APRIL, 1935

Radio Engineering

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VOL. XV NO. 4

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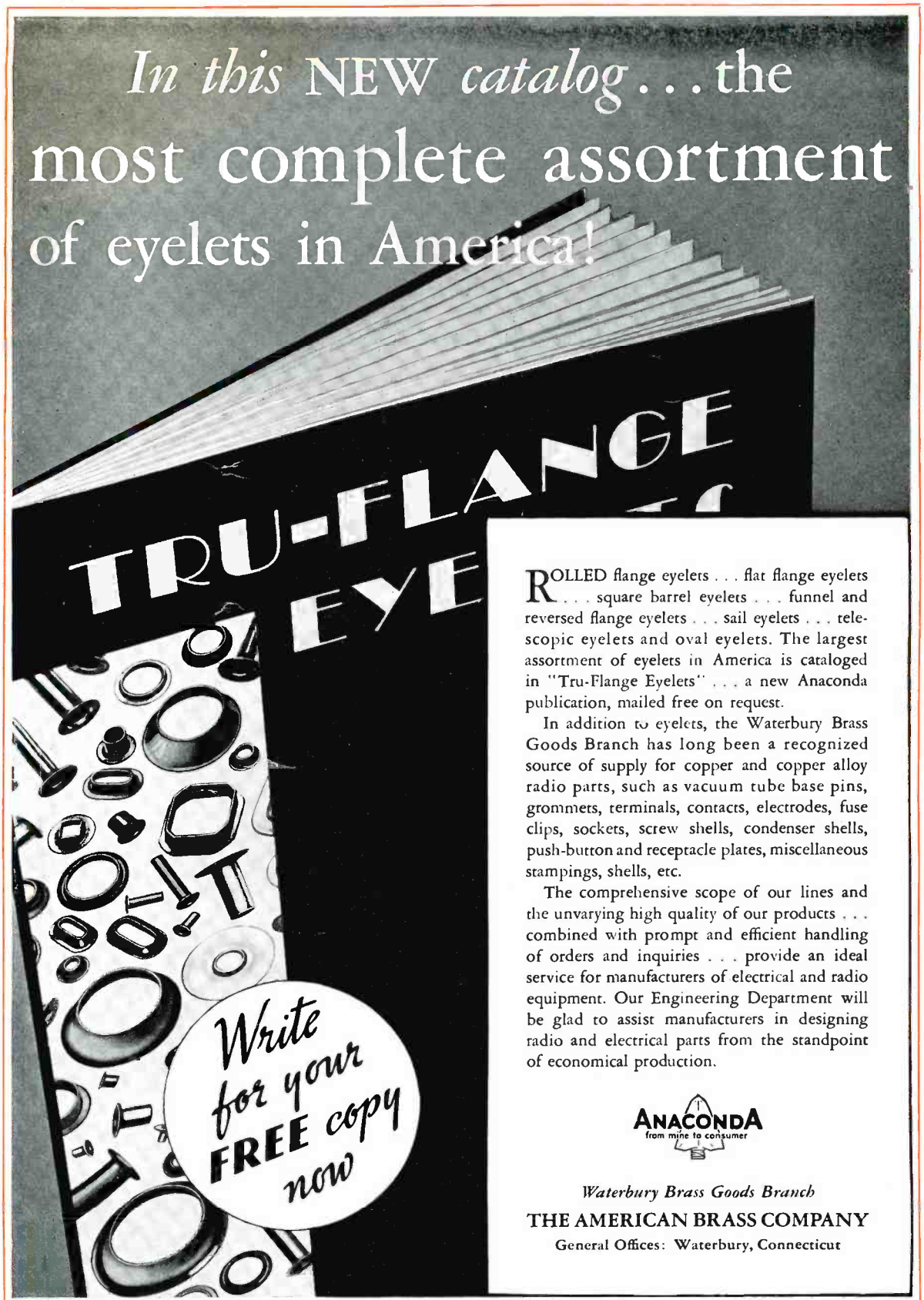
The Journal of the Radio and Allied Industries



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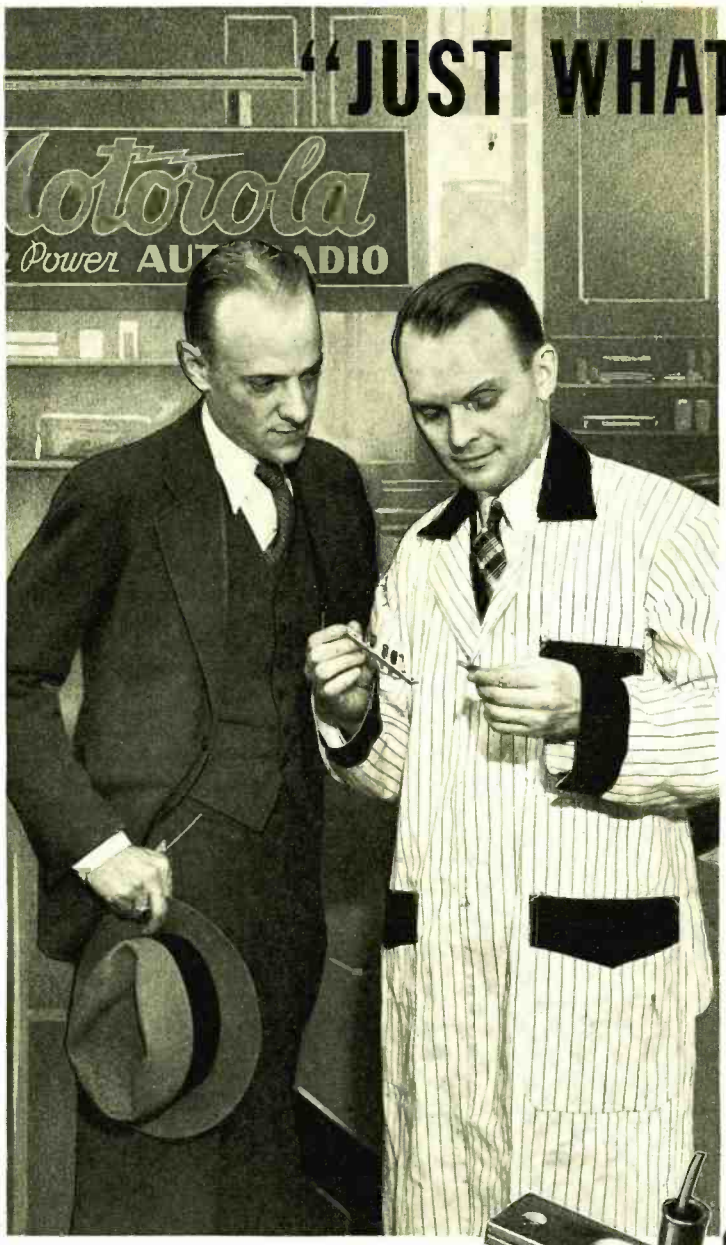

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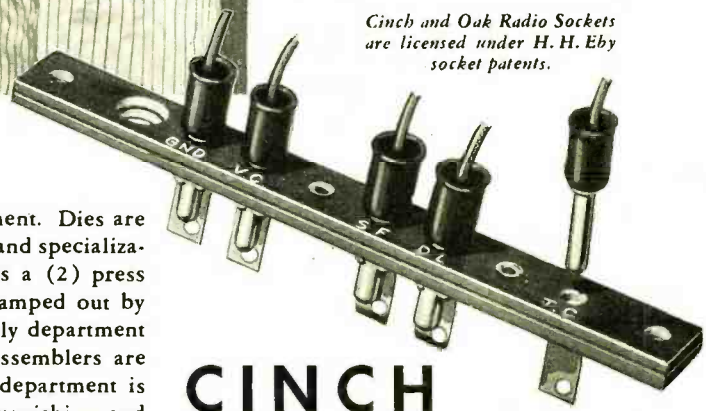

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EDITORIAL

RECEIVER COMPONENTS

RADIO RECEIVER DESIGN has passed through a number of distinct phases. There was, for instance, the "circuit phase," when merit rested more in actual circuit features than in any other factor. This was followed by the "tube phase," when improved operation was gained principally through new tube design —the circuit having become of lesser importance. More recently we have passed through the "big - results - for - little-money phase"—rather a secondary emission of the tube phase. And now, with the tube still a highly important factor, we have definitely entered the "improved components phase."

A slight stiffening of retail prices and the swing of public purchasing toward the console-type receiver, have been instrumental in creating among manufacturers a rising demand for components of better quality. However, the development of an improved-parts consciousness can be directly attributed to the design engineer, who has seen in the all-wave and high-fidelity types of receiver the necessity for more precise electrical tolerances.

It is pleasant to note that engineers are finally getting in a word—even if edgewise —regarding material purchases. In the past, too many engineers have permitted the sales or purchasing departments to dictate requirements. Now it seems the engineer has again found his voice and, motivated by the distasteful vision of quantities of dud receivers, has been pointing the way toward the only ground upon which the receiver manufacturer may safely trod.

The fact is, radio receiver manufacturing is gradually entering a new phase of precision comparable to that now employed in the plants of every automobile manufacturer —with these differences: The auto manufacturer has tightened up on his tolerances for the purposes of reducing the costs of production and increasing the life of moving parts; it is distinctly mechanical precision. The radio manufacturer has introduced electrical precision—which calls for a certain mechanical precision as well—for the purposes of reducing failure costs during production and for the maintenance of definite operating characteristics in a receiver during its life of service.

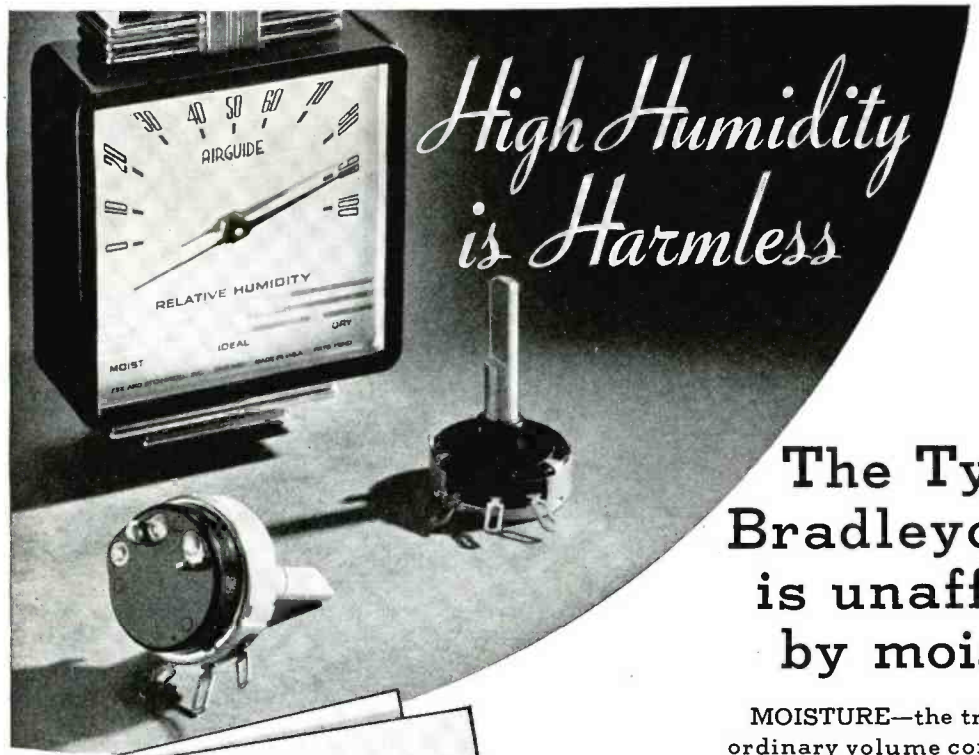
These points were of no particular moment some years ago, but the precision of adjustment, and the *maintenance* of the adjustment during use, required in modern all-wave and high-fidelity receivers, practically demands that quality components be used. Such things as oscillator drift, change of tracking, dial slippage, dial-drive backlash, loss of calibration, alteration in the resonance characteristics of intermediate-frequency amplifiers, wide deviations in resistance values, etc., can no longer be tolerated, for the simple reason that a *slight* change in the characteristics of any one of a number of components used in a modern receiver is sufficient to make the receiver practically inoperative.

Some manufacturers have attempted to shift the responsibility of precision maintenance to the Service Man. The Service Man can make money on that basis, but it is a question how long the manufacturer can. No sane person will bite twice on a make of receiver requiring the constant care of a technician. Many people have had enough experience in this respect with certain makes of electrical refrigerators.

In any event, the number of manufacturers still treading the old path are in the minority. The trend is definitely toward the use of better materials throughout the electrical circuits of a receiver.

The components manufacturers, who are well acquainted with the precision requirements of the modern receiver, have responded to the demand by producing components and materials far superior to the items of a year ago. Constant progress is being made in the components field and it is the manufacturer of parts and materials who will give the radio receiver its next big boost.

The "improved components phase" is destined to accomplish more for the receiver manufacturer than some may suspect.



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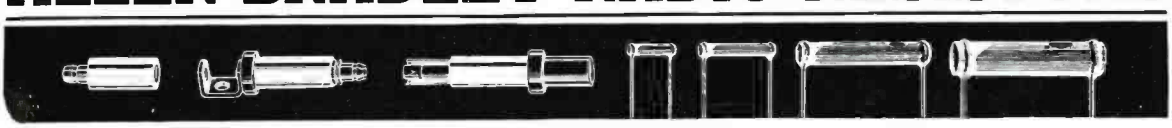


RADIO ENGINEERING

FOR APRIL, 1935

The Inductive Glow-Discharge Oscillator*

By WINSTON E. KOCK
UNIVERSITY OF CINCINNATI

ABSTRACT: An analysis of the intermittent glow-discharge oscillator with inductance inserted in the condenser arm and operating in the neighborhood of resonant frequency is presented. The production of oscillation of the first and second kinds and the application of an over-damped oscillator in producing formants is discussed.

INTRODUCTION

THE INDUCTIVE glow-discharge oscillator consists of the ordinary intermittent glow-discharge circuit with inductance inserted in the condenser arm (Fig. 1) and operating in the neighborhood of resonant frequency.[1] This oscillator was deemed of sufficient importance to warrant an investigation of its characteristics and operating conditions; this analysis accordingly takes into consideration both types of oscillations that can be produced with this circuit, namely those of the first kind (oscillations wherein the current through the discharge tube never ceases completely), and those of the second kind (oscillations wherein the discharge tube current is intermittent.)

OSCILLATIONS OF THE FIRST KIND

The voltage-current characteristic of the glow-discharge tube is shown in Fig. 2. Between A and B the glow lamp presents a negative resistance effect; let us first assume that $\frac{\delta E}{\delta i}$ is constant, then for the circuit of Fig. 1 we have the following equations:

$$i = i_0 - \frac{E_1}{R}, \quad \left(\text{Where R is the positive value of } \left|\frac{\delta E}{\delta i}\right|\right)$$

$$E = i_1 R_1 + E_1$$

$$i_1 = i + i_2$$

$$E = i_1 R_1 + i_2 R_2 + L\frac{di_2}{dt} + \frac{1}{C}\int i_2\, dt$$

Eliminating i and i_1, we get

$$\frac{d^2 i_2}{dt^2} + 2a\frac{di_2}{dt} + \frac{i_2}{LC} = 0$$

whose solution is

$$i_2 = Ae^{-at}\cos\left[\sqrt{\frac{1}{LC} - a^2}\;\; t + \theta\right]$$

where

$$a = \frac{R_1 R_2 - R R_1 - R R_2}{2L(R_1 - R)}.$$

For $\frac{1}{LC} - a^2 > 0$, the solution presents three possibilities:

1. for $a > 0$, damped oscillations,
2. for $a = 0$, oscillations of constant amplitude, and
3. for $a < 0$, oscillations, whose amplitude tends towards infinity.

The second case is not so critical as it may at first seem, since the characteristic is not a straight line $\left(\frac{\delta E}{\delta i} \mp \text{constant}\right)$ as we have assumed, but rather curved, so that for the case where a is slightly negative, the

*Presented before the American Physical Society, Annual Meeting, Pittsburgh, December 27-29, 1934.

[1]See: "The Effect of Inductance on the Intermittent Glow-Discharge," by W. E. Kock, "Physics", 4, 1933, 539.

amplitude will increase, but in so doing, will cause the effective slope to become less negative and eventually a condition will be reached where α becomes zero (Case 2).

The amplitude is thus determined by the position of the operating point on K; when it is too close to B, the damping effect of the actual resistance in the oscillating circuit outweighs the negative resistance effect of the glow lamp, and only damped oscillations can be pro-

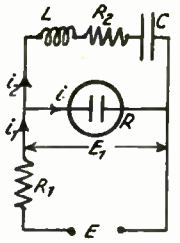


FIG. 1. CIRCUIT OF THE INDUCTIVE GLOW-DISCHARGE OSCILLATOR.

duced; on the other hand, as the operating point is moved towards A (which can be effected by increasing the resistance R_2 or by decreasing the voltage E), the amplitude becomes greater and greater until finally point A is overstepped and oscillations of the second kind take place.

Fig. 3 shows damped oscillations periodically excited.

