ACCURATE R-F CALIBRATIONS

RADIO WORLD

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Eleventh Year—524th Issue

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INSTALLATION OF PHONOGRAPH IN SETS'S CONSOLE

April 9

1932

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A rigid-top console converted to phonograph model.
See page 12

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The First and Only National Radio Weekly
ELEVENTH YEAR

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Accurate R-F Standards

How to Limit Error to 1% or Less

By J. E. Anderson

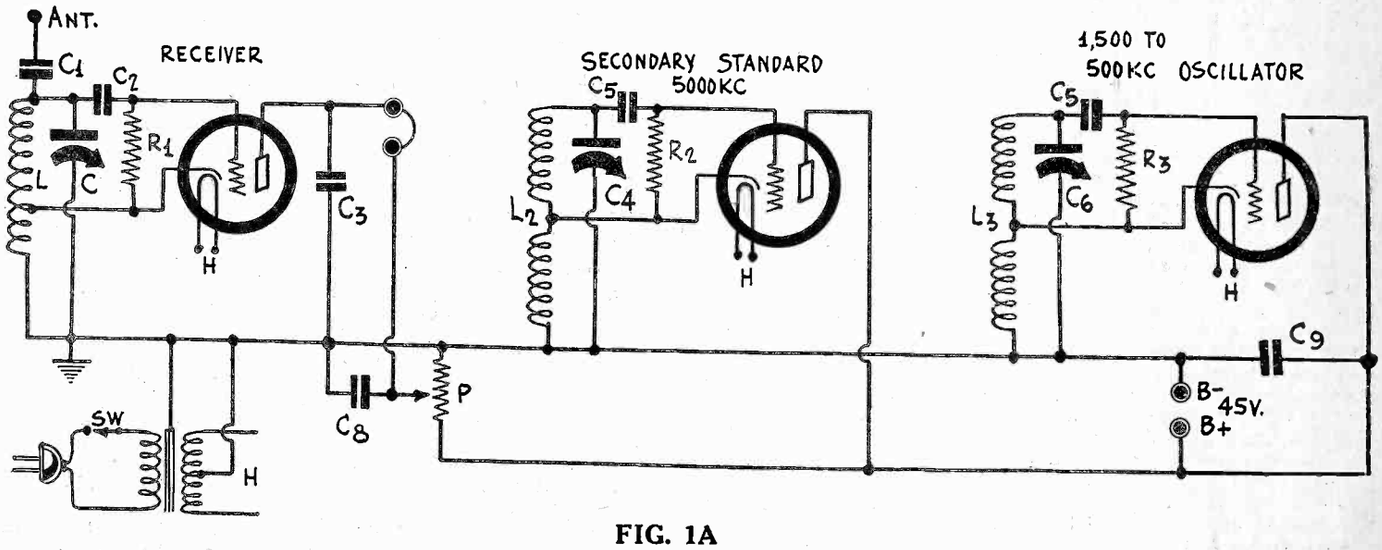

FIG. 1A

A receiver of the 5,000 kc high accuracy standard frequency (left), a secondary standard oscillator tuned to 5,000 kc, (center), and an oscillator to be calibrated or to be used as an aid in calibrating still another oscillator.

THE Bureau of Standards, Washington, D. C., sends out a 5,000 kc signal of an accuracy of better than one part in 5,000,000, that is, better than one cycle out of 5,000 kilocycles. This transmission takes place every Tuesday from 2 to 4 p.m. and from 10 p.m. until midnight, Eastern Standard Time. The power is sufficient to make the signal audible clearly in most parts of the United States, but audible in all parts, provided a regenerative receiver is used.

Since the signals are continuous waves the receiver must be in an oscillatory condition. The object of the transmission is to provide a readily available standard by which all interested parties may check their own secondary standards, such as master oscillators, crystal oscillators, and wave meters. For radio experimenters the usefulness of the transmission lies in the calibration of oscillators and wavemeters. The choice of the standard frequency is such that it can be used throughout the radio spectrum with comparatively little difficulty.

It is not to be supposed that any oscillator can be calibrated to the same accuracy as the standard because errors amounting to as much as one part in a hundred or so are introduced in reading a dial or a calibration curve, unless special precautions have been taken in these respects. But it is well to have a reliable standard.

An idea of the accuracy of the transmission can be gained by comparison with a clock. It is a good clock that keeps time to better than one second a day for a year. That is an accuracy of one part in 86,400. If we could drive a clock with the frequency of the standard sent from Washington that clock would not gain or lose as much as 6 seconds a year. If it were necessary to have such an accurate clock, it would be quite possible to arrange a circuit by which the clock would be controlled by a continuous standard transmission.

Calibration of an Oscillator

In making use of the standard frequency it is necessary to have a receiver of the oscillating type, as was stated. It is also necessary to have another oscillator, and it is desirable to have still another. The receiver is used for tuning in the standard frequency and the first auxiliary oscillator is used as a secondary standard. This second one should be tuned as accurately as possible to the standard frequency, using the zero beat method. Then this standard is available at all times, and particularly when the primary standard transmission is not on the air. The third oscillator is used for getting harmonics and for stepping up or down the frequency. Occasionally we check the secondary standard against the primary standard.

Let us suppose that we are to calibrate an oscillator covering the range from 500 kc to 1,500 kc, or a little higher. We have already adjusted the secondary standard and therefore have available a signal of 5,000 cycles. We also have all the harmonics of this. To calibrate an oscillator we have to make

(Continued on next page)

How to Use the Bureau of Stan for Establishing Seco

By J. E.

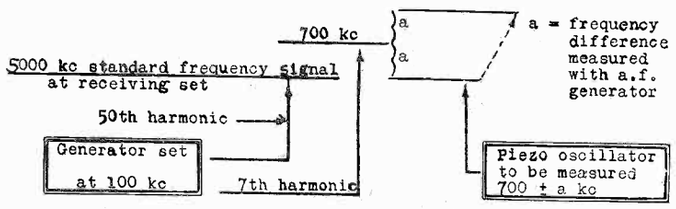

FIG. 1

Diagrammatic representation of the frequencies used in measuring the frequency of a piezo oscillation.

(*Continued from preceding page*)

use of all the harmonics up to a rather high order. And if we are to calibrate an oscillator having lower frequencies than the standard we have to make use of the harmonics of the oscillator under calibration.

Let the oscillator to be calibrated be the third circuit (extreme right) in Fig. 1A, assumed to cover a band from 500 to 1,500 kc. As we turn the dial of C6 we find a number of points at which squeals occur. And at each zero beat point the frequency generated by the oscillator bears a definite relation to the frequency of the secondary standard (center diagram). Incidentally, we can hear the squeals in the headset in the first circuit if the three circuits are close to each other, but not too close.

The Main Heterodynes

The main squeal points are obtained by dividing 5,000 by integers, that is, by 1, 2, 3, and so forth. If we divide by 3 we obtain 1,667 kc, which may or may not be within range of the oscillator under calibration. If we divide by 4 we obtain 1,250 kc. This will undoubtedly be within range. Hence we have at least one point on our calibration curve. If we divide by 5 we obtain 1,000 kc, the second point. Dividing by 6 we get 833 kc, by 7 we get 714 kc, by 8 we get 625 kc, by 9 we get 555.6, and finally by 10 we get 500 kc. Thus we use the harmonics of the oscillator under calibration from the fourth to the tenth to get 7 points on the calibration curve. We plot them on a piece of cross-section paper. In case all the points do not fall on a regular curve we have made a mistake, and any point obviously off should be ignored, temporarily, at least.

The curve we have plotted will enable us to get a few more points definitely, by combining the harmonics of the standard with harmonics of the oscillator under calibration. Taking the second harmonic of 5,000 kc we have 10,000 kc as a standard. If we divide this number by integers we get a few more points. We get new points from 7, 9, 11, 13, 15, 17, and 19, and the respective frequencies are 1,429, 1,111, 909, 779, 666, 588, and 526 kc. Some of these will not be audible because too weak. However, if the curve already plotted is consulted and the dial is explored very carefully near the points where these frequencies should appear, it may be that all can be detected and accurately located on the dial.

If we are not satisfied with the points we have got so far, we may take the third harmonic of the standard, namely 15,000 kc and go through the process again. Thus we can identify 1,500, 1,363, 1,153, 1,071, 937.5, 882.5, and 790 kc. The higher the harmonics used the more difficult it becomes to locate the frequencies on the dial. It will also be noticed that some of the squeal points come very close to each other. Hence there is danger in selecting the wrong one. The course of the curve helps to determine doubtful cases.

Calibrating High Frequency Oscillator

The same process is used in calibrating any other oscillator. For example, we might want to calibrate an oscillator going from 1,500 to 4,500 kc. Combining the third harmonic of the standard with the tenth of the oscillator we get 1,500 kc. Mixing the fundamental of 5,000 with the second and third harmonics of the oscillator we get 2,500 and 1,667 kc. Combining the tenth of the oscillator with the ninth of the standard we get 4,500 kc.

In order to get any desired frequency we can divide the standard frequency by the frequency desired and reduce the fraction to the simplest terms. The numerator of this fraction gives the harmonic of one and the denominator that of the other. For example, suppose in the preceding case we want to get a frequency of 3,000 kc. We have 5,000/3,000, or 5/3. Thus we get 3,000 if we combine the fifth harmonic of the desired frequency by the third harmonic of the standard. This happens to yield a rather strong heterodyne and it is easily located. Again, suppose we wish to get a frequency of 1,800 kc. We have 5,000/1,800, or 25/9. Both harmonics are of a high order and the point may not be easily located, but if we know the approximate position by a previous plotting of determined points it is possible to get it.

It should be pointed out that when the receiver is used to detect zero beat points between two oscillators, the receiver must not be in an oscillatory condition, but otherwise as sensitive as possible, for oscillation in the receiver would give rise to great confusion. It is also well to shield the entire circuit, including th detector, from all external signals, for broadcasting would otherwise cause a great deal of confusion. There will be plenty of squeals without letting extraneous noises into the detector.

Bureau of Standards Data

The Bureau of Standards in Letter Circular No. 314 sets forth the following:

This pamphlet gives methods of frequency measurement for utilizing the standard frequency signals transmitted by the National Bureau of Standards. The references at the end give other methods, which range from those using very simple apparatus giving results accurate to one per cent, to those using complicated and expensive apparatus giving results accurate to better than a part in a million.

Radio Signals of Standard Frequency.—The National Bureau of Standards transmits standard-frequency signals, for adjusting and calibrating frequency standards and other apparatus, one day each week from the Bureau's station, WWV, in a suburb east of Washington, D. C. These weekly transmissions are by continuous-wave telegraphy at 5000 kilocylces, and are accurate at all times to better than 1 cycle per second (1 part in 5,000,000). Announcements of details of the schedules of transmission are given in the newspapers and radio magazines and in the Bureau of Standards Technical News Bulletin and the Radio Service Bulletin. Copies of the current schedule may also be obtained upon request from the Bureau of Standards, Washington, D. C. At the date of this pamphlet, the transmissions are made every Tuesday, continuously from 2 to 4 p. m., and from 10 p. m. to midnight, Eastern Standard Time.

The transmissions consist mainly of continuous, unkeyed carrier frequency. For the first five minutes the general call (CQ de WWV) and announcement of the frequency are transmitted. The frequency and the call letters of the station (WWV) are given every ten minutes thereafter.

Method of Measurement

The commonest use of the standard frequency transmissions is to determine accurately the frequency of a piezo oscillator. The apparatus necessary is (1) the piezo oscillator, (2) a continuously variable radio-frequency generator which is approximately calibrated, (3) an audio-frequency generator, and (4) a radio receiver. A frequency meter of resonance type is also useful as an auxiliary but is not necessary.

The fundamental frequency of a piezo oscillator is fixed by the dimensions of the quartz plate used. The vacuum-tube circuit arrangement in which the quartz plate is connected gives numerous harmonics for each fundamental frequency. The generator, which is continuously variable, can be adjusted to any frequency, and likewise gives a series of harmonics for each fundamental frequency to which it is adjusted. If the frequency of the radio-frequency generator is varied over a wide range, beat notes are produced at a number of settings of the generator by the interaction of various harmonics of the fundamental frequency of the piezo oscillator with a harmonic of the fundamental frequency of the generator. The beat notes may be heard in a pair of head phones suitably connected to the generator or to the piezo oscillator. Any frequency present in the piezo oscillator can beat with a corresponding frequency present in the radio-frequency generator, which makes it possible to set the generator at a number of frequencies which are di-

lards Transmission ndary Standard for Calibrations

Anderson

rectly related to the fundamental frequency of the piezo oscillator. Providing the harmonic relationship is known, measurements can be made at a great number of frequencies in terms of a single standard frequency.

If *f* is the fundamental frequency of the piezo oscillator which is being used and F the fundamental frequency of the auxiliary generator which gives zero beat, then

$$af = bF$$

where a and b are integers (1, 2, 3, 4, etc.)

The procedure is simplest when the ratio of 5000 kc to the nominal frequency of the piezo oscillator to be standardized is a fairly small integer, less than 100. For instance, secondary standards whose fundamental frequencies are 50, 100, 200, 500, or 1000 kc can be measured very readily in terms of the 5000-kc transmissions, and these secondary standards may be advantageously used in turn to calibrate other apparatus. It is, however, possible to use the 5000-kc signals to establish accurately any desired frequency.

Examples of Measurement Method

Suppose it is required to measure the frequency of a piezo oscillator, the approximate frequency of which is 700 kc, in terms of the 5000-kc standard frequency signals.

If the radio-frequency generator is set at 100 kc, the 50th harmonic (5000 kc) will beat with the 5000-kc transmission, and the 7th harmonic (700 kc) will beat with the fundamental of the piezo oscillator.

The 5000-kc standard frequency signal is received first and identified with the receiving set in the generating condition. The radio-frequency generator is then turned on and adjusted to near 100 kc. This should give a beat note with the frequency generated by the receiving set. The regeneration of the receiving set is then reduced until the set just stops generating. A beat note should then be heard which will in general be of less intensity than that previously heard. This is the beat between the frequency of the radio-frequency generator and the frequency of the incoming wave. This beat note should be reduced to zero frequency by adjusting the radio-frequency generator. For most precise work this adjustment should be made by using a beat frequency indicator or other means of indicating exact zero beat. A simpler and equally accurate substitute is to bring in a tuning fork as described below. However, for a simple discussion of the steps involved in the measurement, it will be assumed that an accurate zero-beat setting is obtained.

The radio-frequency generator is therefore precisely adjusted so that it has a frequency of 100 kc. Without changing its adjustment, couple the piezo oscillator to it loosely. A beat note should be heard in the telephone in the output of the piezo oscillator unless the frequency given by the piezo oscillator is an exact multiple of 100 kc. Suppose, for example, it is 700.520 kc. In this case a beat of 520 cycles per second will be heard. To determine the value of this note, the audio-frequency generator must be used.

Comparison of Beats

The frequency of the beat note and the frequency of the audio-frequency generator may be compared by using single phone units from each source and rapidly interchanging them at the ear. If sufficient intensity is available from the two sources then the two audio frequencies will combine and beats may be heard by the ear when the audio-frequency generator is closely adjusted. For exact zero beat the frequency of the adjustable audio-frequency generator gives the difference in frequency between the 7th harmonic (700 kc) of the generator adjusted to 100 kc and the fundamental of the piezo oscillator.

Use of Audio-Frequency Note in Measurement

Fig. 1 gives a diagrammatic representation of the frequencies used. It is necessary to determine whether the piezo oscillator is higher or lower than 700 kc. This can be done by varying the frequency of the radio-frequency generator. If increasing the frequency of this generator results in decreasing the beat note, then the piezo oscillator is higher than the reference frequency, that is, the audio frequency is to be added to 700 kc.

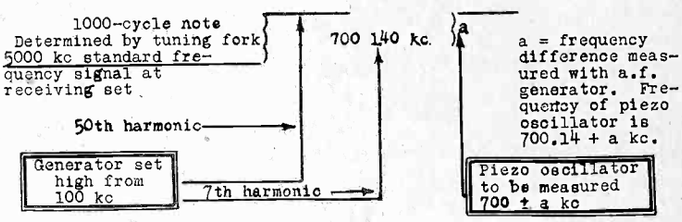

FIG. 2

Use of a tuning fork for adjusting the generator to give a beat note 1,000 cycles below the 5,000 standard.

If the reverse is true, then the audio frequency is to be subtracted.

A change in the method described above which does not require a beat indicator, is to adjust the radio-frequency generator to have a known frequency difference with the incoming wave by means of matching with that of a tuning fork of known frequency such as 1000 cycles per second. This method is more complicated in calculation because a record must be made (1) as to whether the radio-frequency generator was adjusted higher or lower than zero beat, (2) the frequency difference, and the harmonic relations between, (3) the standard signal and the radio-frequency generator, and (4) between the radio-frequency generator and the piezo oscillator. The harmonic relations, however, come in to any method of measurement of this kind. The measurements involving the use of the tuning fork for adjusting the generator to give a beat note 1000 cycles per second below the 5000-kc signal would be made as follows, and are shown diagrammatically in Fig. 2. Set generator from approximate zero beat at 100 kc to 99.98 kc. The 50th harmonic is $99.98 \times 50 = 4999.0$ kc (beats with 5000 kc in receiver which is not oscillating and gives a 1000-cycle note). The 7th harmonic of the generator ($99.98 \times 7 = 699.86$ kc) may now be heard beating in the telephones of the piezo oscillator which is known to be approximately 700 kc. If this value were exactly 700 kc, a note of 700-699.860 kc or 140 cycles would be heard. However, the beat note produced is matched with a corresponding note from the audio-frequency generator. If the piezo oscillator had the frequency of 700.520 kc as assumed previously, the audio-frequency note measured would have been $700.520 - 699.860 = 0.660$ kc or 660 cycles per second.

Whether to add or subtract the audio note of 660 cycles to the known frequency of 699.860 kc would be decided as follows when the radio-frequency generator was set lower than the standard frequency signal. If lowering the frequency of the radio-frequency generator increases the beat note (660 cycles in this case), add the beat note frequency, or if increasing the frequency of the radio-frequency generator decreases the beat note, add the beat note frequency.

Another Method

The measurement could also be made by adjusting the generator to 100.020 kc using the thousand-cycle tuning fork, as in Fig. 3. The 50th harmonic is $100.020 \times 50 = 5001$ kc which beats with the standard frequency signal of 5000 kc and produces a 1000-cycle note. A certain audi-frequency note is produced in the telephones of the piezo oscillator, which is matched with a similar note from the audio-frequency oscillator as before. If lowering the frequency of the radio-frequency generator reduces the audio-frequency note heard, subtract it from the known frequency of 700.140 kc, or if increasing the frequency of the radio frequency generator increases the audio note, subtract it. The audio-frequency note heard with a piezo oscillator having the assumed frequency would be 380 cycles, hence $700.14 + 0.380 = 700.520$ kc.

