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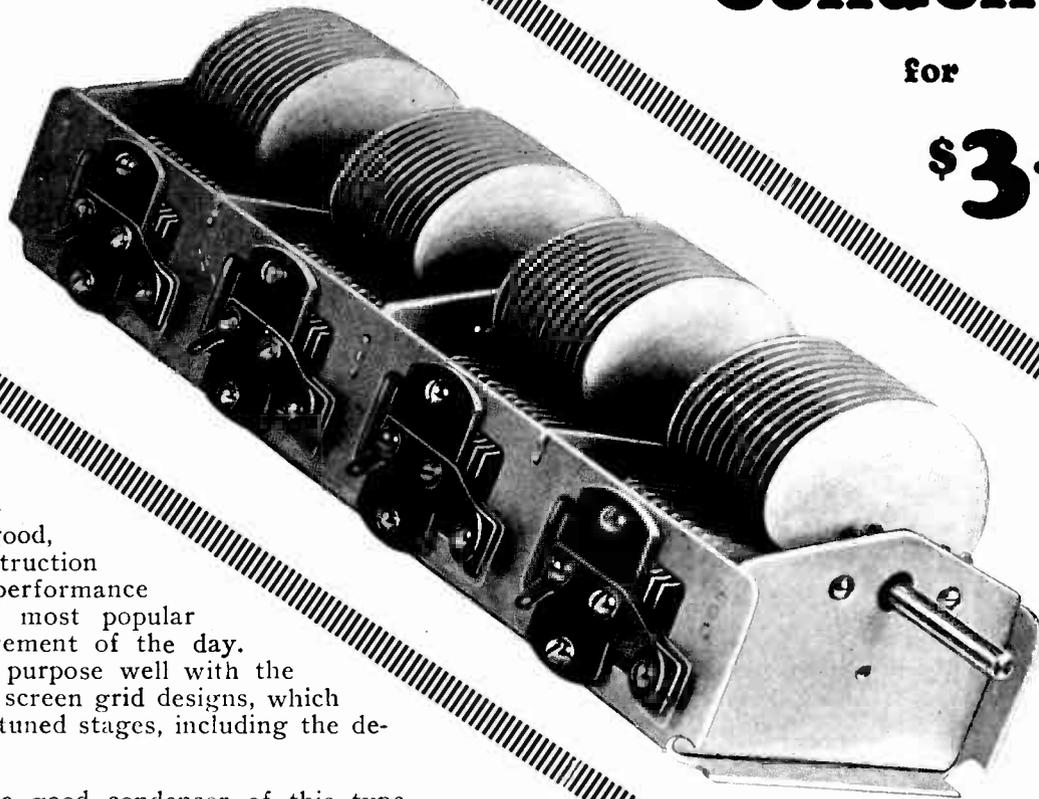
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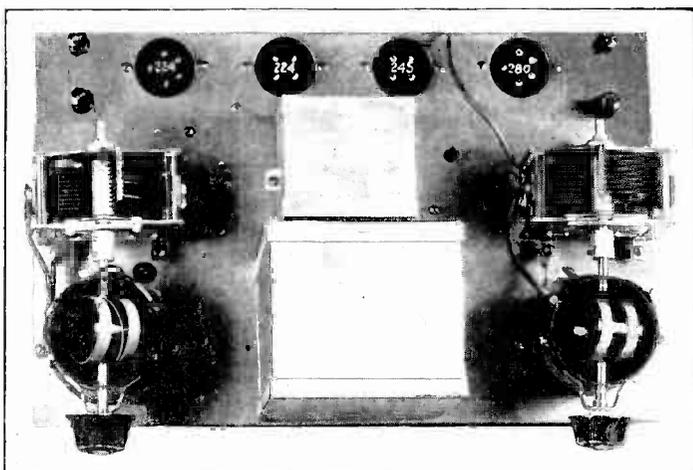
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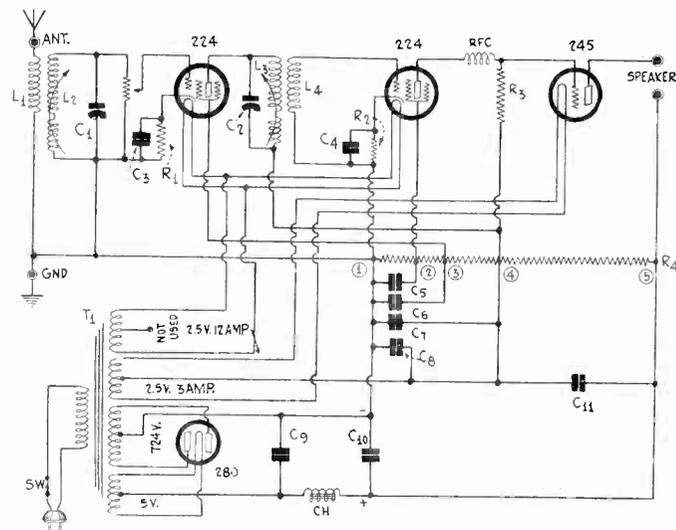
City

State

Non-Reactive Audio with Tuner!



Layout of the NR-4, using a steel chassis, 15" wide x 9 1/4" deep. The volume control (not shown) is at center. For installation dials replace the illustrated knobs.



The NR-4 circuit diagram, with numbers designating voltage divider taps, corresponding to illustration below.

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For non-reactive audio circuits, instead of using variable resistors you may more conveniently use a voltage divider with numerous taps. Used as in the NR-4 it will not get hot—barely tepid after 10 hours continuous operation—because it will stand 125 milliamperes! The conservative rating, actual use, is 50 watts.

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The Multi-Tap Voltage Divider has a total resistance value of 13,850 ohms, in the following steps: 3,000, 4,500, 2,000, 800, 700, 600, 550, 500, 450, 400, 200, 100 and 50 ohms. With the zero voltage lug (at lower left) the total number of useful lugs is fourteen. The resistance stated are those between respective lugs and are to be added together to constitute 13,850 ohms total.

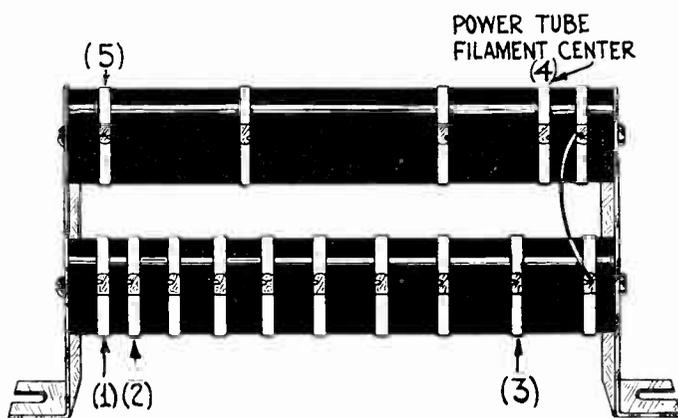
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Order Cat. MTVD at \$3.95.



Multi-Tap Voltage Divider, showing where to connect the leads for plate and screen voltages.

NR-4

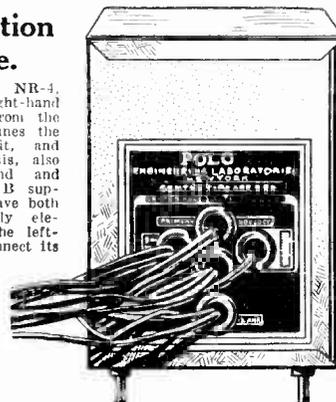
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- C4, C5, C6, C7, C8, C9, C12—Seven 1 mfd. condensers, low voltage..... 3.50
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- Volume Control—One Electrad Tonatrol pot. (500,000 ohms) 1.50
- R1—One Electrad 800 ohm biasing resistor strip20
- R2—One .02 meg. (20,000 ohms) resistor with mounting55
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- RFC—One shielded radio frequency choke, 50 millihenries50
- SW—One pendant AC switch with 12 foot cable 1.12
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- One steel chassis 15" wide by 9 1/4" deep, with sockets affixed 3.50
- Two dials, 100 to 0 1.00
- Insulators (four for subpanel, three for front panel)22

Tubes: Two 224, one 245, one 280..... \$5.27

Construction Advice.

In building the NR-4, insulate the right-hand condenser from the chassis, as it tunes the SG plate circuit, and ground the chassis, also connecting ground and negative of the B supply. Then, to have both condensers equally elevated, insulate the left-hand one, but connect its frame to sub-panel by a lead soldered to a lug fastened to sub-panel.



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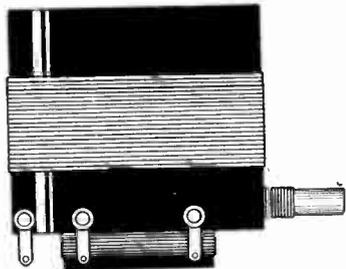
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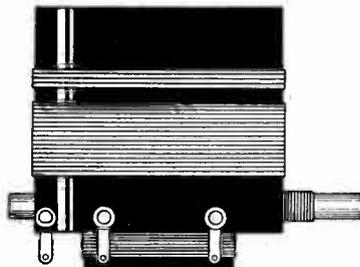
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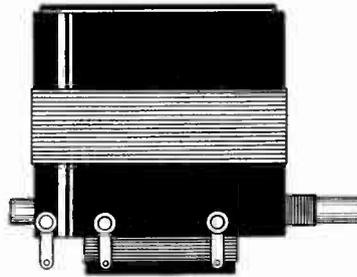
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FOR .0005 MFD. CONDENSER
Moving primary and fixed secondary, for antenna coupling. Serves as volume control.
Cat. No. VA3 for .00035 mfd.\$0.90

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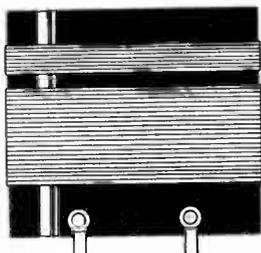
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FOR .0005 MFD. CONDENSERS

Bernard Tuner BT5A for .0005 mfd. for antenna coupling, the primary being fixed and the secondary tuned. This coil is used as input to the first screen grid radio frequency tube. Secondary has moving coil.
Cat. No. BT3A for .00035 mfd. ..\$1.35
Bernard Tuner BT5B for .0005 mfd. for working out of a screen grid tube, tuned primary, untuned secondary. Primary has moving coil.
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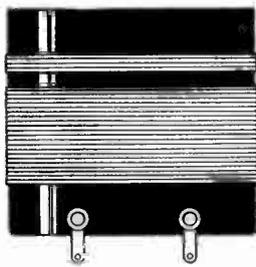


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FOR .0005 MFD. CONDENSER

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FOR .0005 MFD. CONDENSER
Interstage radio frequency transformer, to work out of a screen grid tube, primary untuned.
Cat. No. SGS3 for .00035 mfd.\$0.65



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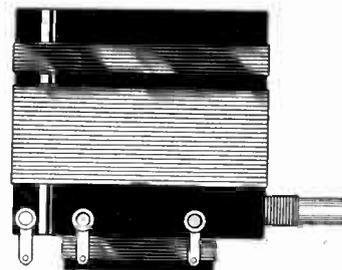
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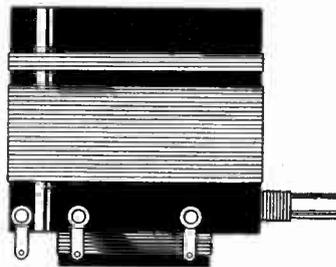
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Order the Diamond Pair, Cat. DP3 for .00035 mfd. at\$1.55
[Note: These same coils are for AC or battery circuit.]

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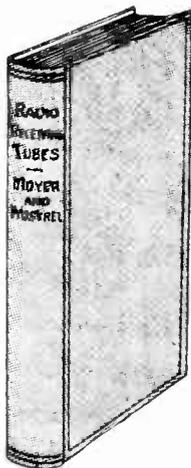


The standard three-circuit tuner is used with primary in the plate circuit of any RF tube, AC or battery type, excepting only screen grid tube.
For .0005 mfd. order T5 at\$0.85
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The coils are wound by machine on a bakelite form, and the tuned windings have identical inductance for a given capacity condenser, i. e., .0005 mfd. or .00035 mfd. Full coverage of the wave band is assured.

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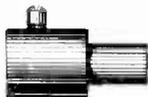
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A Phase Shift Tube

in Non-Reactive Push-Pull Circuit Designs

By *J. E. Anderson*

Technical Editor

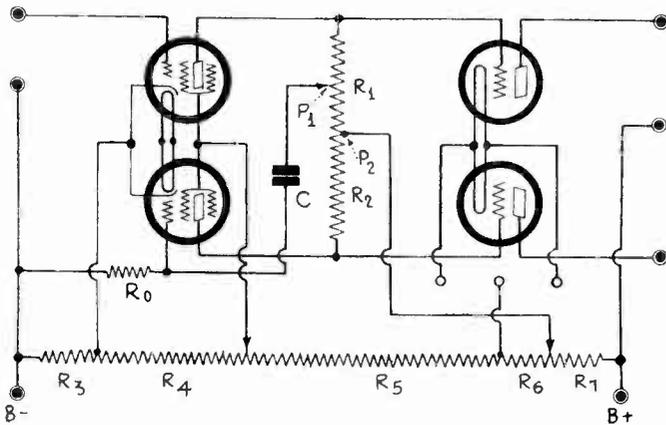


FIG 1

A METHOD OF APPLYING THE PHASE INVERTER TUBE IN THE NON-REACTIVE AMPLIFIER.

THE RENEWED interest in non-reactive amplifiers has revived concern in push-pull amplifiers of the same type, and particularly the method of coupling a single sided amplifier, or detector, to a push-pull amplifier without the use of an input transformer.

A method of effecting this coupling without deadening one side of the amplifier was published in RADIO WORLD October 5th, 1929. In this method the signal from the detector was impressed in the usual manner on a single sided amplifier, but a certain fraction of the output of the first tube was impressed on the grid of a phase inverter tube which then fed into the other side of the push-pull amplifier.

Certain defects in this amplifier were obvious and were emphasized. Due to the presence of stopping condensers the phase of the signal in one side of the amplifier was not exactly 180 degrees different from that of the signal in the other. This lack of true 180 degree phase difference obtained both at the high and at the low ends of the audio frequency scale. However, at both ends the defect was negligible.

PHASE INVERTER IN NON-REACTIVE CIRCUIT

The principle of the phase inverter tube is well suited to the non-reactive amplifiers which are now so popular. In Fig. 1 we show one application of the principle to this type of circuit.

At the outset we should call attention to the fact that the push-pull circuit is not strictly non-reactive because there is a condenser C through which the signal to the phase inverter tube must pass. This condenser, however, will have a negligible effect on the phase relationship between the two sides of the amplifier, as we shall presently see, provided that we choose the constants of C and R_0 suitably.

The input voltage to the phase inverter tube is the signal voltage drop in resistor R_0 , and this is equal to the signal voltage drop in that portion of R_1 which is between the points P1 and P2, provided that C is very large and also provided that the by-passing between P2 and B minus is adequate. Let us

assume that C is not so large that its effect can be neglected and let us also assume that the by-passing between P2 and B minus is satisfactory. Then the voltage drop in LIP_2 is the same as the voltage drop in C and R_0 in series. Any voltage drop in C will be subtracted from the drop in R_0 so that the condenser reduces the input to the phase inverter tube. This reduction could be offset by sliding P1 higher up R_1 but C also introduces a phase shift which cannot be compensated for in this way. Let us see how great the phase shift will be.

AMOUNT OF PHASE SHIFT

Let C have a capacity of one microfarad and let R_0 have a resistance of one megohm. If a generator having a certain electromotive force be substituted for the voltage drop in LIP_2 we have a simple series circuit in which the current will lead the electromotive force by a very small angle. This angle is very nearly equal to the phase shift which will be introduced. Indeed, it will be slightly greater so that if we make this angle small it is certain that the actual phase shift will be still smaller.

The tangent of the phase shift angle is equal to $1/CR_0\omega$, where ω is 6.28 times the frequency of the current involved. Let this frequency be 30 cycles, the lowest frequency it is necessary to consider in an audio amplifier. For higher frequencies the phase shift will be less, as is clear from the fact that ω appears in the denominator of the formula for the tangent of the angle.

Substituting the values for C, R_0 and ω that we have chosen we obtain .0053 for the tangent. But when the tangent is so small it is equal to the angle itself, expressed in natural measure. To convert it to degrees we have only to multiply .0053 by 57.3, the conversion factor between natural measure of angle and degrees. We obtain approximately .3 degree. The phase shift is entirely negligible.

If we choose a smaller condenser or a lower grid leak, or if we choose lower values for both, the phase shift will be greater, but in view of the extremely small shift obtained above we may choose somewhat lower values and still have a shift that is entirely negligible for all essential audio frequencies.

DIFFICULTIES ENCOUNTERED

It would be desirable to eliminate both C and R_0 but as soon as we attempt to do so we immediately encounter voltage difficulties. The grid bias on the phase inverter tube would be too high when P1 is set at the point required to obtain the correct signal voltage on the phase inverter tube. The use of the condenser C, which entails the use of R_0 , is the simplest way of avoiding the difficulty. And since this can be done without introducing any appreciable phase shift there is no objection.

Let us try to determine where the point P1 should be set in order that the signal voltage drops across R_1 and R_2 may be equal. Let us assume that the amplification by each tube is a . Then if the input voltage to the first tube is one volt, the voltage drop across R_1 will be a . It is to be the same across R_2 . Whatever voltages we impress on the phase inverter tube's grid will be a times as great across R_2 . Let LIP_2 be a fraction x of R_1 . Then the voltage drop in LIP_2 will be ax . This voltage is impressed on the grid of the phase inverter tube and is multiplied by a by the tube. Hence the voltage across R_2 will be ax^2 . But this must be equal to a if the voltage drops

Direct Coupled Impedance

Constants Given for the Paris Circuit

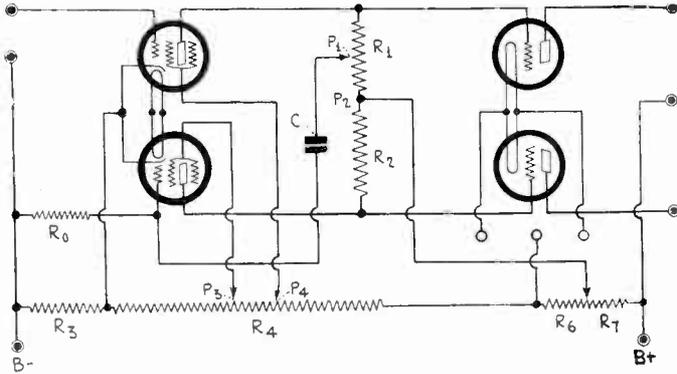


FIG. 2

IF THE TUBES DIFFER IT MAY BE NECESSARY TO ADJUST THE VOLTAGES ON THE TWO SIDES OF THE AMPLIFIER INDEPENDENTLY AS HERE SHOWN. THE GRID AND THE PLATE VOLTAGES MAY BE ADJUSTED SIMILARLY.

in R1 and R2 are to be equal in magnitude. Hence we have the equation $xa^2=a$. Canceling out one of the factors we have the simple equation $xa=1$, or the fraction of R1 used must numerically equal to the reciprocal of the amplification of either tube. We arrive at the same result even when the amplifications by the two tubes are not the same. In that case the fraction of R1 used should be equal to the reciprocal of the amplification in the phase inverter tube.

RESISTANCE VALUE OF P1P2

Therefore if we know the voltage amplification of the phase inverter tube we can determine the resistance that should be included between P1 and P2 as a fraction of the resistance R1. Let us assume the amplification of the tube is 60 and that R1 is equal to one megohm. We found above that the fraction of R1 used should be the reciprocal of the amplification. Hence P1P2 should be $1,000,000/60$, or 16,667 ohms.

It may be that the phase inverter tube is of the 227 type, when the amplification at most will be 7.5. If the value of R1 is still one megohm the portion included between P1 and P2 should be 133,333 ohms. In any practical case the point P1 can best be found experimentally, the calculated values serving only as guides in selecting the approximate values. One way of determining when the magnitudes of the two outputs are equal is to connect the input of an amplifier across R6 through a condenser and grid leak and then adjusting P1 until the sound in the output of this amplifier tube is zero or minimum. The coupling should be effected so that there is no change in the direct current flowing through R6, and of course, the A, B and C voltages for this test amplifier should be independent of those used in the amplifier under adjustment. If there is a by-pass condenser across R6—and there should be one—it should be removed while the adjustment is made.

VALUES OF RESISTORS IN VOLTAGE DIVIDER

We have already specified suitable values for R0, R1 and R3. It remains to give the values for the resistors in the voltage divider. To do this we have to know what tubes are to be used in the circuit. Let the first two be 224s and let the power tubes be 245s. Let us suppose that the available voltage is 400 volts. We can arbitrarily choose the sum of R6 and R7 to be 25,000 ohms. Then the steady plate current in resistors R3, R4 and R5 will be about 72 milliamperes. While this current will not flow through all the resistors it is close enough for practical purposes.

In R3 we wish a voltage drop of 1.5 volts. Therefore R3 should have a resistance of 20.8 ohms. Call it 20 ohms for short. If the sum of R4 and R5 is 2,000 ohms the drop in these two will be 144 volts. This is not high enough for the plates of the screen grid tubes but the drop in R6 adds considerably to this plate voltage.

PRACTICAL SUGGESTIONS

Since the circuit is critical with respect to voltage, two variables are provided on the voltage divider, one on the potentiometer R4R5 for the screen voltage and another on the potentiometer R6R7 for the plate voltage. These two controls are necessary in order to get the correct bias on the power tube and at the same time the proper adjustment of the plate and screen voltages for the screen grid tubes.

It is desirable that the applied plate voltage on the screen grid

tubes be as high as practicable because as the applied voltage is increased the possible amplification is greater. While it is possible to get the screen grid tubes into working adjustment for any applied voltage by merely adjusting the screen voltage, not the same degree of amplification is attainable when both the plate and screen voltages are low. The applied plate voltage is increased by moving the slider on R6R7 toward the positive. This change increases the plate current through the coupling resistors and hence the bias on the power tubes. This increase in the bias permits a still greater increase in the applied plate voltage, indeed requires it. For any setting of the screen voltage there is one setting of the slider on R6R7 which gives the proper bias on the power tubes. The proper bias can be judged by measuring the plate current in either power tube, which should be 32 milliamperes when the plate voltage on those tubes is 250 volts.

If the first adjustment gives satisfactory amplification as judged by quality rather than by volume, well and good. If not, it will be necessary to readjust the screen grid voltage, usually downward. It should be remembered that if the rated values of applied plate and effective screen voltages are used the circuit will not work at all. The screen grid voltage must be much less than rated value because the required screen voltage depends on the net voltage on the plate, which may be very small in view of the high drop in the coupling resistors.

INDEPENDENT ADJUSTMENTS OF VOLTAGES

It may be necessary to adjust some of the voltages independently of the other because of differences in the tubes. The screen voltages may be so adjusted as shown in Fig. 2. The screen returns are brought independently to the voltage divider. In the same way the grid voltages on the first two tubes may be adjusted independently by returning R0 to a separate point on R3, or by cutting the cathode connection and returning the cathodes of the two tubes to different points on R3 or R4. Likewise the plate voltages may be adjusted separately by cutting the junction of R1 and R2 and bringing these resistors to different points on R6 and R6.

IMPEDANCE COUPLED CIRCUITS

Impedance coupled circuits have never been very popular, either with manufacturers or with fans. Yet these circuits possess many outstanding advantages, especially when the blocking condensers are omitted between successive tubes. Such circuits are much more easily adjusted than circuits in which the coupling is by means of pure resistance.