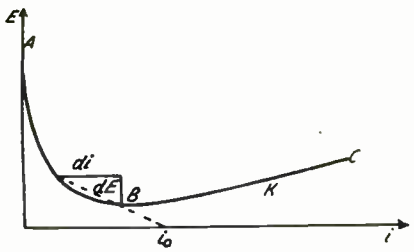


FIG. 2. VOLTAGE-CURRENT CHARACTERISTIC OF A GLOW-DISCHARGE TUBE.

By properly adjusting the applied voltage E, the operating point on the characteristic curve and therefore also the damping factor can be set to any desired value.

We shall see later that this furnishes a convenient method of producing formants.

Fig. 4 shows voltage and current wave-forms for two cases of oscillations of the first kind. In Case 1, the voltage E is greater than in Case 2, the operating point accordingly lies closer to B (Fig. 1), and the greater damping effect produces a smaller amplitude. We can observe at X, Fig. 4, that a noticeably larger damping occurs on the lower parts of the voltage waves. (The

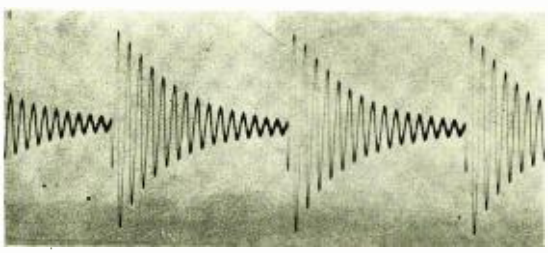


FIG. 3. DAMPED OSCILLATIONS OF THE FIRST KIND PERIODICALLY EXCITED.

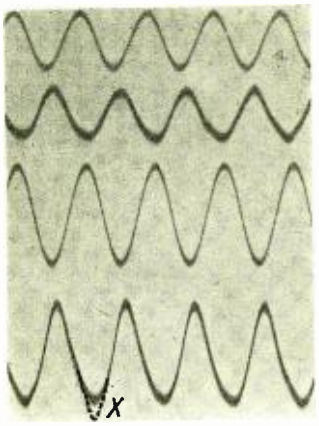


FIG. 4. CONTINUOUS OSCILLATIONS OF THE FIRST KIND.

oscillating circuit, especially the inductance, causes the current wave to be sinusoidal but has no effect on the voltage). In Fig. 4 we can also observe the presence of an inductive effect in the glow lamp. In both cases, current and voltage were photographed simultaneously; since they are more than 180° displaced, the discharge column cannot consist of a pure negative resistance effect.

OSCILLATIONS OF THE SECOND KIND

Fig. 5 shows voltage and current wave-forms of oscillations produced by the intermittent glow-discharge oscillator (no inductance). Because of ionization of the discharge path, the discharge extinguishes itself at a lower voltage than the ignition potential, and the dynamic characteristic appears somewhat as in Fig. 6, where E_* is the ignition potential and E_L is the extinc-

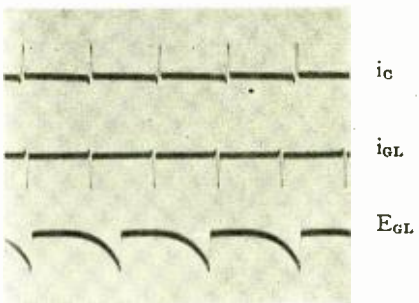


FIG. 5. WAVE-FORMS OF THE INTERMITTENT GLOW-DISCHARGE OSCILLATOR.

tion potential. When the discharge time is neglected, the frequency of discharge is easily calculated to be

$$f = \frac{1}{R\,C \ln \frac{E - E_L}{E - E_*}}.$$

The insertion of an inductance in the condenser arm increases the discharge time, the current peaks are rounded off (Fig. 7, No. 1)*, and the above equation

*The straight portions of the curve portray the condition for no current flow and should therefore be horizontal; the tilt was introduced by the oscillograph amplifier.

no longer holds. Instead of the dependence of frequency on applied voltage as given by the above relation and portrayed by Curve 1, Fig. 8, we obtain Curve 2. Although by very low frequencies the time for charging the condenser is still of prime importance in determining the frequency, as the applied voltage is increased and this charging time consequently decreased, it loses its importance because the discharge time remains approximately constant. An increase in the applied voltage has less and less effect on the frequency and a maximum value is asymptotically approached. Since the charging and discharging time of the condenser is mainly determined through its capacity and the inductance, we find that this maximum frequency is the resonant frequency of the oscillating circuit when account is taken of the inductive and capacitative effects present in the glow lamp. Accordingly,

$$f = \frac{1}{2\pi\sqrt{L'C'}},$$

where l′ and c′ include the capacity and inductance of the glow lamp.

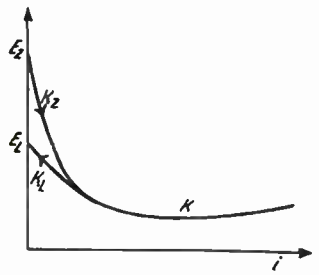


FIG. 6. DYNAMIC CHARACTERISTIC OF A GLOW-DISCHARGE TUBE.

Fig. 9 shows the wave-form of the voltage on the condenser for various values of the applied voltage and shows how sinusoidal this voltage becomes at higher values of the applied voltage.

PRODUCTION OF FORMANTS

We have seen that when the operating point on the characteristic curve is properly adjusted, a resonant circuit with any desired amount of damping is obtainable. With a suitable impulse generator to excite the glow-lamp circuit, a means is obtained whereby formants (damped wave trains) of any desired decrement, frequency and amplitude (through amplifiers) can periodically be excited. An excellent impulse generator, producing an accurate equivalent of the ideal glottal puff, is the intermittent glow-discharge oscillator itself. and by means of a small condenser, these impulse oscillations can be transferred to the damped circuit and the formant thereby excited.

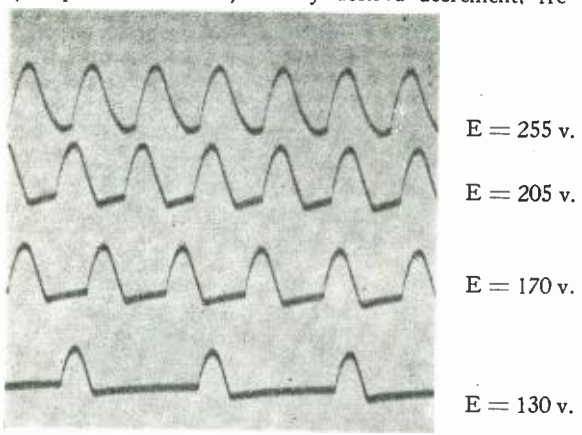


FIG. 7. WAVE-FORM OF THE GLOW-TUBE CURRENT FOR DIFFERENT VALUES OF THE IMPRESSED VOLTAGE.

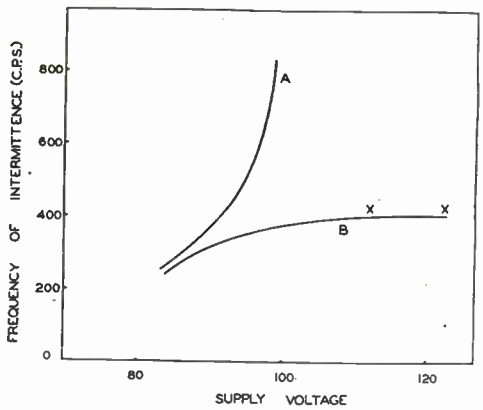


FIG. 8. FREQUENCY-VOLTAGE CURVES. A: THE INTERMITTENT GLOW DISCHARGE (NO INDUCTANCE). B: THE INDUCTIVE GLOW-DISCHARGE OSCILLATOR.

The use of the inductive glow-discharge oscillator as the impulse generator is also possible, for although the inductance makes sinusoidal the voltage on the condenser, the voltage on the glow lamp still possesses discontinuities, and because of the small transfer condenser, these discontinuities present themselves as peaked waves and serve equally well to excite the formants. It is well to point out, however, that the voltage wave-form of the inductive glow-discharge oscillator possesses two discontinuities during every cycle, one when the discharge begins and one when it ceases. In the transferred wave-form, these show up as two sharp peaks pointing in opposite directions, and although the first is much larger than the second, very peculiar and interesting effects can be obtained by adjusting the relative positions of these peaks.

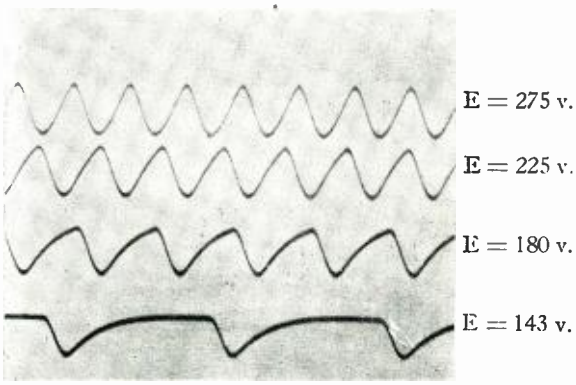


FIG. 9. WAVE-FORM OF THE CONDENSER VOLTAGE FOR VARIOUS IMPRESSED VOLTAGES.

In either case, no vacuum tubes are required for the production of the formants, although amplifying tubes are necessary to obtain the desired amplitude. This generator thus constitutes a simple and effective oscillator in all synthesis work where formants are required, for example, synthesizing the sung vowels, various orchestral instruments, etc.

CLASS AB

By MAURICE APSTEIN
Chief Engineer
MORLEN ELECTRIC CO., INC.

EVERY AMPLIFIER designer and operator knows the importance of having circuit constants of exact values. When Class A amplification was in general use, it was understood that the difference between an efficient amplifier and a poor one was not fundamentally a matter of the circuit used, but a question of the proper voltages being applied to the tubes and proper impedance matching throughout the amplifier, from source to load. With the advent of Class B and Class AB circuits, however, many tall tales have been circulated as to the advantages to be gained from these circuits in the way of high power output with high plate efficiency and low tube maintenance cost. In addition, too much emphasis has come to be placed on the schematic diagram of an amplifier, rather than on the correct basic design of the individual parts comprising the assembled unit.

LESS CIRCUIT EMPHASIS

A cheaply made amplifier with poor transformers and a badly designed power supply, can only deliver poor reproduction of low aural quality, regardless of circuit. There is no reason to believe that an amplifier, no matter what may be its class of tube operation, is going to be any better than the quality of its component parts and the accuracy of its circuit constants. This simple statement goes far in explaining why many amplifiers of the more recent circuit types have neither measured up to announced characteristics nor justified the theoretical design.

It is often stated that Class AB is a compromise between Class A and Class B, delivering almost as good fidelity as a Class A amplifier with the possibilities of the high power output derived from Class B. This statement is doubtless made by reason of the fact that over part of the excitation cycle, the output tubes operate as Class A tubes and for the remainder of the cycle, as Class B tubes. The AB system was evidently introduced to overcome the one serious disadvantage of Class B—relatively high distortion at low output levels. However, this mode of operation does not properly infer that the designer can neglect all Class B precautions and assume that the only similarity between the AB and B systems will be in power output.

CLASS AB AND B COMPARISONS

Actually, although the tubes in an AB stage operate as Class B only part of the time, their associated components are subject to Class B conditions, all of the time, with most of the accompanying rigid requirements of circuits of this type. Furthermore, the fact that grid currents are relatively low in an AB stage does not mean that the grid losses are small. Since the AB grids are driven to higher voltages and since the grid impedances are usually somewhat higher than those of a Class B stage of comparable output, the actual watts in the grid circuit are higher than they seem to be at first glance—a 50 tube swinging to 10 milliamperes grid current with an applied peak grid voltage of 200 is using up two watts of input power. Compare this with a 46 zero-bias Class B tube drawing 20 ma, but at only 40 peak grid volts. The latter, at twice the grid current, is only dissipating .8 watt in its grid circuit. Of course, under these conditions, the AB stage will be delivering considerably more output, but that does not make the power comparison any less surprising, nor does it disguise the fact that an AB stage really requires *power* to drive it if the excellent power-output capabilities of the system are to be realized. Too many designers have been led to consider the AB amplifier from the standpoint of an over-biased Class A amplifier. A much better picture of actual dynamic working conditions can be gained by considering it as an *under-biased* Class B amplifier.

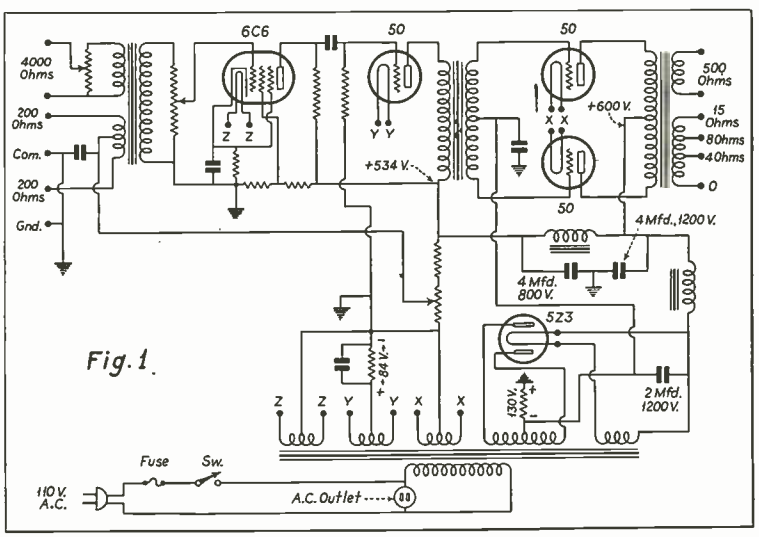


Fig. 1.

Schematic of typical Class AB amplifier, using a type 50 driver and a pair of 50 tubes in the output. All voltages given measured between point indicated and ground.

CLASS AB REQUIREMENTS

With the above considerations in mind, the more important requirements of an AB amplifier may be tabulated as follows:

(1). The audio components of the AB stage must have Class A response characteristics while they are operating under Class B conditions.

(2). The power supply, though not requiring as fine regulation as a Class B supply, must deliver a greater average load than the Class B supply.

(3). The tube must be operated at the proper plate and grid voltages as determined by a theoretical calculation for the power output desired.

(4). The load impedance must be of the value determined by the plate voltage and the grid bias and not by characteristic curves taken at Class A voltages.

AMPLIFIER DESIGN

● PRIMARY CONSIDERATION SHOULD BE GIVEN TO THE DESIGN OF THE COMPONENTS—NOT THE CIRCUIT.

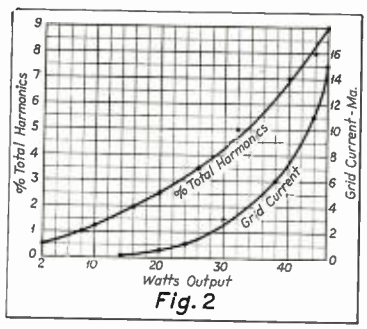
(5). The driver stage should be capable of supplying distortionless audio *power*, regardless of the load the AB stage reflects into it.

(6). Since the average plate current varies, purely self-bias is unsatisfactory and some method of stabilizing the bias voltage is necessary.

TYPICAL CLASS AB CIRCUIT

Fig. 1 shows the circuit diagram used in a Class AB amplifier designed in accordance with the principles outlined above. It uses a 6C6 voltage amplifier feeding a Class A driver and a pair of 50's in the AB output stage. Figs. 2 and 3 show the operating characteristics of this particular amplifier. They are in no way true of all AB amplifiers, but apply only to those being operated under similar conditions of circuit and component design, as explained herein.

Since amplifier design is usually for a particular output or load requirement, it is convenient to examine the design by starting at the output transformer and working back to the input. Needless to say, whether the output transformer is for Class A, AB or B operation, it must safely handle the maximum audio power level of the amplifier. The tendency appears to be, to believe that since Class B and Class AB amplifiers allow the use of smaller power transformers, they will also operate satisfactorily with smaller output transformers. This is a dangerous fallacy. The output transformer for AB or B operation must have a better frequency response and power rating than the average, because it is working under less favorable conditions of sinusoidal input and, in addition, will be subjected to very great audio overloads if the input stage is overdriven by a sudden large input peak.



Performance of "AB" amplifier using a single 50 Class A to drive a pair of 50's Class AB.

LOAD IMPEDANCE

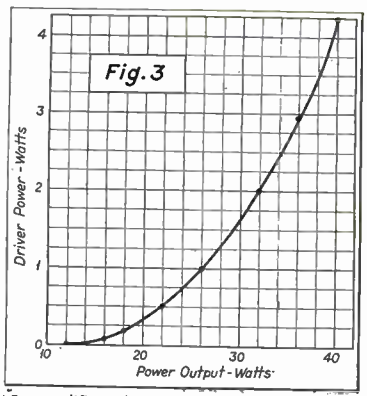
It has been definitely determined that the optimum value of load impedance for a pair of 50's in AB at the above voltages is 16,000 ohms. This is far different from the optimum Class A load impedance and indicates unquestionably that merely over-biasing a Class A stage does not transform it into an AB stage, even over very limited parts of the operating cycle. Under no circumstances can an ordinary "250 push-pull" output transformer be used with the same tubes in Class AB. This statement applies equally as well to any other type of tube.

