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RADIO WORLD

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The First and Only National Radio Weekly

485th Consecutive Issue—TENTH YEAR

SHORT WAVE CONVERTER THAT WORKS ON ANY SET

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Latest Circuits and News

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A Converter that Works on Any Kind of a Set

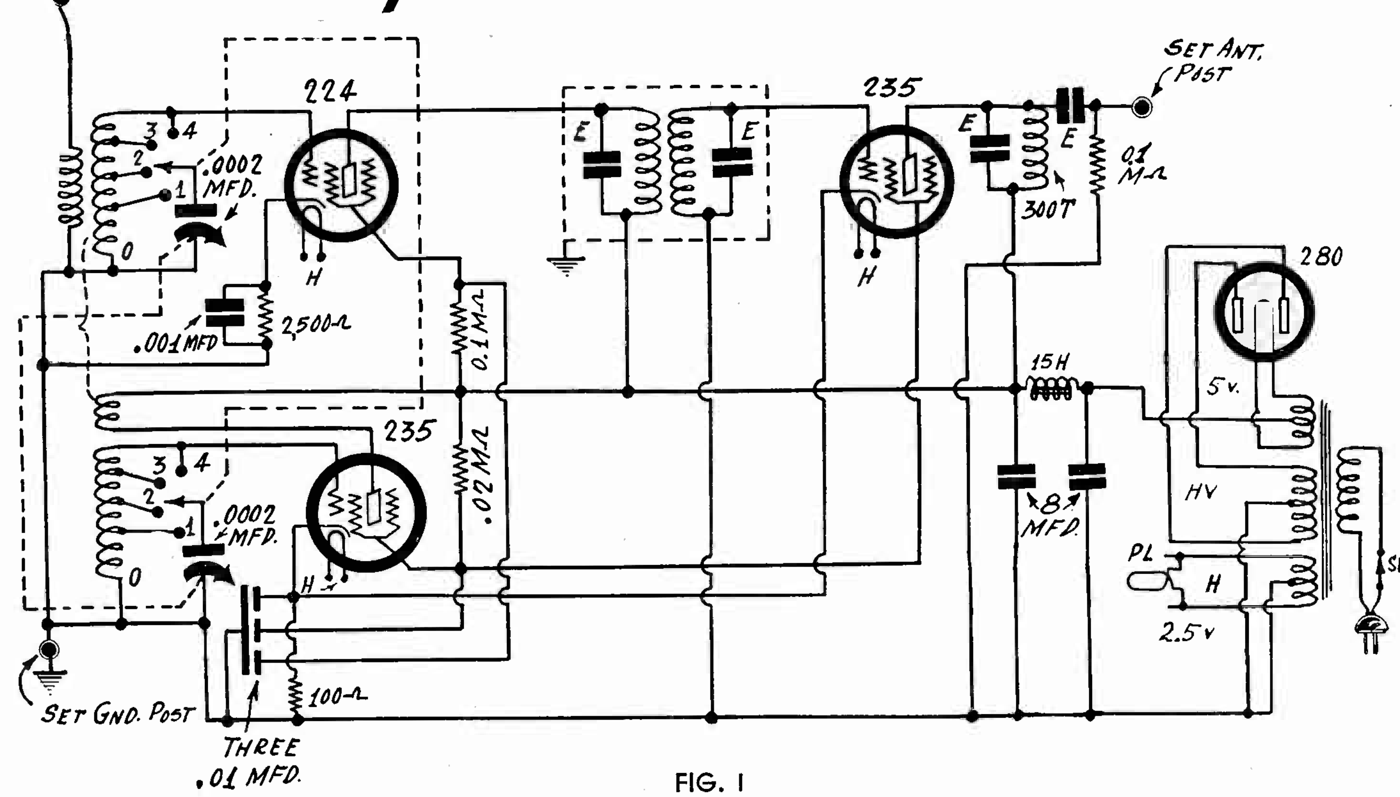


FIG. 1

This type of short-wave converter for AC operation will work with any receiver because of the two tuned circuits in the mixer and because of the built-in stage of intermediate frequency amplification.

THE interest in short-wave reception is so great that possessors of all kinds of receivers desire to use some device to enable bringing in the high frequencies. The selection popularly runs to a converter. The requirement therefore is that the converter itself afford good sensitivity, so that results will be obtained even on sets

(*Continued on next page*)

LIST OF PARTS

Coils

Mixer coils on one tubing, including two secondaries tapped in three places, a primary and a tickler
One 450 kc shielded transformer
One 300 turn honeycomb coil
One power transformer, primary, 110 v. 50-60 cycles; secondaries, all center-tapped, 2.5 volts at 8 amperes; 5 volts at 2 amperes and high voltage to afford 200 v. d. c. at 15 ma.
One 15 henry B supply choke coil

Condensers

Two .0002 junior midline tuning condensers
One 20-100 mfd. equalizer, E (two others are built into intermediate transformer)
One .001 mfd. fixed condenser
Three 0.1 mfd. condensers in one case
Two 8 mfd. electrolytic condensers with brackets

Resistors

One 2,500 ohm flexible biasing resistor
One 100 ohm flexible biasing resistor
Two 0.1 meg. pigtail resistors (100,000 ohms)
One 0.02 meg. pigtail resistor (20,000 ohms)

Other Parts

One modernistic disc type vernier dial, with pilot lamp and socket
One drilled front panel, 7x10 inches
One drilled subpanel with three UY and one UX sockets
One a. c. toggle switch
One dual selector switch for band changing, with knob
One knob for .0002 mfd. condenser in modulator circuit
Three binding posts
Three grid clips
One roll of hookup wire plus leads
One length of high insulation wire for B plus leads
Hardware, including one dozen 6/32 machine screws and nuts; two right angles; four 6/32 flathead machine screws.

How to Build a Superlati

Two Variable Mu Tubes, One

Stage of Intermediate Built in—T

High

(Continued from preceding page)

of relatively low sensitivity. Many sets have a sensitivity of 40 microvolts per meter, compared with 10 m.v.p.m. in modern sets.

This condition of low sensitivity in receivers is reflected in the announcements of some manufacturers that the receiver with which their converter is to be used should have a sensitivity of 20 microvolts per meter or better. However, how many persons know what the sensitivity of their set is, in microvolts per meter?

It is better to remove the doubt entirely, by building in a stage of intermediate frequency amplification. Then you add a gain of about 40-fold, as a conservative estimate, and approach the ideal condition of a converter that works with any receiver. Some intermediate amplification must be built in if that goal is to be reached commercially.

Low Intermediate Frequency

Naturally, since the converter is to be used with a broadcast receiver, the intermediate transformer in the converter must be responsive to some frequency within the broadcast band. As small capacity and large inductance are used in such transformers, the tuning range is limited.

The selection should be made either for one extreme or the other, that is, the lowest frequency to which the receiver will respond, or the highest frequency.

While it is true that most tuned radio frequency receivers are more sensitive at the higher frequency end, and that part of the tuning spectrum should be used if there is no built-in intermediate stage, added amplification as in Fig. 1 almost certainly would cause the intermediate amplifier to oscillate, both the stage in the converter and one or more of the stages in the receiver.

This just about ruins reception, so a choice is made of a low intermediate frequency.

For Best Efficiency

Transformers that tune as low as 450 kc also tune as high as 550 kc, so by turning out the adjusting set-screws of the transformer, and then bringing primary and secondary into resonance with the lowest setting of your receiver, you will have all stages working efficiently together.

In this connection the equalizing condenser across the output choke of the intermediate tube in the amplifier, upper right-hand tube in Fig. 1, should be adjusted to the same frequency. It is practical to use a 450 kc transformer in the output. This will be discussed next week.

Once the intermediate frequency is selected, and the converter lined up with the amplifier in the set, you have a condition otherwise absent from converters, that is, dial settings for any given position of the coil switch arm always will represent the same frequency. Any converter is loggable if the same intermediate frequency is used all the time, but in other systems you can and do change the intermediate frequency, by tuning your set to a different frequency, particularly to avoid direct interference from broadcasts. Of course, the present system avoids that form of interference because the frequency will be just a bit lower than the lowest in the broadcast band. If your set doesn't tune lower than 550 kc, use the lowest frequency possible.

Greater Selectivity

Converters heretofore have been worked with plug-in coils principally, but just as the self-starter replaced the hand crank on automobiles, just so the front panel selection of wave bands is replacing the use of plug-in coils. It is simply a matter of convenience. Since good results are obtainable by the panel switch methods, and since the dual selector switch offers the simplest solution, that manner of adjusting for wave bands has been chosen.

Two of the new 235 tubes are used. One serves as oscillator and the other as the intermediate amplifier for the built-in stage. Selectivity is a little higher that way, even without manual alteration of any of the d.c. voltages. In point of fact there is a little variation of biasing and screen voltages in particular, due to the change in the amount of plate current resulting from the carrier intensity. When the signal is strong the current is greater, the voltage drops in the screen and cathode resistors increase, the screen voltage becomes less and the bias voltage becomes more.

In the interests of selectivity, and reduction of peril of overloading the modulator, the negative bias method of modulation is used. This is well accommodated by a 2,500 ohm flexible biasing resistor, bypassed by a condenser of .001 mfd. or higher capacity. Distortion due to harmonics is virtually removed, and also the trick results of tuning in lower frequencies on windings intended for higher frequencies is avoided. This trick is simply the tuning in of second harmonics of fundamentals, due to the high percentage of harmonics in the modulator.

Use of the 280 tube as rectifier enables attaining full recommended voltages for the tubes with full-wave rectification. It is safe to put as much as 200 volts on plates of the three tubes in the converter proper, although any voltage from 150 to 200 volts may be used, and it will not be necessary to alter the resistance values. These are 2,500 ohms for biasing the modulator, 100 ohms common for biasing of the oscillator and the intermediate amplifier, 0.1 meg. (100,000 ohms) for biasing the screen of the modulator and .02 meg. (20,000 ohms) for biasing the common screens of the intermediate amplifier and the oscillator. Since both oscillator and intermediate tubes are 235's, the same voltages for screens and cathodes of these tubes are required, and common resistors to cause this voltage to be effective are all right.

The plate voltage on all three tubes is the same.

Tunes From 200 to 15 Meters

Looking at the circuit diagram we see that there are two tuned circuits in the mixer, which makes for improved selectivity and improved sensitivity. The tuned circuit that requires close adjustment is the oscillator, hence we use a vernier dial for this. But the modulator requires only a knob, even though on weak signals the setting

General Electric Seeks Deci

Washington.

A reconsideration of the finding that Dr. Irving Langmuir did not invent the use of high vacuum in radio tubes has been requested of the United States Supreme Court by General Electric Co. Papers were served on the opposing party, the De Forest Radio Company.

Findings of fact on which the decision of the court is said to have rested are claimed not to be contradicted by the evidence.

The opinion is claimed also "to depart radically from the well settled law of patents as announced by this court over a long period of years and leaves the whole patent system, in the state of uncertainty and confusion."

The findings objected to, which are said to be the basis of the court's opinion, are listed as follows:

"1. That the alleged prior use was prior to August, 1912, which was the date of Langmuir's invention.

"2. That the tubes which the court accepted as proof of prior use embodied the invention.

"3. That Lillienfeld disclosed the structure and method of the Langmuir patent.

"4. That the relationship of the degree of vacuum to the stability and effectiveness of the discharge passing from the cathode to anode was known to the art when Langmuir made his invention."

Modern Tube Design Problem Is to Overcome Interference

In a recent engineering talk given regarding trends evidenced in radio tube design and manufacture, and the significance of such designs in improving radio reception, D. F. Schmit, chief engineer of the E. T. Cunningham radio tube organization, said:

"It is very interesting to consider the effect of radio station power on the design of receiving sets and tubes. During the early period of radio the entire problem was a question of sensitivity, and no thought was necessary in the design of receivers to prevent distortion due to too much signal being impressed upon the antenna. Today, however, with the large powered broadcasting stations near our large centers of population, a new problem for both the set designer and tube designer has presented itself.

"This concerns the methods to employ in order to control satisfactorily the large amount of energy picked-up from powerful local broadcasting stations, and to prevent interference from such stations when listening to a distant broadcast. It is the overcoming of problems of this nature that makes progress in tube design and manufacture a subject of vital importance to the trade, and an obvious reason why considerable interest may always be expected to be evidenced by the radio public, both lay and professional, in new developments within the radio tube field."

ve Short-Wave Converter

224 and a 280 Rectifier Used

otal of Tuned Circuits is Five—
Sensitivity

of the knob will have to be made accurately. This can be done readily.

The converter is strictly a short-wave device, starting at 200 meters and going down to 15 meters. This can be done with the equivalent of four different inductances. At one extreme setting (4), the full secondary winding is in the tuned circuit, at the next setting (3), about one-third of the total is in the tuned circuit, at the next setting (2), about one-third of the third is left, while from that position (1) there remain only two turns to the grounded end (0).

Change in Percentage Difference

The oscillator and the modulator secondaries are not identical. The requirement for diversity becomes obvious when we consider that the intermediate frequency is, say, 545 kc, and that there must be exactly that difference in frequencies between the oscillator and the modulator at 200 meters (1,500 kc). Then the modulator is tuned to 1,500 and the oscillator should be tuned to 2,040 kc. The frequency ratio with a .0002 mfd. condenser in this range is 2.3, so that the higher frequency limit would be 4,692 kc for the oscillator. Suppose the next tap starts at 4,500 kc.

Now the difference must be the same, so the modulator is tuned to the carrier frequency of 3,960 kc. The difference at the most exacting position, lowest frequency, is less than a little more than 10 per cent., using the modulator frequency as the base, whereas in the first tuning range discussed it was 36 per cent., at the lowest frequency. Therefore as the desired carrier to be tuned in increases in frequency, the difference between the modulator (carrier) frequency and the oscillator frequency becomes a smaller percentage of either. The highest frequency of the oscillator, on the second coil discussed, is 10,791 kc, and of the modulator, 10,251 kc, and the percentage of difference is only a trifle more than .05 per cent., that is, 5 parts in 10,000. It is therefore unnecessary to have dissimilar secondary windings except for the first tap.

All windings may be on one form. The one used had a diameter of 1.75 inches. At one extreme the primary for the antenna coupler was wound, next to it the companion secondary. The plate winding was put between the modulator secondary and the oscillator secondary, because only a small degree of coupling is needed, and the radio frequency power in the oscillator plate circuit is less than that in the grid circuit. Because of the mutual inductive coupling of the two circuits, no pickup winding is needed.

The 224 tube is used as modulator as it is better for this purpose than other screen grid tubes, while permitting placing a tuned winding in its plate circuit.

Band Pass Filter

The intermediate transformer has both primary and secondary tuned. This results in actual band pass filter tuning. Also, the output of the intermediate amplifier is tuned. So we have in the converter five circuits tuned to radio frequencies. Now it can be realized why a converter of this type will far outclass in performance converters that have only one tuned stage and why it is possible to say that this is a converter that will work with any set.

There is only one rub left in the entire scheme, and that relates to the coupling. Naturally, if poor coupling denies to the receiver the major part of the converter's output, then all the pains taken have been for naught. However, the solution is not hard, and it is offered by the converter as diagrammed in Fig. 1.