One advantage of impedance is that it is possible to get a greater amplification with a given tube than is possible with resistance coupling. And the amplification does not depend so much on frequency as might be supposed. It is true that the amplification falls off a little at the low frequencies but this is often an advantage. It is especially advantageous that there is practically no DC amplification.

As an illustration of what frequency distortion may be expected let us assume constants for the coupling impedances. Let the inductance of the choke be 100 henries, and this is a low value as coupling chokes go. At 30 cycles per second, which ought to be the lowest frequency that any one should expect in a broadcast receiver, the impedance of a 100-henry choke is about 18,900 ohms. If, then, the internal plate resistance of the tube is 10,000 ohms and the amplification constant of the tube is 8, the voltage amplification will be 7.1 approximately. The voltage at any frequency cannot be greater than 8 so there can not be any appreciable frequency distortion. If we make the coupling inductance 1,000 henries the amplification even at 30 cycles is practically 8, and 1,000-henry chokes can be obtained very easily. The secondaries of many coupling transformers have this inductance.

There will be a slight reduction in the amplification at the high frequencies due to the capacity across the winding of the inductance coil, but if the coil is properly wound this will not be serious.

DESIGN CONSTANTS OF CIRCUIT

The design of an impedance coupled circuit without the use of stopping condensers is not much different from the design of non-reactive circuits, except that it is simpler. Let us start with the power tube and let this be a 171A. The voltage on the plate of this tube should be 180 volts, which should be the drop in resistance R4, Fig. 3. Let R4 be a 20,000 ohm resistance. The current through it will then be 9 milliamperes. The current in the power tube will be 20 milliamperes when the grid bias is adjusted properly. Hence the current to the left of the center tap of the power tube filament will be 29 milliamperes.

Let us suppose that the choke coil Ch2 has a DC resistance of 5,000 ohms and that the current will be .004 milliamperes.

AF, Single and Push-Pull

and Voltage Adjustments Analyzed

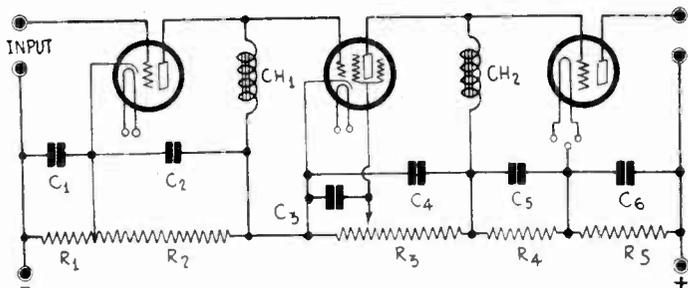


FIG. 3

AN AMPLIFIER WITHOUT STOPPING CONDENSERS USING IMPEDANCE INSTEAD OF RESISTANCES IS SIMPLE TO ADJUST AND IS CAPABLE OF EXCELLENT QUALITY.

The drop in the choke will be 20 volts, but since the tube should have a bias of 40 volts the return of Ch2 should be made to a point of R3 20 volts to the left of the center tap of the power tube, or 690 ohms to the left, since the current is 29 milliamperes.

In the left portion of R3 the voltage drop should be 180 volts and the current will be, in the major portion, 25 milliamperes. Hence the left portion of R3 should have a resistance of 7,200 ohms. The screen should be connected to the point which gives best amplification, which can be found experimentally if a slider is provided for the return of the screen. The screen voltage should be something less than 75 volts. So far we have used up a voltage of 380 volts, 180 volts for the plates of each of the tubes and 20 volts for part of the bias on the power tube.

ADJUSTMENTS CONTINUED

Now the bias on the screen grid tube should be 1.5 volts or somewhat higher. The only provision made for bias is the DC drop in the choke Ch1. We have to guard against getting a too high drop in the choke.

The signal level in the first tube is so small that we need not provide a plate voltage higher than 45 volts. If the bias on the grid of the first tube is 1.5 volts, which is large enough, the plate current with 45 volts on the plate will be 2.5 milliamperes. If then the bias on the second tube is to be 1.5 volts the DC resistance of Ch1 should be 600 ohms. This comes within the limits of the primary of ordinary audio transformers. Since a bias of 3 volts is all right on the screen grid tube it would be feasible to use a choke having a resistance as high as 1,200 ohms.

It is recommended that for Ch1 the primary of a good low ratio transformer be used and for Ch2 the secondary of another good transformer. In each case the winding not used should be left open.

Through the resistance R2 the current will be the 29 milliamperes we started with less the plate current of the first tube, that is 26.5 milliamperes. Since the drop in R2 is to be 45 volts the resistance should be 1,700 ohms. R1 will carry 29 milliamperes and since the drop in it is to be 1.5 volts the resistance should be 51.7 ohms. A 75 ohm rheostat is recommended.

VARIATIONS PERMISSIBLE

It is not necessary to adhere closely to the values given above. Wide variations in nearly all the resistances are permissible. By means of a variable R1 it is possible to adjust the grid bias on the second tube to the correct value, and by means of the slider on R3 it is possible to adjust that on the power tube. Both of these variations vary the plate currents and hence the grid bias.

The total voltage called for in this circuit is 426.5 volts. This is much higher than most B supply units give, except those designed for 250 and 210 tubes. But the circuit will work well even if the total voltage is considerably less. B supply units designed for 245 tubes in push-pull will have a voltage around 300 on full load. When the load is reduced to the value re-

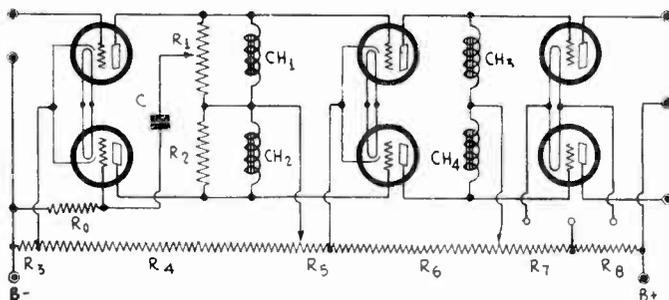


FIG. 4

THE PHASE INVERTER TUBE CAN BE APPLIED TO AN IMPEDANCE COUPLED CIRCUIT AS ILLUSTRATED HERE ALTHOUGH IT IS PREFERABLE TO USE NON-REACTIVE COUPLING IN THE FIRST STAGE.

quired in this circuit the voltage will be around 350 volts. This is high enough to make the circuit operative. The resistances in the voltage divider will have practically the same values as those given for the higher voltages. Any adjustments necessary can be done with the two variables provided.

AMPLIFICATION ATTAINABLE

The voltage amplification that can be expected with this circuit is of the order of 1000. This is much higher than the amplifications ordinarily met in audio circuits. Most of the amplification, of course, is contributed by the screen grid tube.

The phase inverter tube could be applied to the reactive circuit in a manner shown in Fig. 4. In order to tap the voltage on Ch1 it is necessary to connect a high resistance potentiometer R1 across the choke for the grid connection of the inverter tube. To make the two plate circuits equal it is also necessary to connect a resistance R2 of equal value across Ch2. This circuit, however, is not recommended because the phase shift will not be 180 degrees and hence the signals in the two sides will not bear the correct phase relation. It would be better to leave out the first two choke coils and use impedance coupling ahead of the output stage.

When the first two chokes are left out it may become necessary to return the plates of the first tubes to a point on resistor R6 in order to get a sufficiently low bias on the middle tubes.

"Sun" Section Started Something

THE direct coupled audio amplifier circuits, two-tube and three-tube design, have evoked a response from the circuit-building public reminiscent of the building fervor of five and six years ago. Certainly in the last three years nothing has awakened such an intense interest.

While direct coupled amplifiers have been published in previous years, they were not popularized until the New York "Sun" Radio Section, of which E. L. Bragdon is editor, published in December, 1929, issues not only theoretical data, but constants. The articles were written by R. P. Clarkson.

Almost immediately on the appearance of the first issue on the news-stands, radio stores in Cortlandt Street and elsewhere, including out-of-town, were besieged for parts for the circuits, and it was not long before parts manufacturers were eagerly preparing units for the non-reactive amplifiers designed by Loftin and White, which were the basis of Mr. Clarkson's articles.

The data on constants for circuits published in RADIO WORLD issue of January 18th, were the same as those published by the "Sun" Radio Section on December 14th, having been arrived at by development work on the part of the "Sun" Radio Section, an acknowledgement it is a pleasure to make. Figs. 2 and 3 of the Loftin-White article in our January 18th issue are meant particularly.

In other instances the "Sun" Radio Section has showed marked priority, as in the instance of the exposition of beat note detection on which some recent patents were based. Quotations in the "Sun" article by Mr. Clarkson in the November 30th issue appeared in the beat note detection article in our December 14th issue.

Mr. Clarkson and the "Sun" Radio Section have been more than generous to RADIO WORLD. When the Infradyne was being exploited as a new circuit he published the fact that the same reception system had been revealed in RADIO WORLD in 1924. RADIO WORLD proudly republished this statement and felt toward Mr. Clarkson and the "Sun" Radio Section a gratitude that has not yet expired.

Special Non-Reaction Service

IF you have any questions to ask about non-reactive circuits, or are experiencing trouble with any you built, address your questions to Non-Reactive Editor, RADIO WORLD, 145 West 45th Street, N. Y. City. You will get some reaction.

Questions on what parts you have, that can be used, will be answered gladly. Tabulate questions so answers can be written next to them.

active Experimenting

Present—Highly Selective Tuner Discussed

Bernard

frequency amplification, but at with much less selectivity. And what the informed circuit-builder desires is selectivity, as he finds few opportunities to achieve enough of it to render the sensitivity of a receiver practical in the demonstration of distant reception without interference.

I built this circuit by making changes in a model 5A Balkite receiver. This was a Neutrodyne, using three stages of tuned RF, tuned detector input, a stage transformer first audio, all 227 tubes, and a push-pull output, 112As, with 280 rectifier. The output voltage was about 150, but this was not enough for the intended single 245 output, hence the full-wave rectifier was converted to a half-wave rectifier. The 5 volts for the 112A tubes were reduced to 2½ volts for the 245 by a filament resistor marked 1 ohm, but actually a little higher in resistance value, as most of the so-called 1-ohm filament resistors are, since the resultant voltage was 2½ at 1.5 amperes.

RESISTANCE VALUES IMPORTANT

The physical layout was such that it was easy to incorporate the 1 mfd. high voltage filter condenser, the voltage divider, some low-voltage by-pass condensers and, by reason of the gained socket at the audio output, even a Mershon condenser. On the radio side, the conversion to screen grid tubes was easy. One socket, the former first audio, was unused, except to house a spare tube.

The Neutrodyne coils were used, without neutralization. The Neutrodyne was more sensitive than the illustrated circuit, but not as selective. It picked up WTAM on an 18-inch aerial without ground. The present circuit had a 100-ft. aerial, with ground.

The 20-ohm potentiometer was moved over to the filament of the power tube instead of being across the filament of the heater type tubes, but this was experimental and not found imperative.

In the newly included non-reactive audio amplifier the resistance values are very important, especially for the screen grid of the detector tube (second tube from right in diagram) in relationship to the detector biasing resistor marked 20,000 ohms. The total resistance across the divider was 13,850 ohms, and the voltage was 300, due to doubling when half wave rectification was used and the high voltage center tap ignored.

RESISTORS IDENTIFIED

The division of these resistance values is designated on the diagram: 1,200, 500, 2,650, 2,000 and 7,500 ohms. These values are obtained directly from taps on a Multi-Tap Voltage Divider. The unit is in two series-connected parts. Counting the zero lug as number 1, this goes to negative of the B supply and ground and must be connected as stated, since the brackets are not connected to the resistance element. Including the first tap in the count, the sixth one goes to detector screen grid, the seventh to RF screen grids, the twelfth to power tube filament center, the thirteenth to detector plate and the fifteenth to the plate of the power tube. In determining the twelfth tap, etc., include the two interconnected taps, where the series joint is effected, as two taps, not as one.

The bias on the detector tube may be obtained through 20,000 ohms, as shown, but another way is open. The voltage divider's third tap from zero may be used as the cathode connection. This puts only 150 ohms in the bias section for the detector tube, hence lowers the impedance considerably, which is in the right direction, and affords a bias of about 7 volts negative, as the total current through this part is the sum of all plate and screen grid currents, as well as bleeder current through the resistor, the total being about 50 milliamperes. It varies, as will be explained.

AUTOMATIC VOLUME CONTROL

It is recommended that the 20,000 ohm resistor be used. Then, to try the other method, simply connect cathode of the detector to the third tap as described, leaving the 20,000 ohms also in circuit, as the 150 ohm section on the voltage divider will short this out automatically.

The circuit behaves very much differently now. Whereas formerly tuning in and out would produce small effect on a milliammeter and a voltmeter that measure the power tube's plate current and the effective voltage on the plate, now, with the voltage divider furnishing the detector bias, the changes on both meters are large. As much as 40 volts of change will be registered, and 10 or more milliamperes of current, the two in opposite directions. Hence either meter may be used as a resonance indicator.

But the substantial and indeed remarkable change in the circuit when the detector biasing is obtained from the voltage

divider is that the volume control becomes automatic. It is then you tune in the loudest station and note the readings. Those obtained were 200 volts and 25 milliamperes, indicating a negative bias on the 245 tube of about 43 volts.

GOOD OPERATING POINT

While the tube was worked at less than the rated voltage of 250 volts, the bias was less accordingly, and a correct point was reached, although one entailing a little reduction in maximum undistorted power output. But since the maximum undistorted power output under operating conditions is far in excess of what the power tube would be called upon to handle, not only is there no objection to working the 245 tube at that point, but doing so serves the interests of excellent operation throughout the remainder of the receiver.

The establishment of the correct operating point for the general utility of the circuit, with detector bias obtained from the voltage divider, makes all the modulated current flow through the detector biasing section. Hence the loudest station will establish the voltage and current at the power tube as stated, due largely to the voltage drop across the 1 meg. plate resistor.

BIAS SITUATION

The greater the signal amplitude, the greater the drop, hence as the bias for the last tube arises from the drop in this resistor common to detector plate and power tube grid circuits, only the strongest receivable station establishes the values of 200 volts and 25 milliamperes. Approximately these values will prevail in all duplicates, or, to make them prevail if for any reason the use of the voltage divider for detector biasing introduces a change, move the detector screen grid connection lower down, toward zero.

Now, suppose a weaker station is tuned in. The plate current in the 1 meg. resistor is pulsating at audio frequencies, but the amount of current and the amplitude are reduced. Negative bias detection is used. This modulates upward. The greater the signal level, the greater the plate current, both the steady plate current and the amplitude, hence at lesser signal values there is less current of both types.

PLATE RESISTANCE LOWERED

When the current is less, and the resultant drop is less, the power tube bias is decreased. If the plate voltage remained constant we could compute the current readily enough, but as the power tube plate current increases on weaker signals, the plate voltage decreases. The lowered bias decreases the plate resistance. So the weaker signals get the benefit, which in this case is comparative.

This proportioning of bias on the basis of amplitude of modulated current is the basis of nearly all automatic volume controls. It is true, of course, that no station will come in louder than the one that has the greatest strength at the antenna, and also that the weaker stations will not be built up sufficiently to make their volume equal to that of the strongest, but it is indeed true that any predetermined volume level will not be exceeded.

RELATIVE EVENING-UP

Therefore the loudest receivable station can be assigned a suitable volume level. You can tune from local to local without any sudden blasting or roaring-in of tremendous locals, or can pick up distance in between locals, with distant stations much louder by comparison, due indeed to the brakes put on the loudest station, where you have volume to spare and may well devote some of it to automatic volume control service.

All automatic volume controls do their work relatively. There is no absolute levelling. But the advantage is one to be appreciated through experience. The level may be made a fixed value or may be varied as you prefer, the panel control being a variable antenna series condenser (.00025 mfd. or higher), or a 0-500,000 ohm potentiometer in the grid circuit of the first radio frequency tube, as in the NR-4 described last week.

It is only because of the high level of the variations that the automatic volume control advantage arises. There is no such advantage when the 20,000 ohm resistor is used, because the current through it is so small, less than one milliampere, which included both detector plate current and screen grid circuit.

OPPOSITE PHASES

The screen current, despite no load on the screen, is modulated, due to the effect of the plate on the screen, but through

Relativity of Hum

Good Filtration Does Not Increase it Comparatively

the 20,000 ohm resistor alone there is a strong opposition of the phases of the plate and screen voltages, and they tend to cancel each other, hence this resistor alone would not serve automatic volume control purposes.

In other circuits using non-reactive audio, where only a tuner is shown, less any accompanying radio frequency amplifying tube, or where only one such amplifier tube is used, as in the NR-4, the total current is so small through the rectifier that small capacities may be used for filtration, and satisfactory results attained. But here the tuner draws some 15 milliamperes, the detector, a detoured 1 milliamperes, and the power tube 25 milliamperes at the heaviest signal load, or a total of 40 milliamperes, subject to increase to around 50 milliamperes if the unsteadied method of detector bias is used. Some 50 milliamperes constitute relatively small current, as we understand current values in these days of heavy duty power amplifiers, nevertheless 50 milliamperes require more capacity filtration.

IMPROVED FIDELITY

Indeed, the performance of the present receiver, as to its audio frequency response, was greatly improved when high filter and bypass capacities were used. Note that 18 mfd. were placed across the output as reservoir capacity. Another 18 mfd. was used from power tube center tap to ground. Of two remaining 8s in a Q 2-8, 2-18 Mershon, one was used across the detector biasing section—no matter how this bias is obtained—and the other from detector screen grid to ground.

The high capacity across the detector biasing resistor is excellent when 20,000 ohms is used, and even when this is shorted out by 150 ohms as described, the condenser is strongly effective, at least on the radio frequency component, although across 150 ohms 8 mfd. mean little at audio frequencies.

WOULDN'T WORK ONE WAY

A most important condenser is one shown from maximum positive voltage to detector plate voltage point. In fact, no signals were heard when this was omitted, and the constants used as shown, although some juggling of connections would bring in signals. The phase opposition avoided by this condenser makes the circuit operative even while the high capacities are across the points stated. Removal of the high capacity from the reservoir position would dispense with the need for this 1 mfd. low voltage condenser from detector B plus to power tube B plus, but it is desirable, indeed, to include the high capacity.

Even with low capacity, the circuit reproduces well. But when you connect the high capacities, then it reproduces not merely well but entrancingly.

The test I made as to tone quality devolves about three announcers, and it is my favorite test.

You know how deceptive the human ear is, and how little a person should rely on it to sustain disputes with meters and oscillographs. Relative intensities and frequencies fool many ears. But my test, while not wholly scientific, happens to be one that has jibed with metered tests so well in the past, that I rely on it when meters are not handy.

AN UNUSUAL TEST

I personally know three announcers—Graham McNamee, of the National Broadcasting Company; Floyd Neale, of the WOR, and David Ross of the Columbia Broadcasting System (WABC), although when I knew Ross we called him Rosenthal, for the three years I was broadcasting radio technique from WGBS, New York City. I know their voices from personal association, especially Neale's do I know very well, and the shadings, inflections and personal intonations that characterize these voices are part of my assets. These delicacies of speaking are often missed in radio reproduction, due to defects in tuners and audio amplifiers or even in power supplies, but when I get the firm impression of Neale or McNamee or Ross standing right before me, talking to me, with all the distinguishing attributes present that I am familiar with in personal contact, then I know the reproduction is about as good as I can expect.

"That's Neale—his living voice," is the impression that thrills me.

Music may be used as a subsequent test, and it will confirm the previous finding, every time, and so will a performance curve as run in laboratories.

MADE A DIFFERENCE

Well, with the present receiver, my three announcer friends were right there in the room with me, and I was altogether delighted. My instincts of delight are very slow to rise on the subject of tone quality, I believe.

You could remove the 18 mfd. at the end of the filter and notice the difference, particularly at the extremes—the hissing sounds were duller and the bass was weaker. But restore the condenser and the sibilants were sharp, as they are at the microphone, the flute and piccolo were just as true in their reproduction as were the bass viol and the organ at the lowest reproducible note. Indeed, the lowest organ notes were intense, an unfamiliar situation, and agitated the loudspeaker in a most pronounced way, straining it, since all speakers are sluggish in this region, and behave perhaps like one shocked, when subjected to serious movement of the diaphragm in this low region, where they had not been disturbed so much at any previous time.

Hum may be kept low, so that when no signal is tuned in, some one can poke his ear at the speaker and candidly say that he hears no hum. Yes, there is a rushing sound, a little different than that familiar in battery operated receivers, but no hum as considerate folk know that word. Then when the large condensers are used in this receiver, the hum is greater when no signal is on.

WHEN IS HUM GREATER?

This proves one thing: the low-note reproduction has been improved. Hum is a low frequency, usually 120 cycles being stronger.

But hum should be considered comparatively. When hum is what is called absent at no-signal, it is really present to a small extent. When the music is tuned in the result is what it is. Then include the large capacities. The volume increases considerably, and this is most noticeable at the low frequencies, although present at all reproducible audio frequencies. The greater volume is applied equally to hum and music, so that we have no more relative hum than before, only larger response as to both.

Aiding in this low-note development is the capacity from detector B plus to ground, as this bypasses power tube plate current as well.

Feedback effects are present in the audio amplifier and detector, and their study is interesting indeed, but is a special branch not within the intention of the present article.

As for the detector bypass condenser from plate to ground or plate to cathode, found in many circuits, this reduces hum in the present instance, but at the expense of volume—that is, it reduces both equally, and who wants to do that? The usual capacity of condenser from plate resistor to cathode or ground serves as a serious short circuit to 1 meg. For .00025 mfd. from plate to ground, at 1,000 cycles, the response is reduced 50 per cent.

There is no suitable point to which to connect such a condenser without this short-circuiting effect or the introduction of reverse feedback that has equally disastrous consequences. So don't put it in.

Other hum-bucking devices may be tried, and while they work, some of them do not work the way desired. What one hopes for is a hum-bucker that not only eliminates the hum, but which boosts the response. Negative feedback for hum-reduction, from cathode through a condenser to a point on the voltage divider obtained through a potentiometer arm, is negative feedback for all other purposes, and with the familiar consequences of reduced amplification and, at audio frequencies, possible discrimination against all but the middle register of frequencies.

FILTER WISELY AND WELL

As the feedback starts at zero angle, it is made negative at a critical point by this potentiometer device, and becomes effective as a hum-reducer, indeed, all-around amplification reducer, and then, if the arm is turned too far, it reaches a positive region again, and fast becomes so much positive that severe motorboating results. Nevertheless the device can be used effectively, but not impartially.