POWER SUPPLY

The power supply for an AB stage, being subject to varying load conditions, must have good regulation. Since mercury-vapor rectifiers are not practicable in this type of service, unless the plate voltage is applied after the filaments have come up to operating temperature, a high-vacuum type of rectifier is required. To obtain good regulation in spite of this limitation requires just as careful design in the rest of the power supply as in the case of a Class B unit, even though the load variation is not as great. In addition to the usual necessity of low-resistance transformer and filter chokes, and plenty of capacity to fill in the instantaneous peak currents at high audio output, there is also the requirement (for 50 operation) of 730 volts dc output to the amplifier. This is about 40 percent more than the voltage required for Class A operation and demonstrates clearly that the power supply must be designed from the standpoint of its specific use with an AB stage.

DRIVER STAGE

The driver coupling transformer is a very important part of the design of an AB amplifier and must be considered from the standpoint of type of driver tube, power handling capacity, regulation and turns ratio. If the output tubes are to be operated efficiently, their grids must be driven positive, which means low grid-circuit resistance and impedance; yet comparatively high grid voltages.



AB amplifier driver power versus output power: driver, one 50; output, two 50's.

Under conditions of high-efficiency operation, a pair of 50's can easily swing to 15 ma of grid current at 50 to 60 volts positive grid input, which means a total ac input voltage of 180 to 190 volts. With the possibility of a load of 2.5 to 3 watts on the driver, it is easy to see why a pair of tubes designed for voltage-amplifier service, such as the 56's, cannot be expected to drive an output stage of this type with satisfactory results. It must be kept in mind that regardless of conditions of operation of the output stage, the driver must be operated well below maximum in order to insure distortionless input to the power stage. It is advisable therefore to use a tube capable of delivering great power output and to work it over a limited portion of its characteristic curve. This minimizes the possibility of non-linear operation and reduces the load impedance variation, making available a large amount of undistorted driving power without putting heavy demands on the driver itself.

In the amplifier used for illustration a type 50 tube is used as a driver. Because of the heavy plate, an air gap is required in the primary of its coupling transformer to prevent core saturation. This necessitates an extremely well-designed transformer with an abnormally large primary winding in order to get good response characteristics, but the performance curves show that when the transformer is well built, the results justify the extra care and expense and prove the theoretical design.

BIASING

With respect to biasing: Pure self-bias is absolutely unsatisfactory if proper AB operation is to be obtained. Fixed bias from an independent supply is both bulky and power-wasting if the bias

(*Continued on page* 15)

Effects of AVC Voltage Distribution

By E. E. OVERMIER
Engineering Department
HYGRADE SYLVANIA CORP.

A THOROUGH KNOWLEDGE of the proper functioning of automatic volume control circuits in modern superheterodyne radios is of vital importance in receiver design. Many questions pertaining to automatic volume control have been raised, such as:

1. *How much avc is desirable?*
2. *To which stages should it be applied?*
3. *How is the noise level affected through application of avc voltage?*

To answer inquiries of this nature, an investigation was made to determine the effects of applying different percentages of avc voltage to the various stages on which control may be desirable.

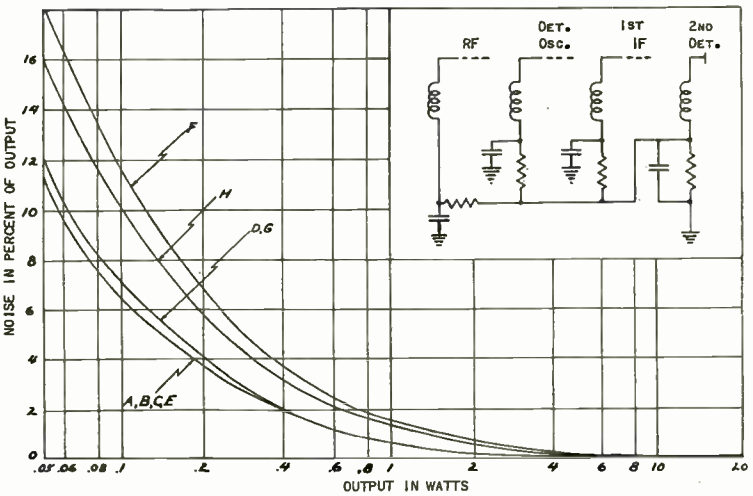


Fig. 2. Change in noise level using various avc circuits.

AVC FUNCTION

The primary function of the automatic volume control circuit is to maintain as nearly as possible a constant signal to the input of the second detector. This is accomplished by utilizing the voltage developed across the resistor in the diode circuit of the second detector to add to the bias voltage that is applied in the preceding stages which are included in the avc circuit. Since this voltage increases in proportion to the input signal to the receiver, a strong signal automatically increases the bias on the control tubes; at the same time the gain decreases. When the input signal is reduced, the voltage across the resistor will decrease so that the bias is reduced and the gain per stage automatically increased.

The gain of the various stages preceding the second detector is not the same, and furthermore their functions are also different. The result of changing the bias of each stage may have several effects on the general operation of the receiver.

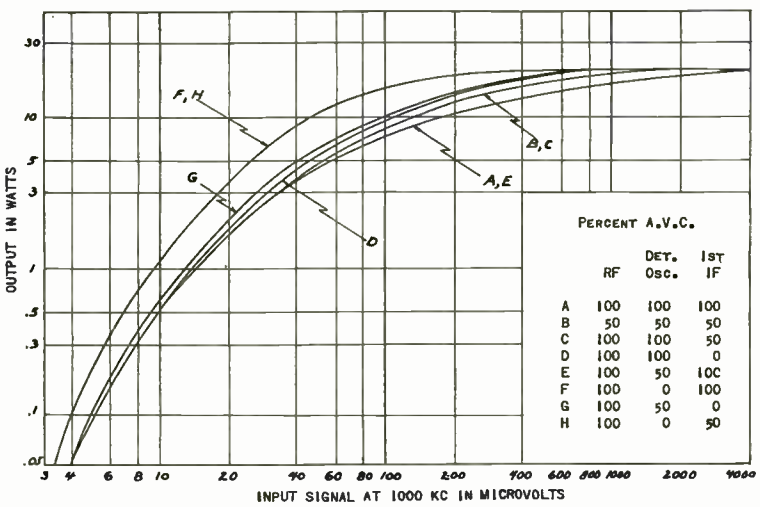


Fig. 1. Changes in sensitivity resulting from different percentages of avc to stages indicated.

TEST SET-UP

The set used for obtaining the data shown in curve form in Fig. 1 and Fig. 2 was a household receiver having a type 78 as the r-f tube, a type 6A7 as the detector-oscillator, and a type 78 in the first i-f stage.

The curves shown in Fig. 1 indicate the changes in sensitivity which resulted by applying different percentages of avc to the individual stages of the automatic volume control circuit. For maximum output the sensitivity varies as much as ten to one.

AVC AND NOISE LEVEL

High sensitivity is desirable in many radios, but it is sometimes gained with a sacrifice in noise level of the receiver. The set designer must arrive at some

(*Continued on page* 19)

NEW ACORN PENTODE

● THE RCA 954 PENTODE, COMPANION TO THE 955 TRIODE, IS A STEP FORWARD IN TUBE DESIGN. GAINS OF THREE OR MORE ARE OBTAINABLE AT ONE METER WITH CONVENTIONAL CIRCUITS. THIS TUBE IS DESTINED TO ACCELERATE PROGRESS IN THE ULTRA-HIGH-FREQUENCY FIELD. THOUGH DESIGNED FOR EXPERIMENTAL PURPOSES, TESTS HAVE PROVEN THE TUBE TO BE HIGHLY PRACTICAL.

THE 954 IS A heater-cathode type of pentode designed primarily for radio amateurs and experimenters working with wavelengths as short as 0.7 meter. As an r-f amplifier at a wavelength of one meter, the 954 is capable of gains of three or more in circuits of conventional design. Higher gains are of course attainable at longer wavelengths. The pentode 954 is a companion tube to the triode 955 and employs a similar unconventional tube structure having small size, close electrode spacing, and short terminal connections. The suppressor is brought out to a separate terminal. In addition to its primary use as a pentode, the 954 with suitable arrangement of terminal connections has application in experimental circuits as a tetrode or triode.

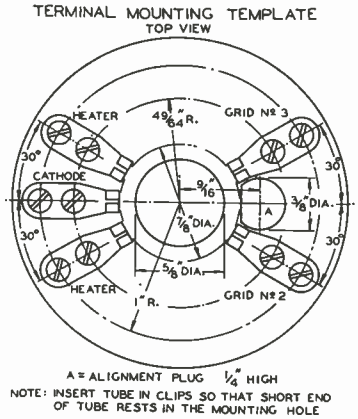


Fig. 1. Terminal mounting template.

INSTALLATION

The terminals of the 954 require a special method of mounting by means of clips supplied with each tube. The two small clips are for the control grid and the plate terminal at the bottom and top of the bulb, respectively. The five large clips may be fastened to a supporting insulator. For minimum losses, it is desirable to clip circuit parts directly to the control-grid terminal and to the plate terminal. Since the circumferential tube terminals are located symmetrically, a stop of insulating material should be placed between the screen clip and the suppressor clip so that the cathode terminal will prevent insertion of the heater terminals in the screen and suppressor clips. This stop is identified on the Terminal Mounting Template (Fig. 1) as Alignment Plug. *Do not attempt to solder connections to the terminals.* The heat of the soldering operation is almost certain to crack the bulb seal.

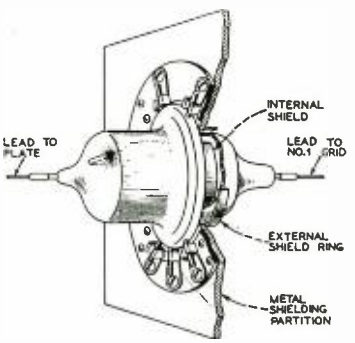


Fig. 2. Shielding arrangement.

THE HEATER

The heater is designed to operate on either ac or dc. When ac is used, the winding which supplies the heater circuit should operate the heater at its recommended value for full-load operating conditions at average line voltage. When dc is used on the heater, the heater terminals should be connected directly across a 6-volt battery. Under any condition of operation, the heater voltage should not deviate more than plus or minus 10 percent from the normal value of 6.3 volts. Series operation of the 954 is not recommended.

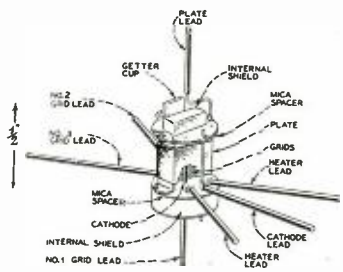


Fig. 3. Internal structure.

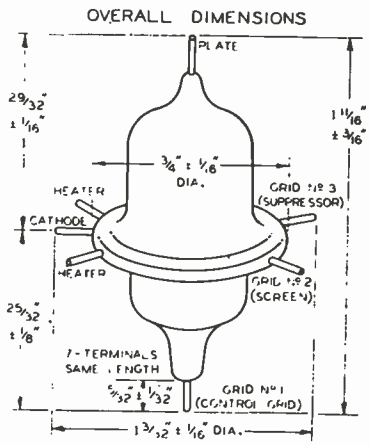


Fig. 4. Dimensional outline.

THE CATHODE

The cathode of the 954, operated from a transformer, should preferably be connected directly to the electrical mid-point of the heater circuit. In the case of dc operation from a 6-volt storage battery, the cathode circuit is tied in either directly or through bias resistors to the negative battery terminal. In circuits where the cathode is not directly connected to the heater, the potential difference between heater and cathode should be kept as low as possible. If the use of a large resistor is necessary between heater and cathode in some circuit designs, it is essential that this resistor be by-passed by a suitable filter network or objectional hum may develop.

THE SCREEN

The screen voltage may be obtained from a fixed tap on the B-battery, or from a potentiometer across the B-supply, or from the B-supply through a series resistor when the tube is self-biased by means of a cathode resistor. This last method, however, is not

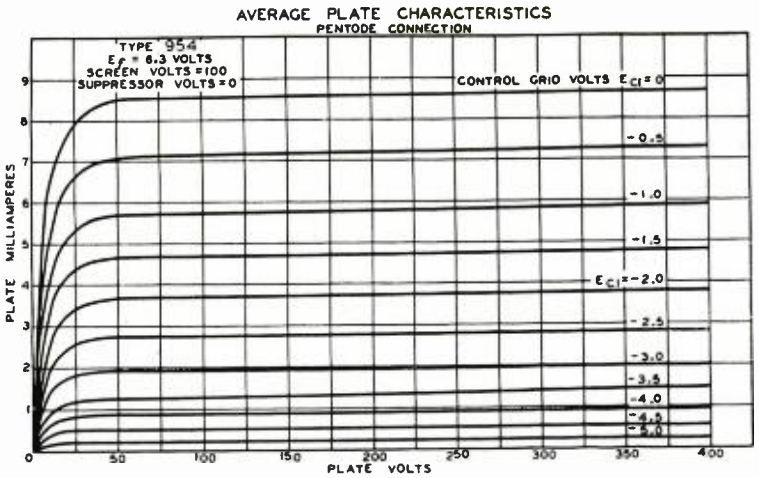


Fig. 5. Average plate characteristics.

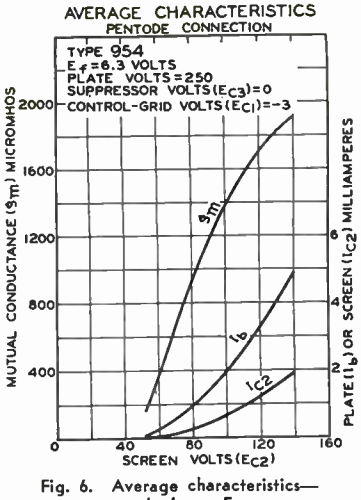


Fig. 6. Average characteristics—
g_m, I_b, I_{c2} vs E_{c2}.

recommended if the B-supply exceeds 250 volts.

SHIELDING

Shielding of each r-f amplifier stage employing the 954 is required in order to prevent interstage coupling. A convenient method of shield construction is illustrated in Fig. 2. The control-grid end of the tube is inserted through a hole in a metal plate so that the metal edge of the hole is in close proximity to the internal shield in the control-grid end of the tube. It may be desirable, depending upon circuit requirements, to provide a small collar on the baffle hole in order to increase the shielding effect.

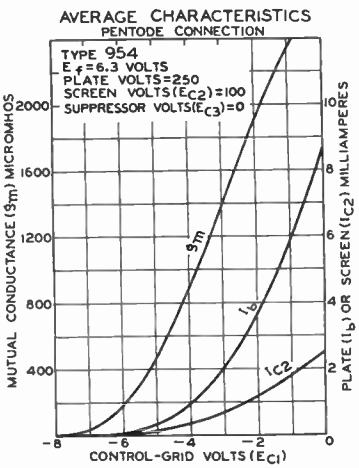


Fig. 7. Average characteristics—
g_m, I_b, I_{c2} vs E_{c1}.

R-F GROUNDING

R-F grounding by means of condensers placed close to the tube terminals is required if the full capabilities of the 954 for ultra-high-frequency uses are to be obtained. Conventional by-passing methods and grounding are not adequate. One convenient method is to use ribbon lead-ins to the clips and to insulate the ribbon lead-ins and the terminal clips from the grounding plate by mica spacers to form by-pass condensers right at the tube terminals. It is important in the cases of the plate and control-grid circuits that separate r-f grounding returns be made to a common point in order to avoid r-f interaction through common return circuits. It may also be advisable in some applications to supplement the action of the by-pass condensers by r-f chokes placed close to the condensers in the return or supply lead for the control-

RCA-954 TENTATIVE CHARACTERISTICS, PENTODE CONNECTION

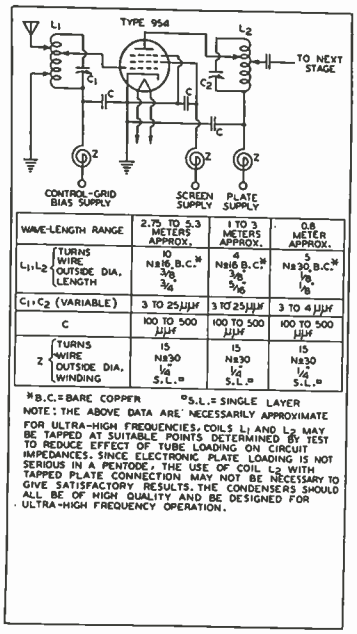
HEATER VOLTAGE (ac or dc)	6.3	Volts
HEATER CURRENT	0.15	Ampere
DIRECT INTERELECTRODE CAPACITANCES:		
Control-Grid to Plate (with shield baffle)	0.007 max.	mmfd
Input	3	mmfd
Output	3	mmfd
OVERALL LENGTH	1-11/16" ± 3/16"	
OVERALL DIAMETER	1-3/32" ± 1/16"	
BULB	J-4	
TERMINAL MOUNTING	Special	

AMPLIFIER—CLASS A

DC PLATE VOLTAGE		250 max.	Volts
DC SUPPRESSOR (Grid No. 3) VOLTAGE		100 max.	Volts
DC SCREEN (Grid No. 2) VOLTAGE		100 max.	Volts
TYPICAL OPERATION AND CHARACTERISTICS:			
Heater Voltage	6.3	6.3	Volts
DC Plate Voltage	90	250	Volts
DC Screen Voltage	90	100	Volts
DC Control-Grid Voltage	-3	-3	Volts
Suppressor		Connected to cathode at socket	
Amplification Factor	1,100	Greater than 2,000	
Plate Resistance	1.0	greater than 1.5	Megohms
Mutual Conductance	1,100	1,400	Micromhos
Plate Current	1.2	2.0	Milliamperes
Screen Current	0.5	0.7	Milliamperes

DETECTOR

DC PLATE VOLTAGE	250 max.	Volts
DC SUPPRESSOR (Grid No. 3) VOLTAGE	100 max.	Volts
DC SCREEN (Grid No. 2) VOLTAGE	100 max.	Volts
TYPICAL OPERATION AS BIASED DETECTOR:		
Heater Voltage	6.3	Volts
Plate-Supply Voltage	250	Volts
DC Screen Voltage	100	Volts
DC Control-Grid Voltage	-6 approx.	Volts
Suppressor	Connected to cathode at socket	
Plate load	250,000 ohms or equivalent impedance	
For resistance load, voltage at the plate will be less than the plate-supply voltage by an amount equal to the voltage drop in the load resistor caused by the plate current.		
Plate Current	Adjusted to 0.1 ma with no input signal.	