For tuned radio frequency receivers, remove aerial from the antenna post of the receiver, and connect it instead to the antenna post of the converter. Leave the ground connected to the receiver and run a wire from ground post of the receiver to ground post of the converter. Connect the output post of the converter to the vacated antenna post of the receiver.

For Exceptional Cases

Under most conditions this method of coupling will work well, because the condenser between the 0.1 meg. resistor and the coil in the output tube's plate circuit is of small capacity (adjustable from 20 to 100 mmfd.). The low capacity means that the output circuit maintains its frequency setting, which would be disturbed if the isolating condenser were of relatively high capacity.

If excellent results are not obtained in that way, then instead of connecting the output of the converter to the antenna post of the receiver, leave that antenna post vacant and connect the output of the converter to grid of the first radio frequency amplifier. If the set has a screen grid tube in the first stage, all you need do is to lift the grid clip off the cap of that tube, put a grid clip on the connecting wire from the converter output, and attach the clip to the cap of the set's screen grid tube.

The grid return is maintained to B minus, that is, the first tube in the set still retains a completed circuit, and to accomplish that the 0.1 meg. resistor is included in the output circuit of the converter. E across the plate coil in the converter output may have to be returned a little when the connection is made direct to grid of the set's first tube.

If the set has another type of tube in the first r. f. stage, a service man's adapter is necessary to pick up grid without associated circuit.

The foregoing accounts for all coupling difficulties, and presents the complete solution, in regard to all tuned radio frequency receivers, and also superheterodynes that have tuned radio frequency amplification.

Special Case of Old Supers

For superheterodynes that have no tuned radio frequency amplification (evidenced by the fact only a two-gang or two separate single tuning condensers are used), the converter's intermediate frequency should be the same as that in the set. Statement of the frequency or the name of the manufacturer and the model of set will enable one to obtain the correct type. The connection of output could be to the grid post of the set's first intermediate tube socket, with that tube remaining in the set. As supers without t. r. f. are old models, a service man's adapter is necessary.

[*The circuit with an output i. f. transformer will be discussed next week.*—EDITOR.]

Rehearing on Langmuir
sion

Pilot Applies for a License for 250-Watt Television Station

Application for a construction permit for a 250-watt visual broadcasting station, using 60-line image transmission, has been filed with the Federal Radio Commission by the Pilot Radio & Tube Corporation, of Lawrence, Mass.

This application marks the return of the Pilot company to the television field in which it did considerable experimental work three years ago, when the company was located in Brooklyn, N. Y. In the summer of 1928 it built the television transmitter used by station WRNY for the first picture broadcasting done in New York by a regular broadcasting station, and in the Fall of the same year it staged, at New York University, the first public demonstration of television held in the East.

Cardwell Announces a New Transmitting Condenser, Type 16-B

The new Cardwell type 16-B transmitting condensers are primarily intended to meet the requirements for moderately high voltages in a medium size condenser.

The 16-B condenser uses aluminum plates of .050" thickness. The rotor plates have a radius of 2¼". With the rotor plates extended a panel space 6⅞" wide by 5⅜" high, is required. A rotor to frame contact is used, a double arm brush being provided. The shaft diameter is ⅜", stainless steel being used as the shaft material.

In the 16-B constructional design it is possible to furnish greater air gap than could be provided using the smaller transmitting condenser design and still retaining adequate structural strength and a proper balance between the various elements. Condensers of low capacity are also available in the 16-B design.

The new Cardwell condensers are available in various capacities and within reasonable limits as to break down voltage. Standard air gaps (actual air gap between adjacent rotor and stator plates) are .168" and .294". The condensers having .294" air gap are furnished with static shields.

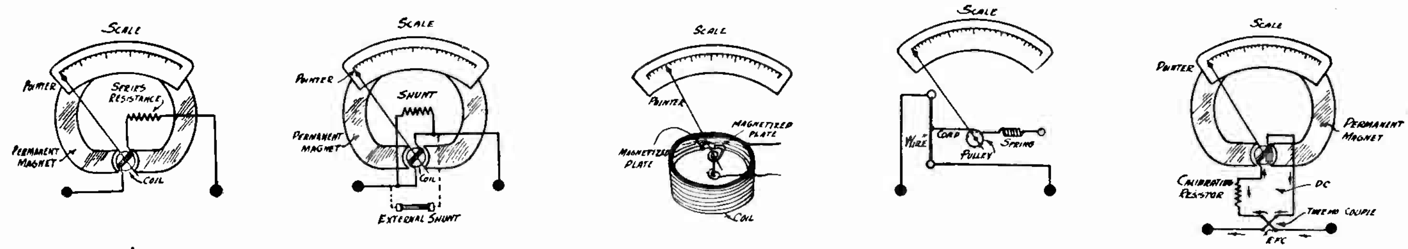
The workmanship is of the most skillful sort, as most extraordinary pains were taken in the manufacture of the condensers.

A descriptive pamphlet has just been published on the 16-B Cardwell condenser, giving general specifications, details of constructional design, available capacities, sizes, list prices, etc. This pamphlet will be mailed on application to the Allen D. Cardwell Mfg. Corp., 95 Prospect Street, Brooklyn, N. Y. Mention RADIO WORLD.

Fundamentals on Meters

Sensitivity and Types Discussed for Novices

By Henry B. Herman



1 2 3 4 5

(1) A voltmeter of the D'Arsonval, or moving coil, type with the resistance built in. (2) A milliammeter of the D'Arsonval type with a range-extending shunt built in. (3) A moving iron type of alternating current meter, which may be used either as voltmeter or milliammeter. (4) A hot wire type of alternat ing current meter. (5) A thermo-couple type of alternating current meter.

EVERY one who experiments with radio, who builds sets for pleasure or for profit or both, must use meters, otherwise he is doing a great deal of guessing where precision is required. Moreover, meters are time-savers, in that they facilitate the quick location of trouble.

To use meters properly it is advisable to have some idea of the functioning of the meter.

One of the points that prove confusing, as attested by the repeated questions from beginners, is the sensitivity rating. Usually a voltmeter is rated at the number of ohms per volt. That is the sensitivity rating, expressed in the popular clumsy fashion.

Since all voltmeters are current meters calibrated in voltage, when the ohms per volt are known, the full-scale deflection current of the meter is known. For instance, if a meter has 1,000 ohms per volt resistance, the full-scale deflection current is .001 ampere (1 milliampere). Therefore the ohms per volt is the reciprocal of the full-scale deflection current in amperes. Likewise, the full-scale deflection current in amperes is the reciprocal of the ohms per volt. The reciprocal of a number is (1) divided by that number. Thus, for the number 1,000, the reciprocal is 1/1,000, or .001.

Same Current for Same Settings

Let us adhere for a few moments to a consideration of the voltmeter with a resistance of 1,000 ohms per volt.

We know that the meter does not change in sensitivity, no more than a 0-1 milliammeter becomes anything else during use, nor does the reading at any point designate any other current value than the one on the scale. Since we desire to use the meter for other purposes, we introduce a change in either of two ways; by putting a resistance in series with the meter to serve as a multiplier and enable the reading of voltages, or by putting a resistor in parallel with the meter to serve as a shunt and enable the reading of higher currents.

The reason why higher currents can be read because of shunts is that the current divides, part flowing through the shunt and part through the meter. The proportion is known or ascertainable, so the scale can be calibrated.

With the multiplier the needle always occupies a given position for a given amount of current, just as when the series resistor was out of circuit, the only purpose of the resistor therefore being to enable the application of greater potential without sending the needle off scale. So the greater the resistance, the greater the voltage that will be read at maximum setting. The only purpose therefore is extension of the voltage range, just as the only purpose with the shunt was extension of the current range.

Is Current Same in Current Meter?

It has been said that the multiplier does not affect the current indication given by the needle, since for any setting of the needle the same current is flowing. Is this situation duplicated when the shunt resistor is used?

In the voltmeter all the current flows through one circuit, composed of two series resistors, one of which is the resistance of the coil of the meter itself, the other the resistance of the multiplier. In the shunt circuit two resistors are in parallel, the amount of current flowing is greater, but the parallel resistors divide the current inversely proportional to their resistance values. The shunt is used to pass current around the meter circuit. Therefore the pointer indication in the case of the meter used for current measurements also represents the same amount of current flowing through the meter for any given setting. The excess is taken up by the shunt.

Therefore the main consideration is the full-scale deflection current. If a voltmeter has a resistance of 1,000 ohms per volt, the full-scale current is .001 ampere, and the meter is a 0-1 milliammeter. If the meter has a full-scale deflection of .0005 ampere (0.5 ma), then the ohms per volt equal 1/.0005, or 2,000 ohms per volt.

The full-scale deflection factor never changes.

Now, it will be observed that the rating in ohms per volt is derived from the full-scale deflection. It is false therefore to say that the ohms per volt rating means the number of ohms per volt at any reading of the meter. The rating applies only to one reading, that of full-scale deflection. At readings of lower voltages (less than full-scale current deflection), the resistance per volt is greater. But the readings at other than full-scale do not count in the rating of the meter. It would be more easily understandable to have meters, even voltmeters, rated at their full-scale deflection current. The smaller the current at that setting, the more sensitive the meter, the greater the ohms per volt resistance.

Meter Must Pass Current

Some current must pass through most types of meter. There are two types of current, alternating current and direct current. The meters already discussed are direct current meters. Whenever nothing special is said about a meter it is of the direct current type. If alternating current is meant, that is specifically stated.

The a.c. meter is often nothing but a d.c. meter with a rectifier. At present copper oxide rectifiers are widely used. They are tiny ones, in no way comparable in size to the rectifiers of the same general type used in some dynamic speakers and A eliminators.

With alternating current the problem is not so simple, because of the impedance factor. Impedance is the phenomenal effect caused by frequency and reactance. Besides, alternating current has all values from zero to maximum during one alternation, while during a complete cycle (two alternations) it has all negative and all positive values, besides zero value. The question is: What shall the meter read? Naturally one thinks of the peak voltage. Sometimes that is used. Another thing that comes to mind is the measurement of the effective d.c. value. How can that be arrived at?

Well, d.c. through a resistance or coil causes a certain amount of heat, so we can measure the a.c. in terms of the heating effect. This is called the root mean square value, or effective value.

Another value for alternating current is the average value of the current or voltage, but this is seldom used in radio, although the principal consideration in electroplating with pulsating current.

Change With Frequency

Alternating current meters, whether for reading voltage or current, are not universal as to frequency, because impedance changes with frequency. Correction factors for these errors may be used. In the better types of instruments satisfactory measurements can be made over a wide range of frequencies, even including radio frequencies.

To sum up, therefore, a meter is always a current indicator, but it may be calibrated in voltage, when it is called a voltmeter. The sensitivity of the meter is a fixture, unaffected by multipliers or shunts, as these do not alter the meter in any way, but only provide, in one case, the means of applying higher voltages without hurting the meter and yet enabling it to disclose these voltages, while in the other case, they provide a detour for current values too large to pass through the meter, yet extending the range.

Capacity and inductance of the elements of a meter upset its value as a universal meter respecting frequency. If the inductance predominates the current is choked out more, the higher the frequency. If capacity predominates the current increases with the frequency, and these changes may not be effective on the elements. Therefore the meter may read either too low or too high depending on the type of meter and the frequency.

Two Short-Wave Supers

Vari-Mu Tubes in One, Auto Series in Other

By Brunsten Brunn

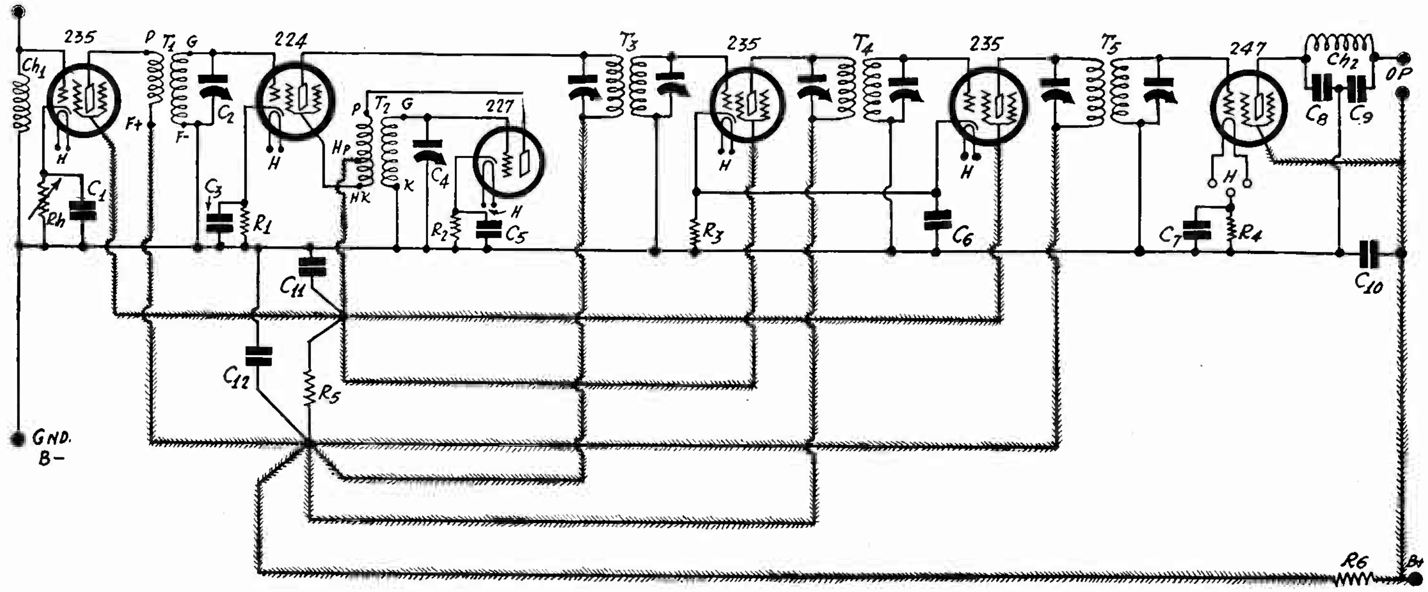


FIG. I

A six tube short wave superheterodyne with variable mu tubes and a pentode detector, operating on the grid bias principle. The intermediate is tuned to 450 kc.

HIGH sensitivity is one of the first requisites of a short wave receiver because most short wave signals come from long distances and very often they are not strong at the origin. Since it is not practical to use many stages of tuned radio frequency amplification to get the required sensitivity it is necessary to use a superheterodyne so that the amplification can be done at one frequency for all signals.

But a high selectivity is also essential because the short wave signals are crowded in some parts of the band and they find much competition with both short and long waves. Now, a superheterodyne, even though it may be too selective in the intermediate frequency tuner, will not always separate stations because of the image effect, that is, because of the fact that any station will come in at two different settings of the oscillator. Hence we need at least some selection in the radio frequency level ahead of the first detector.

Choice of IF

The choice of intermediate frequency is not important for almost any frequency will work. However, if the signal frequency to be received is extremely high, a low intermediate frequency will not work because the RF and the oscillator tuners will pull together or the oscillator will stop functioning. Hence from this point of view we want a high intermediate frequency. On the other hand, if we wish to extend the tuning range of the circuit so as to include the broadcast band it is necessary to select a frequency which is lower than the lowest broadcast frequency, for if the intermediate frequency is in the broadcast band there will be one place where nothing but squealing will be obtained and for a rather wide region around this point there will be little practical selectivity. For these reasons it seems that an intermediate frequency of 450 kc is satisfactory from both points of view. There will be no pulling together at this frequency if the coupling between the oscillator and the modulator is reasonably loose.