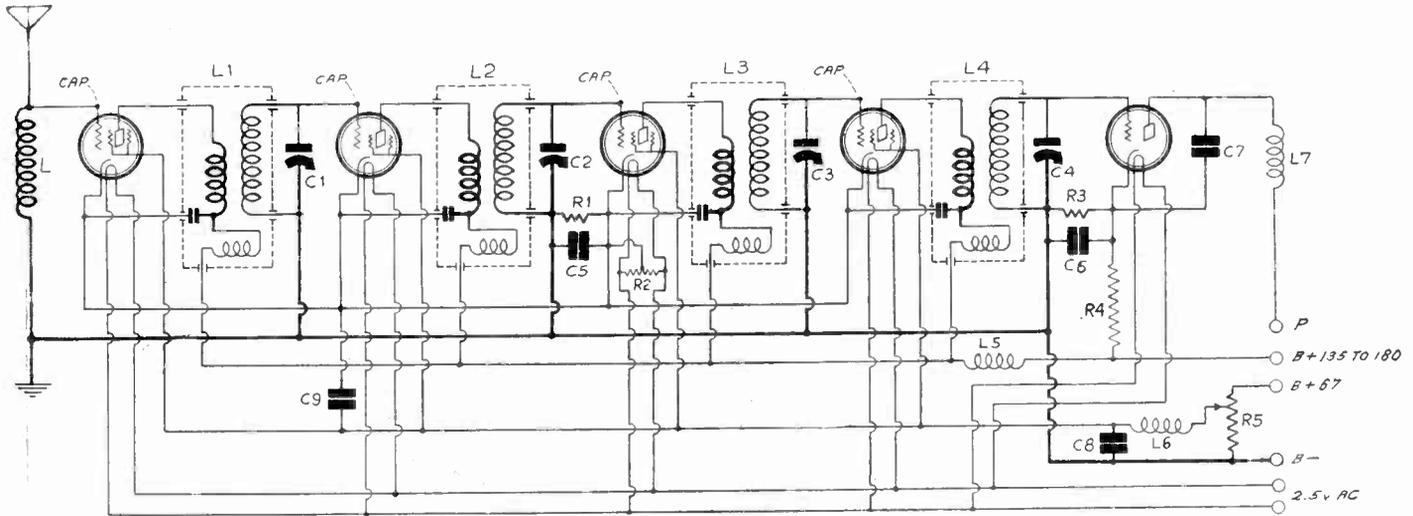
There is no known substitute for adequate filtration that really does more than disguise the hum by adversely affecting the circuit performance. All true-tone audio amplifiers of the AC type hum somewhat, but the ripple is not enough, even in very good ones, to cause any annoyance, hence scientifically acceptable methods involving more elaborate but non-discriminatory bucking systems are not in vogue.

CONSTANTS AUGMENTED

As for the circuit constants, the essentials are stated on diagram. The four-gang condenser may be .00035 mfd. in each section, and primaries have a ratio to secondaries not exceeding 1-to-3. For 1¼" diameters the secondaries may consist of 90 turns of No. 28 enamelled wire, and the primaries 25 turns.

Right or Wrong?

See If You Can Answer These Questions Correctly



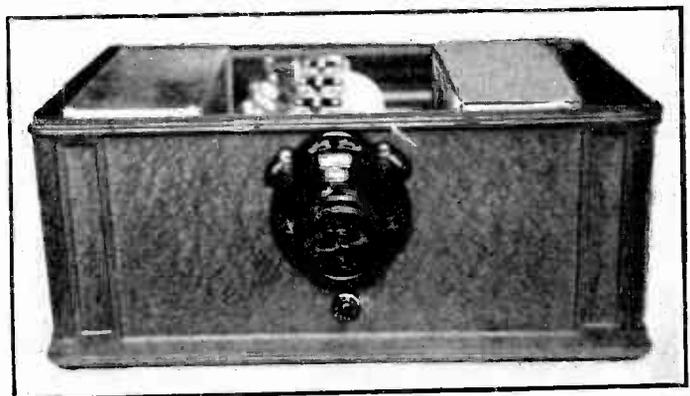
SOMETIMES HUM IS REDUCED IN THE MB-29 BY CONNECTING THE MID-TAP OF R₂ TO GROUND INSTEAD OF TO THE CATHODE.

- (1)—A good way of controlling the volume in an on-reactive amplifier is to use a half megohm potentiometer across the first tuned circuit and connect the grid of the following tube to the slider.
- (2)—One reason small condensers and chokes may be used in the B supply for a non-reactive amplifier is that the current drawn is comparatively small.
- (3)—A non-reactive amplifier cannot be used with a 210 power tube because the plate current would be excessive.
- (4)—A condenser of given value is just as effective across a low resistance as across a high resistance.
- (5)—The Arnold Direct coupled amplifier works only with DC tubes.
- (6)—The Hartley regenerative, non-reactive amplifier regenerates for the same reason and in the same manner as an ordinary resistance coupled amplifier motorboats.
- (7)—The Morgan non-reactive amplifier does not work unless storage batteries are used throughout the circuit.
- (8)—The Johnston non-reactive amplifier is entirely different in principle from the Loftin-White circuit.
- (9)—A three-tube Loftin-White circuit is no more difficult to adjust than a two-tube circuit.
- (10)—If there is no adequate volume control in the radio frequency amplifier ahead of the Loftin-White circuit the best way of controlling the volume level is to use an input potentiometer, connecting the grid of the first tube to the slider.
- (11)—Electrolytic condensers of low voltage ratings are obtainable in thousands of microfarads and these are suitable for use in A battery eliminators.
- (12)—No current flows from the positive to the negative terminals in an electrolytic condenser if the condenser is made of pure materials.
- (13)—When there is a radio frequency choke coil in the plate circuit of a regenerative detector it makes no difference whether the by-pass condenser is connected from the detector side of the choke or from the transformer side.

ANSWERS

- (1)—Right. This is always a good method of controlling the sensitivity of a radio frequency amplifier. The objection to this method that the resistance across the tuner reduces the selectivity is not sufficiently important to offset the advantages gained. If the resistance is half megohm its effect on the selectivity is much less than the effect of the grid to filament resistance of a detector in which the grid is maintained positive.
- (2)—Right. The smaller the current that is drawn the more effective is a filter of given size of condensers and choke coils.
- (3)—Wrong. The 210 does not take as much current as a 245 tube and not nearly as much as a 250, yet both the 245 and the 250 tubes have been worked in the circuit.
- (4)—Wrong. A condenser across a low value resistance has practically no by-passing effect, or it does not reduce the effective resistance. At 30 cycles it requires a condenser of about one microfarad to reduce a 300 ohm resistance by 10 per cent. At the same frequency it takes a condenser of only .0875 mfd. to reduce 30,000 ohms by 10 per cent.
- (5)—Wrong. Non-reactive amplifiers of any type can be made with alternating current tubes. These tubes lend themselves to many more combinations than battery tubes.

- (6)—Right. In the Hartley circuit the regeneration occurs because there is a common impedance or resistance between two alternate tubes. Motorboating occurs because there is a common impedance among all the tubes, but it is the impedance common to two alternate tubes which accounts for the oscillation. If there is a third tube on the same impedance that tube tends to stop the regeneration.
- (7)—Wrong. While the Morgan amplifier can be assembled and adjusted to operating condition most easily with storage batteries it can also be assembled with dry cell batteries and even with B supply units of the rectifier-filter type.
- (8)—Wrong. The Johnston non-reactive amplifier is in all essentials the same as the Loftin-White amplifier. There is a hum-bucking device in the Loftin-White which was not used in the Johnston circuit.
- (9)—Wrong. The difficulty of adjusting a direct coupled amplifier in which there are no stopping condensers increases rapidly with the number of tubes used. Even a tube circuit is sometimes difficult to adjust.
- (10)—Right. As was stated in the first answer above, this is always a good method of controlling volume. It is even more suitable in the audio amplifier than in the radio. There is no objection here on the ground that selectivity is decreased.
- (11)—Right. They are the most effective of all condensers that can be obtained for in no other type can sufficient capacity be obtained to take out the hum.
- (12)—Wrong. There is always a small current flowing through the condenser, and this leakage current is due to impurities in the active material, that is, the aluminum in the usual electrolytic condenser.
- (13)—Wrong. If the by-pass condenser is connected between the junction of the RF choke and the audio transformer and the filament the radio frequency current is choked out by the RF choke and the tube will not oscillate. The condenser must be connected between the junction of the RF choke and the tickler and the filament.



IF THE METAL CABINET OF A RECEIVER IS GROUNDED THE SET AS A WHOLE IS SHIELDED EFFECTIVELY AND IS RENDERED MORE SELECTIVE.

Housing a Receiver

Floor Model Speaker Cabinet Turned to Good Advantage

By Herbert E. Hayden

Photographs by the Author

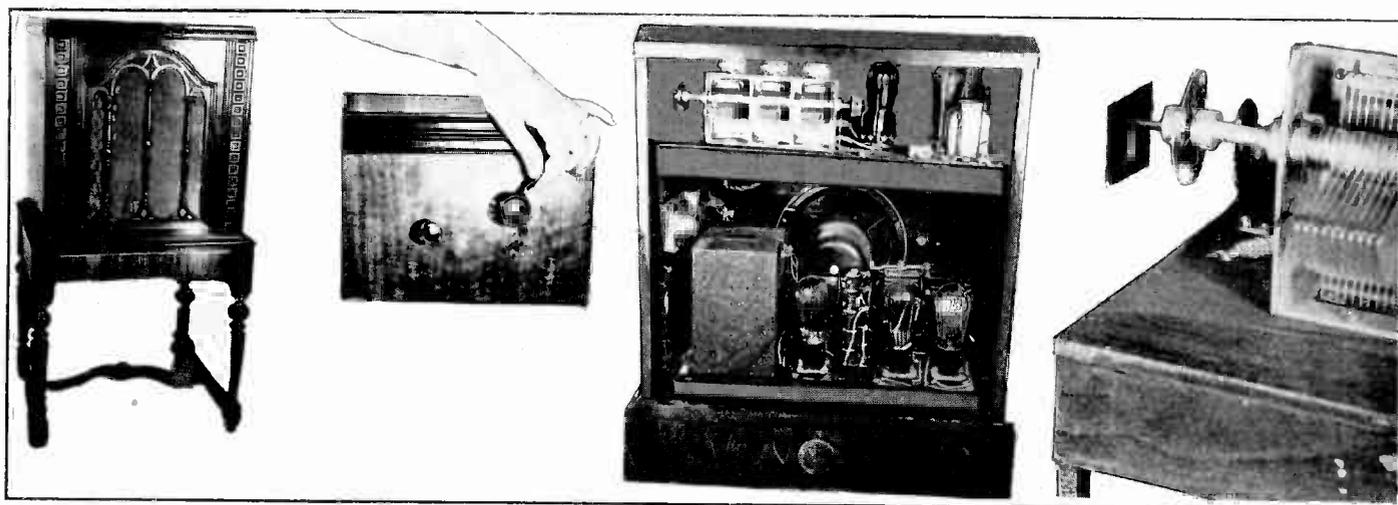


FIG. 1

FIG. 2

FIG. 3

(Photographs by the author)

FIG. 4

FIG. 1—A FLOOR MODEL CABINET SPEAKER INTO WHICH A RECEIVER IS TO BE BUILT.

FIG. 2—TUNING LEVER AND VOLUME CONTROL AT SIDE OF THE CABINET.

FIG. 3—REAR VIEW OF THE COMPLETED TUNER AND POWER AMPLIFIER.

FIG. 4—DETAIL OF HOW THE CONDENSER SHAFT IS CONNECTED TO THE KNOB, BY USE OF A FLEXIBLE INSULATED COUPLER AND A SHORT LENGTH OF $\frac{1}{4}$ IN. INSULATED OR METAL ROD.

MANY possessors of floor model speakers are proud of their good-looking piece of furniture and the performance of the speaker itself, but feel that as there is a fair amount of room to spare inside a receiver could be placed therein.

Two problems that arise are (1), where to place the parts, to be sure not only that everything is accommodated, but also that there will be no objectionable back-coupling, and (2), what to do about the tuner. The placement and operation of the tuner are the main subject of the present article.

Looking at Fig. 1 we see the floor model speaker at left, rather, the exterior of its attractive housing. Now, imagine that we are operating at the right-hand side of this cabinet, in the front-to-back dimension. That is, the cabinet is supposed to be turned 'round quarter way.

Next we see in Fig. 2 a view of this side, with two knobs, one of which has a lever. The unaided knob is for a volume control. The knob with the lever is for tuning. Fig. 3 shows the relationship between the tuning lever and the three-gang condenser. At extreme right, Fig. 4, the method of projecting the tuning shaft through the side of the cabinet is illustrated.

VERSATILITY OF FLEXIBLE COUPLER

The condenser is mounted on a baseboard or other support, and a flexible coupler is used for enabling shaft extension, a piece of brass or bakelite rod being used to continue the shaft effect through the side of the cabinet, in which a suitable hole is drilled for the purpose.

Not only does the flexible coupler permit this but it enables justification for any discrepancies that might arise between the trueness of the condenser mounting and that of the knob at front. Still further, the flexible coupling renders the tuner detachable simply by releasing the flexible coupler and baseboard anchorage. For these advantageous reasons the extension of the volume control is perfected in the same manner, with another flexible coupler.

In the particular type of cabinet used there was room atop for the tuner and its associated tubes, including a coupling transformer to the audio amplifier below. This amplifier has a power pack built in. What the circuits may be is not important to the present discussion, but two stages of tuned radio frequency amplification, tuned detector and two stages of audio were used, with single 245 output. Total, six tubes. The extra tube is the 280 rectifier.

The available room is measured on top for the tuner and a baseboard cut to size, with heavy right-angle brackets underneath, to be screwed to the inside side walls of the cabinet. The weight is very small, so half-inch screws will suffice, and as the wood usually is $\frac{5}{8}$ in. thick, and the bracket thickness

$\frac{1}{32}$ in. or $\frac{1}{16}$ in., there is then no fear of penetration to the exterior.

THE MYSTERIOUS MARKINGS

Now, going back to the second illustration, showing the hand turning the condensers, it will be noted that there are small markings in the shadow of the knob. These represent thumb-tacks, with heads snipped to a triangular shape. As a local station is tuned in, a tack is pressed into position. It is intended that the receiver be for local reception only, as it would be hard to accommodate distant stations, except the strongest ones, to this system.

So you distribute as many tacks as desired, usually around a dozen or so for large centers of population, and perhaps as many for rural localities where reception conditions are particularly good. Now color each triangulated head differently, to distinguish it for future reference, and if you have a poor memory, write down on a sheet of paper the color code in respect to station identities. Pretty soon—in one evening, to be certain—an attentive family in its entirety will become familiar with the color designations.

HOW TO PROVIDE A LEVER

The lever may be improvised, by removing the setscrew entirely from the tuning knob, and replacing it with a gold-plated handle from a Gillette safety razor, or by inserting a 3 in. long headless $\frac{6}{32}$ machine screw, placing a piece of hard rubber or bakelite tubing on it of shorter length, and tightening down with a decorative nut of the same size. Snip off the screw excess.

The example illustrated shows such an extended setscrew, with a shaped handle made by me of plastic wood. The only other requirement is to paint a small arrow-like indicating mark on the knob, to be able to register the knob in respect to the coloration of the triangles.

No switch is shown, as it so happened one was built into this cabinet as part of the dynamic speaker assembly. However, a switch may be provided with a matched knob, and the volume control knob so positioned as to occupy a symmetrical position in respect to the switch knob. Use an AC switch.

It is just as well to leave the back open, especially for acoustical reasons, as cavity resonance is thereby greatly reduced. If the speaker cabinet comes equipped with an imitation cane back, which is really copper or other metal, then it is imperative to leave off the back, otherwise the tuning is adversely affected by the resultant added capacity of the screen to ground.

Acoustical or other back coupling will be avoided by placing parts as shown in Fig. 3.

If desired, station call letters may be etched on the tack heads, instead of use of the color system.

A Short-Wave Mixer

Works Ahead of a Regular Broadcast Receiver

By Stimson Brooks

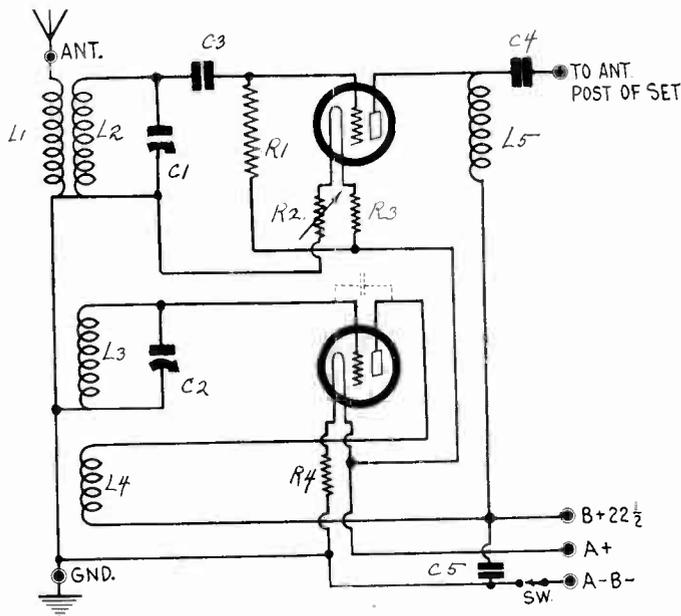


FIG. 1

THE CIRCUIT OF A SHORT WAVE ADAPTER WORKING ON THE SUPER-HETERODYNE PRINCIPLE. THE OSCILLATOR AND THE MODULATOR TUBES ARE LOOSELY COUPLED BY MEANS OF MUTUAL INDUCTANCE, NO SPECIAL COUPLER BEING NECESSARY.

SHORT WAVE ADAPTERS operating on the Super-heterodyne principle and preceding an ordinary broadcast receiver have been suggested and many such receivers have been built successfully. But frequently troubles are encountered. It seems some of these adapters do not work as expected.

There are many reasons why such adapters may fail, and often several of these reasons combine to render the circuit wholly inoperative.

In the first place the oscillator and the radio frequency tuner must be so loosely coupled that there is no appreciable tendency for tuned circuits to pull together and act as one. Making the coupling loose enough is sometimes a problem. At times it is capacity coupling which is excessive, at other times it may be mutual inductive coupling, and at still other times it may be resistance coupling.

Resistance coupling can be overcome by the use of by-pass condensers across the voltage supply and only small condensers are necessary in view of the high frequencies involved. Capacity coupling can be overcome by shielding the coils and by placing the various components of one part, such as the oscillator, at a distance from the parts belonging to the modulator.

INDUCTIVE COUPLING REDUCTION

Most of the inductive coupling is also done away with by the shielding but not necessarily enough to prevent coupling the tubes and their circuits too closely. Placing the coils at right angles will help a great deal.

But some coupling must be retained or the circuit will not function either. The oscillator must induce a certain voltage in the detector or modulator circuit, and this may take place either in the grid or in the plate circuit. If the modulator tube is of the screen grid type the oscillation voltage may also be introduced in the screen circuit.

One reason why these circuits do not always work is that the oscillator tube does not oscillate. There may not be sufficient feedback. Lack of oscillation is often due to losses in the oscillator coil resulting from induced currents in shielding or from absorption by the radio frequency tuned circuit. When the circuit will not oscillate on this account it may be necessary to increase the number of turns on the oscillator tickler or to increase the voltages applied to the tube.

When the oscillator is closely coupled to the RF circuit the two act as one. That is, although the oscillator oscillates all right, it does so at the frequency of the carrier desired and no beat frequency is produced. When the oscillator is finally turned so that the two circuits break apart, the oscillator frequency is higher than that to which the broadcast receiver is tuned, which determines the first, or only, intermediate frequency.

If this appears to be the case the broadcast receiver should be tuned to a higher frequency, 1,500 kc if necessary. If the oscillator and the R. F. tuners are so far apart it may be that the coupling is loose enough to allow the oscillator to function independently of the RF tuned circuits, while at 550 kc that may not be the case.

Still another reason why an adapter of this type does not work is that the coupling between the adapter and the receiver may not be correct. Suppose, for example, that there is a tuner between the adapter and the receiver which is not a part of the tuning system in that receiver. Clearly this tuner must be adjusted to the same frequency as the tuner in the set. If this extra tuner is omitted there will be no difficulty on this account.

THE CIRCUIT OF AN ADAPTER

In the diagram herewith is a circuit of an adapter working on the Super-heterodyne principle. It will be noted that in this circuit there is no obvious coupling between the oscillator and the modulator. The coupling utilized is the mutual inductance between coils L2 and L3. To make the circuit work this mutual inductance must be very small indeed. Just how large it may be can be found by trial and error. Place these coils at right angles as far apart as is practical. It may even be permissible to utilize some shielding between the coils and still leave sufficient coupling.

The tickler coil L4 must have enough turns to make the lower tube oscillate. Usually there is no difficulty at all in securing oscillation on short waves. There are many sets of short wave coils on the market, any one of which will work. The coil intended for tickler is used for that purpose and if the coil has a primary intended for the antenna that winding is not used. The principal winding is used for L3 and the tuning condenser C2 connected across it.

The radio frequency transformer L1L2 may also be any one of a number available on the market, not necessarily like the coils used in the oscillator. If this transformer has a tickler winding it should not be used. The antenna coil L1 on these transformers is usually adjustable for different degrees of coupling between the antenna and the tuned circuit. C1 is a small variable condenser of .00014 mfd. like C2.

If the coils L2 and L3 are placed parallel, even if they are as far as one foot apart, the coupling may be too great. For that reason it is advisable to place them approximately at right angles.

The stopping condenser C3 should be very small, not larger than .0001 mfd. and the grid leak R1 should be about half megohm. The output stopping condenser, which prevents short-circuiting the B battery through the receiver, may have almost any value. A .001 mfd. condenser is suggested. The output, choke coil L5 must have an inductance which is large enough to prevent short-circuiting at 550 kc. A coil of 85 millihenries is large enough.

THE FILAMENT CIRCUIT

The filament current supply should be a storage battery, as it is important that no hum enter the adapter tubes. If the supply voltage is 6 volts and the tubes are of the 201A type, R4 should have a value of 4 ohms, or it should be a 1A amperite. R3 should be a resistor of the same type and value. The rheostat R2, which is used for controlling the volume, should be a 20 ohm instrument.

Since it is important to keep hum out of the circuit the B supply should be a battery. A 22½ volt battery should suffice but it may be that the circuit will not oscillate well unless the voltage is 45 volts. A .25 mfd. condenser C5 is advisable across the B supply. This tends to reduce any resistance coupling which may exist between the tubes.

The principle of the Super-heterodyne type adapter is briefly explained. The tuner consisting of C1 and L2 is adjusted to the short wave carrier desired. The oscillator circuit comprising C2 and L3 is adjusted to control an oscillation which has a frequency higher than the desired carrier by the amount of the frequency to which the radio receiver is tuned. For example, suppose it is desired to receive a signal on 10,000,000 cycles. L2C1 is adjusted to this frequency. Now suppose that the radio receiver has been tuned to receive a broadcast frequency of one million cycles. The oscillator is then set at a frequency of eleven million cycles by adjusting C2 and by selecting the proper coil. The two frequencies, one of 10 million and the other of 11 million cycles, will beat together in the upper tube and produce a beat frequency equal to one million cycles. This is impressed on the broadcast receiver just as if it were an original signal having a one million cycle carrier.

This beat frequency carries the modulation contained in the 10 million cycle carrier and therefore the original modulating frequency is retrieved in the final detector in the usual fashion.

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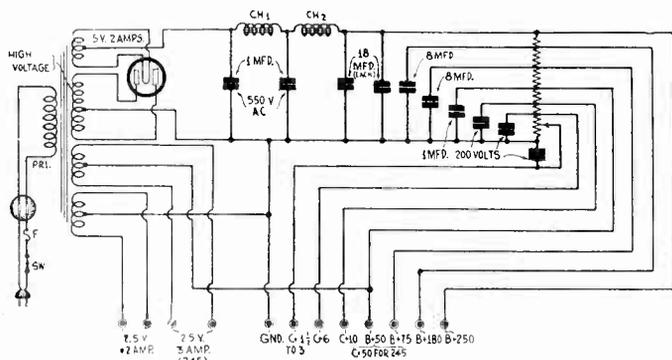


FIG. 828

THIS CIRCUIT PROVIDES NOT ONLY PLATE AND GRID VOLTAGES BUT ALSO FILAMENT VOLTAGE FOR A NUMBER OF 2.5 VOLT TUBES.