The example which has been cited is one of the simplest cases which would be encountered. The frequency of 700 kc which bears a comparatively simple relationship to the 5000-kc standard frequency signal was selected to indicate the fundamental method. In order to be able to measure any broadcasting frequency in terms of the 5000-kc standard frequency signal it is necessary to set the radio-frequency generator to approximately 10 kc and then proceed as before. In this case the beat between

(*Continued on next page*)

A Three-Tube Screen Grid Battery Designed

By Burton

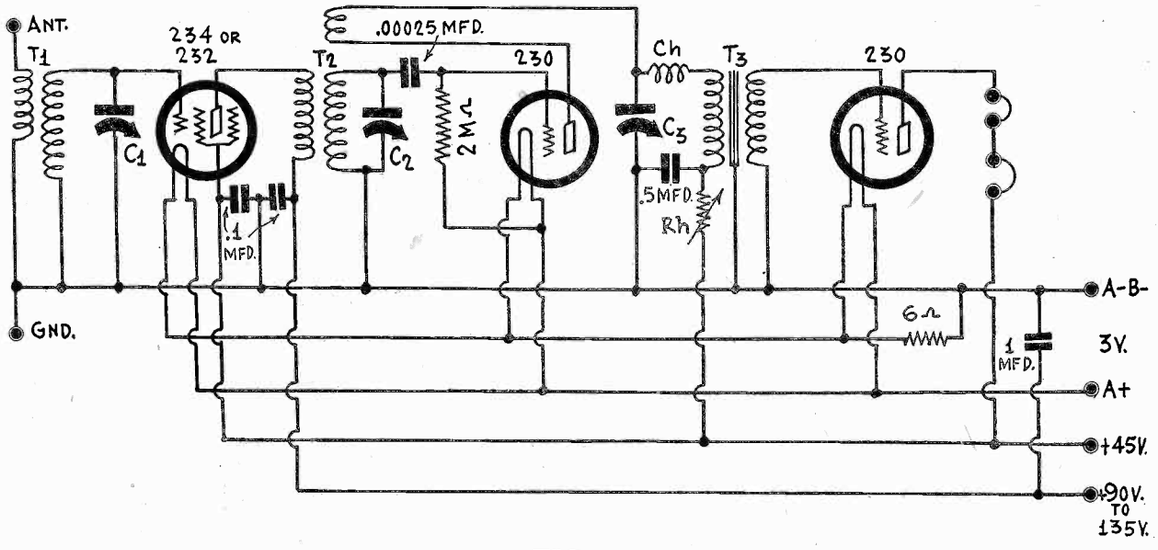

FIG. 1

This three-tube regenerative receiver is selective, sensitive, and economical. It has been designed especially for headphone reception.

OCCASIONALLY there is demand for small receivers to be used with headphones only. As a rule, the requirements are sensitivity, selectivity, and economy. Power is not a requirement because only headphones are to be used but sometimes the demand is for two sets of these so that two persons can listen simultaneously.

A receiver of this kind is required where reception is not to interfere with other people, who may need perfect quiet or who may be listening in on some other set. Invalids and aged people often prefer to have a headphone receiver. Even DX hunters prefer such receivers in many instances.

The Circuit

Sensitivity of such a receiver is achieved with one stage of screen grid amplification and a regenerative detector. Selectivity is achieved by the same means. Economy is achieved by using the smallest available tubes in the set, and by not using any more than are needed for the purpose. One stage of audio is usually sufficient and all that is desirable because another stage of audio, while increasing the gain, might also increase the noise too much.

Therefore a circuit like that diagrammed in Fig. 1 seems to be suitable and it has so proved in many cases. We start out with a tuned stage of screen grid amplification and then follow it with a regenerative detector. This is followed by a stage of audio coupled to the detector with an audio transformer. This combination is capable of high sensitivity as well as high selectivity. The first tube in this circuit is either a 234 r-f pentode or a 232 screen grid tube. Of the two the 234 is the better, but not so much better that if a 232 is available it should not be used. The detector is a 230 general purpose tube, operated in conjunction with a stopping condenser and grid leak to effect detection. The audio tube is also a 230, which gives ample undistorted power for two headphones.

The type of tuning coils to use depends on the desired physical dimensions of the receiver. If there is no objection to having a rather large receiver the two coils T1 and T2 should be of 3 inch diameter without any shielding about them, although a shield between them would not be a bad idea at all. These coils will make a high selectivity and sensitivity possible. If the set is to be very small, midget type coils can be used. These come with shields about them, but if the circuit does not oscillate uncontrollably with the shields off it is not necessary to

LIST OF PARTS

Coils

T1—One r-f transformer for 0.00035 mfd. tuning condenser.
T2—One three circuit tuning coil for 0.00035 mfd. condenser.
T3—One audio frequency transformer.
Ch—One 10 millihenry or larger r-f choke coil.

Condensers

C1, C2—Two 0.00035 mfd. tuning condensers.
C3—One 200 mmfd. midget type tuning condenser with knob.
Two 0.1 mfd. by-pass condenser.
One 0.00025 mfd. grid condenser.
One 0.5 mfd. by-pass condenser.
One 1 mfd. by-pass condenser (optional).

Resistors

One 2 megohm grid leak.
One 6 ohm ballast resistor.
Rh—One 25,000 ohm variable resistor.
Other requirements.
Ten binding posts.
Three UX sockets.
One grid clip.
Two No. 6 dry cells.
Two or three 45-volt B batteries, small size.
Two condenser dials (one i-f C1 and C2 are ganged).

Harmonics Up to

(*Continued from preceding page*)

the 500th harmonic of the 10-kc generator and the 5000-kc standard frequency signal is so weak that it is almost inaudible unless considerable audio-frequency amplification is used. In order to strengthen the beat note, two radio-frequency generators can be used, one set on 100 kc and the other on 10 kc. The 100-kc generator is coupled to the receiving set as indicated, and the 10-kc geenrator is set by means of a visual beat indicator so that its 10th harmonic (100 kc) produces a zero beat with the 100-kc generator. One of the manual adjustments can be eliminated by using a multivibrator which steps the 100 kc down to 10 kc, in place of the 10-kc generator. The accuracy of the measurements will be considerably improved if this is done.

The methods described above are capable of giving very accurate values of frequency if properly carried out. A much simpler procedure by which less accurate values may be obtained is to calibrate a frequency meter in terms of the standard frequency signals and then measure the piezo oscillator by means of the frequency meter.

Other frequency measurement methods are given or suggested in the articles of the reference list appended.

The above data from the Bureau of Standards, Department of Commerce, are complete instructions for use of the 5,000 kc transmission.

Receiver for DX Reception on Headphones

Williams

use them. The dial readings will be different with the shields on and off, but the signals may be a little stronger with the shields off.

Unfortunately, the midget coils are either radio frequency transformers or oscillator coils. There is no three circuit tuner of this type, so that if this type of coil is used it is necessary to add another winding to one of the radio frequency coils. The primary can be used as primary and therefore the tickler winding must be added. If the coil is intended for a 0.00035 mfd. condenser, the midget coil is wound with 127 turns of No. 32 enameled wire on a one-inch form. The primary might contain 50 turns and the tickler could have the same number.

Since larger coils are available both in the two and three winding types for 0.00035 mfd. condensers it is, perhaps, better to use them.

Tuning the Circuit

For best results the two tuning condensers should be separately controlled because even if similar coils are used in the two circuits, the tracking will not be close enough for gang tuning. This is due to the fact that the two circuits are quite different. However, if a trimmer that is controllable from the panel is connected across one of the condensers, first rate results will be obtained with a gang condenser. This trimmer should be not larger than 50 mmfd.

Two provisions are made for controlling the regeneration. As a rough adjuster we have a 25,000 ohm rheostat Rh in the plate lead of the detector by means of which the effective voltage on the plate may be varied. Then we have a variable condenser C3, usually known as the throttling condenser. This provides close adjustment. Its capacity may be the same as the capacity of either tuning condenser, but if room must be saved, a midget type condenser of 200 mmfd. can be used.

The detector uses a stopping condenser of 0.00025 mfd. and a grid leak of two megohms for detection. The grid leak is connected between the grid and the positive end of the filament in order to get a positive bias and at the same time permit grounding of the tuning condenser C2 so that a gang condenser may be used if desired.

Biasing of Tubes

The circuit is arranged so that very little bias is needed, and that is obtained from the one volt drop in the 6 ohm resistor in the negative lead of the filament circuit. This bias is enough for both the radio frequency pentode and the 230 output tube, particularly in view of the low plate voltage used. The bias and ballast resistor is specified at 6 ohms because this is an easily obtainable resistance. The correct value should be 5.5 ohms, but the difference is nothing to worry over and the excess value is in the interest of current economy.

The total filament current required by the circuit is only 0.18 ampere and for that reason a No. 6 dry cell will be sufficient to supply the current. However, the voltage of a single cell is only 1.5 volts and we need 3 volts. Hence we need two of these cells connected in series.

A voltage of only 45 volts is applied to the plate of the output tube and to the screen of the r-f amplifier. The maximum voltage on the plate of the detector can also be made 45, but cutting out all the resistance in Rh. The voltage on the plate of r-f pentode should be at least twice as great as the screen voltage on that tube. Hence it has been marked 90 to 135 volts. Of course, the r-f amplification will be higher when the higher plate voltage is used.

Filtering

In view of the simplicity of the circuit very little filtering is needed to stabilize it. Associated with the r-f pentode we have two 0.1 mfd. condensers, one across the screen voltage supply and another across the plate voltage supply. Another by-pass condenser, one of 0.5 mfd., is connected between the return end of the audio transformer and ground. The fourth by-pass condenser is a one microfarad unit across the B battery. In view of the fact that there already is one of 0.1 mfd. across this line, it may not be needed at all times, or if the 1 mfd. unit is put near the r-f pentode tube, the 0.1 mfd. condenser can be omitted.

A choke Ch of 10 or more millihenries is connected in series with the plate lead of the audio transformer. This is used primarily to prevent the radio frequency from going through the capacity of the primary of the transformer, and thus to force the current through C3 where it may be controlled.

Any good audio transformer may be used. Naturally we want one with a considerable step-up in order to get high sensitivity. One of 3.5 to one ratio is suggested.

One of Two Headphones

The headphones may be connected directly in the plate circuit of the 230 output tube because the plate current will be low. Two sets of headphones may be connected in series without decreasing appreciably the sound in either one. It is convenient to arrange the circuit so that either one or two sets may be used without any switching. A simple way to do this is to employ four binding posts, two for each pair of phones. Two of these are connected together. When only one pair is to be used it is only necessary to connect the phones to the two extremes, the one that connects with the plate and the one that connects with the B battery.

The Fiftieth Used

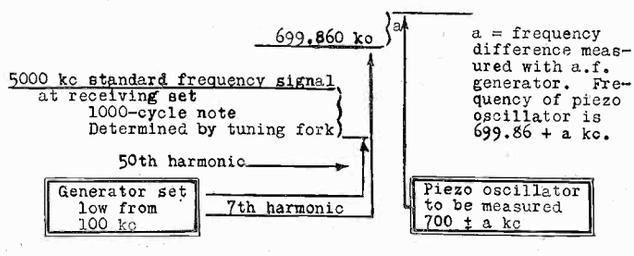

FIG. 3

Another method of using the tuning for in measuring the frequency of an oscillator.

Short Wave Club

Short Wave Editor, RADIO WORLD, 145 *West 45th St., New York.*

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C Batteries Eli

By Capt. Peter

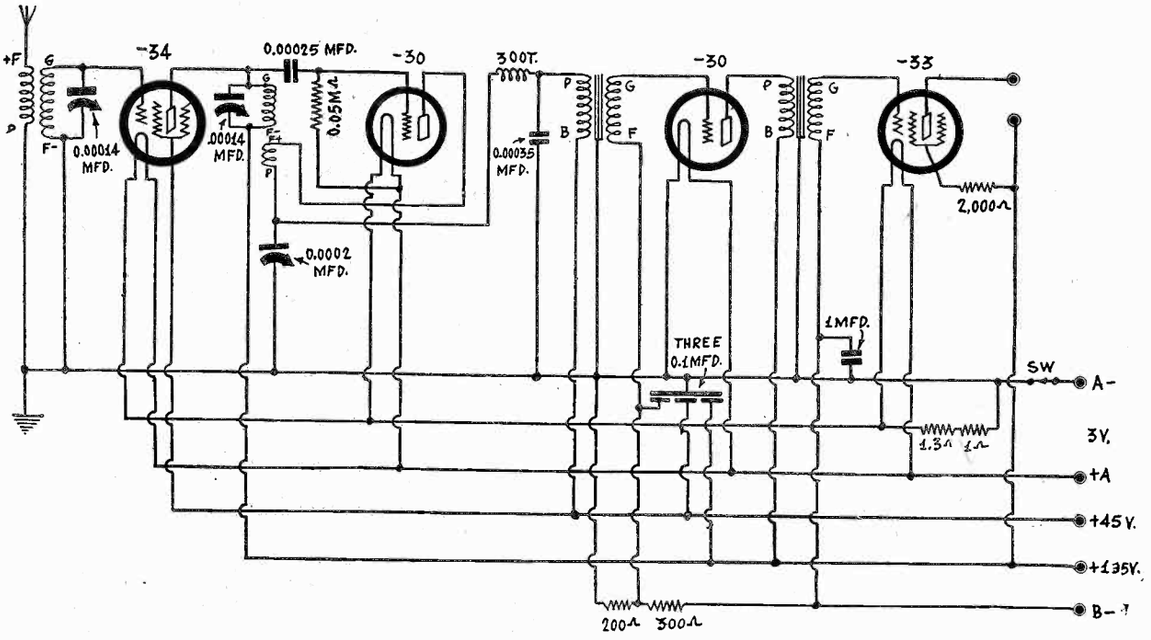

FIG. 1

FOR battery operation the four-tube short-wave set, Fig. 1, enables real results at relatively low cost. The radio frequency amplifier is the new —34 r-f pentode. The detector and first audio tubes are the general purpose type —30, while the output is a —33 pentode. These tubes are of the 2-volt series.

The diagram shows a 3-volt A battery source. This may consist theoretically of two No. 6 dry cells connected in series. Each cell supplies 1.5 volts. The binding post on the circumference of one cell (negative) is connected by a wire to the binding post at the center (positive) of the other cell. Then you have 3 volts, with the free circumference post as negative and the free center post as positive.

Filament Considerations

Since the tube filaments require 2 volts, there must be a drop of 1 volt. The filament current for each of the first three tubes is 60 milliamperes, and that for the output pentode is 260 milliamperes, a total of 440 milliamperes. At this rate the two dry cells would not last long enough, as no more than 250 milliamperes should be drawn, therefore another pair of cells is similarly connected in series, and the corresponding free posts of both arrangements joined together, for parallel connection. This doubles the allowable drain without increasing the voltage.

The resistance required to drop the 3 volts to 2 volts may be computed. It is the voltage in volts (1) divided by the current in amperes (0.44), or about 2.3 ohms. To obtain this odd value two commercially obtainable resistors are used, one at 1.3 ohms, the other at 1 ohm, connected in series. The 1 ohm resistor may be of the type for serving four —01A tubes from a 6 volt source. Or a wire-wound resistor of 4 or 6 ohms may be used, and the intended second connection slid along the wire until the point is reached where 2 volts register across the filaments. Start from the highest resistance point in making this test.

The resistance wire will not take solder, and therefore the excess wire is snipped off, leaving enough, however, to form a loop, so that the wire may be twisted about a screw that is driven into the subpanel. Put a lug at this screw.

If the voltage source for A supply is a 6-volt storage battery, then the voltage drop will have to be 4 volts, instead of 1 volt, and the required limiting resistor 5.2 ohms, which can be made up as previously explained, using a 6 or 6.5 ohm wire-wound resistor.

Virtually all the commercial resistors of such low values will easily stand the current that will have to pass through them for service in this receiver.

Besides the A voltage supply there will have to be a B voltage supply, and this is composed of three 45-volt batteries in series. The medium-sized or large-sized (heavy-duty) batteries may be used, the larger ones lasting longer but costing only little more. In fact, shopping one day disclosed the surprising fact that some stores were charging more for the smaller than for the larger batteries.

The other d-c voltage requirement is for grid bias. In three instances (amplifiers) the biasing voltage is negative, while in one instance (detector) it is positive. Take the r-f tube. The negative filament, which is the reference point, is positive in respect to A minus by 1 volt, or A minus is 1 volt negative in respect to negative filament. Therefore if the grid is returned to A minus the bias will be equal to the drop in the filament resistor, or 1 volt, and will be a negative bias.

The positive grid return for the detector, required for good detection, is easily obtained by connecting the grid return to

LIST OF PARTS

Coils

Five different pairs of plug-in coils, as described, wound on tube base forms; total, ten coils.
One 300 turn honeycomb coil for detector r-f choke
Two audio frequency transformers

Condensers

Two 0.00014 mfd. tuning condensers
One 0.0002 mfd. feedback condenser (0.00025 mfd. may be used, if you have that)
One block of three 0.1 mfd. condensers in a shielded case
One 1 mfd. bypass condenser
One 0.00035 mfd. fixed condenser
One 0.00025 mfd. fixed condenser

Resistors

One 0.05 meg. (50,000 ohm) pigtail resistor
One 200 ohm pigtail resistor
One 300 ohm pigtail resistor
One 2,000 ohm pigtail resistor
One filament resistor of 1 ohm to be connected in series with one filament resistor of 1.3 ohm, or other means of providing 2.3 ohms, as by setting a 6-ohm rheostat permanently at right position

Other Requirements

One 7 x 14 inch insulated front panel
One vernier dial
Two knobs (one for antenna stage tuning condenser, other for feedback condenser)
One push-pull A battery switch
Five UX sockets and one UY socket (two of the UX sockets are coil receptacles, while the UY socket is for the pentode output tube)
One 7 x 13 inch baseboard
One binding post strip with six binding posts on it (A minus and ground are a common post)
Tubes: one —34, two —30 and one —33.
Batteries: four No. 6 dry cells to constitute two pairs of 3-volt batteries in parallel; three 45-volt B batteries.

Receiver;
minated for a VoltageCorrector
V. O'Rourke

positive filament or positive A (these two lines being identical). Now for the two audio tubes. If, instead of directly interconnecting A minus and B minus, we put resistance in this lead, the total plate current will flow through this resistance, A minus will be positive in respect to B minus for tubes with grids returned to any part of this resistance, or points on the resistance will be negative in respect to negative filament and A minus. The filament resistor voltage drop has to be considered, for it is 1 volt, and the rest of the bias is obtained from the resistors. So, if two resistors are connected in series, 200 and 300 ohms respectively, the 300 ohms toward B minus, the grids may be returned as shown, first audio to the joint of the two resistors, output tube to B minus. The drop in the 500 ohm total resistance would be about 10 volts, and the filament resistor voltage drop would give an extra volt, total 11 volts which is just about right for the applied plate voltage on the output pentode. The applied plate voltage for the output tube is about 124 volts, since the bias voltage is substracted from the battery voltage to obtain the actually applied plate voltage.

The screen voltage on the pentode would be higher than the applied voltage plate unless a limiting resistor were included, and besides the speaker winding, or primary of output transformer, if such a transformer is used, would make the effective plate voltage still lower. Therefore the 2,000 ohm resistor (1 watt) is included. This may be a Lynch metallized pigtail resistor.