A Practical Short Wave Set

In Fig. 1 is a five tube short wave superheterodyne tuner designed to meet the requirements of short wave and broadcast reception alike. It has an untuned RF stage with a variable mu tube. This stage serves several useful purposes. First, it prevents radiation from the antenna. Second, it boosts the sensitivity several times without introducing any tuning complications. Third, it provides a means of varying the amplification by grid bias control without introducing cross modulation. Fourth, it removes the antenna constants from the RF tuner that follows the tube.

This first tube is biased by means of a 10,000 ohm rheostat Rh put in the cathode lead. If this is to allow variation of the volume from maximum downward its minimum resistance must not exceed 300 ohms. Some high resistance rheostats or variable resistors are such that they jump from zero resistance to a value that is too high for maximum amplification by the tube. The by-pass condenser C1 across the variable resistance should have a value of 0.1 mfd.

Plug-in Coil

The plug-in coil T1 is wound on a form that fits into a UX socket. If a suitable set of coils is used it is possible to cover the

(*Continued on next page*)

LIST OF PARTS FOR FIG. I

Coils

Ch 1—One 8 mh. radio frequency or smaller.
Ch2—One 800 turn duolateral wound radio frequency choke
T1—One set of radio frequency plug-in transformers as described.
T2—One set of oscillator coils, plug-in type, as described
T3, T4, T5—Three 450 kc doubly tuned shielded transformers

Condensers

C1, C3, C5—One three-section condenser, 0.1 mfd. each section.
C2, C4—Two 0.0002 mfd. Hammarlund midget tuning condensers
C6—One 0.5 mfd. by-pass condenser, or larger
C7—One 4 mfd. by-pass condenser
C8, C9—Two 0.0005 mfd. by-pass condensers
C10—One 4 mfd. by-pass condenser, when batteries are used only.
C11—One 0.1 mfd. condenser or larger
C12—One 1 mfd. condenser

Resistors

Rh—One 10,000 ohm variable resistor
R1—One 3,000 ohm resistor
R2—One 1,000 ohm bias resistor
R3—One 150 ohm grid bias resistor
R4—One 10,000 ohm resistance
R5—One 13,000 ohm resistance
R6—One 4,000 ohm resistance

Other Parts

Six UY sockets
One UX socket
One vernier dial for C4
One knob for C2
Six 1.25 inch plug-in forms, three UX and three UY
An aluminum subpanel, 3x10x15 inches (suggested)
About 25 feet of shielded wire
Four grid clips

Winding Data for Sho

1.25 Inch Diameter Used for Plug-

(*Continued from preceding page*)

band from 550 kc to about 30,000 kc without difficulty. The winding data for these coils and for a tuning condenser C2 of 0.0002 mfd. will be given later in conjunction with the oscillator coil data.

The modulator or first detector is a 224 screen grid tube operating on the negative bias principle, and it is self biased by means of R1. This resistor should have a value of 3,000 ohms and condenser C3 across it should have a capacity of 0.1 mfd. This combination of 3,000 ohms and 0.1 mfd. works very well for this type of tube.

The oscillator coil T2 is wound on the same size form as T1 but one that fits a UY socket. The grid winding of this coil is tuned with a condenser C4 of 0.0002 mfd. The oscillator tube itself is a 227, and it is self biased with a 1,000 ohm resistor R2. The condenser C5 across this resistor has a value of 0.1 mfd. C1, C3, and C5 are all mounted in one block. The winding data for T2 are given in the table together with the data for T1.

Intermediate Amplifier

The intermediate frequency amplifier contains two variable mu tubes of the 235 type. There are three doubly tuned intermediate frequency transformers, T3, T4, and T5, each accurately adjusted to 450 kc, or to some frequency near this value. These transformers are available already tuned to 450 kc and mounted in aluminum shields. While these transformers are tuned to 450 kc at the factory, they must be retuned after they have been connected into the circuit because distributed capacities are added in wiring the circuit and these cannot be allowed for at the factory since they are unknown. However, they are usually so small that even before the retuning the circuit is practically in tune. It is only necessary to adjust each condenser a little until maximum volume is obtained.

The adjusting screws are accessible through holes in the shield can and through corresponding holes drilled in the subpanel directly over them. Since the subpanel and the shield can are grounded and the head of the screw may be alive, it is well to use a wooden screwdriver, or a taped screw driver, for making the adjustment.

The coupling between the primary and secondary of each intermediate frequency transformer is so loose that both windings must be tuned if the maximum volume is to be obtained.

A True Power Detector

The final tube in the circuit is a 247 pentode which is used as power detector. When the plate and screen voltages on this tube are 250 volts, the grid bias should be about 32 volts for best detection. At this bias the sum of the plate and screen currents is about 3.33 milliamperes, and therefore the bias resistor R4 should be 10,000 ohms. The by-pass condenser C7 across this resistor should be chosen with the idea in mind that low audio frequency currents must be by-passed as well as radio frequency currents. If the capacity is 4 mfd. the impedance at 50 cycles per second of the condenser and resistor is nearly 63 ohms. This is not excessive, but a smaller condenser than 4 mfd. should not be used.

A low pass filter in the plate circuit is desirable, though not absolutely essential when the power detector feeds into a dynamic speaker or a suitable transformer. In view of the fact that the pentode is especially effective on the high notes it is permissible to make the cut-off of this filter lower than usual. It might well be placed as low as 100 kc, although the frequency of the carrier is of the order of 450 kc. If each of the two condensers C8 and C9 has a capacity of 0.0005 mfd., the inductance of the choke Ch2 should be 10 millihenries if the cut-off is to be at 100 kc. A duolateral wound coil of 800 turns and used for intermediate frequency transformers at 175 kc has nearly this inductance and one of them is satisfactory.

Biasing the IF

The two intermediate frequency tubes are bias by a common resistor R3, which should have a value of 150 ohms. It is desirable to make the condenser C6 across this resistor at least 0.5 mfd. because the impedance of R3 and C6, connected in parallel, is common to the two tubes and this may either cause oscillation or a reduction in the amplification, depending on the connections of the leads of the transformer T4. It is well to keep either of these effects down as low as possible by using a large condenser across the resistance.

It will be noted that no filters are put in the screen and plate leads of any of the tubes, with the exception of the output tube. The omission is in the interest of compactness low cost of the circuit.

In place of the usual filtering the plate and screen leads are run in a special manner. The herringbone effect on these leads in the drawing represents shielding of the wire. All the screen leads and the plate return lead of the oscillator run to a common point. The shielding around these leads is grounded at both ends, and more frequently if convenient. At the common junction a large by-pass condenser C11 is connected to ground by short leads. Since only RF frequencies are involved the condenser need not be larger than 0.1 mfd., but the larger it is the better. The voltage drop resistor R5 is also connected to the common junction.

Running Plate Return Leads

All the plate return leads are run in a similar manner by shielded individual leads to a common point, and a condenser C12 is connected from the point to ground by short leads. This by-pass condenser carries most RF but it may also carry some audio, which should be by-passed. Hence C12 should not be smaller than one microfarad.

The voltage on the screen and the plate of the pentode should be 250 volts and to this should be added the bias voltage of 32 volts, making a total of 282 volts between B plus and ground. Of course, if the applied is somewhat less or greater there is no harm. However, if the deviation is considerable it may be necessary to change the value of the grid bias resistance R4.

The voltage on the plates of the remaining tubes should be 180 volts. The bias required on these tubes is so low that it is not necessary to allow for it. Hence if the applied voltage between ground and the common junction of R5 and C12 is 180 volts all is well. Now the question is how large R6 should be to drop the voltage from 282 to 180 volts. It all depends on how much current will flow to the screens and the plates of the first five tubes. We are safe in allowing 25 milliamperes. This would require that R6 be of 4,000 ohms.

The Screen Voltage Provided

The screen voltage and the plate voltage on the oscillator should be 75 volts. To get it we have to drop 105 volts in R5. The current through R5 is about 8 milliamperes. Hence the resistance should be about 13,000 ohms. Of course, it is quite permissible to select any value between 10,000 and 15,000 ohms. In case there is oscillation in the IF amplifier this resistance should be increased to stop the oscillation.

C1 is a by-pass condenser across the voltage supply. If the voltage is supplied by a rectifier-filter circuit this condenser may be omitted because it is already in the B supply. In case the B supply is a battery, which is not likely in view of the high voltage and heavy current. C10 should be a 4 mfd. unit.

Winding Data

Coil No.	Transformer	Pr.	Sec.	Tick.	Pickup	Tuned
1	T1	8	40	..	..	..
2	T1	4	13	..	..	..
3	T1	2	5.2	..	..	..
1	T2	..	..	18	5	28
2	T2	..	..	6	2	13
3	T2	..	..	3	1	5.2

The coils the turns of which are given in the table are all wound on 1.25 inch forms with No. 28 enameled wire, the spacing being that determined by the diameter of the wire. For the coil of the RF transformer, that is T1, the separation should be 1/8 inch and the primary should be wound near the bottom so that when a metal subpanel is used the tuned winding will be as far as possible from the metal.

The oscillator coil, T2, should be wound so that the tuned winding is in the middle, the tickler near the bottom and the pickup winding at the top. There need be no separation between the tuned

RCA Acquires Radio Frequen

As a result of inquiries that have been received recently concerning the present patent situation in the radio tube field, the Radio Corporation of America has made available to its tube licensees a list of radio tube patents which are in process of adjudication at the present time, and a supplemental list of additional tube patents included in its licenses.

Patents upon which suits for infringement have been brought cover contributions that have been made to the development of radio tubes by Arnold, Nicolson, Schotty, Langmuir, Seibt, Dushman, Wilson, Van der Bijl and Mitchell. These patents cover features embodied in such modern radio tubes as the alternating current, screen grid, pentode and multi-mu or exponential tubes.

Included in the supplemental list is a large number of other tube patents. It is pointed out that the number is large because for a great many years experimental and research work for the improvement of radio tubes has been carried on in the laboratories of the Radio Corporation of America and its associated companies.

RCA recently has added to its rights in the radio tube field by the acquisition of a group of circuit and tube patents and applications for-

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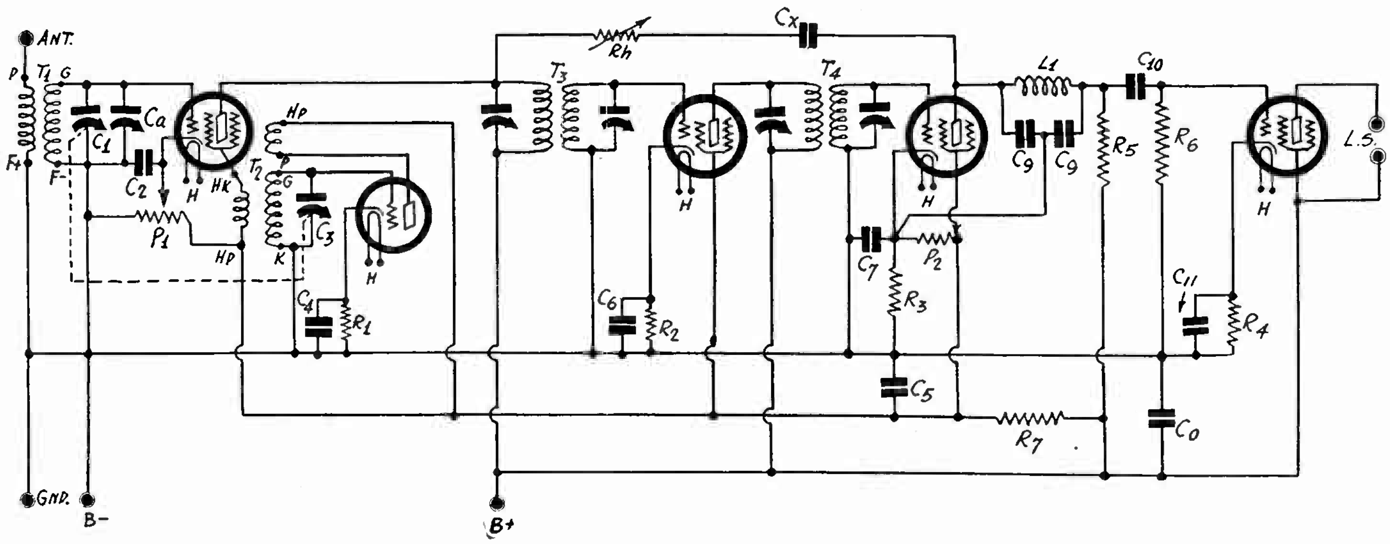

FIG. 2
A short-wave superheterodyne especially designed for automotive type tubes. The RF and IF tuners are the same of those in Fig. 1

and tickler winding, but there may be a separation of a quarter of an inch between the tuned winding and the pick-up. The object of putting the pickup winding away from the tickler is to minimize harmonic pickup and is based on the supposition that less harmonic current flows in the tuned winding than in the tickler.

The tickler and tuned windings of the oscillator must be connected properly if oscillation is to take place. Imagine that the tuned and tickler winding first constitutes a single winding the turns of which are equal to the sum of the two windings, and that this winding be cut at the proper place. The terminal of the tickler which is nearest the bottom is then connected to the P prong on the form. The other end of the tickler is connected to Hp. The terminal of the tuned winding next goes to K on the form and the terminal near the pickup goes to the G post on the form. The connections of the two pickup winding terminals is not important as far as direction is concerned but one of them should go to the Hp post of the form and the other to the Hk.

The connection of the leads to the oscillator coil socket should correspond to this. G goes to G of the oscillator tube, P to the P of the oscillator tube, K goes to ground, Hp, which has two terminals connected to it on the coil, goes to plus 75 volts, and Hk on the coil socket goes to G of the modulator tube.

Circuit for Automotive Tubes

The connections of the RF coil match throughout. That is, the top end goes to G, the other terminal of the secondary to F minus, the lowest end of the primary goes to P and the inside terminal of the primary to F plus. The coil socket is wired to the set accordingly. P goes to P of the tube ahead and G to G on the tube following. F minus goes to ground and F plus to plus 180 volts.

The connections are clearly indicated on the circuit diagram.

In Fig. 2 is a similar circuit that was especially designed for automotive type tubes, but, of course, may be built with the larger tubes by changing the applied voltages. Since there is no variable mu tube in the automotive series, a 236 screen grid tube is used for modulator and tubes of the same type are used for intermediate frequency amplifiers and second detector. A 238 pentode is used for output tube. No untuned radio frequency amplifier is used in this circuit but the same number of tubes is used, the last tube being an audio frequency amplifier coupled to the detector by resistance-capacity.

The design of the RF tuning coil and that of the oscillator coil are exactly the same as for the circuit in Fig. 1. That, of course, implies that the tuning condensers are also of the same capacity. The three intermediate frequency transformers are also the same as in the other circuit.

In this case the volume is controlled in the antenna circuit with a 10,000 ohm potentiometer connected across the primary of the transformer, the antenna being connected to the slider. If a potentiometer of this ohmage is not available it is quite all right to use one as high as 200,000 ohms.