WAVE-LENGTH RANGE	2.75 TO 5.3 METERS APPROX.	1 TO 3 METERS APPROX.	0.8 METER APPROX.
L_1-L_2 TURNS	10	4	5
L_1-L_2 WIRE	No16 B.C.*	No16 B.C.*	No30 B.C.*
L_1-L_2 OUTSIDE DIA.	3/8	3/8	1/8
L_1-L_2 LENGTH	3/4	5/16	1/8
C_1-C_2 (VARIABLE)	3 TO 25 μμf	3 TO 25 μμf	3 TO 4 μμf
C	100 TO 500 μμf	100 TO 500 μμf	100 TO 500 μμf
Z TURNS	15	15	15
Z WIRE	No30	No30	No30
Z OUTSIDE DIA.	1/8	1/2	1/4
Z WINDING	S.L.°	S.L.°	S.L.°

*B.C.=BARE COPPER °S.L.=SINGLE LAYER

NOTE: THE ABOVE DATA ARE NECESSARILY APPROXIMATE FOR ULTRA-HIGH FREQUENCIES, COILS L_1 AND L_2 MAY BE TAPPED AT SUITABLE POINTS DETERMINED BY TEST TO REDUCE EFFECT OF TUBE LOADING ON CIRCUIT IMPEDANCES. SINCE ELECTRONIC PLATE LOADING IS NOT SERIOUS IN A PENTODE, THE USE OF COIL L_2 WITH TAPPED PLATE CONNECTION MAY NOT BE NECESSARY TO GIVE SATISFACTORY RESULTS. THE CONDENSERS SHOULD ALL BE OF HIGH QUALITY AND BE DESIGNED FOR ULTRA-HIGH FREQUENCY OPERATION.

Fig. 8. Typical r-f amplifier circuit.

grid, the screen, the suppressor, the plate, and the heater.

APPLICATION

As an *amplifier*, the 954 is applicable to the audio- or the radio-frequency stages of short-wave receivers, especially those operating at wavelengths as short as 0.7 meter (see Fig. 8). Typical operating conditions for this service are given in the accompanying table.

For a-f amplifier circuits, typical operating conditions are as follows: Plate supply voltage, 250 volts; screen voltage, 50 volts; control-grid voltage, —2.1 volts; suppressor, connected to cathode at socket; plate-load resistor, 250,000 ohms; and plate current, 0.5 milliampere. The control-grid resistor may be made as high as 1.0 megohm. Under these conditions, an undistorted voltage output of 40 to 50 volts rms may be obtained. The voltage amplification is approximately 100.

As a *grid-bias detector*, the 954 may be operated under the conditions given in the table. The control-grid bias may be supplied from the voltage drop in a resistor between cathode and ground. The value of this self-biasing resistor is not critical, 20,000 to 50,000 ohms being suitable.

For *miscellaneous applications* around the laboratory, the 954 offers important features. For instance, its small size permits the design of vacuum-tube voltmeters such that the tube itself can be placed at the point of measurement (see Fig. 9). Thus, long leads and high input capacitance are avoided with the desirable result that measurements can be made at radio frequencies with a minimum effect on the constants of the circuit under measurement.

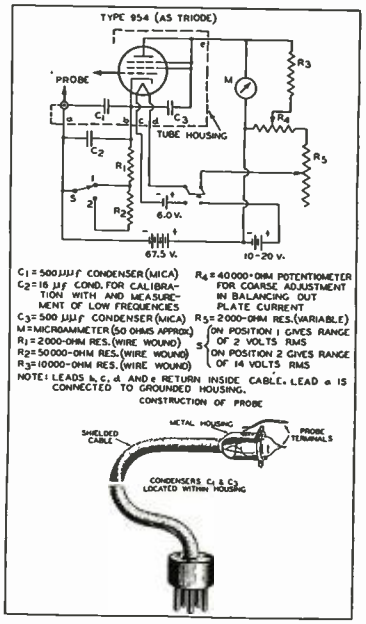


Fig. 9. Typical tube-voltmeter circuit.

CLASS AB AMPLIFIER DESIGN

(*Continued from page* 11)

unit is to maintain actual constant voltage output. In addition, the separate bias unit offers no safety action on grid overloads and allows enormous plate currents to flow when high input peaks force the grids too far positive. This transient current is very dangerous to both tubes and components.

The logical solution to the grid bias problem is in some form of semi-fixed or stabilized bias. When it is accomplished, as in the amplifier described, by putting the voltage-dropping resistor for the driver and voltage-amplifier in the negative leg of the power supply, and using this resistor as a bias resistor for the AB tubes, it becomes a very simple and effective method. The total current drain of the remaining tubes, plus a bleeder of about 30 ma (which also may be used to supply microphone current) maintains an 85-ma fixed current through the output bias resistor. The steady-state plate current of the AB tubes brings this value up to approximately 115 ma, which gives more than three times as stable action as simple self-bias.

It should be noted that bias for the driver and voltage amplifier are taken off separately, after the bias for the output tubes, thus preventing any output bias variation from affecting the operation of the preceding tubes. Naturally, to be able to make use of this method of bias supply, the power-supply unit must be able to furnish the bleeder current without itself being taxed in the slightest, for, in addition, it will be called upon to deliver much greater peak power during operation.

CONCLUSION

In conclusion, the designer of a Class AB amplifier must remember to give the following facts careful consideration:

(1). Over-biasing the output tubes of a Class A amplifier does not make it a Class AB amplifier.

(2). The load impedance of the output tubes will approximate double the Class A value.

(3). The AB input transformer must have the characteristics of a Class B input transformer and in addition deliver high grid voltage. Furthermore, it should have a comparatively high primary impedance to obtain as much voltage gain as possible in the driver without affecting its power-handling characteristics.

(4). The preferred form of bias supply is of the semi-fixed type, but the steady-state current should be as large a percentage of the peak plate current as possible.

Operated under the given conditions, and with high-quality components throughout, a Class AB amplifier can be built to deliver Class B output power with overall fidelity closely approaching that of Class A operation.

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SHANGHAI RADIO IMPORTS

THE MARKET for imported radio-receiving units and parts in Shanghai continued to expand during 1934, imports totaling $1,400,000, or half a million dollars (58 percent) more than during 1933. The United States maintained its premier position as a source of supply, furnishing 66 percent of the total imports. Great Britain, its nearest competitor, supplied 14 percent. (*Electrical Division, Department of Commerce.*)

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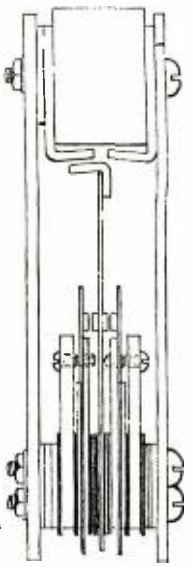
MARKET FOR RADIO SETS

THERE IS SOMEWHAT regular, but limited, demand for radio sets in El Salvador, according to the Electrical Division, Department of Commerce. Local radio dealers estimate the number of sets in the country at more than 4,000—mostly of American origin. Purchases are dependent on the outcome of the sale of the local coffee crop, since this country is practically a one-crop nation. At present there is uncertainty as to the final disposition of the crop now ready for the market.

HIGH-WATTAGE VIBRATOR-TYPE CONVERTERS

By WILLIAM W. GARSTANG
Chief Engineer
ELECTRONIC LABORATORIES, INC.



Four-reed vibrator.

FIG-1

SINCE THE ADVENT of the vibrator as a means of converting direct current to alternating current, it has been the constant aim of developers in the field to obtain a practical converter for operation on 32 volts dc or on 110 volts dc that would deliver relatively high wattage output at 110 volts ac. It has been considered that a 32-volt converter which would deliver 100 watts would be satisfactory for the general operation of most ac radio sets, and in the case of 110-volt converters it was desired to have an output of 200 watts for the operation of therapeutic apparatus and radio equipment in the dc districts of the large cities in the country.

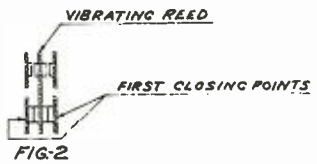


FIG-2
Details of the four-contact arrangement.

PROBLEMS INVOLVED

The first method of attack on this problem was the use of standard full-wave vibrators having one vibrating reed engaging alternately a contact on each of its sides. Difficulties presented themselves in various forms and we believe it best to enumerate these difficulties in the order of their importance:

1. Arcing occurred at the contact points, due to the high current necessarily interrupted, which was almost impossible to eliminate by means of straight capacity.

2. A great amount of heat was generated in the vibrator actuating coil due to the fact that this coil in its ordinary form was merely a shunt coil directly across the line; consequently, it was, of necessity, a high-resistance coil and consumed considerable wattage.

3. For the satisfactory performance of the device it was essential to have a stiff vibrating reed. This presented a problem of producing sufficient starting torque to set this reed in motion, it being a known fact that once the reed is in motion the power of the coil could be considerably lessened.

4. The problem of satisfactorily starting the converter under full load and of operating the converter at no load.

These problems were attacked one at a time and circuits were developed which would individually eliminate these difficulties, thus finally producing a satisfactory device.

FOUR-REED VIBRATOR

A four-reed vibrator was developed similar in structure to the conventional type now used as self-rectifying vibrators in auto-radio sets (see Fig 1). This vibrator had a contact on each one of the semi-stationary side reeds and had four contacts welded in place on the vibrator center reed (Fig. 2). The circuit arrangement with respect to the vibrator utilized one set of contacts in the conventional style; that is, the contact was connected to each end terminal of the primary winding of the converter transformer and the center terminal of the transformer was connected to one side of the dc supply (A-Fig. 3). The center reed of the vibrator was connected to a resistance (C-Fig. 3) and then from the resistance to the other side of the dc supply. This system in itself would constitute the conventional primary circuit arrangement as used on prior type vibrator converters.

"COMMUTATED DC"

As stated above it was a known fact that the resistance in series with the vibrator materially decreased its efficiency and its regulation. Consequently, the other two reeds of the vibrator (B-Fig. 3) were connected together and were then connected to the far side of the resistance in series with the center reed. These reeds and contacts were adjusted so that they would not close until the first mentioned contacts—those connected to the transformer end terminals—had already engaged. The actual function of the device with this circuit arrangement was such that a resistance was in series with the circuit during the time that the circuit was initially closed. Immediately thereafter the resistance was short circuited and eliminated from the circuit. Upon the movement of the vibrating reed in the opposite direction the resistance was again cut in the circuit and the original

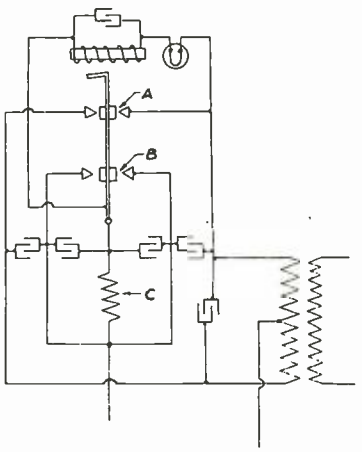


FIG-3
Vibrator reed contact connections.

contact opened. Consequently, a resistance was in the circuit during the make and break of the circuit, thus producing, in effect, a commutated dc. By the use of this circuit the efficiency of the converter was increased from its original 55 percent to in some cases in excess of 80 percent, and the regulation of the circuit was increased from approximately 60 percent to in some cases as high as 90 percent. At the same time any tendency of a prolonged arc at the contact points was quenched by the introduction of the resistance into the circuit during the make and break.

In Fig. 4 a similar circuit can be

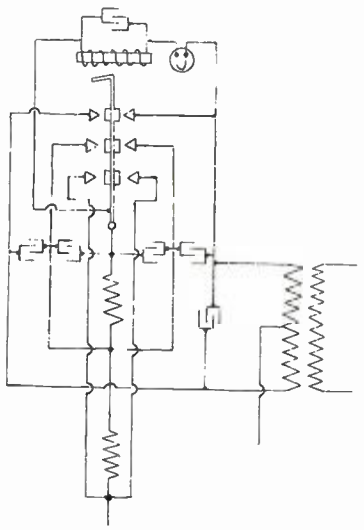


FIG-4
Similar to Fig. 3, but with additional contacts interrupting a circuit containing a second series resistor.

seen where this action is performed twice, namely, two different resistance units are introduced and shorted out of the circuit. It can be shown on the oscillograph that the ac wave as produced in the secondary winding by this circuit can be made practically as perfect as a sinusoidal wave.

TUNED COIL

The elimination of the difficulty as mentioned in the second point above was somewhat more difficult than the first. If we consider the second and third points together it can be seen that if resistance is introduced in series with the coil circuit in order to eliminate the heat from the actuating coil, at the same time the ampere turns of the coil will be reduced and the starting torque correspondingly reduced. It was found, as had previously been known, that by tuning the inductance of the coil by means of a capacitance to the frequency of the vibrating reed that the power necessary to operate the vibrating reed after its initial start was practically nil

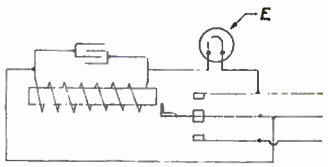


FIG-5
Use of lamp as variable resistance unit.

with respect to the power necessary to operate the reed before it had been tuned. However, the starting characteristics of the vibrator were the big problem. Efforts were made to use a relay (D-Fig. 6) in order to introduce resistance in the circuit immediately after the vibrator had begun its vibration. This was found to be not only of high cost but also not particularly satisfactory in operation. Ordinary resistance units would not have the wide range of resistance characteristics that were necessary for this function.

USE OF LAMP AS RESISTANCE

After a careful search of the field of resistance values it was found that a small incandescent tungsten filament lamp (E-Fig. 5) would perform this function in a perfect manner. In the case of the 110-volt converter, where a 1,000-ohm actuating coil had formerly been used and had been found to give satisfactory starting torque, an incandescent lamp was placed in the circuit which when cold had a resistance of approximately 500 ohms. Immediately upon the actuation of the vibrator, this lamp became hot and its resistance increased to approximately 5,000 ohms. As a result the current in the coil was reduced to one-tenth of its original value and the heat normally in that circuit was dissipated in the form of light and heat by the incandescent lamp. No matter how much the contact points wore off in service, the actuating coil, when the lamp was cold, always had enough power to make the original contact necessary to start the vibrator in motion, and immediately thereafter the lamp would reach its normal temperature and the wattage would be consumed externally from the vibrator itself.

POWER-FACTOR CORRECTION

The fourth problem encountered in vibrating-type converters was the operation of the converter when it was started with an incandescent lamp or a similar device as its load. An incandescent lamp of, say, 100 watts capacity has exceedingly low resistance when cold and presented the problem of practically a short circuit across the secondary of the transformer when the converter was initially turned on. It was found that if some method of correcting the power factor in the primary circuit was developed that the converter would no longer blow a fuse or be destroyed when it was initially turned on. In the case of a 32-volt converter, it was essential in order to correct this power factor or perhaps over-correct it slightly, that a high-capacity condenser, in the order of 20 mfd, be placed across the primary winding. Due to the enormous size of a paper capacitor of this value, experiments were run on ac electrolytic condensers. It was found that inasmuch as the peak value encountered in the primary circuit of the converter was seldom over the dc value, an ac electrolytic condenser of small size could be utilized satisfactorily for this application. Tests were run of approximately one and one-half years duration, and it was determined that an ac electrolytic condenser operated continuously on the 60 volts ac impressed upon it without damage and without excessive heat.

The use of this condenser, together with the above mentioned circuit arrangements, practically eliminated all of the defects found in the prior type converter. As a result, using the circuit illustrated in Fig. 3 with, of course, the essential radio-frequency suppression devices, a converter was developed having an efficiency when operating at

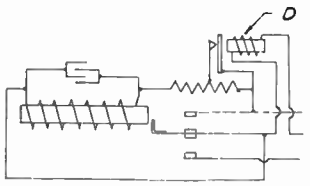


FIG-6
Addition of relay to introduce resistance after starting.

full load of approximately 75 percent, a regulation in excess of 85 percent, and a life, which was unheard of in the annals of vibrating-type converters, of approximately 5,000 hours before vibrator replacement was necessary.