B AND C SUPPLY

WILL YOU kindly publish a diagram of a circuit which supplies both B and C voltages. Which is better, obtaining grid voltage from individual grid bias resistors or from drops in the voltage divider?—L. M. S.

You will find such a circuit in Fig. 828 above. This not only contains provision for plate and grid bias voltages but also two filament voltages. Both bias methods have advantages. Sometimes one method works out better, sometimes the other. Those who are willing to pay for the resistors and the large condensers that should be connected across them should use the individual resistor method. When low cost is of prime importance the voltage divider method of obtaining bias is a good solution.

MEANING OF PHASE SHIFT

I UNDERSTAND what is meant by reversing the phase, or at least I know what the effect is of reversing the phase in audio transformers and ticklers. But I don't understand what is meant by a phase shift introduced by a condenser or a coil. If you can explain phase shift in simple terms I should like to have your explanation.—G. A. C.

The first thing to realize is that phase relates to time, the time that something or other happens. An alternating voltage goes through periodic changes. At any one instant the voltage has a particular value. Twice during every cycle the voltage has that value, and also twice during every cycle it has the same absolute value but in the reverse direction. The time the voltage has a given value in a given direction might be called the phase of the voltage, or one might say that at that phase the voltage has the given value and direction. The happening is that the voltage assumes the particular value and direction at the particular time. The same thing applies to alternating current.

But this definition of phase is not very instructive in so far as phase shift is concerned. The term shift naturally implies relativity, something is shifted, in phase, or in time, with respect to something else. And here the idea of phase difference enters. A given value and direction of a current caused by a voltage may not occur at the same time that the corresponding value and direction of the voltage occurs. For example, the .1 of the maximum value of the current in the positive direction may not occur until a short time after .1 of the maximum value of the voltage occurs. There is then a small phase difference, or a short time interval, between the corresponding values of the voltage and the current caused by that voltage. The current lags behind in this particular case. A choke coil makes the current lag behind and a condenser makes the current lead the voltage. The amount of lead or lag depends on the frequency, on the capacity or inductance, and on the resistance in the circuit. There is a phase difference between the tides and the pull of the moon which may amount to several hours. In this case the pull of the moon represents voltage and the height of the water the current.

UNI-DIRECTION FLOW OF CURRENT

IF CURRENT can only flow in one direction in a plate circuit how is it that there can be alternating current in that circuit? It seems to me that engineers give whatever explanation that best fits the case whether or not that explanation is

consistent with some other explanation of a related subject.—C. W. H.

It is true that the current in the plate circuit only flows in one direction but that does not prevent that current from varying in intensity at an audio or radio frequency rate. Usually the fluctuations in the plate current are spoken of as the AC component of the plate current. There is nothing inconsistent between the explanations, although there may be between the interpretations of them.

DETERMINATION OF PHASE SHIFT

WILL YOU PLEASE explain the meaning of phase shift. How can the phase shift introduced by a condenser and a coil be determined?—J. A. W.

For the explanation of the first part of this question see the answer to G. A. C. above. A pure inductance shifts the phase 90 degrees and the shift is a lag. A condenser shifts the phase 90 degrees in the opposite direction. When there is a resistance in series with the coil the phase shift is determined by the formula $L\omega/R$, where L is the inductance in henries, ω is 6.28 times the frequency and R the resistance in ohms. The formula gives the tangent of the angle of lag, and the tangent can be found in trigonometric tables or on a slide rule. The lead introduced by a condenser in series with a resistance can be found by the formula $1/C\omega R$, the capacity being measured in farads and the resistance in ohms. This also gives the tangent of the angle of lead.

SPEAKER RATTLES

I HAVE AN inductor type speaker which gave me excellent service on a commercial receiver. I tried it on a resistance coupled amplifier which is supposed to be capable of exceptional quality. But it makes the speaker rattle. Is the speaker at fault or the amplifier? If either or both, please suggest the cause and the remedy.—L. A. F.

The resistance coupled amplifier is efficient on the low notes, much more so than transformer coupled circuits. The inductor dynamic also responds well to the low notes. But low notes require a very large amplitude, relatively. Hence the speaker is driven by the resistance coupled circuit more than it is supposed to be driven. It is made to vibrate so much that the armature hits against the buffers and this makes it rattle. A simple remedy is to put a small condenser in the speaker circuit, if the speaker is not fed directly. This prevents the low notes from getting to the speaker in full force—nullifies the resistance coupled amplifier to some extent on the low notes. But this is a makeshift. The best way is to put the speaker on a large baffle board. This will tend to prevent the speaker from vibrating so widely and at the same time the low notes will come out as they should. The speaker must have a load of air to buck against or it will not reproduce the low notes, only run wild.

CONNECTION OF HEATER CENTER

WHICH IS the better place to connect the center tap of the heater winding on a radio frequency amplifier such as the MB-29, the ground or the cathodes, assuming that these are at different potentials?—O. P. R.

Sometimes one, sometimes the other. Try both and retain the one which eliminates hum. In most cases of circuits of this type there is a difference of potential between the two points in question, the difference being the bias on the screen grid tubes. There is a good chance of impressing a hum frequency on the tuned circuits, which might intermodulate with the carrier and thus come through amplified the same way as the desired signal. Since the hum is of a low frequency and the condenser across the grid bias resistor is small, the condenser will not do much by-passing at the hum frequency.

THE JOHNSTON NON-REACTIVE CIRCUIT

I HAVE SEEN references in RADIO WORLD to the Johnston non-reactive circuit several times. The first time was about two years ago when you published the push-pull non-reactive amplifiers and again in the series on the Loftin-White amplifier. Have you ever published a diagram of this circuit? If you have not done so will you kindly do it so that we may try it if it looks good.—C. G. K.

Heretofore we have not published a diagram of the Johnston circuit because we have not regarded it as practical in this country except in a few isolated places where they have high DC voltage available. However, in the Feb. 1st, 1930, issue of

REALLOCATION NOW IMMINENT; FORTY CHANGES

Washington.

The Federal Radio Commission has extended the licenses of many stations for a period of 30 days instead of the usual 90-day period, in cases involving assignments and petitions before the Commission. The 30-day period was as of January 31st, 1930, at 3 P. M. Eastern Time.

The reason for the short term license is that the Commission is contemplating changes in the assignments of many stations after the expiration of the 30-day period.

Board's Statement

The Commission's announcement sets forth:

"Since the Commission is considering the advisability of making changes in frequency, power, or hours of operation with respect to certain broadcasting stations, the applications were granted for a period of 30 days pending further consideration of said applications. A letter setting forth reasons for such action will be mailed to each licensee."

This declaration revealed that a reallocation is imminent, and many petitions will be disposed of at one sweep. About 40 stations will be changed.

The license of KWKH, William K. Henderson, Shreveport, La., was one of those extended for 30 days. Objections to this station had been voiced in the Senate on the ground that alleged profane and indecent language had been broadcast over it.

The license of WGY, General Electric Company, Schenectady, N. Y., was renewed to operate on a frequency of 790 kilocycles. This channel was one of the 40 clear channels in the 1928 reallocation and one of the five cleared channels assigned to the fifth zone.

Some Get More Time

The frequency of the five cleared channels assigned to the fifth zone was given to Station KGO in Oakland, California, also owned by the General Electric Company. WGY was permitted to operate on this channel when there would be no interference with the California station, which limited WGY to a few hours of daylight operation. General Electric Company claimed that it was entitled to a clear channel for WGY and took the matter to court with the result that the Radio Commission was finally ordered to issue a license to WGY for full time operation on the 790 kc frequency.

Both WGY and KGO have been operating full time on this channel during the litigation and will continue to do so now, unless the contemplated reallocation changes the situation. Negligible interference has resulted.

The licenses issued to many stations included permission to use more time on the air. The increased time was made possible by the deletion or frequency change of stations which had previously been licensed to share time on certain waves.

A THOUGHT FOR THE WEEK

OUT of all the turmoil and arguments in official radio circles will surely come, sooner or later, an addition to the President's Cabinet. It will probably carry the title of Secretary of Communications. Thus, finally, will radio reach its majority, and have a permanent place in the President's official family.

Fate of WMAK Is in the Balance

Washington.

Action by the Federal Radio Commission is awaited in regard to WMAK, Buffalo, N. Y., said to be part of a broadcasting monopoly in that city.

The Buffalo "Evening News" has been given a construction permit to erect a station to operate full time on 900 kilocycles at 1kw, the frequency occupied by WMAK.

When the "News" applied for a permit WMAK opposed, and was met with the charge it is one of the stations, owned by the same corporation, that monopolize the Buffalo air. WMAK failed in a court attempt to enjoin the issue of a construction permit to the "News" on 900 kc.

As WMAK cannot occupy 900 kc if the "News" has full time, the WMAK license may be resolved, or either the "News" or WMAK put on some other channel. Frequencies cited in construction permits are not always adhered to in operation assignments.

TUBES RECORD COLOR VALUES

A device for analyzing color employing photo-electric cells and radio amplifier tubes has been developed by Joseph Rezek and Peter J. Mulder, instructors in physics in the University of Pennsylvania. The analysis of a sample takes about 10 seconds. The apparatus is portable and no larger than a suitcase.

The sample to be analyzed is illuminated strongly by a beam of light. The light, reflected perpendicularly from the sample, is admitted into a spectroscope which separates the light into its color components. A selected portion of the spectrum is allowed to enter a photo-electric cell which converts the light intensity values into equivalent electric values. These are amplified enormously by radio tubes like those used in the last stage of an amplifier. A galvanometer connected in the plate circuit gives a deflection which bears a known relationship to the intensity of the particular part of the spectrum which enters the photo electric cell. By means of a crank the entire spectrum may be made to pass before the photoelectric cell so that the intensity distribution of the light may be obtained. The device not only gives a visual indication of the intensity of the reflected light in any section of the spectrum but it also records it on a photographic film which moves as the crank is turned.

Pilot Moving Into 1,500,000 Square Feet

The acquisition of a new factory in Lawrence, Mass., comprising twenty individual buildings having a total area of more than 1,500,000 square feet, was announced by I. Goldberg, president, for the Pilot Radio & Tube Corporation, of Brooklyn, N. Y.

The work of moving the company's equipment from its present factories in Brooklyn, Poughkeepsie (N. Y.) and Detroit, Mich., already started, will require about six months. The Pilot company manufactures radio parts and tubes.

Seven Use 50 kw.; List Is Growing

Washington.

The trend toward higher power for broadcasting stations to permit of more efficient reception for persons residing in areas remote from station locations, is evidenced in data made available at the Federal Radio Commission.

Commission records show that seven stations now are broadcasting with the maximum allowable power of 50,000 watts. Nine other stations hold construction permits for transmitters of this output, while applications are pending from five stations for authority to install such transmitters. In every case except one these stations operate on cleared or interference-free channels, set aside by the Commission expressly for high powered stations.

One Exception Made

The single exception is that of Station WGY, at Schenectady, N. Y., operated by the General Electric Company, which has been operating with 50,000 watts on the 790 kilocycle channel along with Station KGO, at Oakland, Calif., by court order.

Other 50,000 watt stations, broadcasting with that power, are KDKA, Pittsburgh, Pa., operated by the Westinghouse Electric and Manufacturing Co.; WAAF, New York City, National Broadcasting Co.; WENR, Chicago, Great Lakes Broadcasting Co.; WLW, Cincinnati, Crosley Radio Corporation; WTIC, Hartford, Conn., Travelers' Insurance Co., and WTAM, Cleveland, Ohio, WTAM & WEAR, Inc.

In addition to these operating stations, WBAP, at Fort Worth, Tex., operated by Carter Publications, Inc., the records show, although licensed to use the maximum power, is now rebuilding its present 10,000 watt transmitter to this output.

WJZ Uses 30,000 Watts

WJZ, in New York, operated by the National Broadcasting Company, uses 30,000 watts. Station KYW, in Chicago, of the Westinghouse, uses 10,000 watts, but is constructing a 50,000-watt transmitter with the understanding that its power will be restricted to that used at present.

Stations holding construction permits for 50,000 watts other than KYW and WBAP are WABC, New York, Columbia Broadcasting System; KNX, Hollywood, Calif., Western Broadcast Co.; KMOX, St. Louis, Voice of St. Louis, Inc.; WOAI, San Antonio, Tex., Southern Equipment Co.; KFI, Los Angeles, Earl C. Anthony, Inc.; WLS, Chicago, The Prairie Farmer; WFAA, Dallas, Tex., Dallas News and Observer.

Applications Pending

Applications now pending before the Commission for construction permits for 50,000-watt stations are as follows:

WAPI, Birmingham, Ala., Alabama Polytechnic Institute; WHAM, Rochester, N. Y., Stromberg Carlson Tel. Mfg. Co.; WOWO, Fort Wayne, Ind., Main Auto Supply Company; WCFL, Chicago, Chicago Federation of Labor (this station now operating on a regional channel, for which 50,000 watt licenses are not now issued); and KGO, Oakland, Calif., operated by the General Electric Co.

Under Commission regulations, says "The United States Daily," the maximum power actually assigned to broadcasting stations is 25,000 watts. The 25,000 watts additional are assigned experimentally, with the understanding that it may be canceled at any time, it was explained. The purpose of this, it was said, is to determine from the scientific point of view, the feasibility of licensing stations for high power operations without obligation.

Its Profanity Stopped, Listeners Back KWKH

Washington.

If KWKH, at Shreveport, La., discontinues the use of objectionable language, it should not be deprived of its radio rights, Senator Blease (Dem.), of South Carolina, stated in the Senate.

Senator Blease said that he had received letters and telegrams from his State in regard to W. K. Henderson, stating that "people are enjoying his talks." It was said in some of the letters that Mr. Henderson's opposition to chain stores is commendable, the Senator said.

Senator Dill (Dem.), of Washington, stated that he had no further complaint about the station and his only purpose in calling attention to the station on the floor of the Senate had been to cause it to stop the use of objectionable language. He stated that he had no objection to the comments of Mr. Henderson against chain stores.

Senator Fess (Rep.), of Ohio, said he had received letters from his State which carried the impression that Mr. Dill was supporting the chain stores because of his comments about the Shreveport station. Senator Dill explained that he had no objection save to the use of obscene and profane language by the announcer.

A telegram was received by Representative Sandlin, of Louisiana, from W. K. Henderson, of KWKH, Shreveport, La., saying that to preserve harmony in his radio audience he had decided in the future to refrain from using "damn" and "hell" in his radio talks against chain stores, though he did not consider these words profane.

Set Saturation Held Not in Sight

Washington.

W. D. Terrell, chief of the radio division of the Department of Commerce, has reported that the estimated increase in the number of radio-equipped homes in the United States is from 60,000 in 1922 to 10,000,000 at the present time. In 1922 the radio audience was estimated at 75,000 while at this time it is estimated to be 40,000,000.

The total radio sales in 1922 amounted to \$60,000,000, of which \$2,800,000 was exported. In 1928 the total sales amounted to \$650,550,000, of which \$10,907,000 was exported.

Although there are 10,000,000 receivers in use, the saturation point is not in sight, for there are 19,000,000 homes still without radio receivers.

TWO APPOINTED BOARD COUNSEL

Washington.

Organization of the legal division of the Federal Radio Commission was completed for the first time since the creation of the Commission with the appointment of two assistants to the general counsel.

Duke M. Patrick, of Indianapolis, Ind., and Ben S. Fisher, of Marshfield, Oregon, were the appointees. The general counsel, Thad H. Brown, recommended the appointments to the Commission and three days later the Commission approved them.

Under the radio law, the legal division shall comprise a general counsel with a salary of \$10,000 per annum, and three assistant general counsels with salaries of \$7,500 per annum. Paul D. P. Spearman, of Jackson, Miss., now holds one of the assistant general counselships.

Mr. Patrick is 29 years old. He holds the degree of bachelor of science from Purdue University, where he specialized in chemistry and physics. In 1925, says "The United States Daily," he received the degree of doctor of jurisprudence from the University of Michigan.

Mr. Fisher, a practicing attorney at Marshfield, is 40 years old. He is a graduate of the law school of the University of Illinois and has practiced law fifteen years, with the exception of two years when he served as a commissioned officer during the World War. From 1922 to 1924 he served as district attorney, and in 1924 was president of the District Attorneys' State Association of Oregon.

Rapee Quits Air for Hollywood Job

Erno Rapee, who bade farewell to the audience of the Roxy "Gang," said au revoir to his Mobiloil audience over WEA. Mr. Rapee left for the Pacific Coast to take up the duties of musical director for the Warner Brothers.

Joseph Littau, who succeeded Rapee as conductor of the Roxy Symphony Orchestra, conducted the musical group over WJZ. He paid a tribute to Mr. Rapee's fine work with the Roxy unit and said he hoped to continue along the same line.

BOARD UNJUST TO LABOR, SAYS WCFL COUNSEL

Washington.

Organized labor is being denied its entitled position in the air by the repeated refusal of the Federal Radio Commission to give WCFL, Chicago, a cleared channel, said Hope Thompson, counsel for the American Federation of Labor, addressing the Senate Interstate Commerce Commission. He asserted WCFL is engaged in educational work, in spreading labor's gospel, and is not to be compared with stations that stress entertainment, such as jazz.

Too Great for This

"Radio is too great a thing to be used purely for entertainment," added Mr. Thompson. "It reaches the hearthstones of nearly every American home. Why should it be used to sing 'Old Pal' all the time, or pound the air with jazz music? This marvelous power that can help the people is just being prostituted."

He repeated his charge that a virtual monopoly of the air exists, and said the "powers that be" not only have all the choice frequencies, but are so influential Congress has not dared to face the situation. Of the 90 channels labor should be given one free and clear at high power, he argued, whereas WCFL is restricted to daylight reception on 1,500 watts, a denial to labor of a national mouthpiece for its principles.

Wants No Domination

"I think it would be of greatest importance that this entire field of communications be kept entirely free of private domination," said Mr. Thompson. "The person or group which controls radio broadcasting in the years to come will control this Nation."

Mr. Thompson said he believed it is the duty of Congress to save broadcasting "from where it is going," but he declared that "it has got away from you already."

The Federation also was blocked in its efforts to establish a short wave chain for relaying, a plan based on the granting of a cleared channel to WCFL.

WCFL's appeal from the WCFL assignment is now before the Circuit Court of Appeals.

Radio Ends Mule Messenger 'Boys'

Washington.

The Southern Radio Corporation, a subsidiary of the Standard Oil Company of New Jersey, is now engaging in direct radio communication between United States and the jungles of Bolivia where the Standard Oil Co. has extensive oil holdings.

Previous to the establishment of the radio circuit about six months ago, the Standard Oil Company sent its messages to Buenos Aires by cable, thence by a telegraph line, and finally by "mule back" to the oil fields. Sometimes as long as two weeks elapsed between the time the message was filed in New Jersey and the time of delivery. With the radio circuit the communication is practically instantaneous.

CIGARETTE FIRM AGREES TO END BUNK AIR 'ADS'

Washington. Bunk advertising by a cigarette manufacturer over a chain of radio stations and in printed advertisements in newspapers and magazines, will stop, the company stipulated to the Federal Trade Commission. Paid testimonials used by the cigarette manufacturer through his fervid advertising agency proved to have been not only bought, but in many instances utterly false, and not only false, but not even uttered by the testimonialist. The fat check brought the O. K. to use the celebrity's name on an endorsement, and an advertising copy writer did the rest.

A complaint against the broadcasting of this palpable bunk into homes, where heroes and heroines of the day were attesting to the health-inspiring effects of smoking this brand of cigarettes, while even children listened in, lost out before the Federal Radio Commission, which said it was powerless to act, as it had no censorship authority.

The Full Announcement.

The announcement of the Federal Trade Commission, exposing the campaign of bunk, and outlining the stipulation, follows in full text:

"A corporation manufacturing and selling cigarettes and other tobacco products has signed a stipulation with the Federal Trade Commission agreeing to discontinue certain practices. The facts are shown in the following statement:

"Stipulation No. 503.—Respondent, a corporation, engaged in the manufacture of cigarettes and other tobacco products and in the sale and distribution of the same in interstate commerce, in competition with other corporations, individuals, firms and partnerships likewise engaged, entered into the following stipulation of facts and agreement to cease and desist forever from the alleged unfair methods of competition as set forth therein.

"Respondent, as a means of soliciting the sale of and selling its products in interstate commerce, adopted and use numerous newspapers, magazines and other publications having interstate circulation, and wherein the said respondent, and/or its advertising agents or agencies, caused advertisements to be inserted in the aforesaid publications featuring what purported to be the testimonials of famous people who smoke respondent's products and found they protect from irritation.

Non-Smokers Endorsed, Too!

"Certain of said testimonials were obtained by respondent for a valuable consideration from the alleged authors thereof. The said advertising matter also contained a testimonial or endorsement purporting to be that of certain actresses in a musical show who were credited with the statement to the effect that through the use of respondent's cigarettes 'that's how we stay slender,' when in truth and in fact the said actresses were not cigarette smokers and did not stay slender through smoking of respondent's products.

"Further, in soliciting the sale of and selling its products in interstate commerce, the respondent caused certain of its advertising matter to be broadcast through a radio station located in a certain State and having a hook-up with radio stations located in other States of

South Carolina Asks Tax on Sets

Columbia, S. C.

A consumer tax on radio sets, with a penalty for failure to pay the tax, is proposed in a bill introduced in the South Carolina legislature.

the United States, the said advertising matter included a testimonial purporting to be that of a well-known musical comedy star and which, in part, set forth that the alleged author of the testimonial, when making a certain talking picture, smoked that brand of cigarettes, manufactured by respondent, and which because of the special treatment employed in the manufacture of said cigarettes, had been freed of all irritants with the result that the smoking of said cigarettes kept the alleged author in good shape and feeling peppy and his voice as clear as a bell in every scene; when in truth and in fact the aforesaid musical comedy star authorized the aforesaid testimonial and received a consideration for the above statement attributed to him but which statement he did not prepare, see prior to its use, or sign.

Cease and Desist!

"In addition to the use of the alleged testimonials, the respondent caused various forms of advertising matter to contain such statements as 'Every woman who fears overweight finds keen interest in new-day and common-sense ways to keep slender, fashionable figure,' 'Women retain slender figures,' and 'No need you face the rigid requirements of harsh dieting methods. Overweight is banished, etc'; when in truth and in fact health and vigor to men, slender figures to women and reduction of flesh in all cases will not necessarily result from the smoking of respondent's brand of cigarettes.

"Respondent, its officers, agents, representatives, servants, and employees, in soliciting the sale of and selling its product in interstate commerce, agreed to cease and desist from the use in newspapers, magazines, radio talks or other means of any and all testimonials and endorsements unless the same represent and are the genuine, authorized and unbiased opinions of the author or authors or the alleged author or authors thereof, and if a monetary or other consideration has been given for a testimonial, the said respondent shall public or cause to be published, along with said advertisements, in an equally conspicuous manner, the fact that said testimonials have been paid for.

Bunk Spared from Air, Too

"The said respondent, its officers, agents, representatives, servants and employees also agreed to cease and desist from using in advertising matter or in radio talks statements or representations to the effect that 'women retain slender figures,' and 'overweight is banished'; or any other statements, representations, or words in advertisements or advertising matter circulated in interstate commerce or in radio talks broadcast through hook-ups in various States of the United States and in interstate commerce so as to import or imply or which may have the capacity and tendency to mislead or deceive the purchasing public into the belief that the smoking of respondent's cigarettes will bring slender figures and cause the reduction of flesh in all cases.