Grid Leak Detector

The grid condenser and leak method of detection is used in this instance, and for this reason the grid return and cathode are both connected to ground. The grid leak should be not more than 2 megohms and the grid condenser not larger than 250 mmfd.

The oscillation is introduced into the screen circuit, just as in the preceding receiver.

Each screen grid tube should have a 750 ohm bias resistor and it should be shunted with a 0.1 mfd. condenser. The bias resistor for the 237 oscillator should be 1,000 ohms or somewhat more, and it, too, should be shunted with a 0.1 mfd. condenser.

The bias for the second detector is obtained from a 25,000 ohm potentiometer connected between the screen supply and ground, with the slider going to the cathode. A 2 mfd. condenser is recommended across the grid portion of this potentiometer.

The plate resistor should be 250,000 ohms, the stopping condenser 0.01 mfd., and the grid leak one megohm. These refer to the coupler between the detector and the audio frequency amplifier.

The bias resistor for the audio amplifier tube should be 1,250 to 1,500 ohms and the condenser across it 4 mfd.

A resistor is shown connected between the high voltage and the screens of the tubes. This resistance is not needed when batteries are used to supply the plate voltage, as is the case in automobile receivers. Instead the screens should be connected to 67.5 volts on the battery. The plate should be connected to 135 volts.

Tube Patents of
cy Laboratories

merly held by the Radio Frequency Laboratories, Inc. Rights under these patents and applications are automatically extended to RCA's licensees by the terms of their present licenses, which include the right to use inventions newly developed or acquired by RCA. They include the variable mu tube which is now being employed extensively.

The tube patents now in process of adjudication are those involved in the patent infringement suits brought by RCA against Gold Seal Electrical Company, Inc., filed September 10, 1928; the Dale Company (Arcturus Distributor), filed May 28, 1930: Majestic Distributors, Inc., filed September 5, 1930; and the Duovac Radio Tube Corporation, filed October 17, 1930.

Although the Langmuir high-vacuum patent was included under the licenses granted by Radio Corporation of America, nevertheless at the time that such licenses were granted this patent had been declared invalid by the U. S. District Court for the District of Delaware. "It has consequently been incorrectly described as the key patent upon which RCA has based its tube licenses," says the RCA.

The 238 Diamond

Automotive Series Pentodes in Push-Pull Output

By Herman Bernard

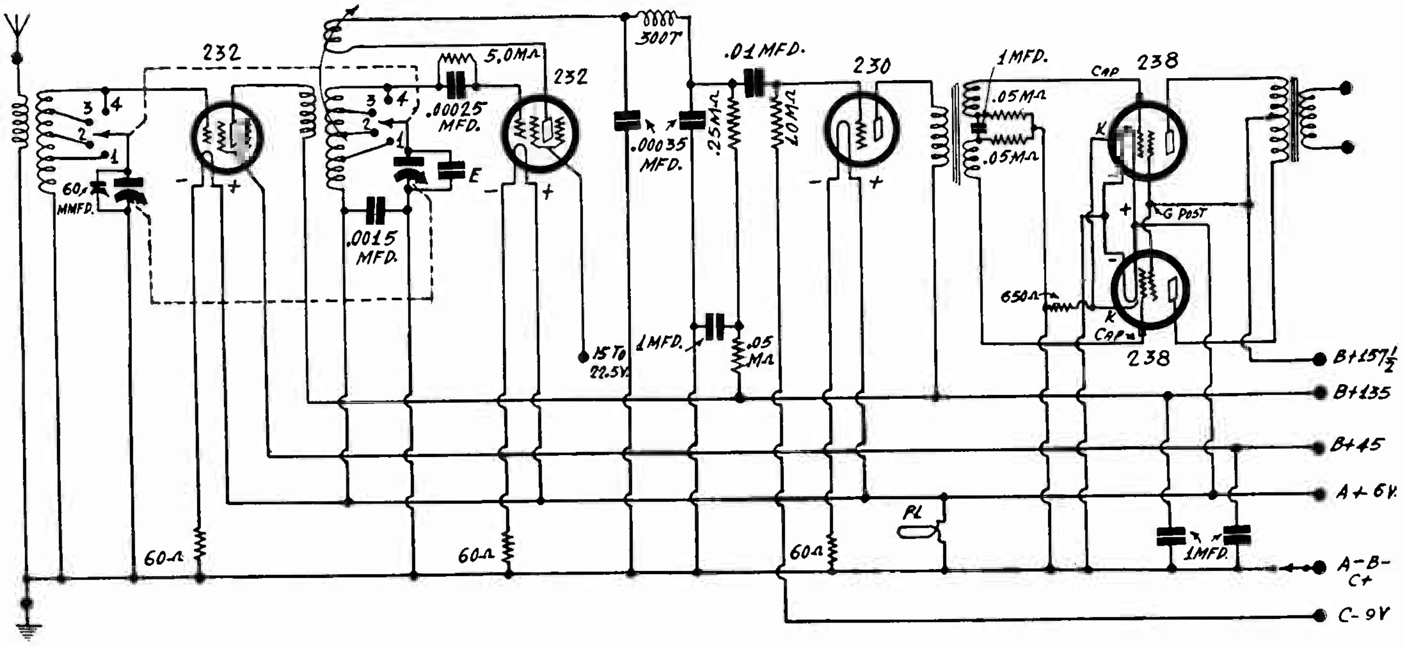

FIG. 1
The battery-operated push-pull Diamond of the Air, Model 238, for use of the automotive pentode tubes. The B current drain is 7 ma. less than with the 233 tubes, at the same voltages.

[The 233 Diamond of the Air, a battery-operated receiver, with 2 volt pentode output tubes in push-pull, was described last week in the July 4th issue. This week the same circuit is shown, but with the 6 volt pentodes. The reason for offering a choice of either 233 or 238 push-pull output is principally B current drain and output. The total receiver, with 233 push-pull output, draws about 45 milliamperes of B current, but with the 238's the current is about 38 milliamperes. The 233 is a 2 volt tube and requires filament resistors, the 238 is a 6.3 volt tube, and requires a 6 volt storage battery. The extra .3 volt is accounted for by the actual voltage of a newly charged storage battery.—EDITOR.]

FOR the benefit of those who did not read last week's article, the 233 Diamond is an All-Wave Receiver, using a front panel switch for band selection, 15 to 550 meters. There are five tubes of the 2 volt variety, all but one being screen grid. The pentode tubes are screen grid tubes, of course.

If one desires to reduce the B current drain a little or get a larger output at no greater drain, and if one has a storage battery, the remedy is to use 238 push-pull output. The 238 is a heater type tube of the automotive series. It is a pentode, different in appearance from all other pentodes in that it has a cap at top for the control grid, and different in construction from all other pentodes in that it is of the heater type.

The connections for the 238 pentode are: control grid connection (transformer C—) to cap of the tube, 6 volts of storage battery direct to the heater with no interposed resistor, G post to maximum B plus, plate to output device, and K or cathode to a biasing resistor.

If push-pull is used, as here, no bypass condenser is required across the biasing resistor, which for push-pull should be 650 ohms, 5 watts minimum rating.

The maximum plate voltage shown last week for the 233 Diamond was 135 volts, but now the maximum has been lifted to 157½ volts. This is done by the addition of a 22½ volt battery. The reason for raising the potential is that the biasing voltage for the power tubes is taken from the voltage drop in a resistor (650 ohms), and this voltage is about 13.5 volts. The total voltage across the tube is therefore whatever the voltage

(Continued on next page)

LIST OF PARTS

Coils

One antenna coil, on 2.5 inch diameter tubing; secondary, 62 turns, tapped at the 42d, 54th and 60th turns.
One three-circuit tuner, main diameter 2.5 inches; secondary, 62 turns, tapped at the 42d, 54th and 60th turns.
One 300-turn honeycomb radio frequency choke coil.
One Amertran push-pull input transformer, No. 151.
One push-pull output transformer or center-tapped impedance for speaker coupling (not needed if speaker has a center-tapped winding).

Condensers

One two-gang .00035 mfd. condenser.
One 20-100 mmfd. equalizing condenser.
One 60 mmfd. manual trimming condenser.
Two .00035 mfd. fixed condensers.
Three 1.0 mfd. bypass condensers.
One .00025 mfd. grid condenser with clips.
One .01 mfd. mica fixed condenser.
One .0015 mfd. fixed condenser.

Resistors

Three 15 ohm filament resistors
One 5.0 meg. tubular grid leak (not pigtail).
One 0.25 meg. pigtail resistor.
One 1.0 meg. pigtail resistor.
Two 0.05 meg. pigtail resistors.
One 650 ohm 5 watt resistor

Other Parts

One dual selector switch, double throw, four point.
One steel subpanel, 7x17.5x1.5 inches (drilled).
One front panel, 7x18 inches (drilled).
One National drum dial, modernistic escutcheon, color wheel, pilot light.
Two grid clips.
Two brass bushings, ⅝ inch high, threaded 6/32 for antenna coil elevation.
Two binding posts (antenna and ground).
One roll of hookup wire.
Two brackets for tuning condenser.
One seven-lead battery cable.
One switch.
One dozen 6/32 machine screws and one dozen nuts.

Short-Wave Interest Big

Club Membership Is Rapidly Increasing

Great interest in short waves is being manifested by radio builders, so much interest in fact, that there is no abatement due to seasonal conditions. The Short-Wave Club, started only about a month ago, has grown to important standing, as evidenced by the list of new members herewith. The list includes about two-thirds of the names received during two weeks. Members are at liberty to correspond with one another and are asked to send in suggestions for hookups, trouble shorting, kinks, etc., publication of which data will begin soon. Address Short-Wave Editor, Radio World, 145 West 45th Street, New York, N. Y.

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The 238 Diamond

(Continued from preceding page)

is between B minus and maximum B plus. Let us assume it is 157.5 volts. Of this, 13.5 volts are not plate voltage at all, since used for grid bias. The plate voltage is measured from cathode to maximum B plus and would be 144 volts. If only 135 volts total were used, and the bias voltage taken from this, there would be only 121.5 applied plate voltage.

Another way of looking at it is that the voltage otherwise used for C bias from a battery is wound to the plate side. Here almost twice as much voltage is added, compared to the C voltage.

The performance is about the same for whichever of the two types and the only reason for offering the 238 option is that of lessened B current.

The filament resistors for the other tubes, 232 and 230, are 60 ohms each, and there will be ample automatic negative bias, due to the 4-volt potential drop across them, except that the detector takes a purposefully positive bias. You will notice the detector grid coil is returned to F plus, which is identical with A plus.

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For picking up the monthly transmissions on the multi-frequencies almost any short-wave receiver may be used, but since the signals are interrupted continuous waves they will not be audible unless there is an oscillator associated with the receiver adjusted to a frequency slightly different from the signal frequencies.

Any regenerative receiver can be made to oscillate and such a receiver is suitable. In the case of a tuned radio frequency receiver it is necessary to use an auxiliary oscillator before the signals can be heard, and this oscillator must be adjusted to generate a frequency differing by an audible amount from the standard frequency.

For example, if the standard frequency is 2,000 kc. the auxiliary oscillator should be adjusted to either 1,999 or 2,001 kc. In either case the tone heard will be 1,000 cycles per second. Since this type of transmission may be on any one of the number of multi-frequencies, the auxiliary oscillator must be adjustable so that its frequency may be changed as the signal frequency is changed. This change is made every 12 minutes during the transmission period.

Receiving With Superheterodyne

If the broadcast receiver is a superheterodyne a fixed frequency auxiliary oscillator is needed to make the signals audible. The frequency of this oscillator must be either higher or lower than the intermediate frequency of the superheterodyne by an audible amount. For example, if the intermediate frequency of the superheterodyne is 175 kc. the auxiliary oscillator must be adjusted to 174 or 176 kc. In either case the signal will appear as a 1,000 cycle note. Of course, the auxiliary oscillator may be adjusted to differ by some other audio frequency, say 500, from the intermediate frequency. Since the intermediate frequency is always the same, it is not necessary to change the frequency of the auxiliary oscillator when the signal frequency is changed. It is only necessary to change the tuning of the superheterodyne in the usual way. The high frequency oscillator in the circuit is tuned until the beat frequency heard has the desired value.

Coupling Oscillator to Set

If the short-wave receiver is not completely shielded, sufficient coupling will usually be obtained to make the beat audible by simply placing the auxiliary oscillator near the receiver. Of course, the auxiliary must not be shielded, either. For a TRF set the auxiliary oscillator must be placed near the antenna of the broadcast set, when the coupling will be sufficient. This even works if the broadcast set is completely shielded. This also works with a superheterodyne provided that the auxiliary oscillator is tuned to a radio frequency and not to the intermediate frequency. If the auxiliary oscillator is tuned to the intermediate, a high resistance and a small condenser, connected in series, may be connected between the grid of the auxiliary oscillator and the grid of the second detector. One megohm for the resistance and 0.0001 mfd. for the condenser are suitable. Sometimes sufficient coupling in any case will be obtained if the auxiliary oscillator is supplied plate voltage from the same source as the broadcast set.

In order to receive the 5,000 kc. transmission a short wave set is needed, and since this signal is also interrupted continuous waves an auxiliary oscillator is needed, which may be a regenerative detector in short wave set. Except for the tuning, the 5,000 kc. transmission is received in the same manner as the broadcast frequency transmission.

While only the 5,000 kc. frequency is sent with high frequency accuracy (a few parts in ten million), it may be used for other frequencies, both higher and lower, by the method of harmonics. Thus the harmonics of the transmitted frequency are 10, 15, 20, 25, etc., kc. It

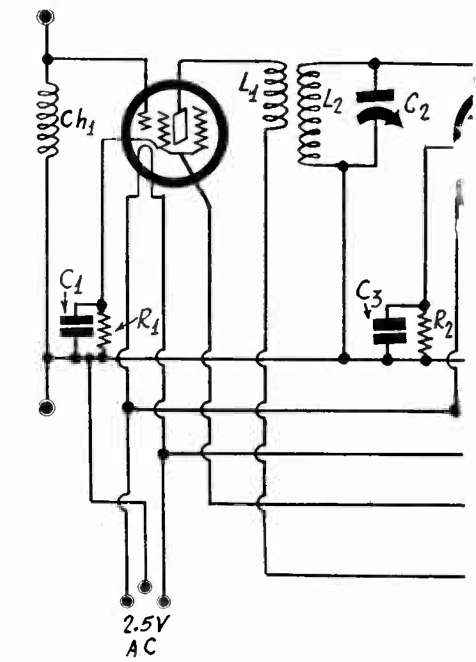


FIG. 1
This short-wave receiver is suitable for the reception of the standard frequency signals from WWV, Washington, D. C. Any oscillating sensitive short-wave receiver or converter covering the standard frequencies can be used.

would be a simple matter to use the tenth harmonic, or 50,000 kc., i
such high frequency were needed.

Subharmonics can also be used if an auxiliary oscillator is availabl
Thus it is possible to get 2,500, 1,250, 1,000, 625, 500, etc., kc., all wit
the same accuracy as that of the 5,000 kc. frequency. The third, se
enth, and ninth subharmonics were left out of this list because th
do not come out even, but they can be obtained just as easily as th
others.