So there are no C batteries, and the reason for omitting them is not only convenience but also to maintain the negative bias at or near its correct value, even though the B battery voltage will change.

Reason for Battery Voltage Change

With the r-f tube this change would not make much difference, but with the audio and output tubes, particularly the output pentode, the difference would make a considerable change in results. The trouble with C batteries would be that since no current is drawn from them their voltage will remain a "spot" voltage for a very long time, whereas the B battery voltage would go down, due to use augmented by age, so eventually the bias would become too high. By the resistance method outlined the bias voltage changes proportionately to the B battery voltage.

This battery voltage change is due to the increased resistance of the battery. When current is drawn this resistance drops voltage proportionate to the current, and therefore the actual voltage from the battery terminals when the batteries are in use needs less by the amount of that drop. In point of fact the B battery voltage may be "spot" voltage when no current is drawn, even when the resistance of the block has increased, but there is small comfort in the fact that the B battery voltage is just as the terminal markings indicate, under conditions whereby the batteries are not in use, or subject to test by only an electrostatic voltmeter!

The Radio and Audio Circuits

So far we have discussed only the d-c voltages. Let us now take up the three sections of the receiver—radio frequency amplifier, detector and audio frequency amplifier.

The radio frequency amplifier is the —34 tube. It is fed by the tuned secondary of an r-f transformer. If a UX socket is provided as coil receptacle, the coils may be wound on a tube base diameter (about 1.25 inches). There will not be any considerable sharpness of tuning in this stage, and certainly not on any stations except the very weakest ones, so a separate condenser may be used, and simply a knob used for turning it.

The detector tube alo affords a little r-f amplification, but generally speaking it simply detects. Here again an r-f transformer is used, with tuned winding in the plate circuit, and inductively related to this winding is the fixed tickler. Regeneration is controlled by a 0.0002 mfd. variable condenser.

Work of R-F Choke

A radio frequency choke coil is helpful in keeping r-f out of the audio amplifier, the regeneration condenser constituting an additional means of bypassing, and the bypassing being completed by a fixed condenser of 0.00035 mfd.

The plate circuit tuning condenser is on an insulated front panel, so the condenser may be directly across the coil as shown. Moreover, the two tuning condensers, although of equal capacity, are not ganged, so there is no conflict of d-c voltages on that account. A little more sensitivity will result from use of the separate-tuning-condenser method, as diagrammed, than by use of a two-gang condenser, although the difference is slight if there is a manual trimming condenser across the antenna condenser and an equalizing condenser (35 mmfd. maximum) adjusted across the plate circut tuning condenser when the manual trimmer is turned to include a little capacity. This condenser must be equipped with vernier dial.

Coil Instructions

The coils should be wound so that as to any one coil the windings are in the same direction. Begin at the top and connect G of the coil form, winding the tuned inductance and terminating at F minus. Leave just enough space to clear, then put on the smaller winding, beginning connected to P of the coil form, end to F plus. As you hold the form upright, filament (large) pins at bottom toward you, F minus is at left, F plus at right, and grid behind F minus and plate behind F plus. Grid, plate, F plus and F minus have no reference to anything but the coil form in these data.

There will be considerable overlap, but that is unobjectionable, if the following data are used, the statement of meters being approximate, but very conservative:

Grid Coil No. Turns, Enamel	*Plate Coil No. Turns, Enamel*	*Range, Meters*
60 of No. 32	32 of No. 32	200 to 118
33 of No. 24	15 of No. 32	118 to 69
20 of No. 18	10 of No. 32	69 to 40
10 of No. 18	10 of No. 32	40 to 24
4 of No. 18	7 of No. 28	24 to 15

Thus a total of ten coils is needed to cover from 15 to 200 meters, but identical coils, any pair, are interchangeable, which makes for convenience.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of Radio World published weekly at New York, N. Y., for April 1, 1932.

State of New York }
County of New York } ss:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Roland Burke Hennessy, who, having been duly sworn according to law, deposes and says that he is the Editor of the Radio World, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business managers are: Publisher, Hennessy Radio Publications Corp., 145 West 45th St., N. Y. C. Editor Roland Burke Hennessy, 145 West 45th St., N. Y. C. Managing Editor Herman Bernard, 145 West 45th St., N. Y. C. Business Manager Herman Bernard, 145 West 45th St., N. Y. C.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of the stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Hennessy Radio Publications Corp., 145 West 45th St., N. Y. C. Roland Burke Hennessy, 145 West 45th St., N. Y. C. Mrs. Mary J. McArthur, 1940 East 82nd St., Cleveland, O.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers, during the six months preceding the date shown above is ..... weekly. (This information is required from daily publications only.)

ROLAND BURKE HENNESSY
(Signature of Editor.)

Sworn to and subscribed before me this 29th day of March, 1932.

[Seal.] HARRY GERSTEN.

Notary Public, Kings Co. Clks. No. 195, Reg. No. 4226, N. Y. Co. Clks. No. 520, Reg. No. 4G288. My commission expires March 30, 1934.

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Mystery Circuit Nears Complete
No Correspondent Has

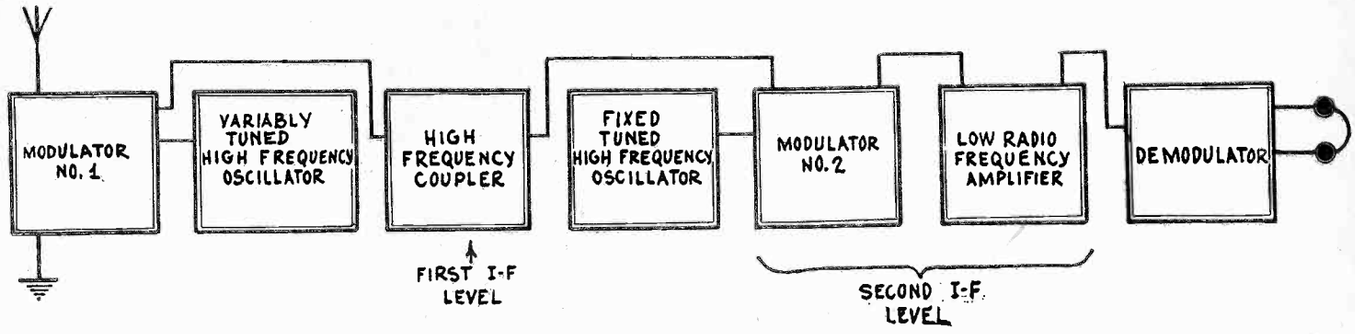


FIG. 1

The mystery circuit reduced to functional blocks. Virtually all waves are received by Modulator No. 1. The variably tuned high frequency oscillator should have a range in very high frequencies.

[*The first hint about the mystery superheterodyne was published in the March 12th issue, while considerable more data were printed in the March 19th issues. Both of these should be consulted by readers desiring to test their ingenuity. Last week, issue of April 2d, some solutions offered by readers were published. The general idea of the circuit was well grasped by these correspondents. This week some more replies are printed, also some comment by Herman Bernard, co-designer with J. E. Anderson of the mystery circuit.*—EDITOR.]

THE first circuit diagram published showed the mystery circuit as having three choke coils in series in the antenna circuit, which enables response in the grid circuit from 15 to 550 meters, or over a greater range. Then there was a variably tuned oscillator. An intermediate frequency channel followed. Second detector, audio and rectifier were included.

The second diagram included another local oscillator, hence a third detector. The audio and rectifier were standard. The previous part of the circuit constitutes the novelty. Replies so far received show that readers have grasped the fundamental situation: All frequencies are received by the first modulator (or first detector), then a variably tuned oscillator is coupled to this detector, and a coupler or amplifier is peaked at an intermediate frequency. There need not be any amplification at this intermediate frequency, a mere coupler sufficing. Then if another modulator (second detector) is used, another local oscillator working at a high frequency can be coupled to it to produce a lower frequency, one at which amplification is practical. Then would come the demodulator (third detector).

Watch These Frequencies

Fig. 1 this week shows the scheme in functional block formation. Take modulator No. 1. This is to be responsive, as stated, to a very wide range of frequencies. Coupled to it is the variably tuned high frequency oscillator. This will be the only variably tuned device in the entire set. Therefore the slogan: all waves with one dial, without any plug-in coils or switching devices.

So far every one has gone wrong on the frequency of the first intermediate level. This level is so high that it would be difficult to obtain amplification by using a tube, so just the coupler will suffice. The object is merely to have a tuned circuit, not amplification, which will come later.

If the high frequency coupler is set at a given frequency—and you are asked now to concentrate on the solution of the single point not yet covered by any one who wrote in—what frequencies should the variably tuned high frequency oscillator cover? When that question is answered the frequency of the fixed tuned h-f oscillator can be determined easily.

Some idea of the answer may be found right on the diagram, Fig. 1. The variably tuned high frequency oscillator is designated as the first i-f level. Now, i-f stands for intermediate frequency, and intermediate means that the frequency is between two others, then—then—you supply the answer!

Where Third Detector Comes In

One of the others is a lower frequency, covered by the low radio frequency amplifier. Now, if the high frequency coupler is peaked at a frequency you must select, to what frequencies should the variably tuned high frequency oscillator respond?

We got as far as the dissection of the high frequency coupler earlier in this discussion. A fixed tuned high frequency oscillator will permit lowering the frequency, so that modulator No. 2 will feed a low radio frequency amplifier. This low r-f amplifier may be 175 kc or 400 kc, or any frequency sensibly lower than 500 kc. The low r-f amplifier would feed the demodulator (third detector) and then the audio channel, not shown, would be included.

That the circuit calls for electrical and mechanical solutions as part of the engineering and design is admitted. E. M. Anderson, of 18626 Dale Avenue, Detroit, Mich., in a letter printed last week (April 2d) mentioned some of them. He described the circuit as "an effort to tune all waves with a single control, the oscillator condenser," which was correct, and said "you have contemplated a high intermediate frequency," also correct. He speculated that an intermediate frequency of at least 10,000 kc would be required, which is an assumption in the right direction, only he should have chosen a higher intermediate frequency (corresponding to the high frequency coupler this week), and then he could have decided the oscillator frequency coverage very nicely. While 10,000 kc could be used, there are objections to it.

Problems Cited

One of the problems he cited was the difficulty in getting selectivity to a degree required by reception of the broadcast band, where stations are 10 kc apart. The reason he gave was "that very slight changes in the oscillator frequency, due to temperature variations and other causes, would be sufficient to detune the set, perhaps to a station 20 or 30 kc from the one originally tuned in!"

Certainly that is a problem. And if his suggested intermediate frequency were considerably higher, the problem would be magnified proportionately. However, consider the fact that oscillators can be stabilized as to frequency by being immunized from the effect of voltage changes, that a meter could be put in the cathode or plate circuit and the current through the tube regulated so that changes due to temperature and even voltages could be nullified in effect, and also that a mere coupler would not have a 10 kc transmission band at such a high frequency, but perhaps may have 100 kc up, and that the low r-f amplifier (second i-f level) would be depended on for selectivity.

Mr. E. M. Anderson alone, among correspondents, raised the point: "Can such a vast range of frequencies be accommodated in one turn of the dial?"

"It seems to me," said he, "that the stations would become very crowded, especially those in the broadcast band."

Dial Problem

That is a problem. A condenser of 360 degree rotation is used, and that helps a little. Then the dial must be of the true vernier design, whereby single divisions on the main scale can be read to one part in 20. If the dial were 7 inches in diameter the circumference would be about 22 inches, and the main scale calibrated in millimeters would afford about 560 divisions, and as each division could be read to one-twentieth, the dial would be readable to 1 part in 11,200. The drive would have to be of the positive type, and an endless belt would serve the purpose. Bearings should be conical, and perhaps ball races included. There would be no lost motion or backlash communicated to the dial, since there should be no change in the reading unless the dial mechanism itself were moved. The play in bearings could be reduced to the lowest possible amount by the conical the dial scale itself were moved. The play in bearings could be reduced to the lowest possible amount by the conical construction.

Theoretical Solution; Picked Frequency High Enough

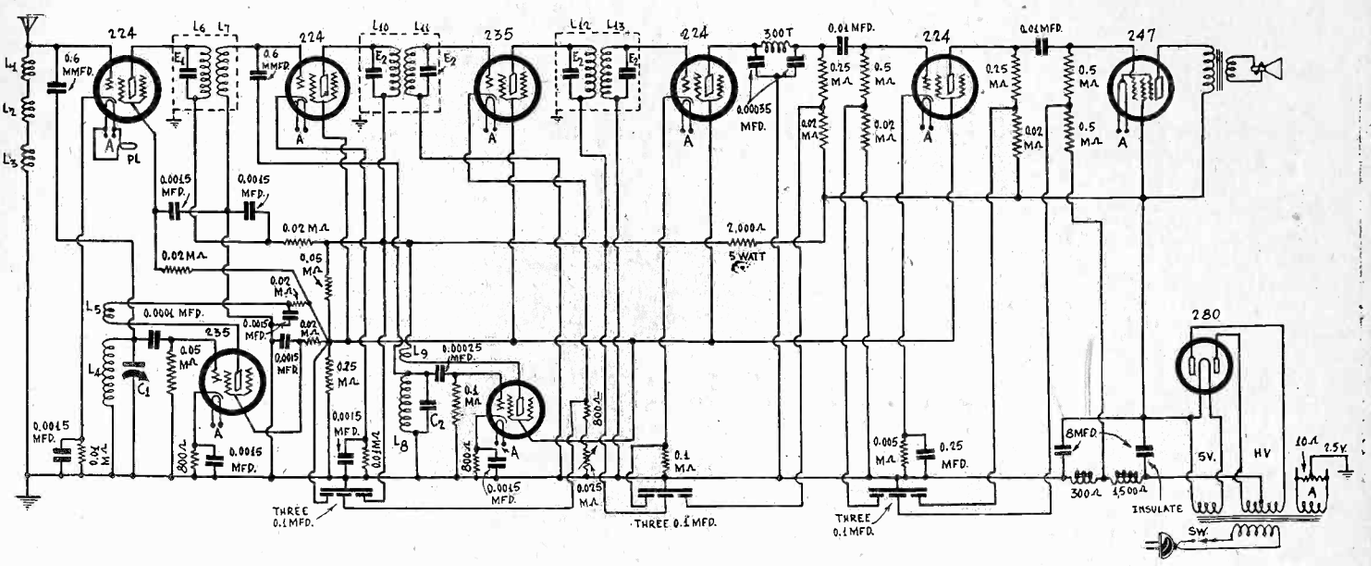


FIG. 2

The frequencies of the variably tuned local oscillators, lower left, and of L6 L7, should be studied carefully.

tuned oscillator's frequencies, which will reveal the frequency of the fixed tuned h-f oscillator, the entire circuit will be described, although virtually all points have been revealed or broached by readers and myself, except that readers who have sent in letters did not select high enough frequencies.—H. B.

* * *

Solution from W9EQB

IN REGARD to your mystery circuit, according to your description, the first 224 is an untuned detector. This detector need not be tuned in the grid circuit. All frequencies which may arise are allowed to pass through this coil save for the fundamental of the antenna. The first local oscillator is manually controlled, thereby being the only necessary tuning element. When the first local oscillator is set at some value, its frequency is heterodyning with all frequencies that are passing through the coils L1, L2, and L3.

But there must be some means of extracting one of these frequencies. For that reason the output of the first detector is tuned. This frequency is found by varying the first local oscillator until the heterodyne beat with some other frequencies produces an intermediate frequency that will pass through the tuned portion of the intermediate frequency transformer. This signal is again detected by the second detector and, as this frequency is always of the same value, the grid circuit of the second detector need be only fixedly tuned. With the intermediate from the first heterodyne circuit always at a fixed frequency and the oscillations from the second local oscillator always at a fixed frequency, there will be a second heterodyne or second intermediate frequency. This newly derived intermediate frequency will then pass through the 235 and be amplified where it meets another or third detector. This third detector will then detect the second intermediate frequency, allowing the audio wave to be amplified and reproduced.

Considering all possibilities, this set should be practical.

MELVIN L. KOCHER (W9EQB),
Pershing, Ind.

The general circuit performance is well stated by Mr. Kocher, who however should accept the fact, revealed last week, that the input is intended to respond well to 20,000 to 550 kc, and should speculate on the first intermediate frequency. The second intermediate frequency may be anything sensibly lower than 550 kc, e.g., 400 or 175 kc.

* * *

Sees Trouble Ahead

IN REFERENCE TO the mystery circuit on page 5 of your March 12th issue:

The writer tried some two years ago to construct a midget radio with a tuned oscillator and the signal frequency detector untuned.

It is true that the intermediate amplifier will give all that is necessary in the way of selectivity and sensitivity. At one time I even thought it would be feasible to make a practical receiver with this system and it certainly seems to offer many advantages due to its simplicity.

Now here are the disadvantages that, as I see them, make it about impossible to work out:

First—Your oscillator will bring in reception at two distinct points on its fundamental. or example suppose your intermediate frequency is 175 kc. Suppose you desire to receive a broadcast signal of 1,000 kc. Your oscillator frequency will have to be either 1,175 or 825 to beat this signal frequency. Regardless of whether you select the higher or lower frequency your set will also respond to the other frequency, as the detector is untuned and responds to an infinite number of signals. Obviously you see this is out, as it won't work satisfactorily.

Second—You will have a whole series of harmonics that are going to repeat this performance all the way up in frequency.

Therefore it will all boil down to the fact that the easiest way out is to tune the signal frequency detector and after you do this you simply have another orthodox superheterodyne. My reason for saying the easiest way out is that I do not think it possible to make a series of tuned traps to absorb these harmonics.

I can give you a tip. If you want to fool with something interesting as well as workable make a super-regenerator and use this as your intermediate at a high frequency. You can work out a practical set this way without doubt and it should be fine for high frequency reception.

R. S. SELLECK,
Radio Standard Laboratories,
3220 West Temple Street, Los Angeles, Calif.

All Mr. Selleck says about repeat points and image interference is true of 175 kc or other low frequency. But it is advisable to consider a high intermediate frequency. If he will theorize on a high one, and reach the logical conclusions, as he did on a low one, it is believed he will find his objections removed. If two intermediate frequencies are used, the second one low, the equivalent signal frequency (in demodulator) of course is tuned, although fixedly.

CHANGING TURNS ON COILS

ON MY RECEIVER WEAF comes in at 92 on the dial. Therefore I need more turns, apparently. Now I want to add turns to make 570 kc come in at 92. How many turns should I add?—F. W. C., Denver, Colo.

Approximately you should increase the turns in the ratio 66/57. It is not possible to give the exact number of turns to put on without knowing how many turns are on the coil now. It may be that you have 104 turns, which is the number of turns on a certain coil which when used with a popular tuning condenser makes 660 kc come in at about 90 on the dial. In that case you would need 116 turns, so you would add 12 turns.