CONCLUSION

In conclusion, it is the opinion of the writer that it is essential in any vibrating-type converter to commutate the dc rather than merely interrupt it. It is also essential to eliminate, as far as possible, heat from the vibrating unit inasmuch as heat and inductive kick-back destroy contact points more quickly than any other two causes. Furthermore, the vibrating reed should be tuned in order to give satisfactory performance and absolutely must be tuned if the converter is to be operated on a voltage higher than 32 volts.

METAL TUBES

FOR RECEIVERS

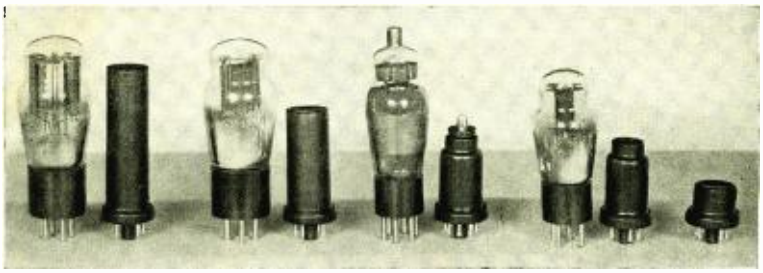


Fig. 1. Showing the contrast in sizes between the new metal tubes and the glass-enclosed tubes of corresponding ratings. The tube to the extreme right is a duo-diode.

● THE METAL CASING IS THE SHIELD AND THE ENVELOPE. THE TUBES SO FAR DEVELOPED ARE SIMILAR IN CHARACTERISTICS TO SOME OF THE EXISTING GLASS TYPES. NEW MANUFACTURING PROCESSES EMPLOYED.

A SERIES OF metal tubes have been developed by the General Electric Company in their Schenectady research laboratories. The tubes are cylindrical in form and smaller than the glass-envelope tubes having similar ratings.

The metal tubes are being manufactured for General Electric by RCA Radiotron and will appear in the General Electric receivers to be introduced for the fall trade.

CONSTRUCTION OF TUBES

The internal elements of the tube are first assembled on a steel plate or header, the shell is placed over the assembly and welded to the header at its circumference.

Elimination of the glass pinch seal allows the leads to enter the header of the new tube at the proper points for short, direct paths. Also, the new design permits a more satisfactory arrangement of connections and supports between base pins and electrode structure.

The direct leads from the tube elements pass through tiny beads of special glass that are fused within alloy eyelets, which in turn are welded to the holes in the metal header. This alloy, having substantially the same coefficient of expansion as glass, is known as Fernico and is a combination of iron, nickel and cobalt. It was developed expressly for this purpose.

The tube base pins are mounted in an insulating sub-base and fastened to the metal header so that the pins are integral with the holes in the header. The leads are soldered into the pins in the usual manner.

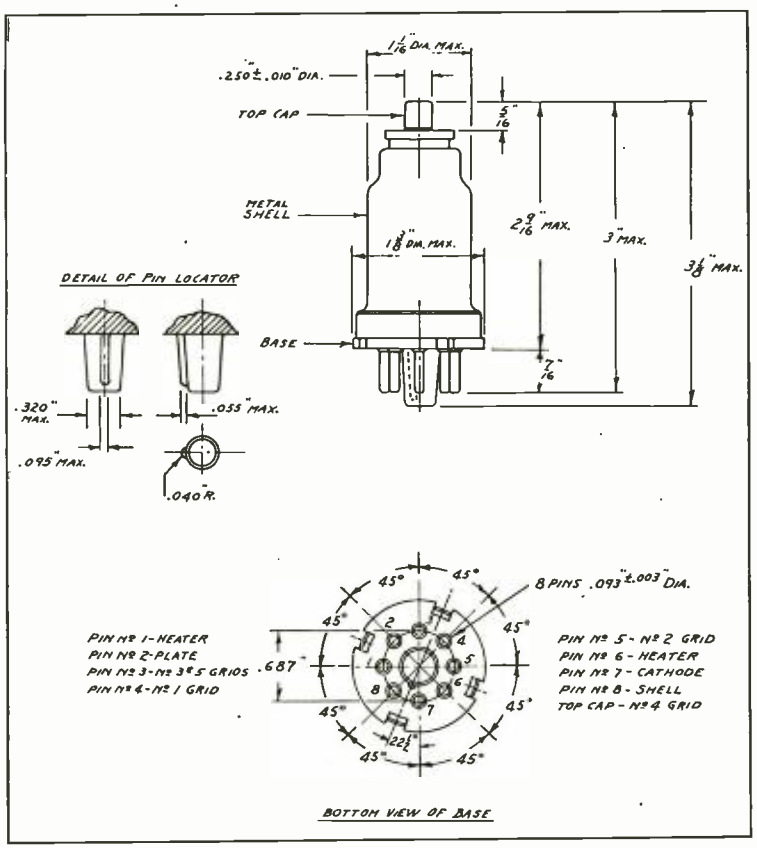


Fig. 3. Outline drawing of the "6A8" pentagrid converter, with dimensions, base details and detail of the pin locator.

KEYED BASES

The new tubes have one more base pin than comparable glass tubes; this pin is used to ground the metal envelope to the chassis, or to "ground," depending upon circuit design. Moreover, all pins are of the same diameter, and in the center is a longer insulated keyed pin. By placing this insulated pin in a hole centrally located in the socket, and rotating the tube until the key slips into its groove, the tube is quickly and easily inserted. Details of the keyed pin are shown in Fig. 3.

It is an interesting observation that the metal envelope is spot welded to the metal base in one-twentieth of a second, the timing of the weld being controlled by a thyratron tube. The complete circumferential weld is completed in that period.

The method used to seal off the metal exhaust tubulation, through which the metal tube is evacuated, is to press the

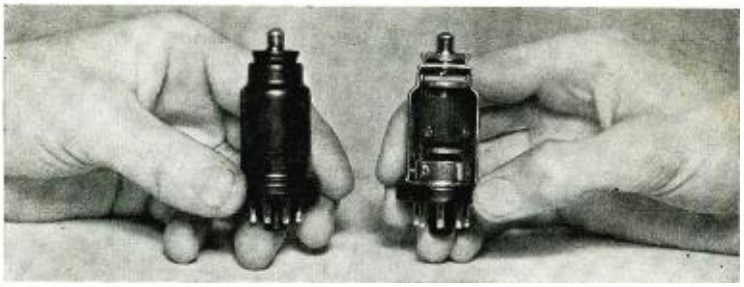


Fig. 2. Exterior of a metal-type triple-grid super-control amplifier tube, and, to the right, a cutaway view of the same tube.

tube between jaws, weld it together. and cut off the excess material.

GAS CLEAN-UP

It is said that the metal shell contributes to residual gas clean-up. Just why this is so has not been detailed. but is presumably due to the manner in which the tubes are bombarded. The internal elements cannot, of course, be brought up to the necessary temperature through heating by induction, since the elements are enclosed in a metal shell. In the processing of the metal tubes, intense heat is produced in the shell itself by subjecting it to gas flame. The shell is brought up rapidly to white heat or near-white heat with a resulting intense heat transmitted to the internal elements and to the air within the tube. It is presumably this higher relative temperature which contributes to the effective clean-up of residual gas.

TUBE TYPES

The metal tubes so far announced are the 6A8 pentagrid converter; the 6C5 detector amplifier triode; the 6D5 power amplifier triode: the 6H6 twin diode; the 6J7 triple-grid detector amplifier, and the 6K7 triple-grid super-control amplifier. All these tubes are of the 6.3-volt heater type, drawing 0.3 ampere. So far no type numbers have been alloted to high-voltage rectifiers, which differ from the typical metal tube in that the metal envelope is punched with holes to assist in heat radiation.

Due to the better heat radiation characteristics of the metal as against the glass envelope, higher efficiency is claimed for power-amplifier tubes. Moreover, though the transmission of heat to the surrounding air is more effective, the temperature of the metal shell and the air in the vicinity of the shell, is said to be no higher than the relative temperatures of glass-envelope tubes.

NEW ZEALAND ANTI-INTERFERENCE REGULATIONS

THE NEW ZEALAND government has put into operation 23 regulations concerning radio interference, with a penalty clause providing for a fine up to 50 pounds for any breach of the regulations.

The subject has been dealt with cautiously in the Dominion, because it was realized that electrical apparatus was in use in the country long before broadcasting became established. For this reason the regulations are not to be enforced automatically against owners of appliances which may contravene the law; though the regulations state that. for the future, it shall not be lawful for any person to install, use, sell, or manufacture any interfering equipment. whether wireless, telegraphic apparatus, or not, unless, on appeal to the Postmaster-General, a certificate of exemption has been granted.

Radio inspectors are given power to require either the complete discontinuance of interfering equipment or discontinuance during particular hours, and this provision will get over a difficulty caused by the use of electrical apparatus by medical men, who will be required to operate it at times when interference with broadcasting is likely to cause the least annoyance to listeners.

An advisory committee has been constituted to administer the regulations and make recommendations to the Postmaster-General on appeals. It comprises an officer of the Post and Telegraph Department as chairman, an officer of the Public Works Department (which owns the Dominion's hydro-electric generating stations), a member nominated by the New Zealand Broadcasting Board, and another to represent the electrical supply authorities and electric tramway promoters of the Dominion. (*World-Radio,* London, Nov. 23, 1934.)

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GERMANY HAS LARGE INCREASE IN RADIO SUBSCRIBERS

THE NUMBER of radio subscribers in Germany on February 1, 1935. amounted to 6,439,232, having registered an increase of 296,311 during January as against 231,591 during December, 1934. This increase is the largest ever registered during any single month since the start of radio in Germany, according to March 25, 1935, *Electrical Foreign Trade Notes.*

Out of the total number of subscribers 453,845 were exempt from paying the usual fee of 2 marks each month.

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EFFECTS OF AVC VOLTAGE DISTRIBUTION

(*Continued from page* 12)

conclusion as to the best compromise which will be tolerated between sensitivity and noise level. A great deal of noise may be filtered from the output in the audio amplifier of the set, but only with a loss in output and some alteration in tone quality. Quite a large number of receivers depend upon the tone control to serve as a noise filter in conjunction with its normal purpose. The change in noise level using various avc circuits is illustrated in Fig. 2. Noise removed in this part of the receiver does not affect the audio gain so that more of the output for which the tubes used in the audio stages were designed may be realized. The tone control may also be designed for a single purpose with more satisfactory results.

FIXED BIAS I-F

Referring to Fig. 1, this study of the avc effect shows that too much automatic volume control has a tendency to decrease the sensitivity to a marked degree. Curve "A." where the full 100 percent avc is applied to the r-f, detector-oscillator and first i-f stages, shows that a very strong signal is required for maximum output of the set. However, the noise level under this condition is at a minimum. The sensitivity is the greatest with no avc on the pentagrid converter, but noise level is then highest as indicated by curves "F" and "H" of Fig. 2. The percentage of avc applied to the first i-f stage has very little effect on the noise level. A large number of sets employing an r-f stage do not include the i-f stage in the avc circuit, thereby gaining considerably in sensitivity with very little increase in noise level. Automatic volume control on the pentagrid converter is apparently an essential requisite. The degree to which the sensitivity is to be increased depends on the limiting factor of noise level to be tolerated.

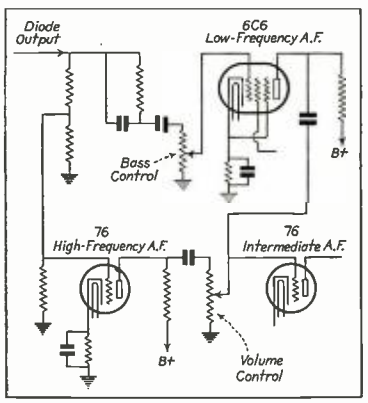
A similar investigation taken with a more sensitive type automobile receiver checked the general results indicated by the curves shown, although a much higher percentage noise level was inherent.

Design .. NOTES AND

DUAL A-F AMPLIFIERS

SOME TWO YEARS ago, Stuart Ballantine, in an address before the Institute of Radio Engineers, proposed the use of two audio amplifiers for radio receivers. One amplifier was intended to cover frequencies below, say, 1000 cycles in which the energy content of speech and music is relatively great. The other audio amplifier was intended to cover the higher frequency range in which lesser amplitudes prevail. It was also suggested that much higher powers be employed than had previously been the case. It was suggested that the low-frequency amplifier which fed a separate low-frequency loudspeaker have a high power output, while the high-frequency amplifier which fed a high-frequency speaker might have a smaller output.

From a purely technical standpoint, such a system has very obvious advantages. First, it permits adequate power outputs without high-frequency distortion due to overload when both a high-frequency and low-frequency note are amplified together. Second, it eliminates the necessity of filtering the high-frequency and low-frequency loudspeakers to prevent overload and distortion in these units. Such filters, which, of course, must be designed to operate at high levels and at low impedance, present many difficulties. Not only are the elements of such filters large, but unless the sections are carefully damped, transients are likely to be set up in the filter circuits which will result in annoying hangovers and consequent whiskers in the reproduced program. Third, the use of two amplifiers permits simpler equalization at both high- and low-frequencies as well as simple circuits for the adjustment or balance between high-frequency and low-frequency response.



The dual audio-frequency voltage-amplifier circuit used in the Howard "Grand" receiver.

It is gratifying to note that the new Howard "Grand" receiver, which employs some nineteen tubes, makes use of a double-channel a-f amplifier. While this receiver does not employ two entirely separate amplifiers to feed two loudspeakers, it does separately amplify the low-frequency and high-frequency notes before combining them in the final power stage.

The signals are split in the first stage by means of a filter, as shown in the accompanying diagram. The bass frequencies are amplified most since it is in this range that greatest equalization is required. The high frequencies are amplified by a 76 tube and the low frequencies by a 6C6 tube. Bass control is accomplished by an adjustable equalizer in the grid circuit of the 6C6 tube. The outputs of these two tubes are mixed in the volume-control circuit which feeds the grid of the next audio-amplifier stage.

It is also interesting to note that this receiver has an output of some 20 watts. This is a far cry from the sub-midget type of receiver with an output of 0.1 watt. Moreover, it represents a tendency which has recently been shown by many receiver designers and it appears one which is likely to continue to find favor. High output capability, even though there is no necessity for its actual use in practice, permits of low distortion in the output stage when the receiver is operated at reduced levels.

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BEAT OSCILLATORS

PROBABLY ONE OF the reasons for the hesitancy of some people to purchase all-wave receivers has been the critical adjustment always necessary in the short-wave bands and the difficulty experienced in tuning in fading signals. It is not uncommon for short-wave signals to fade so badly that tuning is almost impossible, because the signals fade beyond the range of the avc system. To overcome this difficulty, beating oscillators are now becoming more common in all-wave receivers which permit tuning of a beat note between the desired signal and that of the beating oscillator.

If the amplitude of the beating oscillator voltage fed into the second detector or intermediate-frequency amplifier is adjusted to be approximately equal to the signal amplitude appearing at this point in the valleys of a fading signal, optimum heterodyne action is obtained in the valleys but not on the peaks, resulting in a readable signal during the tuning process which is more nearly independent of fading. In some receivers the amplitude of the beating oscillator voltage is alone adjustable, while in others the best note is adjustable. So far as we are aware, no receiver employs both adjustments. It is predicted, however, that both adjustments will eventually come into use.

There is now a tendency among receiver designers to call attention to the fact that continuous-wave telegraph stations may be tuned in and the signals read by means of the beating oscillator. To the Ham and others among the broadcast listeners, this is of considerable value. It gives the average listener the feeling that he is not barred from listening to certain commercial services. Moreover, through its ability to spot any signal, it proves a time-saver for listeners who unwittingly hang on to a weak, unmodulated code signal in the belief that it is an unmodulated, short-wave broadcast station carrier.

A more extended use of the beating oscillator as an aid in locating and tuning in the short-wave signals should do much to popularize short-wave reception and the use of all-wave receivers.

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TUNED ANTENNA CIRCUITS FOR AUTO RADIO

SINCE AUTO-RADIO receivers employ a small antenna in which the pickup is limited, it is not infrequent for first-circuit noise or thermal agitation to be a matter of some concern. In the usual antenna coupling system the antenna step-up, which is, after all, the factor that determines signal-to-noise ratio in such cases, is relatively low. The obvious way of improving matters is to tune the antenna circuit. While this requires a much larger capacity than that of the remainder of the condenser gang, it may increase antenna step-up many fold.

Of course, series condensers in the antenna circuit are required to compensate for varying antenna capacity from one installation to another. If the antenna tuning condenser is to track properly with the remainder of the circuits, several fixed capacities might be used for this purpose, or a single semi-adjustable unit employed. In such cases it appears that since the minimum capacity will be very high, two variable condensers in parallel might well be used to tune the antenna circuit.

An approximation to this condition may be had by employing closer coupling than is customary between the antenna and the first tuned circuit, and

COMMENT . . *Production*

then using an adjustable series antenna condenser to limit the antenna capacity. Such a circuit is employed in the new Delco auto radios.

