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1932

STATIONS BY FREQUENCIES

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RADIO WORLD

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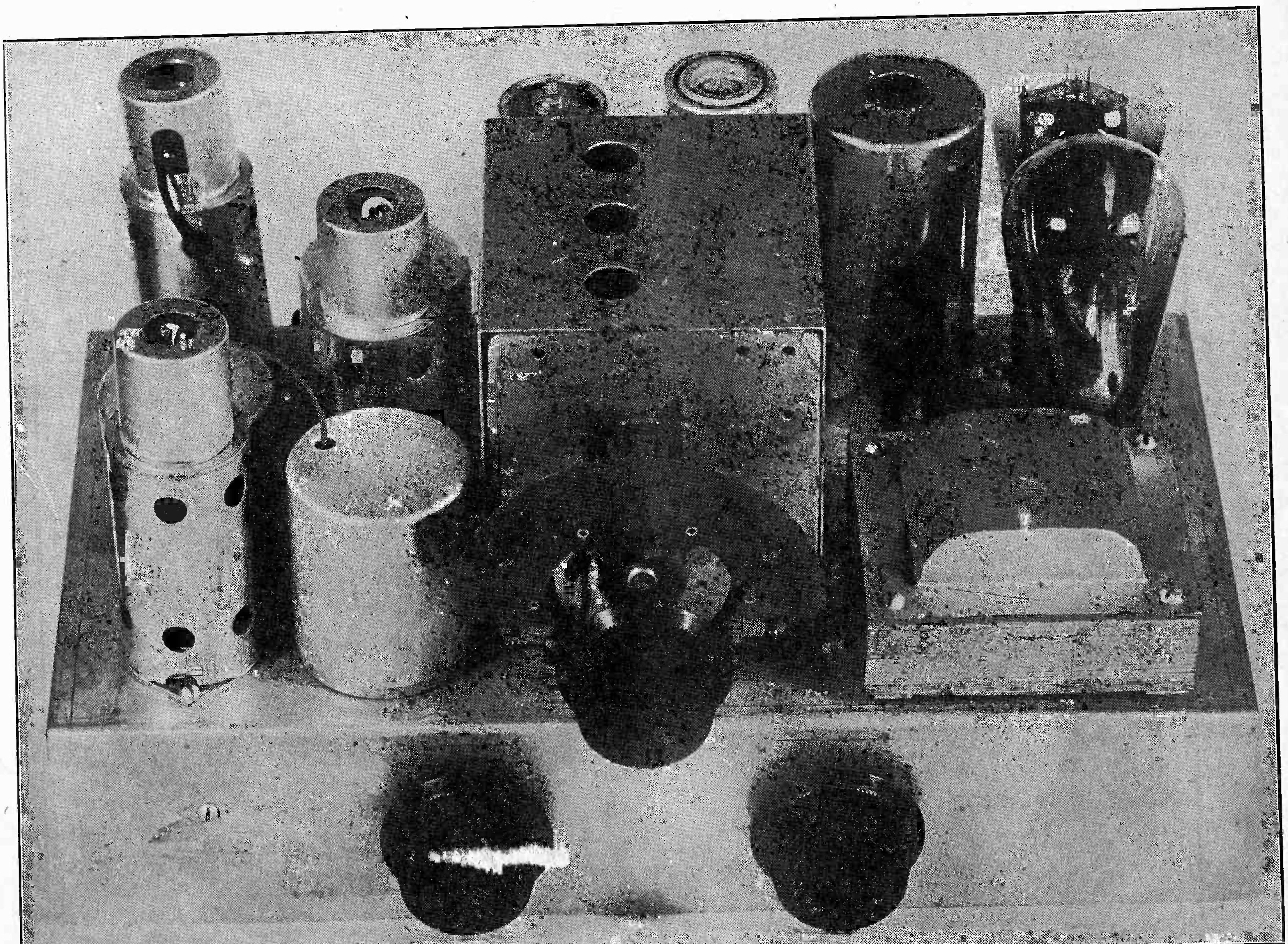
The First and Only National Radio Weekly

Eleventh Year *557th Issue*

Suggestions for 11-2500-Meter Set

Design of Intermediate Amplifiers

A-V-C IN A T-R-F RECEIVER



Quality reproduction obtained in t-r-f set with a-v-c, using 59 output tube as a triode.

—See page 3.

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RADIO WORLD

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ELEVENTH YEAR

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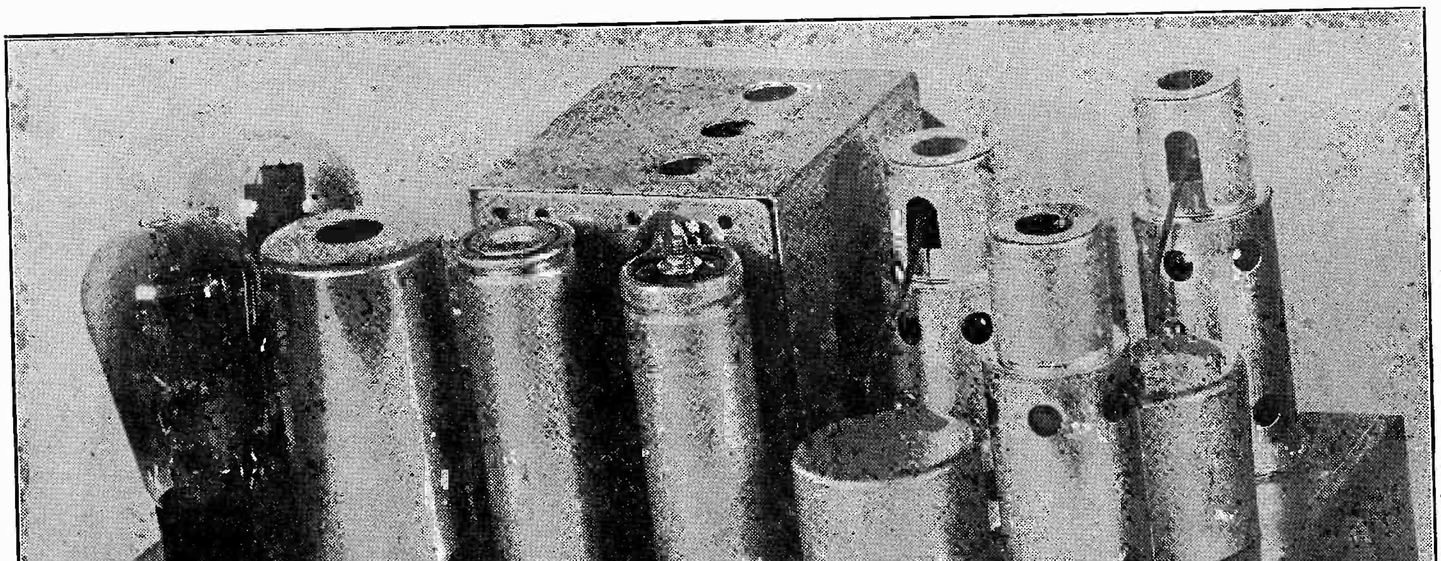
A.V.C. IN T-R-F SET

Diode Full-Wave Detection Aids Quality

By S. J. W. Enfield



FORTUNATELY radioists are not of one mind, so that some are keenest for distance reception while others are most concerned about quality. The present circuit comes under the quality classification, not being a great distance-getter because the selectivity is not high enough. When automatic volume control is included in any set the sensitivity and selectivity are less than what they would be without it. Here we make up in part for the sensitivity drop by a stage of semi-tuned r-f amplification, which also builds up the low radio frequencies so that the response at the r-f level is more nearly uniform. Usual t-r-f systems have greater amplification at the higher frequencies, but the falling off at the low r-f end sometimes causes concern, because desired stations come in too weakly.

The three tuned circuits provide enough selectivity, even with a-v-c, to make the receiver useful for local reception even in congested areas like Chicago and New

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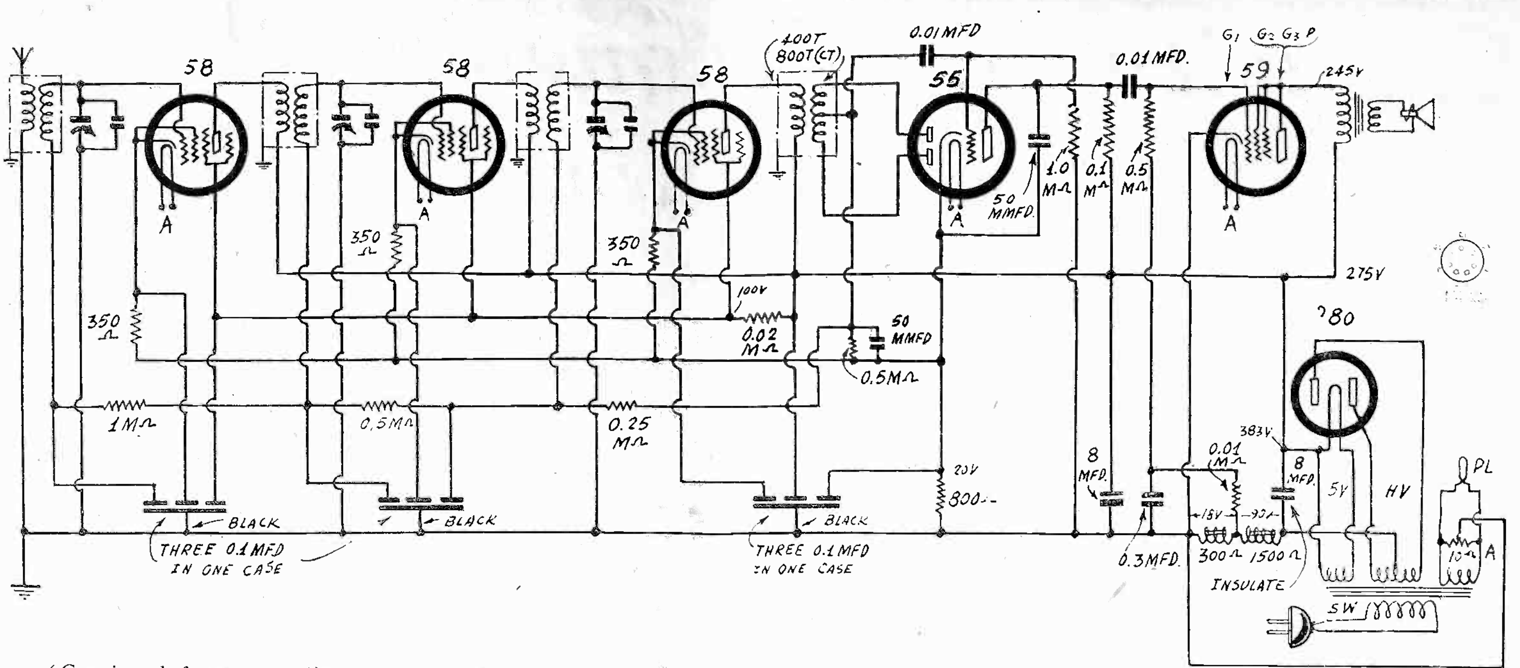


(*Continued from preceding page*)
York City, and the sensitivity is high enough to make the receiver of practical advantage in rural districts. But the strictly DX classification does not apply to this receiver. On the basis of quality, however, it approaches the utmost.

For one thing, lessened selectivity works in the direction of better quality. For another, the detector tube is of the linear type, and full-wave to boot. For another consideration the output tube is of the better quality type, being the new 59 used as a triode, that is, giving performance somewhat akin to that of the '45 tube, but of course the 59 has an independent heater. The sensitivity is less when using the tube this way than if it were used as a pentode, and no doubt some may desire the extra sensitivity, although the quality will not be quite so good, and therefore the diagram of the receiver shows a compromise that may be viewed as a contradiction until the matter is cleared up.

The 59 tube may be used in either of three ways, and the two applicable to the present circuit will be discussed.

First, it may be used as a triode. In that case the two extra grids (Nos. 2 and 3) are to be tied to the plate, and grid No. 1 used as control grid. Thus the control grid is in the same relative position, compared to the heater, as it is in the '27 and 56. The tube has a cathode in the same relative position in respect to heater as in those two tubes, also. In that case the output tube connection would be as diagramed, but the resistance apportionment of the field coil of the dynamic speaker would be 1370 and 430 ohms, the smaller resistance between ground power and power tube grid return. This is true because the negative grid bias should be higher than for pentode connection (26 volts compared to 18 volts).

Pentode Connection

If the pentode connection is to be used, then the field coil would remain as diagramed but the connections to the 59 tube would be: Grid No. 1, control grid; Grid No. 2 tied to cathode; Grid No. 3 connected to the high voltage (275 volts).

The tube ha sa seven-pin base and is the first such tube to be put out by the group of licensed tube manufacturers as a whole, and moreover the first heater type power tube to be merchandised by the tube industry at large.

The speakers required for the two different output types therefore differ as to field coil resistance apportionment, and also as to impedance of output transformer. However, both types of speakers are obtainable.

The detector follows the approved lines of full-wave rectification and a-v-c combined, it being more practical to attain both ends this way than by most other means. To prevent squealing there should be resistor-capacity filters in the grid return circuits, and these are included ,the resistance values increasing as the feedback tendency normally would increase, and thus aiding to keep the undesired voltages out of the most critical circuits.

In general, unless a special detector hookup is used, the diode-triode can not be used in t-r-f sets because of the grounded rotor. If tuned secondary is separated from the tuning condenser by the cathode-anode load resistor, then a condenser has to be across that resistor, and it is in effect a series condenser. Since this capacity must be small, the input to detector would be entirely upset as to frequency. This is because the cathode itself is not directly grounded. However, if an extra stage is used, and is devoted as here to semi-tuned r-f, using r-f choke coils of dissimilar inductance, with step-up ration of turns, then there is full freedom of choice as to anode return, and it may be made independently to the 0.5 meg. load resistor as diagramed.

