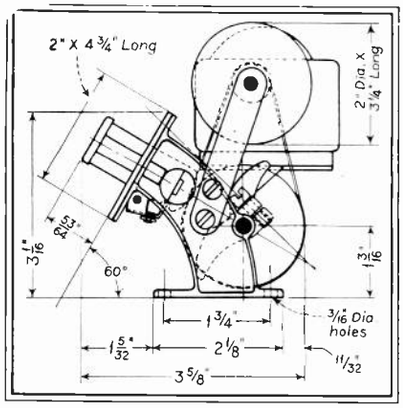


Fig. 2. Arrangement of tuner of Fig. 1.

This system, which is available only to manufacturers, can be obtained in various combinations. In Fig. 3 is shown a two-circuit six-button back-adjusted unit, while Fig. 4 shows a two-circuit, six-button, front-adjusted assembly. "Back-adjusted" refers to a unit in which push buttons are operated from the opposite face to that from which the trimmers are adjusted; while "front adjusted" means an assembly in which push buttons operate on the same face from which the trimmers are adjusted.

The manufacturer of these latter assemblies furnish: three-gang tuners in a six-button, back-adjusted type; four-, six- and eight-button, back-adjusted types for two-circuit tuning; and four-, six-, and eight-button, front-adjusted types for two-circuit tuning. These standard units, further, can be varied to meet special situations; for example, a six-button unit can be obtained with five buttons for station selection and the sixth as a double-pole-single-throw dis-

IN PUSH-BUTTON TUNING

connect switch, or a double-pole-double-throw change-over switch.

A push-button tuner circuit with permeability tuning is shown in Fig. 5. The permeability tuning on push-button control is provided in the oscillator, using a Colpitts circuit. The antenna circuit is tuned by use of the regular antenna coil and the push-button-switched tuner condensers of the type just described. Good stability in the oscillator circuit can be obtained through

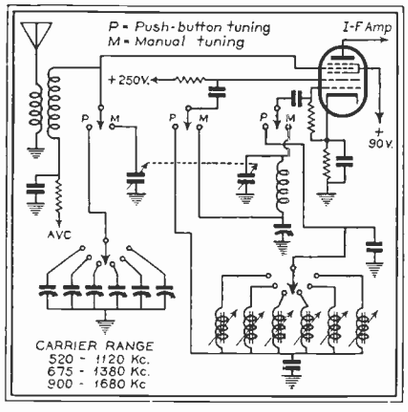


Fig. 5. Circuit with permeability tuning.

careful design of the permeability-tuned coils, and the use of a Colpitts oscillator circuit with the high-capacity fixed condenser minimizes the variable circuit elements.

The automatic push-button tuner shown in Fig. 6 has been developed by the Meissner Manufacturing Company. It may be used with any superheterodyne or t-r-f receiver having a two- or three-section tuning condenser. It is recommended by the manufacturer for single-band two-gang receivers, providing full automatic operation on such sets. On receivers with three-gang condensers, only two sections are tuned by the push-button condenser assembly. If, however, the signal strength of the stations selected is adequtae to give good reception on a four-tube receiver, a receiver with five or more tubes will give satisfactory performance when used with this push-button condenser assembly. The Meisner tuner provides

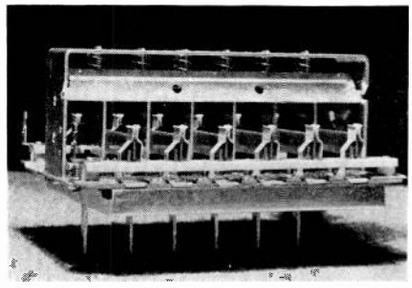


Fig. 4. Sprague's front-adjusted tuner.

for selection of any of six pre-determined stations. A seventh push button is used to return the receiver to normal tuning condition when desired.

The Harbray Company's push-button tuning unit is shown in Fig. 7. This assembly permits the selection of five stations, the sixth button being used to shift from manual to automatic tuning. Like the previous one, this unit can be used on any two-gang superheterodyne.

The Automatic Devices Manufacturers' B-6 tuner is shown in Fig. 8, while a typical superheterodyne application of the unit is given in Fig. 9. The operation of the switching unit is completely automatic, so that when one button is

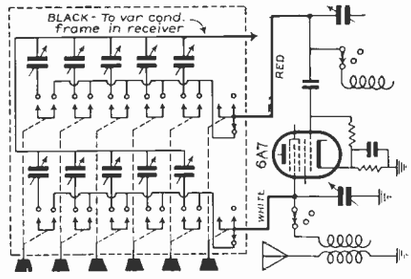


Fig. 9. Application of tuner of Fig. 8.

pressed it remains in position until released automatically by pushing any of the remaining buttons. In operation the push-button switches connect the small variable condensers to the oscillator and antenna circuits of the radio receiver.

A push-button station selector switch, which is similar in action to the well known apartment house lobby telephone selective ringing switch, has recently

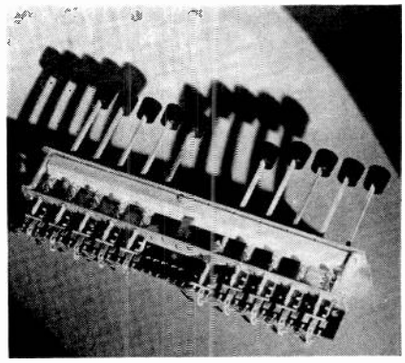


Fig. 10. Mallory's ten-button switch.

been introduced by P. R. Mallory. This Yaxley station selector switch is adaptable to both motor drive and condenser applications. Flexibility of tool design makes combinations possible up to twelve buttons and allows adaptation to the mechanical requirements of the individual designer. A ten-button switch is shown in Fig. 10, while Fig. 11 shows an 8-button unit for use in station selection, and other applications. The switches are available in two circuit combinations—one designed for cir-

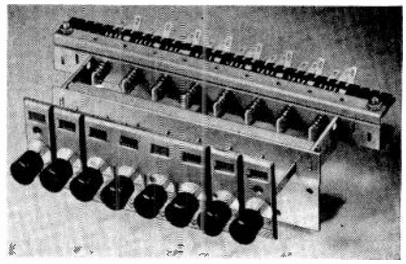
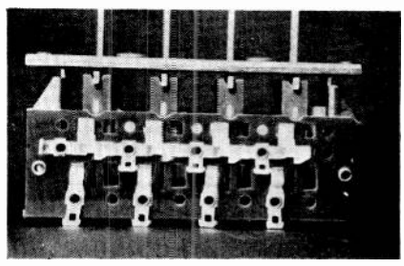


Fig. 11. A Mallory eight-button switch.

cuit closing applications and the other for circuit transfer applications.

The unit shown in Fig. 12 is a push-button switch which has been designed by Oak Manufacturing Co. Silver-plated, double-wiping contacts are employed and the contacts are entirely floating. This switch also features a slide latch-bar to automatically compensate for wear. It is available with any number of buttons from four to twelve. A variety of circuit applications may be used. It is adaptable either to trimmer or permeability tuning and may be used for band changing.

Fig. 12. An Oak push-button switch.



THE DELTA-STAR MIXER

By J. N. A. HAWKINS

SPEECH-INPUT MIXERS are used to mix the outputs of two or more sound sources into the input of an amplifier channel. The output of the amplifier channel may modulate a radio transmitter or it may be directly reproduced by loudspeakers as in a public-address system. Also the sound may be stored to be reproduced at some later time, as in disc and film recording.

Mixers may be either electronic or resistive. Electronic mixing has both advantages and disadvantages, but as resistance mixing is almost standard in high-quality mixing circuits, this discussion will describe a new resistance-mixer circuit.

Resistance mixers use either series mixing, parallel mixing, or a combination of the two methods. These older mixing methods will not be discussed in detail as the common circuits can be seen in any broadcast or recording handbook. It is enough to say that some four-position mixers average a 700% impedance mismatch and 17 decibels minimum insertion loss.

In the four-position mixer circuit shown in Fig. 1 the impedances are matched looking forward or backward, and standard variable pads can be used for any number of inputs from two to sixteen. The inherent mixer loss (minimum insertion loss) is 6 db up to four positions and only 12 db for the sixteen-position mixer.

The same impedance pads which serve as master gain also serve for each input channel, which reduces the number of spare pads necessary. The input and output circuits are identical and can be used interchangeably as either inputs or outputs.

The mixer can do a number of things that the average mixer circuit cannot do. Two inputs can feed up to four separate outputs, each with its own gain control. Four inputs can feed two outputs, or three inputs feed three outputs, with always a separate gain control on each input and output channel.

However, one precaution must be kept in mind. The inputs and outputs must be chosen with care due to the hybrid balance which exists between inputs A and B, C and D, and between E and F. Thus if terminal A is used as an input, terminal B cannot be used as an output as there is nearly infinite loss between A and B regardless of the pad settings.

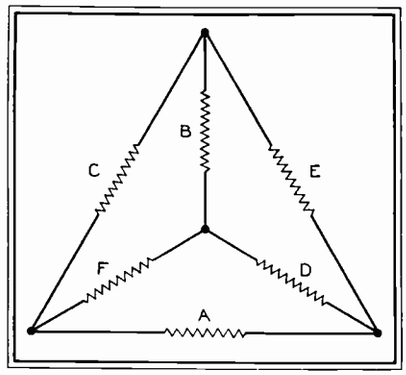
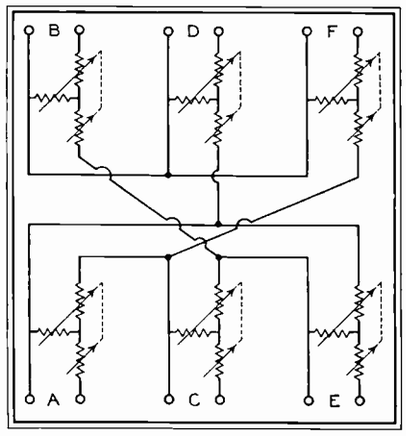


Fig. 2. Equivalent circuit of delta-star mixer of Fig. 1.

Likewise there is nearly infinite loss between terminal C and terminal D, and terminal E and terminal F. However, the minimum loss between terminal A and terminals C, D, E or F is only 6 db. Thus, while there are six pads shown, this particular arrangement can only be used as a four-position mixer, with the other two pads acting as separate master gain controls in two separate output channels. These two output channels are useful in many services; such as, feeding the main and monitoring amplifiers, feeding a network and a local transmitter, etc. Note that the nearly infinite loss between the two output circuits prevents line noise, switching clicks or other unwanted sounds appearing in one output channel from reaching the other output channel.

The high loss between the terminals in the same vertical plane in the diagram of Fig. 1 (AB, CD, EF) can be visualized more easily by examining the equivalent circuit of Fig. 2. It is from this equivalent of the four-position mixer that the arrangement gets its name. Fig. 2 will be seen to be a delta network combined with the common star network, both borrowed from common three-phase practice.

Fig. 1. Schematic of the 4-position mixer circuit.



Each of the resistances in Fig. 2 represents the output resistance of the variable pads shown in Fig. 1, and they are all equal. In Fig. 2 it will be seen that any voltage applied across A will not appear across resistance B because both ends of B are at the same potential as long as C equals F and E equals D. However, any voltage impressed across A will produce a voltage across the other four resistances C, F, E and D.

By the same token it is seen that any voltage impressed across C will not appear across D. Likewise nearly infinite loss exists between E and F. The circuit resolves itself into a balanced bridge, but it is shown in this form to show that in certain balanced bridges three conditions of balance exist and not just one.

This matter of infinite loss between three pairs of terminals has an unusual and interesting aspect. It means that three studios, for example, can be interconnected by means of microphones and monitoring speakers, so that each studio can talk or listen to the other two studios without singing or audio feedback as long as the acoustic loss in each studio, from speaker to mike, is greater than one-half of the net gain between any mike and loudspeaker. This condition is easy to realize in practice without special mike or speaker placement.

While it is rarely necessary to interconnect three studios for full triplex conversation, the use of two studios with full duplex facilities is not uncommon. At the present time it requires the use of headphones at one end of the conversation, at least, but with this mixer arrangement loudspeakers can be used at both ends without trouble.

One of the main advantages of the Delta-Star mixer is that standard and similar pads are used throughout. In the four-position arrangement of Fig. 1, six 200-ohm pads may be used working out of four 200-ohm sound sources and feeding two 200-ohm lines or amplifier inputs. Mixing transformers are not shown in Fig. 1, but they might consist

(*Continued on page* 35)

NEW TUBES

Fig. 7
Taylor T-40

A NUMBER of new tubes, both transmitting and receiving, have recently been made available. The purpose of this article is to briefly review the most recent developments in this field.

Shown in Fig. 1 is a television amplifier pentode, designated as the RCA-1851, and for use by experimenters and amateurs in experimental television receivers. This pentode features high grid-plate transconductance (9,000 micromhos). It is designed for use in the r-f and i-f stages of the picture amplifier as well as in the first stages of the video amplifier when several video stages are used. This RCA Radiotron requires a heater voltage (a-c or d-c) of 6.3 volts, while the heater current should be 0.45 ampere. Direct interelectrode capacitances are given as follows: grid-to-plate, 0.02 mmfd maximum; input, 11.5 mmfd; output, 5.2 mmfd.

A new RCA triple-grid amplifier tube has been made available to radio-equipment manufacturers. This tube, designated as the RCA-6S7, is a pentode type of metal vacuum tube intended for services in the r-f and i-f stages of radio receivers designed for low heater-power consumption. Its heater requires only 0.15 ampere at 6.3 volts. Its direct interelectrode capacitances are as follows: grid-to-plate, 0.005 max. mmfd; input, 6.5 mmfd; output, 10.5 mmfd.

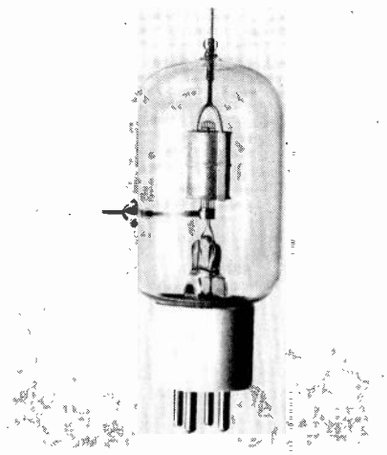


Fig. 3. The Gammatron 54.