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ADJUSTABLE COUPLING FOR I-F TRANSFORMERS

A NOVEL TYPE i-f transformer, in which the coupling between primary and secondary is adjustable from zero to 1.5 times critical coupling, is receiving attention. This transformer is constructed of two iron-core coils suspended at right angles to each other. One coil is fixed in position and the other may be moved backward or forward along an axis perpendicular to that of the fixed coil. Adjustment is by means of a screw. Access to the adjusting screw is had through a hole in the side of the coil shield. When the two coils are properly centered, the magnetic coupling between them is substantially zero. Moving one coil off center, either backward or forward, increases the magnetic coupling.

Probably the most obvious advantage in an arrangement of this sort lies in the ease of adjustment and precision with which intermediate-frequency transformers may be aligned in the factory, or adjusted later, if desirable. At the present time it is common practice to place the two coils of an i-f transformer co-axially with fixed spacing. This obviously results in manufacturing irregularities since it is impossible for each transformer to be an exact duplicate of the next. While manufacturing irregularities can, by proper control, be held to a minimum, and by resorting to grouping of the transformers in the factory the i-f system of any given receiver can be held to quite close limits, adjustment of coupling permits not only identical i-f stages but identical receivers as well. Moreover, such a system should result in noteworthy manufacturing economies.

Another advantage, of course, lies in the fact that tuning can be accomplished by the simple process of adjusting all transformers with the tuning condensers at weak coupling for a single peak. Afterwards, of course, the coils can be adjusted to any condition from critical coupling to an overcoupled condition. This permits considerable reduction in time and effort directed toward alignment procedure and permits adjustment during tests. This has been tried, of course, by means of adjustable de-coupling rings inserted between co-axially wound coils. However, so far as is known, no simple system of this sort has ever been devised that has been reliable.

It seems safe to predict that this type of coupling will be widely used and will result in greater precision and more uniform receivers in the near future. One of the greatest advantages of this arrangement lies in its simplicity. Some one has said that the best things in this world are the simplest and he might have added that simple arrangements usually result from careful study and a great deal of development.

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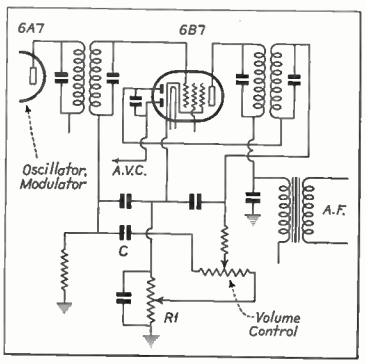
THE OVERWORKED MULTIGRID TUBE

AS AN ITEM of interest, there is shown in the accompanying diagram a 6B7 arranged to provide i-f amplification, detection, a-f amplification, noise suppression, and avc. Such a circuit has been used in some of the more compact receivers in which the number of tubes has been reduced to a minimum.

In the particular receiver in mind, a 6A7 oscillator-modulator tube feeds through the i-f transformer shown connected to the control grid of the 6B7. Intermediate-frequency amplification is



Circuit of 6B7 used for i-f, a-f, detection, avc and noise suppression.

accomplished in the pentode portion of the tube. Cathode bias resistor R-1 furnishes self-bias to the pentode section of the 6B7, while the screen and plate circuits are connected in the usual manner. The amplified intermediate frequency is fed back to one diode in the usual manner. The second diode, the circuit for which is not shown in the figure since it is conventional, provides avc.

Audio frequency is picked off the volume control and fed back into the pentode circuit through condenser C. The amplified audio voltage appears across the primary of the audio-frequency transformer.

Noise suppression is accomplished by varying the detector diode bias. Resistor R-1 provides variable bias for the diode detector. The pentode plate current flowing through this resistor produces a voltage drop which is not variable in so far as the pentode itself is concerned, because current flows through the entire resistor irrespective of the tap position. However, the diode plate returned to cathode through a movable arm on R-1 may be made more or less negative with respect to the cathode by utilizing any desired part of this drop. Movement of the top thus controls the rectifier cut-off and in consequence provides adjustable noise-suppression limits.

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DUAL I-F AMPLIFIERS

IT HAS PREVIOUSLY been suggested in these pages that double i-f amplifiers, one for use in the broadcast band and the other for use in the short-wave bands, should eventually come into use. The obvious technical advantage of such an arrangement is that it permits high fidelity and freedom from unwanted responses by proper choice of the intermediate frequency for the broadcast band, and high selectivity in the short-wave bands. It can be shown that a frequency in the neighborhood of 175 kc is best for broadcast reception alone. Since this was predicated on minimum undesired responses, it obviously does not hold for the short-wave bands. Moreover, a reasonable image-frequency ratio can only be had for short waves by the use of a higher intermediate frequency. It has been customary to compromise in this respect and use an intermediate frequency of the order of 456 kc in all-wave receivers.

The new Howard "Grand" receiver employs a double-channel i-f amplifier. While the same intermediate frequency is used in both channels, it does permit the use of separate intermediate-frequency amplifiers for high-fidelity broadcast reception and high-selectivity short-wave reception.

In this particular receiver a single-stage i-f amplifier, with low Q coils and a broad band, is used for high-fidelity broadcast reception. A two-stage i-f amplifier, employing six tuned circuits with high Q coils, is used for distant broadcast reception and the short-wave ranges.

This trend is indicative of the tendency of manufacturers of broadcast receivers not only toward a better product but toward the acceptance of engineering advice as against the previous tendency to produce receivers with the earmarks of the sales department.

RMA Engineering Activities

DETAILED REPORT TO RMA BOARD OF DIRECTORS, MARCH 22, 1935.

By Dr. W. R. G. BAKER
Chairman
RMA ENGINEERING COMMITTEE

THE GENERAL STANDARDS Committee will hold a meeting in New York City early in May and it is expected that a number of the important projects of the various Committees will be in shape for final action at that time.

The Joint RMA, NAB and IRE Committee will also hold a meeting early in May to discuss several problems relating to the broadcasting "system."

The dissemination of information, standards, etc., is carried on by the office of the Chairman of the Standards Section to the extent of the facilities available. This is done by circular letters to the various committees, "Standards Proposals" and Engineering Bulletins. These mailings from that office including also questionnaires, meeting notices, and minutes of meetings are approximately 100 in number since the beginning of the fiscal year. The total number of sheets (mimeograph, off-set, blue prints) involved in these mails and reserve copies is approximately 28,500.

Close cooperation is continued with the Engineering Division of the RMA of Canada and it is felt that this relationship is to the mutual benefit of both groups.

The activities of the Technical Committees are being conducted by the respective chairmen most satisfactorily and to the very considerable benefit of the industry. The following is a brief resume of the present and proposed activities of the various committees:

COMMITTEE ON BROADCAST RECEIVERS

Among the most important problems on the agenda of this Committee at present are the collection of data working toward a standard intermediate frequency for superheterodynes, the development of color coding for wiring for chassis components, and methods of measuring susceptiveness of receivers to interference. A special committee headed by Mr. Dickey recently did excellent work in cleaning up a dangerous situation with the N. E. Code on bare-neutral wiring, which threatened to cause serious radio interference.

COMMITTEE ON VACUUM TUBES

The usual work of assigning designation numbers to new tubes and standardizing their characteristics is being carried on by the Sub-Committee on Tube Numbering. This is most important to the industry, and this committee has prevented several situations which would have had serious commercial consequences. Among other projects under way at present is the standardization of bulb sizes, and the development of data on characteristics of tubes already on the market for vital standardization. A complete standardization of receiving tube base dimensions and connections has been developed, and will be submitted to the American Standards Association.

COMMITTEE ON COMPONENT PARTS

In view of the diversified nature of this work, this committee functions as a group of special committees under the general chairmanship of Mr. Van Dyck. While he has only been chairman a short time, Mr. Van Dyck has started work leading towards standardization in many branches of the parts field, which will be of enormous dollar value to the industry. The use of a preferred number system of fixed resistor sizes and the development of standard can sizes for electrolytic capacitors are examples of a number of such projects. Information will also be disseminated in the industry on the use of preferred numbers. The activity of this committee with the cooperation of the member companies can be made to effect a substantial cost saving to both parts and receiver manufacturers within a reasonable period.

COMMITTEES ON FACSIMILE AND TELEVISION

From the commercial state of these two branches of radio, it can be seen that these committees have necessarily confined themselves to general discussions and the development of definitions which have been helpful to workers in these fields. The next meetings of these Committees will probably be held at the I. R. E. Convention in Detroit the first of July.

COMMITTEE ON INTERFERENCE

The first meeting of the Committee on Interference, under the chairmanship of Dr. Goldsmith, was held in New York City on March 8. A majority of the organizations that had been requested to cooperate were represented at the meeting.

Prior to the meeting some of the organizations interested suggested that the work of the Committee could be pushed ahead by transforming the Committee into a Sectional Committee of the American Standards Association under sponsorship of the RMA.

This suggestion was investigated and the ASA found to be agreeable. The matter was further discussed by the interested officers of the RMA Engineering Division, and it was agreed that the advancement of this Committee to ASA status would be most desirable if it were possible.

During the discussion of this proposition at the meeting there were a few objections, practically all of which were cleared up. Action was taken to indicate the sense of the meeting being in favor of the elevation of this work to ASA procedure, and to send a letter to all the cooperating groups requesting their approval of this change.

When this approval is secured the Engineering Division will approach the ASA asking for the formation of a Sectional Committee to handle this problem. The membership setup already approximates that of an ASA Sectional Committee, so that there will be no delay in starting this work. The ASA have agreed that the original purpose and proposed activities of the Committee will not be changed under their procedure, and the activities will be entirely up to the Sectional Committee itself.

The officers of the Engineering Division will promote this activity to the greatest possible extent, in view of its enormous importance to the radio industry.

A great deal of data has been collected and more is coming in. This data will be surveyed, and the important parts of the information will be disseminated through publicity.

COMMITTEE ON SOUND EQUIPMENT

The most important problem before this Committee at present is that of standard mounting dimensions for loudspeakers. Mr. Knowles, the chairman, is having his committee work up suitable proposed standards for immediate presentation to the RMA membership for comment and criticism.

· RMA NEWS ·

RMA CONVENTION IN JUNE; NEW RADIO SHOW POLICY

ARRANGEMENTS FOR THE annual RMA convention and membership meeting next June in Chicago, adoption of a general policy regarding public radio-electrical shows, and continuance of the RMA national trade promotion activities were among general industry affairs acted upon by the RMA Board of Directors at their meeting, March 22, at the Commodore Hotel in New York City. President Leslie F. Muter of the RMA presided and many present and future industry problems received the attention of the Association's governing board.

Continued and cooperative promotion, on a national scale, of radio sales by the RMA and allied organizations, will be planned at the June meeting of the industry in Chicago. June 11-12 were the dates chosen for the Eleventh Annual Convention and Membership meeting of the Association which, in accord with past precedent, will be held at the Stevens Hotel. Paul B. Klugh of Chicago was again chosen chairman of the Convention and Entertainment Committee. Details of the convention program, including a membership dinner and golf tournament, are being arranged.

In considering public radio-electrical shows, the RMA Board decided that the Association would not sponsor, approve or support any radio-electrical shows and, therefore, declined an invitation to sponsor the proposed public show next September at Grand Central Palace in New York. While strictly "local" radio shows are not disapproved, the RMA Board felt that Association sponsorship of any show gave it a national character and retarded sales with a resultant loss of business.

Powel Crosley, Jr., of Cincinnati, chairman of the RMA Trade Promotion Committee, reported in detail of the satisfactory results secured from the trade promotion program of the Association instituted last winter. Arrangements for continuance of the trade promotion activities of the Association were approved by the Board of Directors.

RADIO CARLOAD REDUCED

The RMA Traffic Committee has effected another traffic saving for the industry. On May 16 a new tariff will be issued by the carriers providing for reduction of carload minimum weight on receiving sets to manufacturers east of Denver. The new tariff, according to advice to the RMA from H. G. Toll, chairman of the Transcontinental Freight Bureau, will be published as a supplement to Westbound Transcontinental Tariffs, 1-0 and 4-L and will provide for a carload minimum of 18,000 pounds on shipments loaded in cars with inside measurements of 39' 6" and under; 20,000 pounds in cars over 39' 6" to 41' 6", and 24,000 pounds in cars over 41' 6" to 50' 6". These specifications compare with the general minimum carload weight of 24,000 pounds which is now in effect applicable on all sized cars.

O. J. Davies of Camden, N. J., chairman of the RMA Traffic Committee, has been advised that the new tariffs on May 16 will be applicable from the territories east of and including St. Louis, Peoria, Chicago and Milwaukee to the Pacific Coast and intermountain points inasmuch as there is no change in the rating. The new tariff permits manufacturers to make cars of 18,000 pounds which will result in more carload shipments and assist greatly in distribution of receiving sets because manufacturers now are compelled to pay charges on a minimum of 24,000 pounds on transcontinental cars.

FEBRUARY EXCISE TAXES

A decrease during February in U. S. Internal Revenue Bureau collections of the five percent excise tax on radio and phonograph apparatus is reported. February tax collections were $193,467.30 compared with $272,335.09 in February 1934, and with $173,987.28 in February 1933.

TWO NEW RMA DIRECTORS

Two new directors of the RMA were seated at the meeting of the Association's board at New York on March 22. George A. Scoville of Rochester, New York, who was elected to succeed the late W. Roy McCanne, and Allen H. Gardner of Buffalo, New York, were the new RMA directors beginning service. Mr. Gardner succeeded Mr. W. S. Symington of New York City, who resigned from the RMA Board because of a change in company personnel. Mr. Symington was succeeded as chairman of the RMA Membership Committee by Director Ben Abrams of New York City.

RADIO INDUSTRY OPPOSING AUTO-RADIO BILL IN CONNECTICUT

Opposition of the radio and also the automotive industry has been centered against a bill in the Connecticut Legislature which would prohibit radio sets in automobiles. The bill would impose a $50 prohibitive penalty for equipping an automobile with radio "or other device of diversion."

The Connecticut bill is unique in that it is the only measure ever proposed in any state or city to absolutely prohibit radio sets in motor vehicles. A few states prohibit automotive radio which will receive police signals. Many state and municipal investigations of automotive radio have been held in past years and without prohibition of automotive radio resulting. There is no record of any major traffic accident attributable to automotive radio, which decreases driving speed and thus is a safety factor in automobile operation. About two million automobiles are equipped with radio, with a public investment of nearly seventy-five million dollars.

SPECIAL RADIO TAX DEFEATED IN ARKANSAS

An effort in the Arkansas Legislature to impose a discriminatory "luxury" tax on radio and other articles has been defeated. Instead of a discriminatory sales tax on a few commodities, as proposed in a bill introduced by the House Steering Committee in the Arkansas Legislature, a general two percent sales tax was substituted and has been passed. The RMA organized industry opposition in Arkansas against the original discriminatory bill which also proposed to tax refrigerators, tobacco, cosmetics, sporting goods and other articles. Through its State Legislative Committee in Arkansas, composed of leading radio distributors, and from its Washington office the RMA made vigorous opposition to the original bill. A brief was filed with the Arkansas Legislature by the RMA denying that radio was a luxury and also contending that State taxation of radio is unconstitutional under a ruling secured by the RMA a few years ago in the Federal Court of South Carolina. The RMA brief also contended that imposition of further sales taxes by States was a burden on industry and finally won its contention that a general sales tax, which was adopted, would obviate the unfair discrimination proposed in the original bill.

JANUARY EXPORTS

American exports of radio apparatus during January 1935, according to an advance report of the Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce, were 43,898 receiving sets valued at $1,172,129; 481,668 tubes valued at $219,237; 11,047 speakers valued at $25,522; parts and accessories valued at $292,903, and transmitting tubes, sets and parts valued at $264,267, not including exports to American possessions.

CANADIAN RADIO SALES

Through the cooperation of the Canadian RMA, statistics on Canadian sales received at the Washington office of the RMA report 125,373 sets sold in Canada during the six months ending December 31, 1934, with a list of value of $11,853,492.49. Set sales during January in Canada were 7,693 with a list value of $792,329.46. Projected Canadian manufacture for February and March was estimated at 30,157 sets.

RADIO TARIFFS REDUCED IN BELGIUM TREATY

Tariff reductions of 15 percent on radio receiving sets and 50 percent on tubes are important concessions secured by the American radio industry in the reciprocal trade agreement which has just been negotiated between the United States and Belgium. This is the second radio tariff concession secured in the various reciprocal trade treaties which are being negotiated by the Administration.

The Belgium trade agreement was signed February 27 and does not require parliamentary ratification. It will become effective following future proclamation by the President and also applies to Luxembourg as well as Belgium.

In the negotiation of the various reciprocal trade treaties by the State Department, radio industry interests have been represented by the RMA through its Washington office. The Belgian radio tariff concession is regarded as of special importance

(*Continued on page 25*)

News Of The Industry

RITTENHOUSE TRANSFERS OFFICE

Synthane Corporation announces that J. B. Rittenhouse, Vice-President, has transferred his headquarters from Chicago to the main office of the company at Oaks, Pennsylvania.