Semi-Tuned Transformer

The chokes used were primary 400 turns, secondary 800 turns center-tapped. The distributed capacity across a small honeycomb coil is larger than that across a large one, and therefore the primary is broadly peaked around the lower radio frequency limit of the broadcast band. If the secondary were just the same, then there would be double-hump tuning, a severe drop in selectivity. Hence one of the resonant frequencies (that of the secondary) is placed well below the lowest broadcast frequency limit, to avoid this trouble.

Of course the diode feeds its own triode unit, thus the effect is htat of a seven-tube set, although six envelopes are used.

Some circuits in which a-v-c has been attempted have resulted in positive grids on controlled tubes at no signal. This is due to the return of the cathodes to ground, even though through a supposedly biasing resistor, because the grid return is ultimately to cathode of the 55 tube, and that is always positive, unless there is a substantial signal. Since the cathode of the 55 is positive by some 20 volts, the signal would have to exceed 20 volts before rectification in the diode would take place.

Bias Negative at No Signal

This trouble does not arise in the present receiver, of course, as each controlled tube has its independent biasing resistor, whereby at no signal there is some 3.5 volts of negative bias, despite the grid return to diode's cathode, for the biasing resistors establish the steady bias voltage difference between these very points. When a signal is picked up there is a voltage acros sthe 0.5 meg. load resistor, and this is negative in respect to cathode, at the center-tap equivalent, hence the bias is more negative, the amplification less, and volume is controlled automatically on that basis.

The grid cap at top of the 55 tube is the control grid of the amplifier or triode unit. The heater has conventional position, recognized by the larger holes for the heater prongs. The cathode and plate are conventionally disposed in respect to heater. The two remaining socket terminals, on a line with the heater, at the opposite end, are for the anodes, and go to the extremes of the secondary of the semi-tuned transformer.

No manual volume control is shown in the diagram, for one may exercise his choice in this respect. It is customary to put the control in the audio circuit, if the r-f is subject to a-v-c, and this may be done by using instead of a fixed leak in the grid circuit of the 55 triode a potentiometer of equal resistance value (1 meg., 1,000,000 ohms), with pointer to grid, other terminals respectively to stopping condenser and ground. Or, if preferred, in addition to the fixed resistor in the first r-f stage, used for bias, an extra resistor, consisting of a rheostat of around 25,000 ohms, may be used. There are other methods of volume control, too, and some may prefer one f these other methods, and therefore may introduce it into the circuit.

Television Band Width

IF A TELEVISION channel is 100 kc wide how wide should the "audio" band be for good picture reproduction? Must the lows as well as the highs be reproduced faithfully?—W. H. C., Newark, N. J.

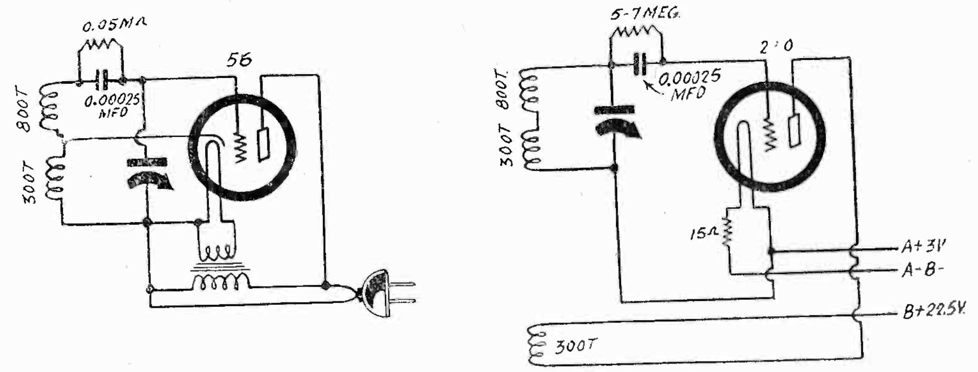
The sideband in television on a 100-kc channel is about 40 kc wide and therefore all frequencies from zero to 40 kc should be reproduced. Perhaps it is not essential that the very highest frequencies should be reproduced in full strength, but certain frequencies as low as 10 cycles per second should be reproduced. assuming that the number of frames per second is 20. These requirements are very severe and only a resistance coupled amplifier is capable of reproducing the lows. Even the highs will not come through such an amplifier unless special precautions have been taken. There must be taken in the tuner, in the detector, and in the audio amplifier. Perhaps the best way to get a wide coverage is to do away with the audio amplifier entirely and use a detector only having the required output. That is coming, undoubtedly.

Capacity and Frequency Calibration Simplified

By Herman Bernard

MANY exeprimenters would like to do their own calibrating, and the relationship of inductance, capacity and frequency can be established very easily. The inductance is known in advance, as an oscillator is built containing two inexpensive r-f choke coils, used for tuning, and if these are 800 and 300 turns respectively, then the inductance is about 11.5 millihenries. The two coils then are separated 2.5 inches, but the inductance may be increased somewhat by putting the coils closer together.

The first thing to do is to build the oscillator, which may be of the a-c or the battery-operated types illustrated. In both instances modulation is supplied. The a-c model uses the line frequency for modulation while the battery model uses the frequency resulting from grid blocking, which is a high-pitched note.



The a-c operated modulated oscillator is diagrammed at left, the battery model modulated oscillator at right.

Extreme Frequencies

In the a-c oscillator, built with laboratory type dial for gaining highest possibility of accuracy of reading, to pass on this accuracy to the constructors themselves, a calibrated condenser was used, and the capacity values have been put down on the curve. The maximum capacity was 375 mmfd. and the lowest capacity calibrated was 25 mmfd. The highest frequency calibrated, at this same point of 5 on the dial, was 237.5 kc. The highest capacity calibrated was the condenser's maximum of 375 mmfd., and the equivalent frequency was 81.4 kc.

The particular dial used could be read accurately to one part in 1000, or to tenths of a division, as 100-division scale was used. Actually the sweep of the condenser accounts for 101 divisions, and the dial was set at 101 for full capacity, then the calibration made on the basis of 100 being maximum, because there was only a tiny change in capacity at this end and low frequencies were represented. While the change in capacity also is small at the other end, the requency is nearly three times as high. Hence, to put it differently, zero setting of the dial denoted the smallest capacity of the condenser (plates entirely disengaged).

Double Purpose of Arrows

The capacity curve therefore holds good for any condenser you use, provided that the maximum capacity is not greater than 375 mmfd. (0.000375 mfd.) If the oscillator is built with the specified honeycomb coils, and a commercially rated condenser of 0.00035 mfd. used, with coils positioned as illustrated, and condenser trimmer set so that 220 kc. is registered at or very near to 5 on the dial, the rest of the capacity values may be read from the curve.

At the left upright (ordinate) of the curve are written the capacity values in mmfd., at the right-hand side of the upright (ordinate) are written the frequencies, while on the lower horizontal (abscissa) are the dial settings. The curves are identified as "frequency curve" and "capacity curve" and the arrows at the end of the lettering point not only to the curves themselves but also in the direction you should cast your eye to pick up the frequency or capacity values.

The frequency calibration was done as follows:

The inductance of the coils being known to a close approximation, the frequency to be reached was estimated by computing the frequency of maximum capacity across 10 millihenries, which was around 100 kc. So the actual frequency, because of the higher inductance, would be somewhat lower.

Broadcasting stations were used for calibration, on the basis of beats with various harmonics of the oscillator. The high frequency end was easily attended to by using the third harmonic of the test oscillator for beating with the fundamental of WEAF (660 kc). The fourth harmonic of 165 kc, the fifth of 132 kc, the sixth of

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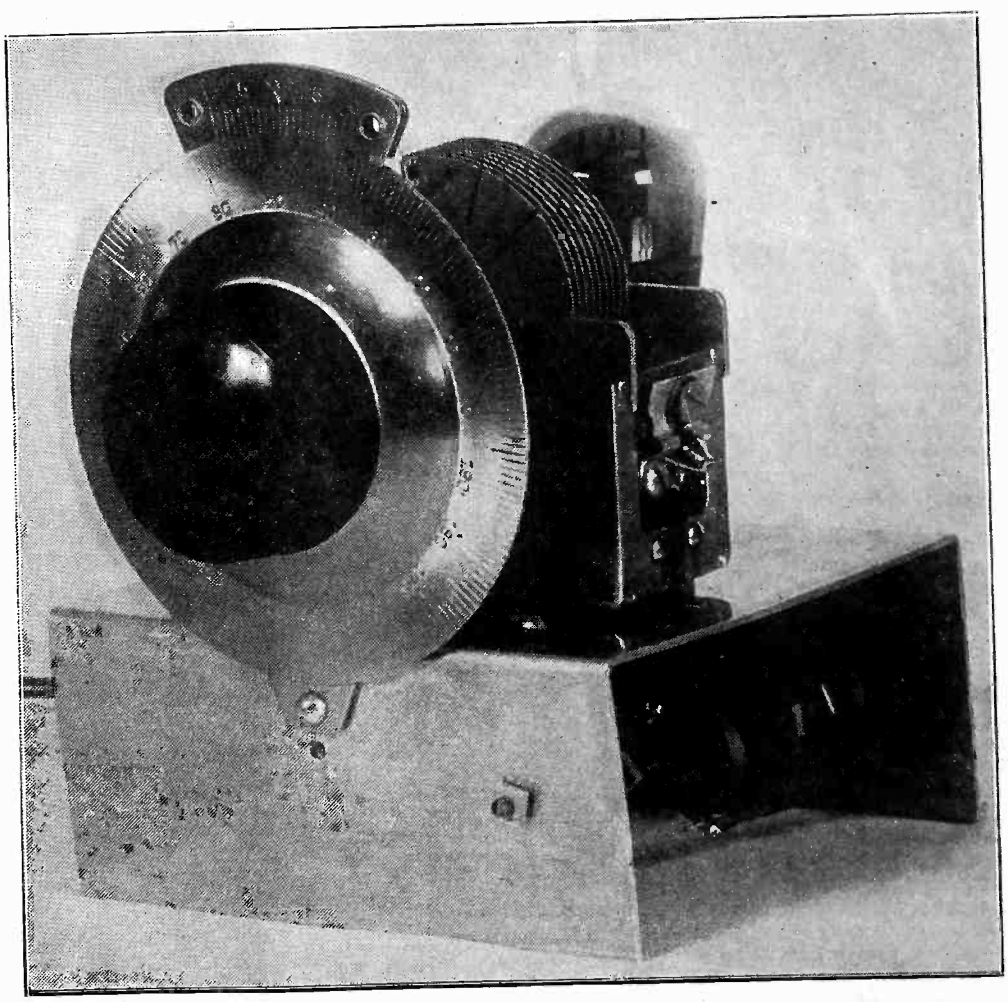
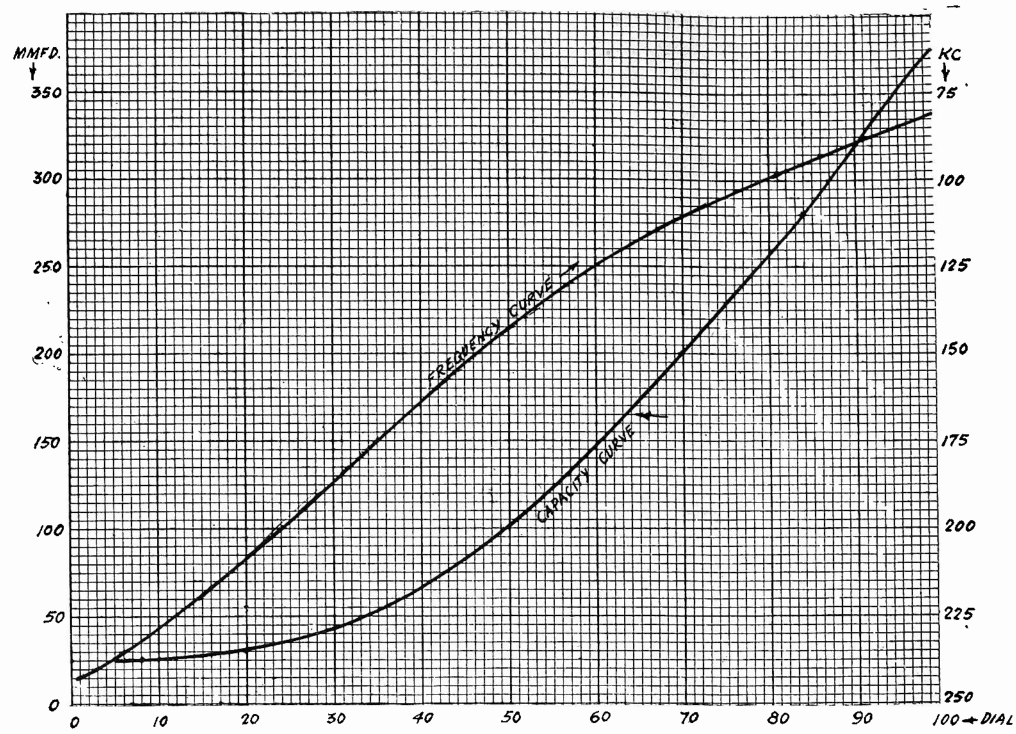


Model a-c oscillator built for running the curves illustrated. The a-c oscillator as intended for construction by readers, is on a wooden panel, in a wooden box.



Calibration curves, frequencies against dial settings, and capacities against dial settings. The capacity values are for the condenser alone.

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110 kc, the seventh of 94.43 kc and the eighth of 82.5 kc were beaten with WEAF's 660 kc to get other dial points.

Check-up of Calibration

The calibration was checked at 95 kc, of the test oscillator, whereby WMCA (570 kc) and WJZ (760 kc), both produced a squeal, when the set into which these station signals were fed was tuned from one station to the other with the test oscillator remaining at 95 kc. This was a good check-up because the two stations represent different harmonics of the same fundamental of the oscillator, that is, 570 kc (WMCA) is the fifth harmonic of 95 kc, and 760 kc (WJZ) is the eighth harmonic of 95 kc. Another check was made at 190 kc of the test oscillator, with its third harmonic beating with WMCA's 570 kc, and then the receiver dial turned to 760 kc (WJZ), with test oscillator unmolested, when another squeal was picked up, i.e., the fourth harmonic of 190 kc of the test oscillator beating with 760 kc (WJZ).