One of the uses of the accurate 5,000 kc. transmission is the calibr
tion of piezo crystal oscillators, magnetostriction oscillators, and simil
secondary frequency standards. This calibration can be done to a hig
degree of accuracy, but probably not at one time. It may be necessar
to regrind the crystal or to change the length of the magnetostrictio
rod in order to get the frequency desired, and to measure the frequenc
again when the next standard transmission occurs.

Calibration of Wavemeters

If the oscillator to be calibrated contains an inductance and a varia
condenser the calibration against the standard can be done in a jiff
It is only necessary to tune in the standard signal, vary the local fr
quency by the variable condenser until zero beat is obtained, and n
the dial setting. This can be done for the fundamental or any of th
harmonics or subharmonics. An electrical oscillator of this type is n
constant enough in frequency to justify the use of this highly accura
standard. But its use at least removes one uncertainty about the cal
bration, the doubt about the accuracy of the standard. Any subseque
deviation would then be due to changes in the oscillator calibrate
And these changes are likely to be quite large unless a special fr
quency-stable oscillator has been built.

In Fig. 1 is a four-tube circuit suitable for receiving the standar
transmissions provided that the tuners are suitably adjusted. Ther
is first a radio frequency amplifier coupled to the antenna aperiodicall
After the tube is a tuned circuit which must cover the frequency of th
standard. The second tube is a detector using a screen grid tube. Th
third is an oscillator capable of being adjusted to a frequency differin
slightly from the signal frequency. This is coupled to the detect
through the screen circuit. The fourth tube is an audio frequen
amplifier coupled to the detector by means of a choke and conden
Its only object is to boost the audible note after it has been produ
in the detector.

Data for 5,000 kc. Coil

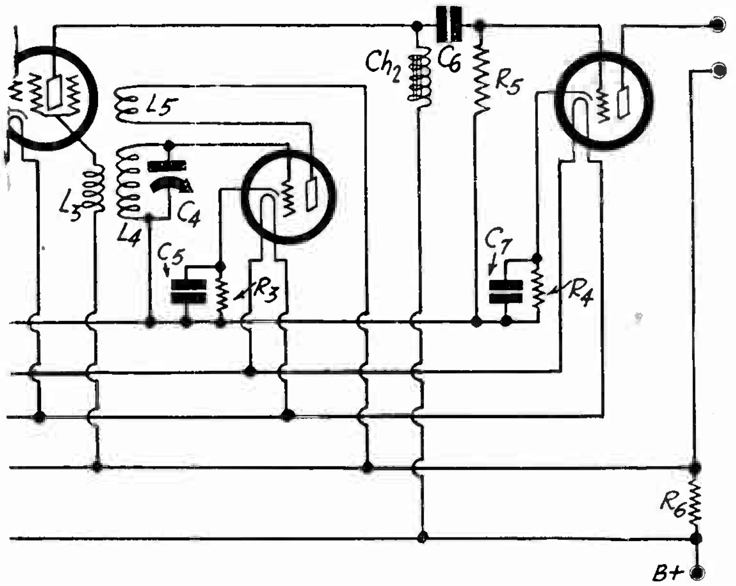
If the frequencies to be received were in the broadcast band, both
RF and the oscillator tuners would be regular broadcast equipment
the 5,000 kc. signal is to be received, both tuners must be tunable to
frequency.

Suppose we use a condenser of 60 mmfd. for tuning the two circ
If we determine the inductance required to tune to 5,000 kc. when

ındards Frequency Signals

Vaves; Oscillation Required for Reception

ıten Brunn



condenser is set at 30 mmfd., we are sure to cover the frequency desired. Let us assume that there is a distributed capacity of 15 mmfd. in addition to the capacity of the condenser. Then the total capacity in the circuit is 45 mmfd. For 5,000 kc. this requires a coil of 22.5 microhenries. If we select No. 20 enameled wire and a form of 1.5 inches in diameter we will need 24 turns. This applies to both the secondary of the RF coil and the grid coil of the oscillator. To make the circuit sensitive the primary of the RF coil might contain 18 turns. The same number of turns may be used for the tickler on the oscillator. The pickup winding on the oscillator should not have more than five turns. Any fine insulated wire may be used for the primary, tickler, and pickup windings. There is no real necessity for using heavy wire for these windings.

The Bureau's announcement follows:

The Bureau of Standards announces a new schedule of radio transmissions of standard frequencies. This service may be used by broadcasting and other stations in adjusting their transmitters to exact frequency and by the public in calibrating frequency standards and transmitting and receiving apparatus. The signals are transmitted from the bureau's station WWV, Washington, D. C., every Tuesday afternoon and evening. They can be heard and utilized by stations equipped for continuous-wave reception at distances up to about 1,000 miles from Washington, and some of them at all points in the United States. The time schedules are different from those used in transmissions prior to this July.

There are two classes of transmissions provided: One, transmission of the highest accuracy at 5,000 kcs. for two hours afternoon and two hours evening on three Tuesdays in each month; the other, transmissions of a number of frequencies in 2-hour periods in the afternoon and evening, one Tuesday a month. The transmissions are by continuous-wave radio telegraphy. The 5,000-kc. transmissions consist mainly of a continuous CW transmission, giving a continuous whistle in the receiving phones. The first five minutes of this transmission consist of the general call (CQ de WWV) and announcement of the frequency. The frequency and the call letters of the station (WWV) are given every 10 minutes thereafter. The transmissions of the other type are also by continuous-wave radiotelegraphy.

What Transmission Includes

A complete frequency transmission includes a "general call," "standard frequency signal," and "announcements." The general call is given at the beginning of each 18-minute period and continues for about two minutes. This includes a statement of the frequency. The standard frequency signal is a series of very long dashes with the call letters (WWV) intervening; this signal continues for about eight minutes. The announcements follow

Once-a-month Transmissions Scheduled Also on 1,600 to 10,000 kc.

and contain a statement of the frequency being transmitted and of the next frequency to be transmitted. There is then a 6-minute interval while the transmitting set is adjusted for the next frequency.

Information on how to receive and utilize the signals is given in Bureau of Standards Letter Circular No. 280, which may be obtained by applying to the Bureau of Standards, Washington, D. C. Even though only a few frequencies are received (or even only a single one), persons can obtain as complete a frequency meter calibration as desired by the methods of generator harmonics.

The 5,000-kc. transmissions are from a transmitter of 1-kilowatt power; they occur every Tuesday except the first in each month. The other transmissions are from a transmitter of one-half kilowatt power; they are given on the first Tuesday of every month.

5,000-Kilocycle Transmissions

2 to 4 p.m. and 10 p.m. to 12 midnight, Eastern Standard Time

July	August	September
14	11	8
21	18	15
28	25	22
..	..	29

Multifrequency Transmissions

Eastern Standard Time		Frequencies in Kilocycles		
p.m.	p.m.	July 7	August 4	September 1
2.00	10.00	1,600	3,600	6,400
2.18	10.18	1,800	4,000	7,000
2.36	10.36	2,000	4,400	7,600
2.54	10.54	2,400	4,800	8,200
3.12	11.12	2,800	5,200	8,800
3.30	11.30	3,200	5,800	9,400
3.48	11.48	3,600	6,400	10,000

The frequencies in the 5,000-kc. transmissions are piezo controlled, and are accurate to much better than a part in a million. The frequencies in the multifrequency transmissions are manually controlled, and are accurate to a part in a hundred thousand.

Reports Welcome

Since the start of the 5,000-kc. transmissions the Bureau of Standards has been receiving reports regarding the reception of these transmissions and their use for frequency measurements from nearly all parts of the United States, including the Pacific coast and Alaska. The bureau is desirous of receiving more reports on these transmissions, especially because radio transmission phenomena change with the season of the year. The data thus far obtained cover the first six months of 1931, and give information regarding approximate field intensity, fading, and the suitability of the transmissions for frequency measurements.

It is suggested that in reporting upon the field intensity, of these transmissions the following designations be used where field intensity measurements apparatus is not at hand: (1) Hardly perceptible, unreadable; (2) weak, readable now and then; (3) fairly good, readable with difficulty; (4) good, readable; and (5) very good, perfectly readable.

A statement as to whether fading is present or not is desired, and if so, its characteristics, such as whether slow or rapid and time between peaks of signal intensity. Statements as to the type of receiving set used in reporting on the transmissions and the type of antenna used are likewise desired. The bureau would also appreciate reports on the use of the transmissions for purposes of frequency measurements or control.

Reports on the reception of the transmissions should be addressed to Bureau of Standards, Washington, D. C.

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Answers printed herewith have been mailed to University Members.

Radio University

To obtain a membership in Radio World's University Club, for one year, send $6 for one year's subscription (52 issues of Radio World) and you will get a University number. Put this number at top of letter (not envelope) containing questions. Address, Radio World, 145 West 45th Street, New York, N. Y.

Annual subscriptions are accepted at $6 for 52 numbers, with the privilege of obtaining answers to radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

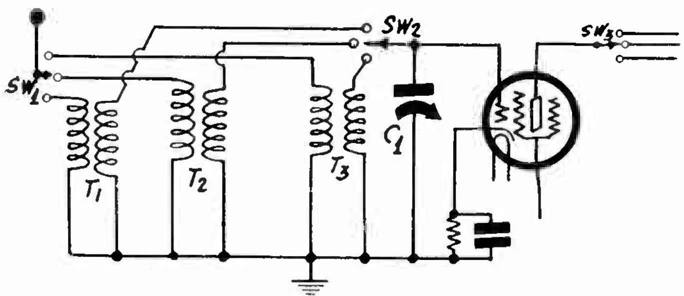


FIG. 934

A suggested diagram for an oscillator in which plug-in coils are avoided by the use of permanently mounted coils and selecting switches.

Oscillator Switch for Coil Changing

I WISH to build an oscillator that will cover a wide range of frequencies. I do not like to have plug-in coils but prefer to use switches for picking up the different coils. Will you kindly publish a diagram showing how this may be done?—W.E.

In Fig. 934 is a diagram that may be converted into such an oscillator. There are two switches Sw1 and Sw2. From the plate of the tube to the binding post over switch Sw1 connect a condenser of 0.001 mfd. Switch Sw3 is not needed. From the plate of the tube to B plus connect a choke coil which is efficient over the range the oscillator is to cover. While there are only three transformers, and thus only three frequency ranges, there is no reason why more should not be used. These should be placed so that those covering the highest frequency ranges are close to the tube. It is not necessary, nor even desirable, to use a screen grid tube for oscillator. Just ignore the screen in the diagram and regard the tube as a 227. The two switches Sw1 and Sw2 may be put on one shaft so that there will be no chance of picking up the tuned winding of one coil and the tickler of another. The output of the oscillator may be obtained by connecting a small condenser to the plate of the oscillator and then connecting this condenser to the grid of another tube. A grid leak is needed.

* * *

Wavelength of Sound

IN radio, we are told, the product of the wavelength and the frequency is a constant equal to the velocity of the propagation of the wave motion. Does this law also hold in sound? That is, is the product of the wavelength and the frequency equal to the velocity of the sound wave? If that is the case the wave length for a given frequency must vary with the temperature because the velocity of the sound wave varies with temperature.—W. H. C.

The same law holds for all wave motion in every medium. Sure, the wavelength for a given frequency changes with temperature. The wavelength increases with the temperature. At zero degrees Centigrade and standard air pressure, the velocity of a sound wave is 332 meters per second, and it increases 60 centimeters per second for every degree of temperature. Thus at 20 degrees Centigrade (68 degrees Fahrenheit) the velocity is 344 meters per second. As a result of this change in velocity with temperature, the pitch of musical instruments involving air columns, such as whistles, organs, and key trombones, changes with temperature.

* * *

Squawking of Grid Leak Detector

WHAT is the reason that a regenerative detector in which there is a grid leak and stopping condenser squeals Please give a simple explanation?—E. R. W.

Here is a stock explanation. When the circuit is oscillating or when a very strong signal is impressed on the grid, the grid accumulates electrons during the moments it is positive. This accumulation cannot leak off rapidly through the grid leak so when the swing goes negative the grid assumes such a negative potential that no plate current can flow. Oscillation stops. Then the negative charge on the grid leaks off and when the plate current has assumed a certain value oscillation starts again. Then the grid begins to go negative again as before, and the cycle is repeated. This stopping and starting of radio frequency oscillation occurs at an audio rate and the result is the squeal.

Using 247 As Detector

CAN the 247 pentode be used as a power detector? If so, what should be the value of the grid bias resistor and what value by-pass condenser across it do you recommend? Would there be likely to be a lot of hum with this tube as detector and AC current on the heater?—W. H. L.

It can be used, all right, as a power detector, if the bias resistance is made about 10,000 ohms. This resistance depends on the value of the applied plate and screen voltage. When this voltage is 135 volts the bias resistor should be about 5,000 ohms. For detection the plate current should be about the same, regardless of the voltage, so that the required resistance is proportional to the plate voltage, or the control grid voltage. That is, if the best value of the bias resistance is 5,000 ohms when the plate voltage is 135 volts, 9,260 ohms will be about right for 250 volts. The value in either instance is not critical. There will be considerable hum.

* * *

Relation of Harmonics to Fundamental

IS the relation between the fundamental and harmonics always that of exact multiples, or do the harmonics ever deviate from the true harmonic relationship? I am asking this because an argument has arisen concerning this point. Some students at our college claim that under certain conditions the harmonics are not exact multiples while I have read in radio books that the relation is always exact. Who is right?—F.W.C.

The students are right. If the harmonics are generated in a non-linear, driven device such as a vacuum tube, the harmonics are always exact multiples of the fundamental. In radio we hardly ever deal with any other and for that reason the statements you have read in books are not far from correct. The only exception is damped waves. If the circuit in which the damped waves are generated contains harmonics, they differ from the true multiple frequencies considerably, and differ more the greater the damping. The same is true of any freely vibrating device. Take a piano string, for example. Once the string has been struck it is a freely vibrating body. If there are harmonics on the string, which there will be if it was not struck at the proper place, the harmonic frequencies will be considerably different from the exact multiples, and the difference will be greater the greater the damping on the string, that is, the faster the sound dies down after the string was struck. This proposition is general. If the vibrations are produced under forced conditions, the harmonics, if any of them are generated, will be exact integral multiples of the fundamental, but if the vibrator is free after it has been set into motion by impact the harmonics, if generated, will differ from exact multiples of the fundamental. The students may also have had in mind harmonics which are not simple harmonics. For example, a tuning fork will generate certain natural frequencies mathematically called harmonics which bear no simple relation to the fundamental. In the case of percussion instruments and other impact instruments of high damping the deviation from true multiple relationship may be so great that the harmonics are dissonant with the fundamental.

* * *

High Resistance Voltmeter

CAN a 50-0-50 microampere galvanometer be used for a high resistance voltmeter, and if so, what will be its ohms-per-volt? If it is possible to use it, what are the disadvantages if any?—P.B.K.

It can be used and the ohms-per-volt will be 20,000 ohms. The only disadvantage of such an instrument is the expense of the multipliers. They should be wire-wound if they are to be reliable. If the instrument is to read up to 500 volts, for example, the total series resistance would have to be 20,000x500, or 10,000,000 ohms. Such a resistance will run into money. But it would make an excellent voltmeter. However, an equally good voltmeter could be arranged with a vacuum tube and a less sensitive milliammeter, and the whole set-up would not cost nearly as much. It would be less convenient to use, though.