"Respondent also agreed that if it should ever resume or indulge in any of the practices in question this said stipulation as to the facts may be used in evidence against it in the trial of the complaint which the Commission may issue."

OFF NIGHT AIR, WCBD ASSERTS VESTED RIGHT

Washington.

A petition for rehearing of its decision in the case of station WCBD, operated by Wilbur Glenn Voliva, overseer of Zion City, Ill., was filed with the Court of Appeals of the District of Columbia by John W. Guider, counsel for the station.

The decision of the court, rendered January 6th, involved WENR and WLS, of Chicago, as well as the Zion City station. The court stated the applications in question represented competitive claims of the three stations for operating time on the 870 kilocycle channel. It granted WENR an increase in operating time from two-sevenths to five-sevenths, and reduced WLS's time from five-sevenths to one-half. WCBD, which sought evening hours on the channel, was denied outright.

In the motion for rehearing Mr. Guider contends that the appeal of his station should not have been confined to the question of operating time on the 870 kilocycle channel alone, according to "The United States Daily." WCBD, which formerly operated on the 870 kilocycle channel during evening hours, sought not the right to use any particular frequency, but rather the right to broadcast during evening hours.

Wants to Be Winner

"It is respectfully submitted that the appellant is entitled to a decision by this court determining whether or not the substance of his request, namely, the privilege of broadcasting during the evening hours, is to be granted or denied," said Mr. Guider. "His rights in that respect are determined by a decision that a particular frequency should be divided between two other appellants to the exclusion of this appellant."

Among other things, Mr. Guider argues that the decision of the Federal Radio Commission on the application of WCBD "was rendered in plain disregard of the protective provisions of the radio act of 1927." Mr. Voliva, he continues, "had a property right in his station which was denied him by the decision of the Federal Radio Commission."

Extenuates on Property Right

"The property right of the appellant here has a dual aspect," continues the petition. "Conceding for the purposes of this argument that broadcasting is interstate commerce and that the Congress has the power to regulate broadcasting, the appellant nevertheless submits that: '1. The regulation thus exercised must be reasonable, and if it is not reasonable the property right requires that the unreasonable regulation be held invalid.

"2. That where the regulation is held to be reasonable, and where the reasonable regulation destroys the value of the property, the property cannot be so diminished or destroyed unless the regulating law provides for the taking of that property by due process and with compensation."

Inquiries About Compensation

In conclusion the petition states that if it is held that the Commission's decision was a "reasonable regulation," then the radio act "is unconstitutional in that no provision is made for compensating the appellant for his property loss."

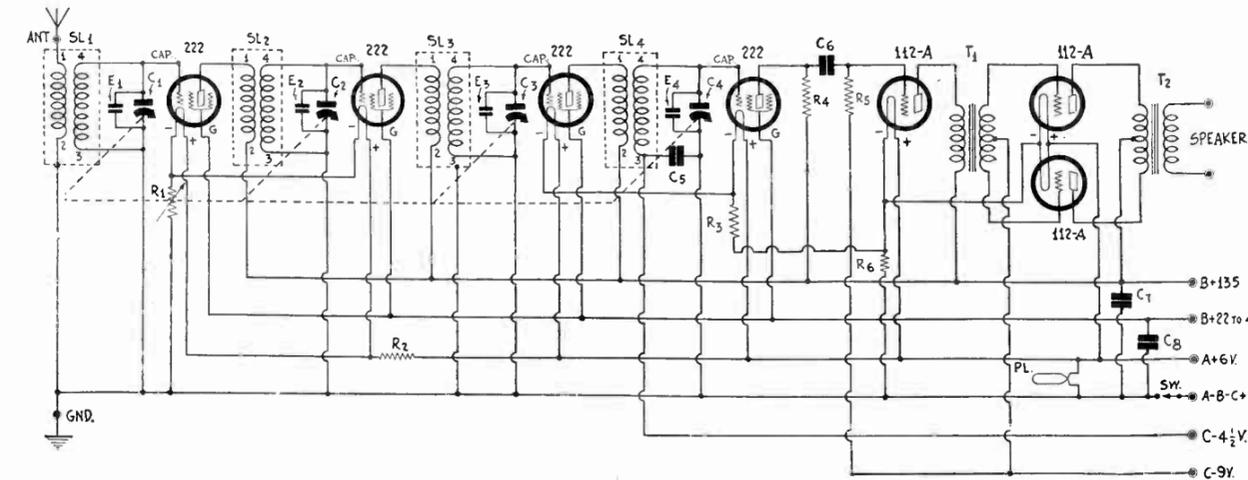


FIG. 829 THIS SEVEN-TUBE RECEIVER INCORPORATES FOUR DC SCREEN GRID TUBES AND THREE 112A TUBES. SHIELDING OF COILS IS NECESSARY BUT IT SHOULD NOT BE OVERDONE.

RADIO WORLD we publish a simplified Johnston circuit because of its historic interest. It will be noted that when this circuit is built with 227 tubes, or with AC tubes of any kind so arranged that a separate transformer winding is used for each tube, the principle of the circuit is the same as that of the Loftin-White circuit.

MODULATION HUM

DO YOU BELIEVE that the grid bias resistor in a screen grid tube radio frequency amplifier could cause modulation hum even though the resistor is by-passed with a one microfarad condenser? The same resistor is used for all the radio frequency tubes and it has a value of about 200 ohms. If you think this could cause the hum can you suggest a remedy?—T. A. R.

Yes, it is quite possible that this may be the cause of modulation hum because a one microfarad condenser across a 200 ohm resistance does not by-pass any appreciable portion of the 120 cycle hum component. Hence any hum that may exist in the plate currents will establish a considerable voltage across the resistor and intermodulate with the carrier. A method of eliminating this is to substitute a grid battery for the grid bias resistor. Frequently the hum is caused by induction from the power transformer or the chokes in the B supply. As a test these units might be removed several feet from the amplifier.

A DC SCREEN GRID TUBE CIRCUIT

YOU VERY seldom publish any screen grid tube receivers for DC filament supply. There are many of us who are not fortunate enough to have AC available and we feel that you ought not to neglect us entirely. We may be in the minority as far as actual numbers are concerned but I believe we are in the majority when it comes to actual builders of sets. So give us some circuits. Why not start off by putting circuits in the Q and A department?—J. P. A.

You may be right about the contention that the majority of potential radio set builders are among those who have DC supply. So we publish a screen grid receiver to meet such requirements. You will find the diagram in Fig. 829. In building such a receiver allow plenty of room for the tuning coils so that the shields can be made large. For a given size of solenoid coil the shield should be so large that the shortest distance between the shielding and the coil is at least as great as the diameter of the coil. It is absolutely essential that the tuned circuits track well otherwise the signal may get weaker stage by stage rather than stronger. Large shields are also essential to avoid reduction in intensity rather than amplification.

REGULATION IN B SUPPLY

IN WHICH CIRCUIT would the regulation be better, one in which the two plates of the 280 tube are connected together and the tube used as a half wave rectifier or one in which the two plates are used in a full wave rectifier?—K. K. G. There is practically no difference as far as the tube is con-

cerned. In one case the two plates work half of the time, each delivering the same current. In the other case the plates take turns at working, one plate working half of the time and the other plate the other half. The current delivered in either case is about the same after it has been averaged, or filtered. When the transformer and the filter are taken into account the full wave rectifier may have a slightly better regulation.

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City and State

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Circulation Dept., Radio World, 145 W. 45th St., N. Y. City.

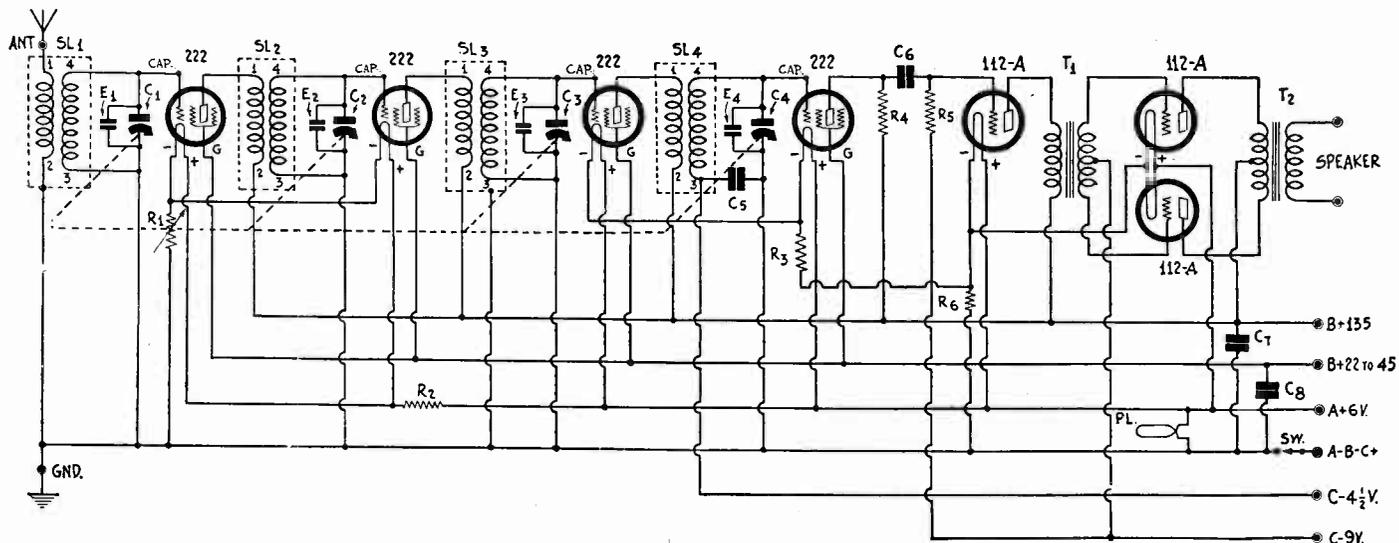


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REALLOCATION NOW IMMINENT; FORTY CHANGES

Washington.

The Federal Radio Commission has extended the licenses of many stations for a period of 30 days instead of the usual 90-day period, in cases involving assignments and petitions before the Commission. The 30-day period was as of January 31st, 1930, at 3 P. M. Eastern Time.

The reason for the short term license is that the Commission is contemplating changes in the assignments of many stations after the expiration of the 30-day period.

Board's Statement

The Commission's announcement sets forth:

"Since the Commission is considering the advisability of making changes in frequency, power, or hours of operation with respect to certain broadcasting stations, the applications were granted for a period of 30 days pending further consideration of said applications. A letter setting forth reasons for such action will be mailed to each licensee."

This declaration revealed that a reallocation is imminent, and many petitions will be disposed of at one sweep. About 40 stations will be changed.

The license of KWKH, William K. Henderson, Shreveport, La., was one of those extended for 30 days. Objections to this station had been voiced in the Senate on the ground that alleged profane and indecent language had been broadcast over it.

The license of WGY, General Electric Company, Schenectady, N. Y., was renewed to operate on a frequency of 790 kilocycles. This channel was one of the 40 clear channels in the 1928 reallocation and one of the five cleared channels assigned to the fifth zone.

Some Get More Time

The frequency of the five cleared channels assigned to the fifth zone was given to Station KGO in Oakland, California, also owned by the General Electric Company. WGY was permitted to operate on this channel when there would be no interference with the California station, which limited WGY to a few hours of daylight operation. General Electric Company claimed that it was entitled to a clear channel for WGY and took the matter to court with the result that the Radio Commission was finally ordered to issue a license to WGY for full time operation on the 790 kc frequency.

Both WGY and KGO have been operating full time on this channel during the litigation and will continue to do so now, unless the contemplated reallocation changes the situation. Negligible interference has resulted.

The licenses issued to many stations included permission to use more time on the air. The increased time was made possible by the deletion or frequency change of stations which had previously been licensed to share time on certain waves.

A THOUGHT FOR THE WEEK

OUT of all the turmoil and arguments in official radio circles will surely come, sooner or later, an addition to the President's Cabinet. It will probably carry the title of Secretary of Communications. Thus, finally, will radio reach its majority, and have a permanent place in the President's official family.

Fate of WMAK Is in the Balance

Washington.

Action by the Federal Radio Commission is awaited in regard to WMAK, Buffalo, N. Y., said to be part of a broadcasting monopoly in that city.

The Buffalo "Evening News" has been given a construction permit to erect a station to operate full time on 900 kilocycles at 1kw, the frequency occupied by WMAK.

When the "News" applied for a permit WMAK opposed, and was met with the charge it is one of the stations, owned by the same corporation, that monopolize the Buffalo air. WMAK failed in a court attempt to enjoin the issue of a construction permit to the "News" on 900 kc.

As WMAK cannot occupy 900 kc if the "News" has full time, the WMAK license may be resolved, or either the "News" or WMAK put on some other channel. Frequencies cited in construction permits are not always adhered to in operation assignments.

TUBES RECORD COLOR VALUES

A device for analyzing color employing photo-electric cells and radio amplifier tubes has been developed by Joseph Rezek and Peter J. Mulder, instructors in physics in the University of Pennsylvania. The analysis of a sample takes about 10 seconds. The apparatus is portable and no larger than a suitcase.

The sample to be analyzed is illuminated strongly by a beam of light. The light, reflected perpendicularly from the sample, is admitted into a spectroscope which separates the light into its color components. A selected portion of the spectrum is allowed to enter a photoelectric cell which converts the light intensity values into equivalent electric values. These are amplified enormously by radio tubes like those used in the last stage of an amplifier. A galvanometer connected in the plate circuit gives a deflection which bears a known relationship to the intensity of the particular part of the spectrum which enters the photo electric cell. By means of a crank the entire spectrum may be made to pass before the photoelectric cell so that the intensity distribution of the light may be obtained. The device not only gives a visual indication of the intensity of the reflected light in any section of the spectrum but it also records it on a photographic film which moves as the crank is turned.

Pilot Moving Into 1,500,000 Square Feet

The acquisition of a new factory in Lawrence, Mass., comprising twenty individual buildings having a total area of more than 1,500,000 square feet, was announced by I. Goldberg, president, for the Pilot Radio & Tube Corporation, of Brooklyn, N. Y.

The work of moving the company's equipment from its present factories in Brooklyn, Poughkeepsie (N. Y.) and Detroit, Mich., already started, will require about six months. The Pilot company manufactures radio parts and tubes.

Seven Use List Is

The trend toward higher power for broadcasting for persons residing in areas remote from station the Federal Radio Commission.

Commission records show that seven stations no power of 50,000 watts. Nine other stations hold put, while applications are pending from five stations. In every case except one these stations operate aside by the Commission expressly for high power.

One Exception

The single exception is that of Station WGY, Electric Company, which has been operating with Station KGO, at Oakland, Calif., by court order.

Other 50,000 watt stations, broadcasting with the by the Westinghouse Electric and Manufacturing Co.; WENR, Chicago, Great Lakes Broadcasting Corporation; WTIC, Hartford, Conn., Travelers' WTAM & WEAR, Inc.

In addition to these operating stations, WBAI, Inc., the records show, although licenses present 10,000 watt transmitter to this output.

WJZ Uses 3

WJZ, in New York, operated by the National KYW, in Chicago, of the Westinghouse, uses 10,000 mitter with the understanding that its power will be limited to 10,000 watts.

Stations holding construction permits for 50,000 WABC, New York, Columbia Broadcasting System cast Co.; KMOX, St. Louis, Voice of St. Louis, Instrument Co.; KFI, Los Angeles, Earl C. Anthony, Inc. Dallas, Tex., Dallas News and Observer.

Application

Applications now pending before the Commission are as follows:

WAPL, Birmingham, Ala., Alabama Polytechnic Carlson Tel. Mfg. Co.; WOWO, Fort Wayne, Ind., Chicago, Chicago Federation of Labor (this station no 50,000 watt licenses are not now issued); and KCO, Electric Co.

Under Commission regulations, says "The Uni assigned to broadcasting stations is 25,000 watts. mentally, with the understanding that it may be proposed of this, it was said, is to determine from the licensing stations for high power operations with

Its Profanity Stings Listeners

If KWKH, at Shreveport, La., discontinues to be deprived of its radio rights, Senator Bleas will introduce legislation in the Senate.

Senator Bleas said that he had received letters from W. K. Henderson, stating that "people are enjoying" the station's profanity.

Senator Dill (Dem.), of Washington, stated that station and his only purpose in calling attention to the comments of Mr. Henderson against the station was to cause it to stop the use of objectionable language.

Senator Fess (Rep.), of Ohio, said he had received a telegram from Mr. Dill was supporting the charge against the station. Senator Dill explained that and profane language by the announcer.

A telegram was received by Representative Sandlin from Shreveport, La., saying that to preserve harmony in the community he would refrain from using "damn" and "hell" in his radio talks. These words profane.

50 kw.; Growing

Washington. Stations to permit of more efficient reception locations, is evidenced in data made available at

are broadcasting with the maximum allowable construction permits for transmitters of this out-ions for authority to install such transmitters. on cleared or interference-free channels, set red stations.

on Made

at Schenectady, N. Y., operated by the General 50,000 watts on the 790 kilocycle channel along rder.

it power, are KDKA, Pittsburgh, Pa., operated ng Co.; WEAJ, New York City, National Broad- dcasting Co.; WLW, Cincinnati, Crosley Radio Insurance Co., and WTAM, Cleveland, Ohio,

P, at Fort Worth, Tex., operated by Carter Pub- sed to use the maximum power, is now rebuilding

0,000 Watts

Broadcasting Company, uses 30,000 watts. Station 00 watts, but is constructing a 50,000-watt trans- l be restricted to that used at present.

000 watts other than KYW and WBAP are tem; KNX, Hollywood, Calif., Western Broad- nc.; WOAL, San Antonio, Tex., Southern Equip- ic.; WLS, Chicago, The Prairie Farmer; WFAA,

s Pending

ion for construction permits for 50,000-watt sta-

Institute; WHAM, Rochester, N. Y., Stromberg nd., Main Auto Supply Company; WCFL, Chi- w operating on a regional channel, for which O, Oakland, Calif., operated by the General

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The 25,000 watts additional are assigned experi- nced at any time, it was explained. The pur- e scientific point of view, the feasibility of put obligation.

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of Louisiana, from W. K. Henderson, of KWKH, his radio audience he had decided in the future to lks against chain stores, though he did not consider

Set Saturation Held Not in Sight

Washington.

W. D. Terrell, chief of the radio divi- sion of the Department of Commerce, has reported that the estimated increase in the number of radio-equipped homes in the United States is from 60,000 in 1922 to 10,000,000 at the present time. In 1922 the radio audience was estimated at 75,000 while at this time it is estimated to be 40,000,000.

The total radio sales in 1922 amounted to \$60,000,000, of which \$2,800,000 was exported. In 1928 the total sales amount- ed to \$650,550,000, of which \$10,907,000 was exported.

Although there are 10,000,000 receivers in use, the saturation point is not in sight. for there are 19,000,000 homes still with- out radio receivers.

TWO APPOINTED BOARD COUNSEL

Washington.

Organization of the legal division of the Federal Radio Commission was com- pleted for the first time since the creation of the Commission with the appointment of two assistants to the general counsel.

Duke M. Patrick, of Indianapolis, Ind., and Ben S. Fisher, of Marshfield, Oregon, were the appointees. The general coun- sel, Thad H. Brown, recommended the appointments to the Commission and three days later the Commission ap- proved them.

Under the radio law, the legal division shall comprise a general counsel with a salary of \$10,000 per annum, and three assistant general counsels with salaries of \$7,500 per annum. Paul D. P. Spearman, of Jackson, Miss., now holds one of the assistant general counselships.

Mr. Patrick is 29 years old. He holds the degree of bachelor of science from Purdue University, where he specialized in chemistry and physics. In 1925, says "The United States Daily," he received the degree of doctor of jurisprudence from the University of Michigan.

Mr. Fisher, a practicing attorney at Marshfield, is 40 years old. He is a grad- uate of the law school of the University of Illinois and has practiced law fifteen years, with the exception of two years when he served as a commissioned officer during the World War. From 1922 to 1924 he served as district attorney, and in 1924 was president of the District At- torneys' State Association of Oregon.

Mr. Fisher, a practicing attorney at Marshfield, is 40 years old. He is a grad- uate of the law school of the University of Illinois and has practiced law fifteen years, with the exception of two years when he served as a commissioned officer during the World War. From 1922 to 1924 he served as district attorney, and in 1924 was president of the District At- torneys' State Association of Oregon.

Rapee Quits Air for Hollywood Job

Erno Rapee, who bade farewell to the audience of the Roxy "Gang," said au revoir to his Mobiloil audience over WEAJ. Mr. Rapee left for the Pacific Coast to take up the duties of musical director for the Warner Brothers.

Joseph Littau, who succeeded Rapee as conductor of the Roxy Symphony Or- chestra, conducted the musical group over WJZ. He paid a tribute to Mr. Rapee's fine work with the Roxy unit and said he hoped to continue along the same line.

BOARD UNJUST TO LABOR, SAYS WCFL COUNSEL

Washington.

Organized labor is being denied its en- titled position in the air by the repeated refusal of the Federal Radio Commission to give WCFL, Chicago, a cleared chan- nel, said Hope Thompson, counsel for the American Federation of Labor, address- ing the Senate Interstate Commerce Com- mission. He asserted WCFL is engaged in educational work, in spreading labor's gospel, and is not to be compared with stations that stress entertainment, such as jazz.

Too Great for This

"Radio is too great a thing to be used purely for entertainment," added Mr. Thompson. "It reaches the hearthstones of nearly every American home. Why should it be used to sing 'Old Pal' all the time, or pound the air with jazz music? This marvelous power that can help the people is just being prostituted."

He repeated his charge that a virtual monopoly of the air exists, and said the "powers that be" not only have all the choice frequencies, but are so influential Congress has not dared to face the situa- tion. Of the 90 channels labor should be given one free and clear at high power, he argued, whereas WCFL is restricted to daylight reception on 1,500 watts, a denial to labor of a national mouthpiece for its principles.

Wants No Domination

"I think it would be of greatest impor- tance that this entire field of communi- cations be kept entirely free of private domination," said Mr. Thompson. "The person or group which controls radio broadcasting in the years to come will control this Nation."

Mr. Thompson said he believed it is the duty of Congress to save broadcasting "from where it is going," but he declared that "it has got away from you already."

The Federation also was blocked in its efforts to establish a short wave chain for relaying, a plan based on the granting of a cleared channel to WCFL.

WCFL's appeal from the WCFL as- signment is now before the Circuit Court of Appeals.

Radio Ends Mule Messenger 'Boys'

Washington.

The Southern Radio Corporation, a subsidiary of the Standard Oil Company of New Jersey, is now engaging in direct radio communication between United States and the jungles of Bolivia where the Standard Oil Co. has extensive oil holdings.

Previous to the establishment of the radio circuit about six months ago, the Standard Oil Company sent its messages to Buenos Aires by cable, thence by a telegraph line, and finally by "mule back" to the oild fields. Sometimes as long as two weeks elapsed between the time the message was filed in New Jersey and the time of delivery. With the radio circuit the communication is practically instan- taneous.

CIGARETTE FIRM AGREES TO END BUNK AIR 'ADS'

Washington.

Bunk advertising by a cigarette manufacturer over a chain of radio stations and in printed advertisements in newspapers and magazines, will stop, the company stipulated to the Federal Trade Commission. Paid testimonials used by the cigarette manufacturer through his fervid advertising agency proved to have been not only bought, but in many instances utterly false, and not only false, but not even uttered by the testimonialist. The fat check brought the O. K. to use the celebrity's name on an endorsement, and an advertising copy writer did the rest.