There were thus enough points to produce the curve. Also the notation could be made now of intermediate frequencies, using the test oscillator's fundamentals from around 81 kc to 235 kc. All the other intermediate frequencies could be obtained by using the test oscillator's second harmonic, that is, multiplying the frequency of the fundamental by two.

Coupling by Radiation

The a-c model illustrated was built on a special aluminum chassis, and the laboratory dial affixed for purposes already stated, although it is not necessary to use such a dial. In fact, the general form of the oscillator as available for construction is the wooden box model, which meets all requirements. The oscillator is built on a wooden panel and placed in a wooden box. While an output binding post is shown, all that need be connected to it is a piece of wire that has the other end made into a few turns and placed somewhere underneath the socket containing the 56 tube. That is simply an extra assurance of adequate coupling, but in no instance so far has there been found any necessity for such additional coupling, because the intensity of the oscillator is strong enough to provide coupling by ordinary radiation. However, for intermediate frequency tests many like to use an output post, and then would run a wire from post to plate of a modulator or intermediate tube for lining up the intermediates.

It so happens that the frequency curve as shown does not come out just right for utilizing a particular harmonic of the test oscillator's various frequencies to beat with all the broadcast frequencies in rotation, as the lowest frequency of the broadcast band thus reached would be 570 kc, and 550 kc or a little lower is desired. However, the inductance of the coil system may be increased a little, so there is ample opportunity to lower the frequency curve in its entirety. Simply tune in 550, 560 or 570 kc on the broadcast band, set the test oscillator going, and move the coils closer together than shown, using dowel sticks or pencils, and retune so that the beat is established at a dial position guaranteeing that the seventh harmonic will strike the lowest broadcast frequency.

Capacity Curve

The object of the capacity curve is to enable calibration of any condenser you put into the circuit. If another oscillator is set up, using the same type of coils, similarly coupled, then any unknown capacity placed from grid to grid return (across the total windings), if within the range of 25 to 375 mmfd., may be measured by beating with the dialled test oscillator.

The two coils should be connected in series aiding, as the other method (series opposing) drops the inductance considerably, and the frequency curve printed herewith would be of no particular value. To connect in series aiding see that the coils are on a long machine screw or other support run through the coil dowels, and that the beginnings of the coils face in the same direction (not face each other). Thus the same rule would automatically apply to the ends. Mere inspection of the coils, to see the exterior terminal of the winding, and also the interior terminal's emergence, solves the problem of beginning and end. Then connect the beginning of the larger coil to grid condenser, the end of the larger coil to beginning of the smaller coil, and end of the smaller coil to grid return.

The diagram below shows the coils the opposite way, so that for this system beginning of one connects to end of other for series aiding.

Recapitulation

To restate some of the considerations, therefore, the object is to build a test oscillator, either a-c operated or battery-operated, to calibrate it as to its fundamental frequencies, to use the fundamentals and second harmonics thereof for intermediate frequencies of superheterodynes, and the seventh harmonics for the band of broadcasting frequencies. The extreme frequencies required for this broadcast band coverage are 78.57 kc and 214.28 kc. Since the frequency ratio actually prevailing is 2.88, if the low frequency adjustment is made at 100 on the dial, for 78 kc, the desired high frequency end will be 224.6 kc, about 10 kc excess, which is very substantial at such a low frequency, proving that the ratio is abundant.

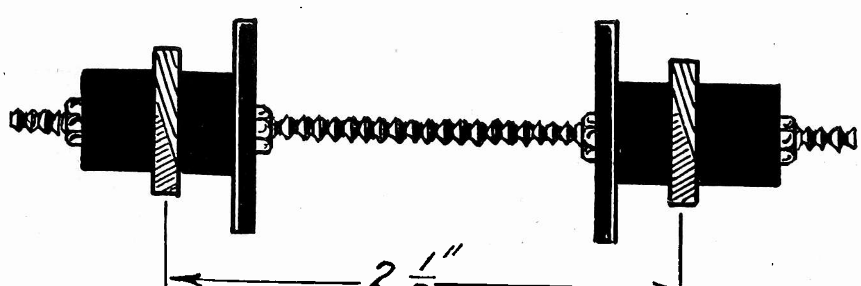
The actual total minimum capacity of the circuit is 45 mmfd., because of the distributed capacity of the coil, the capacity of the wiring and the tube's elemental capacity, but the capacity curve shown is that of a tuning condenser you put into the circuit, for frequencies stated, and this calibration should be made with the coils positioned 2½" apart, and before any corrective is applied for lowering slightly the lowest frequency of response. This, by the way, makes all the dial settings account for lower frequencies, but knowing that the curve shown is approximately the same as the one that will obtain, the recalibration may be made easily, using broadcasting stations as standards. Only those stations in the low frequency spectrum will be useful.

A THOUGHT FOR THE WEEK

THE ASCAP (otherwise the American Society of Composers, Authors and Publishers) is after them again. Its officials have informed the members of the American Hotel Men's Association that Court of a Western State, this decision they will have to pay to the ASCAP one dollar a year for each loud-speaker installed in hotel rooms wherever a master-controlled radio has been installed.

This one dollar per room is based on a claim for royalty, which claim has been passed upon formally by the Supreme being based on the idea that installations of master-controlled radios are made by hotel proprietors for profit.

Thus does radio continue to add to the income of the ASCAP, even though it is accused of making a song over night and then killing it almost as fast.



How the coils are arranged. The inductance increases as the coils are moved closer together.

Capacity Measurement with an A-C Milliammeter

WE HAVE already explained how the capacity of a condenser can be measured with an a-c voltmeter when the line voltage is 10 volts and the frequency is 60 cycles per second. But there are many other voltages and frequencies. Moreover, sometimes it is desired to measure with an a-c milliammeter. Let us see what can be done about a formula that is general.

Let us start with an a-c milliammeter having a range from zero to 1 milliamperes. Let the voltage available be E volts and let the frequency be f cycles per second, w radians per second.

If we set up a circuit containing the voltage source, the condenser to be measured, a resistance R, and the milliammeter, all in series. Then we have $E=I\ (R^2+1/C^2w^2)^{\frac{1}{2}}$, which states simply that the current flowing in the circuit, multiplied by the impedance is equal to the voltage applied. That is Ohm's law as applied to alternating current. If we are to make the best use of the meter R should be selected so that the meter reads full scale when the capacity is infinite, that is, when the condenser is short circuited. If we choose such a value of the resistance we have $E=I_0R$, in which I_0 is the maximum reading on the meter used. Eliminating E we obtain $RI_0=I(R^2+1/C^2w^2)^{\frac{1}{2}}$. Squaring both sides of the equation we get $(R^2I_0{}^2=I^2(R^2+1/C^2w^2)^{\frac{1}{2}}$. Solving for C we obtain $C=I/wR\ (I_0{}^2-I^2)^{\frac{1}{2}}$. Since R was determined in terms of the line voltage and the maximum current readable on the meter we can rewrite the formula as follows: $C=I/wE\ (1-I^2/I_0{}^2)^{\frac{1}{2}}$, in which C is given in farads when E is measured in volts. I and I_0 in amperes, and w in radians per second. For any given line w and E are constant and for any meter I_0 is constant. It must be remembered that the resistance R in series with the meter is determined by $R=E/I_0$.

Using this relation we can put the formula into still another simple form. It is $C=(I/I_0)/wR(1-I^2/I_0{}^2)^{\frac{1}{2}}$. I/I_0 is the relative deflection of the meter and if the scale ends in 1, 10, or some other integral of 10, the relative deflection is also the actual deflection. If the scale is divided in any other way we have to compute the current ratio.

Let us suppose that the scale is divided decimally. Then we can let $I/I_0=D$, the deflection. The formula becomes $C=D/wR\ (1-D^2)^{\frac{1}{2}}$. It is worth while to select a meter with a scale divided decimally, not only because the formula takes on a simpler form but because it makes reading easier.

Looking at this simplified formula we might suspect that something is wrong in view of the fact that it is the same no matter what the range of the meter and what the voltage used are. Again we must remember that the value of R takes care of this. We have to select an R that fits the voltage and the meter.

Let us now get down to a specific case in respect to the meter. Let us say we have a 0-1 m.h. a-c milliammeter. Also let us suppose that we have a voltage of 230 volts. R must be 230/0.001, or 230,000 ohms. The formula becomes $C=4.35D/w(1-D^2)^{\frac{1}{2}}$, where C is now measured in microfarads. Now let us take the case where the frequency is 50 cycles per second. Then $w=2\pi f=100\pi$. Putting this into the formula and simplifying we get $C=0.01385D/(1-D^2)^{\frac{1}{2}}$, C being measured in microfarads. From this formula we can construct a calibration curve for the case when the range of the a-c milliammeter is O-1, the line voltage is 230 volts, and the frequency is 50 cycles per second.

Suppose we connect this meter in series with an unknown condenser and find that the deflection is 0.5. What is the capacity of the condenser? The radical is 0.866. Hence C=0.008 mfd. Again, if the deflection is 0.25, the capacity turns out to be 0.00358 mfd. The smallest deflection that can be read accurately is about 0.05. With this value of D we obtain a capacity of about 0.00069 mfd. The largest deflection is full scale, but this represents an infinite capacity. Accurate values of large capacities cannot be measured. Let us see what it is when the deflection is 0.9. We get a value of 0.0286 mfd. for C. Thus the range may be said to be from 0.00069 to 0.0286 mfd.

If we are to measure larger capacities we have to use a meter having a greater current range or a lower voltage, in series with the circuit.

DX Corner

By J. Murray Barron

In compiling your DX records you will find it far more satisfactory to have actual verifications from broadcasting stations, for then there can be very little doubt as to your reception of a distant or difficult station. There are countless DX-ers who have actual records that anyone would be proud of, and who pull in the hard ones repeatedly, yet have never or very rarely sought a verification.

Fans who have good lists of verified reception are invited especially to send along the data so that cub DX-ers and others may enjoy the benefits. If you get a real thrill fishing for and actually landing that seldom-heard or hard-to-get station, you'll likewise enjoy reading of the accomplishments of others. With this thought in mind just kindly remember that others feel the same way, hence we must have correspondence from all the fans.

Never mind if you have never written to publication before. If your reception has not been exceptional, there must be some trick or knowledge in radio you have found helpful, so pass that along, or maybe you seek information regarding certain conditions that you would like to overcome. This column aims not only to give DX records and news, but to be helpful in assisting interested fans by publishing the ideas and experiences of others, and in this way help iron out the kinks so that all may enjoy the pleasure of DX-ing.

There have been a number of requests for battery circuits. Of course there are large numbers still using battery sets, in fact in a recent issue of RADIO WORLD an item was published to the effect that there are more than two dozen manufacturers now turning out two-volt jobs, but just how interested the fan is in building a battery job we'd like to know. It might be well for those interested to send along their request and if there is a real interest we will take care of you.

Besides the logging of DX, fans will find the dialing for 100-watters quite as thrilling, and some have a considerable list. We are now getting some of the accomplishments in order for early printing. To quote a few approvals from scattered points: Jos. H. Stephenson, 140 N. Butler St., Madison, Wis., writes: "I am interested in DX-ing and think a DX column in RADIO WORLD would be quite the proper thing.."

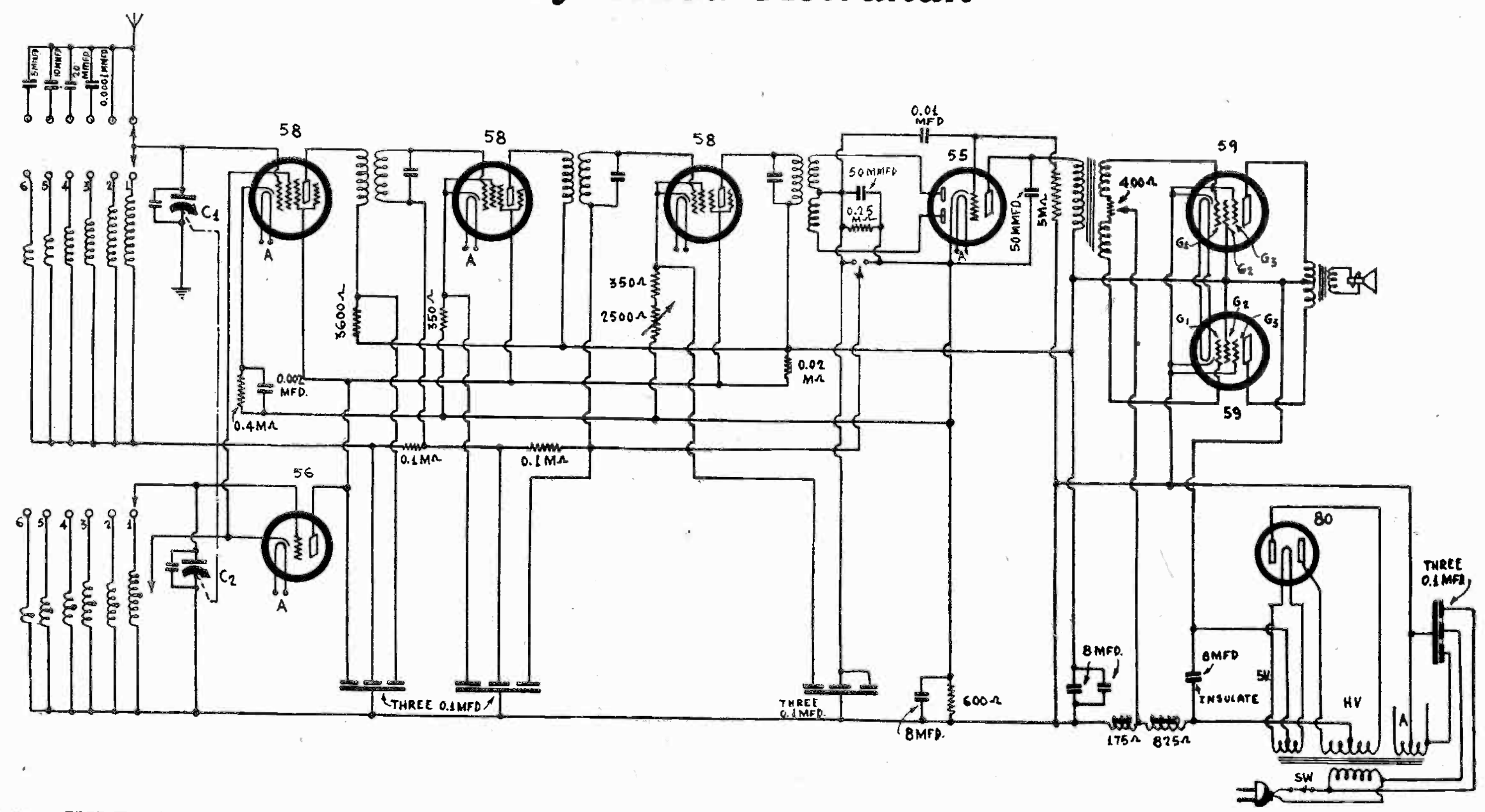
T. J. Johnson, Bowlegs Okla., says: "By all means let's have a DX page. DX-ing is my one and only hobby, and I for one would surely like to see you have this feature incorporated in your already fine magazine."