Information has also been released on the RCA-6K8 triode-hexode converter. This tube is a multi-unit type of all-metal vacuum tube incorporating a triode unit and a hexode unit. It is intended primarily for use as a converter in superheterodyne receivers, especially those of the all-wave type. In such receivers, performance of the 6K8 is characterized by improved frequency stability, according to the manufacturer. It requires a heater voltage of 6.3 volts, the heater current being 0.3 ampere.

A 6K8 metal-type triode-hexode converter has also been announced by Raytheon for use in superheterodyne receivers. It may be used satisfactorily in a-c/d-c receivers inasmuch as the screen, oscillator plate, and mixer plate may all be operated from the same 100-volt supply. The heater of this tube also requires 6.3 volts while the heater current is 0.3 ampere.

Fig. 1
RCA-1851

A type 6J8G triode-heptode converter has been released by Hygrade Sylvania. This tube consists of a triode unit and a heptode unit having a common cathode. The applications of this unit are similar to those of the separate oscillator and mixer tube combination. However, new construction is said to make possible some circuit simplifications and to give improved performance at high frequencies.

A 6J8G triode-heptode converter has been announced by Ken-Rad. It was designed especially for converter operation in high-frequency receivers.

Among other new tubes which have been made available to radio-equipment manufacturers are the following: Sylvania 6AC5G high-mu power-amplifier triode; Sylvania VR150 voltage regulator; Sylvania 6F8G double-triode amplifier; Sylvania 6G6G power-amplifier

Fig. 6. The Eimac RX21.

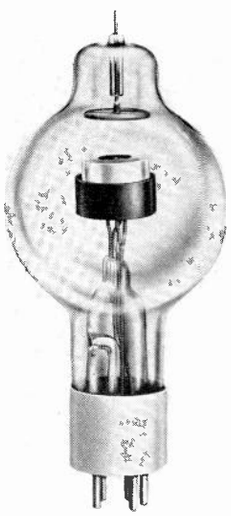
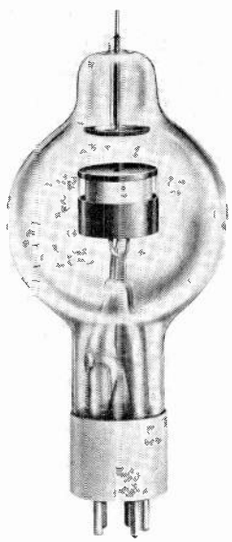


Fig. 4. United's 312-E.

Fig. 5. Eimac Type KY21.



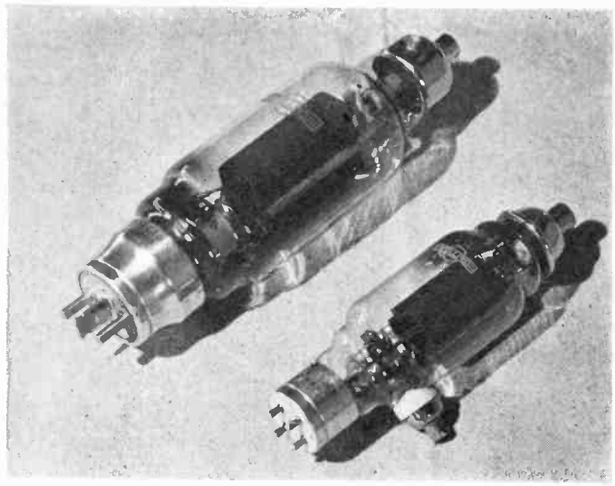


Fig. 8. The Collins C-849A and C-849H.

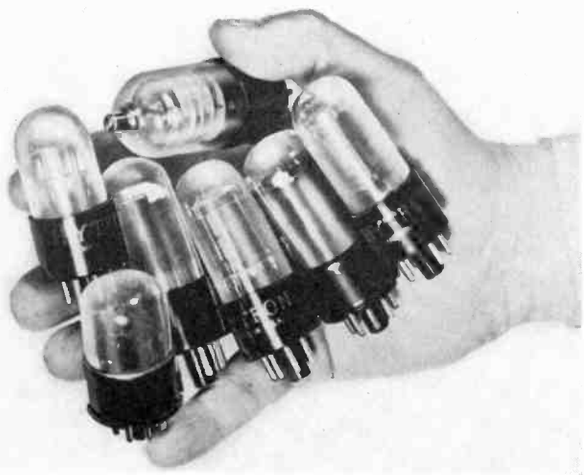


Fig. 2. Hytron's "Bantam" tubes.

pentode; Sylvania 6W7G triple-grid amplifier; Raytheon 6W7G pentode-type amplifier; RCA-1G5-G power-amplifier pentode; RCA-6C8-G twin-triode amplifier; RCA-6F8-G twin-triode amplifier; RCA-6G6-G power-amplifier pentode; RCA-6V6 beam power amplifier; RCA-6Z7-G Class B twin amplifier; and RCA-25A7-G rectifier pentode.

Still another recent development in receiving type tubes are the glass "Bantam" tubes developed by Hytron (see Fig. 2). A complete series of these tubes are available, and they are said to be identical in electrical characteristics to the larger glass types. These tubes were designed for applications where space economy is required. The short connection leads in conjunction with the metal shield band about the base is said to increase the stability of operation. Lower interelectrode capacities are a result of the geometric construction and short connection leads in the base, according to the manufacturer.

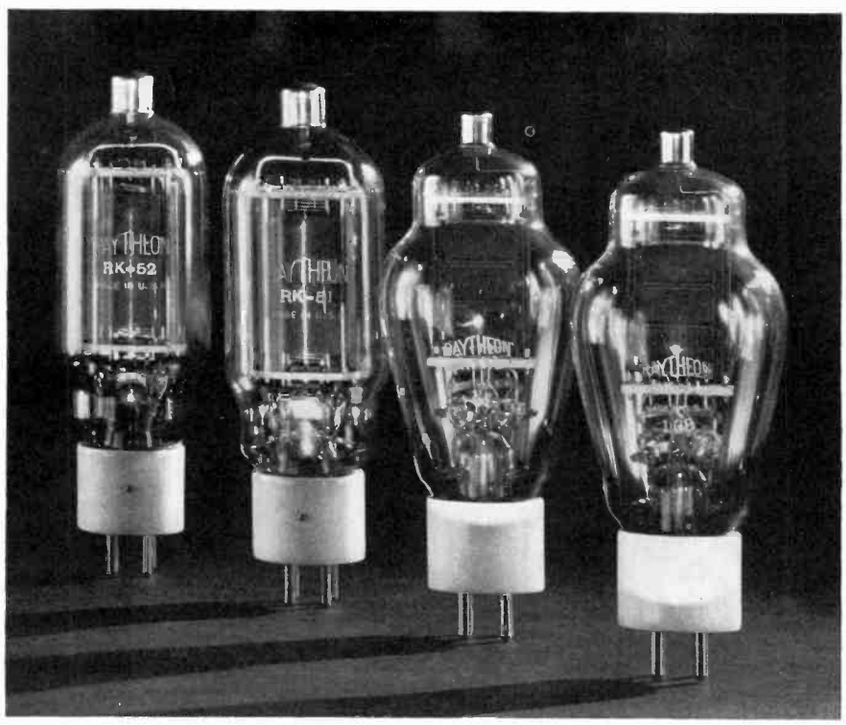
For ultra-high-frequency usage, Heintz & Kaufman have announced the type 54 Gammatron shown in Fig. 3. This tube is a 50-watt plate triode having an amplification factor of 27. The electrical characteristics of this tube are as follows: filament voltage, 5.0 volts; filament current, 5.0 amperes; normal plate dissipation, 50 watts; maximum average plate current, 150 ma; maximum average grid current, 30 ma; average plate impedance, 7500 ohms.

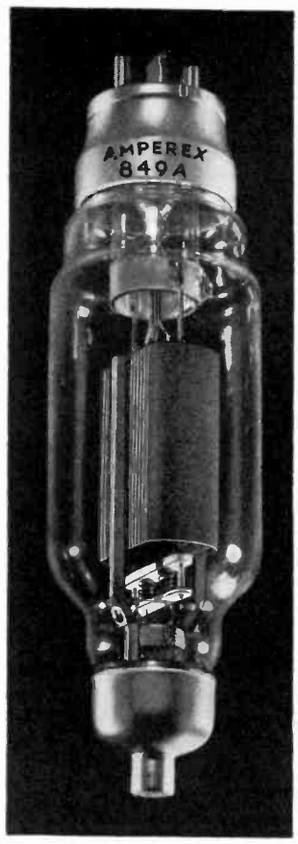
Another recent development of Heintz & Kaufman is the Gammatron type 654. The electrical characteristics of this tube follow: filament voltage, 7.5 volts; filament current, 15 amperes; normal plate dissipation, 300 watts; maximum average plate current, 0.6 ampere; maximum plate voltage, 4,000 volts; maximum average grid current, 0.10 ampere; average plate impedance, 3,700 ohms; average amplification constant, 22; grid-plate capacitance, 5.5 mmd; grid-filament capacitance, 6.2 mmfd; plate-filament capacitance, 1.5 mmfd.

A redesigned version of the United type 212 is the new United type 312-

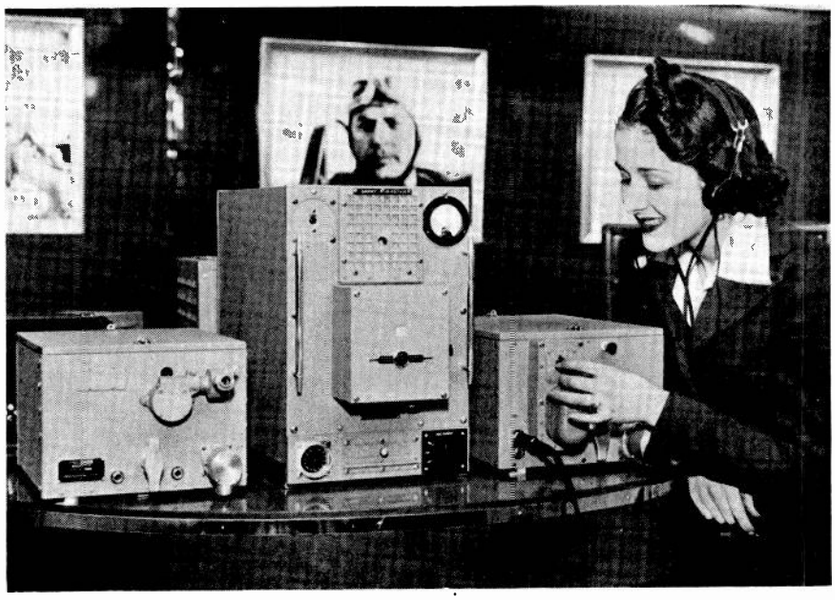
(*Continued on page 26*)

Below: Fig. 9. Raytheon's RK-11, 12, 51, 52. Right: Fig. 10. Amperex 849A.





Among the interesting developments at the International Air Show was the two-way radio equipments shown by Bendix Aviation Corporation.



Ranging in power from 10 to 100 watts, these equipments provide multi-crystal controlled operation and remote electrical frequency shift.

COMPROMISES IN ALLOCATION ENGINEERING

RAYMOND M. WILMOTTE

THE BROADCASTING INDUSTRY has forged ahead since its inception in all its branches; administration, engineering and in its final product, entertainment. It has been fortunate in working on an expanding market. It seems that the industry may be entering a new phase shortly, which may be akin to what psychologists term a plateau. This statement should be limited to the regular broadcast band, for the opening of the ultra-high-frequency bands, the developments of facsimile and the laboratory successes of television are not likely to let the industry settle down to rest, however, well earned that rest may be.

In the regular broadcast band, it seems likely that international agreements, particularly the one recently negotiated in Havana, will lead in one way or another to the clarification of broad policies, such as power, number of stations, quality of reproduction permissible, and broad allocation principles, which, while fairly well defined at any one time, have always operated under the assumption that some day, in the not distant future, these allocation standards might be changed. The effect has been to keep broadcasters on the alert all the time to make sure that they would not lose any opportunities to improve their position. There must have been a tremendous duplication of work. Here is a job in which the National Association of Broadcasters could be of valuable assistance; it could prevent much of this duplication, by analyzing the decisions of the Commission and keeping the industry informed of the cases in which the engineering and other standards were not rigidly adhered to.

Allocation standards are bound to be and should be subject to exceptions. At best they are compromises between ideal engineering standards and the economic and social forces of the country as a whole. These economic and social forces are not the same all over the country, nor are they the same for all stations. To the extent that they change, so should the standards change also. Rigid standards can only be countenanced on the assumption that all the details of engineering, economics and sociology, affecting the problem have been fully taken into account in the establishment of the standards. Unless it is believed that there will be no changes in technique or in the nature of the demand by the public, it is essential to have a flexible system to meet these changes.

It is, therefore, important for the industry to be kept in continual touch with the direction and degree of compromises made in special cases, so that an intelligent analysis of trend may be evolved.

What are desirable trends? The Federal Communications Commission can foster them, and the coming period of re-allocation may prove to be an opportunity. It could foster desirable trends by granting special protection from interference to special stations or to stations that operate in a way that the Commission thinks desirable, or for the establishment of stations in certain localities.

On the program angle, most of the Commission's attention has been properly directed toward the elimination as far as possible of undesirable or obnoxious entertainment or advertising. A station that has a consistently bad record of that kind should have its service restricted, if not eliminated. But the influence of the Commission should not stop at this point. If a station has unusually good programs, which are substantially different in type or quality from the other programs that are receivable in its service area, it would be in the public interest to give such a station as broad a service area as possible, so that more listeners would be able to have a variety of programs at their command. The Commission could make use of the special qualities of this station

(*Continued on page* 40)

BACKGROUND NOISE CORRECTIONS*

By L. E. PACKARD
GENERAL RADIO COMPANY

IN MANY PLANTS soundproof rooms are either not available or are not practical, and it is found necessary to make sound measurements under existing noise conditions. It is always advisable to reduce the level of extraneous noise as much as possible, but satisfactory sound measurements can usually be made, even under adverse conditions. Separate measurements are made of the background noise alone and the background plus the unknown noise. The difference of these readings is then taken and, from the chart of Fig. 1, the correction in db for the background noise is determined. This correction is subtracted from the db reading obtained in the second measurement to obtain the level of the unknown noise.