* * *

Tubes Reduce Selectivity

IF a coil and condenser connected in series have a certain selectivity when not connected metallically, is that selectivity decreased or increased when the condenser is connected to the grid and cathode of a tube? If a resonance curve is taken on such a circuit should it be taken without any connections or should it be taken with the coil as it is supposed to be connected in a receiver?—B. C. Z.

The selectivity is decreased because the grid to cathode circuit has some conductance, or there is a high resistance from the grid to the cathode. This resistance is connected in parallel with the coil and the condenser and in effect it adds to the series resistance of the coil and condenser. If the resonance curve is to mean anything it should be taken with the circuit connected as it is supposed to be used. For example, if the coil is the secondary of a radio frequency transformer the resonance curve should be taken with the coil and condenser connected exactly as they will be connected in the receiver. If the circuit is to be used as a wave meter nothing should be connected to it except the resonance indicator.

* * *

Electromotive Force and Voltage

CAN you state in simple words the difference between electromotive force and voltage drop? Please explain also the terms potential and potential difference, both of which are measured in volts.—F.C.N.

Electromotive force is the force that drives current around in a circuit when the circuit is closed. It is sometimes called voltage because it is measured in volts. Voltage drop is practically the same as potential difference. The voltage drop in a resistance is the potential difference between the terminals of that resistance. Potential itself usually means potential difference, a point of zero potential always being implied. If there is an electromotive force in a conductor there is a potential difference across its terminals and when no current is flowing the potential difference is equal to the electromotive force in numerical value. If there is a current flowing in the circuit under the influence of the e. m. f. the potential difference across the "terminals" is equal to the e.m.f. less the voltage drop in the source of e.m.f. For example, if the source of e.m.f. is a battery the potential difference between the terminals of the battery is equal to the e.m.f. but if there is current flowing the potential difference across the "terminals" is equal to the e.m.f. less the voltage drop in the battery. The quotation marks are used advisedly because when there is current flowing there can't be any terminals, for the circuit is complete, like a ring. The "terminals" are the two nearest available points to the source of e.m.f. If a voltmeter is connected across the battery the meter reads the potential difference betwen its own terminals, or the voltage drop inside the meter. This reading is smaller than the e.m.f. of the battery if current flows and if there is any resistance between the available terminals on the source. A source of e.m.f. might be called a voltage rise, or potential rise.

* * *

Tube Output Voltage

HOW does the plate output voltage of a 227 tube vary with the grid bias for different applied plate voltages in a resistance coupled circuit? If you have any curves showing the variation I should like to see them. The object of the curves is to aid in the design of direct coupled amplifiers without the use of stopping condensers.—B. W.

You will find the curves in Fig. 935. They are for three different plate voltages in series with a 250,000-ohm plate resistance. The circuit diagram in the figure shows the meaning of the plate voltage. It is the actual voltage between tthe plate and the cathode measured with a vacuum tube voltmeter. Note that if the plate battery voltage is 180 volts and the grid bias is 8 volts, the effective voltage on the plate is 80 volts. This is about right for bias on a 250 tube with 450 volts on its plate. With direct coupling between the two tubes it would not be necessary to provide any bias nor to do anything to raise or lower the bias on the power tube.

* * *

Mutual Inductance of Two Equal Coils

I HAVE two equal coils wound on the same form. Each coil contains 100 turns of No. 28 enameled wire on a form 1.75 inches in diameter. The distance between the nearest turns on the two coils is 1.25 inches. Can you give the approximate inductance of each coil under conditions of non-shielding and the mutual inductance between them, or the coefficient of coupling? I plan to tune both of these coils to the same frequency to get a band pass effect. What is the width of the band?—T.W.C.

The inductance of each coil is approximately 357 microhenries. The mutual inductance is approximately 102.2 microhenries. Hence the coefficient of coupling is 0.286. Not knowing the frequency of resonance nor the capacity of the tuning condenser, it is not possible to say what the width of the band passed is. However, the ratio of the low frequency to the high frequency is 0.745, the frequencies being at the two peaks. The coupling is a little too close for a band pass filter.

* * *

Secondary Effect on Primary

WHAT effect does the secondary circuit have on the impedance of the primary circuit? If the secondary of a transformer is shorted, fuses in the primary line are likely to go, which would indicate that the primary impedance would be less with the secondary present, yet formulas show that the reverse is the case. Which is right?—T.L.J.

The resistance of the primary increases when a secondary which draws current is coupled to it because the power expended in the secondary must come from the primary. The reactance of the primary, on the other hand, decreases. Curves in Morecroft's latest book, "Experimental Radio Engineering," show that the effective primary impedance decreases as the resistance in the secondary circuit decreases. This would account for the blowing out of fuses in the primary line when the secondary is short circuited.

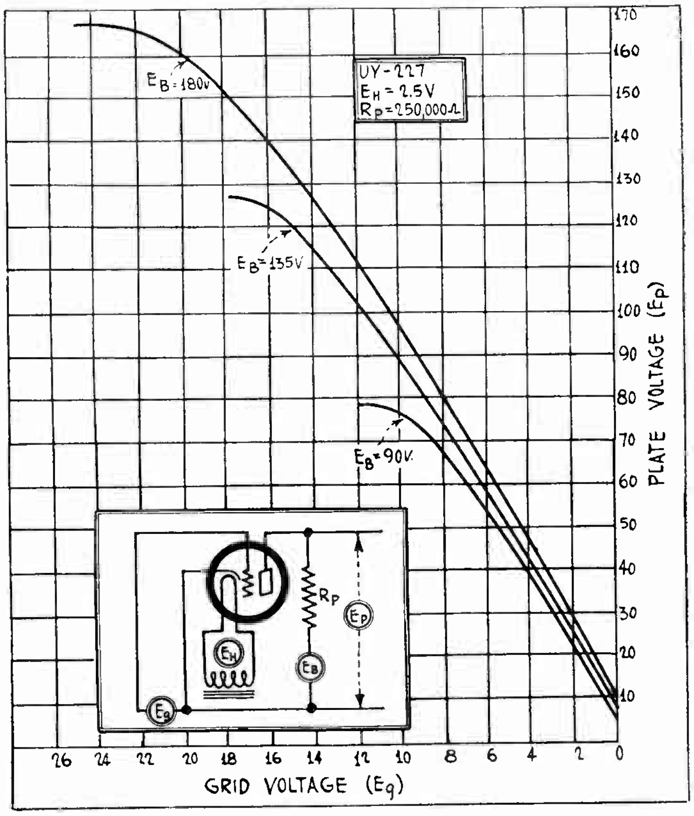


FIG. 935

The curves in this diagram show the manner in which the effective plate voltage on a 227 tube, with 250,000 ohms load resistance, varies with grid bias and applied plate voltage.

* * *

Inductance of Small Coil

I HAVE a small coil consisting of 20 turns of No. 24 double silk wire on a half-inch diameter. The turns are wound as close together as the insulation permits and the length of the winding is one-half inch, as near as I can measure it. What is the inductance?—W. G. F.

If the winding is one-half inch long and contains 20 turns, the diameter of the coil, measuring from center to center of the wire on opposite sides of the coil, is 0.525 inch. Using this value for the diameter and 0.5 inch for the length, the inductance turns out to be 3.74 microhenries.

* * *

Antenna for Portable Set

I HAVE a portable set which I wish to use in a car while traveling. As a portable the set is very good as it will bring in distant stations almost anywhere, but to do it I have to use an antenna of some sort. Just ten feet of wire run from the set to the top of the car is enough. But when I put the set in the car it does not bring in anything. I presume that the antenna is shielded by the metal framework of the car. Can you suggest a way of picking up signals while the set is in the car?—W.E.S.

Obviously the trouble is what you suspect. It is just the thing to expect. If you will hold the antenna wire out of the car window you will at least get something. Another way is to throw out a well insulated wire and let it trail behind the car. Still another is to mount a wire on top of the car. The wire used for antenna must be outside the car for at least a few feet.

OFFENSES GET STATIONS INTO LICENSE SNARL

Washington.

Temporary licenses were issued by the Federal Radio Commission to more than a dozen broadcasting stations, while probationary licenses previously issued to 30 other stations were made permanent because they had complied with engineering regulations in the meantime. The Commission also granted temporary licenses to nine stations which have cases pending.

The Commission found that 14 applicants were violating orders of the Commission which prescribe that they must operate a minimum of 12 hours per day.

Nine stations received temporary licenses because of pending applications: WDAE, Tampa, Fla.; WFLA-WSUN, Clearwater, Fla.; WIBR, Steubenville, Ohio; WLBZ, Bangor, Me.; WLOE, Boston, Mass.; WMBA, Newport, R. I.; WMBC, Detroit, Mich.; WTMJ, Milwaukee, and KGEF, Los Angeles.

Clause In Licenses

Each license will contain this clause:

"This license is issued on a temporary basis and subject to such action as the Commission may take after hearing on the licensee's pending application for renewal of license. No authority herein contained shall be construed as a finding by the Federal Radio Commission that the operation of this station is in the public interest."

The Commission issued temporary licenses to WABZ, New Orleans; WMAK, Buffalo, and WPSC, State College, Pa.

KUT, Austin, Tex., and KWEA, Shreveport, La., licensed for unlimited time, operate less than 12 hours a day in violation of General Order 105, so were granted similar temporary licenses.

Nine stations licensed for unlimited time, but operating less than 12 hours daily, were given temporary licenses, as follows: WABI, Bangor, Me.; KCRJ, Jerome, Ariz.; KFIU, Juneau, Alaska; KFQD, Anchorage, Alaska; KGCU, Mandan, N. Dak.; KGDA, Mitchell, S. Dak.; KGHI, Little Rock, Ark.; KGIX, Las Vegas, Nev., and WKAV, Laconia, N. H.

Offenders Make Good

KOV, of Pittsburgh, which failed to file a time-sharing agreement as required, was subjected to a temporary license.

The stations given renewals of licenses since they have complied with engineering regulations, are:

KFBL, Everett, Wash.; KFJM, Grand Forks, N. Dak.; KGCR, Watertown, S. Dak.; KGFI, Corpus Christi, Tex.; KGHF, Pueblo, Colo.; KIDO, Boise, Idaho; KIT, Tacoma, Wash.; KLX, Oakland, Calif.; KOOS, Marshfield, Oreg.; KPPC, Pasadena, Calif.; KSMR, Santa Maria, Calif.; KFBS, Shreveport, La.; KWKC, Kansas City, Mo.; WBBL, Richmond, Va.; WCCO, Minneapolis; WCKY, Covington, Ky.; WDWF, Providence, R. I.; WHAZ, Troy, N. Y.; WJBO, New Orleans, La.; WKAR, East Lansing, Mich.; WSOC, Gastonia, N. C.; WWRC, Asheville, N. C.; KFXM, San Bernardino, Calif.; KOY, Phoenix, Ariz.; KRE, Berkeley, Calif.; KVOA, Tucson, Ariz.; WEXL, Royal Oak, Mich.; WHBY, Green Bay, Wis.; WPAD, Paducah, Ky.; WSAI, Cincinnati, Ohio.

FIRE CHIEF CALLS ROOF AERIALS MENACE TO LIFE

The Fire Commissioner of New York City stated that he planned to take action to have radio antennas removed from the tops of roofs as a menace to fire fighting.

Trade Board Drops Case Against RCA

Washington.

The Federal Trade Commission has dismissed a complaint charging tthe Radio Corporation of America, New York, with practicing unfair methods of competition in the sale of vacuum tubes.

Dismissal follows final disposition in the Federal Courts of a case against the corporation involving the same subject matter as the Commission's complaint. The court entered final injunction against the company's continuing the practice charge.

TIME ENACTED IN WISCONSIN

Madison, Wis.

Governor Philip La Follette has signed a bill making it a penal offense to use any other than standard time in Wisconsin. Violators are liable to a fine of $25 to $50 or 10 to 30 days in jail, or both.

The law is significant to radio users because of the radio stations in the state. Time for program schedules therefore is Central Standard Time. The Wisconsin stations, with frequencies and locations follow (T designating transmitter locations where differing from studios):

WTAQ—Eau Claire 1330
T—Township of Washington
KFIZ—Fond du Lac 1420
WHBY—Green Bay 1200
T—West De Pere
WCLO—Janesville. 1200
WKBH—La Crosse 1380
WHA—Madison ... 940
WIBA—Madison .. 1280
WOMT—Manitowoc 1210
WDH—Milwaukee. 1120
WISN—Milwaukee. 1120
WTMJ—Milwaukee 620
T—Brookfield
WIBU—Poynette.. 1210
WRJN—Racine ... 1370
WHBL—Sheboygan 1410
WISJ—South Madison 780
WLBL—Stevens Point 900
WEBC—Superior . 1290

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, RADIO WORLD, 145 West 45th Street, New York, N. Y.

W. B. Homback, 140 Crestmoor Ave., Louisville, Ky.
Edward H. Pelowaki, 849 Filmore Ave., Buffalo, N. Y.
George A. Beaver, Servicing, 428 North 12th St., Lebanon, Pa.
Clifford E. Biggard, 426 N. 12th St., Lebanon, Pa.
A. O. McElroy, 826 Walker Ave., Oakland, Calif.
W. M. Mervine, 3266 Pleasant St., Camden, N. J.
Oscar Ise, 1517 Coit Ave., East Cleveland, Ohio.
Herman Phillips Radio Shop, Box 326, Baird, Tex.
O. H. Gallinger, 363 E. Mercury St., Butte, Mont.
J. Needham Radio Shop, 207 North Pen. Drive, Daytona Beach, Fla.
Allied Eng. Services Co., P. O. Box 751, Lima, Ohio.
Louis A. Levine, 1487 St. Marks Ave., Brooklyn, N. Y.
Frank S. Gurden, C. G. Station, Box 681, Shreveport, La.

New Corporations

Capitol Radio Tube Co., Inc., Newark—Atty. A. V. Shedeker, Newark, N. J.
North American Broadcasting System, Ltd., Wilmington, Del., radio network and broadcasting—Corporation Trust Co.
Royal Television of America, Inc., Philadelphia, Pa., television devices—Corporation Guarantee and Trust Co.
Mercola Radio Co.—Atty. E. J. Bausch, 84 Granite St., Brooklyn.
Television Corporation of America, Wilmington, Del., wireless telegraph, telephone, and television instruments—Corporation Trust Co.
Palen Radio—Atty. M. Lipton, 245 Broadway, New York, N. Y.

NATION LISTENS AS ELECTRONS BARK IN TESTS

An electron, a unit so tiny that it takes billions upon billions of them to weigh an ounce, was dropped in WEAF's studio and the sound so amplified that it could be heard by radio listeners all over the country. The experiment and the talk accompanying it were made by Orestes H. Caldwell, former United States Radio Commissioner, who several months ago during a radio talk dropped a pin, the sound being heard by millions of radio listeners.

The recent experiment was carried out over a National Broadcasting Company network under the auspices of the Century of Progress, International Exposition, Chicago, 1933. Mr. Caldwell is a committee member.

How Tiny An Electron Is

The electron-dropping experiment was carried out by using an instrument known as a Geiger counter, loaned by the Museum of Science and Industry. The device is employed to detect the amount of radio-active substances in ores.