From Los Angeles, Calif., W. B. Stevenson, of 3612 So. Cataline Street, writes: "By all means let's have a DX column."

W. E. Smith, Oak Forest, Ill., member of Official Radio Service Men's Association, Inc., sends in his vote for a DX column and writes his approval while listening to a DX programme received at 3.12 a. m. His set he writes "is an 8-tube 100-volt d-c super of my own construction, with Mr. Anderson's assistance."

A Scheme for Covering from 11 to 2500 Meters

By Hood Astrakan



WHILE there is a considerable demand for a receiver that covers a wide band of frequencies, without plug-in coils, there are admittedly several serious problems, and in fact there is hardly a set on the market that reaches even a level of respectable performance and yet covers even a few bands of switching.

With this less than glowing introduction the subject is brought up of building a receiver with a still greater frequency span, nothing less than 11 to 2500 meters.

Such a problem naturally invites the experimenter, and with a view toward aiding him in trying to achieve results some suggestive data will be given.

What Intermediate Frequency?

First we must consider whether the receiver is to be a superheterodyne or a tuned radio frequency set. If it is to be a super we may rely on two manually tuned circuits,—modulator and oscillator. If it is to be a t-r-f set, then we would require three tuned circuits for the broadcast band and lower radio frequencies, perhaps cutting out an r-f stage for short-wave use, because of stability difficulties. Since six coils are used for each tuned circuit, if we have three such circuits we need fifteen coils. Also we desire some stability of selectivity, so we are persuaded again to select the superheterodyne.

Given the mixer circuit, we then have two stages of intermediate frequency amplification, 55 detector-amplifier-automatic volume control tube, a stage of resistance audio derived from the 55 triode unit and a push-pull output, using the new 59 tubes as Class A pentodes. The total tubes are eight.

Next after the general circuit selection we must decide on the intermediate frequency. We do not want a frequency within the band that is to be tuned in, so anything from around 30,000 to 90 kc is ruled out, except that we may select a frequency at the lower limit and not actually use the set for tuning that low, as the receiver, as a super, would be inoperative say at 120 kc or so, but the highest wavelength limit is 2500 meters, and we have no requirement for going any higher.

So we may select an intermediate frequency of 90 kc, and that requires that the first, second and third bands be padded, as to oscillator, the third band being the one for broadcast coverage, and the apportionment so selected that one switch setting accounts for the entirety of that band. The bands are identified by ascending numerical order.

As has been stated, the theoretical lower limit of tuning with the two-gang condenser is 90 kc, and on that basis the inductances have been figured out.

Frequency Ranges

The frequency ranges are as follows:

Modulator kc	*Oscillator* kc
90-250	180-340
209-600	299-690
530-1520	620-1610
1500-4300	1500-4300
4200-11800	4200-11800
11000-31000	11000-31000

It can be seen that the difference frequency is accounted for in the three bands for which padding is done, but that the higher frequencies of the oscillator are cited as the same as those of the modulator. One of the advantages of a low intermediate frequency is that there is no necessity for padding on short waves, as the difference between the two circuits should be only 90 kc, and that is such a small percentage of the signal or oscillator frequencies that not only is it not possible to pad for the difference but the modulator selectivity is not great enough to exclude frequencies even farther from the resonant frequency than 90 kc.

Highest selectivity in superheterodynes is obtained when the intermediate frequency is lowest, and therefore at 90 we have a degree of selectivity in the intermediate channel that helps atone for the diminishing selective effect of the modulator tuning in the short-wave bands.

For the three short-wave bands the coils are of the same inductance for both modulator and oscillator circuits, but the oscillator windings are center-tapped. For the three lower frequency bands the coils are different.

By using 1 inch diameter much space is gained, and the coils may be wound on that form for the short-wave and broadcast bands, total of four bands, the form being about 4.5 inches long. This is easily practical because the wire for the broadcast and first short-wave band is No. 30 enamel, and while No. 18 enamel is used for the higher frequencies, only few turns are required, e.g., 12 and 3.5 respectively.

Honeycombs for Lower Frequencies

So, too, compactness is served by using honeycomb coils for the frequencies lower than the broadcast band. Commercial honeycomb coils of about 1 inch average outside diameter may be used to advantage. The inductance requirements are different for the two circuits, as stated, e.g., for the lowest frequency band 8000 and 4800 microhenries respectively, for the next band 1400 and 1300 microhenries, respectively.

Those who wind their own small honeycomb coils of this type (for which a special machine is required) may do so on the basis of 715 turns for the 8000 microhenry inductance, 555 turns center-tapped for the 4800 microhenry inductance. Since the two inductances for the second band are so nearly alike, 1400 and 1300 microhenries, one coil may have 350 turns and the other coil 300 turns.

Coupling Variants

It is obvious that the broadcast inductances are nearly alike, too, in fact more nearly so than the others, but as we have no difficulty in winding such coils we are prepared to establish even minor inductance differences. So, using No. 30 enamel wire, we wind a secondary of 142 turns for the modulator and 130 turns (center-tapped) for the oscillator. The comparataively large difference in the number of turns here, despite small difference in inductance, is due to the shape factor, for as the coil length becomes greater the proportionate increase in inductance becomes less.

There is no need to shield the honeycomb coils, although they should be so positioned that there is very little, if any, inductive coupling. Some will be present, of course, but the main coupling is expected from the tying of the modulator suppressor grid to the cathode of the oscillator. This is a very special electron coupling system and is one that takes into some account the difference in coupling required in different bands.

The difference is respected also in the antenna circuit, where a very long aerial—the longest and highest you can erect—is fed uninterrupted to the grid of the modulator for the lowest and second lowest frequency bands. Then for the broadcast coil a series condenser of 0.0001 mfd. is used, and thereafter smaller capacities, from 20 mmfd. down. These may be equalizing condensers for the broadcast and first short-wave band, one set at 100 mmfd., (maximum) the other at 20 mmfd. (minimum), whereas the still smaller capacities may be made by twisting a few inches of insulated wire together, using one side as one plate and the other side as the other plate of the tiny condenser thus formed.

The padding is not at all difficult, due to the low intermediate frequency, with the possible exception of the lowest frequency band, but an easy way to get pretty good results is to use a 0.00025 mfd. fixed condenser for this padding purpose, although theoretically Cp1 calls for 260 mmfd. (0.00026 mfd.) Of course a small equalizer may be put across the 0.00025 mfd. to add the extra 10 mmfd. or so, although the main consideration really is that the padding condenser be fairly close to 0.00025 mfd., as the value of commercial fixed condensers of that or any other rating is not close enough. The condenser capacity may be checked up, however, by a method to be explained.

The Intermediate Amplifier

The theoretical value for the next band is 770 mmfd. padding condenser, easily made up to a close approximation by 0.00025 mfd. and 0.0005 mfd. fixed capacities in parallel, or use of a 700-1000 mmfd. adjustable padding condenser. Again the values of the fixed condensers should be near the rating, but that may be determined by the promised method of testing.

The final padding capacity, for the broadcast band, should be 1920 mmfd. (0.0019 mfd.), theoretically, but of course 0.002 mfd. commercial values will suffice, if anywhere near their rating. The 10 per cent. commercial tolerance, plus or minus, would make no serious difference.

Therefore, once the mixer coils are prepared, the next consideration is the intermediate channel. For inductances honeycomb commercial coils of 1600 turns may be used, or two 800 turns in series, especially the series method for feeding the detector.

May Use Commercial Coils

Only the secondaries are tuned, except at detector input, where the primary is tuned because of the better facility for adjusting the condenser, otherwise in a high potential circuit. The condenser across these two secondaries and the one primary may be a 20-1000 mmfd. equalizer.

Moreover, it is possible to obtain shielded intermediate transformers commercially, for around 90 kc, which used to be a popular intermediate frequency in the earlier days of kit supers, for instance the Victoreen and the Magnaformer.

MODULATOR CIRCUIT
C1 = 50 — 410 mmfd.

Coil No.	*Microhenries*	*Winding Data*	*Frequencies kc*
1	8000	715-turn honeycomb coil, No. 38 enamel	90-250
2	1400	300-turn honeycomb coil, No. 38 enamel	209-600
3	250	143 turns No. 30 enamel on 1" diam.	530-1520
4	29	30 turns No. 30 enamel on 1 inch diam.	1500-4300
5	4	12 turns No. 18 enamel on 1 inch diameter.	4200-11800
6	0.5	3.5 turns No. 18 enamel on 1 inch diam.	11000-31000

OSCILLATOR CIRCUIT
C1 = 50 — 410 mmfd.

Coil No.	*Microhenries*	*Winding Data*	*Frequencies kc*	*Padding*
1	4800	555 turns No. 38 enamel; center-tapped honeycomb	180-340	260 mmfd.
2	1300	288-turns No. 38 enamel; center-tapped honeycomb	299-690	770 mmfd.
3	230	130 turns No. 30 enamel center-tapped on 1" diam.	620-1610	1920 mmfd.
4	29	30 turns of No. 30 enamel center-tapped, 1" diam.	1500-4300	——
5	4	12 turns No. 18 enamel, center-tapped, 1" diam.	4200-11800	——
6	0.5	3.5 turns No. 18 enamel, center-tapped, 1" diam.	11000-31000	——

The coils wound on the 1 inch diameter tubing, for broadcast and short-wave bands, may be separated by ¼ inch, and enclosed in a shield. The honeycomb coils for the mixer need not be shielded, and may be placed underneath the chassis.

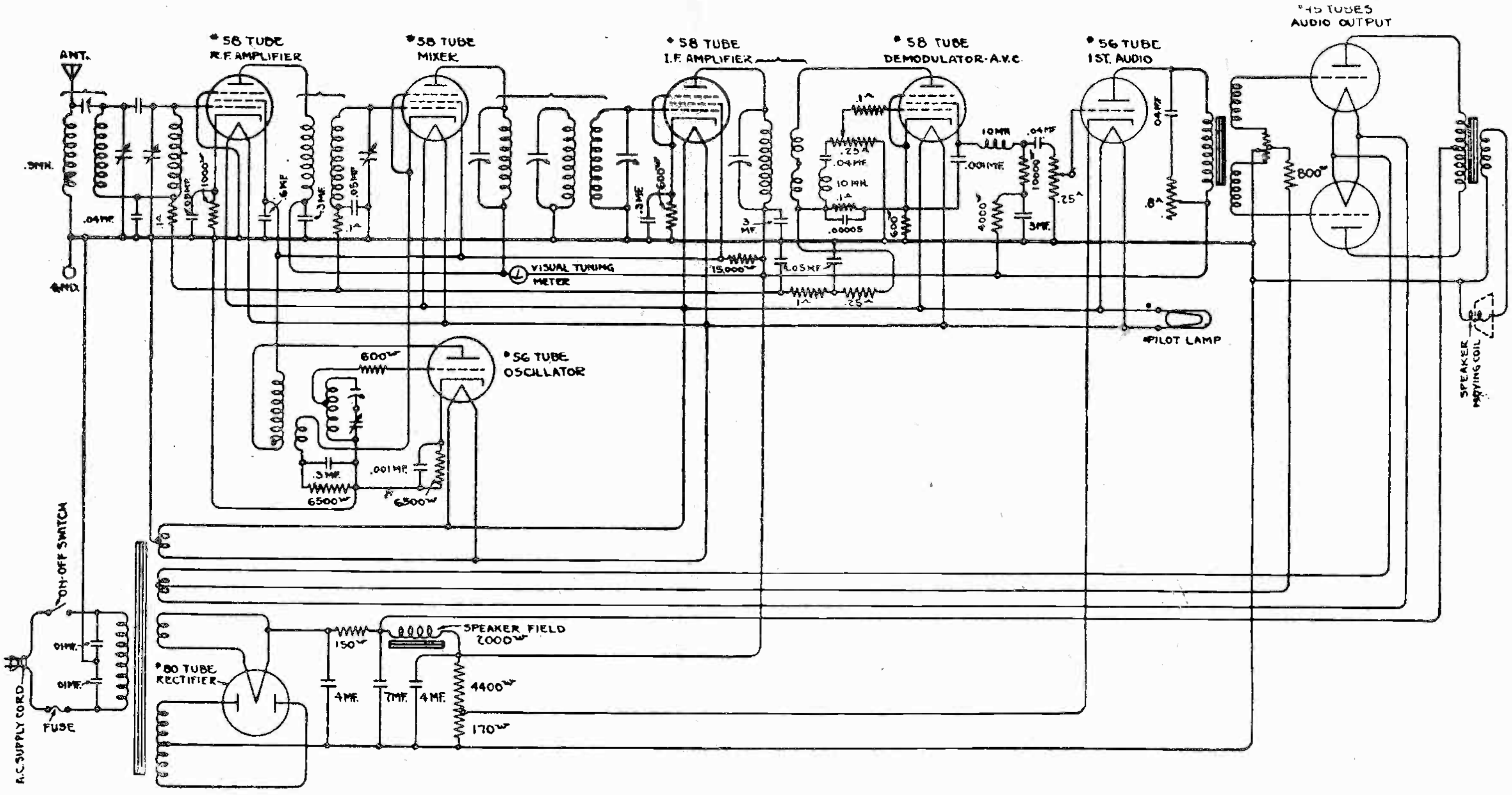
Do Dial Divisions Test Selectivity?