A Simplified Two-Tube A-C or Intermediate

By Brunsten

HERE we have a very simple and effective converter for receiving short waves on a broadcast set. It contains only two tubes, one a 236 mixer and the other a 237 oscillator, which is of the Hartley type. There are three tuned circuits in the set, one for selecting the desired signal frequency, another for producing the desired local frequency, and a third for selecting the intermediate frequency. This tuned circuit, which is C5 and the primary of T3, is tuned to the same frequency as the broadcast set.

The two tuning condensers C1 and C3 may be ganged provided that another condenser C2 is connected across the first variable to be used as a manual trimmer. If we make C2 equal to C1 we can obtain a wide coverage of frequencies and it is not necessary to use more than three coils in each group, although four would provide more coverage and allow going a little higher in frequency.

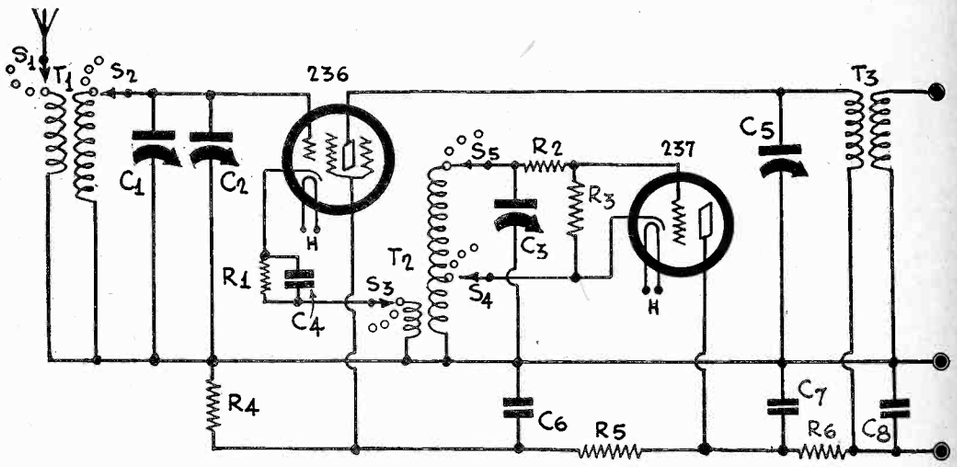


FIG. 1

A two-tube short-wave converter utilizing the Hartley oscillator and heater tubes. Tuning the input to the signal and the output to the intermediate frequency insures high selectivity and sensitivity.

Choice of Intermediate Frequency

It makes comparatively little difference what the intermediate frequency is just so it falls in the broadcast band and it is not too close to 1,500 kc. Provision should be made for varying it in case there is interference on the one selected and also in case the broadcast set is more sensitive on one frequency than another. We might say that any frequency between 550 and 1,200 kc. would be satisfactory provided there is no interference. We shall design the coils on the basis of a frequency of 750 kc.

With this choice inductance of the largest r-f coil should be 42 microhenries and that of the largest oscillator coil 37.4. This is based on the assumption that all the capacity of C1 and C2 is used when all of C3 is in the oscillator circuit. These will tune to about 4,000 kc. Hence we start at this value for the next coil. The coils now required are 11.3 microhenries for the r-f and 7.85 for the oscillator. These will tune 8,000 kc. very easily. The inductances needed are 2.83 and 2.36 microhenries. If another coil is desired it can be wound by cutting the turns on the two windings in half, or as indicated in the table below.

Winding Data

If we use forms of 1.25 inch diameter and wind with No. 24 enameled wire we shall need the following turns. L1 is the primary of the r-f coil, or of T1, L2 is the tuned winding on that coil, L3 is the tuned inductance on the oscillator coil, L4 the pick-up coil, and L5 represents the number of turns on L3 between ground and the tap to which the cathode is connected.

T1		T2		
L1	L2	L3	L4	L5
6	39	36	5	16
3	16	12.5	2	5
2	8	6.25	1	3
1	4	4	1	2

It makes practically no difference whether the plug-in coils or separate coils pick-up with a multiple switch are used, except, of course, the switch is much more convenient. More room, of course, is needed if the switching arrangement is used because the switch takes considerable room and all the coils must be mounted permanently on the sub-panel. Fig. 1 indicates the switching type of construction although only one coil system is connected to the circuit. The small circles represent position on the switch to which the other coils are to be connected.

The oscillator has been wired so that if plug-in coils are used the oscillator will fit a UY, or five-prong, socket. The r-f coils should be wound on four-prong forms so that the r-f and oscillator coils cannot be interchanged.

The Intermediate Tuner

Transformer T3 is a regular t-r-f coil connected in reverse so that the plate circuit may be tuned and so that the secondary will contain only a relatively small number of turns. A suitable coil is one employed in midget sets and encased in an aluminum shield.

Lift-Cover for

There are radio consoles with rigid tops that can be had for very little money in certain radio stores. These are ideal for the installation of a phonograph, provided the top is put on hinges. To man handy with tools the change is not difficult. Just run a saw along the top under the rigid lid, all the way around. After the top has been sawed off in this manner, smooth the rough edge of the cabinet with a fine rasp and sand paper and apply a varnish that matches the color of the cabinet. Treat the under side of the lid in the same manner. A piano hinge of the proper length can now be attached to the back of the console and the lid. Such a hinge can be obtained for about a quarter.

After the lid has ben sawed off and hinged in this manner, a phonograph turn table and motor can be installed as indicated in the photograph at the right. There is ample room for a radio receiver under the phonograph. In the job illustrated at the right and on the front cover a radio receiver, a loudspeaker, a microphone, and a phonograph motor and turntable were installed at a total cost but a small fraction of a similar combination ready made.

In these cabinets there is a place for the loudspeaker on the front, located so that the front side of the cabinet acts as a baffle.

The moor installed was of the type that is capable of two differen speeds, 33⅓ and 78 revolutions per minute, thus accommodating both types of records now available. A switch mounted on the platform holding the phonograph permits easy change of speed. There is also a neon lamp connected to the a-c line mounted on the platform. This is used as a stroboscope obtaining the proper speed, since the motor is not of the synchronous type.

D-C Converter; Frequency of 750 kc. Preferred

unn

LIST OF PARTS

Coils

T1—One set of r-f transformers as described
T2—One set of oscillator coils as described
T3—One r-f output transformer as described

Condensers

C1, C2, C3—Three 140 mmfd. tuning condensers, with C1 and C3 ganged
C4, C6, C7—Three 0.1 mfd. by-pass condensers, all in one case
C5—One 350-450 mmfd. adjustable condenser
C8—One 1 mfd. by-pass condenser

Resistors

R1—One 30,000 ohm resistor
R2—One 5,000 ohm resistor
R3—One 100,000 ohm grid leak
R4—One 1,000 ohm resistor
R5—One 3,500 ohm resistor
R6—One 7,000 ohm resistor
(All resistors one watt)

Other requirements

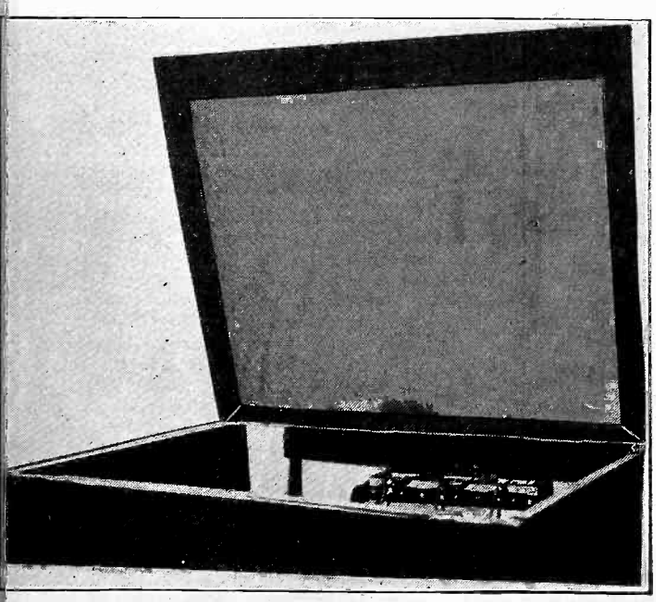
S—One five pole, four throw switch
Two UY, or five-prong sockets
One grid clip
One dial, vernier type
Four binding posts

If plug-in coils are used the multiple switch may be omitted and one four-prong and one five-prong sockets added.]

This type of coil may be had with almost any ratio of turns and also for either 350 or 500 mmfd. condensers. One coil containing 27 turns in the tuned winding and 25 turns on the untuned and designed for a 350 mmfd. condenser is recommended.

If the full range of broadcast frequencies is desired for the intermediate frequency, condenser C5 should be a 350 mmfd. variable. However, it is not necessary to have the full range and therefore a large trimmer type of condenser can be used. One such condenser has a range from 350 to 450 mmfd. This could be used but if it is it becomes necessary to reduce the turn on the tuned winding if the broadcast band is to be reached. Another possible combination is this condenser and a coil designed for a 500 mmfd. tuning condenser. There is also a smaller trimmer condenser, one having a range of from 210 mmfd. down. This is approximately correct for a 350 mmfd. coil. However, it may be that if this is used, another trimmer may have to be connected in parallel. There is nothing critical about the choice of this coil and condenser just so the combination falls within the broadcast band and allows for some variation within that band.

Rigid Console



Intermediate Coil

If T3 is wound on a one inch form with No. 32 enameled wire, and a tuning capacity of 400 mmfd. is used across it, then the circuit will tune to 750 kc if the number of turns is 66. The 350-450 mmfd. trimmer will cover this easily. This coil might have 15 turns for secondary, wound at one end of the tuned winding.

Connect the ungrounded end of the secondary to the antenna post on the broadcast set and the other end, of course, to the chassis of the converter and to the B minus of the broadcast set, which in most cases is also the chassis of the broadcast set. When this connection is made it is not necessary to ground the converter for it becomes grounded automatically.

The plate voltage for the converter may be obtained from the broadcast set by connecting B plus to a suitable voltage in the set, say 135 volts. Since the B minus terminal of the converter is connected to B minus of the set, no other connection is needed. However, if the plate voltage is not accessible in the set, it may be obtained from either a battery or eliminator.

The two heaters of the tubes have not been connected to anything because of desired flexibility. If there is a 7.5 volt center tapped winding available it can be used for heating the two filaments. No ballast resistor is needed as the tubes will stand 7.5 volts. The center tap should be connected to ground, or to the chassis, and of course, the two heaters should be connected in parallel.

Using Storage Battery

Another way of heating the filaments is to connect them in parallel and then connect them across a 6 volt storage battery. Another possibility is to use a toy transformer giving a voltage of 20 volts. In this case the two heaters should be connected in series. The voltage will probably be a little high in this case for drop inside the transformer will not be great on only 0.3 ampere. In that case a ballast resistor should be connected in series with the heaters. The voltage of the transformer is not definite enough to specify the value of this resistance. It can best be obtained experimentally with an a-c voltmeter and a rheostat. Six ohms should be enough for the ballast. The line connecting the two heaters might be grounded in this case for this is the nearest approach to a center-tapped ground.

In the event that no suitable heater voltage is available, a 224 tube may be substituted for the 236 and a 227 for the 237 without making any other changes in the circuit, except changing the heater voltage to 2.5 volts. There is no lack of 2.5 windings from which this heater voltage may be obtained.

The Voltage Divider

The voltage divider and the bias resistors take care of the various voltages other than the heater voltage, provided that a suitable voltage is applied at B plus. A low voltage is applied to the screen of the mixer tube, not more than 10 volts, although this voltage is not at all critical. If we make R4 1,000 ohms and allow a bleeder current of 10 milliamperes we get a screen voltage of 10 volts. On the plate of the oscillator we can use 45 volts, approximately. Practically the same current flows in R5 as in R4 so that if we want 45 volts on the oscillator we have to make R5 3,500 ohms.

The current to the plate of the oscillator is not more than 2.5 milliamperes so that the current in R6 is 12.5 milliamperes. Now if we want 135 volts on the plate of the mixer tube, the voltage drop in R6 will be 90 volts. Since the current in it is 12.5 milliamperes the value of R6 must be 7,200 ohms. The nearest commercial resistor is 7,000 ohms, which should be used.

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 53 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.

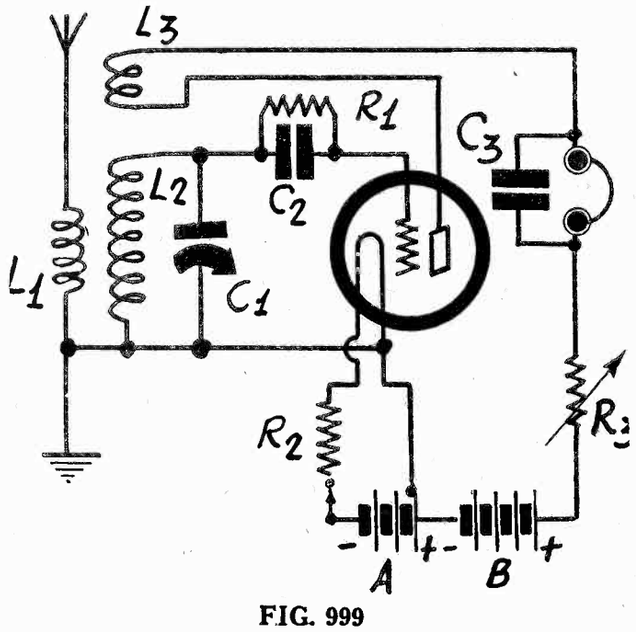


FIG. 999

One-tube regenerative short-wave receiver, for covering a frequency ratio of about 3-to-1, using 0.00035 mfd. for tuning.

Short-Wave Earphone Set

AS I WOULD LIKE to try listening to short waves, at little expense, please show a one-tube earphone circuit. I have a 0.00035 mfd. condenser for tuning. Is this all right? I am interested in police calls, also possibly going to higher frequencies, say, 25 meters.—R. R. D., Pasadena, Calif.

If you want to cover from about 200 to about 70 meters, thus bringing in police calls, amateurs, television and a few relay broadcasting transmissions, you may follow Fig. 999, using 1 wide diameter, winding 35 turns of No. 28 enamel wire for the the secondary (any size wire), and putting the primary next to the secondary, just enough separation to separate, primary, consisting of 15 turns of No. 28 enamel wire. If you want to go from about 75 meters to about 25 meters, use 12-turn secondary, No. 18 enamel, 10 turn tickler (any size wire) and 8 turn primary, No. 18 enamel. C1 is 0.00035 mfd., C2 is 0.00025 mfd., R1 is 50,000 ohms, C3 is 0.00035 mfd. fixed or larger up to 0.001 mfd., R2 is 16.5 ohms, if the tube is a 230 and the A battery source is 3 volts, while the B voltage is 45 volts and R3 is at least 100,000 ohms.

* * *

Unity Coupling in Mixer

IT SEEMS TO ME I have hit upon the long-sought-for "floating" or "fixed" oscillator, in this case the modulator tuning being fixed so that only the oscillator is variable.

My opinion is based on recent experiments with a superheterodyne orthodox in every way except that there is no r-f ahead of the modulator. There are separate dials on the modulator and oscillator tuning condensers. In lieu of the customary inductive coupling of the oscillator I am using a 0.5 mfd condenser grid to grid.

With a 15 turn primary closely coupled to 120 turn secondary on 1 inch form and using 150 feet of aerial and ground, the modulator tunes just as sharply as a modern highly selective set. Peculiarly, if the oscillator dial be left at any point setting many stations, local and DX, may be tuned in with only the modulator dial. Conversely, if the modulator dial be left at any point setting, many of the same stations may be tuned in with only the oscillator dial. One of the amazing results is that DX comes in almost as strong as locals. It might better be stated that locals do not blast.

I have logged about fifty stations outside the metropolitan territory in two evenings, but the dial settings are so wild that it is impossible to graph the tuning lines.—J. B. G., Upper Montclair, N. J.

The coupling between modulator and oscillator is so close that it is virtually unity. Therefore when you turn either the modulator or the oscillator condenser you are in fact tuning the oscillator. This interdependence is exactly what is not wanted. The same system of capacity coupling is used occasionally, and we have shown hookups, but the coupling condenser was 0.6 mmfd. In other words, the capacity you use, 0.5 mfd., is 8,333 times as great. While 0.6 mmfd. gives loose coupling, and more capacity may be used without risk, not much more should be included, otherwise one circuit will "pull" the other, as explained. In favor of the scheme you outline, however, where interdependence is established, the situation is better than if the modulator had no tuning condenser across it, for the oscillator frequency is nearer to the signal frequency than the natural period of an untuned input. The system you outline has been tried and discarded by many experimenters. However, you may be able to work out something satisfactory, but the wild dial readings would have to be eliminated, therefore your solution would have to produce excellent results consistent with calibration.

* * *

Why Always the Five-Tube Set?

THE MIDGET T-R-F set has been more or less standardized at five tubes. There is a three-gang condenser. How about a four-gang condenser, using six tubes? Would not results be much better? Why always five tubes?—A. K. L., Dubuque, Ia.

The reason for the five-tube set is that exceptionally good results are obtainable with the improved modern circuits, at very low cost (as with Blueprint 627), while the addition of one section, another tube, socket, coil, etc., would increase the cost and require careful filtration. As it is, the five-tube sets are built with high impedance primaries, and oscillation will begin at around 1,400 kc unless the fixed resistor that limits the bias on the r-f tubes is increased beyond the standard value. So 600 or 800 ohms are used, serving two tubes, and the volume control resistance is additional. Then the circuit is stable to higher than 1,500 kc. If another r-f stage were introduced, since already means had to be provided for stability with only two r-f stages, plate, screen and even grid leads would have to be filtered, the circuit would become not only more expensive but more complicated. However, performance would be better, in the way of sensitivity and selectivity, if all these precautions were taken, and it would be advisable to include band pass filter tuning ahead of the first tube and also perhaps between two tubes, and equalize the sensitivity over the broadcast band. The cost becomes nearly twice as much. It is intended to show a circuit with three stages of t-r-f in about two months, using two three-gang condensers, to take care of the band pass filter requirements and also to aid in a special way in making the sensitivity uniform.

* * *

Neon Tube Doesn't Oscillate

PLEASE ACCEPT my sincere thanks for the fine oscillator you disclosed in the March 26th issue, in the article by E. M. Shiepe. You did not give the coil data, but I wound my own coils, as I am somewhat familiar with the requirements. Using the 360-degree condenser, which has 375 mmfd. maximum, I put 60 turns of No. 28 enamel wire on 2-inch diameter for the tuned winding, center-tapping for the cathode connection. Then I used 20 turns of No. 24 enamel wire for the next winding, center-tapping it. For intermediate frequencies used two 300-turn honeycomb coils in series, joined to cathode. It is highly commendable that you continue to show how to build multi-frequency range oscillators, with switch for band shifting, as in this case. However, I am unable to get audio oscillation from the neon tube oscillator, and ask you please to supply a remedy. The tube does not light. I assume it should do this.—H. W. A., Los Angeles, Calif.