Describing the experiment, Mr. Caldwell said:

"In the field of electrical engineering, of course, the underlying unit is the electron itself, that final subdivision of electricity and of matter which flows in our wires, spans the space in our vacuum tubes and makes up everything we see or feel.

"The electron itself is a tiny thing. In fact, compared with a grain of sand, the electron is as much smaller than the grain of sand as the grain of sand is smaller than the earth. In other words, it would take five hundred billion billion billion of these electrons to weigh a pound. In size an electron measures about one-thirteen trillionth of an inch in diameter.

"Yet so sensitive are the devices used in radio that I can let you hear an individual tiny electron particle as it enters the ionization chamber of a Geiger counter.

Reason For Crash

"In my hand, in front of the instrument, I hold my radium-dial watch which I have carried for years. On the hands and dial tiny solar systems of electrons which make up the radium atoms are constantly breaking down and throwing off some of their electron plants, both as single electrons (beta particles) and as electron groups carrying a positive charge (the alpha particles). It is this electron bombardment which keeps the luminous material constantly aglow. If you will look real closely at a radium-dial watch under a strong magnifying glass you will see the particles strike.

"If I hold the watch-face near the instrument one of these tiny alpha particles, thrown into the air, gets through the tiny opening into the ionization chamber of the instrument and causes the air insulation inside to break down, battery current rushes through and you hear a crash."

Sounds Like Machine Gun

During the experiment Mr. Caldwell explained:

"That series of sounds like a machine gun patter marks the electrons that got inside the instrument, one bang for each electron.

"It is a stream of electrons that is carrying to you this broadcast, the strength of the stream from instant to instant giving you the modulation which reproduces my voice. Other streams of electrons in the tubes of your own radio set pick up the tiny impulse in the air and multiply it so you can hear it. Electrons in millions pass through your reading lamp—in fact, an ordinary 50-watt lamp takes three billion billion per second."

BOARD DECIDED 25,000 CASES IN 12 MONTHS

Washington

Concluding the most active 12-month period since its creation four years ago, the Federal Radio Commission adjourned over the Summer, having handled approximately 25,000 applications covering every phase of radio regulation.

The last week, it was stated orally at the Commission, probably was the busiest, from the view of cases cleared, of any corresponding period since the Commission began its functions in February, 1927. That agency has taken action on approximately 300 cases in that week, to clear, so far as possible, its docket until it reconvenes in September.

Emergencies Provided For

While the Commission is in adjournment until September, routine and emergency matters will be cared for by special delegation of authority. It is expected that at least one member of the body will be in Washington at all times to act on such matters, subject to the Commission's ratification at some future date.

At odd times, also, it is expected that a quorum of the Commission will be present, although no regular meetings will be held. Hearings on pending applications will be held during the Summer before examiners, following customary procedure.

The following additional information was made available, according to "The United States Daily":

More than 250 hearings on applications from existing stations or applications for new facilities have been held since last September, when the Commission's examining division was created. Reports have been rendered and acted on by the Commission in about 210 of these cases, and some 55 are still pending. About 500 cases were designated for hearing, but in about one-half of these the applicants either defaulted or withdrew their requests.

Mainly Amateurs

Of the aggregate of some 25,000 applications which have been received, by far the major portion was from amateurs seeking renewal of their licenses to carry on experimentations in both radiotelephony and telegraphy in high frequencies. Ship license applications, including renewals, aggregated about 2,500; broadcasting, about 2,750, and commercial communications, about 1,900.

What is construed as the most important case ever to come before the Commission, involving possible cancellation of the licenses of some 1,400 licenses of every character in radio, held by subsidiaries of the Radio Corporation of America, was decided during the final week by the Commission. The decision, by a three-to-two vote, cleared the RCA of the charge of violation of section 13 of the Radio Act because of a previous adverse opinion by the Federal courts on the so-called tube clause contract of the parent company.

In this case the future operations of the National Broadcasting Co., RCA-Communications, Inc., engaged in transoceanic radio communication, and the Radiomarine Corporation of America, maintaining ship to shore radio communications, as well as the experimental television operations of RCA-Victor Co., were imperiled.

The Commission found that the opinion of the courts holding the RCA had violated the Clayton Act by requiring receiving set manufacturers licensed to use its patent initially to equip their sets with RCA tubes, did not come within the meaning of section 13 of the Radio Act, which specifies that any final judgment of guilt in violation of the antimonopoly laws in radio communication shall be grounds for refusal to renew license.

Just prior to its decision in the RCA case, the Commission adopted a new general order having to do with the efficiency of broadcasting station operations which is designed virtually to eliminate heterodyne interference for radio listeners. Although this order does not become effective for one year, all of the 615 broadcasting stations, in the interim, must install equipment which will reduce their wave "wobble" or deviation, from the present allowable maximum of 500 cycles to 50 cycles. The heterodyne whistle then would be inaudible for listeners within the "constant" service areas of all stations, it is held, with a resultant substantial improvement in general service.

High Power Action Deferred

Another case considered of paramount importance in radio—that of high power for broadcasting stations operating on cleared channels—was considered during the final week by the Commission, but action was deferred until October 1st. No reason was assigned for the postponement.

In this situation, 24 leading broadcasting stations of the nation are competing for the eight remaining vacant assignments with the maximum power of 50,000 watts. The case already is 10 months old, having had its inception last September following an order by the Commission restricting the number of cleared channels which would be authorized to accommodate stations of the maximum power to 20 of the 40 exclusive channels.

After five weeks of hearings before Chief Examiner Ellis A. Yost, the Commission refused to act on a recommendation by the Chief Examiner that all of the 40 cleared channels be allowed to have 50,000-watt station. Since 12 of the positions already were occupied, it instructed Mr. Yost to select stations to fill the eight vacancies, which request later was complied with. Oral arguments were presented before the full Commission three months ago, and now, with all the evidence in the case before it, the Commission again has deferred final consideration until next Fall.

Move For More SW Stations

In the short-wave field, where international, domestic and ship communications are carried on, the Commission paved the way for a new allocation that ultimately will have the effect of virtually doubling the number of available frequencies. It rescinded two previous general orders prescribing that the separation between those channels shall be two-tenths of 1 per cent of the channel width, thus opening the way for an allocation based on one-tenth of 1 per cent separation.

The closer separation was recommended as technically feasible by the international technical radio conference which met at The Hague last year, and the Radio Commission's legal division since that time has been working out a tentative allocation based on this separation. Since the Commission now is in adjournment, it is the view that the new allocation will not be acted upon until next Fall, at least.

During the past year, the Commission has had occasion to delve into every branch of radio regulation. From the broadcasting legal side, the most significant occurrences were the removal from the air of three stations for alleged use of profane, obscene or indecent language, or for other practices considered inimical to the public health or welfare.

The fact that the Commission, under the radio law, is specifically prohibited from exercising a power of program censorship makes these cases all the more interesting and important, legally, since the stations were removed from the air with court sanction, without violating the censorship restriction. The Commission took into consideration the past programs of the three stations as grounds for its summary action, on the theory that the law empowered it to determine the "public interest" of stations, and that such a practice was not censorship.

The Court of Appeals of the District of

SUMMARY OF COMMISSION'S BIGGEST YEAR

Columbia sustained this theory. "By their fruits we shall know them" was the Biblical analogy used by this court in one of these cases, in its opinion sustaining the Commission. The stations deleted were KVEP, Portland, Oreg., KFKB, Milford, and KTNT, Muscatine, Iowa. The latter station, although not on the air, still has an appeal pending in the Court of Appeals.

Stricter Engineering Regulations

In numerous ways, the Commission has "tightened up" engineering regulations with the aim of improving service for the listeners, and of reducing interference. Stations now are required to broadcast with a minimum of 75 per cent modulation at their rated power.

Failure to comply with this provision has forced stations to relinquish so much of their licensed power as would meet the requirement as to quality of emitted signals. In other ways the Commission has imposed engineering regulations, making for all-around efficiency in operation.

In the continental short waves, development was retarded by litigation in the Court of Appeals protesting the Commission's allocation, in December, 1928, of some of the 88 channels available for domestic service to the Universal Wireless Communication Co., Inc. In the meantime, however, that company went bankrupt and the whole case was remanded to the Commission, subject to approval by the Court, which retained jurisdiction.

New Allocation

Radio Corporation of America, Mackay Radio & Telegraph Co. and Intercity Radio Telegraph Co. appealed from the Commission grant of the 40 channels to Universal, which was obligated to link more than 100 cities by radio, serving the public like the established land line telegraph companies by the end of 1931. Intercity also became insolvent during the litigation, and its application for facilities were cancelled, by stipulation.

As it now stands, the Commission must make a new allocation of these continental short waves, taking into consideration the requests for both RCA and Mackay for facilities. When that allocation is arranged, the plan must be submitted to the Court of Appeals for approval.

In its routine and general regulatory operations, the Commission has demanded strict adherence to regulations. Under a regulation adopted several months ago, stations licensed for full time are required to operate a minimum of 12 hours daily, or else forfeit portions of their assigned time. Other regulations of a similar nature were adopted, and as a consequence more than 100 stations have been given temporary licenses from the license period beginning July 3d, to show cause at hearings to be held in the Fall, why they have not complied with the regulations.

Lindbergh Receives License for 'Plane Use

Washington.

Col. Charles A. Lindbergh received from the Federal Radio Commission a license for an aircraft radio station license aboard his plane, "NR-211," for use on his flight with his wife to Japan.

The application requests a power output of 12 watts, to operate on the frequencies 333, 500, 3,130, 5,615, 8,450 and 13,240 kilocycles. It was explained orally at the Commission that this would permit communication at varying distances from shore.

A THOUGHT FOR THE WEEK

MR. RADIO MAN, has your business improved since President Hoover's recent international gesture that started the whole world talking? If it hasn't or if there has been no decrease in volume, just keep right on thinking that things are righting themselves. If enough millions think that way, the things that are wrong will be righted, all right, all right! Oh, psychology, thy name, if properly invoked, stands for healing and comfort and relief, even if the man in the street doesn't quite know what it's all about!

RADIO WORLD

The First and Only National Radio Weekly
Tenth Year

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.

Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. E. Anderson, technical editor; L. C. Tobin, advertising manager.

The RCA Decision

THE decision by the Federal Radio Commission that the Radio Corporation of America did not exercise a monopoly in radio communication when it instituted clause 9 in its contracts with set licensees will suit the public. For a while it looked as if the broadcasting activities of the National Broadcasting Company, as well as the communications and experimental work of RCA Communications, Inc., Radiomarine Corporation of America and RCA-Victor Company, subsidiaries of RCA, were imperilled.

No form of public service could be imagined in a refusal to grant license renewals to the subsidiaries holding 1,400 licenses for various types of radio service. It seemed as if the chronic opponents of RCA and all its works were striving just a little too hard to work disaster to the world's greatest radio aggregation. It so happens that public interest and welfare are tied up very closely with the activities of great corporations, and it is becoming less and less sensible to engage on corporation-baiting or any other over-zealous activities intended to wreak revenge or promote political ambitions rather than execute justice.

The tube clause, the famous clause 9, was incorporated into contracts that RCA made with set manufacturers, whereby these manufacturers were permitted to make and sell the sets, provided, however, that besides paying the royalty, the manufacturers would equip the sets initially only with RCA tubes. This clause soon was abandoned as poor policy, but meanwhile independent tube manufacturers had started suit for damages, asking for an injunction which was granted after the offense had ceased. The injunction, from a practical viewpoint, was academic, although the independents had a full right to seek it, and its possession is part of their stock in trade in the suits now pending for money damage.

The United States Supreme Court did not take any action when the case came before it for review, other than not to grant the petition for review, so RCA had exhausted its legal remedies. A lower court had found that the tube clause was in restraint of trade. Since section 13 of the radio law directs the Federal Radio Commission to refuse to issue a license renewal to any applicant where there has been an adjudication of violation of the anti-monopoly laws of the United States, the Commission was petitioned to refuse renewals. Fifteen licenses were up for consideration, and of course eventually all the licenses would come before the Board on applications for renewal.

The decision that the licenses should be renewed was reached on the basis that here had been no adjudication of guilty of monopoly in radio communication. Three of the Commissioners so decided—Ira E. Robinson, William D. L. Starbuck and Harold A. Lafount. Two voted for refusal—Chairman Charles McK. Saltzman, and Vice-Chairman Eugene O. Sykes.

Commissioner Robinson, who used to be a judge, in his separate opinion, said:

"I have given more than a month to the consideration of this question. Out of that consideration I can not, in proper legal analysis, bring my mind to any other conclusion than that the decree of the said court does not adjudicate that radio communication has at all been monopolized or attempted to be monopolized. The decree does adjudicate that the sale of radio broadcasting tubes was controlled, but the Court does not go further and adjudicate that by such control radio communication was monopolized or attempted to be monopolized."

Starbuck and Lafount filed a joint opinion, arriving at the same conclusion.

Pointed Quotations

C. C. DILL, United States Senator from Washington State: "The people of Europe may endure government control of radio, but such a plan would not satisfy the American people. England and Germany have organized radio especially well. Denmark makes it serve the people in unusual ways and has introduced the home element in the programs. Yet in all European countries the officials who manage radio are restricted and limited. Freedom in radio broadcasting, like all other kinds of freedom, may be abused just as there is abuse of freedom of speech and freedom of press, but the benefits greatly overbalance the defects."

* * *

EDGAR H. FELIX, Radio Consultant: "The broadcasting fraternity is only beginning to appreciate that recording for broadcast purposes is a new and highly specialized art. The methods used in making satisfactory records for home phonograph use are quite at variance with the most desirable practices in making transcriptions for broadcasting purpose. Therefore, only transcriptions made by experienced radio impresarios show appreciation of the difference between the levels and volume limitations suited to broadcasting as compared with the narrower range which can be well reproduced on home instruments."

* * *

SIR JOHN C. W. REITH, Director-General of the British Broadcasting Co.: "I do not believe in the necessity for keen competition among broadcasting companies for talent. If competition is necessary to provide the best programs it doesn't speak well for those in charge. The high prices paid by United States broadcasters for the best talent do not prevail in England, where, instead of the artist setting a price, the program directors determine his worth and their valuation for the particular broadcast is final. The artist agrees to this or does not appear."

The Radio Census

Oregon.

The whole number of families in Oregon on April 1, 1930, was 267,690, as compared with 202,890 in 1920. The number of persons per family in 1930 was 3.6 as compared with 3.9 in 1920. The number of families reporting radio sets in 1930 was 116,209, or 43.5 per cent of the total.

Radio Week Set for Sept. 21 to 27

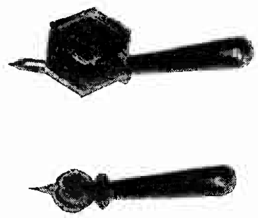
The National Federation of Radio Associations, including all of the distributing side of the radio industry, has selected the week of September 21-27, coinciding with the Radio World's Fair in New York, to be observed throughout the nation as National Radio Week.

H. G. Erstrom, executive vice-president of the association, said: "During National Radio Week in 1930 there were thirty-three chain programs dedicated to radio. Over 200 broadcasting stations carried frequent announcements during the week concerning the event. Thirty-five metropolitan areas held gala demonstrations celebrating radio's tenth birthday and nearly one hundred newspapers ran special Radio Week supplements carrying radio news.