I RECENTLY constructed a receiver that was very selective and sensitive. Then I concluded to install an automatic volume control. I was disappointed to find that the selectivity disappeared. What is the cause of this? Is there no way of using an automatic volume control and still retain selectivity?—S. G., New Haven, Conn.

Are you sure that the selectivity was decreased? Are you not judging by the number of degrees on the dial that a station can be heard? Suppose you have a given selectivity. When you are on the peak of the selectivity curve you get the strength of signal required. As you detune in either direction of that signal decreases, but at the same time the a.v.c. makes the set more sensitive, and therefore the signal remains at nearly full strength. You cannot judge the actual selectivity by the usual method of detuning the dial. That is the reason visual tuning indicators are used in sets equipped with a.v.c. Without a visual tuning indicator you cannot tell when you are on the tip of the tuning curve because of the apparent lack of selectivity. Tune in a weak station and note whether the strong locals interefere. If they do, the set is not selective enough in the first place and the a.v.c. did not make it so.

THE TUNING METER

Its Necessity in A-V-C Circuits



The Model 37 uses this circuit, the picture diagram of which is on the opposite page. Since automatic volume control is used, a tuning meter is included.

[*The latest Stromberg-Carlson circuits were diagramed and discussed in last week'c issue, as part of the weekly series of articles on commercial receivers. They were the models* 37, 38, 39, 40 *and* 41, *representing two circuits, one for the* 37, *the other is the rest. The picture diagram of the* 37 *wiring was not printed last week, but is shown this week, on the opposite page.*—EDITORS.]

IN nearly all first-class superheterodynes incorporating automatic volume control, like this Stromberg-Carlson, a visual tuning meter is used to indicate exact resonance. This is necessary because the effect of the automatic volume control tends to make the set appear broad so that it is difficult to tell where exact resonance occurs by the sound alone. The visual tuning device works on the principle that the plate current in the controlled tubes is minimum when the signal is strongest, which occurs only at exact resonance. In this circuit the radio frequency amplifier and the mixer are controlled by the automatic voltage from the a.v.c. and therefore the visual tuning indicator is put in the common plate leads to these tubes. When the signal is strongest the automatic volume control voltage is greatest and therefore the bias on the two tubes is also greatest and therefore the plate current is least. Hence the deflection on the meter is least.

Effecting Balance

A refinement is noted in the input circuit of the output stage. Between the two halves of the secondary is a potentiometer with its slider connected to ground. In the common lead, that is, the lead to the center of the filament transformer is an 800 ohm bias resistance. It will be noticed that as the slider is moved the bias resistance can be increased in one side or the other. As the slider is set in the drawing a part of the potentiometer resistance is added to the bias resistance of the lower tube.

The object of this arrangement is to effect closer balance. Ordinarily one tube is slightly stronger than the other and if this tube be biased more than the other the tubes become more nearly alike as far as the operating characteristics are concerned.

Several devices are used to prevent the carrier component in the detector from entering the audio amplifier. At first we have a 10 millihenry choke coil in series with the stopping condenser between the demodulator control grid and the top of the rectifier load resistance. This prevents radio frequency current from flowing through the 0.25 megohm potentiometer grid leak, and hence from reaching the grid. In case any current of appreciable magnitude should reach the grid a 0.001 mfd. condenser between the plate (in this case the screen grid) and the cathode shunts them to the cathode. But that is not all, for there is another 10 m.h. choke in the plate circuit. By the time we get to the tone control in the plate circuit of the 56 amplifier there is little for it to do.

There are two band-pass filters in the receiver. One is in the radio frequency tuner between the antenna and the first tube and the second is in the intermediate amplifier between the mixer and the intermediate amplifier. The band-pass tuners are more selective than the others. It is noteworthy that these filters are at the respective inputs. The first filter excludes signals not wanted at the very beginning. The second does the same thing in respect to the intermediate amplifier. This is important from the point of view of cross modulation. There can be no cross modulation products if one of the components entering into the cross modulation is excluded.

It will be noticed that the power tube plate current is subjected to the filtration of 11 mfd. of capacity, but that this current is not passed through the B supply choke coil. This method is particularly suitable when the output stage is push-pull, due to the symmetrical nature of such a circuit, which in a sense is of itself a sort of filter. However, it should be remembered, too, that 17 mfd. capacity provide no mean order of filtration for an output stage, even without a choke.

Excellent Filtration

For the other tubes, however, the choke is in the circuit and also 4 mfd. more capacity. Thus there is an abundance of capacity in the circuit, and every precaution has been taken to keep the hum below the tolerance level of general factory standards.

So that the full voltage of the rectifier output will not be applied to the power tubes the 150-ohm resistor is used for dropping the excess.

DIAGRAMS

of Commercial Receivers

Read RADIO WORLD weekly and follow the authoritative, detailed discussions of the technical aspects of latest receivers, invaluable for information on radio today and in augmenting knowledge necessary for proper service work. Diagrams and text are authentic and unusually complete. The following circuits have been printed recently:

Philco Model 15 Superheterodyne, October 29th issue.

Sparton Model 28 Superheterodyne, November 5th issue.

Majestic Model 320 Superheterodyne, (employed in Model 324 receivers), November 12th issue.

Stromberg-Carlson Models 38, 39, 40 and 41 Superheterodyne Receivers, November 19th issue.

Stromberg-Carlson Model 37 Superheterodyne Receiver, November 19th and 26th issues.

Pilot Dragon Superheterodyne (18 to 555 meters), November 19th issue.

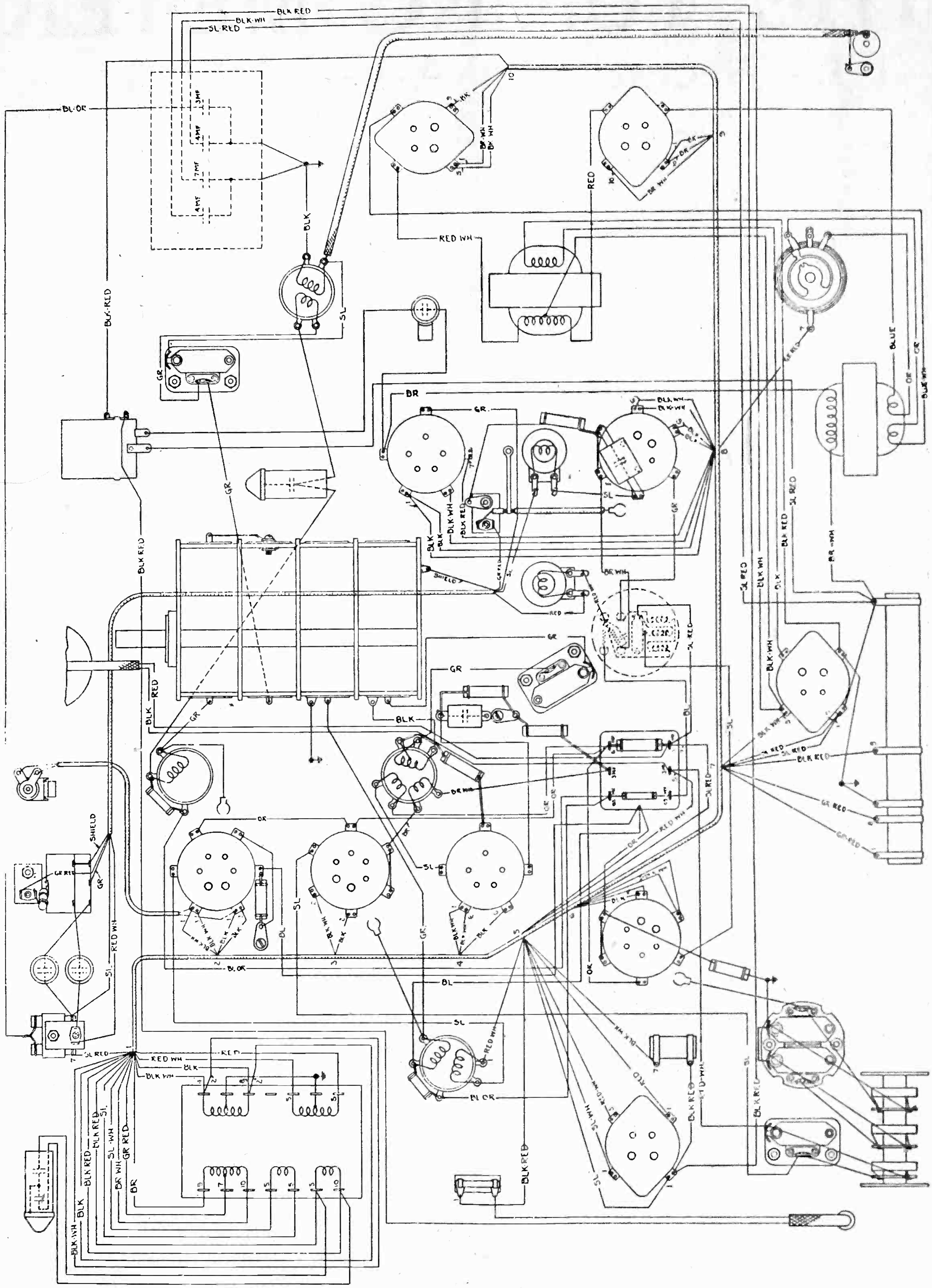


Fig. 2. Wiring Diagram of No. 37 Receiver Chassis.

IMAGE IN

And Intermedia

By J.

[*This is one of a weekly series of articles on the superheterodyne by J. E. Anderson, technical editor of* RADIO WORLD, *an authority on the subject.*—EDITOR.]

IT was stated that the point of inflection of the tracking curve, that is, the point where the curvature changes direction, should fall below the zero line by a small amount. The encircled point in Fig. 3 is that point, and it falls just a little below the zero line. It will be noted, however, that at 750 kc the deviation is greater than it is at 1,250 kc. A slight improvement, therefore, could have been made in the tracking if F_1 had been chosen slightly below 1,000 kc rather than exactly 1,000 kc. The point of inflection would then have been closer to the zero line and the curve would have been more nearly symmetrical. The difference is so slight, however, that it was not considered worth while to select a lower value for F_1 in view of the simplicity of computation with 1,000 kc.

We mentioned the possibility of finding the frequency at which the point of inflection occurs. The point may be found as soon as C_m and C_s have been found, for the relation determining it is $C = C_m [1 + (4 + 3C_s/C_m)^{1/2}]$. The frequency is obtained from C thus determined and from the inductance Lo in the radio frequency circuit. Sometimes the relation is useful in estimating the closeness of the tracking.

As an example of the application of this formula let us take the case plotted in Fig. 3. The value of C_m is 7.98 mmfd. and that of C_s is 410.4 mmfd. Therefore $3C_m/C_s$ is 154.4 and the quantity under the radical is 158.4, the square root of which is 12.6. The coefficient of C_m is 13.6, and therefore C = 108.5 mmfd. Putting this in the frequency formula together with Lo = 245 microhenries, we obtain F = 975 kc, which is 25 kc less than the value of F_1. If it had come out larger than F_1 it would have been desirable to assume a smaller value for F_1 and redetermine L, C_m, and C_s. This formula is applicable only to Case II.

The main object of making the computation of the three quantities is to find the correct value of L, the inductance in the oscillator. C_m and C_s are found experimentally while adjusting the circuit. However, it is necessary to know the approximate value of C_s in order to choose a condenser that is adjustable to the correct value.

Case II. Applied to Long Waves

Before passing to the next case let us apply Case II. to a long wave superheterodyne. Let Fo = 172 kc, F_1 = 284 kc, and F_2 = 411.5 kc. Also let f = 115 kc. Putting these values in equation (3) and solving for C_m we obtain $C_m = 0.02849Co$, and putting this C_m together with the frequency ratios in equation (4) we obtain $C_s = 1.433Co$. Now equation (5) gives us L = 0.59976Lo. Lo is the inductance in the long wave tuner and Co is the value of C in either the oscillator or the long wave tuner at the signal frequency 172 kc.

In order to obtain the actual values of C_m, C_s, and L we must know Lo. Let us assume that it is 3,010 microhenries. Then the frequency formula gives us Co = 284 mmfd. Therefore we have C_m = 8.09 mmfd., C_s = 407 mmfd., and L = 1,805 microhenries.

The data were used in computing a tracking curve over the long wave tuning range from 155 to 433 kc and it is reproduced in Fig. 4. Again it will be noticed that the maximum deviation is about one per cent. of the intermediate frequency. At 155 kc the deviation is 1.22 kc, which is just over one per cent. At 215 kc the deviation is about 1.07 kc, at 355 kc it is 0.95 kc, and at 435 it is 1.1 kc. At the three tie-down frequencies selected the intermediate frequency is just 115 kc so that in this case the computation was accurate.

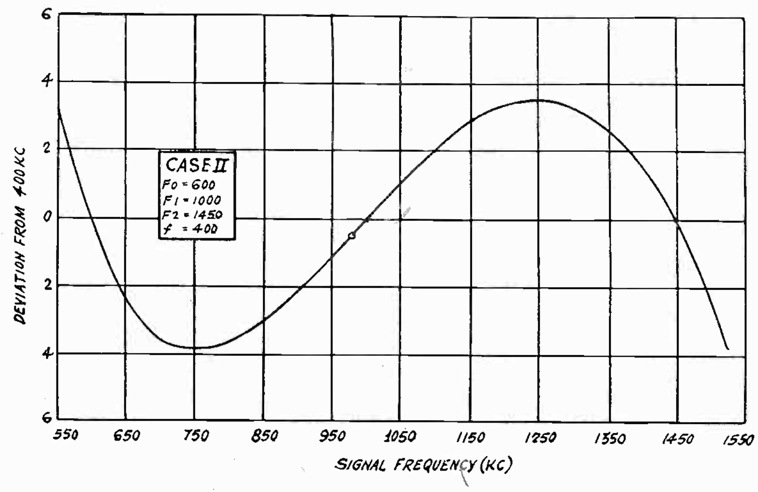


FIG. 3 (CASE II.)