The coil data were not given as the coils used in the laboratory model did not overlap sufficiently, but it was stated that these data would be supplied to those who wrote in for them. Address E. M. Shiepe, care RADIO WORLD, 145 West Forty-fifth Street, New York, N. Y. They will be printed in these columns some day. The reason the neon tube does not glow or oscillate is that the d-c- voltage is too low. Move the slider across the voltage divider in the direction of higher voltage until the glow appears. This is one of the best oscillators we have ever published, we use it continuously in our laboratory, and we highly recommend it to our readers as something well worth building—15 to 2,000 meters, approximately, with no plug-in coils, and with modulated-unmodulated service.

New Tubes Expected

ARE THE MERCURY rectifier tubes coming along? Some independents have been making them. What advantages do they possess? Are there any new tubes in the offing?—O. J. E., Salt Lake City, Utah.

Yes, the mercury vapor rectifier tubes are gaining in use, but at present are not for home receiver use, but for purposes where current and voltage are much greater. Voltage can be kept constant despite wide differences in current drain. It is expected that a mercury rectifier similar to the 280 tube in purpose, but not replaceable for the 280, will be announced by the receiver tube manufacturers, also that soon there will be an a-c screen grid r-f pentode of the variable mu type as well as a new output pentode. Aside from the rectifier it is believed the tubes cited will require six-prong sockets, and also that there will be a general purpose tube of this a-c 6-prong series. As soon as official announcements are made the technical details will be revealed in these columns and characteristic curves given.

* * *

Static as Storm Signal

HAS STATIC any relationship to storms? Is it true you can tell that a storm is coming by noting the static?—J. J. O'R., Peoria, Ill.

Yes. Some lighting companies use a receiver tuned to a fixed frequency, which may be in the broadcast band, and connected thereto meters that read the amount of static in relative values. These meters are watched during daylight, for in large centers, when a storm is approaching or arrives, with consequent darkness, there would be a tremendous overload on the system unless extra dynamos were cut in. These take half an hour or so to get working at peak, so when the static warning is received, the engineer in charge directs that as many auxiliary dynamos be put in operation as the extent of the static reading seems to warrant. On some occasions the storm comes up so suddenly that the full preparation for the extra load on the system can not be made in time, and during a short period an overload may exist, so that line voltage readings are low all over, until the corrective is applied.

* * *

A Trick Oscillator

IN RECENT ISSUES you have published circuits containing a certain oscillator and also circuits of the same oscillator not associated with any other circuit. The characteristic of this oscillator seems to be that plate is grounded. How can there be any feedback if the plate is grounded? Certainly, if there is no feedback there can be no oscillation. I should like to have an explanation of the circuit.—R. M. C., Camden, N. J.

There is feedback, all right, and that is why the circuit is an oscillator. The external plate circuit is counted from the cathode to the plate. In going around the circuit from the cathode to the plate, or from the cathode to ground, we encounter the tickler, the lower part of the tuned coil. Any point of the plate circuit may be grounded. What part of the plate circuit is grounded is immaterial. The phase of the tickler winding with respect to the grid winding is such as to produce oscillation. That is all that is needed. Incidentally, the part of the coil that is in the cathode circuit, as well as in the plate circuit, develops a signal voltage just as a resistor without by-pass condenser placed in the same position would develop a voltage across it. In an oscillator of this type, which is shown in Fig. 1,000, it is essential that no condenser be connected from the plate to the cathode, or from the cathode to ground, unless we want to tune the tickler.

* * *

Oscillation Without Mutual

I HAVE HEARD that an oscillator of the Hartley type will oscillate even if there is no mutual inductance between the two parts of the inductance in the circuit, that is, the part in the plate circuit and that in the grid circuit. Particularly, it will oscillate if two equal coils are connected in series, one in the plate, the other in the grid circuit, and the tuning condenser is connected across the two. Is this a fact, and if so, how can you explain it?—T. H. J., Richmond, Va.

It is a fact and the frequency of oscillation is determined by the capacity of the codnenser across the two coils and the sum of the two inductances, at least to a first approximation. The error in making this assumption is very small, so that in designing oscillators of this type it is permissible to proceed on that basis. When there is mutual inductance between the two coils and is such that it is additive, the inductance of the two coils in series is much higher than when there is no mutual. Since the tuning condenser is connected across both coils, the oscillating current flows in both coils and there is a voltage drop in the grid coil. This is amplified by the tube and the resulting plate current excites the oscillating circuit. The phase happens to be right to maintain the oscillation.

* * *

Choice of Intermediate Frequency

SEVERAL TIMES I have seen it stated that the intermediate frequency of a superheterodyne must be lower than the lowest frequency to be received, or that it must be higher than the highest frequency to be received. If these statements are correct, please explain the necessity for these conditions.—R. B. M., Atlanta, Ga.

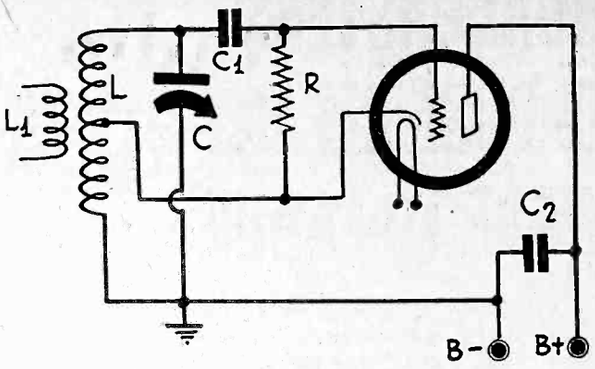


FIG. 1,000

A Hartley oscillator in which the plate is virtually grounded by C2.

If the intermediate frequency, or more accurately, the fixed frequency, in a superheterodyne falls in the band of frequencies to be received it will be impossible to receive signal frequencies near the fixed frequency, first, because there will be no selectivity there and second, because at the fixed frequency there will be terrific squealing.

* * *

Trouble in Supers

FROM 100 TO ABOUT 25 on the dial my super works fine but below 25 there is a very strong and unpleasant hiss. I have tried many changes which have been suggested to me but nothing I have done has helped in the least. What do you think is the cause of the trouble and what is the remedy?—A. B. Q., Brooklyn, N. Y.

It is probable that the hiss is due to overloading in the first detector by the oscillator. The intensity of the oscillation increases with the frequency and at a certain point it becomes so great that the voltage impressed on the mixer reaches the overloading point. You can decrease the number of turns on the pick-up coil, or if this is not practical, you can reduce the intensity of the oscillation by putting a resistance in the lead between the tuned circuit and the grid. It is customary to use about 5,000 ohms when the grid leak is 100,000 ohms. The added resistance should be connected so that the grid leak and the new resistance form a voltage divider, with the grid connected to the junction of the two. Another way of reducing the oscillation is to use a lower value of grid resistance. Still another is to decrease the number of turns on the tickler. Lowering of the plate voltage on the oscillator also helps. Take your choice.

* * *

Variation of Oscillator Frequency

WHY IS IT that the frequency of an oscillator varies with the plate and filament voltages? I have noticed that this is the case in all oscillators that I have tried. In some the variation is large while in others it is reasonably small.—S. G., New Rochelle, N. Y.

In most oscillators the frequency depends not only on the L and the C of the circuit but also on the resistance in the resonant circuit and on the plate resistance of the tube. In fact the expression for frequency usually contains the factor $(1 + R/r)^{\frac{1}{2}}$, in which R is the resistance in the oscillating circuit and r is the plate resistance in the plate circuit of the tube. Now r varies with the voltages on the tube, grid, plate, and filament voltages. Hence the frequency varies as the voltages vary. R is always very small in comparison with r and therefore the variation in the frequency can only be a second order effect. Obviously, to make the ratio of R/r small we can reduce the value of R, that is, we can stabilize the frequency by selecting a resonant circuit of very high selectivity. Again, we can make r large. However, it will not help to select a tube with a high plate resistance, because the variation would be proportional to the resistance. But we can put a constant resistance in the plate circuit. For high constancy we can make this resistance so high that the circuit will just barely oscillate. Let us examine the probable frequency change in a typical circuit. Suppose the plate resistance is 20,000 ohms and that the effective resistance in the tuned circuit is 50 ohms. This resistance in a broadcast coil is not excessive although the resistance of the coil itself not connected to a tube may not be more than 5 ohms.

Let us further assume that the increase in the plate resistance due to a change in voltage is 10 per cent., or an increase of 2,000 ohms. Under these conditions the change in the frequency is very nearly 125 cycles per second, if the natural frequency of the tuned circuit is 1,000,000 cycles. Other changes in the frequency are due to changes in the capacity of the tube resulting from temperature changes.

BROADCASTERS OPPOSE CLEAR WAVE TO LABOR

Washington.

"I have no quarrel with labor, but the principle of granting a cleared channel to any organization is not in the interest of broadcasting."

So said Harry Shaw, president of the National Broadcasters Association, speaking before a subcommittee of the Senate Committee on Interstate Commerce, opposing a cleared channel grant to organized labor. Such a channel is requested by labor through legislation, since the Federal Radio Commission is not disposed to grant the request. Labor wants to put a chain of stations on a cleared channel, expending from $300,000 to $400,000 on the project.

The hearing was held on the bill introduced by Senator Hatfield (Rep.) of West Virginia, authorizing the Commission to grant a cleared channel.

Opposes "Vested Right"

Mr. Shaw said that such a grant would result in labor virtually owning the frequency thus obtained. He said:

"The bill would grant a vested right to labor forever. What effect this right would have on a North American conference to decide on allocations is problematical, but at present it does not seem to be in the interests of broadcasting."

As a background for introducing his bill Senator Hatfield had obtained from the Commission answers to questions directed at its attitude and findings in respect to WCFL, the labor station, located in Chicago, which now is restricted to daylight hours.

"The bill, designed wholly for the benefit of the American Federation of Labor, would be wholly inconsistent with the provisions of the Davis amendment, which undertakes to make all broadcast facilities available for assignment geographically," the Commission explained, pointing out, according to "The United States Daily," that to grant this right to labor in Chicago would not be in accord with the spirit of the law.

Effect on Other Groups

Mr. Hatfield, in his questionnaire, pointed out that there are more than 47,000,000 wage earners in the United States, and asked why the Commission should deny a voice to the largest group of radio listeners in the country.

"There are numerous groups of the general public which might similarly demand the exclusive use of a frequency for their benefit," the Commission answered. "There are nearly 5,000,000 Masons in the United States and about as many Odd Fellows. This classification could be carried on until more groups than frequencies would be found.

"Since there is only a limited number of available frequencies for broadcasting this Commission is of the opinion that there is no place for a station catering to any group, but all stations should cater to the general public and serve public interest as against group or class interest."

Answers "Prejudice" Charge

Of these 47,000,000 wage earners, the Commission pointed out, at the most 500,000 are affiliated with the Chicago Federation of Labor and other labor organizations in Chicago, and no station, no matter if it operates with maximum power of 50,000 watts, can consistently serve an area greater than that within a 200-mile radius of its transmitter. Thus WCFL would be serving, not the wage-earning class of America, but only a small percentage of it.

Answering the charge that cleared channels were allocated with "prejudice," the Commission told of extensive investigations in cooperation with other Government agencies and radio engineers before it was decided that 40 of the 90 existing channels should be cleared, and presented records of written advertisements that any station dissatisfied with its assignment under the reallocation had but to appeal to the Commission for hearing on its case.

The question of whether original holders of licenses for cleared channels have "vested right" to these channels was answered by quoting the radio law to the contrary.

Vision Licenses Under Scrutiny

Washington.

A hearing will be held by the Federal Radio Commission on the application of Shortwave and Television Corporation, of Boston, for renewal of licenses it holds in the vision field. The stations are W1XAU, W1XG, W1XAV and W1XAL.

Questions to be determined are whether the corporation is financially able to go ahead with experimental work and whether the object of holding the licenses is stock promotion.

"CORRECT TIME" PROVES WRONG

Washington.

All broadcasting stations have been advised by the Federal Radio Commission that telegraphed Naval Observatory time signals should not be announced as the correct time as transmitted by the Observatory, due to the inherent time lag in the line wires that introduces appreciable error.

The Navy Department requested that the Commission prohibit the rebroadcasting of Naval Observatory time signals sent by telegraph to the station.

Capt. S. C. Hooper, director of Naval Communications, wrote the Commission as follows:

"The Chairman, Federal Radio Commission: It has come to the attention of the Navy Department that a number of broadcasting stations are transmitting time signals which they receive over a Western Union wire, and they announce them as originating from the Naval Observatory, Washington, D. C.

"The Navy Department has, in the past, upon application from a broadcasting station, authorized the rebroadcasting of time signals if the station intercepted the direct transmission of the signal from Washington.

"The rebroadcasting of Naval Observatory time signals which are transmitted over a land wire is objectionable because of the inherent time lag in the system which creates an appreciable error in the signal.

"Accordingly, it is requested that suitable instructions be incorporated in the Federal Radio Commission's Rules and Regulations for the guidance of broadcasting stations."

WOV IS INDICTED UNDER A STATE INSURANCE LAW

The first test of whether an insurance company not licensed to do business in the State of New York may broadcast from the State air talks intended to sell insurance policies is up for test in General Sessions, New York City. WOV, and its president, John Iraci, were indicted because the Union Mutual Life Insurance Company, of Iowa, which had no New York State license, broadcast statements that it offered the lowest rates of any other company in the country, and requested listeners to write in for rates, stating their ages.

The case came up previously in a magistrate's court, but the complaint was dismissed on the plea by the defense that broadcasting constituted interstate commerce and that therefore the Federal government alone, and not the State, had jurisdiction. However, Attorney General Bennett of New York State asked that the District Attorney submit the case to the grand jury, and after this was done the indictment was voted.

State Official Heard Sales Talk

Josiah L. Wood, of the State Insurance Department, was the complainant. He said that he personally listened to a broadcast from the station on October 29th, 1930, and recited the sales talk given, adding that applicants were asked to write either to the broadcasting station direct or to the insurance company in Des Moines, Ia. Subsequently the investigation of a license of the Iowa company in New York was made, and it was then found no license to do business had been obtained.

Louis H. Levin, lawyer for WOV, exhibited a contract entered into between the insurance company and the station providing for twice-a-week programs of five minutes each, to run for thirty-three weeks, including singing, instrumental music and the sales talk played from a phonograph record.

What Station Was to Get

The broadcasting company was to receive and keep one-third of the premium receipts. The contract expired and was not renewed.

Section 50 of the State Insurance Law provides that a fine of $500 be imposed for the first offense and additional fines of $100 for each subsequent offense.

Station Changes

Changes in the list of stations by frequencies, made since the publication of the list in the March 26th issue, follow:

630 kc, WOS, Jefferson City, Mo. Change owner to Missouri State Marketing Bureau.

860 kc, KMO, change frequency to 1330 kc, and power to 250 w.

1010 kc, KGGF, new location, Coffeyville, Kans. (Instead of South Coffeyville, Okla.)

1120 kc, KRKD, new location, Los Angeles, Calif. (Instead of Inglewood, Calif.)

1330 kc, Insert KMO, Tacoma, Wash. KMO, Inc. 250 w.

1360 kc, WCSC, Charlotte, N. C. Change ownership to South Carolina B'dc'g Co., Inc.

1420 kc, KGKX, Sandpoint, Idaho. Change owner to Sandpoint B'dc'g Co.

NEW WOR "MIKE" QUICKLY NOTED BY LISTENERS

WOR, Newark, N. J., has completely equipped its studios with the new dynamic microphone, the latest innovation in broadcasting pick-ups and which engineers say is 300 per cent more sensitive than either the condenser or carbon type.

While Bell Laboratory engineers have monitored WOR with a view toward checking tone fidelity, it was not expected that listeners would notice the difference for a week or two, but hundreds of them proved more observing than the technicians presupposed.

Flat Characteristics

J. R. Poppele, chief engineer of WOR, says that the new microphone has an over-all frequency response characteristic from 30 to 10,000 cycles with a gradient that is entirely flat in this range. Non-technically that means it is equally sensitive to any part of this scale.

"It is much better on the low end and also on the high," said Mr. Poppele. "The condenser microphone heretofore had been regarded as the last word in pick-ups. But a peak always has been manifest in the upper range of response in the condenser variety.

"The dynamic microphone lends a perspective not obtainable with any other type. For example, but one unit is necessary to pick up a program of huge symphony groups. This does away with the necessity of the so-called mixer panel, though various microphones are cut in and out as needed.

Fewer Extraneous Noises

"It has other advantages, too. One can stand a considerable distance away from it without loss of efficiency. Its low output impedance eliminates extraneous noises picked up by induction in the connecting cables."

The new microphone is so sensitive that all artists will have to be re-educated in broadcasting. As an illustration one of the microphones was used in a household talk the other morning and the woman at the microphone seeking to add "atmosphere" to her talk dropped a lump of sugar into a teacup. The result was that the tubes were badly overloaded. It sounded as if a mechanic had struck a huge iron boiler with a sledge hammer.

NEW COLUMBIA PROGRAM

A New Columbia Program to be heard on Tuesdays, Wednesdays and Thursdays at 5:30 p.m. is "The Professor and the Major," featuring Brad Browne and Al Llewelyn, sponsored by Kolynos. Very glad to hear that these boys, as a team, are to be heard once more. They do good work together.—A. R.

TUNE IN FOR STEPPY NUMBERS!

Dance Music For Saturday Night, April 16

Buddy Rogers and His California Cavaliers	WEAF	11:30 p.m.
Coon-Sanders Orchestra	WEAF	Midnight
Larry Funk and his Orchestra..	WJZ	Midnight
Edgewater Beach Band, Chicago	WJZ	12:15 a.m.
Don Redmond & Connies Inn Orchestra	WABC	11:00 p.m.
Enric Madriguera's Biltmore Orchestra	WABC	11:30 p.m.
Guy Lombardo and his Royal Canadians	WABC	Midnight
Ben Cutler's Cafe de la Paix Orchestra	WOR	11:00 p.m.
Julian Woodworth and Governor Clinton Orchestra	WOR	11:30 p.m.

Brown Sworn in; Patrick Promoted

Washington.

Following confirmation by the Senate of his nomination by President Hoover to be a member of the Federal Radio Commission, Thad H. Brown, of Ohio, was sworn in by Judge Charles H. Hatfield, of the United States Court of Customs and Patent Appeals. Commissioner Brown succeds Ira E. Robinson, resigned, and the term of office is six years.

Brown was general counsel to the Commission prior to his present appointment. The post of general counsel has been given to Duke M. Patrick, of Indiana, formerly assistant general counsel.

STATIONS MAKE OUSTER PLEAS

Washington.

In a brief filed with the Federal Radio Commission Arthur J. W. Hilly, corporation counsel of the City of New York, asked that full time be awarded to WNYC, the municipal station, which now shares time with WMCA on 570 kc. On the other hand, WMCA asked that its companion station, WPCH, also in New York City, be put on 570 kc as its time-sharer. If the Commission denies the application of WNYC for renewal of its license, and grants the applications of WMCA and WPCH, WNYC would be off the air.

The two 570 kc stations have been at loggerheads for years. In his present brief Mr. Hilly recites that WNYC is an educational station operated by the public in the public interest, but finds that its work is hampered by WMCA, which, he says, is constantly resorting to interfering and obstructing tactics. He openly declared that WMCA is fulfilling no public need, but is doing all possible to feature commercial programs, and that the programs are of a decidedly inferior quality, whereas WPCH was "apparently" serving no public need.