A complaint against the broadcasting of this palpable bunk into homes, where heroes and heroines of the day were attesting to the health-inspiring effects of smoking this brand of cigarettes, while even children listened in, lost out before the Federal Radio Commission, which said it was powerless to act, as it had no censorship authority.

The Full Announcement.

The announcement of the Federal Trade Commission, exposing the campaign of bunk, and outlining the stipulation, follows in full text:

"A corporation manufacturing and selling cigarettes and other tobacco products has signed a stipulation with the Federal Trade Commission agreeing to discontinue certain practices. The facts are shown in the following statement:

"Stipulation No. 503.—Respondent, a corporation, engaged in the manufacture of cigarettes and other tobacco products and in the sale and distribution of the same in interstate commerce, in competition with other corporations, individuals, firms and partnerships likewise engaged, entered into the following stipulation of facts and agreement to cease and desist forever from the alleged unfair methods of competition as set forth therein.

"Respondent, as a means of soliciting the sale of and selling its products in interstate commerce, adopted and use numerous newspapers, magazines and other publications having interstate circulation, and wherein the said respondent, and/or its advertising agents or agencies, caused advertisements to be inserted in the aforesaid publications featuring what purported to be the testimonials of famous people who smoke respondent's products and found they protect from irritation.

Non-Smokers Endorsed, Too!

"Certain of said testimonials were obtained by respondent for a valuable consideration from the alleged authors thereof. The said advertising matter also contained a testimonial or endorsement purporting to be that of certain actresses in a musical show who were credited with the statement to the effect that through the use of respondent's cigarettes 'that's how we stay slender'; when in truth and in fact the said actresses were not cigarette smokers and did not stay slender through smoking of respondent's products.

"Further, in soliciting the sale of and selling its products in interstate commerce, the respondent caused certain of its advertising matter to be broadcast through a radio station located in a certain State and having a hook-up with radio stations located in other States of

South Carolina Asks Tax on Sets

Columbia, S. C.

A consumer tax on radio sets, with a penalty for failure to pay the tax, is proposed in a bill introduced in the South Carolina legislature.

the United States, the said advertising matter included a testimonial purporting to be that of a well-known musical comedy star and which, in part, set forth that the alleged author of the testimonial, when making a certain talking picture, smoked that brand of cigarettes, manufactured by respondent, and which because of the special treatment employed in the manufacture of said cigarettes, had been freed of all irritants with the result that the smoking of said cigarettes kept the alleged author in good shape and feeling peppy and his voice as clear as a bell in every scene; when in truth and in fact the aforesaid musical comedy star authorized the aforesaid testimonial and received a consideration for the above statement attributed to him but which statement he did not prepare, see prior to its use, or sign.

Cease and Desist!

"In addition to the use of the alleged testimonials, the respondent caused various forms of advertising matter to contain such statements as 'Every woman who fears overweight finds keen interest in new-day and common-sense ways to keep slender, fashionable figure,' 'Women retain slender figures,' and 'No longer need you face the rigid requirements of harsh dieting methods. Overweight is banished, etc'; when in truth and in fact health and vigor to men, slender figures to women and reduction of flesh in all cases will not necessarily result from the smoking of respondent's brand of cigarettes.

"Respondent, its officers, agents, representatives, servants, and employes, in soliciting the sale of and selling its product in interstate commerce, agreed to cease and desist from the use in newspapers, magazines, radio talks or other means of any and all testimonials and endorsements unless the same represent and are the genuine, authorized and unbiased opinions of the author or authors or the alleged author or authors thereof, and if a monetary or other consideration has been given for a testimonial, the said respondent shall public or cause to be published, along with said advertisements, in an equally conspicuous manner, the fact that said testimonials have been paid for.

Bunk Spared from Air, Too

"The said respondent, its officers, agents, representatives, servants and employes also agreed to cease and desist from using in advertising matter or in radio talks statements or representations to the effect that 'women retain slender figures,' and 'overweight is banished'; or any other statements, representations, or words in advertisements or advertising matter circulated in interstate commerce or in radio talks broadcast through hook-ups in various States of the United States and in interstate commerce so as to import or imply or which may have the capacity and tendency to mislead or deceive the purchasing public into the belief that the smoking of respondent's cigarettes will bring slender figures and cause the reduction of flesh in all cases.

"Respondent also agreed that if it should ever resume or indulge in any of the practices in question this said stipulation as to the facts may be used in evidence against it in the trial of the complaint which the Commission may issue."

OFF NIGHT AIR, WCBD ASSERTS VESTED RIGHT

Washington.

A petition for rehearing of its decision in the case of station WCBD, operated by Wilbur Glenn Voliva, overseer of Zion City, Ill., was filed with the Court of Appeals of the District of Columbia by John W. Guider, counsel for the station.

The decision of the court, rendered January 6th, involved WENR and WLS, of Chicago, as well as the Zion City station. The court stated the applications in question represented competitive claims of the three stations for operating time on the 870 kilocycle channel. It granted WENR an increase in operating time from two-sevenths to five-sevenths, and reduced WLS's time from five-sevenths to one-half. WCBD, which sought evening hours on the channel, was denied outright.

In the motion for rehearing Mr. Guider contends that the appeal of his station should not have been confined to the question of operating time on the 870 kilocycle channel alone, according to "The United States Daily." WCBD, which formerly operated on the 870 kilocycle channel during evening hours, sought not the right to use any particular frequency, but rather the right to broadcast during evening hours.

Wants to Be Winner

"It is respectfully submitted that the appellant is entitled to a decision by this court determining whether or not the substance of his request, namely, the privilege of broadcasting during the evening hours, is to be granted or denied," said Mr. Guider. "His rights in that respect are determined by a decision that a particular frequency should be divided between two other appellants to the exclusion of this appellant."

Among other things, Mr. Guider argues that the decision of the Federal Radio Commission on the application of WCBD "was rendered in plain disregard of the protective provisions of the radio act of 1927." Mr. Voliva, he continues, "had a property right in his station which was denied him by the decision of the Federal Radio Commission."

Extenuates on Property Right

"The property right of the appellant here has a dual aspect," continues the petition. "Conceding for the purposes of this argument that broadcasting is interstate commerce and that the Congress has the power to regulate broadcasting, the appellant nevertheless submits that:

"1. The regulation thus exercised must be reasonable, and if it is not reasonable the property right requires that the unreasonable regulation be held invalid.

"2. That where the regulation is held to be reasonable, and where the reasonable regulation destroys the value of the property, the property cannot be so diminished or destroyed unless the regulating law provides for the taking of that property by due process and with compensation."

Inquiries About Compensation

In conclusion the petition states that if it is held that the Commission's decision was a "reasonable regulation," then the radio act "is unconstitutional in that no provision is made for compensating the appellant for his property loss."

MOST PERSONS LIKED PROGRAM SENT OVERSEAS

The National Broadcasting Company has analyzed the comments on the exchange of radio programs with Europe on Christmas Day and the day after.

Among the thousands of letters were many bitter complaints against the predominance of popular music in America's contribution to Europe's radio Christmas.

But the final comparison showed that eleven persons considered the programs an excellent representation of American music, for every one who resented the jazz.

Foreigners Enthusiastic

Returns from England, Holland and Germany, where the American programs were rebroadcast clearly over national networks, were enthusiastic about the material selected.

Foreign listeners urge that such exchanges of entertainment be made more frequently.

Listeners of the European continent point out that American jazz there is all the rage and orchestras playing it are in great demand, but that the public is seldom privileged to hear such elaborate symphonic jazz as American listeners enjoy by the twist of a dial any night.

They further emphasize that even American orchestras abroad, except in the most important capitals, are unable to keep their music abreast of the latest products on Broadway, hence consider an authentic program of current favorites from the shows "as good as a trip to New York."

Comments From America

By far the greatest number of comments, however, was received from American listeners. A nation-wide audience here overheard the programs addressed to Europe as well as those sent here from London, Berlin and Amsterdam. Some of those who complained disliked certain parts of these foreign relays, and took occasion to point out the superiority of American programs over the general run abroad, judging by such samples.

But the majority of listeners realized the difficult problem facing program builders on both sides of the Atlantic, and recognized the impossibility of condensing a real cross-section of any nation's programs into the time available.

Hazeltine Prevails in Final of Patent Suit

Washington.

The decision of the Circuit Court of Appeals for the Second Circuit in the case of Wildermuth v. Hazeltine Corporation will not be reviewed by the Supreme Court of the United States.

The Hazeltine Corporation is the owner of the Hazeltine patent in suit, No. 1538858, covering "grid circuit neutralization," while the petitioner is a jobber, sued because he sold sets held to infringe the patent.

It was Wildermuth's contention that the Hazeltine patent was deliberately limited to "close coupling." However, it was pointed out, the Circuit Court of Appeals for the Second Circuit held that Wildermuth's "loose coupling" did infringe the Hazeltine patent.

Forum

What He Did With HB33

IN THE course of considerable experimenting, using the HB33 as the foundation, I have obtained such excellent results that perhaps others would like to know what I did.

First I took off the four shields, and found circuit uncontrollable, even with no B on grids of 22 tubes. I then hooked aerial and ground to fourth coil (detector), and found it a pretty good 4-tube set, with fine audio.

Substituting a high mu-40 tube for the 22, volume was greater; leaky-grid detection was found more satisfactory than grid-bias. I then added one stage of radio-frequency, bringing in coil 3, and had a good set.

When I added another stage the set became almost uncontrollable. I then took off all four coils, remounted three of them as far apart as practicable on same side of subpanel, and made larger shields, thus cutting out one stage of radio frequency. The energy absorption was as great as before.

I finally ran upon a solution. It is to use no shields, and to arrange the first three coils on the left side of subpanel as far apart as possible and at the Neutrodyne angle:

My set at present is as follows: first three coils as far apart as possible at at Neutrodyne angle feeding the first three tubes (22s). Half of the turns have been removed from the primary of aerial coil. Detector tube in place of first audio tube on your hookup, the input push-pull transformer having been pushed back nearer the output transformer, and fourth coil placed where the first transformer was. The angle of this coil makes little difference. The 240 high mu tube is used as detector, with grid leak-condenser detection. The front tube on left (112A) is first audio, and push-pull tubes as before, using, however, 171A tubes, as I have a dynamic speaker. The audio bias is 15-22 volts. The screen grid voltage is about 22, and 180 volts are used everywhere else.

Notwithstanding the elevation of condensers, I found it necessary to remove 10 turns from each secondary coil.

The Neutrodyne angle is gotten by test, and believe me it is critical! A little less and volume is cut fast, a little more angle and the receiver howls, but when it is right you can tune from one end of dial to other with no oscillation, and neither screen grid voltage nor front volume control rheostat particularly critical.

Last night I literally received America on this set, and this morning got 15 stations, loudspeaker volume, at 9 o'clock.

J. H. C. WINSTON,
Hampden-Sidney, Va.

* * *

R. W. O. K., But O. U. Reinartz!

IHAVE around twenty different radio magazines issued, and one of the most interesting is RADIO WORLD. Of the rest most went west. Only few left, but RADIO WORLD sticks it out. I have read it ever since it went on the news-stands. It always was a leader and we hope it always will be. You can find in it from time to time almost anything you want to know.

I would like to try my old Reinartz circuit again with one or two stages of radio frequency and await such a circuit.

JAMES C. HALEY,
St. Joseph, Mo.

\$3,500,000 FOR MAJESTIC 'ADS' IS 1930 BUDGET

Grigsby-Grunow Corporation, of Chicago, world's largest set manufacturers, makers of the Majestic line, have budgeted \$3,500,000 for advertising the receivers and Majestic tubes in 1930. Less poster and magazine advertising, more newspaper advertising, especially in afternoon papers, is planned.

The company produced about 25 per cent of all the sets made in the United States in 1929, or 1,000,000 sets, list price \$150,000,000, as compared with a \$490,000,000 value for all manufacturers.

Hopes to Reach \$600,000,000

The \$3,500,000 is not to be spent to finance struggling afternoon papers, but to patronize the leaders so \$600,000,000 worth of sets will be sold in a year, or four times as much as in 1929.

"The man is still the big factor in the purchase of sets, and we feel that the afternoon papers are our best bets in reaching men," said Duane Wanamaker, advertising manager.

Majestic distributors now have exclusive territory. A dual plan was given up as "not so hot."

Cites Benefits

"As a result of the exclusive territory plan," Mr. Wanamaker said, "the distributors in most cases have eliminated all other lines, and are now engaged exclusively in the Majestic business. The increased interest and support which they give to their single line of activity more than justifies the exclusive distribution plan.

"Our distributors all have their own advertising and promotion departments, and work closely with their dealers in promoting Majestic sales and tying up dealer effort with newspaper advertising placed directly by the manufacturers and by themselves."

Dealers Victimized by Radio Joy Riders

"There are many 'joy riders' on radio sets who keep them out on demonstration as long as they can work the dealers for them," said G. W. Weston, manager of the Kansas City Electrical and Radio Association, who presided at a session of the Society of Electrical Development, Inc., convening in New York. He suggested that each local association send the names of persons who take out sets

Representatives of various leagues reported that they were cooperating with their local better-business bureaus to eliminate false, misleading and unfair advertising from the radio.

New Magazine on Tubes

A new engineering magazine called "Electronics," to deal with the radio vacuum tube and its application in various industries, was announced by the McGraw-Hill Publishing Company, 370 Seventh Avenue, New York City. The first issue will appear in April.

CECO RELEASES PENTODE, STIRS TRADE FURORE

A furore was created in the radio industry by the announcement of a tube new to the American market by CeCo Manufacturing Company. The tube is called a pentode, because it has five elements: Cathode, plate, control grid, screen grid for the plate and screen grid between cathode and control grid.

The Radio Manufacturers Association, Inc., sent out a counter-announcement captioned, "Radio Makers Declare Pentode Tubes Not New Nor Give Better Service."

Back of this announcement by the association, comprising all important manufacturers, is resentment toward the springing of a tube new to the American market when set manufacturers are having a hard time selling their receivers requiring established tubes.

CeCo's announcement, sent out by its New York publicity representatives, read in full as follows:

CECO ENGINEERS PERFECT AC PENTODE TUBE

New Five-Element Tube Three Times As Powerful As Screen Grid—Will Cancel Need for Multi-tube Receivers—Makes Possible Lower Unit Cost for Sets—Called Greatest Advance in Radio Since Three-Element Tube Was Perfected Twenty Years Ago.

In the laboratories of the CeCo Manufacturing Company, Providence, R. I., tube engineers working under the direction of N. O. Williams, vice-president and works manager, after months of experimentation have perfected the AC pentode or five-element tube.

According to Ernest Kauer, president of the company, the pentode tube will represent as great an advance in radio as did the three-element tube back in 1906. Mr. Kauer summarized its principal features as follows:

- a—Three times as powerful as the screen grid tube.
- b—Capable of being utilized to its full efficiency.
- c—Cancels necessity of multi-tube receivers.
- d—Will lower manufacturing costs of sets.
- e—Will decrease maintenance costs for set owners.
- f—Through savings will greatly enlarge radio merchandise market.

Asserts Public Demand

"The public has been asking for receiving sets," said Mr. Kauer, "which do not employ so many tubes. This new development makes it possible to build sets which will satisfy that demand. Bringing, as it is bound to do, more simplicity into radio manufacture and receiver operation and maintenance, it will reduce manufacturing costs, material costs and therefore costs to the radio public."

Mr. Kauer did not believe that by the use of few-tube instead of multi-tube sets, the tube division of the radio industry would suffer.

"It means less tubes per family, but a great many more families will own receivers," he said. "The probabilities are that tube sales would be greater than ever."

Mr. Kauer said that the circuit worked out by the CeCo engineers for the use of the new pentode tube would be made available to manufacturers of radio receiving sets without obligation. He added:

"Our general sales manager, Larry Hardy, and Franklin Snow Huddy, assistant to our chief engineer, Mr. Williams, are soon to

start out on a visit to set manufacturers, to show them this new tube, how it works, what its possibilities are. Our engineering staff and our engineering facilities are available for co-operation on set-building problems. This is a service tube makers owe to set makers and we are eager to render all the aid we can."

The new tube is a sort of double screen-grid, having a screen grid around the plate, as is the case with the screen grid of the present; also another screen between the control grid and the cathode. The insertion of this second screen permits a greatly increased amplification; three to four times as great as the screen grid.

Mr. Williams, CeCo's chief engineer, who since his graduation from Pennsylvania State College has spent his entire working life in tube research and manufacture, said the new pentode tube will realize the hopes which were entertained of the so-called screen grid or four-element tube.

"The screen grid is a very wonderful tube," Mr. Williams said, "but the radio industry has not been able to develop a receiving circuit which permits the use of the tube's full efficiency. Nor is such a circuit likely to be developed. There are too many difficulties in the way."

"The easier method has been to center research on the development of a newer tube which would make possible the building of a circuit capable of getting out of the tube all the power and valuable attributes inherent in it. This is what we have done in the case of the pentode."

Statement for RMA

The release sent out by the Radio Manufacturers Association, Inc., 11 West 42nd St., N. Y. City, was as follows in full:

RADIO MAKERS DECLARE PENTODE TUBES NOT NEW NOR GIVE BETTER SERVICE.

To advise the radio public and industry correctly and authoritatively regarding the "new" pentode radio tube, the Radio Manufacturers Association, comprising all important manufacturers, today issued a statement regarding the pentode. It was declared neither new nor revolutionary. No improvement in performance can be obtained with pentodes that cannot be had with present tubes, the official statement declared, and it is unlikely that pentodes will replace present tubes this year.

The statement was prepared by Mr. Walter E. Holland, a prominent radio engineer of Philadelphia, and director of the Engineering Division of the Radio Manufacturers Association, after consultation with other leading radio engineers.

"Nothing New"

"There is nothing new or revolutionary about pentodes," said Director Holland. "No improvement in performance can now be obtained with pentodes that cannot be had with present tubes. A given result is impossible with less tubes, using pentodes, but it is unlikely that the cost of a complete radio receiver would be any less."

"The pentode is used more widely in England because of the greater popularity of battery operated portable sets, and because patent licenses are based on the number of tubes in the receiver. Reduction of number of tubes has, therefore, been more important in England, just as low-powered automobiles are more popular there on account of the license taxes being based upon horsepower of the motor. These factors are not important in this country, so that there is no advantage here at present in either low-powered automobiles or pentodes."

Summarizing the development in Europe of the pentode tube and experimental work in this country, Director Holland added:

"The pentode tube has long been known abroad and has found limited commercial use there, especially in England. Many radio receiver and vacuum tube engineers in this country have experimented with this type of vacuum tube, and are thoroughly familiar with its characteristics and possible applications."

"The pentode, as the name implies, has

NEW TUBE OLD, NO NEED FOR IT, TRADE RETORTS

five electrodes or electrical elements. It has the usual cathode and plate, but between these elements there are three grids or screens as compared with two in the tetrode, commonly known as the screen grid tube.

"The pentodes developed abroad are designed for use in the last audio stage, where we use triode power tubes, such as the 245 and 250 tubes.

Use as RF Amplifier

"There is a possible application of the pentode to radio frequency circuits, but it is unlikely that this type of tube will prove of much practical importance as a radio frequency amplifier. All it could do would be to reduce the number of stages of amplification required for a given sensitivity. The elimination of a stage of radio frequency amplification ordinarily means a reduction in the number of tuned circuits, and such a reduction is impracticable for the reason that a given number of tuned circuits is essential to give the high degree of selectivity needed under the broadcasting conditions existing in this country.

"The pentode power tubes used abroad have greater sensitivity, and, therefore, provide higher amplification per stage than our triode power tubes. This makes it possible to eliminate a stage of audio amplification and work from the detector directly into a single power stage without overloading the detector or the radio frequency amplifier tubes.

Disadvantages Listed

"Another advantage is that it is possible with pentodes to obtain greater undistorted output where the plate voltage is limited, as in battery receivers and receivers for operation on the 110 volt direct current supply used in certain sections of a few cities.

"Against the above advantages the pentode has a number of disadvantages. It is a most difficult tube to manufacture with uniformity owing to its complexity, and to the fact that it must be exhausted to an extremely high degree of vacuum. Non-uniformity of pentodes will make greater differences in the operation of a radio receiver than with tubes of the present type. It is inherently a high-cost tube.

"In radio receivers for use on the common alternating current supply used for house lighting, the pentode presents a more difficult problem from the standpoint of manufacturing cost, than the standard type of power tube. With present power tubes of the 245 type it is almost universal practice to use two tubes connected in push-pull circuit to reduce hum and improve the quality of reproduction.

Pentodes in Push-Pull

Owing to the high cost of pentodes and the greater complexity of the circuits, it is a question whether it is practical to use pentodes in push-pull. On the other hand, if a single pentode is used to give the same result as two triode power tubes in push-pull, the cost of the filter, required to smooth out the ripple in the rectified alternating current, will come up probably enough to more than offset any possible saving in eliminating the power tube and the usual first stage of audio amplification. In addition a larger and more expensive output transformer would have to be used on account of the high direct current flowing in one direction in the primary winding of the transformer.

NOW RECEIVER IS ASKED FOR DE FOREST CO.

Following the receiverships of Sonora, Earl and Kolster, came an action in Paterson, N. J., by H. C. von Korff, of Staten Island, New York City, for a receivership for the DeForest Radio Corporation, of Jersey City, N. J. The petitioner says he owns 1,300 shares, and alleges fraud in a stock transaction as well as operation at a loss and issuance of a false financial statement. The petition was filed with the Court of Chancery.

Mr. von Korff charged that a fraud had been perpetrated on stockholders in the De Forest Company when 345,680 shares of the De Forest stock were traded for 604,940 shares of the Jenkins Television Corporation.

The petition charges the De Forest Corporation with having issued the false financial statement in September, 1929, showing profits of \$261,000, when it was operated at a loss.

Alleged Fraud Detailed

The alleged fraud in the stock transaction, the petitioner set forth, consisted of the identity of interests between officers of the two corporations, and he pointed out James W. Garside was president of both corporations, adding the Jenkins stock was worth only fifty cents a share at the time of the transaction, as if the De Forest stock was worth only about \$1 a share. Patent rights represented extra value, he admitted, but were carried on the Jenkins books at a fanciful figure.

Little faith, indeed, does Mr. Korff place in the conduct of the Jenkins Corporation or its contributions to the practical art of radio-vision. Although the De Forest Corporation acquired a majority of the Jenkins stock by the transaction, what was there to it, asks the petitioner, but a business with no income, no immediate prospects, yet a propensity for eating into capital investment to finance multifarious experiments and experiments and experiments, all business, if any, being transacted at a loss.

In June, 1929, De Forest stockholders subscribed for additional De Forest stock at \$7 a share, 164,109 shares, all told, which netted \$1,148,763, but \$143,244 of this is unaccounted for, states the petitioner.

Says Plant is Closed

The main business of the De Forest Corporation is the manufacture of tubes and accessories. Dr. Lee De Forest, inventor in 1906 of the three-element tube and recently elected president of the Institute of Radio Engineers, is associated with the corporation in an engineering capacity, and his name and photographs are used freely in advertising the De Forest tubes.

The De Forest Corporation, says von Korff, is now operating at a loss, and its Jersey City plant is shut down.

The De Forest Corporation went through one receivership early in 1926. A "friendly receivership action," marked by some bitterness, was started against the corporation in Delaware by Dr. De Forest and William H. Priess, a stockholder. Dr. De Forest alleged at the time that within two and one-half years the company had lost \$1,250,000 through mismanagement. As a result of this action virtual control of the De Forest company passed to W. R. Reynolds and associates.