This is a tracking curve of a super in which the oscillator trimmer condenser is across the variable condenser only. The conditions are specified on the graph. The maximum deviation from perfect tracking is less than 4 kc.

The encircled point, as before, is the point of inflection of the curve, and it falls at 278 kc, which is just below F_1. As in the preceding case a slight improvement could have been effected by choosing a slightly lower frequency for F_1, for that would have made the deviation at 215 kc less and that at 355 kc greater. But if the tracking can be made in an actual case as close as that represented by the curve in Fig. 4, nothing more could be desired.

Intermediate Channel

The intermediate, or fixed, frequency amplifier in a superheterodyne is responsive to the frequency to which it has been tuned regardless of the source of that frequency. Sometimes it happens that the intermediate frequency is equal to a signal frequency, when the circuit will receive the signal unless the receiver has been carefully shielded from it. In most cases when the intermediate tuner is adjusted it is supplied with a suitable frequency from a local laboratory oscillator and the circuit is tuned to that frequency.

Normally, the signal of intermediate frequency is produced by the heterodyning of two different frequencies, one of which is the signal frequency desired and the other of which is the frequency of the oscillator. When the two different frequencies are impressed on a device in which detection occurs the output of that device contains a component of a frequency equal to the difference between the two impressed frequencies. To receive the signal it is only necessary to vary the difference frequency until it is equal to the frequency to which the intermediate amplifier has been tuned, or else to tune the intermediate amplifier to the difference frequency. In the ordinary superheterodyne the difference frequency is varied until it is equal to the resonant frequency of the intermediate amplifier, and the variation is done by varying the oscillator frequency.

The strength of the intermediate f quency component is proportional to strength of the signal frequency and to oscillator frequency impressed on the tector, or it is proportional to the prod of the two heterodyning components. Th is also a constant of proportionality, wh may be regarded as the coefficient of tecting efficiency. The greater this efficient the stronger will be the signal the intermediate amplifier.

Constant Strength

The strength of the oscillator compon is practically constant, or it should be a well designed superheterodyne. strength of the signal component var with the strength of the signal as it exi at the antenna, with the amplification tween the antenna and the first detector, mixer, as it is called, and also with tuning of the radio frequency amplifier.

It will be remembered that the int mediate amplifier is responsive to any sig having a frequency equal to the frequen to which the intermediate amplifier has be tuned, regardless of the source of t signal. This fact gives rise to much terference in a superheterodyne. We h already pointed out that an external sig might cause interference if it happens have the right frequency. However, this easily avoided by shielding. But there other sources of interference that are so easily avoided. One of the most ann ing causes of interference is the fact t the intermediate frequency can be produ both when the oscillator is higher than signal frequency by a certain amount a when it is lower by the same amount. Su pose we wish to receive a signal frequen F with a superheterodyne in which the termediate channel is tuned to a frequency Then the proper intermediate frequen will be produced both when the oscillat is adjusted to F+f and when it is adjus to F—f. When the tuning condenser free from the radio frequency condens so that it can be adjusted independently is possible to receive the same signal b

ERFERENCE

Amplifier Design

Anderson

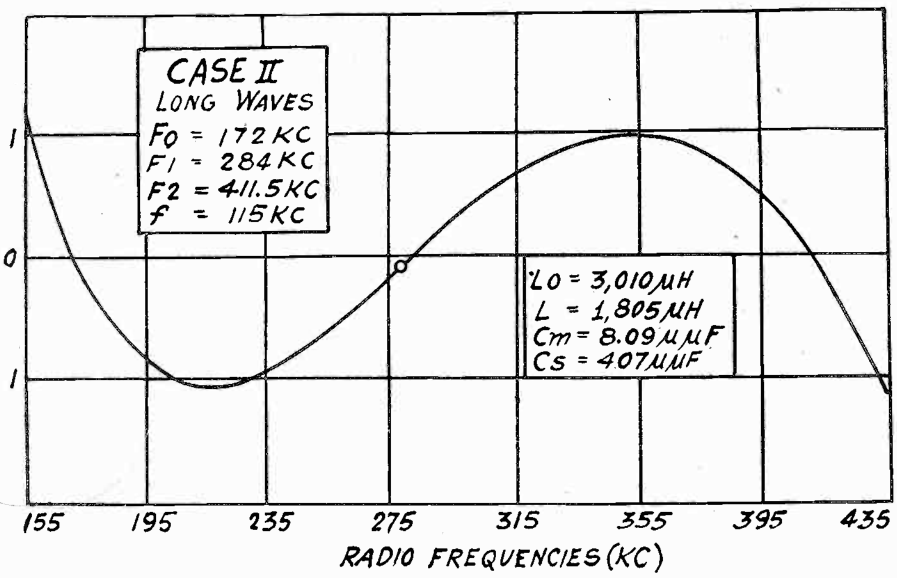


FIG. 4 (CASE II.)

is is a tracking curve over the 155-435 kc. band obtained by the method of Case II.

when the oscillator is set at F+f and at F—f. It is believed by many that one of these settings of the condenser represents a harmonic of some frequency and that this supposed harmonic can be avoided by some mysterious trick in design. It is not due to a harmonic and it cannot entirely be avoided. It can only be concealed. Both settings of the oscillator are normal and both will exist in all superheterodynes.

Two Normal Settings

The type of interference usually called image interference is caused by the fact that there are two normal settings of the oscillator at which a given signal can be received. Suppose, for example, that we have a superheterodyne in which the intermediate tuner is adjusted to f kilocycles. If we wish to receive a signal of frequency F with this superheterodyne we can set the oscillator at either F+f or at F—f. Suppose, now, that there is another signal frequency F+2f. This can be received by setting the oscillator at either F+3f or at F+f. Hence we can receive both the signal F and the signal F+2f by setting the oscillator at F+f. Therefore if both F and F+2f are present at the detector both signals will come through the intermediate amplifier when the oscillator is set at F+f. Strong squealing will in general result. This type of interference will always result when there are two signal frequencies present that differ by 2f kilocycles and when the oscillator is set half way between them.

Sometimes it is possible to avoid the interference, but not often in a congested band of frequencies. Suppose, for example, that we wish to receive the signal F and that we find interference with a signal F+2f when the oscillator is set at F+f. We can then try to receive F by setting the oscillator at F—f. If there is no signal on F—2f, F can be received without interference. But the chance that F—2f is unoccupied is small, yet it may be that the signal on this frequency is so weak that the resulting interference is tolerable.

In the so-called "one-spot" superheterodynes, to which class nearly all present superheterodynes belong, the circuit is so designed that a given signal can be received on only one of the oscillator settings, usually the higher frequency. That is, if the signal desired is F, the oscillator is set at F+f, and there is no provision for selecting F—f. This limitation on the oscillator does not remove image interference, but only removes the possibility of receiving a clear signal on the lower oscillator setting. To some extent it conceals the image interference and gives the impression that there is an abnormal oscillation present in the set.

The advantage gained by coupling the oscillator and the radio frequency condensers so that only one oscillator setting can be selected for each signal frequency is so great that the doubtful advantage of receiving clear signals on the lower oscillator setting is negligible. There are other methods of minimizing image interference.

Since the signal frequency that causes image interference is always 2f removed from the desired signal, there is no great difficulty in making the radio frequency tuner so selective that the strength of the interfering signal at the detector is negligibly small. It is a matter of discriminating between two frequencies one of which is F and the other F+2f. If we tune the radio frequency circuit to F the signal F+2f should be reduced in strength so much that even when it is mixed with a strong oscillator signal the product will be negligible. It is clear that the larger f is, the easier it will be with a given tuner to suppress F+2f adequately. Suppose for example that f is 175 kc and that we wish to receive a signal of 1000 kc. The signal causing image interference would therefore be 1350 kc. The radio frequency tuner is then called on to suppress 1350 kc and receive 1000 kc. It does not require a very selective circuit to suppress a signal 350 kc removed from the desired signal in a tuned radio frequency receiver, but in a superheterodyne a much greater selectivity is required. The reason for this is that the oscillator multiplies the interference that reaches the mixer, and it may multiply the interference more than the desired signal.

If the intermediate frequency is still higher, say 450 kc, it becomes still easier to suppress the interference, for in this case the interference will be 900 kc removed from the desired signal.

Minimizing Images

It is possible to select an intermediate frequency so high that most of the possible interfering signals are off the range of the radio tuner. At first thought it would seem that this would entirely remove the possibility of image interference. But we must not forget that there are signals outside the broadcast band as well as in it. It does not have to be a broadcast signal to cause image interference. It is easy to determine what the intermediate frequency should be in order that the lowest interfering frequency should be just above the broadcast band. Let the lowest broadcast frequency be 540 kc and let the highest be 1,500 kc. Then 540+2f=1,500, or f=480 kc. The intermediate frequency, therefore, should be 480 kc or more. As was stated above, using such a frequency does not insure against image interference.

There is an infinite number of oscillator frequencies that will give rise to a frequency f that will go through the intermediate amplifier. If F_o is the oscillator frequency and n a whole number representing harmonics and if F_r is the signal frequency and m a whole number representing harmonics, then the conditions for the production of a frequency f are $nF_o—mF_r=f$ and $mF_r—nF_o=f$. The only conditions placed on n and m are that they be integers. The normal combination in most superheterodynes is $nF_o—mF_r=f$ when $n=m=1$. When n and m are large the harmonics are weak and the resulting intermediate frequency signals are weak. Only those combinations in which $m=1$ will give rise to clear signals for when higher harmonics of F_r are involved the detected audio components will be harmonics of the original audio signal frequencies. Any combination involving $nF_o—F_r=f$ or $F_r—nF_o=f$ will give rise to clear signals if they are strong enough, for no component in the original signal is multiplied by an integer. Even though the signals produced by some of the various combinations are not clear, they will cause interference in the form of heterodyning and growling, if they are strong enough.

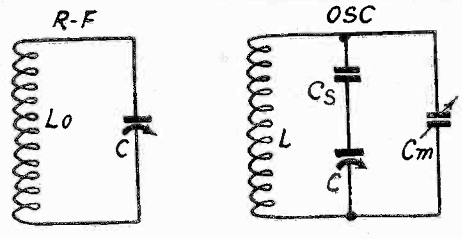
Second Harmonic Super

In the so-called second harmonic superheterodyne the combinations $nF_o—F_r=f$ and $F_r—nF_o=f$ are used, n normally being 2. Suppose f=90 kc and F_r=600 kc. What should F_o be? The first formula gives F_o=345 kc and the second gives F_o=225 kc. These are the two normal settings of the oscillator on a second harmonic superheterodyne for a signal frequency of 600 kc when the intermediate frequency is 90 kc.

The second harmonic superheterodyne brings in the same signal at a large number of places on the oscillator. Why this is so is clearly shown by the two formulas, for every time we change the value of n we add two places. Suppose we take $n=3$, still using F_r=600 kc and f=90 kc. Then we get F_o=230 kc and F_o= 170 kc. As we use higher values of n the values of F_o become lower and ultimately the settings will be off the range of the oscillator.

It appears that there will not be many repeats on the low frequencies on a second harmonic superheterodyne, but on the higher frequencies there will be many. Let us investigate this a little further. If the intermediate frequency is 90 kc, the oscillator of a second harmonic superheterodyne that is to cover the broadcast band will have a range from 320 kc to 795 kc, assuming that the oscillator has been designed so as to

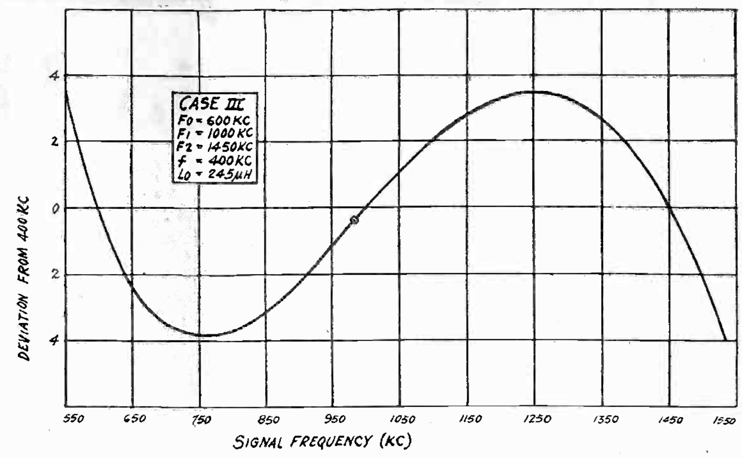
(*Continued on next page*)



CASE III

FIG. 1

The circuit arrangement of the condensers and coils in the oscillator when the oscillator trimmer condenser is connected across the tuning and series condenser connected in series.



CASE III

FIG. 3

A tracking curve over the broadcast band when the intermediate frequency is 400 kc. The tie-down frequencies are 600, 1,000, and 1,450 kc.

(*Continued from preceding page*)

cover the band with the higher settings throughout. Now let us take the signal frequency $F_r = 1{,}500$ kc. The two normal settings which will bring in the signal are 795 kc and 705 kc, both in the range of the oscillator. If we use the third harmonic we get the two points $F_o = 530$ kc and $F_o = 470$ kc. Both fall within the tuning range. If we take the fourth harmonic we get the two frequencies $F_o = 397.5$ kc and $F_o = 352.5$ kc. Both are in the tuning range of the oscillator. The fifth harmonic gives us $F_o = 318$ kc and $F_o = 282$ kc. Both are outside the tuning range. Each of the second, third, and the fourth harmonics gave two settings of the oscillator where the same signal came in, six places in all, and it is probable that the setting $F_o = 318$ kc would also be reached.