"This year we have laid more auspicious plans for the observance of radio's eleventh birthday. We intend to make the public more radio conscious and to realize the vast influence radio has on the public life of our nation.

National Co. Makes Lever Type Indicators

National Company, Inc., of 61 Sherman Street, Malden, Mass., announces three lever type indicators. These units are now being used considerably in laboratories with high voltage condensers. Two types are illustrated. A third type will be known as Type M and will be similar to the Type J (illustrated in two sizes), but it will not have the hexagonal knob.



New Condenser Treatise

A. M. Flechtheim & Co., Inc., 136 Liberty Street, New York City, has a booklet containing information regarding the construction, design and utilization of light types of paper dielectric condensers. Descriptions and illustrations cover a complete line of condensers from 200 to 7000 volts d.c.

The company has produced a 7000-volt transmitting filter condenser, employing a special process paper dielectric. A treatise on fixed condensers will be sent by the manufacturer for the asking. Mention RADIO WORLD.

Additional Channel Assigned to Aircraft

Washington.

An additional radio channel was assigned for aircraft and aeronautical radio stations by the Federal Radio Commission in a general order:

"General Order No. 118.—It is ordered that General Order No. 99 be and it is hereby amended in the following particulars:

"'The frequency hereinafter mentioned is hereby added to those already assigned the Southern Transcontinental Chain and Feeders (Brown):

"'Mobile Service available for aircraft and aeronautical stations: 4,915 kilocycles day for use only between Chicago, Ill., Peoria, Ill., Springfield, Ill., and St. Louis, Mo.'"

Forum

How It Is in the West

HAVE just received my weekly copy of your valued magazine from my newsdealer and note with interest on page 6 of June 20th issue your diagram and description of a set very similar in general design to that which we have been recommending to set builders who use our store as their parts and tubes headquarters. I beg to differ with you on several important points, however.

You fellows who live and work in the East get sort of—shall we say—acclimated to receiving stations say from 250 to 450 meters, and pay not so much attention to the upper end of the band, say from 450 to 550 meters. This is probably due to the fact that your best stations on an average are below 460 meters, and if you can have a steady range of reception from a dozen or more of them during daylight with an average car set, not operating anywhere near maximum efficiency, most of you are satisfied. Understand, the "you" is purely impersonal.

Not only that, but you get a fictitious impression of the working of the set. Out in this neck of woods, between KSTP on 205 and WCCO on 370 meters, we have only two or three small locals to choose from. When we get away from locals in daytime, we have to jump to Waterloo, Iowa; Yankton, S. D.; Omaha, Neb.; Des Moines, Ia.; or Iowa City, the nearest being several hundred miles, and for this kind of country (if you have ever been here you'll know what I mean) that's a man-size daylight jump.

Now what I am leading up to is that all the above stations last mentioned are above 475 meters, and if the set is not efficient—and I mean really efficient—on the upper waves, you've got a darned good local set, and nothing else until evening rolls around. Which leads to the main reason for writing this letter.

Your circuit as shown will be far from efficient on these upper bands. If you want to have an inkling of what we call efficiency on these upper stations, make the following changes in your circuit and then try it. Better yet, make the changes in another set and compare the two side by side.

First—Your antenna coil should be increased to use 40 turns of No. 34 enameled or silk enameled wire wound not more than an eighth of an inch from the filament end of the first secondary coil, and wound in the same direction as the secondary coil, with the antenna lead on the outside and ground lead on the inside. This primary will then resonate roughly to about 500 meters with the average car antenna and will increase the punch on the upper waves very much without any great decrease in selectivity, sensitivity being the most important feature in a car set.

Second—A choke coil resonating to a bit above 600 meters should be inserted in the detector plate lead following the condenser C8, between this C8 and R3. If this choke increases the amplification in the detector tube, or increases the detector efficiency—whichever you will—to a point of oscillation, it's a cinch the original shielding was insufficient. In any case, it should be left in.

Third—A 25,000 ohm resistance bypassed by a .1 mfd. condenser should be inserted directly in the detector screen grid lead, so that at the maximum setting the screen grid voltage on this tube will be less than that on the r.f. tubes, which is best for maximum results.

Fourth—A 1 henry choke should be inserted directly in the grid lead to the 238, as this tube is more efficient on high notes than on low, and this corrective device will help to straighten out the response in the speaker.

Fifth—Because of the high audio gain in this set, fading is even more marked than when using three r.f. stages and one audio, or two straight audio. I have therefore designed a simple automatic volume control using a 237 tube which takes up no more room in the set than the tube itself would take, plus a few small accessories, and could probably be easily added to these sets already built without disturbing the general layout and using the volume control (manual) already used.

M. G. Goldberg,
376 Robert Street,
St. Paul, Minn.

* * *

Can't Get Short Waves

WHEN about to describe a short-wave converter, why not find out first just what the public wants? Take, for instance, your one-tube converter, page 13, June 20th issue. In the first place, who wants a converter where you have to pull out most of the tubes from your broadcast receiver before you can use it? What the public wants is a converter that can be hooked into the set in a permanent manner, and by simply throwing a switch the converter can be cut in or out of the circuit at will without disturbing the broadcast set in any way.

The converter need not have a B supply built in, but if it is going to use AC tubes it ought to carry its own heater transformer. A B tap can always be gotten from some part of the receiver.

The next important thing is that the converter must be simple to build and when it is built it must work. I have never in my life met a man who has built an adapter that would work. I have met several who have tried but so far not one of them has gotten any more than grunts out of the so-called adapters.

I bought the parts for one adapter. I built it and rebuilt it. Nothing but noise. I gave it to a service man. He built it three times, using a larger sub-base. All he got was the same results as myself.

There you have the usual experience of the fan. Is it any wonder he gets soured on short-wave stuff? It looks to me like simply a scheme to sell parts.

J. Parker,
194 Young Street,
Winnipeg, Man., Canada.

* * *

A Microphonic Transformer

RECENTLY I experienced something I never heard of before. I heard a noise when I had my speaker disconnected. I listened closely and discovered that my output transformer was reproducing every word or note of our local station, which I had tuned in at the time. Does this indicate that the transformer is defective or do all output transformers reproduce at all times? The transformer also reproduces when the speaker is connected. I thought it might be a loose stamping in the core of the transformer.

I have a set of audio and push-pull transformers in the set.

Clarence L. Moyer,
1013-22nd Avenue,
Altoona, Pa.

* * *

Commercialized "Music"

DOUBTLESS I am one of millions of radio listeners who want to pat on the back the American Association of Newspaper Publishers, the American Society of Magicians, or any other national organization who have finally succeeded in arousing sentiment against the inane claptrap that has been put on the air in the various forms of "fortune telling."

Now, if the National Bureau for the Advancement of Music, 45 West 45th Street, N. Y. C., may be heard, perhaps some of the concoctions (called "songs") that are being placed on local radio programs—songs that have been ground out by fake publishers and song factories, and paid for over-the-counter by some who could not get personal advertising any other way—would be stifled and a high standard gained and held in music.

I personally know of a certain crystal-gazer and "palmist" in this community, who has very little knowledge of music, who is "hooked-up" with these professional arrangers, and she is managing to get these "songs" put on programs, that she may keep her name and "fame" in the minds of the public.

S. C. F., Arkansas.

* * *

Calls for a New Broom

WHY not include sensitivity and selectivity curves with each new hook-up you publish? It would considerably increase the enthusiasm of all readers, especially those who only occasionally buy Radio World, and who put down the claims of extraordinary sensitivity of these circuits as just so much bunk.

Sometimes your proofreading is poor. Turn to issue of June 20, page 16, middle of right hand column; read—"Coil for 250 Mfd. Condenser."

Issue of May 16th, page 15, middle of left column, in answer to request for information re measuring ohms per volt of voltmeter. Half way down the paragraph read: "Divide the voltage of the battery used by the current indicated by the voltmeter."

Issue of April 25th, page 5, paragraph on winding IF coils, line 4: "Using 1/8 diameter bakelite, about 1½ inches long . . . The dowels may be drilled with a No. 30 drill and tapped with a 6/32 tap . . ." These directions may be right; but it is certainly a tricky job to drill 1/8 inch bakelite with a No. 30 drill and then tap it 6/32, without making a horrible mess of it. I believe that even a manufacturing jeweler would have some difficulty in accomplishing it.

These are but a few, culled at random from issues of the last two months. If I had the time and inclination to read over each article carefully I have no doubt that I would find many more, and more serious errors. You will readily see by the above that if a beginner at the game was to take all you say at face value, in a short time he would be hopelessly muddled.

Occasionally you have something worth while reading, and it is for this that I go to the trouble and expense of getting Radio World each week, and reading page after page of articles.

You should get a new broom and sweep some of the trash out of the pages of Radio World, and you will find that the readers will be more enthusiastic about it. Try it.

Hoping that you will find something of benefit in this epistle, I beg to remain,

Thomas C. Rumney,
36 Fuller Avenue,
Toronto 3, Ont., Canada.

* * *

Wants Currents, Voltages Stated

I HAVE long been a subscriber for Radio World, which I find more useful to me than any other magazine. May I offer a friendly suggestion? Please refer to page 6 of the February 15th, 1930, issue, entitled "Performance of NR4." Note that prominently displayed is a table giving the voltages and currents to be expected in each circuit.

This is an especially valuable feature in case one doesn't use the exact voltage divider specified in the article. Is it possible this information could be given always?

Wm. L. Wilcox,
Water Valley, Miss.

* * *

"Best Buy"

ALLOW me to congratulate you for putting out a weekly like Radio World. It is the best buy in technical radio publications and I could not get along without it.

J. Donald Magnuson,
Route 2, Box 51, Lansing, Iowa.

ALL ABOUT TUBES

The following illustrated articles on Tubes have appeared in back numbers of Radio World:

Published in 1930

A PHASE SHIFT TUBE IN NON-REACTIVE PUSH-PULL CIRCUIT DESIGNS. By J. E. Anderson—Feb. 8.
THE PENTODE. Six Full Pages Discussing the Five-Element Tube. By J. E. A.—Feb. 22.
A PENTODE CIRCUIT. By Spencer Watson Pierce—March 1.
HOW TO ADAPT SCREEN GRID RECEIVERS TO PENTODES. By J. W. L. Bradford—March 1.
VACUUM TUBE VOLTMETER FOR LOFTIN-WHITE CIRCUITS. By J. E. A.—March 1.
RESOLVED, THAT THE PENTODE IS DESIRABLE. Affirmative, By Adam J. Broder. Negative, By Quinlas Ross. March 15.
NEW TUBES IN A CONVERTER. By William J. Woods—August 2.
NEW TUBES IN BATTERY OPERATED AF CIRCUITS. By J. E. A., August 2.
MODERN RADIO TUBES. By J. E. Anderson—August 9.
THE THYRATRON TUBE. By William T. Meenam. August 9.
120, 201A and 240 TUES. By J. E. A.—August 16.
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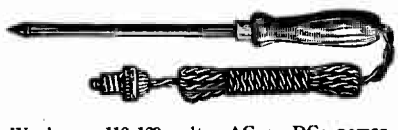

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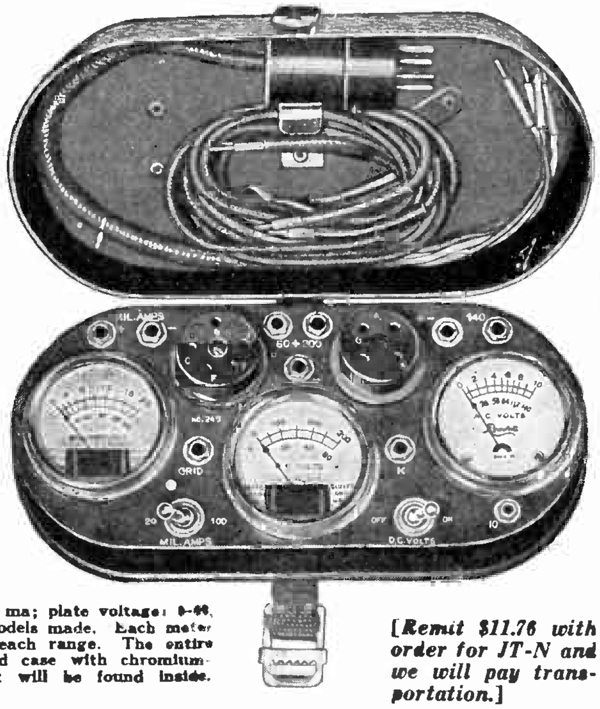

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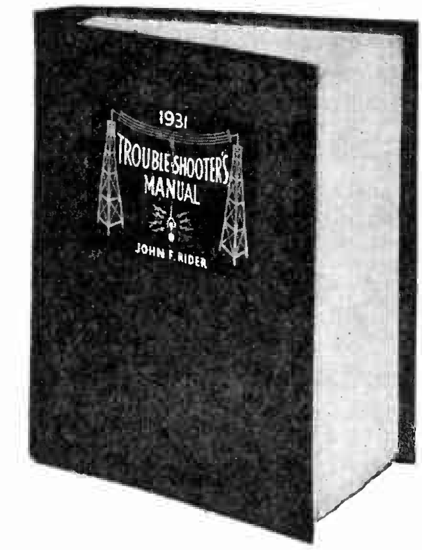

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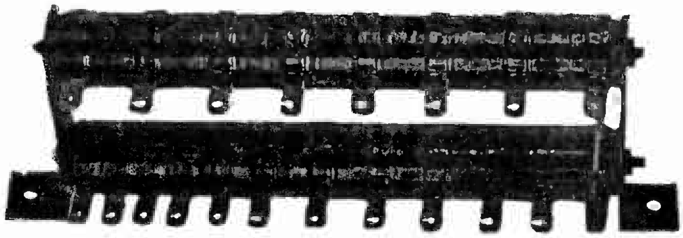

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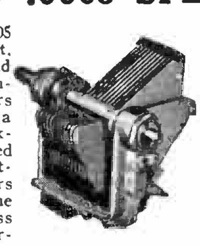

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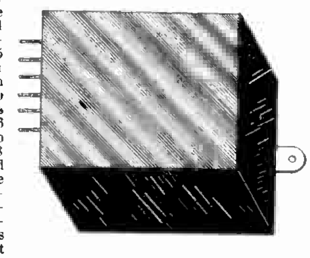

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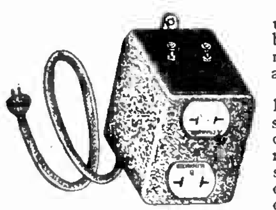

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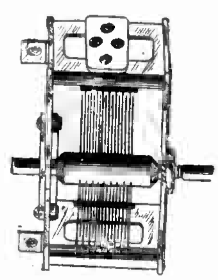

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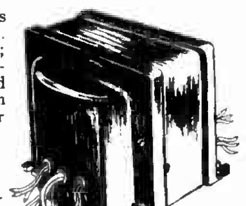

180-volt power transformer for short-wave sets and converters, for use with 280 rectifier. 2½ v. at 12 amps., 2½ v. at 3 amps., 5 v. at 2 amps; high voltage at 100 ma.; all secondaries center-tapped. Primary 110 v. 50-60 cycles. In polished aluminum case. Send $8 for 70 weeks subscription and get this dandy power transformer FREE. Order PR-SWPT. Shipping weight, 7 lbs.

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