Garside Pledges Vigorous Contest

James W. Garside, president of the De Forest Radio Corporation, was flabbergasted when he learned that a stockholder had petitioned for a receivership. He got in touch with the corporation's lawyers at once, and in answer to a request for comment, said:

"A most vigorous contest will be waged to prevent a receivership, as not only is none justified, but the very petition itself is fallacious and unfair. The action was taken late Saturday afternoon and no opportunity given to combat the allegations at once.

"The whole petition is without foundation in fact. The entire document appears to have been prepared by some one entirely unfamiliar with the facts concerning the De Forest Radio Company and the Jenkins Television Company."

NO SCOOP, RCA SAYS OF TUBE

RCA did not like the idea of CeCo springing a pentode at this time. Agreeing there was no present need for one a representative of RCA said:

"We are fully aware of the pentode tube and its possibilities. We have been experimenting with the tube for some time and no one is ahead of us."

It so happens the tube was announced when there was already a terrific sag in the tube market. Factories that made \$100,000 in three months last year, making tubes, reported they were losing money now. In fact, some tube plants have stopped making tubes, temporarily. RCA, however, is very active.

Radiotron Company Unifies 3 Activities

The RCA Radiotron Company, Inc., was formed recently by Radio Corporation of America, Westinghouse and General Electric. It takes over the tube manufacturing and sales of the three parent organizations.

With its five factories located at Harrison, Newark, Cleveland and Indianapolis, the RCA Radiotron Company, Inc., says it is the largest producer of radio tubes in the world. These factories provide 1,147,000 square feet of floor space, will employ 5,500 people, and have an output of 210,000 tubes a day. The total output and sales exceed those of all other American manufacturers, says Radiotron Co.

Senators Are Asked to Question Mitchell

Washington.

Dereliction of duty was charged to the Attorney General's office by Oswald F. Schuette testifying before a Senate committee that the Attorney General refuses to act against "the radio trust." He asked that the committee call Attorney General Mitchell to testify why no action was taken under the anti-monopoly laws.

Schuette is executive secretary of the Radio Protective Association, which he says consists of independent set and accessory manufacturers.

KOLSTER HEAD MADE \$698,000 ON ITS STOCK

At a hearing on a petition for the appointment of a receiver for the Kolster Radio Corporation, which has factories in Newark, N. J., and Toronto, Can., Albert Schwartz, a lawyer of Paterson, N. J., speaking for himself as a stockholder of 400 shares, charged that the stock market for Kolster shares had been "rigged." The equity court in Newark appointed three as receivers—Harry J. Hendriks, real estate; Harry Meyers, bank president, and Ellery W. Stone, Kolster president—and named John A. Bernhard, Newark attorney, special master for the Court of Chancery to investigate the "rigging" charge.

Stone Testifies

Mr. Stone was called as a witness a few days later and testified that during the bull market on stocks, by trading in the open market strictly "on his own," he bought and sold 14,000 shares of Kolster stock, during about two years, up to June, 1929. His profit, he testified, was \$698,000. There was no "manipulation" of this stock, he said, and he denied knowledge of any pool, besides stating he never sold the stock short.

"I made all my purchases in the open market, hoping to make a profit as I had previously done, and having in mind," he said, "the dizzy heights to which stock of the Radio Corporation of America was then soaring."

High 95%—Low 2¼

The high of Kolster stock was 95%, attained in 1928, and the price finally declined with the market crash. Then the receivership caused another slump, until 2¼ was reached.

Mr. Stone testified he bought some shares at \$94, which was near the "high." At that time the earning was \$10 and the book value \$12 a share. Later, in September, 1929, he learned for the first time that the company was operating at a loss. He ascribed this to over-production by set manufacturers, occasioned by fierce competition.

Spreckels Testifies

At a later hearing before Mr. Bernhard, Rudolph Spreckels of San Francisco, Chairman of the board of directors of the Kolster Radio Corporation, testified he sold 254,976 shares of Kolster common in November, 1928, out of 387,504 shares he acquired by transactions in the latter part of 1927 and the early part of 1928. His present holdings, Mr. Spreckels said, consisted of 18,219 shares of common and 57,246 preferred, the difference being accounted for by other sales and gifts of stock.

He said he had lent the company \$500,000 and had endorsed notes amounting to \$1,350,000.

Mr. Spreckels denied having done any "rigging" and stated that he had disposed of his holdings in the Kolster company solely because he needed the money for the Federal Sugar Refining Company, of which he has been manager since 1927.

He denied emphatically that he had "run out on the stockholders," adding that if he had done so he would not have underwritten the 54,246 shares of preferred stock in 1929 after Kissell, Kinnicut & Co. had refused to do so, nor would he have lent the company half a million and endorsed its notes.

GLOBE REPORTS ON HOW KING'S VOICE CAME IN

Some of the reports on reception abroad of the speech by King George of England, etc., opening the London Naval Conference, were a little late coming in, or were crowded out of last week's issue, accept which excuse you like. So here goes for some more inside information of outside reception, remembering we are not only talking about a king, but one might say The King.

If listeners believed that any chances were being taken that they were would miss the royal treat due to engineering oversight they were much mistaken, because chains had several short wave receivers doing the pickup, the NBC had as many as four focused on 5SW alone, as well as others on Holland, Swiss and other short wave stations that were sending out the program. Occasional switches from one of the four were made for clarity. Likewise the CBS had this type of air insurance. The chains were taking no chances that for the six minutes of the King's speech the listeners could tune in any other program. The royal monopoly of the air was complete.

Came In Fine In England

Reports from overseas described the reception in other countries as, in general, good. His Majesty's voice came in fine in England, as it would have been treason to the best broadcasting traditions for it to have come in otherwise, when San Francisco liked the sparkling clarity so much. Australia did not fare at all well, and this gave rise to repeated hints that the Empire again wasn't doing so well by its Antipodean. The signals were received on short waves via Manila, but the best that could be said was that His Majesty's first few words were intelligible, and persons who had heard the voice before could recognize it, but whatever the King said after that successful opening had to be ascertained later from the newspapers. Manila picked up on 25 meters from Chelmsford and transmitted on 32 meters, both waves having been successful on previous important occasions.

Indeed, after His Majesty had finished, the speakers came in well enough, especially Tardieu. Every word he uttered could be understood, said a listener who did not know French. Some static gave Tardieu tough sledding for brief periods, but the complaint was that he talked too fast. However, not for a Frenchman, or a foreigner who had been in France.

Japan did not like the results so far as the King was concerned. His voice was loud but distorted, said Japanese, usually ready to say the kindest things. However, when M. Wakatsuki spoke, everything was fine. Again, knowledge or understanding of the language used seemed to help somewhat. Matters were made worse suddenly by a Russian station that was sending out a piano solo very loud, but not necessarily mischievously, although one never can tell.

This station is located at Khabarovsk, in case any one wants to write in a complaint direct to the station.

You Can Guess

India had good luck. Everything was received in pomme pie sequence, especially the remarks of—you can guess the answer yourself—Sir Atul Chatterjee, the Indian delegate.

Literature Wanted

THE names and addresses of readers of RADIO WORLD who desire literature on parts and sets from radio manufacturers, jobbers, dealers and mail order houses are published in RADIO WORLD on request of the reader. The blank at bottom may be used, or a post card or letter will do instead.

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Alvah F. Sneed, Box 114, Handley, Texas.
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W. Woelpee Jr., 1506 Walnut St., Philadelphia, Pa.
J. G. Mullan, 248 Edmund Pl., Detroit, Mich.
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Wm. L. Smith, 103 Waco St., Wichita Falls, Tex.
A. Perry, 295 W. 147th St., New York City.

WANTS RALEIGH LICENCE

Washington.—W. A. Wynne, of the Wynne Radio Co., of Raleigh, N. C., wants to build a new 50-watt broadcasting station for operation on the 1,210-kilocycle channel, with unlimited time. He said the territory is inadequately served with radio facilities.

STORE SPEAKERS CALLED NOISY; BILL ASKS CURB

Albany, N. Y.

State Senator Benjamin Antin, Democrat, of the Borough of the Bronx, in New York City, has introduced a bill providing that it shall be a misdemeanor for any person to operate radios, phonographs, or other sound-producing devices in such manner as to disturb the quiet or public peace.

Senator Antin said that he was trying to assist Dr. Shirley W. Wynne, New York Health Commissioner, and the Commissioner's Noise Abatement Commission in New York City. The bill is especially aimed at radio stores that operate loudspeakers on the sidewalks with such volume that they disturb people in buildings nearby, and even in the streets.

In commenting on the bill he had introduced, Senator Antin expressed the belief "that those who seek to operate amplifying sound devices from the front of stores should do so only under proper licenses to be issued by the proper officials, and that none should be permitted to operate within 250 feet of schools, churches and hospitals while these institutions are in use.

WOR, Newark, N. J., is assisting Dr. Wynne by reminding its listeners at 11 p. m. that they should turn their loudspeakers down so as not to disturb the neighbors who at that time may be trying to sleep. The announcement mentions that it is pursuant to a request from Dr. Wynne.

Home RF Talkies Are Demonstrated

Home radio talkies, or synchronized sight and sound broadcasting, left the laboratory and appeared before the public for the first time at the Lauter Auditorium, Newark, N. J. The demonstration of Jenkins equipment was given under the auspices of D. W. May, Inc.

That the demonstration is not so much a technical advance as a practical exhibition, is the point emphasized by D. E. Replogle, treasurer of the Jenkins Television Corporation. He pointed out that while other demonstrations of radio television or radiovision have been given in the past, the Newark exhibition is the first public demonstration of combined and synchronized sight and sound broadcasting, utilizing equipment now offered to the public for use in the average home within those territories served by an electric power system common with that of the transmitter.

Fenway Puts Sets In Automobiles Now

Leo Fenway, famed among circuit builders for the Fenway Superheterodyne and the Concertrola, is now engaged in the specialty of installing his own receiver design in automobiles. He is one of the owners and executives of Motoradio, Inc., 6212 Thirty-ninth Avenue, Woodside, Long Island (N. Y.).

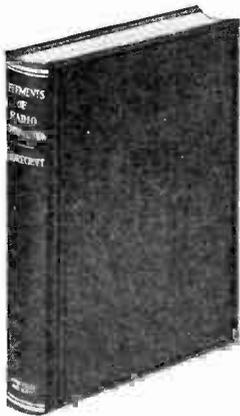
He reports that the interest in radio sets for auto installation is higher than ever before and that the business on Long Island is thriving.

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By the same author: "Principles of Radio Communication," second (new) edition. This book is for advanced students. It is the standard of excellence in its field. It covers much the same ground as the later book, only much more fully and more technically. Contains 1,001 pages, 831 illustrations. Cloth bound. Order Cat. MP @ \$7.50

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The need for an elementary book on radio tubes that answers all the important questions has been filled by James A. Moyer, Director of University Extension, Massachusetts Department of Education, and John F. Wostrel, Instructor in Radio Engineering, Division of University Extension, Massachusetts Department of Education.

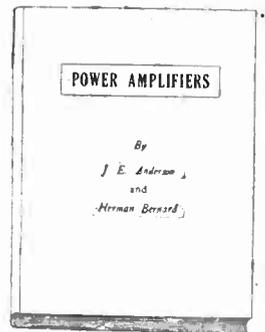
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[NOTE: The standard book on tubes for advanced students is "The Thermionic Vacuum Tube," by Hendrik Van der Bijl. Order Cat. VDB @ \$5.00]

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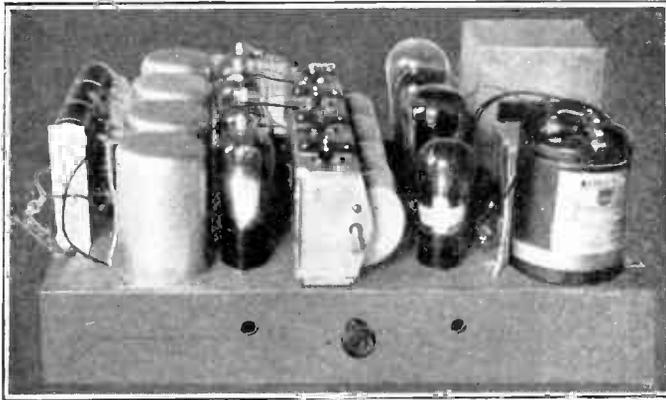
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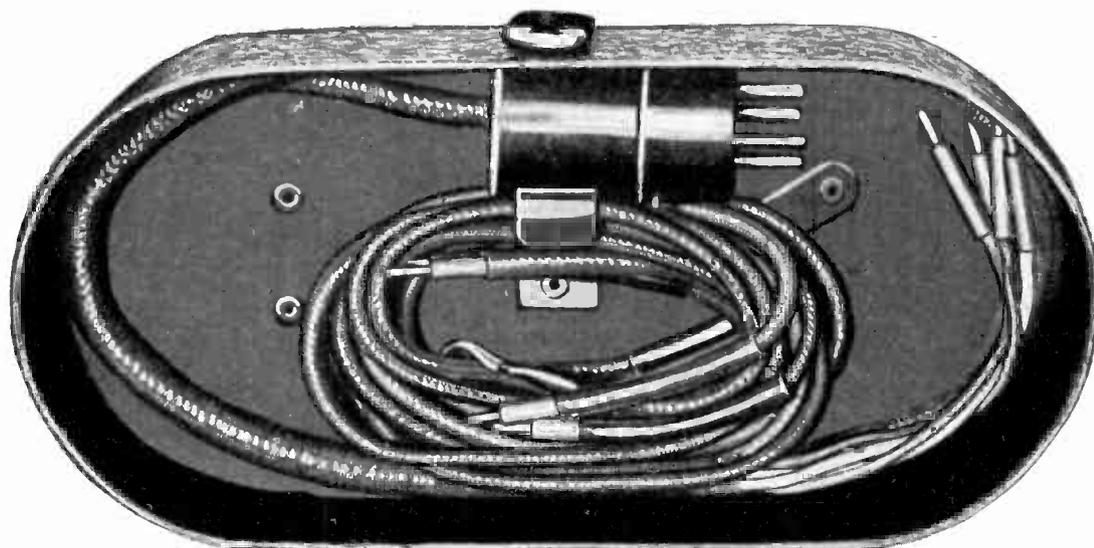
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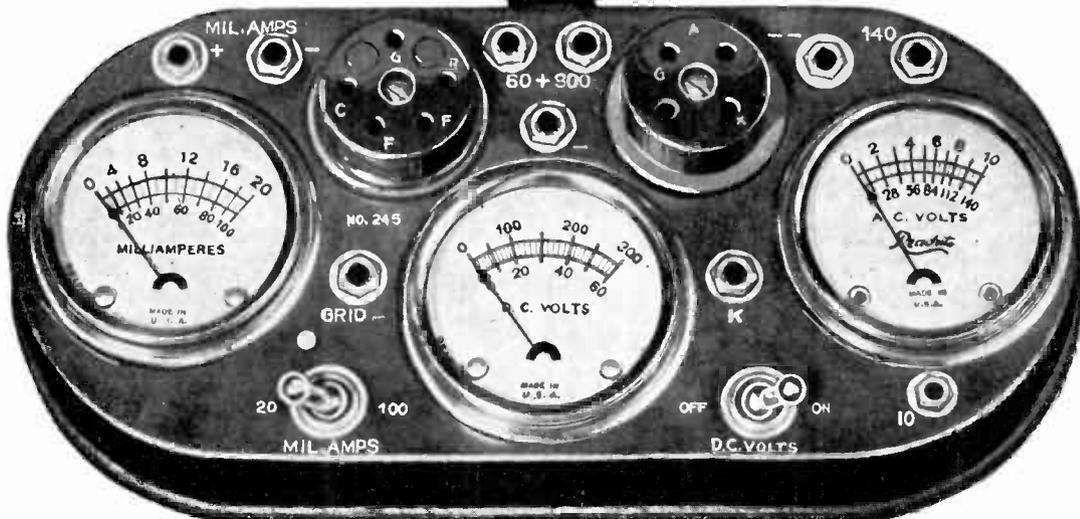
NEW J-245-X TROUBLE-SHOOTING JIFFY TESTER

Illumination Continuity and Polarity Tester FREE with Each Outfit!



Your Price
\$15.82

Complete



Illumination Tester. Vest Pocket Size. Shows Shorts and Opens Visually, also polarity of DC line. A Neon lamp is built in.



The three-meter assembly, in the crackle-brown finish carrying case, with slip-on cover in place. The handle is genuine leather. The buckled strap holds the cover on.



Illustration above is 2/3 scale.



J-111 Multiplier: upper left, with tip; below it, J-106 Multiplier with tip; plugs, left to right, J-18, conforms UV socket to UX plug; J-20, conforms UX tester socket to UV199 tube; J-24, to test Kellogg and old style Arcturus tubes.



Makes All Necessary Tests in a Jiffy and Simplifies Service Work!

WHEN servicing a radio set, power amplifier, speech amplifier or sound reproduction or recording equipment, the circuits and voltages are almost inaccessible, unless a plug-in tester is used.

The Jiffy 245-X plugs in and does everything you want done. It consists of:

- (1)—The encased three-meter assembly, with 4-prong (UX) and 5-prong (UY) sockets built in; changeover switch built in, from 0-20 to 0-100 ma.; ten vari-colored jacks, five of them to receive the vari-colored tipped ends of the plug cable; grid push-button, that when pushed in connects grid direct to the cathode for 224 and 227 tubes, to note change in plate current, and thus shorts the signal input.
- (2)—4-prong adapter for 5-prong plug of cable.
- (3)—Screen grid cable for testing screen grid tubes.
- (4)—Pair of Test Leads for individual use of meters.
- (5)—J-106 Multiplier, to make 0-300 DC read 0-600.
- (6)—J-111 Multiplier, to make 0-140 AC read 0-560.
- (7)—Two jack tips to facilitate connection of multipliers to jacks in tester.
- (8), (9), (10)—Three adapters so UV199 and Kellogg tubes may be tested.
- (11)—Illumination Tester.

The illumination tester will disclose continuities and opens and also the polarity of DC house mains. It is as handy as a pencil and fits in your vest pocket. It works on voltages from 100 to 400. There are two electrodes in a Neon lamp in the top of the instrument. On AC both electrodes light. On DC only one lights, and that one is negative of the line, the light being on the same side as the lead. Hence the illuminator shows whether tested source is AC or DC, and if DC, which side is negative.

Even the output of the speaker cord will show a light. Also, the device will test which fuses are blown in fused house lines, AC or DC. Besides it tests ignition of spark plugs of automobiles, boats and airplanes, also faulty or weak spark plugs.

Just flash on the illumination tester momentarily. It will last about 4,000 flashes

THE new Jiffy Tester, J-245-X, is a complete servicing outfit. It consists of a three-meter assembly in a metal case, with slip-on cover and a cable plug. There are ten adapters. It is vital to have the complete outfit so you can meet any emergency.

With this outfit you plug the cable into a vacated socket of a receiver, putting the removed tube in the tester, and using the receiver's power for making these tests: plate current, up to 100 milliamperes; plate voltage up to 300 volts; filament or heater voltage (AC or DC), up to 10 volts.

Each meter may be used independently. One of the adapters—a pair of test leads, one red, the other black, with tip jack terminals—serves this purpose. Multiplier J-106 extends the range of the DC voltmeter to 600 volts, but this reading must be obtained independently, as most readings on the 0-60 scale of the DC voltmeter. Independent reading of the AC voltmeter for line of voltage is necessary; also to use 0-140 scale while Multiplier J-111 extends the AC scale to 560 volts for reading power transformer secondaries.

The other adapters permit the testing of special receiver tubes, so that tests may be made, in all, of 22 different tubes: 201A, 200A, UX199, UV199, 120, 240, 171, 171A, 112, 112A, 245, 224, 222, 228, 280, 281, 227, 228, 210, 250. Kellogg tubes and old style Arcturus tubes.

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Please send me on 5-day money-back guaranty your J-245-X Jiffy Tester, complete, with all 10 adapters, and with illuminated Tester FREE with each order. Also send instruction sheet, tube data sheet and rectifier tube testing information.

Enclosed please find \$15.82 remittance. Ship at your expense. [Canadian must be P.O. or Express M.O.]

Please ship C. O. D. @ \$15.82 plus cartage and P.O. fee.

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O-1 MA, \$5.95

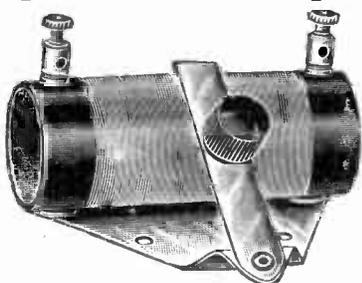


Here is a 0-1 milliammeter, accurate to plus or minus 1% clearly legible to two-one hundredths of a milliampere at any reading (20 microamperes). This expertly made precision instrument is offered at the lowest price so far for a 0-1 ma. Order Cat. FO-1 at \$5.95. C. O. D. orders accepted.

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New York City

AERIAL TUNER

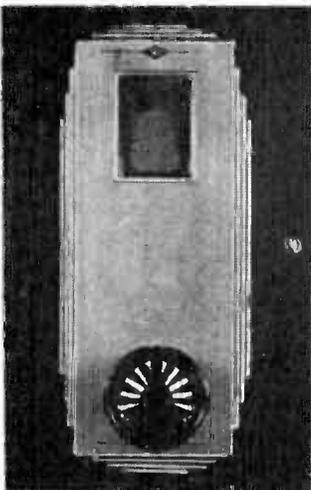
Improves Your Reception



Remove aerial lead from set. Connect aerial instead to one of the binding posts of the Aerial Tuner. Connect the other binding post of the Aerial Tuner to antenna post of your set. Then move the lever of the Aerial Tuner until any weak station comes in loudest. The lever need not be moved for every different frequency tuned in. The Aerial Tuner acts as an antenna loading coil and puts the antenna's frequency at any frequency in the broadcast band that you desire to build up. Price, 85c.

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NATIONAL
MODERNISTIC PROJECTION DIAL
WITH RAINBOW FEATURE



Modernize the appearance of your receiver by installing the brilliant new National dial, with color wheel built in, so that as you turn the dial knob one color after another floods the screen on which the dial numbers are read. On this screen the numbers are projected, so that you get the same dial reading from any position of the eye. This is just what DX hunters want—laboratory precision of dial reading.

The escutcheon is of modernistic design. The Velvet Vernier mechanism drives the drum superbly. Order today. Remit with order and we pay cartage. Shipments day following receipt of order.

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180 Volts (280 Tube Free)



Lowest Model National Velvet-B, Type 8880, is handsome crackle finish black metal casing, for use with sets up to and including six tubes. Input 105-120 volts AC, 50 to 60 cycles. Output 180 volts maximum at 35 milliamperes. Three variable output intermediate voltages. (Det., RF, AF). Eliminator has excellent filter system to eliminate hum, including 30 henry choke and 18 mfd Mershon condenser. No motorboating! (Eliminator Licensed under patents of the Radio Corporation of America and associated companies.)

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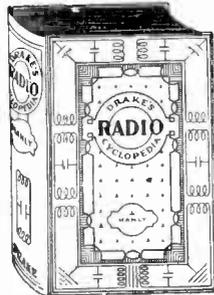
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Each rule, fact, method, plan, layout and diagram is instantly picked out and separated from everything else by placing all subjects in alphabetical order with cross references for every imaginable name under which the information might be classed.