WMCA is owned by the Knickerbocker Broadcasting Company, Inc., and WPCH by the Eastern Broadcasters, Inc., but there is a relationship of financial interest between the two corporations.

Examiner Ellis A. Yost recommended that WMCA and WNYC be granted renewal of licenses but that the application of WPCH for modification (to go on 570 kc with WMCA) be denied.

CORPORATION REPORTS

Scovill Manufacturing Company and subsidiaries—Year ended Dec. 31: Net profit after interest, depreciation, taxes and other charges, $152,912 equivalent to 17 cents a share on 879,765 shares of stock outstanding, excluding shares in treasury, compared with $506,618, or 57 cents a share on 882,912 shares, in previous year.

Zenith Radio Corporation—Quarter ended Jan. 31: Net loss, after expenses, depreciation and adjustments, $98,603, against $69,098 in preceding quarter and $165,386 in quarter ended on Jan. 31, 1931. Nine months ended Jan. 31: Net loss, after depreciation and other charges, $226,212, against $438,238 for the nine months ended Jan. 31, 1931.

Pilot Radio & Tube Corporation and subsidiaries—Year ended Dec. 31: Net loss after depreciation, taxes and other charges, $215,579, against net profit of $62,361 in 1930; gross sales $1,251,850, against $1,720,436.

Electrical Products Corporation of Washington—Year ended Dec. 31: Net income after expenses, Federal taxes and other charges, $90,171, equal to 90 cents a share on 100,000 common shares, compared with $107,365, or $1.07 a common share, in 1930.

PHONE PERMIT IN BIG DEMAND BY AMATEURS

Washington.

Amateur radio operators made a last-minute rush to apply for supplementary indorsement of licenses to allow them to operate radio phones on the 80 and 20 meter bands, according to W. D. Terrell, director of the Commerce Department's Radio Division. These bands are good for long distances, and it is considered desirable that those operating on these frequencies have considerable knowledge of radio and radio transmission to minimize interference with foreign stations.

Desirable Bands

In the past, holders of amateur radio operator licenses were allowed to operate either code or phone sets on any of the specified bands. Under the new arrangement, phone operators who have not received the indorsement will be forced to confine their activities to the 5 and 175 meter bands, which have a limited range.

The 20 meter band is considered very desirable for day-time transmission, but its range is limited after sundown. The 80 meter band is good for night work. By the use of these two bands, amateurs may communicate over long distances at any hour of the day or night, it is pointed out.

"Unlimited" Operators

Those obtaining indorsement of present license are known as unlimited amateur operators. Amateurs operating code sets only are required to have any change in the class of license held, Director Terrel stated.

ARTHUR H. LYNCH WITH TRIAD

Arthur H. Lynch, formerly editor of "Radio Broadcast," later editor of "Radio News," and more recently an executive of the corporation sponsoring the Stenode, is now publicity director for Triad Manufacturing Corporation, Pawtucket, R. I., manufacturers of Triad tubes.

New Incorporations

Radio Syndicate, New York, N. Y.—Atty., E. Reitman, 111 Broadway, New York, N. Y.

Ferguson Radio Corp., New York, N. Y.—Atty., L. Farbstein, 401 Broadway, New York, N. Y.

Birns Radio Co., Brooklyn, N. Y.—Atty., S. Flug, 2,738 E. 19th St., Brooklyn, N. Y.

Boundry Line Repair and Electrical Service (Queens)—Atty., A. Korwan, Jr., Jamaica, N. Y.

Electric Television and Broadcast Corp., Wilmington, Del., television and broadcasting devices—Attys., Corporation Trust Co., Wilmington, Del.

Republic Radio Manufacturing Corp., Wilmington, Del., deal in radio equipment, supplies, and accessories—Atty., Franklin L. Mettler, Wilmington, Del.

Radio Screen Artist Productions, New York City—Attys., Telleris & Gluskin, 276 Fifth Ave., New York, N. Y.

Adams Production Corporation, New York City, production of plays, concerts, radio broadcastings—Attys., United States Corporation Co., 150 Broadway, New York, N. Y.

Allied Power Corp., New York City, electrical appliances—Attys., Rubinstein & Bass, 1,441 Broadway, New York, N. Y.

Moderne Equipment Corp., New York, N. Y., refrigerators—Atty., H. R. Mooney, 21 East 40th St., New York, N. Y.

Goldman Electric Co., New Rochelle, N. Y.—Atty., J. S. Slote, Mount Vernon, N. Y.

Durable Luminous Tubing Co., Inc., Newark, N. J., manufacture luminous tubing—Atty., Philip S. Lieberman, Newark, N. J.

Blue Flash, Pleasantville, N. Y., electrical work—Atty., M. Zuckert, White Plains, N. Y.

Central Hardware and Electric Corp., New York City—Attys., Albany Service Co., 299 Broadway, New York, N. Y.

A THOUGHT FOR THE WEEK

"COAST TO COAST" is the title of a new play to be produced on the speaking stage by the Adams Broadcasting Service. It is a comedy based on radio—you know, one of those things devoted to the weaknesses and more or less whimsical comedy angles of life in the broadcasting station. Now let the peevish ones of radio rear up and insist that the stage is doing all it can to kill radio. Anyway, hasn't the stage accused radio of helping to kill the theatre?

RADIO WORLD

Title Reg. U. S. Pat. Off.

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; J. Murray Barron, advertising manager.

Oscillator is Essential

THE whole scientific world is moving toward greater and greater accuracy, radio along with it, as one of the important partners in the business of science.

Up to a few years ago it was possible for a radio worker to get along with a few simple tools and meters, and any one who had a calibrated oscillator for the broadcast band was rated as one of the advanced scientists of the age among his envious fellows. Right now, with superheterodynes occupying so important a position among radio circuits, it is next to impossible to get along without an oscillator, one calibrated for more than the broadcast band, for the intermediate frequency is at least as important as any other frequencies. Some say it is impossible to do any good work without an oscillator, for how else can one pad the superheterodyne?

A great deal of trouble is still being experienced by builders of superheterodynes who have no oscillator, and the result always has been, in instances that came to our attention, that the shortcoming of the builder was mentally communicated by him to the designer or the author of the constructional article. If there is any particular statement that can be made to convince all they must have an oscillator, consider that statement made.

There are commercial oscillators on the market, and these may be used. If for any reason one can not be obtained right now, the least that can be done is to build an oscillator. The broadcast band of frequencies should be covered, and also frequencies from a little below 1,500 kc to about 2,000 kc, so that the oscillator in the superheterodyne set may be tested even if the intermediate frequency is 400 kc. If the highest signal frequency to be received is 1,500 kc, then the oscillator must be tuned to 1,900 kc for an intermediate frequency of 400 kc. The intermediate frequency may be from 450 kc to 150 kc, which can be accomplished if solenoid coils are carefully made, or for a somewhat lesser coverage of possible intermediate frequencies, small honeycomb coils may be used. There should be some provision for modulation, as zero beat is hard to work, because at resonance nothing is heard, whereas modulation provides a tone, the intensity of which may be judged by ear, if the preferred method of using an output meter can not be followed.

Those who build their own oscillators have been using broadcasting stations as standards of frequency. If stations from the honor list are selected—and such a list is published in these columns from time to time—the result is satisfactory. Stations varying not more than 50 cycles either way should be selected. However, in June all stations will have to maintain this standard of accuracy, so the work will be still better done then.

In the interest of still greater accuracy it is advisable to use the 5,000 kc transmissions from the Bureau of Standards, sent out from 2 to 4 p.m. and from 10 p.m. to midnight E. S. T. each Tuesday. If a 5,000 kc fixed oscillator is set up it can be checked weekly against the standard transmission, which is accurate to better than 1 part in 5,000,000.

A lower frequency fixed oscillator may be established also, say one at 500 kc. Then, if both oscillators are of the detecting type, the harmonics can be used. For the first the harmonics, with fundamental, could be 5,000, 10,000, 15,000, 20,000, 25,000, 30,000, 35,000 and 40,000, thus accounting for fundamental and seven harmonics, while the low frequency oscillator could be used additionally for calibrating an unknown, yielding, with fundamental, 500, 1,000, 1,500, 2,000, 2,500, 3,000, 3,500, 4,000, 4,500 and 5,000, or fundamental and nine harmonics, and the two would give adequate basis for running curves on almost any other oscillator or circuit desired to be calibrated. Since 5,000 kc is the tenth harmonic of 500 kc, the low frequency oscillator could be checked weekly against the secondary (5,000 kc) local oscillator, as well as against the primary oscillator.

So, besides having an oscillator, the requirement is growing that one should have an accurate oscillator. Accuracy relates to frequency finally. The factors that change frequency are mechanical, electrical and meteorological. Mechanical difficulties concern vibration mostly, and rigidity of construction and mounting are requisite to a solution. Electrical changes are those due to voltage, and may include reactance. The oscillator can be stabilized against frequency changes resulting from d-c voltage changes, and some part of the circuit can be made non-reactive. Temperature concerns room temperature and emission changes due to supply voltage changes, but a d-c current meter can be used so that the current will be adjusted to be the same in the cathode or plate circuit as when the original calibration was made. Finally a high order of accuracy can prevail, and from that point on radio work becomes much more intensely interesting.

Television Improvement

FOR television to advance to the stage where it affords entertainment value all hands must produce improvement. Not only is more light needed for the image at the receiving end, and less interference, but a greater number of scanning lines than the 60 now prevailing. And one point concerning which very little mention is made is as important as any of the others: the programs must have interest. What is sent out now has experimental interest only, as a rule, and nothing more comprehensive than hip-to-shoulder views of two persons goes on the air. Why, also, should not the method of pickup be improved? The flying spot has served its purpose. It is a system of having the light travel over the subject. But direct pickup could be far superior, whereby the light is on the subject all the time, the complete picture is picked up, say, on a ground glass or equivalent and that complete picture is scanned in its changing aspects.

There should be no objection to greater detail, as made possible by more scanning lines, even if the light is not all that it should be. Lamps affording more light have come out in the last few months, also receivers have been improved, with greater power output, and methods of modulating the lamp are better. The scanning method itself has been improved, as in the mirror wheel disc invented by Peck, so that a much greater percentage of the light present is utilized. The less light there is, the greater the vice of wasting light.

Actually television is moving along, although slowly. The present advisability of anyone marketing a television receiver is, however, extremely doubtful. The field is for the experimenters but may spread into the entertainment realm any time.

In New York City, and no doubt elsewhere, much marking time is being done, until the National Broadcasting Company puts a regular scheduled program on the air, which would be simultaneous with its own fortification with receivers (probably an RCA-Victor set). As many thousands of dollars are being invested in the installation in Radio City for television transmission, it is believed that the NBC and its owners, RCA, Westinghouse Electric & Manufacturing Co. and General Electric Company, will decide to await occupancy of Radio City before embarking on commercialized television. Up to now this combination, like independents, has spent a great deal of money on television laboratory work, and is testing, testing and testing. Perhaps the opening of Radio City will be an event of double importance.

Europe is Assured On Polo's Converter

An experiment conducted by Polo Engineering Laboratories, 125 West Forty-fifth Street, New York City, in the merchandising of the DX-3, their new a-c operated short-wave converter, has proved highly successful.

Amid large claims made by nearly all manufacturers of short-wave apparatus, Polo Engineering Laboratories went one step farther, and vouched for the reception of European stations, backing this up with a five-day money-back guarantee. Some merchandising specialists warned the laboratories that such a policy was ruinous, but the Laboratories insisted that the only ruinous policy would be to make a short-wave converter that did not bring in Europe consistently.

As a result of the unqualified promise and money-back guarantee many felt that the Laboratories certainly must have something most remarkable, and an excellent sales record resulted, with not a single converter having been returned, the only letters received being ones of high commendation of results.

Using a five-tube a-c broadcast set is nothing unusual to tune in Paris, Rome, Chelmsford, Geneva, Germany, Bermuda, Hawaii, etc., as well as relay stations and amateurs from all over the United States, as was demonstrated to the full satisfaction of a representative of RADIO WORLD.

The DX-3 has its own power supply, operates from the a-c line, and has a front panel knob for band shifting. Three tubes are used.

FROM DAY-LITE-R ENTHUSIAST

I THOUGHT I would drop you a line to let you know what good results I have had with the Super Da-Lite-R (March 26th issue). I have had coast-to-coast reception and all on loudspeaker.

Havana, Cuba, comes in like a local, in fact all the distant stations come in this way.

I get coast stations and Cuba anytime after 9 p. m.

WILLIAM ANWAERTER,
306 Stockholm St.,
Brooklyn, N. Y.

STATION SPARKS

By Alice Remsen

The Heart of a Friend
FOR "FRIENDSHIP TOWN"
(WJZ, Fridays, 9:00 p.m.)

The glow of a glorious sunset,
The warmth of a campfire at night,
The depth of a pool in the forest,
The beauty of birds when in flight,
The love of a dog for his master,
Which knows not beginning nor end;
Are found, if you want them sincerely,
Combined in the heart of your friend.
—A. R.

* * *

And If You Have Forgotten the True Meaning of the word friendship, tune in on "Friendship Town," the Chesebrough program on WJZ. Let Jeff Quimby, Hank Peters and Doctor Fowler take you back in fancy to the little old town where you were born. Their homely philosophy, their sincerity and friendliness will warm your heart. You'll surely sympathize with Mary Ellen's love affair, and laugh at the wise cracks of Sooty and Boxcar. These folks in real life are Don Carney, who plays Jeff Quimby; Edwin W. Whitney, who plays the double role of Dr. Fowler and Hank Peters; Virginia Gardner, as Mary Ellen; Edith Spencer, as Abigail Quimby; Pat Padgett and Pick Malone, as Sooty and Boxcar, and Frank Luther, who owns the fine tenor voice that sings the theme song "Gee, But It's Great to Meet a Friend From Your Home Town." Each one is a fine artist and well worthy of your listening time.

* * *

The Frostilla Program, Featuring Mildred Hunt and Harry Salter's orchestra, is going off the air. But that doesn't mean that you won't hear Mildred again. She is due for more than one program this summer and deservedly so, for her style is her own and she has a great radio following.

* * *

Met Jerry Wald in Lindy's Restaurant the day he got out of a sick-bed. The lad still seemed rather rocky. He is a nice-looking youngster, just as smart as he writes, and that's saying something. He tells the truth with a vengeance. It's great to tell the truth, but it's just as great to suppress it sometimes.

* * *

Betty Bond and Arthur Behim may be heard over WOR these Thursdays at noon. Betty is Belle Baker's cousin, but she sings in her own style. Arthur Behim, as everyone knows, is an ace pianist and a good fellow into the bargain. He used to be in the music publishing business, but got wise to himself and quit. I predict he'll be well known over the airwaves in a very short time.

* * *

Heard a Very Charming Feminine Speaking Voice attributed to "Miss Daggett Ramsdell," on the Stanco Big Time program last week. The young lady didn't talk down to her audience, but told her story in an easy and natural conversational manner, making even commercial credit a pleasant thing. Hope to hear her again.

* * *

Charles R. Smith, Born in Philadelphia, but raised in Germany, has an invention which may revolutionize radio reproduction. He calls it the Phantom Orchestra and one evening last week I journeyed over to the 55th St. Auditorium and listened to this very remarkable device. From what I can gather, Mr. Smith takes the scrambled sound waves, sorts them out and sends them by themselves very neatly through their own sound channel, so that a violin really sounds like that much-abused instrument, and the listener can readily tell the difference between the sound of a tuba and a bass fiddle. If you wish the clarinets to predominate, Mr. Smith turns a gadget on his control panel and the mellow voice of a clarinet responds to his magic touch. About forty delicate filaments are tuned to reach corresponding suond waves emanating from musical instruments. A veritable godsend to true music lovers, who are compelled to gather all their music from the air. Let us hope that the powers-that-be in radio will investigate Mr. Smith's invention and use it for the dissemination of their ether-music.

* * *

WOR Has New Equipment consisting of the new dynamic microphone. J. R. Poppele, chief engineer of the station, asserts that the new instrument has an over-all frequency response characteristic from 30 to 10,000 cycles with a gradient that is entirely flat in this range—whatever that means. Anyhow, I'll be afraid to breathe anywhere near it and goodness only knows what the poor crooners will do; use a long horn, I guess, and moo into that; and I know one control man, named Miller, who chuckles with glee every time he thinks about it.

* * *

Sidelights

JAMES WALLINGTON was a brave man when he took for his wife a lady of the name of Stanislawa Elbiebeta Elbanora Buttkiewicz. . . . BURNS AND ALLEN use a screen between them and the musicians while they are broadcasting. . . . CHARLES LYON, NBC announcer in Chicago, collects dictionaries; he likes to study words. . . . JUNE PURSELL plays both golf and tennis. . . RUTH LYON'S first job was with Wayne King's orchestra. . . . ANNE SUTHERLAND is of Scotch parentage, but was born in Washington, D. C. . . . HERMAN "DODO" HUPFELD produces on the average of more than one new song every week of the year. . . . FRANK LUTHER'S great ambition is to be a cartoonist. . . . EVERETT MITCHELL'S secret longing is to be a criminal lawyer instead of a Chicago NBC mike-man. . . . THE VAGABOND TRIO has returned to the staff of Station KMOX, the Voice of St. Louis, after an absence of a year. . . . ERNIE HARE, of Billy Jones and Ernie Hare, married the beautiful Marie Flood while they were both members of Al Jolson's Winter Garden Company sixteen years ago. . . . BILLY JONES is unmarried, and insists that he got that scar on his head from an automobile accident. . . . SAM LANIN began his professional career by touring the United States with the New York Boys' Symphony Club at the age of eleven. . . . DICK ROBERTSON was born in Brooklyn. . . . SCRAPPY LAMBERT was born in New Brunswick, N. J.

* * *

Biographical Brevities
ABOUT ERNIE GOLDEN

Erine Golden, popular conductor of the Sylvanians, was born in Manchester, N. H., where he passed a part of his boyhood. At the age of eight he went before the footlights as a boy soprano, touring the Keith theatres in New England during a summer vacation and singing 16 songs a day. At the age of ten, and still in short trousers, he was playing the piano for Haye's Comedians, a medicine tent show traveling also through New England. He also played the trombone in the show's orchestra and helped to mix powdered orris root and chalk to make the wonderful "tooth powder" sold by the "doctor," and counted the peanuts that were sparsely allotted to five cent bags, and wrapped up soap.

Ernie ran away to New York at the age of 12, hoping to get a part in a road company of "Peck's Bad Boy," which was being cast at the time, but he was apprehended by the Gerry Society and sent back home, where he stayed peacefully for six years.

Then he went to Boston to study under Gustav Strube at the Boston Conservatory of Music. Shortly after that he went to the University of Minnesota to continue his musical studies under Carlyle Scott. Still later he studied in New York under Percy Grainger. During this time he organized his own orchestra and played for dances and theatrical engagements. He directed the orchestra and scored the music for the Lyric Theatre in Minneapolis when Roxy made his first bow, and later played under that showman's banner, conducting a large orchestra at the Strand Theatre, Syracuse, N. Y. He was for a long time musical director for Rock and White, and for two seasons filled the same position with the "Greenwich Village Follies," in New York and on the road.