Assume, for instance, that the problem is to measure the noise produced by a machine mounted in an assembly room or test room where an appreciable background noise level is present. The sound-level meter is placed in the desired test position, and a measurement is made of the general background noise without the machine running. An average measurement of the background noise in db will be sufficient, although, if a widely fluctuating noise is present, it is often desirable to note the peak readings. As an example, let this reading be 72 db. The machine under test is then set in operation and, when it is operating at the desired conditions of load and speed, a second measurement is made of the total noise level. Let the result of this measurement be, say, 78 db. The difference between these two readings is then 6 db. Entering the chart of Fig. 1 at 6 db, along the horizontal axis, we find the correction to be 1.25 db. This subtracted from the sound reading of 78 db gives a result of 76.75 db which is the true noise level of the machine itself.

To obtain this correction it is assumed that the power in the background noise and the power in the measured sound are added arithmetically by the sound-level meter. From the relation

$$db = 10 \log_{10} \frac{P_2}{P_1}$$

the power ratio corresponding to the 6-db difference is found to be 3.981. This means that the total noise is 3.981 times the background. The desired noise and the total noise level are therefore in the ratio $\frac{3.981 - 1}{3.981}$ or .75, which corresponds to 1.25 db. The actual noise being measured is then 1.25 db lower than the reading of the sound-level meter.[1]

If actual sound-power levels corresponding to the db readings are desired, these can be calculated from the expression given above. An easier method is to refer to a set of decibel tables.[2] A reading of 72 db, for instance, corresponds to a power ratio of 1.585×10^7. Since the reference level (corresponding to zero db) is 10^{-16} watts per square centimeter, sound-power level for 72 db is 1.585×10^{-9} watts per square centimeter.

*Reprinted from the December, 1937, *General Radio Experimenter*.

[1] A general expression for which the curve of Fig. 1 can be calculated is
Error db $= \frac{1}{2} [d - 20 \log_{10} (2 \sinh \{0.1151\, d\})]$
where d is the difference in decibels between the two readings.

[2] See tables published on pp. 162-167 of General Radio Company's Catalog J.

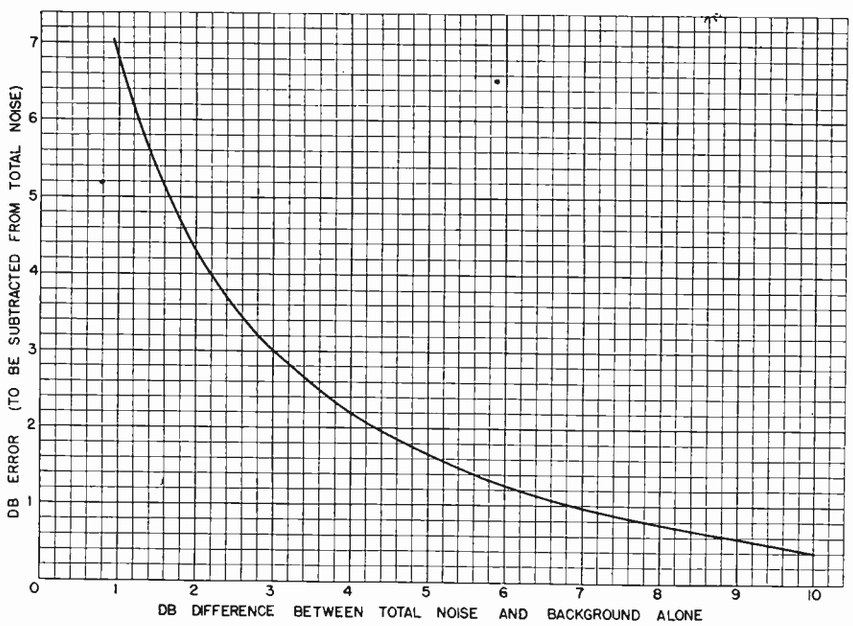
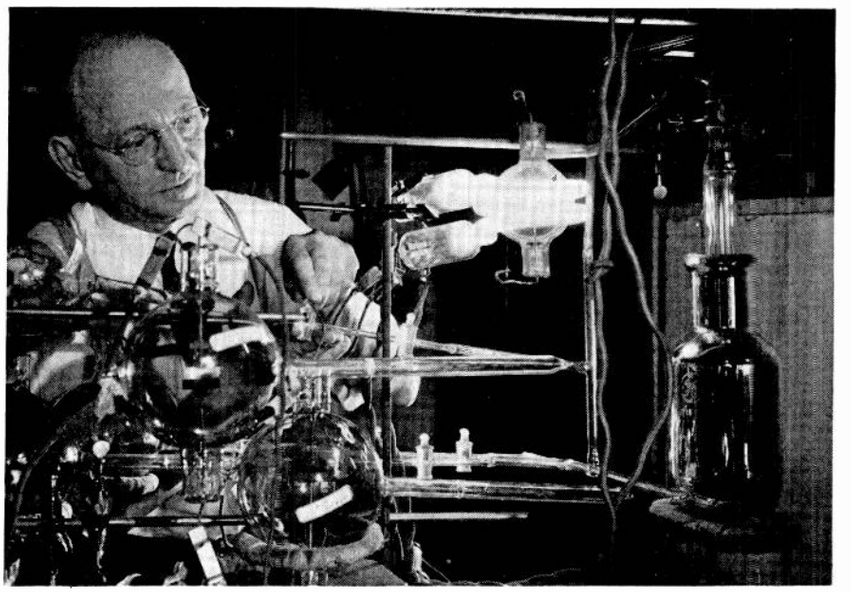


Fig. 1. A curve giving the relation between the db difference between total noise and the background alone and the db error (to be subtracted from the total noise.) This curve is of value in determining the background noise correction for sound-level measurements.

In use, separate measurements are made of the background noise alone and the background plus the unknown noise. The difference of these readings is then taken and db correction for background noise is determined from curve. Correction is subtracted from second measurement.



William A. Ruggles at work in the General Electric Research Laboratory at Schenectady.

Mr. Ruggles is in charge of the glass-blowing and exhausting facilities for the organization.

SOME NOTES ON SNOW STATIC

By Dr. VICTOR J. ANDREW

THE LION'S SHARE of recent development work in aviation radio communication has been devoted to elimination of "snow static" or "rain static." This kind of disturbance is relatively uncommon, but when it does appear, it is of such intensity as to totally block communication, and unfortunately, the time it occurs is during bad weather when radio-range signals, bearings, and communication are most needed. Certain air accidents are believed to have occurred when communication was disturbed by such static.

The usual characteristic of this static is a steady hiss or roar, rather than the bursts of the more familiar form of static. It usually starts and stops abruptly, and lasts for only a few minutes. It is often heard over only a small area, or at one point only. It is more commonly heard on a plane than in a ground station.

Before this type of interference can be eliminated, its cause must first be determined. Much of the work to date has been in studying and trying to duplicate in the laboratory the source of interference. The cause is not yet fully understood, although it has become evident that there are really several different mechanisms producing similar interference, and now all known by the general name, "snow static."

One of the first opinions was that this interference was due to snow flakes, rain drops, or dust particles carrying static charges which impinged on the antenna proper and discharged into it. Ship and shore stations, particularly in the Great Lakes region, found this kind of static many years ago. It is also often noticed when fresh smoke, such as that from a locomotive, blows across an antenna. On the Great Lakes, many ships use direction-finder loops with the loop wires encased in a metal tube. The tube is open at one point to prevent it from acting as a short-circuited turn on the loop. The loop is then sensitive to electromagnetic fields, but is insulated from electrostatic fields or direct contact with charged particles.

Transcontinental and Western Air Lines studied the application of loops with static shields to aircraft, over a year ago. Recently, government regulations have required the installation of such loops on all transport planes. While these loops are entirely satisfactory in stopping this one kind of snow static, it has been found that there are other kinds on which the loop has little or no effect. The loops are usually installed with provision for rotating them, so that they may also be used for taking bearings on ground stations.

Even when the antenna proper is shielded from impinging charged particles, these random discharges into the loop shield of the body of the ship sets up some disturbance. This is probably negligible in amount.

A somewhat greater source of interference is probably the accumulation of charge on insulated metal bodies or on insulating surfaces such as the windshield, and then a spark discharge to the body of the ship. Such causes may be eliminated by adequate bonding, and possibly by applying high resistance films to the surface of insulated bodies on the outside of the ship.

The engineering staff of United Airlines are now actively engaged in further study of causes and remedies for snow static.[1] They have found evidence that much of this interference results from the plane building up sufficient charge to start brush discharge from points. Such discharges are sometimes seen by pilots at night. The charge may originate by friction with the air, by collision with charged particles, or by passing into a space where the atmospheric potential is different from that of the plane.

When interference results from the discharge of a body, it is usually definitely periodic, and often repeats at an audio frequency. It is equivalent to a

(*Continued on page* 39)

[1] "Snow Static Effects on Aircraft," by H. M. Hucke, *Communication and Broadcast Engineering*, p. 7, July, 1937.

NEW TUBES

(*Continued from page 22*)

E. This triode, which is shown in Fig. 4, has a thoriated filament suspended from four instead of three spring retained hooks on the top lava member. Electrically floating anode is another feature of this tube. Characteristics of this tube are as follows: filament voltage, 14 volts; filament current, 6.0 amperes; max. d-c plate voltage modulated, 2,000 volts; max. d-c plate voltage unmodulated, 3,000 volts; max. d-c plate current modulated, 325 ma; max. d-c plate current unmodulated, 350 ma; max. plate dissipation, 325 watts; max. d-c grid current, 80 ma; max. r-f grid current, 10 amperes; amplification factor calculated at 150 ma plate current, 16; plate resistance at 150 ma, 1,900 ohms; grid-to-plate capacitance, 18.5 mmfd; grid-to-filament capacitance, 15.0 mmfd; plate-to-filament capacitance, 8.5 mmfd.

The Eimac KY21 (Eitel-McCullough) is shown in Fig. 5, while the Eimac RX21 is illustrated in Fig. 6. Both of these tubes are mercury-vapor rectifiers having filament voltages of 2.5 volts, filament current of 10 amperes, peak inverse voltage of 11,000 volts, and peak plate current of 3 amperes. Using a reasonable input choke to the filter, a pair of these tubes are said to supply a d-c output power of 3,500 volts at 1.5 amperes in a conventional full-wave circuit.

The tube shown in Fig. 7 is designated as the Taylor T-40. It is a general-purpose triode with an r-f output of 86 watts. The T-40 has a rated filament voltage of 7.5 volts, while the plate current is given as 2.5 amperes. Other characteristics are as follows: plate resistance, 8,700 ohms; amplification factor, 25; plate-to-grid capacitance, 4.5 mmfd; max. d-c plate volts, 1,000; max, d-c plate current, 40 ma.

The Taylor TZ-40 is a recently announced high-mu triode designed for zero-bias Class B audio operation or for frequency multiplying. Operating at rated input, an output of 175 watts of audio can be obtained. It is recommended by the manufacturer for all Class C amplifier purposes. General characteristics are: filament volts, 7.5; filament current, 2.5 amperes; amplification factor, 62; plate resistance, 17-500 ohms.

The Collins C-849A and C-350 tubes are shown in Fig. 8. The C-350 is a slightly enlarged version of the type C-300. Three of these 350's can be used as a Class C modulated 1000-watt amplifier. The filament voltage of the C-350 is 11.5 volts while the filament current is 4.0 amperes. Amplification factor is 24, and the plate resistance is 5,500 ohms. The maximum plate dissipation is given as 250 watts.

The general characteristics for the C-849A and 849H are as follows: filament volts, 11.0; filament amperes, 7.7; maximum plate dissipation, 500 watts; plate resistance, 3,300 ohms; amplification factor, 19; max. d-c plate volts, 4,000; max. d-c plate ma, 500; max. d-c grid ma, 125.

Raytheon is now offering four new RK triodes for use as power amplifiers, oscillators, or frequency multipliers. These tubes are shown in Fig. 9. The RK-11 has an amplification factor of 20 and a power output of 55 watts. The RK-12 is a zero-bias modulator tube having an output of 55 watts. The amplification factor of the RK-51 is 20, while the output is 170 watts. The output of the high-mu zero-bias RK-52 is 135 watts.

The Amperex type 849A and 849H tubes are redesigned versions of the older 849. The 849A is shown in Fig. 10. These tubes utilize an 11-volt, 7.7-ampere filament. The electrical characteristics of the 849A are identical with those of the 849. The new tube carries an FCC rating for use in the final stage of low-level modulated broadcast transmitters of 250 watts. The 849H differs from the 849A in that the grid is brought out the side of the bulb, extending the capabilities of the tube to frequencies in the vicinity of 30 megacycles.

REBUILDING TRANSMITTER TUBES

(*Continued from page 17*)

and plate are accurately put back in place and the necessary getter cups mounted.

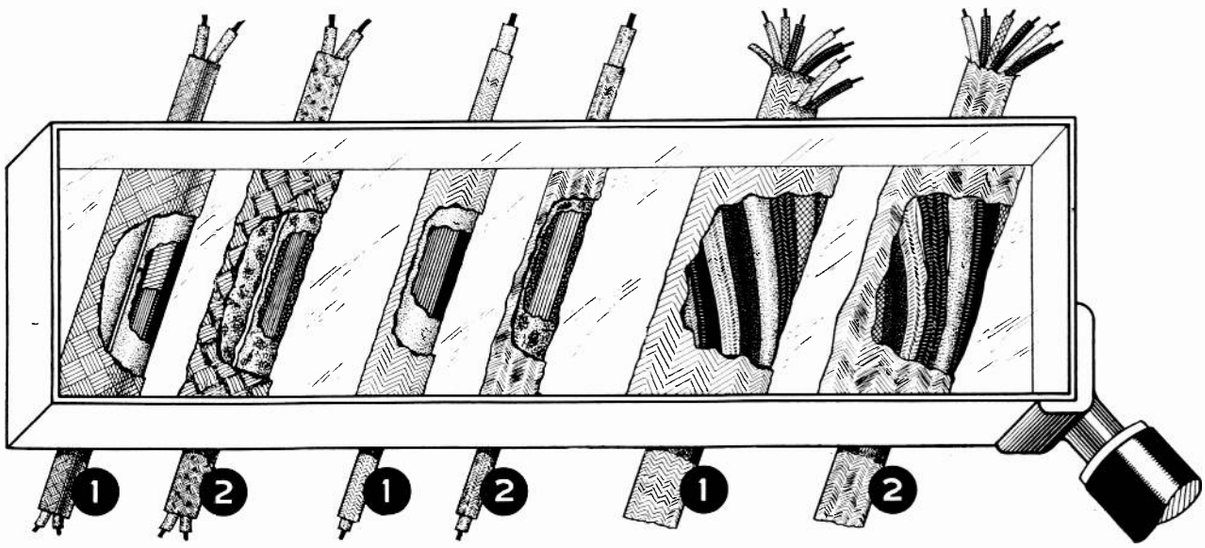
The bulb is washed out to remove the old magnesium getter and metallic deposits from the original exhaust procedure with acids and water, then dried out with acitone. After the bulb is dry, the tube is ready to be sealed together and the exhaust tube attached.