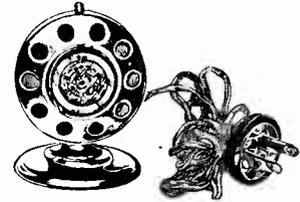
This alphabetical arrangement lets the experienced worker refer directly to the one thing in which he is interested at the moment without hunting through non-essentials. The needs of the beginner are cared for.

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Model A lighter, microphone design, with 5-ft. AC cable and plug. Works on 110 volts, AC any frequency and on direct current. Price \$1.00



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he heater element is renewable. Price 35 cents.

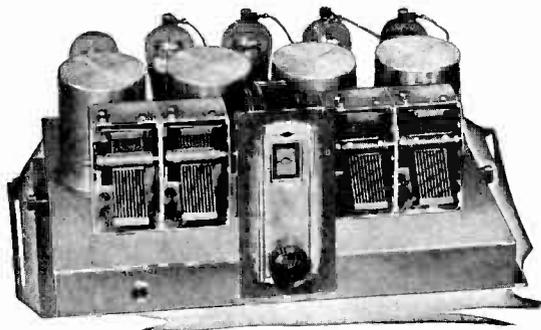
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- Please send me Model A Microphone Lighter at \$1.00.
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The most sensitive tuned radio frequency tuner so far developed, the MB-29 is long on distant reception, and penetrates seemingly unsurmountable barriers to reception. On the MB-29 the stations come in no matter where you are. The MB-29, designed by James Millen and Prof. Glen H. Browning, is the choice of the most discriminating. It is designed only for AC operation, uses four stages of screen grid BF and a power detector (227). Use 135 to 180 volts on the detector. Testimonials from radio's hardest-boiled experts prove this is the circuit of circuits. Buy the parts and find fullest radio delight. You will be sure nobody else has a tuner as good as yours, unless he has an MB-29. Complete component parts for National Screen Grid Tuner MB-29, mounted on frosted aluminum chassis, including rainbow modern-lytic drum dial HC. Order catalog No. MB-29-K, list price, less tubes, \$69.50. Your price

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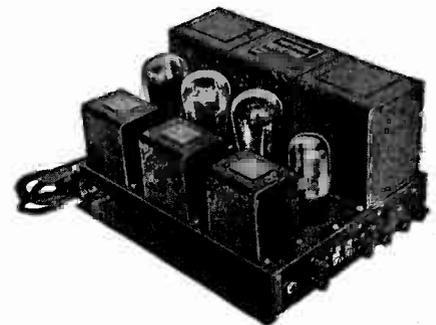
MB-29

Push-Pull Amplifier

The National Velvetone Push-Pull Power Amplifier (shown at right) consists of an AC-operated filament-plate supply, with two stage transformer audio amplifier and output transformer built in. Made only for 110-V., 50-60 cycles. Sold only in completely wired form, licensed under RCA patents.

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View of National Velvetone Push-Pull Power Amplifier, an expertly made A, B and C supply and audio amplifier, producing marvelous tone quality.

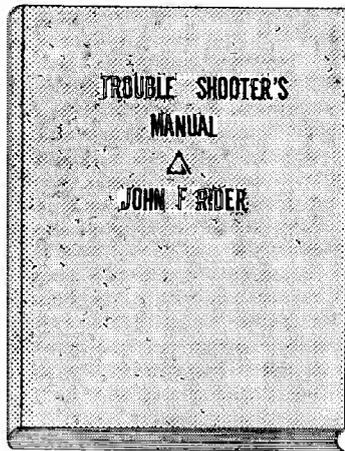
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THREE IMPORTANT BOOKS FOR SERVICE MEN!

- "Trouble Shooter's Manual"** *The most popular and fastest-selling book in radio today. Wiring diagrams of commercial receivers are contained in this outstanding book.*
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- These Three Books by John F. Rider Constitute an Outstanding Asset to All Possessors!



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is the first comprehensive volume devoted exclusively to the topic. The 240 pages include 200 illustrations devoted to wiring diagrams of factory-made receivers, besides other illustrations. It is not only a treatise for service men, telling them how to overcome their most serious problems, and fully diagramming the solutions, but is a course in how to become a service man.

This book is worth hundreds of dollars to any one who shoots trouble in receivers—whether they be factory-made, custom-built or home-made receivers.

Besides 22 chapters covering thoroughly the field of trouble shooting, this volume contains the wiring diagrams of models, as obtained direct from the factory, a wealth of hitherto confidential wiring information released for the first time in the interest of producing better results from receivers. You will find these

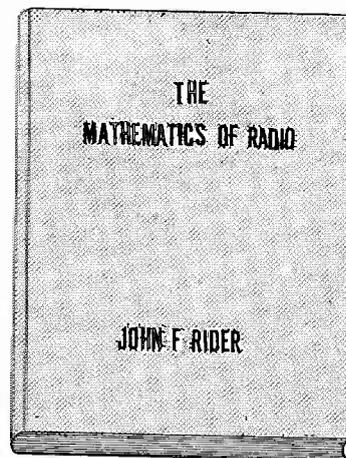
diagrams alone well worth the price of the book. The wiring diagrams are of new and old models, of receivers and accessories and as to some of the set manufacturers, all the models they ever produced are shown in wiring diagrams! Here is the list of receivers, etc., diagrams of which are published in this important and valuable book:

Wiring Diagrams of All These Receivers

- R. C. A.** 60, 62, 20, 64, 30, 105, 51, 16, 32, 50, 25 A.C., 28 A.C., 41, Receptor S.P.U., 17, 18, 33.
- FEDERAL** Type B series filament, Type B series filament, Type D series filament, Model K, Model H.
- ATWATER-KENT** 10B, 12, 20, 30, 35, 48, 32, 35, 40, 38, 36, 37, 40, 42, 52, 50, 44, 43, 41 power units for 37, 38, 44, 43, 41.
- CROWLEY** XL, Tridyn 3R3, 601, 401, 401A, 608, 704, B and C supply for 704, 704A, 704B, 705, 706.
- STEWART-WARNER** 300, 305, 310, 315, 320, 325, 330, 335, 340, 345, 350, 355, 360, 365, 370, 375, 380, 385, 390, 395, 400, 405, 410, 415, 420, 425, 430, 435, 440, 445, 450, 455, 460, 465, 470, 475, 480, 485, 490, 495, 500, 505, 510, 515, 520, 525, 530, 535, 540, 545, 550, 555, 560, 565, 570, 575, 580, 585, 590, 595, 600, 605, 610, 615, 620, 625, 630, 635, 640, 645, 650, 655, 660, 665, 670, 675, 680, 685, 690, 695, 700, 705, 710, 715, 720, 725, 730, 735, 740, 745, 750, 755, 760, 765, 770, 775, 780, 785, 790, 795, 800, 805, 810, 815, 820, 825, 830, 835, 840, 845, 850, 855, 860, 865, 870, 875, 880, 885, 890, 895, 900, 905, 910, 915, 920, 925, 930, 935, 940, 945, 950, 955, 960, 965, 970, 975, 980, 985, 990, 995, 1000.
- GREBE** MU1, MU2, synchrophase 5, synchrophase AC6, synchrophase AC7, Deluxe 428.
- PHILCO** Philco-electric, 82, 86.
- KOLSTER** 4-tube chassis used in 6 tube sets, tuning chassis for 7 tube sets, power amplifier, 7 tube power pack and amplifier, 6 tube power pack and amplifier, 6 tube power pack and amplifier, rectifier unit K-23.
- ZENITH** 39-39A, 392, 392A, 40A, 35PX, 35APX, 352X, 352APX, 37A, 35P, 35AP, 352P, 352AP, 34P, 342P, 33, 34, 35, 35A, 342, 352, 352A, 362, 31, 333, 353A, power supply ZEL12.
- MAJESTIC** 70, 70B, 180, power pack 7BP3, 7P6, 7P3 (old wiring) 8P3, 8P6, 7BP6.
- FRESHMAN** Masterpiece, equaphase, G, G-60-S power supply, L and LS, Q15, Q, K60-S power supply.
- STROMBERG-CARLSON** 1A, 2B, 501, 502, 523, 524, 635, 638, 403AA power plant, 404 RA power plant.
- All-AMERICAN** 6 tube electric, 8 tube 80, 83, 84, 85, 86, 88, 6 tube 60, 61, 62, 65, 66, u and 8 tube A.C. power pack.
- DAY FAN** OEM7, 4 tube, 5-5 tube 1925 model, Day Fan 8 A.C., power supply for 6 tube A.C., B power supply 5524 and 5525, motor generator and filter, 6 tube motor generator set, 6 tube 110 volt D.C. set, 6 tube 32 volt D.C. set.
- FADA** 50/80A receivers, 460A, Fada 10, 11, 30, 31, 10Z, 11Z, 30Z, 31Z, 16, 17, 32, 16Z, 32Z, 18, 18, special, 192A-192S and 192BS units, R80A, 480A, and SF 50/80A receivers, 460A receiver and R60 unit, 7 A.C. receiver 475 UA or CA and SF45-75 UA or CA, 50, 70, 71, 72, C electric unit for special and 7 A.C. receivers, ABC 6 volt tube supply, 88V and 82W, E180Z power plant and E 420 power plant.
- FREED EISEMANN** NR5, FE18, NR70, 470, NR57, 457, NB11, NB30 D.C.
- COLONIAL** 28, 31 A.C., 31 D.C.
- WORKRITE** 8 tube chassis, 6 tube chassis.
- AMRAD** 70, 7100, 7191 power unit.
- SPARTON** A.C. 89.
- MISCELLANEOUS** DeForest 45, D10, D17, Super Zenith Magnavox dial, Thermodyne, Grimes 4DL inverter duplex, Garod neotryne, Garod EA, Ware 7 tube, Ware type T, Federal 102 special, Federal 59, Kennedy 220, Operadio portable, Sleeper RX1, Amrad inductrol.

HERE ARE THE 22 CHAPTER HEADINGS

- Service Procedure
- Practical Application of Analysis
- Vacuum Tubes
- Operating Systems
- Aerial Systems
- "A" Battery Eliminators
- Troubles in "A" Eliminators
- Trouble Shooting in "A" Eliminators
- "B" Battery Eliminators
- Troubles in "B" Battery Eliminators
- Trouble Shooting in "B" Battery Eliminators
- Speakers and Types
- Audio Amplifiers
- Trouble Shooting in Audio Amplifiers
- Troubles in Detector Systems
- Radio Frequency Amplifiers
- Trouble Shooting in RF Amplifiers
- Series Filament Receivers
- Testing, and Testing Devices
- Troubles in DC Sets
- Troubles in AC Sets



"Mathematics of Radio"

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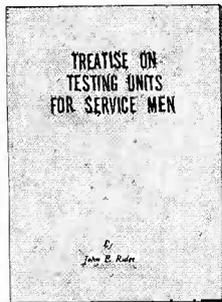
- OHM'S LAW.**
- RESISTANCES:** Basis for resistance variation, atomic structure, temperature coefficient, calculation of resistance variation, expression of amperes, volt and Ohm fractions, application of voltage drop, plate circuits, filament circuits, filament resistances, grid bias resistances.
- DC FILAMENT CIRCUITS:** Calculation of resistances.
- AC FILAMENT CIRCUITS:** Transformers, wattage rating, distribution of output voltages, voltage reducing resistances, line voltage reduction.
- CAPACITIES:** Calculation of capacity, dielectric constant condensers in parallel, condensers in series, voltage of condensers in parallel, in series, utility of parallel condensers, series condensers.
- VOLTAGE DIVIDER SYSTEMS FOR B ELIMINATORS:** Calculation of voltage divider resistances, types of voltage dividers, selection of resistances, wattage rating of resistances.
- INDUCTANCES:** Air core and iron core, types of air core inductances, unit of inductances, calculation of inductance.
- INDUCTANCE REQUIRED IN RADIO CIRCUITS:** Relation of wavelength and product of inductance and capacity, short wave coils, coils for broadcast band, coupling and mutual inductance, calculation of mutual inductance and coupling.
- REACTANCE AND IMPEDANCE:** Capacity reactance, inductance reactance, impedance.
- RESONANT CIRCUITS:** Series resonance, parallel resonance, coupled circuits, bandpass filters for radio frequency circuits.
- IRON CORE CHOKERS AND TRANSFORMERS:** Design of chokes, core, airgap, inductance, reactance, impedance, transformers, half wave, full wave windings.
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- THREE ELEMENT TUBES:** Structure of tube, detector, grid bias, grid leak and condenser, amplifiers, tube constants, voltage amplification, resistance coupling, reactance coupling, transformer coupling, variation of impedance of load with frequency, tuned plate circuit.
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- GRAPHS AND RESPONSE CURVES:** Types of paper, utility of curves, types of curves, significance of curves, voltage amplification, power amplification, power output, radio frequency amplification.
- MULTIPLE STAGE AMPLIFIERS:** Resistance coupling, reactance coupling, tuned double impedance amplification, underlying principles, transformer coupling, turns ratio, voltage ratio, types of cores, late current limitation, grid current limitation.
- ALTERNATING CURRENT TUBES:** Temperature variation hum, voltage variation hum, relation between grid and filament, filament circuit center tap, types of AC tubes.
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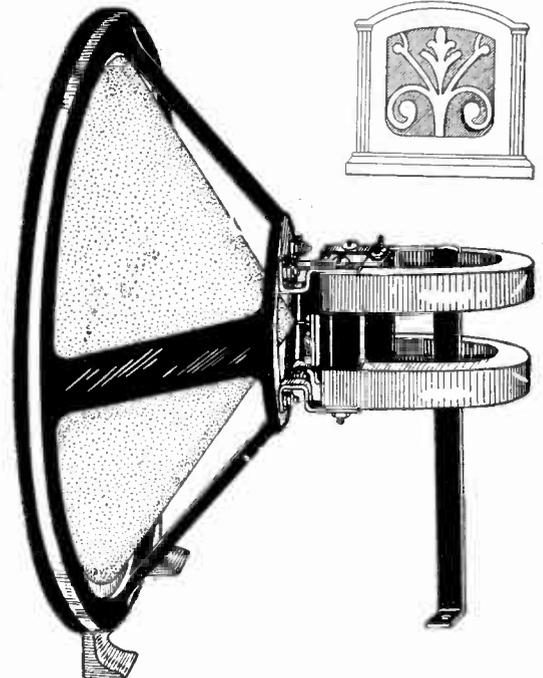
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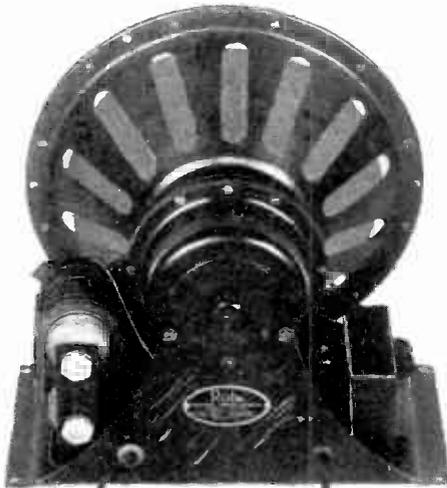
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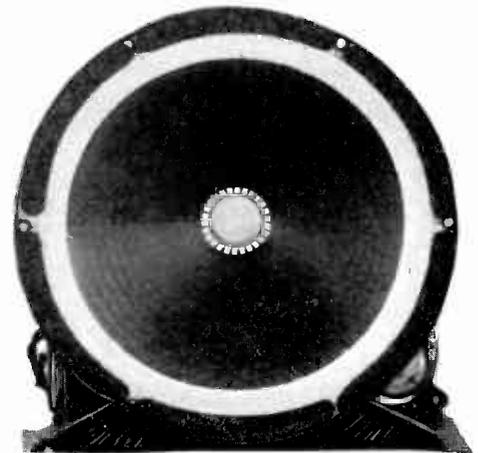
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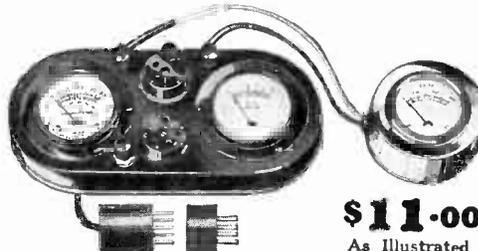
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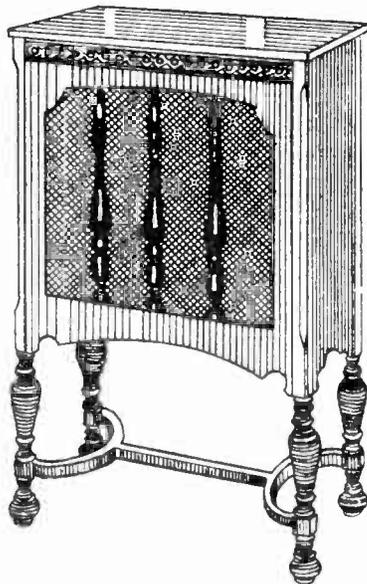
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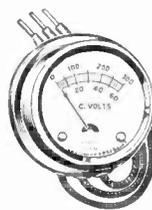
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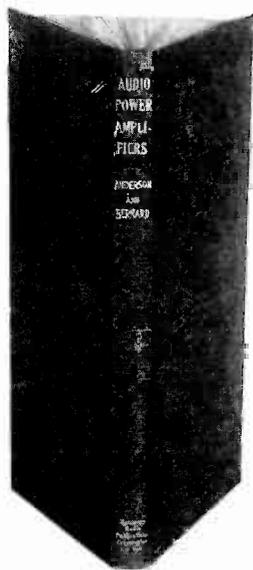
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J. E. Anderson, M.A., former instructor in physics, University of Wisconsin, former Western Electric engineer, and for the last three years technical editor of "Radio World."
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Rectification theory and practice in all the applied branches, grid bias methods and effects, push-pull principles, power detection, reproduction of recordings and methods of measurements and testing are set forth. And besides there is a chapter on the subject of motorboating, with which one of the authors is probably better familiar than any other textbook author. Then, too, there is a chapter on tubes, with essential curves and a full list of tables of tube data. Every tube that will be used in an audio amplifier—therefore virtually all tubes—is clearly diagnosed, classified and tabulated! These data on tubes should be at every radio engineer's hand.

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The book consists of 193 pages in type the size used in printing these words, known as 8 point, and therefore a great deal of text is contained in these 193 pages, and the book is small enough to be carried conveniently in the side pocket of a sack coat. It was purposely printed that way because busy engineers and other experimenters will want to consult this precious volume while riding in conveyances, as well as when in the laboratory, and compactness was therefore desirable.

The edition is strictly limited to 1,000, and the publishers recognize that the field of distribution is necessarily small, hence the price is \$3.50. Those to whom such a volume is of any value would not be without it at any price.

The device of presenting no more information or greater number of illustrations, but of using larger type, and thicker and often cheaper paper, to present a bulkier appearance, was purposely avoided. The paper is finest super stock and the size of the page is 5 x 8".

Detailed Exposition of Chapter Contents

Chapter I. General Principles, analyzes the four types of power amplifiers, AC, DC, battery-operated and composite, illustrates them in functional blocks and schematic diagrams, and treats each branch in clear textual exposition. Audio coupling media are illustrated and discussed as to form and performance: transformer, resistance-resistance, impedance-impedance, impedance-resistance, resistance-autotransformer, autotransformer-resistance and non-reactive. Push-pull forms are illustrated, also speaker coupling devices. Simple audio amplifiers are illustrated and analyzed. Methods of connection for best results are stressed.

Chapter II. Circuit Laws, expounds and applies Ohm's laws and their special form known as Kirchhoff's laws. Direction of current flow in tube circuits is revealed in connection with the application of these laws to several circuits, including a DC 110-volt A, B and C supply, and series and parallel filaments in general. Special diagrams are published for Ohm's and Kirchhoff's laws.

Chapter III. Principles of Rectification, expounds the vacuum tube, both filament and gaseous types, electrolytic and contact rectifiers, and explains why and how they work. Full-wave and half-wave rectification are treated, with current flow and voltage derivation analysis. Regulation curves for the 280 tube are given. Voltage division, filtration and stabilization are fully illustrated and dissected.

Chapter IV. Practical Voltage Adjustments, gives the experimental use of the theoretical knowledge previously imparted. Determination of resistance values is carefully revealed.

Chapter V. Methods of Obtaining Grid Bias, enumerates, shows and compares them.

Chapter VI. Principles of Push-Pull Amplifier, defines the push-pull relationship, with keys to the attainment of desired electrical symmetry.

Chapter VII. Oscillation in Audio Amplifiers, deals with motorboating and oscillation at higher audio frequencies, explaining why it is present, stating remedies and giving expressions for predetermination of regions of instability. The trouble is definitely assigned to the feedback through common impedance of load reactors and B supply, and in some special instances to the load's relationship to the C bias derivation as well. The feedback is shown as negative or positive and the results stated.

Chapter VIII. Characteristics of Tubes, tells how to run curves on tubes, how to build and use a vacuum tube voltmeter, discusses hum in tubes with AC on the filament or heater, and presents families of curves, plate voltage-plate current, for the 240, 220, 201A, 112A, 171A, 227 and 245, with load lines. Also, plate-screen current characteristics of the 224, at five different control grid biases, at plate voltages 0-250. Then Table I gives the Average Characteristics of Amplifier and Detector Tubes 220, 200A, 201A, 112A, 171A, 222, 240, 226, 227, 224, 245, 210 and 250, stating use, filament voltage, current, and resistance, Det. B volts, Amplifier B volts, grid bias for amplification and detector, plate current, plate AC resistance, mutual conductance, mu, maximum undistorted power output, physical size. There is a composite table (II) of characteristics of Rectifier and Voltage Regulator Tubes, and individual tables, giving grid voltage, plate current characteristics over full useful voltage ranges for the 220, 201A, 112A, 171A, 222, 240, 227, 245 and 224.

Chapter IX. Reproduction of Recordings, states coupling methods and shows circuits for best connections.

Chapter X. Power Detection, explains what it is, when it should be used, and how to use it. A rectifying detector, designed by one of the authors, is expounded also.

Chapter XI. Practical Power Amplifier, gives AC circuits and shows the design of a sound reproduction system for theatres. A page is devoted to power amplifier symbols.

Chapter XII. Measurements and Testing, discloses methods of qualitative and quantitative analysis of power amplifier performance. A scale illustrates the audio frequencies in comparison with the ranges of voice and musical instruments. A beat note oscillator is described. Thirteen causes of hum, with remedies, are stated, also the estimation of power required for output and preliminary tubes.

You may safely order "Audio Power Amplifiers," either enclosing your remittance or ordering the book mailed C.O.D. Examine it for five days. If you are not completely satisfied with it for any reason, or for no reason, send it back in five days with a letter asking for a refund. A check refunding the purchase price will be sent to you immediately. We can not send the book on approval, without payment before receipt, so please do not ask us to do so.

What Is Not As Well As What Is

SOMETIMES it is more important to expose a fallacy than merely to state the fact. A crop of technical weeds has grown into the garden of audio amplification, and the authors have gone to the pains of exposing these.

The book "Audio Power Amplifiers" is free from traditional errors, except in citing them as fallacious conclusions. Each attack on a fallacy is abundantly supported by proof of the REAL facts.

As an example, take the theory that motorboating is due to grid blocking. The authors say: "Many explanations for this oscillatory condition (motorboating) have been made, some of which are wholly untenable. One of these is that the oscillation is due to blocking of the grids of the amplifiers. . . . If blocking of the grid were the cause of the phenomenon, the wave form of the oscillation would be very irregular, but an oscillograph shows that it is very nearly of a sinusoidal form."

Then follows an exposition of motorboating, and oscillation at other frequencies, with expressions for predetermining the instability or stability of audio circuits.

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