For four years he and his orchestra played for dancing in the Grill Room of the Hotel McAlpin. This was during the ear-phoning era of radio, and he made a high reputation as one of the pioneering maestros of the air. At this time his words, "This is Ernie speaking. For the next 'numbah'—," became a familiar phrase. You have gathered by this time that Ernie Golden has done some splendid work during his rather crowded career. He is still doing it over WABC on Sundays at 7:45 p.m., directing the orchestra and announcing, and supplying ten of the "Forty Flying Fingers," a novelty piano quartet heard on this Sylvania period.

Ernie is regarded highly as a composer, and has had more than a hundred of his compositions published, including such tunes as "Wedding of Punch and Judy," "Toymaker's Dream," and "Parade of the Goops." He spends most of his time composing. He is fond of golf, hunting, fishing, and billiards, and is expert at all of them. As a golfer he is considered one of the country's best amateurs, although he has never taken time enough from his musical activities to engage in tournament play. He is married to a sweet little lady and they are seldom apart. Ernie is slender, rather pale-faced, not too tall. He has a fund of original humor, is good-natured and fond of fun, is an excellent story-teller, a fine companion, and a great entertainer at parties. A conservative dresser, and very neat about his personal appearance.

* * *

SUNDRY SUGGESTIONS FOR WEEK COMMENCING APRIL 10, 1932

April 10: Belle Baker .....WABC 9:00 p.m.
April 10: Footlight Echoes (Maria Cardinale, Alice Remsen and Jack Arthur) ..... WOR 10:30 p.m.
April 11: Lanny Ross .....WABC 7:15 p.m.
April 11: Evening in Paris (Max Smolen, Pierre Brugnon and Alice Remsen) ..... WOR 9:30 p.m.
April 12: Alice Joy .....WEAF 7:30 p.m.
April 12: The Pickens Sisters.... WJZ 10:45 p.m.
April 13: Jack and Jean ..... WOR 6:45 p.m.
April 13: Big Time. (Jack Arthur and Alice Remsen).....WEAF 8:00 p.m.
April 14: Golden Blossoms ..... WJZ 8:30 p.m.
April 14: Music That Satisfies..WABC 10:30 p.m.
April 15: Friendship Town ..... WJZ 9:00 p.m.
April 15: RKO Theatre of the Air .....WEAF 10:30 p.m.
April 16: Little Symphony ..... WOR 8:00 p.m.
April 16: Club Valspar .....WEAF 9:30 p.m.

(If you would care to know something of your favorite radio artists, drop a card to Alice Remsen, care Radio World, 145 W. 45th St., New York City.)

INTOLERANCE MARKS RADIO'S ACCEPTANCE

By BENJAMIN SOBY
Director of Sales Promotion,
Westinghouse Broadcasting Stations

The radio, one of the recent ideas which has changed our mode of living, has followed the trail of all other civilizing factors through the periods of doubt and novelty in relatively rapid strides. At first the radio was treated, by a vast majority, with indifference, as a sort of toy. It was not long, however, before the novelty of hearing voices and music, coming seemingly from nowhere, caught the fancy of more and more people. During this stage every new program was listened to with close attention. Each offering carried with it the tingle of a new experience. "Hook-ups" were the prevalent subject of conversation, getting DX was a popular pastime, yet many of the radio entertainers provided, and listened to with enthusiasm, in those days would be tuned out immediately.

That radio has reached the stage of acceptance is evident. Ever since the beginning of broadcasting, as we know it, nearly twelve years ago, there has been a constant stream of mail to the stations criticising programs and reception favorably and unfavorably. But there was not, in the earlier days, that note of intolerance which is being heard more and more today, both by mail and in conversation.

Advertising Created an Opportunity

Granted each one of us is entitled to his or her opinion, his or her likes and dislikes of this or that program, but to condemn the whole structure for everyone else, because of such individual opinion, is intolerance, to say the least.

One complaint about the radio heard today has to do with advertising. May we make it clear that what follows is no defense of those advertisers or stations who have abused the privilege afforded them to tell their story through our receiving sets to the members of our home circle. The cure for such infringement and blatancy rests with us—another station may be tuned in.

On the other hand, without the support, financially and otherwie, given to radio broadcasting by advertisers we would not have the excellent quality of programs at present available for our education and entertainment.

The competition for our attention which has developed between advertisers has done more to improve the standard of programs broadcast than any other one thing. Lacking this incentive the progress would have been greatly retarded.

Work for 10,000 Artists

It was not very long after the birth of broadcasting that advertisers welcomed the opportunity to tell to the ever increasing audience of the radio stations about their products, and what was more to the point, these advertisers were willing to pay for the privilege. Programs showed an immediate improvement. With additional funds provided, stations were able at once to pay talent not only for the advertisers programs but the sustaining features as well. As a result, artists of national and international fame were attracted to radio and, of course, better programs provided over the whole broadcasting period. Now, it is estimated more than 10,000 trained professional musicians and artists are employed daily to furnish us with our radio entertainment.

Another advantage, which can be credited to the competition between advertisers, is the type of talent employed. In the early days artists of renown were slow to accept the radio. The idea of playing, singing or speaking into a "tomato can" did not appeal. There were missing the visible audience and the gratification of applause.

$120,000,000 Spent in Year

Slowly, but surely, the more prominent artists were sold. Only recently the Metropolitan Opera Company of New York has been added to the list. Today the remotest quarters of the country are privileged to hear the greatest musicians, artists and educators of the day. Events such as football games, the Sistine Choir from the Vatican in Rome, Floyd Gibbons in Manchuria, and a host of other features too numerous to mention are part of our feast.

It is well to consider what the advertisers, heard on our receiving sets, are doing for our pleasure and edification. If such advertising did not pay these advertisers would discontinue their advertising, which proves that a very sizable portion of the total audience must like their offerings. However, we must realize that more than $120,000,000 was expended during 1931 to provide us with our radio enjoyment.

Equals $8 Tax

This means on an average $8 for each receiving set in the United States. Suppose, for example, if instead of the sponsored program broadcasting system or method we have, each receiving set was taxed a fixed amount, this would mean each radio set owned would have to pay $8 annually to have anything approaching the present quality of radio programs, and under such an arrangement it is questionable if we would have as good.

One reason is the lack of competition, already mentioned. Another is, it would remove to a great extent our right to demonstrate our likes and dislikes. For the sponsor of any program to be successful his program must be listened to by a sufficient audience to make his advertising pay its way.

Program Must Be Good to Pay Out

If enough of us decide we do not care for the entertainment offered we naturally tune it out, and at once the effectiveness of that sponsors advertising and the sales of his product are reduced to a point where the endeavor is no longer profitable. That program is discontinued and another, usually a better one, is submitted for our approval.

It is true that in the long run it is the consumer who pays, but where could we obtain as much real pleasure and cultural benefit at a cost, excluding the receiving set and its operation, of a fraction over two cents per day?

On the other hand, increased volume afforded to manufacturers by our patronage makes for better products at lower unit production cost, which in turn saves us money, adds to our comfort and happiness and makes the world a better place in which to live.

Short-Wave Claims Under Scrutiny

The Better Business Bureau is giving attention to the claims of a few manufacturers of all-wave receivers to determine whether some of the claims made are extravagant.

The Bureau states that "in a few instances claims made for the short-wave outfits have failed to take into consideration the limitations imposed by atmospheric and local conditions."

METROPOLITAN OPERA LOOMS FOR RADIO CITY

Results of broadcasting operatic performances from the Metropolitan Opera House in New York City have been so gratifying to the opera directorate that it is expected a large-scale plan of sending out opera will be inaugurated after the National Broadcasting Company moves into Radio City, now building.

At first the opera executives were doubtful whether broadcasting could be done with sufficient justice to the opera to make the reproduction worth while, but are said to have become convinced that not only were the acoustical results excellent but also the public response was keen. Therefore the opera, heretofore restricted more or less to the wealthy clientele, including leading New York families as patrons, may become a steady and growing asset to the nation.

May Show Deficit

The financial affairs of the Metropolitan Opera are such that the present season is likely to show a deficit. In line with the desire to house the opera in a more modern building, and affording an auditorium with much greater seating capacity so that revenue will increase, talk has been revived of the opera activities being transferred to Radio City also.

Owen D. Young, on behalf of the opera directorate, has reopened negotiations with John D. Rockefeller, Jr., to revive the suspended project of housing the opera in Radio City, which is a Rockefeller development.

Got $150,000 for Broadcasts

The opera executives also take into account the revenue derived from broadcasting. About $150,000 was paid by the broadcasters for the privilege of putting the opera on the air.

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.

Norbert D. Sundale, Box 1373, Weirton, W. Va.
Claude Wadsworth, 12019 Second Bvd., Highland Park, Mich.
Caryl P. Baldwin (automatic code machines for practicing the code), 402 Center St., Bangor, Maine.
Robert Crandall, 180 Clinton Ave., Brooklyn, N. Y.
J. W. Van Horn, 18550 Wood Ave., Melvindale, Mich.
Roy L. Small, 34 Lothrop, Detroit, Mich.
J. C. Penn (Radio tubes and parts), P. O. Box 185, Greenville, Miss.
Edw. N. Fox, 4514 N. Broad St., Philadelphia, Pa.
Carl M. Rowles, 111½ N. Main, Winchester, Ind.
Arthur Kussrath, 1240 W. 31st Place, Chicago, Ill.
John J. Murphy, 149 Saratoga Ave., Mechanicsville, N. Y.
Elton Hoornsta, 1015 Young St., Sault Ste. Marie, Mich.
F. B. Parker, (short wave converter parts) 630 Industry St., Pittsburgh, Penna.
Kalamazoo Electric Co. (Radio Sets and supplies, radio repairs), 1207 Forbes St., Kalamazoo, Mich.
W. B. Stevenson, 3612 So. Catalina St., Los Angeles, Calif.
Henry N. Sessions, 1528 Alta Avenue, Santa Monica, Calif.
Broadway Electric Co., 3222 E. Broadway, Long Beach, Calif.
John P. Kunz, 717 Wilmington Ave., St. Louis, Mo.

PECK EXHIBITS 5 x 6' IMAGES! LIGHT IS GOOD

A second demonstration for the benefit of members of the press and the trade was given by William Hoyt Peck at the Hotel St. Moritz, New York City, inventor of a scanning wheel with mirrored lenses embedded at angles on its periphery, for constructing a compact and inexpensive assembly.

The same principle was used as during the first demonstration, but a newly made disc was included, more accurate than the first, the result being that there were no visible line streaks in the picture and illumination was better.

Shows 5 x 6-Foot Picture

By the Peck system the picture may be brought up to any size simply by moving the screen toward or away from the disc, the limiting factors being the size of the room, the size of the screen and the amount of illumination.

A crater neon lamp of the familiar commercial variety was used, except that the spot of light was more highly concentrated.

The screen was 5x6 feet, and the picture easily covered it with good illumination. It was noted that when small pictures were exhibited some of the pinkish hue of the neon lamp was apparent, but that the larger pictures appeared black and white. The reason for this phenomenon was not understood.

As a stunt Mr. Peck threw the picture of a man's face on the wall so that from chin to forehead the image covered the height of the wall, and although hardly any one expected legibility, it was there, nevertheless. The illumination was too diffuse, however.

Peck Shows Leadership

For the 5x6-foot size Mr. Peck provided an excellent "show," the results being as good as those obtained by the Bell Telephone Laboratories in their exhibitions.

Mr. Peck focuses the spot of light on his mirrored lenses, so that the light passes through the lens to the mirrored reverse side and is reflected back directly to the screen. Since there are no holes to penetrate the light efficiency is high. In this respect Mr. Peck is in the van of television experimenters. He is an optical expert with long experience in lens manufacture and in movie work.

Mr. Peck used the transmissions of the Columbia Broadcasting System for his demonstrations, including the sound track, so there was a "show" of television talkies. A masculine trio of singers was on at one time, hip-to-head views; also a woman entertaining for the benefit of children, with songs and toys, and a woman doing an interpretative dance.

New Lamp Expected

Mr. Peck has been working with Eveready-Raytheon and with Duovac on the possibilities of improving crater lamps to meet his purpose, and it is expected that soon a new lamp of more highly concentrated spot will be announced. Also Mr. Peck has a patent application for a new method of using the crater tube.

For tests Mr. Peck has been using the t-r-f television receivers of the Shortwave and Television Corporation of Boston, of the DeForest Jenkins Radio and Television Corporation and of Insuline Corporation. The demonstration for the press was given on a Jenkins set.

The standard set was changed so that two 45 tubes were used in the output in parallel and B voltage increased.

Robot Maneuvers for Ex-Battleship

Washington.

One of the most interesting and spectacular examples of the control of direction of a moving entity is the remote control of the battleship Utah, which however is not a battleship right now, but a radio-equipped laboratory. All the armaments were dismantled according to the terms of the London Naval Treaty.

The floating naval laboratory can be controlled as to stopping, starting, backing and ahead speed, as well as to steering, laying down smoke screens and varying speeds. Another sea vessel will accommodate the control apparatus, but a plane could do so as well.

The trials are conducted in Pacific waters, and operations are from San Diego, Calif. The Utah, manned by a crew, left Norfolk Navy Yard for the robot maneuvers.

TAX OF 5% ON SETS IS VOTED

Washington.

The House of Representatives has voted to impose a five per cent. sales tax on radio sets, phonographs, and accessories, which, it is estimated, will yield a sum of $11,000,000. The section imposing the tax reads:

"There is hereby imposed on the following articles, sold by the manufacturer, producer or importer, a tax equivalent to 5 per centum of the price for which sold: Chassis, cabinets, tubes, reproducing units, power packs and phonograph mechanisms suitable for use in connection with or as part of radio sets (including in each case parts or accessories thereafter sold on or in connection therewith or with the sale thereof) and records for phonographs. A sale of any two or more of the above articles shall, for the purposes of this section, be considered a sale of each separately."

CODE OF GANGS DECIPHERED BY FEDERAL STAFF

Washington.

The growing use of outlaw radio by criminal bands, including bootleggers, drug smugglers and "importers" of aliens, is proving a difficult problem for the Federal Government. In the war on the offenders the Department of Justice's Bureau of Investigation is co-operating with the Radio Division of the Department of Commerce, which has set up a staff of decoding experts.

During the war the famous "black chamber" was established to decode radio messages sent by persons in this country to Germany direct or to aides in Germany's service located in this country or on ships on the high seas. Some of the members of the staff that worked at this task during the war are now engaged on the Department of Commerce's activities.

W. D. Terrell, chief of the Radio Division of the Department of Commerce, said that the principal decoding office is in New York City. The locations of the other offices were not revealed.

However, it was admitted that the sending of radio messages by outlaw operators for criminal purposes is carried on at a considerable scale, for in the New York district alone there were fifty such transmitters last year.

The decoding of the messages occasionally leads to the capture of at least some of the members of the gang, and it is expected that by close co-operation among the Federal agencies concerned that the use of outlaw radio can be even more greatly checked, if not totally eliminated.

Besides decoding, the Department's bureau radio is able to track down suspected transmitters.

The method used is to have one of the radio-equipped cars that look something like an ambulance scout about for the direction whence emanates a transmission that is under suspicion.

Tradiograms

By J. Murray Barron

The West Side Y. M. C. A., 5 W. 63rd St., N. Y. City have a new course in broadcast studio work, conducted by R. C. Powell, president and chief engineer of R. C. Powell & Co. Sessions are held Wednesday and Saturday morning. The course runs 16 weeks.

* * *

Harrison Radio Co. is now in its new and enlarged quarters at 142 Liberty St., N. Y. City. A television department has been installed. Motors, scanners, discs, brackets, etc., are carried in stock.

* * *

The Sun Radio Co., 64 Vesey St., New York City, has a very excellent window display, featuring meters and short-wave apparatus. There is also a display of the latest broadcast receivers.

* * *

Radio Products Corporation, 548 South Eleventh Street, Newark, N. J., which has been manufacturing components for radio tubes, is planning to go into the tube and set business. Sets to sell from $15 to $25 are under consideration, using tubes one-sixth the size of standard ones, the new tubes having been developed by Dr. Earl L. Koch. Tubes used in television, as well as televising methods, may be commercialized also, under patents of Television, Inc. Montgomery Carrott is the new president, Joseph Warren is plant superintendent, and James V. Capicoto is in charge of the tube division. Eric Palmer is directing publicity.

* * *

M. Schrater & Co., 54 Dey St., N. Y. City have been appointed the New York representatives for the Standard Transformer Corp. of Chicago. They are also the Balkite Service Station.

* * *

A. L. Rudick, formally of the Pilot Radio & Tube Corp., of Lawrence, Mass., and also of "Radio Design," announces the forming of the Radio Publishers Service, 22 West 21st St., N. Y. City., to carry all publishers' radio books for local customers and mail order. There is some literature.

* * *

Brodco Corp., 142 Liberty St., now carries a full line of replacement parts for the Brunswick radios and phonographs. Morris Brodney is in charge.

NEW STATION OPPOSED

Washington.

Examiner R. H. Hyde of the Federal Radio Commission has recommended that the application of Theodore F. Zemla, E. L. Pelletier, and Harold T. Coughlan for a new broadcasting station on the 800 kc channel at Pontiac, Mich., be denied because interference would result if this station were operated.

Forum

Wants Analyzer Circuit

I HAVE BEEN a reader of RADIO WORLD for more than two years and find it the most up-to-date and accurate publication of its kind, though at times too technical for average use.

However, I, like a great many others, am on the lookout for a comprehensive article dealing with the building of a universal set analyzer and tube tester which the average radio service man can build at the lowest possible cost and I firmly believe this article would win wide approval for two good reasons:

(1)—Because the average service man can build an analyzer of this kind at a much lower cost than that of commercial set analyzers that meet requirements.

(2)—There is always present the dyed-in-the-wool radio enthusiast who prefers to build his own equipment and make slight changes here and there to suit his own particular convenience. He would also be thoroughly familiar with the functions of his analyzer after building it.

The nearest thing you published was the wide-range laboratory meter in your January 16th issue and while it was a very ingenious idea, the price was prohibitive for the average purse in times like these, as the meter alone lists for $19, unless one could use a d-c meter with a suitable rectifier to measure a-c voltages, as most of us have d-c meters on hand.

I do not know of any publication better qualified to deal with an article of this kind than the RADIO WORLD and I will be interested to know what you think of it.

M. J. KASMARCK,
8808 Saginaw Ave., Chicago.

* * *

Imagine His Surprise!

MY SUPER-DA-LITE-R is sure the berries.

I returned home about 1 a. m. and tuned in KFI, Los Angeles, which came in like a local with minimum noise.

Then I went looking for WTMJ, Milwaukee, and found a dandy program of light classical music rendered by a band of stringed instruments with a slight accompaniment of brass.