It is now ready to exhaust and is sealed to the vacuum manifold. A preliminary vacuum test is made for leaks. If ok up to this point, it is baked in an electric oven, at from 400°C for lead glass to 500°C for hard glass, for at least one hour or until the gas and water vapor is completely exhausted.

An ionization gauge gives a constant

(*Continued on page 30*)

All Wire Is *Not* The Same!



SHIELDED WIRE ***HOOK-UP WIRE*** ***MULTI-CONDUCTOR CABLE***

1 Holyoke shielded wire, under critical inspection, proves to be properly sheathed with high quality, corrosive-proof strands that afford maximum, long-life service. The rubber (or gutta-percha) covering the cotton served conductor wire itself is specially treated, uniformly applied—has no "thin spots," is perfect moisture-proof insulation.

2 The inherent (but not easily seen) defects found in inferior brands of shielded wire are numerous. Poorly spun sheathing "bunches." Vibration wears it through the (ofttimes porous) rubber insulation causing leaks and short circuits.

1 Holyoke hook-up wire has a braided, heat resistant, fire retardant covering of the highest possible quality. The smooth outside finish speeds production. The rubber insulation, uniformly applied, prevents moisture absorption or oxidation under the severest conditions, strips easily and leaves the bare wire strands clean, ready for assembly.

2 Inferior insulation on cheap grades of hook-up wire deteriorates quickly, affording but little protection against heat, moisture and climatic conditions. Current uniformity is impossible to obtain. Rejects and high production costs result.

1 Holyoke specializes in making harnesses for mass-production users. The finest quality wire and materials are used throughout. Each conductor lies uniformly in its place. The outside covering and finished-ends prevent friction, insuring long-life, efficient service. Every harness is subjected to critical inspection, guaranteeing uniformity that helps reduce production costs.

2 Defects in harnesses made of poor quality materials are not easily discernible. Loose outside covering or unfinished end-wrappings allow friction to damage the conductor's insulation. Non-uniformity of cables to specifications causes increased production costs.

All buyers and users of wire should study the above reasons as to why "All Wire Is *Not* The Same." For over a quarter of a century Holyoke has been recognized as *the* Quality Wire Supplier. Leading radio, communications and electrical equipment manufacturers throughout the world know Holyoke quality wire costs no more, and in many cases less, than inferior brands. Communicate with us so we may prove it to your entire satisfaction.

Holyoke Makes A Wire-Cable or Cord-Set For Every Purpose

Write for Engineering Data, Samples and Quotations

● HOLYOKE WIRE & CABLE CORPORATION, 730 MAIN ST., HOLYOKE, MASS. ●

Holyoke Wire & Cable Corporation

BOOK REVIEW

DICTIONARY OF RADIO TERMINOLOGY IN THE ENGLISH, GERMAN, FRENCH AND RUSSIAN LANGUAGES, by A. S. Litvinenko, edited by Prof. V. I. Basheneff, M.I.R.E., Moscow, U.S.S.R., 1937, 559 pages. Price $4.00. *Obtainable from Bookniga Corporation, 255 Fifth Avenue, New York City, N. Y.*

According to its author this dictionary is an initial attempt at a systematic comparative review of modern radio terminology in English, German, French and Russian. Approximately five thousand terms encountered in communication engineering and related fields are listed with their equivalents for each of the four languages. The alphabetical arrangements are such that it is possible to go directly from one language to any of the other three. Thus, this one volume is comparable to twelve one-way dictionaries.

Wherever possible English terms standardized by the Institute of Radio Engineers or given in the International Electrotechnical Dictionary are employed, and in general care has been exercised in a difficult task. However, partly as a result of the profusion and rapid extension of our own terminology, this reviewer discovered omissions.

This volume should serve as a valuable supplement to non-technical dictionaries in the translation of material pertaining to communication engineering.

CATHODE-RAY ELECTRON BALLISTICS

(*Continued from page* 15)

geometry. Thus far general waveform deflection correction with frequency has involved the terminal velocity. One can now proceed with the results of study as it relates with the distance of fall y.

THE DISTANCE OF FALL Y

y, the second term of expression (3) is a function of the terminal velocity in the vertical direction and thus subject to K of expression (4). In addition the time through which the charged particles have to fall in conjunction with K is also a function of frequency by inspection of Fig. 2. Let the correction for the latter be $k = f(f)$ such that kl_ε will be the effective deflecting plate length corresponding to the time allowed for particle fall at the plate tips. k is determinable for any charge stream force function but surprisingly well given for any waveform by curve 2, Fig. 3, which has a dual purpose; representing K for a square waveform and k for any waveform.

DEFLECTION EXPRESSIONS

Expression (2) was shown in two forms, the purpose of which was to allow comparison. When expression (3) is properly filled in, the following represent deflection and sensitivity expressions:

$$D_e = \frac{E_p L' l_\varepsilon}{2 s E_v} = \frac{E_p l_\varepsilon}{2 s E_v}(L + l_\varepsilon/2)$$ standard electrostatic deflection. Not applicable at high frequencies.

$$\frac{D_e}{E_p} = \frac{L' l_\varepsilon}{2 s E_v} = \frac{l_\varepsilon}{2 s E_v}(L + l_\varepsilon/2)$$ standard electrostatic deflection sensitivity. Not reliable at high frequencies ..... (1)

$$D_m = \frac{vHL' l_\varepsilon}{2 E_v} = \frac{vHl_\varepsilon}{2 E_v}(L + l_\varepsilon/2)$$ standard magnetic deflection. Not reliable at high frequencies.

$$\frac{D_m}{H} = \frac{vL' l_\varepsilon}{2 E_v} = \frac{vl_\varepsilon}{2 E_v}(L + l_\varepsilon/2)$$ standard magnetic deflection sensitivity. Not reliable at high frequencies ..... (2)

WITH WAVEFORM AND FLIGHT TIME CONSIDERED

$$D_e = \frac{E_p K l_\varepsilon}{2 s E_v}\left(L + \frac{k l_\varepsilon}{2}\right)$$ electrostatic deflection for any K..... (6)

$$\frac{D_e}{E_p} = \frac{K l_\varepsilon}{2 s E_v}\left(L + \frac{k l_\varepsilon}{2}\right)$$ electrostatic deflection-sensitivity for any K.... (6)'

$$D_m = \frac{vHK l_\varepsilon}{2 E_v}\left(L + \frac{k l_\varepsilon}{2}\right)$$ magnetic deflection for any K..... (7)

$$\frac{D_m}{H} = \frac{vK l_\varepsilon}{2 E_v}\left(L + \frac{k l_\varepsilon}{2}\right)$$ magnetic deflection-sensitivity for any K... (7)'

The last four expressions (6) to (7)' are especially useful to communications, television and high-frequency experimenters where accurate determinations are in order.

Of importance is the next relation. The manufacturer gives the ratio (D_e/E_p) for several E_v's in the tube specifications. Since L' is measurable, or available from the manufacturer upon request, the effective length of the deflecting plates is given by the expression

$$l_\varepsilon = \frac{2 s E_v}{L'}\left(\frac{D_e}{E_p}\right) \quad \ldots\ldots (8)$$

where (D_e/E_p) is the corresponding sensitivity for the E_v given.

FIGURE 3

This figure—which is an absolute magnitude plot—is applicable to any tube of known geometry and applied potentials. The frequency axis is general for any v of E_v and l_ε. Since $T = l_\varepsilon/v$ the frequency axis is fixed for any tube when E_v is set and l_ε determined by expression (8). The ordinates for the curves of Fig. 3 are fractions for both K and k. With the frequency axis located as mentioned above, a known deflection or sensitivity can be interpreted or corrected with the aid of the expressions (6) and (7). Fig. 3 is arranged with all the necessary data for ready use by the experimenter and, inasmuch as the chart and the expressions of this paper consider the waveform as well as the existence of two correction factors which are not the equivalent of the ones to date proposed, it is more inclusive and exacting.

From Fig. 3 it is also to be noted that the frequency at which any cathode-ray device deflected magnetically, electrostatically or both, will begin to lose sensitivity and thus require data correction for quantitative work is given by

$$f_{(megacycles)} = \left(\frac{2.985\, L'}{s\sqrt{E_v}}\right)(E_p/D_e)$$

for a sine wave. f is much higher for waveforms approaching a square wave and lower for those simulating a saw-tooth form.

TELECOMMUNICATION

PANORAMA OF PROGRESS IN COMMUNICATIONS

RCA WORLD'S FAIR EXHIBIT

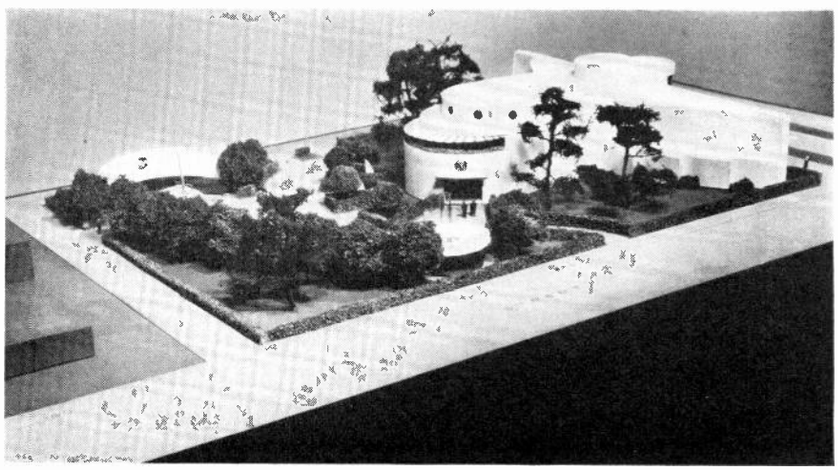
PLANS were made public recently by David Sarnoff, President of the Radio Corporation of America, and Grover Whalen, President of New York World's Fair, 1939, for the erection of an exhibit building of unique design to house a panoramic display of the latest developments of the radio art and industry as reflected by RCA products and services. The exhibits will embrace all the products of RCA companies including RCA Manufacturing Co., RCA Communications, Radiomarine Corporation of America, the Radio Institutes and the National Broadcasting Company.

Experimental television programs will be shown to the public in viewing rooms in the building. Ample opportunity will be given for visitors to view various forms of television entertainment in surroundings approximating those in American homes.

The building, as viewed from the air, will be shaped somewhat like a huge radio tube 136 feet in length, resting on a broad base 190 feet wide. The entire front of the two-story structure will be of glass, which will be brilliantly lighted at night. Working models of various radio devices will be placed in the large rotunda, around the sides of which will be six television viewing rooms.

Proceeding further into the "tube" section of the building, the visitor will see the latest radio receiving sets and tubes in actual process of construction, together with animated demonstrations of some of the principal RCA services. A picked crew of expert workers from the big RCA Victor factories at Camden, N. J., will assemble radio sets at one exhibit, while at another tubes of various types, including those used in television will be constructed.

Behind the building a large garden of trees and fountains, 200 feet wide by 150 feet in length, will provide space for novel outdoor exhibits of the RCA Communication and Marine services.



Architects' model of the RCA building to be built for the New York World's Fair.

Plans for the structure were drawn by Skidmore and Owings, architects, New York, with Paul Cret acting as consultant.

•

REBUILDING TRANSMITTER TUBES

(*Continued from page* 26)

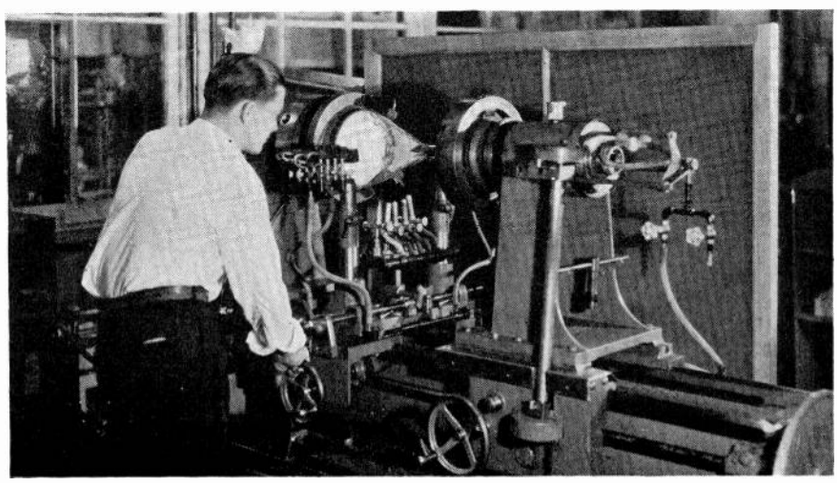
check on the gas liberated. The next step is to carbonize the filament to its proper conductance, about 80 per cent of its original conductance, if it is a thoriated filament. If it is a pure tungsten filament, no carbonizing is needed. A high-frequency water-cooled vacuum-tube furnace or coil is put around the tube and the parts outgassed slowly at first, then the temperature is raised to 1300°C or higher while there is an air blast on the tube which keeps the glass from collapsing.

The parts are bombarded alternately internally and externally at the highest temperature they will stand and still hold their correct shape from 6 to 18 hours or until there is no more gas liberated. It is baked again to clear the glass from gas deposited during the bombardment of the metal parts.