Harmonics Strong

The strength of the signal on these positions would depend on the strength of the harmonics. All may be quite strong because if the second harmonic superheterodyne is to be sensitive the design of the oscillator must be such that the second harmonic is strong, and that means that all will be strong. When the first harmonic is used, as it is in most superheterodynes, the design can be such that only the fundamental is strong. There is a much more rapid decline in the strength between the first and the second than between the second and the third.

Even the ordinary superheterodyne employing the first harmonic is not exempt from the harmonic effect. Take for example a superheterodyne with an intermediate frequency of 175 kc. If the oscillator is designed so that the higher setting is used the range is from 725 kc to 1,675 kc, at least. Suppose we wish to receive a station having a frequency of 1,500 kc. From the second harmonic of the oscillator we have the two settings $F_o = 837.5$ kc and $F_o = 662.5$ kc, one of which is within the range of the oscillator. Therefore there is one chance of getting harmonic interference, and it would be with a frequency of 662.5 kc. There is no signal on this frequency but there are signals on 660 and 670 kc. Audible interference with either could result.

It is understood that interference will result only if the undesired signal will get to the mixer. If we are receiving a signal of 660 kc, the radio frequency tuner is adjusted to that and not to 1,500 kc. Hence very little of the 1,500 kc signal will get to the mixer and the interference will be weak. It is when the radio frequency tuner is not selective that this type of interference will be strong, or when an antenna of excessive length is used.

Power of Discrimination

The intermediate frequency tuner has no power of discrimination whatsoever against image or harmonic interference. It accepts any signal having a frequency f and rejects signals of other frequencies. If, however, the image or harmonic interference should appear on the oscillator slightly off the setting required for the signal desired, then the interference will not produce a frequency equal to the resonant frequency of the intermediate tuner, but one slightly off that value, and in that case the intermediate tuner does discriminate against the interference, just as it would discriminate against any other frequency off resonance. But then the interference is no longer of frequency f, which we have reserved as the frequency to which the intermediate selector is tuned.

If we are to avoid image and harmonic interference the discrimination must be introduced ahead of the mixer tube by tuning sharply to the desired signal. We must also avoid the generation of harmonics in the radio frequency amplifier and in the oscillator. The generation of harmonics in the radio frequency amplifier may be minimized by using variable mu tubes. In the oscillator we can avoid harmonics by minimizing feedback, by using a bias on the grid of the tube, and by coupling the oscillator to the mixer so that only resonant voltage is impressed on the mixer. That is, the coupling should not be effected between the plate of the oscillator tube to the mixer but rather between the resonant circuit of the oscillator and the mixer.

Case III.

AS HAS been stated, Case III. differs from Case II. only in the arrangement of the oscillator trimmer capacity in relation to the other condensers. It is connected across the coil L and also across C and C_s connected in series, as illustrated in Fig. 1 . As in the preceding case the three tie-down frequencies are F_o, F_1, and F_2 and the corresponding values of C are C_o, C_1, and C_2. The frequency ratios R, r_1, and r_2 are defined exactly as in the preceding case.

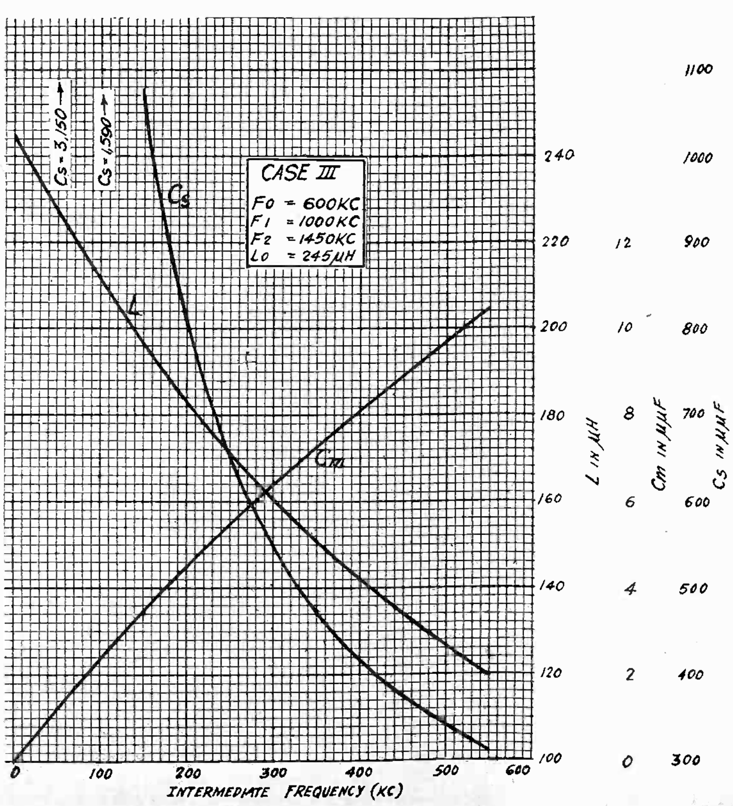
Three equations are set up, each expressing the condition that the natural frequency in the oscillator circuit should exceed the natural frequency in the radio frequency circuit by the intermediate frequency at the three tie-down frequencies selected. It is convenient to write these equations in the form $[CC_s/(C + C_s)] + C_m = 1/4\pi^2 L(F + f)^2$. The three equations are alike except that C is given the three values C_o, C_1, and C_2, and F the corresponding values F_o, F_1, and F_2.

In solving these equations for L, C_s, and C_m it is convenient to eliminate C_m first, which is done simply by subtraction. Then L can be eliminated from the two resulting equations. Finally C_s is obtained from the single equation obtained by the elimination of L. Carrying through the necessary eliminations and the solution for C_s we obtain equations (1) and (2).

$$C_s = (C_1 B - C_2) / (1 - B) \quad \ldots\ldots\ldots\ldots (1)$$

$$\text{in which } B = \left(\frac{r_1}{r_2}\right)^2 \left(\frac{1 + r_2}{1 + r_1}\right) \left(\frac{1 + r_1 + 2R}{1 + r_2 + 2R}\right) \left(\frac{r_2 + R}{r_1 + R}\right)^2 \quad \ldots (2)$$

B is obtained from the various frequency ratios alone, all of which are known because they involve the three tie-down frequencies and the intermediate frequency. Since B is a fraction that may differ only



CASE III

FIG. 2

These curves give the inductance L, the series capacity C_s, and the trimmer capacity C_m for Case III. for intermediate frequencies from zero to 550 kc.

slightly from unity it is necessary to compute its value with high accuracy if C_s is to be determined accurately.

When C_s has been determined its value can be inserted in one of the two equations resulting from the elimination of C_m. By means of a little manipulation we can obtain a value of K_0, the value of the capacity in the oscillator circuit at the value F_0. This is given in equation (3).

$$K_0 = \frac{C_s^2 C_0 (r_1 + R)^2 (1 + r_1)}{(C_0 + C_s)(C_1 + C_s) r_1^2 (1 + r_1 + 2R)} \quad \ldots\ldots (3)$$

When K_0 has been computed from (3) we can obtain C_m from (4).

$$C_m = K_0 - \frac{C_0 C_s}{C_0 + C_s} \quad \ldots\ldots (4)$$

Since C_m is the difference between two very nearly equal quantities it is essential to compute quantities accurately if an accurate value of C_m is to be obtained. However, C_m is not directly involved in the formula for the inductance so it is of no great importance to get an accurate value for it.

The value of the inductance L is obtained by solving one of the original equations of condition. Formula (5) has been obtained from the first, that is, the one involving C_0 and F_0.

$$L = \frac{L_0 C_0}{K_0 (1 + R)^2} \quad \ldots\ldots (5)$$

Equation (5) contains K_0 and therefore it should be computed accurately from equation (3). Since there are no differences in equation (3) there is no difficulty in obtaining adequate accuracy from this, but, as was stated, C_s must be computed very accurately or there may be a large error in K_0.

As in the preceding case, the inductance is the last to be obtained in the computation, which is unfortunate, for it is the value in which we are most interested. However, the order in which the three unknown values are obtained leads to simpler formulas and for that reason it is worth while to get L by the circuitous method.

Tracking Curve

The value of C_m obtained from formula (4) varies from 1.236 mmfd. when f is 50 kc to 10.44 mmfd. when f is 550 kc. L obtained from (5) varies from 226.7 microhenries when f is 50 kc to 119.6 microhenries when f is 550 kc. Cs as obtained from (1) varies from 3,150 mmfd. when f is 50 kc to 230 mmfd. when f is 550 kc. The variation in these values as f varies from 0 to 550 kc is given in the curves in Fig. 2. The computation was based on the tie-down frequencies $F_0 = 600$ kc, $F_1 = 1{,}000$ kc., and $F_2 = 1{,}450$ kc.

From Fig. 2 we note that for an intermediate frequency of 175 kc the value of C_m is 4 mmfd., the value of C_s is 905 mmfd., and the value of L is 189 microhenries.

Fig. 3 gives a tracking curve resulting from the values of L, C_m, and C_s obtained with the formulas (1), (4), and (5) at an intermediate frequency of 400 kc, the tie-down frequencies being those specified on the graph. This curve is practically identical with that obtained with the method under Case II. The greatest deviation within the broadcast band is 3.8 kc and occurs at 770 kc. At the three tie-down frequencies the tracking is exact, which is only a check on the numerical computation.

The formula for the point of inflection of the curve in Fig. 3, that is, for Case III., is $C = C_s C_m [1 + (4 + 3C_s/C_m)^{1/2}]/(C_s + C_m)$. Computing the frequency at which this occurs on Fig. 3 we find that it is 982 kc.

By comparing the tracking curves for Cases II. and III. we note that there is practically no difference. The maximum deviation in both is less than one per cent.

Radio University

A QUESTION and Answer Department. Only questions from Radio University members are answered. Such membership is obtained by sending subscription order direct to RADIO WORLD for one year (52 issues) at $6, without any other premium.

RADIO WORLD, 145 WEST 45th STREET, NEW YORK, N. Y.

What Is Decibel?

WILL YOU KINDLY explain the meaning of decibel? This term is used always in performance curves of radio receivers but I have never seen an explanation of it.—F. W. C., Chicago, Ill.

If Po is the output power of one receiver under certain conditions and Pl is the power of another receiver under similar conditions, or of the same receiver under another set of conditions, then D = (10) log (Pl/Po) tells how much better Pl is as compared with Po, D being the number of decibels of superiority. The logarithm is to the base 10. If the quantities compared are voltages or currents instead of powers the factor 20 is used instead of 10. Let us illustrate. Suppose the signal voltage across the output transformer of a speaker is Vo at 400 cycles per second and Vl at some frequency F, then D = 20 x log (Vl/Vo) gives the number of decibels the signal is stronger at F than it is at 400 cycles. If Vl is smaller than Vo the logarithm is negative and therefore D is also negative. In that case the signal at F is weaker than at 400 cycles. When D is positive it is said that the signal is "up" at F, and when D is negative it is said that the signal is "down" at F, in each case in reference to level at 400 cycles. While a frequency of 400 cycles is used as the basis in comparing tone quality in radio receivers, the number of decibels up or down may be with respect to any other frequency agreed upon. Indeed it does not have to be any frequency. We might compare the outputs of two receivers at any one frequency, in which case one of the receivers is used as a basis of comparison. Of we might compare two resonant circuits by comparing the currents in the two due to a constant voltage or e.m.f. in the circuits. Ten times the common logarithm of the ratio of two powers gives the number of decibels. Twenty times the common logarithm of two currents or two voltages gives the number of decibels. In both cases powers are compared.

* * *

450 kc Oscillation

CAN THE PRESENT Philco Model 095 oscillator be altered so as to provide a 450 kc signal for adjustment of the intermediate frequency stages in the Model 43?—E. L., Emporia, Kans.

Yes. This can be done by adding a compensating condenser and a snap switch to the circuit.

* * *

New Battery Set

WHAT ARE the factors in the circuit of the new Philco Model 37 Superheterodyne battery receiver which are responsible for the tone and volume of this model?—L. M. S., Los Angeles, Calif.

The new Philco type 19 tube is one of the features. This is a class B amplifier, and is a push-pull tube having two control grids and two plates. The volume which is thus available is equal to that afforded by two separate tubes in a push-pull class B amplifier circuit. The new Philco permanent magnet dynamic speaker used in this model is an advance. The special magnet construction gives a speaker field strength practically equal to that of a dynamic speaker in an a-c operated set. The new cone construction is extremely light and strong affording excellent response at all musical frequencies. The air gap between the voice coil and the magnetic field is extremely small so that all of the available magnetic energy is utilized to produce greater speaker efficiency.

* * *

Condenser Substitution

CAN substitutions be made in the case of Philco by-pass condensers in the black bakelite containers?—L. E., Waco, Tex.

It is possible in practically all cases to substitute one part for another when the only differences are in the terminal lug arrangement. For example, part 3615-W can be substituted for part 3615 AE since the only difference between these two is in the arrangement of the terminals. All 3615 condensers are .05 mfd.; the letter after the part number indicates the terminal arrangement, twin condensers, and wire wound resistor combinations. Part 3909 is .01 mfd.; part 3793 is .015 mfd.; and part 4989 is .09 mfd.

* * *

Shadow Tuning

CAN PHILCO shadow tuning be used as an indicator when adjusting the antenna, high frequency, and low frequency condensers?—C. F. L., Bangor, Me.

Yes. Shadow tuning operates on the carrier of a station and unlike an output meter, it is independent of any variations produced by voice or music. Thus if a station of known frequency is tuned in at or near 1400 kc ,the high frequency and antenna condensers can be adjusted for minimum shadow width when the dial reading is set at the correct station frequency. The same adjustment can be made on the low frequency condensers by tuning in a station near the low frequency end of the dial.

* * *

Band Pass Filters?