You can imagine my surprise at the announcement when I heard: "This is KZRM, Manila, Philippine Islands, broadcasting a special DX program on fifty kilowatts power." I could not believe my ears and so stayed with it for about an hour to hear whether I had made an error. But each announcement was in the same vein, preceded by a long rigamarole of Spanish for the benefit of local listeners. This was between 4 and 5 a. m.

The program came in exceptionally well during the whole time and the atmospherics did not interfere to any great extent. A few heavy crashes of static came in but did not mess up the music.

I have logged stations in every channel from 550 to 1500 kc.

I have had programs from 800 to a thousand miles during the afternoon every day that I have used the set.

As a rule interference comes from the locals on most sets, but with the Super-Da-Lite-R my trouble comes from XER, Mexico, and CMK, Havana, as well as KFI. Early in the evening I have had XER and Havana with all locals going full blast. Also KFI, KOA, WLW, WFAA, WOAI, WMAQ, WSB, WBBM, WCCO, CKGW, WENR, WMMN, WJAX, WCHS, KNX, KEX, WHO, KRLD, KSL, WAPI, and a host of others.

ERNST WIDMER,
23 Funston Place,
Middle Village, N. Y.

Peeking into Periodicals

More Light at Receiver End Called Television Need

More light and less interference are required, whereupon it will be commercially practical to produce television sets to sell to the public for $150, and the results will be acceptable, though far from perfect, in the estimation of Dr. Paul G. Weiller.

He discusses "Television Progress from an Engineering Viewpoint" in the March issue of "Radio Engineering." Instead of looking for sensational developments, he says, television engineers should improve what they have, so that better than the present effective one-watt illumination will prevail, and also so that interference will not impair the picture. At present, he finds, the television stations do not use enough power to crush the interference, and engineers working on the problems of the receiving end are looking to the stations for more scanning lines for greater detail, without capitalizing fully what is being sent out. He finds that pinhole scanning disc with plate lamp, lens scanning disc with point source of light (creater lamp), mirror wheel with creater lamp and the cathode ray tube have produced passable results, except that mechanical difficulties have hindered the production of mirror wheels.

He says that "the road to immediate progress most certainly does not lie in the direction of more lines and more detail in the picture" since "there is no use worrying about image detail when there is not enough light to see the object, and so long as there is enough interference to destroy the detail anyway."

Providing more light is not an easy task, he says, finding that the amount of light from the cathode ray system is, however, pretty good as it is. He especially notes that saw tooth scanning is practical, by use of a neon tube oscillator, a condenser across the lamp, a resistor in series with the lamp, the d-c applied to one side of the resistor and the other side of the lamp. One criticism others have made of the cathode ray system is that it produces sinusoidal scanning, graphically shown like the representation of a radio wave, instead of producing a graph like the teeth of a saw. However, Dr. Weiller does not side with these doubters.

Comparing television to home movie projection, the doctor stresses that a 5-watt lamp is used for television. (In home projection 60 watts is the usual minimum). Then the scanning disc, in the one case, or the shutter in the other, introduce periods of darkness on the screen, and the effective illumination is greatly reduced. The 5-watt television neon lamp equals about one watt effective, he states. He cites the possibility of neon crater lamps of minute size mounted on the scanning disc in place of pinholes or lenses. Bigger output tubes in receivers are recommended.

* * *

"Volume Control" Is O.K. But "Tuning Control" Is Taboo

As is always true when a set of manufacturing standards and definitions is devised, nearly every one connected with radio suffers a few jolts on observing some of the standards. There is so much independence in the radio industry that it has been hard to have manufacturers get together on anything. But conditions are improving, and standards as proposed by the Sectional Committee on Radio, American Standards Association, do not impose any restrictions that should prove hard to follow.

Standards for vacuum tube dimensions and for broadcast receivers are published in "Year Book of the Institute of Radio Engineers." It will be found that *tuning control* will not do to describe the knob or dial you turn bring in different stations. *Selector* or *station selector* is what it should be called. "The use of the word control as applying specifically to manual tuning adjustments is not approved," says a note.

All of us who have been talking so much about vernier dials will find no encouragement in the standards. A vernier is something entirely different from a reduction ratio, and applies to the system of reading to fractions of a single division, by consulting an adjacent auxiliary scale, having nothing to do with reduction ratio. So we have, in the standards, *direct selectors*, represented by a simple knob on a shaft, the motion ratio being unity. *Close selectors* "are those in which the motion ratio between the knob, dial or other actuating means and the driven device, is greater than unity." Mind you, no verniers!

In *volume control*, however, *control* is all right, since control is actually practiced. *Local-distance switch* is all right, we are relieved to learn, but *range control* is considered preferable.

An *on-off* switch is nothing other than its name implies, but when the lever operates in an up-and-down motion, "it shall be standard to have the 'up' position for 'on.'

Also, for horizontally planed switching, "on" is to the right when you face the switch, whereas for push-pull actuation, "out" is "on."

* * *

Fever Machine's Use Grows; Doctor (of Philosophy) Tells About It

Growing use of the fever machine by doctors of medicine the world over is noted by Irving J. Saxl, Ph.D., in an article in the April issue of "Radio News." Due to the need of a localized higher temperature the machine is gaining ground, as chemical methods previously used increased the temperature of the entirely body.

The fever machine is a high frequency oscillator, and different frequencies are used by different manufacturers, from 1,000 kc up. Some European models use 10,000 kc (approximately 30 meters). Between two plates at the output the patient (or part of him) is put, so that the high frequency current passes through him.

"Fever," says the author, "is an increase in the normal body temperature, together with general functional derangement, a higher pulse rate, etc. A body with raised temperature has marked changes in metabolism; for instance, it is able to eliminate poisons, destroy bacteria and other destructive elements of the body at an increased rate. This is of tremendous importance for maintaining health. For instance, in a body infected with bacteria, the heat-regulating mechanism raises the temperature in such a way that the disease virus finds less favorable living conditions at the new temperature."

A diagram is shown for a short-wave transmitter (as the fever machine is), output in push-pull, using 504-A or 204-A tubes, about 500 watts. The device is a-c operated and has two single-sided rectifier tubes used for full wave rectification. Such a circuit is used in the French Hospital in New York, the author says.

PROGRAM SENT FROM TRAIN

As a stunt to attract attention, and also as a gauge of technical skill, a sponsor cooperated with the Columbia Broadcasting System in the broadcasting of a complete program from a speeding train. A short-wave transmitter on the train sent the program to a pickup point at Laurel, Del., for relaying to WABC key transmitter, which distributed it to a chain by land wires. The results were good. A little fading accompanied the train's travel through tunnels. The train was on the Baltimore and Ohio Railroad, Washington to New York.

Belle Baker sang, Jack Denny and his orchestra played, and Senator Clarence C. Dill, of the State of Washington, spoke.

This Opportunity Comes But Once

Special Announcement!

Cathode Ray Television Pictures are now on the air. The television art has been revolutionized with the coming of the tube which will make commercial television successful. Arthur H. Halloran, Instructor in Television for the Extension Division of the University of California, has prepared a NEW non-technical course of instruction in cathode ray television . . . written so that ANY radio man can understand every word of it. No knowledge of mathematics is required to master this NEW course. It is a correspondence course in 10 lessons. The entire course costs but ten dollars; $5.00 down and $5.00 after you have completed the fifth lesson. You get one lesson at a time. Arthur H. Halloran corrects each lesson for you. A limited number of enrollments can be accepted now. Those who enroll will be the first to learn the heretofore unexposed secrets of the new art, — first to reap the rewards which are coming.

ARTHUR H. HALLORAN

430 PACIFIC BUILDING SAN FRANCISCO, CALIFORNIA

BLUEPRINTS OF STAR CIRCUITS

8-TUBE AUTO SET

Sensitivity of 10 microvolts per meter characterizes the 8-tube auto receiver designed by J. E. Anderson, technical editor of Radio World, and therefore stations come in with only six feet of wire for aerial, and without ground. Most cars will afford greater aerial pickup, and besides the car chassis will be used as ground, so with this receiver you will get *results*. The blueprint for construction of this set covers all details, including directions for cars with negative A or positive A grounded. The circuit features are: (1) high sensitivity; (2), tunes through powerful locals and gets DX stations, 10 kc either side; (3), latest tubes, two 239 pentode r-f, two 236 screen grid, two 237 and two 238; push-pull pentodes, all of 6-volt automotive series; (4), remote tuning and volume control on steering post, plus automatic volume control due to low screen voltage on first detector; (5), running board aerial. The best car set we've published. This circuit was selected as the most highly prized after tests made on several and is an outstanding design by a recognized authority. Send for Blueprint 631, @ 50c

SHORT-WAVE CONVERTER

If you want to build a short-wave converter that costs only a very few dollars, yet gives good results, furnishing all its own power from 110 volts a-c, and uses no plug-in coils, you can do so from Blueprint 630. Price.....25c

5-TUBE AC, T-R-F

Five-tube a-c receivers, using variable mu r-f, power detector, pentode output and 280 rectifier, are not all alike by any means. Forty circuits were carefully tested and one selected as far superior to the others. This prized circuit was the 627, and if you built it, you will always be glad you followed our authentic Blueprint, No. 627. This is the best 5-tube a-c t-r-f broadcast circuit we have ever published. Price 25c

A-C ALL-WAVE SET

An all-wave set is admittedly what many persons want, and we have a circuit that gives excellent broadcast results, and is pretty good (not great) on short waves. No plug-in coils used. Cost of parts is low. Send for Blueprint, No. 628-B, @.....25c.

In preparation, an 8-tube broadcast superheterodyne for 110v d-c. Write for particulars.

RADIO WORLD, 145 West 45th Street, New York, N. Y.

Quick-Action Classified Advertisements

7c a Word — $1.00 Minimum
Cash With Order

TRANSFORMERS, (Radio Power) rewound; specials made. Supreme Radio Laboratory, Dept. W, 16 Fulton Ave., Rochester, N. Y.

THE FORD MODEL—"A" Car and Model "AA" Truck — Construction, Operation and Repair — Revised New Edition. Ford Car authority, Victor W. Page. 703 pages, 318 illustrations. Price $2.50. Radio World, 145 W. 45th St., New York.

"TALKING MOVIES," by James R. Cameron. A History of the Talking Movie since 1899, with an elementary explanation as to how the pictures are produced and reproduced. Paper cover, $1.50. Radio World, 145 W. 45th St., New York, N. Y.

"THE CHEVROLET SIX CAR AND TRUCK" (Construction—Operation—Repair) by Victor W. Page, author of "Modern Gasoline Automobile," "Ford Model A Car and AA Truck," etc., etc. 450 pages, price $2.00. Radio World, 145 W. 45th St., N. Y. City.

"1932 OFFICIAL RADIO SERVICE MANUAL," by Gernsback. Complete Directory of all 1931-1932 Radio Receivers. Full Radio Service Guide. Leatheroid binding, $4.00. Radio World, 145 W. 45th St., New York, N. Y.

"THE MODERN GASOLINE AUTOMOBILE," by Victor W. Page, M.S.A.E. New Revised and Up-to-date Edition. A whole library of information now complete in one large octavo volume of 1,146 (6 x 9) pages—1,000 engravings. Bound in flexible scarlet fabrikoid. Price $5.00. Radio World, 145 W. 45th St., New York, N. Y.

SITUATIONS WANTED

SITUATION DESIRED—28 Years of Age, single, in good physical condition; have degree of B. S. in Electrical Engineering, have some experience servicing radio and television sets and can read and speak four foreign languages. P. J. Santos, 282 Potter Avenue, West New Brighton, S. I., N. Y.

STATIONS BY FREQUENCIES

Frequency list, broadcasting stations, call, owner, location, power, wavelength. United States, Canada, Cuba, Mexico and Newfoundland. In March 26th issue Radio World. Send 15c for a copy to Radio World, 145 West 45th Street, New York, N. Y.

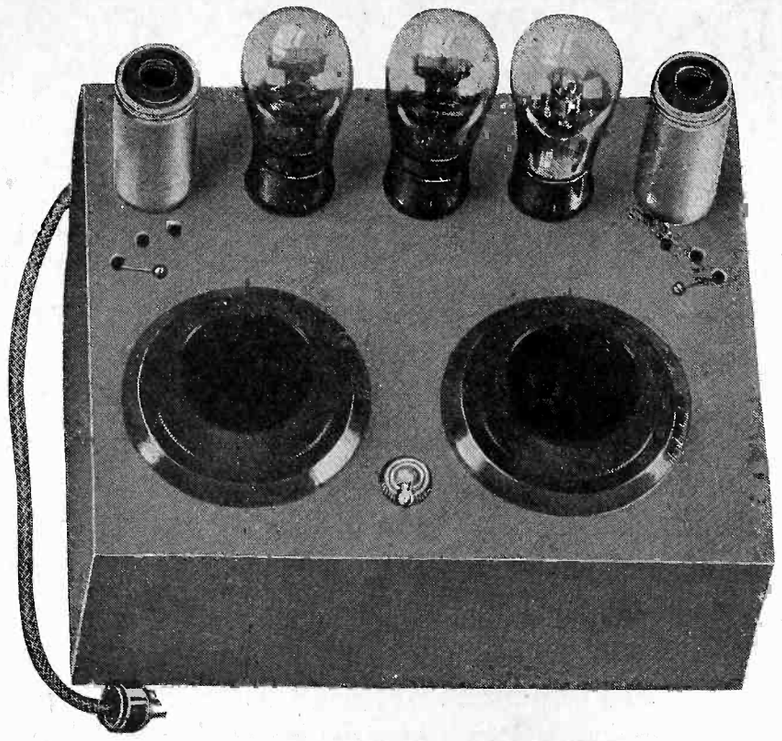
EBY antenna-ground binding post assembly for all circuits. Ground post automatically grounded on sets using metal chasses. Assemblies, 30c. each. Guaranty Radio Goods Co., 143 West 45th St., New York, N. Y.

SOLDERING IRON F R E E !

Works on 110-120 volts, AC or DC; power, 50 watts. A serviceable iron, with copper tip, 5 ft. cable and male plug. Send $1.50 for 13 weeks' subscription for Radio World and get these free! Please state if you are renewing existing subscription.

RADIO WORLD
145 West 45th St. N. Y. City

15 TO 200 METER CONVERTER



HERE at last you have it—a highly sensitive short-wave converter, 15 to 200 meters, that works on *any* set and that has its own A, B and C supply built in and that does not use plug-in coils for band shifting

Two separate tuning condensers and two dials are used, so there *can not be any possibility of sensitivity loss* due to mistuning, as where ganging prevails. Also, any intermediate frequency may be used.

The little extra effort in tuning is well repaid by thousands of miles of extra reception. Stations all over the world have been tuned in, using this converter with a good broadcast set.

There are only three connections to make in teaming up the converter with a receiver.

Two coils are used, one for oscillator, the other for modulator, and two tube sockets are near these coils, and underneath the top panel, not for tubes but so that you can move the grid connecting wire of the two condensers to any one of four points for wave shifting. Simple, effective, inexpensive, infallible!

Three 237 tubes are used. These are of the automotive series and are most economical, the total consumption, A and B power being less than 10 watts, hence costing no more than one-tenth of a cent per hour to operate!

This converter works on superheterodynes as well as on tuned radio frequency sets, because IF ANY CONVERTER IS A GOOD ONE IT IS BOUND TO WORK ON ANY TYPE OF SET.

There are 16 mfd. of filter capacity and a 15 henry B choke, in the B supply, as well as a husky line transformer.

Do not suppose just because the price of parts is low that this converter does not perform efficiently, for it is a knockout! What sensitivity! What power! What results! Send for complete parts to-day. A clear diagram is furnished with each kit. Order Cat. R-CNV.....

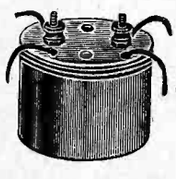
Complete Parts, Less Tubes

$7.60

TUBES USED: THREE 237.

(SEE TUBES ADVERTISED AT BOTTOM OF OPPOSITE PAGE)

INTERMEDIATE FREQUENCY TRANSFORMERS



FOR short wave superheterodyne work 1,600 kc. is the popular intermediate frequency, because you can tune to below 9 meters without interlocking of modulator and oscillator circuits, due to the high intermediate frequency. Our 1,600 kc. shielded transformers have large diameter wire, loose coupling for selectivity and stability, and Hammerlund's new superheterodyne condensers built in, accessible to a screwdriver. Both plate and grid circuits are tuned. Shield is 2⅛ inch diameter, 2⅞ inches high. For variable mu tubes. Order Cat. FF-1600 @ $1.65

Doubly tuned fixed-frequency transformer, 1 to 1 ratio, 175 kilocycles. Band pass filter characteristic. Hammarlund 20-100 mfd. equalizers across primary and secondary accessible. Aluminum shield (must be grounded) 2¼ inches diameter, 2½ inches high, removable bottom. For variable mu tubes. Order Cat. FF-175 @ .$1.50

Same as directly above, for 450 kc. Order Cat. FF-450 @.....$1.50

15 TO 200 METER SET

YOU can build a midget short wave set that will give you the acme of performance—six tubes, including variable mu radio frequency amplification, screen grid power detection, and THREE STAGES OF REGENERATED AUDIO AMPLIFICATION. Then you can bring in short waves with a wallop.

This set enables band shifting from the front panel without any further effort than turning a single knob. It is equipped also with on-and-off switch and volume control (one unit) and a rotary band selector switch of the anti-capacity and non-shorting, insulated type.

You know from your experience with short waves that you need plenty of audio amplification, and here you have it—two stages of screen grid audio and 247 pentode output! The audio amplifier is of the highest quality and is *perfectly suitable for television.*

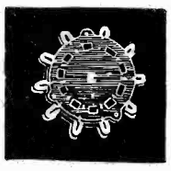
The radio frequency end affords the simplest possible method of tuning in a wide band of frequencies, so that the radio circuits are all tuned to the same frequency, and no padding or other difficulties present themselves. The circuit is tuned radio frequency.

The cabinet into which the chassis fits is one of exquisite beauty, being a two-tone walnut effect, with decorative grille for a 7 inch dynamic speaker. All parts are of the highest class, including Rola full dynamic speaker (7 inch cone). Build this set and know real short wave reception. All parts and diagram are supplied at this price, excepting tubes. Order Cat. R-S.....

$24.25

(Tubes used: three 235, one 224, one 247 and one 280. See tube prices at bottom of opposite page.)

SHORT WAVE SWITCHES



SWITCHES of special precision, positive contact, non-shorting, are needed for short waves. These rotary selector switches are suitable for moving the stator connections of tuning condensers to taps or to separate coils. Single knob actuates multiple circuits. Knob can't slip on shaft and switch can't slip on panel.

Single circuit, 4 taps and index. Cat. 4-1-SW @ **$1.05**

Two circuits, 4 taps and index for each. Cat. 4-2-SW @ **$1.87**

Three circuits, 4 taps and index for each (fewer taps may be used). Cat. 4-3-SW @ **$2.28**

These switches may be used for any purpose where single, double or triple circuits are to be worked, up to four different positions, and are suitable for all wave switching because the shafts are totally insulated. These are anti-capacity switches of the precision type.

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