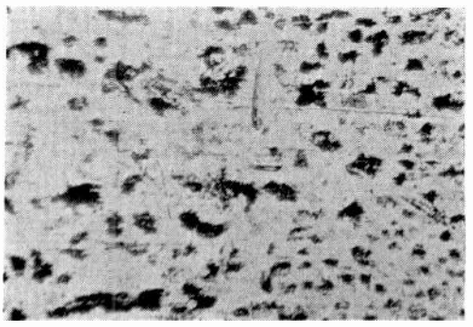
The getter is flashed and the elements sparked out with a coil. The tube is generally bombarded again before sealing off. The bases are mounted and baked on, after which it is put in an aging rack for some time to stabilize its operation.

JOHN W. JAFFRAY
General Electronics Co.

A precision lathe for fusing the deflecting electrodes into the side walls of a cathode-ray tube bulb. In the larger tubes, the bulbs are sealed together in sections to facilitate pumping. Head and tail chucks are gear-driven so that both rotate at same speed. Photo courtesy RCA Manufacturing Co., Inc.



CHEAPER . . . yes, but—

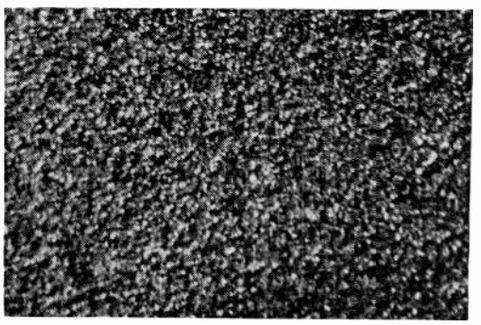


This photomicrograph shows why we do not offer electroplated strip. Note the effect of corrosion on this nickel plated strip as sold for radio tube use.

WE CANNOT AFFORD THE RISK! *CAN YOU?*

YOUR PROTECTION IS SVEACOTE which is well worth the slight additional cost

Here is a photomicrograph of Sveacote with the same magnification (100X) made after the same corrosion test.



(Darkness due to low reflection from matte surface.)

THE REASON

Sveacote is a definite alloy made by a special process to resist rust. Note compact structure, uniformity and freedom from impurities.

Swedish Iron & Steel Corporation

17 BATTERY PLACE NEW YORK, N. Y.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President | RCA Building, 30 Rockefeller Plaza, New York, N. Y. | H. H. PARKER, Secretary

THIRTEENTH ANNUAL

THE THIRTEENTH ANNUAL Dinner-Cruise of our Association was held in the North Ballroom of the Hotel Astor, Times Square, New York City, on the evening of Friday, February 11, 1938, and simultaneously Chapter cruises were held in cities throughout the country and the world. The Cruise at the Astor was adjudged by most of those present as the best cruise in the history of our Association.

A feature of the evening was the presentation of our Association's Marconi Memorial Gold Medal of Valor to Lieut. Carl O. Petersen, a member of both Byrd Expeditions. A coast-to-coast broadcast over the Blue network of the National Broadcasting Company accompanied the presentation and after the announcer made known the origin of the broadcast, he introduced our President, William J. McGonigle, who dedicated the broadcast to the memory of Marconi and then spoke of the ideals and objectives of our Association, in turn, introducing Mr. Sarnoff who detailed some of the background of our profession and our Association. Mr. Sarnoff in presenting our Medal of Valor to Lieut. Petersen paid high tribute to his resourcefulness and courage under trying circumstances. Lieut. Petersen responded with profound thanks for the high honor bestowed upon him by our Association and expressed his heartfelt gratitude to Admiral Byrd who made it possible for him to accompany the two Byrd Antarctic Expeditions. (The text of the addresses will appear in a later issue.)

A message from Admiral Richard E. Byrd: "To the members of the Veteran Wireless Operators Association: I deeply regret that I will not be able to be present on the occasion when the Veteran Wireless Operators Association is honoring Carl O. Petersen, by presenting to him the Marconi Memorial Gold Medal of Valor.

"Lieut. Petersen was a member of both my expeditions to the Antarctic; on the first as Radio Operator; and on the second, Photographer and Radio Operator. On both of these expeditions by his hard work, endurance, and great efficiency, working under the most trying of circumstances, and at times with inadequate equipment, he made great contributions to the science of radio and to our expedition. On the second expedition he took part in a number of flights of exploration, helping to solve the mysteries of the Antarctic. Above this, and what I believe to be even more important, Petersen is a most loyal friend and comrade and has the good-will and respect of all his shipmates.

"I am glad that he is to be rewarded with this Medal which he so richly deserves." Signed, R. E. Byrd.

Seated at our Distinguished Guests table were the following: Geo. P. Smith, Executive in the Concessions Department of the New York World's Fair 1939, and Chief Radioman aboard the Flagship on the round the world trip of the United States Navy Fleet in 1908; Theodore Haubner, who sent the first SOS signal in March 1909 from the Steamship *Arapahoe* and had the honor of receiving the second SOS signal later in the same year. He recently donated the headphones used in both these cases to the Ford Museum at Dearborn, Michigan; H. H. Parker, General-Secretary of our Association; Paul Borovoy, Acting Soviet Consul General who was present as our guest to receive the Marconi Memorial Testimonial Scrolls of Honor awarded to his fellow countrymen, heroes of the Russian Trans-Polar flights —Alexander Beliakoff, Serge Danilin, Georgi Baidukoff and Andrey Yumasheff; A. F. Wallis, Vice-President of our Association and Sales Manager of the Marine Department of the Mackay Radio and Telegraph Company; Rolf Christensen, Norwegian Consul General who was present to pay tribute to Norwegian born Carl O. Petersen; Lieut. Carl O. Petersen, USNR, our Guest of Honor and recipient of the Marconi Memorial Gold Medal of Valor; William J. McGonigle, President of our Association, who acted as Master of Ceremonies; David Sarnoff, Life Member of our Association, President of the Radio Corporation of America and Chairman of our Marconi Memorial Committee, who presented the Gold Medal to Lieut. Petersen; Ibrahim Mahmoud, Representative of the Royal Egyptian Consulate in New York; Admiral Luke McNamee, President of the Mackay Radio and Telegraph Company and the Federal Telegraph Company and our most recent Honorary Member (Admiral McNamee was present to accept his Honorary Membership in our Association); J. R. Poppele, Chairman of our Scholarship Committee and Secretary and Chief Engineer of the Bamberger Broadcasting Service, Inc., and Radio Quality Group, Inc.; J. W. Scanlin, the Number One Radioman in the United States Navy, whose service dates back to 1901, who made the trip up from Washington especially to be at the dinner; H. F. Coulter, Comptroller of the Radiomarine Corporation of America and a pioneer in the Department of Commerce; Miss Lena Michelsen, one of the few of the fair sex who worked commercially as a wireless operator for some few years; Fred Muller,

(*Continued on page* 34)

Now - a substantially Flat response, even to 10,000 cycles

AUDAX

adds fresh weight
to its slogan:—

"The Standard by Which Others Are Judged and Valued"

ENGINEERS and sound technicians will surely welcome this announcement—that practically flat response at "ceiling" frequencies can at last be assured. To 5,000, then to 6,000; then to 7,000—AUDAX has steadily raised the standard, till now the most difficult special studio work, involving real wide range, reproduces with uniformly flat characteristic. All the accustomed *facsimile* realism, the uncompromising conformity to original microphone recording—with this added feature which only AUDAX could provide!

THREE DISTINGUISHED MICRODYNE MODELS AT RIGHT

A pick-up for every purpose, from the humble portable to the most elaborate sound system.

List $7.50 to $260.00

MICRODYNE RF-6 Substantially flat to 10,000 cycles; for records up to 18 inches; needle impedance practically nil; feather touch on record; list.....**$125.00**

MICRODYNE RF-5 Identical with RF-6, except that its response is not quite so uniformly flat; list..**$98.00**

MICRODYNE RF-3 Substantially flat to 8,000 cycles; for records up to 12 inches; very low needle impedance; feather touch on record; list..... **$60.00**

The above models may be had with a permanent point at small extra cost. Also available for Hill and Dale at slightly higher prices.

AUDAK COMPANY

500 Fifth Avenue, New York

"Creators of High Grade Electrical and Acoustical Apparatus Since 1915"

VWOA NEWS

(*Continued from page 32*)

a past President of our Association, Life Member and at present a member of our Board of Directors.

MESSAGES

WE REPEAT, here, the last message from our late beloved member, Guglielmo Marconi, wireless veteran number one, in whose honor we have named our Year Book for 1938 and our awards, Gold Medal and Testimonial Scrolls of Honor and the Certificate of Merit which will now and henceforth be known as Marconi Memorial awards: "As the original wireless veteran may I participate your reunion and wish you all best of luck." This message was received at the Twelfth Annual Cruise last year at the Great Northern Hotel.

The Royal Italian Ambassador the Hon. Fulvio De Suvich felicitated our Cruise as follows: "It is with distinct pleasure that I associate myself with the members of the Veteran Wireless Operators Association in doing honor to the memory of Italy's illustrious son Guglielmo Marconi whose inventions made possible the modern science of radio communication. His name will be remembered as long as the human voice is heard and his career will serve as an inspiration not only to the people of Italy but of all the world which with each passing year will be more profoundly affected by the remarkable achievements of radio."

From California we received the following message from our Honorary Member Dr. Lee De Forest:

"Dear Fellow Vets:

There is tonight a spell of sadness about us, of a deep and personal loss, which we can not dispel, even if we would. The Pioneer of pioneers, the Veteran of all Wireless Veterans has passed over the boundless horizon, whither each one of us, when the Skipper summons, must bravely follow.

"Marconi, Commendatori, the ether waves which your daring spirit first summoned to do man's bidding are bearing that spirit with the speed of light into the realms of eternal light.

"But the effulgence which marked your life among us here on Earth, that glory remains unfading and undimmed, for our encouragement and inspiration!

"What blessings have come to man through the work and genius of that exceptional man! None are so qualified to appreciate the full magnitude of this gift as ourselves, Veteran Wireless Operators of America. Let us realize then that the mantles of great men who have passed before have fallen especially upon our shoulders; of Faraday, Hertz, Edison, Fessenden, and now Marconi. Be enheartened thus to follow on, to sail the seas where they first piloted.

"In recalling scenes of my early wireless labors, memory carries me fondly to those days in Key West when I was installing one of the large Naval Stations. It was then all so new, so wonderful, before this triumph of Science had become commonplace and un-romantic and incidental.

"This is how it then impressed me—reading from my Diary of 1905:

"'Fascinated I stand and watch, seeking to fathom its significance, the great wierd mystery of it all, these shining pillars holding aloft an invisible vault of etheric echoes, silent voices whose echoes nevertheless resound over a thousand miles;

strangely fashioned listening things that harken silently, by night, by day, and hear the inaudible calling from distant cities across the sea.'

"Let us not today become so lost in the mazes of our headlong, dizzy, or routine living that we fail ever to realize, and pause before the wonder, the mystery of what we first knew as Wireless.

"And let us not as Veterans forget the early thrills of sending and then receiving those first signals from some ship lost beyond a hundred wide horizons—those memories should keep alive a never waning pride in the profession which we chose so long ago, or helped to found.

"And now, be I in California or once more in your midst as of yore, as I long to be tonight, please know that on each succeeding Cruise I am still with you, fellow Veterans, in heart and spirit, until the last sign-off.

"'Beyond the light of far Cathay,
Beyond all mortal dreams,
Beyond the reach of night and day
Our El Dorado gleams,
Revealing—as the skies unfold—
A star without a stain
The Glory of the Gates of Gold
Beyond the Spanish Main.'

And so—

73 forever!
Lee de Forest."

SMOKER

THE APRIL MEETING of the New York group will take the form of a Smoker and Beer party and will be held on Monday evening, April 4, 1938, at the Castle Garden Cafe, 62 Pearl Street, New York City. Admission, $1.50—all the beer you can drink. Don't fail to be there. Let us know how many in your party.

•

DELTA-STAR MIXER

(*Continued from page* 20)

of 200-ohm to 200-ohm isolation transformers to allow the one side of each incoming and outgoing circuit to be grounded. The mixer may be extended up to 16 inputs and 2 outputs, still using 200-ohm pads throughout, and with all impedances matched regardless of the number of inputs. This means that a station can standardize on one impedance for its inputs, outputs, lines, pads and mixing transformers, and yet be flexible enough to meet future mixing requirements.

•

BROADCAST CONFERENCE

(*Continued from page* 12)

"Snow-Static Effects on Aircraft," by H. M. Hucke, United Air Lines; and "Aeronautical Ground Radio Station Design," by P. C. Sandretto, United Air Lines.

The Broadcast Engineering Conference was sponsored by the Department of Electrical Engineering of Ohio State, and much credit for its success is due Professor W. L. Everitt, the Director of the Conference.

OVER THE TAPE . . .

NEWS OF THE COMMUNICATIONS FIELD

BENDIX EUROPEAN REPRESENTATIVE

Appointment of H. F. McEnness as special European representative for the Bendix Aviation Export Corporation and the opening of a new Paris office at 51 Avenue George V have been announced by Howard S. Welch, Vice-President and General Manager. Traveling out of his Paris headquarters, Mr. McEnness will cover the Continent, the British Isles and the Near East.

GARRETT W. LEWIS

It has been announced that Garrett W. Lewis, San Jose, California, is the successor to National Radio Tube Co., of San Francisco. Mr. Garrett W. Lewis, who for fourteen years served as Chief Engineer for the old company, heads the new organization, which will engage exclusively in the repair of electron tubes. Associated with Mr. Lewis on the engineering staff will be Mr. Eldreth Hodges of San Jose.

CENTRALAB BOOKLET

Centralab now has available an engineering data booklet on carbon composition fixed resistors. This 8-page booklet contains dimensions, general specifications, cold-voltage and hot-load curves, power-temperature characteristics, noise-limit curves, life and humidity test data, as well as resistance-frequency and voltage-limit curves. To secure a copy write to Centralab, 900 E. Keefe Ave., Milwaukee, Wis., for form No. 647.

PAULEY-JAMES CORP.

The Pauley-James Corporation, of 4619 Ravenswood Ave., Chicago, Illinois, has been formed for the purpose of manufacturing and distributing a new auto-radio replacement vibrator. Sales Manager of the concern is Hal. M. Pauley, who was General Service Manager of Grigsby-Grunow Co., and connected with Stewart Warner Corp. Stephen F. James, formerly with Grigsby-Grunow Co., is acting in the capacity of Chief Engineer and as a Director of the Corporation.