Mr. Rittenhouse has been associated continuously with the laminated bakelite industry since 1916, and with Synthane Corporation since its inception in 1928.

The rapid expansion of Synthane Corporation's interests in a constantly broadening market is said to have necessitated this further step towards best possible co-operation with its customers.

During recent months Synthane Corporation has successfully introduced its materials for radio dials in addition to the older established radio uses such as coil forms, sockets, panels and insulation.

Of considerable interest in mechanical fields is the increasing adaptability of Synthane products for use as non-metallic containers, buckets, tanks, etc., where resistance to corrosive liquids is important.

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WILLIAMS JOINS IRC

The appointment of Fred D. Williams as Vice-President and General Manager of the International Resistance Company has been announced by President Ernest Searing.

Mr. Williams who has already assumed his new duties at IRC headquarters, 2100 Arch St., Philadelphia, Pa., needs no introduction to the radio trade.

Mr. Williams' association with IRC comes as a result of that company's program of expansion on the IRC resistors and volume controls as well as on other developments to be announced in the near future.

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RCA TUBE PRICES REDUCED

Substantial price reductions on 57 types of RCA Radio Tubes, ranging from a cent to $1.75 per tube, were announced by C. R. King, Sales Manager of RCA Radio Tubes. The price reductions, the announcement stated, are in accordance with the Company's policy of keeping selling prices in line with manufacturing and distribution costs, and of passing on savings made possible by increased production and manufacturing efficiency.

Lowered tube costs are expected to further increase the volume of radio-tube sales because of the stimulus it provides for the estimated 18,000,000 radio-set owners to replace worn-out tubes.

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LAMPKIN LABS. MOVE OFFICE

The Lampkin Laboratories announce the new location of their main office and shop at Bradenton, Florida, where the manufacture of specialized equipment of original design will be continued. All technical inquiries, orders, etc., should be addressed to the main office.

A sales office will be maintained at the old address, 146 West McMillan Street, Cincinnati, Ohio.

Prepaid shipment will be made on all orders accompanied by the full purchase price . . . this is lieu of cash discount, it is stated.

"PREPARATION OF SVEA METAL"

"Preparation of Svea Metal" is the title of the latest bulletin published by the Swedish Iron and Steel Corporation of 17 Battery Place, New York City. This bulletin, No. 12, covers the preparation of Svea Metal for use in electronic devices other than receiving tubes.

Those interested may be placed on the regular mailing list for these bulletins by writing to the Swedish Iron and Steel Corp.

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ROCKE INT. ELEC. CORP. REPORTS BRISK BUYING ABROAD

Arthur Rocke, President of the Rocke International Electric Corp., reports intense interest abroad in the new Franklin Flush-Type Radio-Tube Socket, announced in these columns recently.

Because of the easy soldering position of the lugs, the insulation disc and the bulldog grip of the tapered brass contact, the new Franklin Flush-Type Socket is said to be meeting hearty response where engineers want a socket that resists vibration. This is particularly true of the automobile receiver set which is subject to harder usage than the home receiver set.

Mr. Rocke represents the Albert W. Franklin Manufacturing Corp., in Latin America, Australia, Great Britain, Continental Europe, South Africa and the Far East.

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RAYTHEON'S SAFETY RECORD

During the last five years, not one employee of the Raytheon Production Corporation has lost time because of a major accident in the factory at Newton, Mass. Up to January 27, 1935, more than 5,900,000 man-hours had been worked with no time out for serious injuries.

Visitors to the Raytheon Factory can see a growing list of awards for safety and factory efficiency. In January, 1931, the factory management erected a bronze plaque "In Recognition of the Excellent Safety Record Made by the Employees of this Plant. Working without a Loss-Time Accident Since January 26, 1930, to January 26, 1931". Each year thereafter, another bar has been added to the plaque, until now it has a total of four . . . one for January, 1931, to January, 1932; one for January, 1932, to January, 1933; one for January, 1933, to January, 1934; and the newest one for January, 1934, to January, 1935.

These employees and the factory at Newton, Mass., produce all of the Raytheon 4-Pillar Radio Receiving Tubes that are used as original set equipment, as replacements in home and automobile receivers, by Polar Expeditions, by Police Departments, Aviation Companies, and the like.

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G. E. REPORT

At the March meeting of the board of directors of the General Electric Company the preliminary results for 1934 were presented, showing orders received of $184,000,000 compared with $143,000,000 in 1933, an increase of 29%, and sales billed of $164,797,000 compared with $136,637,000 in 1933, an increase of 21%.

The net profits available for the common stock, as a result of the year's operations, are $17,151,000 compared with $10,855,000 for 1933. This is equivalent to approximately 59c per share compared with 38c in 1933. The dividends in 1934 were 60c per share compared with 40c in 1933.

The dividend for the first quarter of 1935 of 15c per share was declared on the common stock, payable on April 25, 1935, to stockholders of record of March 15, 1935.

The annual report shows cash and marketable securities of approximately $108,000,000 compared with $112,000,000 last year.

The average number of employees during 1934 was 49,642 compared with 41,560 in 1933. The total earnings of these employees amounted to $75,227,000 for 1934 compared with $55,287,000 for 1933, an average annual earning of $1,515 and $1,330, respectively, an increase of 14%.

Between March 1, 1933 (the approximate low), and December 31, 1934 (the high), the number of employees on the payroll increased almost 37% and the total annual payroll rate increased from $47,604,000 to $81,300,000, or 70%.

On December 28, 1934, there were 196,248 stockholders compared with 188,316 on December 29, 1933.

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AEROVOX CATALOGS

The Aerovox Corporation, Brooklyn, N. Y., have available their Catalog No. 152, which covers Aerovox Condensers for industrial uses. This 24-page catalog contains a great deal of valuable and interesting material.

Also available is a catalog covering Industrial Condenser Replacements for use in Electrical Refrigerators, Oil Burners and other motor-driven equipment.

Both catalogs may be obtained from the Aerovox Corporation, 70 Washington Street, Brooklyn, N. Y.

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CHANDLER VISITS U. S.

Mr. J. B. Chandler of J. B. Chandler & Co., 43 Adelaide Street, Brisbane, Australia, a firm of electrical merchants and operators of five commercial broadcasting stations in the state of Queensland, left Sydney on March 6 and arrived in San Francisco, March 27. Mr. Chandler's visit was made for the purpose of inquiring into broadcasting and merchandising in this country.

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DAVID SARNOFF HONORED BY FRANCE

The Cross of the Legion of Honor was conferred by Consul General Charles de Fontnouvelle of France upon David Sarnoff, President of the Radio Corporation of America and pioneer in the science of radio. The presentation took place in the Consulate General in La Maison Francaise, Rockefeller Center.

In presenting the Cross and the Diploma of the Legion of Honor, Mr. Fontnouvelle said:

"It is my great pleasure to inform you that the President of the French Republic has bestowed upon you the Cross of Knight of the Legion of Honor, in recognition of your pioneering and great accomplishments in the science of radio."

NEW JOBBERS FOR RCA VICTOR SOUND

Six leading radio distributing companies have been appointed wholesale distributors for the sale of RCA Victor centralized radio, public address, sound re-enforcement and other commercial sound applications, according to an announcement by W. L. Rothenberger, Manager of the newly created RCA Victor Commercial Sound Sales Department.

All of the new distributors already represent RCA Victor in the sale of "Magic Brain" radio and radio-phonograph instruments and are expanding their activities to include the sale of commercial sound systems in the same territories they are now serving. The new appointments, which are soon to be followed by others, Mr. Rothenberger said, are in line with the Company's new policy of expanding and intensifying this phase of its activities to meet a constantly growing and profitable market for numerous applications of sound in commercial and institutional fields.

The newly appointed distributors include the R. S. Proudfit Company, Lincoln, Nebraska, whose President, Geo. E. Proudfit, has organized a new sound-equipment division headed by L. R. Bickley; the Cleveland Distributing Company, Cleveland, Ohio, whose President is R. M. Becktol; Phillip Werlein, Ltd., whose President is Paul S. Felder; the Klaus Radio and Electric Company, Peoria, Illinois, of which Henry Klaus is Sales Manager; the Dixie Maytag Corporation, Nashville, Tenn., headed by J. O. Smith; and the New York Talking Machine Company, of which H. P. Fillmore is President.

Continued technical development has kept pace with the constantly growing market for commercial sound systems, and the various types of apparatus have become simplified so that standard sound systems for public address, sound re-enforcement, centralized sound distribution or multiple antennae are now available for every possible application with a minimum of adaptation, it is stated. Each distributor will be headquarters for technical information in his territory and is prepared to provide consultative services to radio dealers, contractors and architects. The RCA Victor commercial sound sales activities also include Antennaplex systems, non-theatrical applications of Photophone sound motion-picture equipment, all-purpose amplifiers and associated apparatus.

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PIONEER GEN-E-MOTOR BULLETIN

The Pioneer Gen-E-Motor Corporation, 466 West Superior Street, Chicago, have available literature describing their power-supply devices and B eliminators. This Bulletin includes numerous illustrations, charts, and the like. It is available on request.

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DEJUR-AMSCO BULLETINS

The DeJur-Amsco Corporation, 95 Morton Street, New York City, have available two new and interesting bulletins.

Bulletin No. 36 covers variable condensers. Descriptions, illustrations, technical data, drawings, etc., are included for both direct and gear-driven units. Of special interest are the gear-driven variable condensers with two-speed built-in planetary drive, Series 50, 60 and 70.

Bulletin No. 37 features DeJur-Amsco Remote Controls.

Both of these bulletins are available upon request.

E. S. COLLING TRANSFERRED

Ernest S. Colling, for the last two years with the National Broadcasting Company, was transferred to the Radio Corporation of America, RCA Building, Radio City. He is now in the Department of Information of that company, under Frank Mullen.

Mr. Colling formerly was a feature writer in the NBC press department and was heard on the air frequently in broadcasts of special events.

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LEE ROBINSON WITH STANCOR

Mr. J. Kahn, President of the Standard Transformer Corp., Chicago, has announced the appointment of Lee Robinson, formerly Advertising Manager of *Radio Merchant,* to the office of New York District Manager, with headquarters at 11 East 44 Street, New York City. Mr. Robinson will handle Stancor's eastern affairs.

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I. T. & T. ASSOCIATES SHOW GAIN

The improvement in business conditions in various parts of the world during 1934 was reflected in a net gain of 50,673 telephones by associated companies of the International Telephone and Telegraph Corporation. All telephone companies in the I. T. & T. system had gains for the year. Figures for January, 1935, show that the increase is continuing.

The National Telephone Company of Spain had a net gain of 22,537 telephones last year. Argentina accounted for approximately 10,000. The telephone system of Rumania and the Shanghai Telephone Company gained approximately 5,000 each.

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WILTBANK HEADS SALES FOR EBY

In line with an aggressive program of expansion in the radio parts field, Charles N. Wiltbank has been appointed sales manager of Hugh H. Eby, Inc., 2066 Hunting Park Ave., Philadelphia, Penna. Mr. Wiltbank is well acquainted with both service replacement parts and amateur needs, having been closely associated with radio since the early days of the industry. He has been with the Eby organization for more than a year.

A number of important new Eby parts developments are now in the process of production and will be announced in the near future.

RMA NEWS

(*Continued from page* 23)

because Belgium is an American export market in which no patent restrictions are placed on the sale of radio tubes. Tube purchases by Belgium amount to 10 percent of total American tube exports.

FOREIGN TRADE NOTES

The Austrian Government now requires a special permit for importation of radio, according to a report from Vienna to the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce. A permit is required before even license imports will be cleared by customs authorities; permits also are necessary for domestic production and sale of radio apparatus in Austria.

Ten new radio broadcast stations are projected in Spain and the Spanish Director General of Telecommunication has authorized the opening of bidding for their construction but no detailed sales information is available.

WOMEN REGARD RADIO AS HOME "ESSENTIAL"

Next to the electric iron, a radio set is the most essential of all household electrical appliances, according to a survey among 1,017 housewives in New Jersey in McCall's Magazine. Asked to vote on the "most essential" household electrical equipment, the New Jersey housewives voted as follows: Irons 68.9%; radio 64.4%; vacuum cleaners 63.3%; refrigerators 38%; washing machines 36.3%.

The thousand-odd New Jersey women were found to own 8,882 electrical appliances with homes equipped as follows: Irons 96.5%; radio 95.6%; vacuum cleaners 76%; toasters 73%; clocks 53.5%; waffle irons 51%; refrigerators 44.2%, and washing machines 41%.

Of the 8,882 electrical appliances owned by these families, only 222 or 2.5%, were not in use for various reasons, ranked in order as follows: Heater, perculator, waffle iron, fan, vacuum cleaner, clothes washer, toaster, radio and clock.

AUTO-RADIO MARKET IN FRANCE

Several firms in France are interested in securing American automotive radio which may be laid down in France for approximately $45, according to advices to the RMA from the U. S. Bureau of Foreign & Domestic Commerce. A market exists in France for automotive radio at approximately $45. The average retail prices in France of automobile sets now range between 1200 and 1500 francs, or about $80 to $100. If possible to land automotive sets in France, duty paid, at approximately $45, it is believed that a considerable market for American automotive radio would develop. Manufacturers interested should correspond with Andrew W. Cruse, Chief of the Electrical Division of the U. S. Bureau of Foreign and Domestic Commerce, Washington, D. C.

TENTATIVE PROPOSAL TREATY PROVIDES RADIO REDUCTIONS

Twenty-five percent reduction on radio receiving sets and tubes exported to Brazil is a substantial benefit proposed for the American radio industry under the tentative reciprocal treaty negotiated by the State Department with Brazil. In cooperation with the Bureau of Foreign and Domestic Commerce, Department of Commerce, the radio industry's interests in Brazil and other reciprocal treaty negotiations of the State Department have been represented by the RMA at Washington through Bond Geddes, executive vice-president, general manager.

The trade agreement with Brazil has been approved by the U. S. and Brazilian official representatives. It will not become effective, however, until approved by the Brazilian Congress and will come into force thirty days after ratification by the Government of Brazil and the approval of President Roosevelt.

Light radio apparatus and tubes of American manufacture would be given the twenty-five percent customs reduction under the Brazil trade agreement. Also heavy radio, telephone and telegraph equipment, motion picture films, mechanical refrigerators, agricultural and other machinery would be continued at the present tariff rates. The present favorable Brazilian customs treatment for these heavy commodities would be "bound for the life of the agreement."

NEW PRODUCTS

PERMEABILITY-TUNED IRON-CORE I-F TRANSFORMERS

A new development in intermediate-frequency transformer design is announced by the Electrical Winding Corporation, Radio Coil Manufacturers, of 22-26 Wooster Street, New York City.

In this transformer, which is known as the "Elwin Linoperm," the conventional compression-type mica trimmer condensers are replaced by fixed condensers of special construction. The resonant period of each tuned circuit is adjusted by means of a sliding iron core. This core is said to greatly increase the efficiency of the coil in addition to being the means for adjusting the inductance to resonance.

The fixed mica condensers used in the Elwin Linoperm are not only molded in bakelite, but are also vacuum wax impregnated to minimize moisture absorption and capacity drift. The power factor is low and stays low, while microphonic effects are entirely eliminated, it is stated.

The iron-core tuning arrangement used gives a slow and nearly linear change of frequency with rotation over eight or ten turns of the adjusting screw. Turning the adjusting screw half a turn will change the frequency only two or three kilocycles in 456 kc. This makes exact tuning very easy and small mechanical changes have a negligible frequency-drift effect. This also eliminates any possibility of microphonics, it is said.

The core material used in the Elwin Linoperm is unaffected by moisture or magnetic shock, and since this material is not produced under pressure, it maintains constant permeability indefinitely.

Where the tuning of several sharply-tuned stages have been staggered to secure high fidelity with sharp adjacent-channel selectivity, the permanence of adjustment attainable with the Elwin Linoperm is particularly desirable. it is stated.

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SEMI-AUTOMATIC TRANSMITTER TUNING

In changing transmitter tuning from one wavelength to another it is desirable and necessary to effect the change in the shortest possible time. This is especially true in airway communications where a ground station may be transmitting weather reports on one wavelength, a direction beam on another and talking with pilots aloft on the third. It is also essential that the transmitter be returned to identically the same wavelength each time the same information is again to be broadcast to make it easier for the pilots to tune their receivers. To accomplish semi-automatic tuning of the transmitter the following equipment is used:

A six-position selector switch, mounted on the control panel, provides for selection of any one of five circuits and an off position. Selection of any one circuit may be made from any previous position of the switch without closing any other circuit. A relay is used to connect the transmitter for the desired wavelength. It consists of five independently-operated relays mounted side by side, each one having three normally open poles. The contacts short circuit various sections of the tuning coils and are located as close to the coils as possible to reduce capacity effects and prevent inductive coupling.

Struthers Dunn, Inc., of Philadelphia, Pa., are in position to supply this equipment, and also the solution to most other problems involving relays. Similar equipment may also be had for transport companies, and other radio stations working on several wavelengths. Complete data will be sent on request to the above company.

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"FRONT OF PANEL" SOCKET

The Gates Radio and Supply Company, Quincy, Illinois, announce the introduction of an improved type of L design or, better known, "Front of Panel" socket. These are made for standard tubes as well as for 50-watt type tubes and are of heavy cast

brass with bakelite sockets, or on special order Isolantite sockets may be had.