GENERAL RADIO BULLETIN

The General Radio Company, 30 State Street, Cambridge, Mass., have recently issued an interesting 4-page bulletin covering an improved standard-signal generator, Type 605-B. A general description, circuit diagram and specifications are given. A copy may be secured by writing to the above organization.

SOLAR APPOINTMENT

Solar Manufacturing Corporation have announced an addition to their executive staff. Mr. J. I. Cornell has joined the organization as Consulting and Field Engineer. Mr. Cornell was formerly Chief Engineer of the Magnavox Company, and previous to that was Section Engineer in charge of audio components with RCA Manufacturing Co., Inc.

TRANSMITTING TUBE MANUAL

"Air-Cooled Transmitting Tubes" is the title of RCA's Technical Manual TT-3. This 192-page manual covers general vacuum tube considerations, generic tube types, transmitting tube installation, application, technical description, ratings, design considerations, etc. In addition, useful formulas and transmitting tube charts are given. Also special sections have been devoted to rectifiers and filters as well as to circuits. To add further to the value of this manual a reading list is provided. Copies of the manual may be obtained from RCA transmitting tube distributors or by sending 25c to the Commercial Engineering Section, RCA Radiotron Division, RCA Manufacturing Co., Inc., Harrison, N. J.

LOVEJOY PLANT AT WINDSOR

Lovejoy Flexible Coupling Corporation, Chicago, Illinois, makers of L-R flexible couplings, are opening a Canadian factory at Mercer Street, Windsor, Ontario. L-R flexible couplings are made in several types for use by manufacturers in Canada as well as the United States.

OPERADIO APPOINTMENT

The Operadio Manufacturing Company announce the promotion of Howard A. Wilson to the position of Sales Manager of the Public-Address, Sound and Amplifier Trade Division, according to a statement issued by Larry King, General Sales Manager. Howard Wilson has been with Operadio for several years.

SHALLCROSS BULLETIN

Bulletin No. 835 has recently been issued by the Shallcross Mfg. Co., Collingdale, Pa. This bulletin describes the 800 series of Decade Resistance Boxes. Complete descriptions and specifications are given. Copies are available from the above organization.

MICROPHONE BULLETIN

Universal Microphone Co., Inglewood, California, on March 1 issued a special bulletin showing various types of hand microphones. It covers the subject of hand microphones exclusively and shows the exterior appearance as well as circuit diagrams for use as call systems in hospitals, paging systems, sports announcing, ship-to-shore, police car transmitters, aircraft use, etc.

BULLETIN ON BUSHINGS

Isolantite Inc., announces the issuance of a new 8-page bulletin on bushings for lead-in, transformer and condenser service. The bulletin, identified as Bulletin No. 104, lists all of the company's standard bushings. All the insulators listed are of the low-loss ceramic type, suitable for high-frequency service. Mechanical drawings give complete working dimensions. Bulletin No. 104 is the third of a series listing groups of the company's insulators. Copies may be obtained from Isolantite Inc., 233 Broadway, New York City.

HARRY TERRY MOVES OFFICES

Harry Terry has moved to 8 So. Michigan Ave. Until Feb. 1, 1938, he had offices at 360 N. Michigan Ave., Chicago. Mr. Terry, who was Vice-President of The Cramer-Krasselt Co. for ten years, resigned Jan. 1, 1937, to open his own offices as Advertising and Sales Economist. He works with both advertising agencies and advertisers in co-ordinating sales and advertising plans by making sales and market studies and advertising audits at the point-of-sale.

GATES CATALOGS

The Gates Radio & Supply Company announce the release of three new catalogs devoted to speech-input equipment, remote-control equipment and accessory equipment, all for broadcast station and associated fields. Copies of these catalogs may be had by writing to either the Gates Radio & Supply Company of Quincy, Ill., or the Gates Radio & Supply Company, 5334 Hollywood Blvd., Hollywood, Calif.

SPAULDING DATA BOOK

Spaulding Fibre Company, Inc., 310 Wheeler, St., Tonawanda, N. Y., have made available their 1938 Engineering Data Book. This 32-page booklet covers their line of fibre sheets, tubes, rods, radio coil forms, etc. To secure a copy, write directly to the above organization.

RCA LICENSES HEINTZ & KAUFMAN

Radio Corporation of America have announced that they have granted a non-exclusive license to Heintz & Kaufman, Ltd., of San Francisco, California. The license extends to various commercial radio apparatus for use on ships and aircraft, and by governments. The agreement effects termination of certain patent litigation pending between the parties.

"THIRD HAND INFORMATION"

"Third Hand Information" is the title of an interesting 4-page bulletin recently released by the American Screw Company of Providence, R. I. This bulletin describes the patented Phillips recessed head type of screw, which is said to save considerable time in production operations. A copy of "Third Hand Information" may be secured from the above organization.

THORDARSON TRANSMITTER GUIDE

The Thordarson Transmitter Guide, No. 344-C, has just been issued. This 48-page guide is offered as a practical work-book to aid the builder and operator of amateur transmitters. It contains descriptions of 5 and 10-meter transmitters, as well as other transmitters ranging in power from 100 to 1000 watts. In addition, about 15 pages have been devoted to technical data, calculations, circuits, etc. To secure a copy of this guide, write to Thordarson Electric Mfg. Co., 500 W. Huron Street, Chicago. The price is 15c.

RAYTHEON DATABOOK

The Raytheon Production Corp. have recently issued a pocket databook on Raytheon radio-receiving tubes. This databook contains information on tube elements, classification by structure and function, characteristics, application and circuits, operating practice, conversion curves, resistance-coupled amplifier design curves, etc. Copies may be secured from Raytheon Production Corporation, 55 Chapel Street, Newton, Mass. The price is 25c.

WESSNER JOINS WEBSTER-CHICAGO

Absent for a long time because of ill health, the many friends of Fred Wessner will be glad to welcome him back into the radio business. Mr. Wessner has accepted the position of Sales Promotion Manager of Webster-Chicago and will be located at the home offices in the Bloomingdale Avenue plant, Chicago.

HOFFMAN HEADS WESTINGHOUSE TUBES UNIT

Foreseeing an enlarging field of usefulness for electronic tubes, the Westinghouse Electric & Manufacturing Company has reorganized its manufacturing facilities at Bloomfield, New Jersey, to form the Special Products Division, under the management of H. J. Hoffman. The new Division embraces the design, manufacture and sale of electronic tubes, according to an announcement of D. S. Youngholm, Vice-President.

The new Division will continue the manufacture of a complete line of radio-transmitting tubes, including the 50-kw type AW-200, the largest ultra-high-frequency television tube made. It will also continue the manufacture of special ultra-violet devices, and complete lines of electronic tubes of industrial types, as well as X-ray tubes and associated rectifiers.

VARNISHED CAMBRIC CABLE DATA

A carefully prepared study on the correct uses of varnished cambric cable, the various types, physical properties and characteristics is now available. In addition to this information, a new booklet contains a series of new tables relating to recommended thickness of insulation, tests and new current capacities data for use of this cable in both air and ducts. The concluding pages give recommended instructions for making straight joints on varnished cambric cable. This publication is available through the Anaconda Wire and Cable Company, 25 Broadway, New York, N. Y.

MILLER BULLETINS

J. W. Miller Company, 5917 South Main Street, Los Angeles, California, have recently made available two interesting bulletins. One bulletin describes the Series 813 dual-wave interference traps and the Series 812 standard wave trap. The second bulletin gives a complete description of a band-pass tuned-radio-frequency coil kit including circuit diagrams of a high-fidelity tuner and a high-fidelity receiver.

GENERAL ELECTRIC BULLETINS

The General Electric Company, Schenectady, N. Y., have recently made available two bulletins on capacitors. One bulletin covers Pyranol-treated radio-transmitter capacitors for amateur radio equipment, while the second deals with d-c Pyranol capacitors for radio and X-ray equipment, impulse generators, etc. Write to the above organization.

REMCO BULLETIN

The Remco 3A portable remote amplifier is described in a bulletin which has recently been issued. Write to Radio Engineering & Manufacturing Co., 26 Journal Square, Jersey City, N. J.

AIEE CONVENTIONS, MEETINGS

The American Institute of Electrical Engineers, 33 West 39th St., New York City, have announced the following schedule of national conventions and district meetings:

National Conventions

1938

Summer Convention—Washington, D. C., June 20-24.
Pacific Coast Convention—Portland, Oregon, August 9-12.

1939

Winter Convention—New York, N. Y., January 23-27.
Combined Summer and Pacific Coast Convention—San Francisco or vicinity, Calif. Dates to be determined.

District Meetings

1938

North Eastern District—Lenox, Mass., May 18-20.
Southern District—Miami, Florida, November 28-30.

1939

North Eastern District—Springfield, Mass., May.
South West District—Houston, Texas, Spring.
Middle Eastern District—Location to be determined, October.

Further information may be secured from H. H. Henline, National Secretary of the above organization.

WILCOX BULLETIN

The 45-M portable remote amplifier is described in a bulletin available from Wilcox Electric Company, 1014 West 37th St., Kansas City, Missouri. Complete description and specifications are given.

TAXATION OF BALLAST RESISTOR AND TUNING "TUBES"

Ballast, or resistor, tubes and also cathode-ray tuning eye tubes are exempt from the federal 5 percent excise tax, when sold separately from a chassis or receiving set, according to an informal ruling secured by the RMA from Internal Revenue Bureau headquarters at Washington. When the ballast or resistor tubes or the tuning tubes are incorporated in a chassis or receiver, they are, of course, part of the complete chassis or receiver which is thus assembled and subject to the excise tax.

Regarding the ballast or resistor type of "tube," so far as the excise tax law is concerned it is not regarded as a "tube." It is a resistance unit or voltage regulator, in the opinion of Internal Revenue Bureau officials, who are of the opinion that a tube must consist of at least three elements in the modern receiving set to perform the functions of a tube and be subject to excise taxation.

PIERSON-DE LANE CATALOG

Pierson-De Lane, Inc., Los Angeles, manufacturers of communications receivers, the middle of January published their first catalog. The organization was established several months ago and manufactures and distributes PR 15 communications receivers, and the PR 15 UH, special police receivers. Address requests to the above organization at 407 I. N. Van Nuys Bldg., Los Angeles.

SOME NOTES ON SNOW STATIC

(*Continued from page 25*)

relaxation oscillator, such as, a condenser charged steadily through a high resistance, and discharged periodically through a neon tube which has an unstable resistance. The audio waveform of such a discharge is jagged, which gives a tone harsh, or right in audio harmonics. If conditions are suitable for generation of r-f oscillations in the metallic structure near the discharge, then the audio wave appears as modulation on the r-f carrier. Such a carrier is highly damped, and therefore very broad in frequency. If no actual r-f oscillations are present, still the steep wave front of the audio wave is actually equivalent to harmonics of the audio frequency across the radio frequency spectrum, and consequently produces interference.

Such a periodic discharge gives a tone or whistle readily distinguishable from the roar or hiss which results from a random discharge such as impinging particles. Often the periodic discharge is confused by several independent sources at different frequencies. Whistling static with distinct and varying tones is heard at times. In an urban location, such as the usual broadcast receiver, it is probably taken for a man-made interference.

It appears impossible to prevent a charge from building up on a plane. It is necessary therefore to try to find some way to discharge the plane without generating radio interference. United Airlines are working experimentally on discharge through a small trailing wire, with a series resistor. The effects of this wire are (1) to offer a sharp point where discharge will occur before the plane reaches a high potential, and therefore generate lower amplitude of interference, (2) to locate the discharge some distance behind the plane, and so quite remote from the receiving antennas, and (3) to damp out r-f and possibly audio oscillations by passing the discharge current through a series resistor.

The snow static discussed thus far originates in the plane, or in the case of a ground station, results from wind passing the receiving antenna. There is now abundant evidence that some snow static originates some distance away from the receiving station, and is due to a natural cause at present beyond the reach of the engineer to stop at the source or to discriminate against in the

(*Continued on page 40*)

SNOW STATIC

(*Continued from page 39*)

receiver. A relaxation oscillator type of discharge between two clouds, between a cloud and the earth, or between an insulated object and the earth is a probable source of such interference.

Snow static is sometimes present when there is a thunder storm nearby. When a discharge of lightning occurs, the static disappears for a short time and signals are heard normally. This indicates that the lightning has discharged the primary source of power supplying the assumed relaxation oscillator. The whistling tone usually rises steadily, indicating an increasing voltage in the primary source of power, until it is climaxed by the lightning discharge.

The author recently observed whistling static in the El Paso ground station of the Continental Airlines. A thunder storm was evident in the nearby mountains. At times several independent tones were present. Local tests were made to determine that the oscillation was not occurring in one of the local antennas. The interference was present in a broadcast receiver in an automobile, but of quite low intensity.

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ALLOCATION ENGINEERING

(*Continued from page 23*)

on behalf of the public by insuring that its service area was protected as far as possible beyond the boundary to which that station would be normally limited. Such a station might be asked to increase its power in order to increase its coverage, provided that it retained its desirable program and advertising policies.

It might be possible to adopt a similar attitude toward stations that cooperate together to increase each others' service area. A station can usually increase the service area of the other stations operating on the same channel without materially affecting its own by using directional antennas and other means. The increase in service area obtainable will usually be several hundred percent, and would materially improve the coverage of regional and local stations. Moreover, it would make it possible for some stations to give service to large surrounding rural areas. (Such rural service is seldom available now.) The protection of other stations will involve substantial expenditures, and, unless there were a reciprocal policy on the part of these other stations, there is no reason why a station should embark on such an altruistic policy. It is hardly debatable that cooperation between stations on the same

frequency is desirable for the service of the public. It should therefore be desirable to foster such cooperation within the industry with the assistance of the Commission.

Another aspect of allocation is the market area which a station serves. A large station in a small town is no more economically reasonable than a small station in a large town, quite apart from the economics of the station itself, but from the point of view of the best distribution of the energy of radio waves. As far as possible a station should be granted enough power to give good and sufficient service to the market area in which it is located.

The question of the relationship between the power of a station and its market area raises the question of horizontal power increases. While such increases are probably desirable in many cases, the general desire of the industry that was indicated in the public hearing of October 5, 1937, that stations be permitted to operate at higher powers, may not have disclosed all the facts. There has been considerable pressure from advertising agencies to increase power on the grounds that such an increase would permit higher rates, and it is possible that such higher rates would be obtained immediately after a horizontal power increase were introduced. If, however, such an increase does not materially improve the service rendered, and that will be the fact in some cases, it is not likely that the initial increase in rates will be retained for any length of time. These stations will then find themselves with higher costs to meet and no better revenues, so that the quality of their programs will be affected. In such cases the increased costs will not benefit the public, and on the contrary it may be desirable to protect the industry against building up such unjustified operating costs.

Engineering principles are not the only criteria for station allocation. In this article, I have considered a few cases in which it may be desirable to make compromises from the standards based on pure engineering in order to meet other important factors from the point of view of service to the public and to the industry. Such compromises imply reasonably flexible rules, it is hoped, therefore, that rigidity will not be a characteristic of the new allocation rules to be adopted, so that exceptions may be made to meet special cases such as those described. It seems that it would be to the benefit of the public to give special protection to cases of this kind. There is no real need for rigid rules, for the industry and the Commission should be able to and can work hand in hand to give the best service in the most economical manner.

THE MARKET PLACE

NEW PRODUCTS FOR THE COMMUNICATIONS FIELD

RECEIVING REMOTE

The Receiving Remote is a combined, complete high-gain remote-control amplifier and small radio tuner having self-contained loudspeaker and a-c power supply. Nothing is needed to complete its readiness for broadcasting other than the microphone.

The Receiving Remote is so arranged that all operation is handled by a single key-type switch. The radio is tuned by means of a slotted control and can not be changed by the operator. When the key switch is up or to position "radio" the receiver is in use and local program is reproduced through the small self-contained loudspeaker. When the key is down or to position "amplifier" the radio is shorted out, speaker cut off and the amplifier is connected to the telephone line. The entire equipment is 20" long, 7" high and 5" deep.

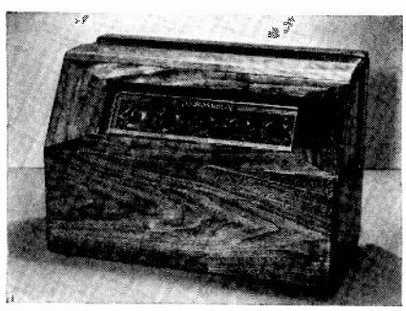
Additional information may be secured from *Gates Radio & Supply Co.*, Quincy, Illinois.—COMMUNICATIONS.

Gates Receiving Remote.

THORDARSON AMPLIFIERS

A new line of amplifiers in modernly styled, solid walnut cabinets has just been announced by Thordarson. Outstanding features are: illuminated dials, protected controls, window visibility dials, dual tone control, multiple inputs with individual controls, universal output impedance selected by convenient plug-in connectors. Inverse feedback is employed.

The full line includes sizes from 8 to 60 watts output. Amplifier and speaker carrying cases are available. Free Catalog No. 600-C may be obtained from *Thordarson Electric Mfg. Co.*, 500 West Huron Street, Chicago, Illinois.—COMMUNICATIONS.



Thordarson Amplifier.

BELL P-A SYSTEM

An announcement has just been made of the Bell Model 424 portable public-address system, which is of modern design, and which can be had with the amplifier in a choice of colors—red, blue or black. It has a 24-watt output, and utilizes both bass and treble compensators. By proper use of compensating controls it is said that the feedback difficulties encountered because of different room acoustics can be largely overcome. The system has two 12-inch heavy-duty dynamic speakers. Matching terminals permit the use and matching of as many as six speakers. Three input channels allow for simultaneous use of two microphones and a phono pickup.

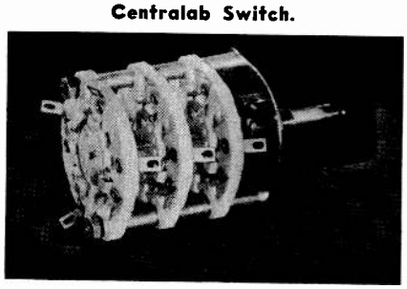
For additional information write to *Bell Sound Systems, Inc.*, 61 East Goodale St., Columbus, Ohio.—COMMUNICATIONS.

CENTRALAB SWITCHES

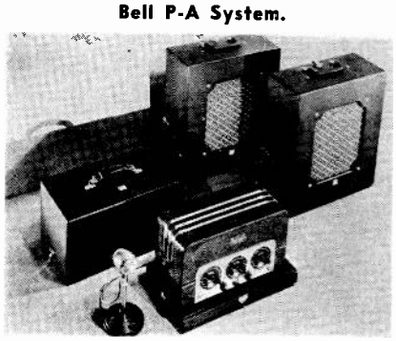
Centralab has made available a complete line of selector switches assembled with Isolantite insulation. Two general classes of switches are available. The first of these is designed primarily for the radio amateur and has sufficient clearance between all electrical parts to operate safely at potentials up to 1000 volts d-c. The contacts are designed to operate in transmitters rated up to 100 watts. The second general classification of Isolantite switches is similar in design to the present popular Centralab Bakelite type, but will differ in that Isolantite insulation is used throughout. These will be available in all the usual multiple-pole multiple-position types.

Bulletin No. 684 covering the new line of Isolantite switches will be forwarded to those requesting it. Write to *Centralab*, 900 E. Keefe Ave., Milwaukee, Wisc.—COMMUNICATIONS.

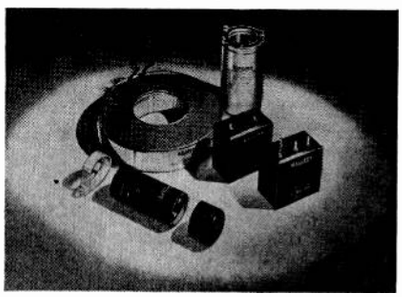
Centralab Switch.



Bell P-A System.



Mallory Capacitors.



MOTOR-STARTING CAPACITORS

A complete line of motor-starting capacitors designed to service all replacement needs has been announced. The entire line consists of 106 units, only 22 of which are required to serve 90% of the field applications. Nine "universal" units may be satisfactorily used on a wide variety of replacements even though they do not duplicate the original capacitor in physical appearance. All units incorporate latest construction improvements. A special folder, with more than 160 replacement listings by motor make and model number, will be sent on request. Write to *P. R. Mallory & Co., Inc.*, Indianapolis, Indiana.—COMMUNICATIONS.

TELEVISION TRANSFORMERS

Three transformers, for use with the new Kinescope television tubes, are announced by Thordarson. T-16R50 delivers 3000/2000 volts d-c at 3 ma for a type 1801 tube and 2.5 volts at 1.75 amperes for an RCA-879. T-16R51 delivers 6000/4500/3000 volts d-c at 5 ma for a type 1800 tube and 2.5 volts at 5 amperes for an RCA-878. T-16F55 delivers 2.5 volts at 2.1 amperes for the heater of either an 1800 or an 1801.

Three replacement type output transformers, for use with push-pull 6L6's, 6V6's etc., single 25L6's, 6L6's, etc., and single 1F4's, 1F5G's etc., and a modulation transformer for use with the new TZ-40 tube, are also announced.

A copy of Catalog 400-AX describing these units is available from any Thordarson jobber or will be mailed postpaid to any one writing to the *Thordarson Electric Mfg. Company*, 500 West Huron Street, Chicago, Illinois.—COMMUNICATIONS.

TRIMMER CONDENSER

A new Solar trimmer condenser is available in two different constructions, Type TP and Type TPB. The Type TP is the ceramic base type which is available in either individual units or in multiple units up to any desired number of sections with the ceramic base fastened to an L channel steel strip. The TPB units are mounted on a bakelite strip, and are available in single or multiple units up to any desired number of sections.

In general, for push-button tuning where a high order of stability is required, the ceramic base units should be used.

Additional information may be secured from the *Solar Manufacturing Corp.*, 599 Broadway, New York City.—COMMUNICATIONS.

PRECISION CAPACITANCE

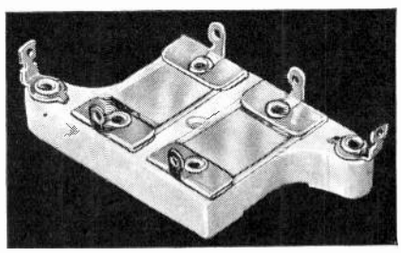
After two years of development and test, a new type of precision condenser is being offered for radio production purposes. The new condenser is based on the use of conducting films of silver, chemically deposited on thin sheets of India ruby mica. Connection to the films is made by means of silver-plated terminal clips which are pressed down over the ends of the mica. This assembly is fastened to a ceramic block.

Adjustment of capacity is accomplished by removing the required amount of silver. The maximum capacity using a single mica is about 150 mmfd. This range may be increased by using additional plates connected in parallel. Close capacity tolerances can be maintained in production because of the ease of adjustment. A special treatment given the finished and adjusted assembly is said to insure uniformly high Q, while a wax dip provides protection against moisture.

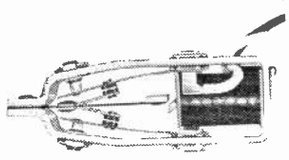
Additional data may be secured from *The F. W. Sickles Co.*, Springfield, Mass. —COMMUNICATIONS.

VIBRAPOWR

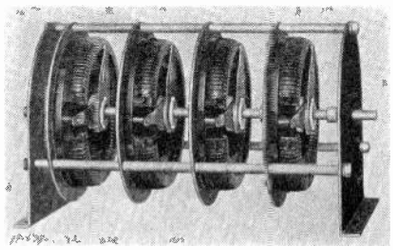
Vibrapowr is the trade name of a recently announced auto-radio replacement vibrator. This unit is said to incorporate a different mechanical design, and adjustability with a self-cleaning wiping action of the contact points. Filing and readjusting the points in a Vibrapowr unit is practically the same as the method employed in automobile distributor work, without the use of an oscillograph, meters or gauges. Further information may be secured from *Pauley-James Corp.*, 4619 Ravenswood Avenue, Chicago, Illinois.—COMMUNICATIONS.



Sickles Capacitor.



Pauley-James Vibrapowr.



Ohmite Tandem Assembly.

RHEOSTAT TANDEM ASSEMBLY

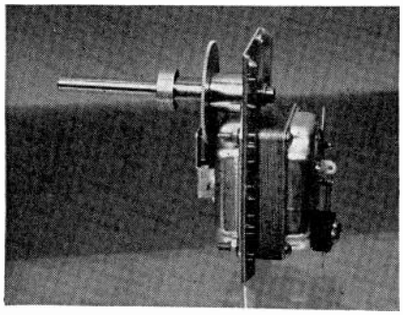
A special type of tandem construction and assembly has been designed by Ohmite engineers for special use with the larger-size Ohmite rheostats. This assembly, like the standard Ohmite tandem assemblies, is used for the control of electrical apparatus where several circuits are to be simultaneously varied, as in the control of the individual phases of a 3-phase line, etc.

A four-unit assembly recently completed consists of four Ohmite Model "U" rheostats rated at 1,000 watts each. The overall length is approximately 3'2" and the height 15⅛". It is 12" in diameter, and has a ¾" through shaft.

Each rheostat is individually driven from the shaft through specially made universal couplings, designed to eliminate lost motion—the contacts thus remaining in alignment.

This special construction and assembly can be supplied for 2, 3, 4 or more rheostats in tandem, using any combination of Model "N" (300-watt), Model "R" (500-watt), or Model "U" (1,000-watt) units. Standard-type tandem assemblies are available for use with all Ohmite rheostat models from 25 to 1,000 watts, or with Ohmite tap switches.

Ohmite Manufacturing Company, 4835 Flournoy Street, Chicago, Illinois.—COMMUNICATIONS.



MIDGET MOTORS

The unit shown in the accompanying illustration incorporates the new Utah 3-wire reversible midget motor. It is one of the mechanical arangements supplied to radio manufacturers for push-button or automatically tuned radio sets. The gear train gives a reduction ratio of 34.56 to 1. A gear mounting plate is inserted between one end cover shell and the lamination stack, providing alignment of the low-speed shaft. As usually used in radio receivers, this shaft carries the manual tuning knob in addition to a pulley for the gang condenser drive cord.

Complete specifications on this and other Utah motors are contained in a bulletin recently issued by *Utah Radio Products Co.*, 820 Orleans Street, Chicago, Illinois. —COMMUNICATIONS.

POWER-LEVEL INDICATORS

For measuring levels of audio-frequency signals a new line of miniature power-level indicators has been developed. Useful wherever audio-frequency signals are generated, amplified, transmitted, received, and utilized, these instruments provide for efficient operation of lines and circuits carrying audio-frequency currents.

Power-level indicators are essentially rectox voltmeter. When provided with scales marked in decibels, overall power gain or loss in a system may be obtained by adding algebraically the "db" gains or losses of the individual devices or lines comprising the entire network.

Modified permanent-magnet moving-coil instrument mechanisms are used in conjunction with selected rectox rectifiers.

All standard power-level indicators have scales marked —10/0/+6 decibels; however, power-level indicators can be furnished with special scales, speed, response, and damping, and special calibration to meet any requirements within the possibility of design.

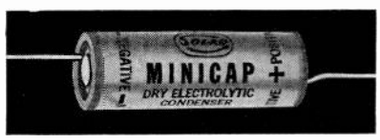
Further information may be secured from *Westinghouse Electric & Mfg. Co.*, East Pittsburgh, Pa.—COMMUNICATIONS.

AMERICAN MICROPHONE

A small dynamic microphone has recently been announced by American Microphone Co. The diameter of the instrument is 1½ inches and the weight is 8½ ounces. The frequency response is said to be good. Both high-impedance (D7T, 10,000 ohms) and low-impedance (D7, 50 ohms) models are available. For complete information write to *American Microphone Co.*, 1915 South Western Ave., Los Angeles, California.—COMMUNICATIONS.

MINICAP TUBULAR CONDENSERS

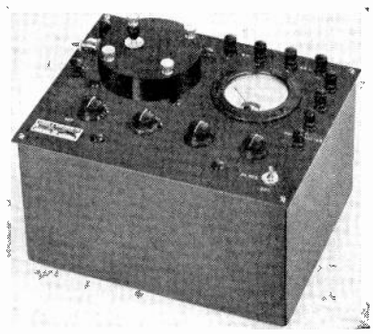
Solar Minicap tubular condensers, small, dry electrolytic condensers, have been announced. In addition to their small size, these condensers are produced in single values only to prevent inter-coupling or inter-leakage between sections. They are hermetically sealed in metal cans, and being in tubular form they are easy to mount, singly or in multiple. Electrical characteristics are said to be as good as larger types.