Finish is in black, baked on to assure a rugged finish that will not chip.

Full details and prices available by writing the above concern.

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STA-WARM IRONS

The Sta-Warm Electric Co., 508 N. Chestnut, Ravenna, Ohio, have available their Sta-Warm Irons in four sizes, ⅜-inch to 1½-inch. These units have a twistlock connection. And, it is stated, that by rotating the tapered copper tip in its special seat, all scales may be ground out to continually maintain maximum heat transference. Further data will be supplied by the above company.

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ALSIMAG PARTS

Alsimag is a ceramic composition of practically pure Steatite. The name is coined from the principal alloying constituents. It was designed for the radio and electrical-apparatus fields because of its characteristics as an insulator body.

Dielectric strength at room temperature is 200 volts per mil in a disc ¼-inch thick. As temperature increases it remains an excellent insulator long after other materials have broken down, it is stated. Dielectric constant is 5.2, power factor .22, and loss factor 1.14.

The manufacturer asserts that in physical strength it is superior to any other ceramic material, having a modulus of rupture as tested on cylinders 1⅛ inches in diameter and 6 inches long of 18,600 pounds per square inch. Porosity test shows less than .02 percent absorption. It has compressive strength of 79,000 pounds to the square inch. Co-efficient of thermal expansion at 20 degrees is 6.37×10^{-6}. A hardness equivalent of 8-8½ makes it exceedingly resistant to wear or abrasion. In the green state the material can be machined by the manufacturer, turned, threaded or shaped in much the same manner as metal and with great accuracy. Tubes or rods are extruded in various shapes and sizes, while other parts are pressed to shape on automatic presses.

Extruded parts at present are limited to 3 inches in diameter and inasmuch as turned parts are made from extruded blanks, these also are limited to that diameter, while length may be considerably more. Pressed parts are limited to about 3 inches in diameter and may be up to 1 inch in thickness.

It is used extensively in electric appliances, especially where heat is a factor, in radio sets and broadcasting equipment and in vacuum tubes for broadcasting use.

Alsimag parts are manufactured by The American Lava Corporation, Chattanooga, Tenn.

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OAK R- AND S-TYPE SWITCHES

Oak Manufacturing Company, 711 West Lake Street, Chicago, Illinois, is introducing additions to its line of rotor switches in the form of compact, single- and double-pole, two-position units. The new switches fill requirements for tone-control applications, phonograph switches, and waveband switches for midget radios.

Retaining the desirable characteristics of the Oak Junior types, the new RG type,

shown, available with grounded common poles, measures only ½" deep from bushing shoulder by 1½" long by 11/16" wide. The R type, of the same dimensions, has the common poles insulated from ground.

The single grounded pole S type is of the same construction and size as the RG type, except for its length which is only 1-1/16".

Three-position units are now being developed.

Standard bushings for both types are ⅜" by ¼" thread length. Standard shafts are ½" diameter by length specified.

The makers invite requests for samples and quotations.

NEW ANTENNA COILS

The problem of the design of a suitable antenna input system to be used in conjunction with the new all-steel top automobiles, is said to have been greatly simplified by the introduction of a new antenna-coil series, employing Aladdin Poly-iron cores, by Aladdin Radio Industries, Inc., 4049 W. Diversey Ave., Chicago, Ill. These units, when installed in turret-top models, make possible reception which is equal to that usually secured in roof-antenna installations, it is said.

By employing Aladdin Poly-iron cores these transformers produce higher gains in the antenna-input systems than can usually be secured with air-core coils. Therefore, they are said to improve the signal-to-noise ratio when employed in roof-antenna receivers, a highly desirable feature in car radios. The selectivity is of course better with these units. Another feature is that they are adaptable to small-sized shield cans.

These units may be supplied to specifications for various antenna capacities either as high- or low-impedance inductive-coupled transformers or as capacity-fed tuned impedances.

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NEW OAK VIBRATORS

The Oak Manufacturing Co., 711 W. Lake St., Chicago, announces a new line of vibrators with numerous features and advancements in design.

The outstanding differences in construction are found in the separate set of driving contacts and in the driving coil, which incorporates a shorted winding for prevention of arcing across the driving contacts. The consequent elimination of wear and oxidation of the driving contacts is said to assure starting under all operating conditions.

Longer use of the power contacts, because of the removal of the driving function from them, greatly increases the useful life of the unit.

The vibrator is available in both synchronous and non-synchronous types, both being only 3-1/16" high by 1¼" in diameter. Standard 4-prong base mounting is used on the non-synchronous and standard 6-prong base mounting on the synchronous type.

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"ORDERING PHONE BOX"

A new current product of the Universal Microphone Co., at Inglewood, Cal., is an "Ordering Phone Box" for use in cafes, restaurants, night clubs and other spots where a remote-control ordering system is used.

The microphone control box is 3½ x 5 x 2 inches, and weighs a pound and a half. It is threaded for standard half-inch pipe conduit.

There is a "press" button for use when speaking. The press-button switch is double-pole, single-throw, for single-button microphones and three-pole, double-throw for two-button microphones. Light signals include the green for "ok" and the red for "in use."

The new Universal device is supplied without wiring, but with two circuit diagrams for any number of stations in either ac or dc operation.

In actual usage, common feeders may be extended any distance, and boxes may be added or deducted on the circuit without disturbing the remaining stations, it is said.

ERIE SUPPRESSORS

The Erie Resistor Corporation, Erie, Pa., has added to its line of suppressors for use in eliminating high-tension ignition interference in auto radios. Known as type A-2, this new midget design takes up but little more space than a standard spark-plug nut and is equally efficient as the large Erie types.

The D-7 distributor-type suppressor was developed with the assistance of a prominent automotive engineer. It has a snap fitting which fits into the distributor head and is so designed that there are no ex-

posed metal parts, making it impossible for arcing to take place between it and the spark plug leads.

The L-2 elbow-type Erie suppressor is

said to have long been a favorite with manufacturers of auto radios.

Research by Erie engineers definitely shows that all suppressors of equal resistance are not necessarily equal in suppression efficiency. Laboratory tests are said to conclusively prove that there is a definite relationship between voltage coefficient and suppression efficiency; suppressors with high-voltage coefficient are correspondingly poor in suppression efficiency. All Erie suppressors have small voltage coefficient—0.55 percent at 20,000 ohms.

Thus with Erie suppressors, maximum efficiency is attained without the necessity of using high resistance values. A recently issued bulletin giving technical data on these suppressors may be had by writing the Erie Resistor Corporation, Erie, Pa.

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GRAPHITE FILMS

Graphite films formed on solids with the aid of concentrated dispersions of colloidal graphite in water (such as Acheson's "Aquadag"), are steadily finding new applications in the electronic field. The adaptability of such films to resistance elements and as ray-focusing anodes in cathode-ray tubes are but two of the well-known applications of this type of product.

The use of graphite films with other electronic devices as shields against glass charging and extraneous high-frequency disturbances also offers possibilities. Two cases, in point, are said to be the Pliotron and its supplementary tube, the Thyratron. The former is a three-element tube used to amplify minute photoelectric currents; while the latter, a mercury-vapor type rectifier, is used wherever adjustable currents require automatic control in response to mechanical movements and electrical functions.

Frequently during experimental work with these types, extraneous fields, due to nearby induction coils or similar apparatus, must be reduced and electric charges collecting on the glass from internal tube operation must be prevented. A solution to these immediate and oftentimes troublesome problems is a grounded graphite film.

To obtain coatings of this kind the glass envelope should first be cleaned with any oxidizing agent like chromic acid, then carefully rinsed and later dried in warm air. A single coating of fairly concentrated colloidal graphite solution can then be applied by means of a soft camel-hair brush.

In order not to cut down appreciably on the heat radiation from the internal electrode structure, this exterior coating might well cover only three-fourths of the tube or be applied with latticed-effect strokes. By fixing a loop or wire or strip of metal about the tube before applying the coating, a good permanent grounding connection can be made.

An additional application of the graphite film is the formation of guard rings on photoelectric cells, evacuated systems, and in other instances where metal rings were used, it is said.

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SHUNTS FOR AUTO-RADIO SERVICING

Recently, the Triplett Electrical Instrument Company, Bluffton, Ohio, announced that the growth in popularity of the auto radio had resulted in a large demand for their Radio Shunts.

Triplett Shunts are designed for severe service and are made from heavy strips of shunt material that are mounted on pin-jack tips, which are plugged directly into tester jacks. Shunts Nos. 1115 and 1215 (capacity, 15 amperes) are used to detect power-pack and vibrator troubles in automobile radio sets. Shunts Nos. 1116 and 1218 (capacity, 30 amperes) are used to set the generator at the correct value in order to prevent the battery running down and the generator burning out when installing auto radios. These units are equipped with binding posts.

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EISLER AIR-OPERATED ELECTRIC SPOT WELDERS

Electric Spot Welders which utilize air pressure for closing the electrodes upon the work have recently been developed by Charles Eisler of the Eisler Engineering Co., 768 So. 13 St., Newark, N. J.

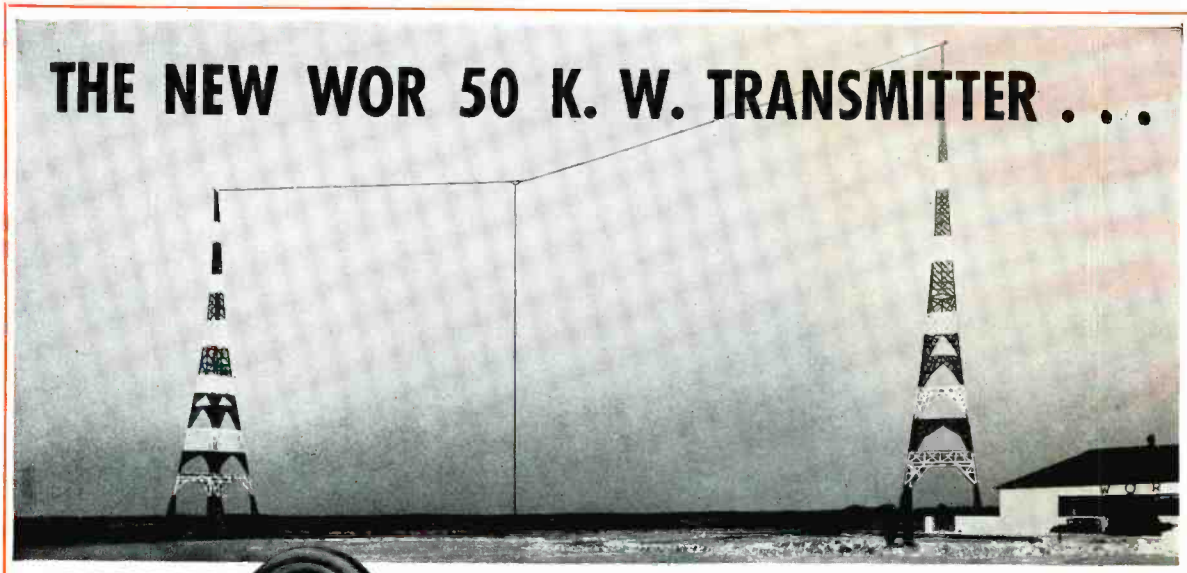
These air-operated types are the latest addition to the line of foot-operated and motor-driven welders manufactured by the above company.

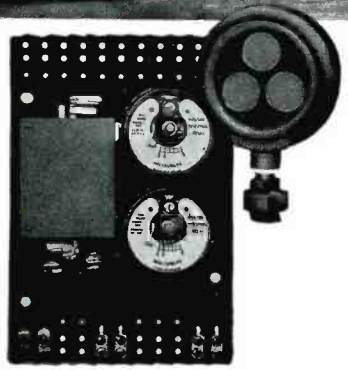
Available in sizes from five to seventy-five kva and capable of welding metals up to .750" in thickness, these new air-operated welders, because of the particular design of the air cylinder, require a very small volume of air for their efficient and economical operation. Air pressures up to 80 pounds are used; the pressure depending upon the size of welder used.

The use of air-operated welders not only relieves the operator of supplying the force to bring the electrodes together, but permits, by means of a regulating valve in the supply line, exact regulation of electrode pressure upon the work, an essential factor for the production of uniform welds.

INDEX TO ADVERTISERS

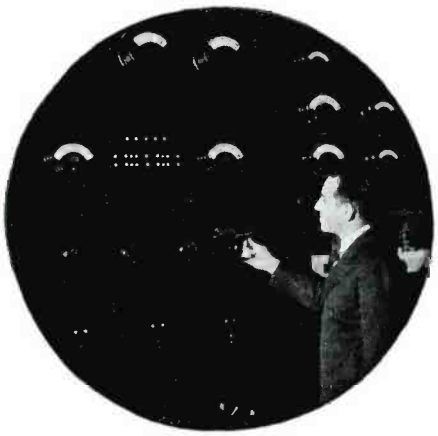
THE NEW WOR 50 K. W. TRANSMITTER . . .



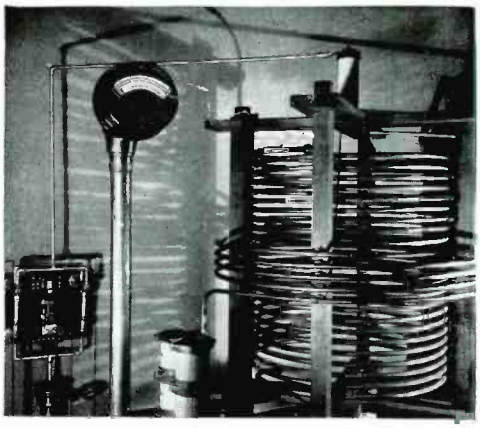


Beacon lights on the towers and station roof of the new WOR station are automatically lighted by a Weston PHOTRONIC Cell whenever the light intensity falls below a point of good visibility, thus protecting against plane mishaps.

Another WESTON *equipped station!*



As in all carefully engineered jobs, standard Weston electrical indicating instruments are used in this new station.



A specially mounted Weston high frequency ammeter measures this new station's high output current as it leaves the transmitter building. At lower left is seen the nitrogen-filled tube through which the concentric transmission line runs underground for 600 feet to the antenna system.

Weston Electrical Instrument Corporation, 612 Frelinghuysen Avenue, Newark, N. J.

WESTON *Instruments*

X-Ray Your Engineering Problems

CATHODE RAY OSCILLOGRAPH

$84.50 With RCA Tubes, Including RCA 906 Cathode Ray Tube

for . . .

- ★ direct monitoring of modulation
- ★ remote monitoring of modulation
- ★ visual alignment of circuits
- ★ examining amplifier phase shift
- ★ detection of wave shape distortion
- ★ study of R-F Voltage wave shapes
- ★ A-F and R-F frequency measurements

Wherever electrical circuits are studied, wherever phenomena can be interpreted electrically, there the RCA Cathode Ray Oscillograph is a valuable aid to the engineer. It is the instrument of a thousand uses. Let us tell you how it can help *you*.

A Complete Instrument . . .

The RCA Cathode Ray Oscillograph, Stock No. 9545, is complete in every essential requirement for immediate use. It includes two power supplies (one for the cathode ray tube and one for the amplifier), vertical and horizontal amplifiers, saw-tooth frequency generator and six tubes, including the RCA 906 Cathode Ray Tube (3-inch).

The Frequency Modulator . . .

The RCA Frequency Modulator, price $27.50, and the RCA Test Oscillator, Type TMV-97-C, are auxiliary instruments for aligning radio circuits with the RCA Oscillograph. The Frequency Modulator is a combined motor-driven capacitor and a-c generator. The Test Oscillator has a range from 90 to 25,000 kc.

SPECIFICATIONS

TUBES—1 RCA 906, 1 RCA 879, 1 RCA 885, 1 RCA 80, 2 RCA 57. Total tubes, 6.

ACCURATE FOCUSSING—Control on panel. Screwdriver adjustments for beam centering.

ILLUMINATION — Brilliant image — may be photographed with ordinary commercial camera.

SENSITIVITY—From 20 to 100,000,000 C.P.S.: 27.0 Volts R.M.S. for 1 inch deflection, 74.0 Volts R.M.S. for full screen image. From 20 to 90,000 C.P.S.: 0.7 Volts R.M.S. for 1 inch deflection, 1.9 volts R.M.S. for full screen deflection.

SWEEP CIRCUIT—Linear "saw-tooth" oscillator, adjustable from 20 to 15,000 cycles, positively synchronized with voltage under test by special circuit. Binding posts also for external synchronization.

AMPLIFIERS—Horizontal and vertical. Linear from 20 to 90,000 cycles ±10%. Amplifier gain is approximately 40.

NEW APPLICATIONS

The RCA Cathode Ray Oscillograph, the X-Ray of the engineer, can be used to interpret any phenomenon which can be represented electrically, as well as for the more common use of examining alternating current wave shapes, phase relations, or any intermittent electrical currents.

New applications of the Cathode Ray Oscillograph are being discovered constantly in the RCA Victor research laboratory. Correspondence regarding your possible use of the RCA Oscillograph is invited.

Write to RCA Parts Division, Camden, N. J., for Instruction Book RE and treatise on Oscillographs

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