Additional information can be secured from the *Solar Manufacturing Corp.*, 599 Broadway, New York City.—COMMUNICATIONS.

BULL MARINE SPEAKER

The Bull Marine Speaker, shown in the accompanying illustration, is a large reentrant type of horn, 28 inches in diameter and 21 inches deep. It is made of heavy aluminum casting and unbreakable bell and center section. It is designed to operate with standard Racon marine receiving unit. or the 60-watt Bull unit. It is said to be entirely weatherproof and salt spray proof. Additional information may be secured by writing to *Racon Electric Co., Inc.*, 52 East 19th St., New York City.—COMMUNICATIONS.



THERMIONIC AMPLIFIER

The Thermionic amplifier, shown in the accompanying illustration, is said to bring high sensitivity to potential measurements in high-resistance circuits. This unit, drawing negligible current, is also said to adapt any potentiometer of suitable range to the measurement of glass electrode potentials. It is further useful for measuring potentials encountered in polarization studies, corrosion and oxidation-reduction potentials, as well as potentials and currents in circuits of very high resistance.

The thermionic amplifier is a product of *Leeds & Northrup Co.*, 4901 Stenton Ave., Philadelphia, Pa.—COMMUNICATIONS.

DELCO MOTORS

Two new Delco fractional horse-power motors have recently been announced. One is of the split-phase reversible type, while the other is a series reversible unit. Unidirectional models of both are available, and they are said to be non radio interfering. Rotation is reversed as desired by means of remote control.

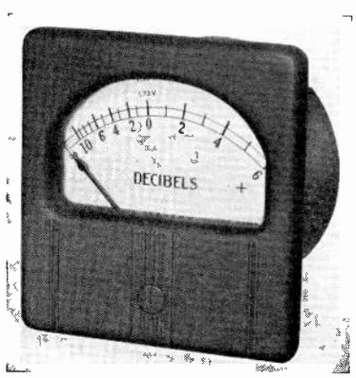
Bulletins describing these motors are available from the *Delco Appliance Division, General Motors Sales Corp.*, Rochester, N. Y.—COMMUNICATIONS.

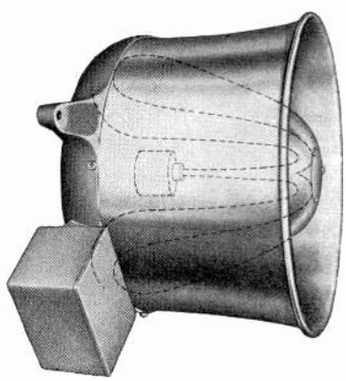
HEAVY-DUTY RESISTORS

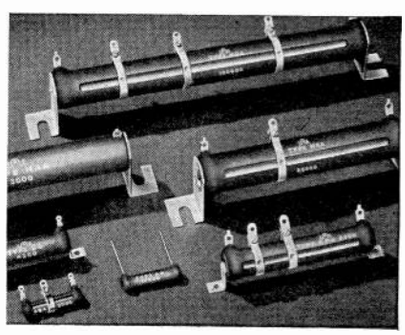
As a result of engineering research, a new and improved coating for tubular type wire-wound resistors has been announced. This is known as the IRC Type C coating. It is now available on all IRC power wire-wound resistor types at a slight increase in cost over standard units using the IRC Type A coating.

Tests on the new coating are said to prove its superiority under abnormal atmospheric conditions. Among other features, tests indicate greater life on accelerated salt solution immersion tests, it is said.

This development is detailed in the 1938 IRC Resistor Catalog just off the press. Write to the *International Resistance Co.*, 401 N. Broad St., Philadelphia.—COMMUNICATIONS.



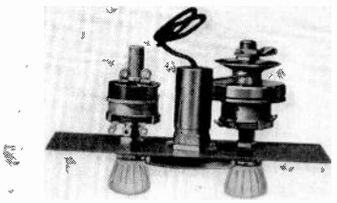




AUTO-RADIO CONTROL

The unit shown in the accompanying illustration is arranged with three independent mechanisms; the center, which consists of the dial and the lighting arrangement; on the right is the tuning device; and on the left is the volume control. These units may be placed in any position on the instrument panel and function in a satisfactory manner. It is furnished in the aeroplane type dial and will fit the majority of the 1937 and 1938 automobiles. Special care has been taken in arranging the dials so that they are attractive and may be illuminated either by edge-lighting or direct-lighting.

For details address *F. W. Stewart Manufacturing Corporation,* 340 West Huron Street, Chicago, Illinois.—COMMUNICATIONS.



Stewart Auto-Radio Control.

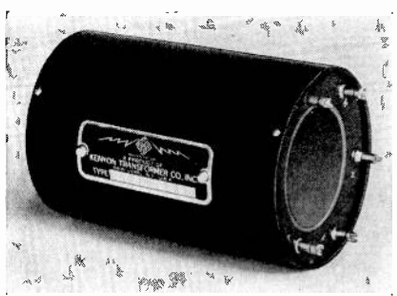
DEFLECTING YOKE & TELEVISION TRANSFORMERS

Deflecting yoke Type T-700, recently introduced, is designed for use with cathode-ray tubes of the electromagnetic-deflection type. Special care is taken in the winding and placement of coils in this yoke to reduce to a minimum any distortion which may occur due to unbalanced magnetic flux or non-uniform fields. Coupling between high and low-frequency coils is said to have been reduced to a negligible value. An internal shield is effective in reducing the effects of external fields on the image to be projected. The low-frequency coils are so constructed that a low-impedance line may be run to them from the new output transformers Type T-112. This helps to minimize pickup and eliminate coupling condensers. Ample deflection is obtained from the Type T-700 yoke on nine-inch tubes at a plate voltage of 6000.

The new Type T-111 high-frequency sweep output transformer is wound with low-capacity coils in order to pass the higher harmonics of 13,200 cycles necessary for the production of a linear deflection. The power transformers T-203, T-204, and T-208 are said to be insulated for the high voltages at which they must operate and at the same time compactness is retained.

Further information may be secured from *Kenyon Transformer Co., Inc.,* 840 Barry St., New York City.—COMMUNICATIONS.

Cornell-Dubilier Beaver Capacitor.

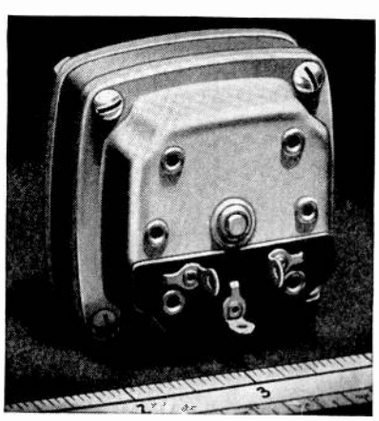


Kenyon Deflecting Yoke.

TUNING MOTOR

The motor shown in illustration is now ready for immediate delivery, equipped with mounting and gear assemblies to specification. Securely mounted, oilless bearings guarantee permanent shaft alignment and noiseless operation, it is said. Housing provides ample heat radiating area plus thermostatic protection against accidental burning out. Overall dimensions 2⅛" x 2⅛" x 1⅝". *The Allinance Manufacturing Co.,* Alliance, Ohio.—COMMUNICATIONS.

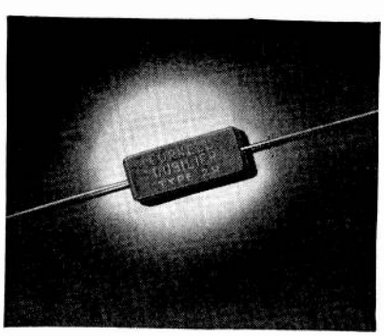
Alliance Tuning Motor.



MICA CAPACITORS

The new C-D Type 2R mica capacitors have been designed to meet the stability limits required by push-button tuning. A new silver-plated mica construction method is said to give a capacity tolerance within 3%, high Q, and good retrace. The C-D Type 2R's are encased in low-loss bakelite. For further information on these units, write to the *Cornell-Dubilier Electric Corporation,* South Plainfield, N. J.—COMMUNICATIONS.

Cornell-Dubilier Mica Capacitor.



ELECTROLYTIC CAPACITORS

The small, etched foil, dry electrolytic capacitors designated as the "Beaver Line" have been designed primarily for use in the more compact models of radio receivers.

The small physical size of the Beaver unit is said to result from an engineering development in the etching of anodic materials. The new etching method is said to give a larger effective anode surface and no alkalies or acids are used in the etching process. Also, the Beaver units employ newly developed electrolytes which are stable and free from tendencies toward corrosion of the anodic film during active as well as idle shelf life, it is said.

A bulletin giving the general specifications of "Beaver" etched foil, dry electrolytic condensers is available from *Cornell-Dubilier Electric Corp.,* South Plainfield, N. J.—COMMUNICATIONS.

BALL-BULLET MIKE

In addition to their Bullet microphones, Transducer has announced a new Ball-type dynamic microphone. Model MK-35. The new "Ball-Bullet" is housed in a spherical metal case 3 inches in diameter, finished in "satin black." It is equipped with a swivel bracket and can be used as either a directional or non-directional microphone. Sensitivity of the Ball-Bullet is said to be -52 db, impedance approximately 50,000 ohms or approximately 200 ohms, frequency response flat, from 30 to 10,000 cycles.

To secure further information write to *Transducer Corporation,* 30 Rockefeller Plaza, New York City.—COMMUNICATIONS.

BASS REFLEX ENCLOSURES

The new Jensen Bass Reflex enclosures for speakers have been so designed that they can be used with 18-inch and auditorium speakers that are now being used in the field. The enclosure is shipped knocked down and all that is necessary to do is to set up the enclosure and put the speaker unit in place. All Jensen public-address speakers—8", 10", 12", 15", auditorium and 18" speakers are now offered as complete reproducers, no baffles being necessary. For further information on the new auditorium and 18-inch Bass Reflex enclosures, write for special folder to *Jensen Radio Manufacturing Company,* 6601 South Laramie Ave., Chicago, Ill.—COMMUNICATIONS.

ULTRA-HIGH-FREQUENCY CONDENSER

Bud Radio has just announced a new series of transmitting condensers especially designed for use in ultra-high-frequency circuits. There are said to be no closed inductive loops in the frame. Metal tie rods are used to permit a rigid type of construction, but they are insulated from the end plates with ceramic bushings one inch long. The rotor connection is said to be placed at the electrical center of the rotor. This contact is a 4-point self-cleaning phosphor bronze spring.

Further information may be secured from *Bud Radio, Inc.,* 5205 Cedar Avenue, Cleveland, Ohio.—COMMUNICATIONS.

NEW LEAR LABORATORY

Mr. Wm. P. Lear, President of Lear Developments, Inc., announces that on March 14, 1938, the company opened their new office, laboratory, factory and service set-up at Roosevelt Field, Building No. 31, Mineola, Long Island, N. Y.

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RADIO AIDS TO AIR NAVIGATION

CONTINUOUSLY on the alert for the latest developments in radio safeguards to air transportation, the leading airlines for years have been steady customers of General Radio Company.

General Radio measuring equipment is used regularly to check the design and performance of aircraft transmitters and receivers by lines such as American, Braniff, Delta, Eastern, North American, Northwest, Pan American and United, to mention a few. In addition, the aircraft departments of the U. S. Government, including the Army, Navy, Coast Guard and Department of Commerce, are large users of G-R apparatus.

General Radio equipment for aircraft use includes standard-signal generators, primary and secondary frequency standards, beat-frequency oscillators, power-level indicators, heterodyne frequency meters, radio-frequency bridges, standards of resistance inductance and capacitance, wave analyzers, noise and vibration meters and many other instruments and accessories.

Air transportation demands the highest precision, accuracy and stability and the latest engineering design in radio laboratory equipment. Airlines rely on G-R equipment. You can depend on their choice.

● Write for Bulletin 235 for complete information on all General Radio products.

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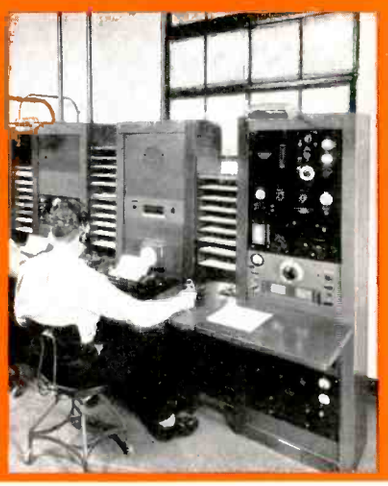
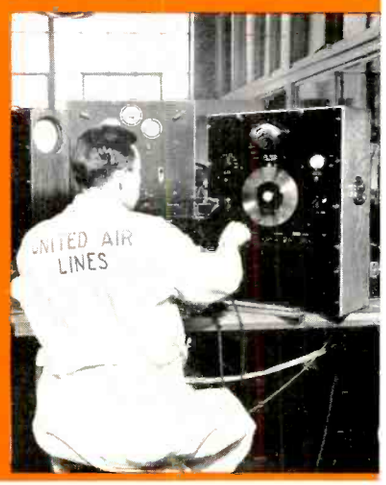


UNITED



Again..THE RCA LABORATORIES PRODUCE A NEW TUBE DESIGN!

A Money-Saving, Air-Cooled Power Tube!

Year in and year out, the RCA Laboratories are the birthplace of radio's great advances. Among many of RCA's achievements in design is the new, money-saving, air-cooled power tube, now available in two types—891-R and 892-R.

These new tubes incorporate the design advantages of the water-cooled tube construction—plus the economy and simplicity of air-cooling.

These new RCA air-cooled tubes are outstanding because they eliminate the need of very expensive water cooling equipment. Pipes, machinery, tanks, cooling ponds—all are unnecessary. This results in lower installation cost. Because these tubes remove the intermediate step in cooling, there's no chance of cooling apparatus going bad or leaking and the cooling system is more simple and reliable, assuring a maximum of time on the air.

Write for full technical details of this sensational new RCA achievement.

Ask your distributor or send 10¢ to Camden for a commemorative advertisement on RCA's television tube announcement.

Better programs every day—when your station's tubes are RCA.

RCA *Radiotrons*

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