ARE the doubly tuned transformers used in the intermediate frequency amplifiers of supers band-pass filters and so adjusted as to pass a band of 10 kc? What determines the width of the passed band in a band pass filter? Is there any difference between band-pass filters having a common inductance and a common capacity?—W. F. E., Toledo, Ohio.

If two equal circuits are independently tuned to exactly the same frequency and then coupled a little closer than critical coupling they form a band pass filter the band of which depends on the mutual inductance between the coils. But if the two coils are coupled together and then each circuit tuned for maximum signal strength they do not form a band-pass filter. This is the way they are mostly tuned. In a band-pass filter in which the coupling is capacitive the width of the band varies inversely as the frequency because the coupling is less the higher the frequency. In a filter in which the two circuits are coupled with an inductance the width of the band varies directly as the frequency because the higher the frequency the greater the common impedance. In both one of the peaks is fixed, the other moving in opposite directions as the tuning is changed. Therefore it is not practical to combine the two filters for the width of the band would only vary twice as rapidly.

STATION SPARKS
By Alice Remsen

My Prayer
(FOR "THREADS OF HAPPINESS")
WABC, Tuesdays, 9:15 p. m.

I'd be content with just a little house,
A clean-swept hearth, a tiny little fire,
A cat to purr or catch the wary mouse,
A cow to chew her cud within the byre;

A garden in the front to charm the eye,
A wee one in the back where praties grow;
A clock to tick and tell the hour by,
A little stool on which to sit and sew;

A well of water, outside at the right
An apple tree to shade me from the sun;
A patchwork quilt to cover me at night,
A bed to sleep on when my work is done;

A roof to cover me if rain should fall;
I do not ask for much—I only cry
For these few crumbs of comfort, that is all.
Oh, Lord! Please give me them before I die!

—A. R.

* * *

And all these little threads of happiness will come into your mind as you listen to Andre Kostelanetz and his beautiful orchestra and the exquisite voice of Tommy McLaughlin. Your dearest wishes will materialize in your imagination. Listen to this program. You will like it.

* * *

The Radio Rialto

What a time I've been having all the week. . . . Getting ready to leave New York for Cincinnati . . . and it has rained most of the time. . . . Scrambling around the old rialto ordering orchestrations of new songs to take along with me. . . . Found some jolly good ones, too. . . . One thing we can be thankful for; election's over, and the air is clearer. . . . Radio is back to its regular schedule and you'll be able to hear your favorite crooner at a certain hour, or goose-flesh will be raised by your favorite mystery drama without the risk of hearing an office candidate butting in at the crucial hair-raising moment, and what a great relief that is! . . .

Ran into Jack Foster, erstwhile Radio Editor of the New York World-Telegram. Jack told me how very happy he is in his new job as Feature Editor of his paper; he was all enthusiasm about it. . . . He thinks James Cannon is doing a good job on Jack's old column. . . . I think so, too. . . . I'm writing this between packings. . . . Do a few lines and then remember something I've forgotten and dash madly over to trunk and stick in a shoe-horn or something. . . . It's quite an adventure for me. . . . First time I've packed a trunk for five years—and I used to do it every week . . . sometimes every day. . . . In the old days I was not happy unless trouping. . . . Now—well, I don't know what to think about it. . . . Had some new photographs taken. . . . By the way; speaking of photographs, if you are interested in those cute little miniature photographs, you can have them made up of yourself, friends or what-not, members of your family, pets, etc., stick them on your letters, adding a little personal touch. . . . I'll be glad to send you all particulars if you'll drop me a line. . . .

Received a lesson in audible illusions last week while watching Urban Johnson, the sound effects man of "Fu Manchu," at work. . . . A man near the mike has a pair of shoes on his hands. Before him is a dish of breakfast food, sans cream. . . . Is he eating it? He is not. . . . He is in it with the shoes on his hands, crunching them methodically up and down—all this a perfect illusion of footsteps on gravel. . . . An electric fan whirls at a dizzy pace; the blades of the fan have been removed and slender rattans have been substituted—bringing to the microphone the sounds of anything from a gentle breeze to a full gale. . . . Near at hand is a drain-pipe, with a drum head across one end—that becomes an airplane. . . . On a stand near-by is a tub of water and a paddle wheel—used when Scotland Yard gets too close and "Fu" takes to the river. . . . The entire corner of the studio is littered with a most amazing collection of junk. . . . Inasmuch as nothing sounds quite as much like a slamming door as a slamming door, there's a miniature house in the corner, with a door, a key, a lock and a bolt. . . . On the other hand, nothing sounds less like a pistol shot than a pistol shot, so a leather pad and stick are used. . . . So unusual are the audible illusions in this thriller series that scores of letters are received from technically-minded fans each week, wanting to know how it's done. . . . Hope you're a little bit wiser now. . . .

Frank La Forge has commenced a series of musicales over WABC and the Columbia network. He may be heard each Thursday from 3:00 to 3:30 p. m. . . . He will bring his outstanding pupils to the air. Mr. La Forge, as you probably know, is an internationally-known concert pianist and teacher. . . . Ernest Schelling has also started a series of twelve young people's concerts, broadcast every Saturday from 11:00 a. m. to 12:30 p. m., EST. Mr. Schelling will conduct the New York Philharmonic-Symphony orchestra in selections from the works of Handel, Bach, Tschaikovsky, and Dvorak; in order to point out the function and development of the strings in symphony compositions, he will amplify his musical illustrations with verbal explanations. A very interesting and instructive series. . . . The Carborundum Band has started its sixth season on the air. This is a fifty-piece band under the direction of Edward d'Anna, emanating from the Niagara Hotel, Niagara Falls, New York. Francis Bowman will narrate an authentic Indian legend on each program.

Discovered a few ambitions hovering around the radio stars at WABC. Like the clown who would play Hamlet, Georgie Price would jump at the chance to describe horse races and baseball games. . . . Fred Allen would, with gestures, read you the English classics. . . . Arthur Pryor envies the "hot" trombone soloist. . . . Morton Downey hankers to tell jokes over the air. . . . Norman Brokenshire, the ever-playful chap, would be a sound-effects expert. . . . Guy Lombardo would like to direct a film extravaganza. . . . The Boswell Sisters would teach the country how to cook Southern dishes. . . . Vaughn de Leath would like to be a make-up expert in the television department. . . . Colonel Stoopnagle might be the author of tragic radio dramas. . . . Singin' Sam would like to be Ted Husing's assistant at golf tournaments, while Ted wouldn't mind changing places with Singin' Sam. . . . Edwin C. Hill would rather talk about dogs . . . and Don Ball would strum a ukulele and sing popular songs. . . . Oh, well, there's no accounting for tastes. . . .

Kate Smith has left New York for Hollywood, where she will make her feature motion picture; her broadcasts will continue as usual over the Columbia System direct from the cinema center. A retinue of ten persons accompanied the star when she left from the Grand Central Station on her private car. . . . Elsie Hitz is appearing in a new series of programs for the Ex-Lax, Inc., of Brooklyn, entitled "The Magic Voice"; every Tuesday and Saturday from 8:15 to 8:30 p. m. . . . The Three X Sisters have sung in eight different dialects since they started their CBS broadcasts a few weeks ago and they have received letters in five different languages, none of which they could read. . . . Over at NBC, Jean Sargent will be starred in a new series of programs for Dr. Lyons Tooth Powder; with her will be Scrappy Lambert, Frank Luther, David Percy and Gene Rodemich's orchestra. . . . The program will be called the Manhattan Merry-go-Round, and you may hear it each Sunday at 3:30 p. m. over WJZ.

Howard Thurston, an old acquaintance of mine from vaudeville days, may now be heard over the air via WJZ each Thursday and Friday at 8:45 p. m. Howard is an internationally-known magician and is producing some of his famous illusions under the sponsorship of Swift and Co. . . . The Sinclair Minstrels gave their two hundredth program last Monday evening at 9:00 p. m. over WJZ. . . . Evelyn Herbert and Robert Halliday, noted operatic stars, are now to be heard every Saturday night at 10:00 p. m. over WEAF, during the Lucky Strike Hour; tune in, they're okay. . . . The Atwater-Kent auditions are now on for the sixth time. . . . In spite of my hectic packing have managed to scrape a few news items together for you. . . . This time tomorrow shall be on a train Cincinnati bound; shall tell you in my next what time you may listen in to your girl friend. . . . Octavia's going to miss me—and shall I miss her cooking . . . well, rather!

* * *

Biographical Brevities
ABOUT CHARLIE AGNEW
"YEAST FOAMERS"
Chicago NBC Studios, through WJZ; Sunday's 2:30 p. m.

Charlie Agnew was born in Newark, N. J. . . . When ten years old discovered an old cornet in the attic of his home; that started him on the road to fame; he studied in secret—or as much as any cornetist can study in secret—and perfected his technique. . . . Upon his graduation from high school his parents presented him with a new cornet, because he had made good in the High School Band. . . . Was known as the champion window-breaker of his school. . . . Was a track star also, specializing in the 440-yard dash, and the 220 yard hurdles.

After leaving school he joined a local band leader, graduated to several well-known bands, among them being the ones headed by Vincent Lopez, Harry Yerkes and Charles Strickland. . . . Went to Chicago and played side by side with Wayne King. . . . Soon afterwards he organized his own band and has conducted it ever since. . . .

When he took Paul Whiteman's place at the Edgewater Beach Hotel he made a hit with his singing orchestra, each member of which is a trained singer able to do both solo and ensemble work. . . . Charlie himself plays any instrument in his orchestra and sometimes takes a chance and sings, too. . . . During his comparatively short time in "big time" musical circles he has written many well-known hits, including "Slow But Sure," "I'm Singing to Hide My Tears," "Fools in Love" and "Too Many on Your Mind."

* * *

(If you would like to know something of your favorite radio artists, drop a card to the conductor of this page. Address her: Alice Remsen, care of RADIO WORLD, *145 W. 45th St., New York, N. Y.*)

STATIONS BY FREQUENCIES

United States, Canadian, Newfoundland, Cuban and Mexican Transmitters Listed

Corrected to November 15th, 1932

The stations listed herewith are in the order of frequencies, with equivalent wavelengths given. The call, location, owner, and power are stated. The location is that of the main studio, for United States stations. If the transmitter is located elsewhere it is indicated additionally, preceded by T. The power given is the licensed maximum. Some stations use maximum power in daytime only. These are identified by an asterisk after the power figure (*). Usually in such cases the night power is half the day power. CP means construction permit, license awaited.

—EDITOR.

540 KILOCYCLES—555.6 METERS

CKWO—Windsor, Ont., Can.; Essex Bdcsters Lmt. 5 KW.

550 KILOCYCLES—545.1 METERS

WGR—Buffalo, N. Y.; T—Amherst, N. Y.; Buffalo Broadcasting Corporation; 1 KW.
WKRC—Cincinnati, Ohio; WKRC (Inc.); 1 KW.
KFUO—St. Louis, Mo.; Concordia Theo. Sem.; 1 KW.*
KSD—St. Louis, Mo.; Pulitzer Publishing Co.; 500 W.
KFDY, Brookings, S. Dak.; South Dakota State College, 1 KW.*
KFYR—Bismarck, N. Dak.; Meyer Broadcasting Co., 2½ KW.*
KOAC—Corvallis, Oreg.; Oregon State Agricultural College, 1 KW.

560 KILOCYCLES—535.4 METERS

WLIT—Philadelphia, Pa.; Lit Bros. Bdcg. System, Inc.; 500 W.
WFI—Philadelphia, Pa.; WFI Bdcg. Co.; 500 W.
WQAM—Miami, Fla.; Miami Broadcasting Co.; 1 KW.
KFDM—Beaumont, Tex.; Sabine Bdcg. Co., Inc.; 1 KW.*
WNOX—Knoxville, Tenn.; WNOX, Inc.; 2 KW.*
WIBO—Chicago, Ill.; T—Des Plaines, Ill.; Nelson Bros. Bond & Mortgage Co.; 1½ KW.*
WPCC—Chicago, Ill.; North Shore Church; 500 W.
KLZ—Denver, Colo.; Reynolds Radio Co. (Inc.), 1 KW.
KTAB—San Francisco, Calif.; T—Oakland. Calif.; The Associated Broadcasters (Inc.), 1 KW.

570 KILOCYCLES—526.0 METERS

WNYC—New York N. Y.; City of N. Y.; 500 W.
WMCA—New York, N. Y.; T—Hoboken, N. J.; Knickerbocker Broadcasting Co. (Inc.); 500 W.
WSYR-WMAC—Syracuse N. Y.; Clive B. Meredith; 250 W.
WKBN—Youngstown, Ohio; WKBN Broadcasting Corp.; 500 W.
WEAO—Columbus, Ohio; Ohio State University; 750 W.
WWNC—Asheville, N. C.; Citizen Broadcasting Co.; 1 KW.
KGKO—Wichita Falls, Tex.; Wichita Falls Broadcasting Co., Inc.; 500 W.*
WNAX—Yankton, S. Dak.; The House of Gurney (Inc.); 1 KW.
KMTR—Los Angeles, Calif.; KMTR Radio Corporation; 500 W.
KVI—Tacoma, Wash.; Puget Sound Bdcg Co.; 500 W.

580 KILOCYCLES—516.9 METERS

WDBO—Orlando, Fla.; Orlando Bldg. Co., 250 W.
WTAG—Worcester, Mass.; Worcester Telegram Publishing Co. (Inc.), 250 W.
WOBU—Charleston, W. Va.; WOBU (Inc.), 250 W.
WSAZ—Huntington, W. Va.; WSAZ (Inc.); 250 W.
WIBW—Topeka, Kans.; Topeka Broadcasting Association (Inc.), 1 KW.
KSAC—Manhattan, Kans.; Kansas State Agricultural College; 1 KW.*
KMJ—Fresno, Calif.; Jas. McClatchy Co.; 500 W.
CFCY—Charlottetown, Prince Edward Island, Canada; Island Broadcasting Co., Ltd.; 500 W.
CHMA—Edmonton, Alberta, Can.; Christian & Missionary Alliance, 250 W.
CKCL—Toronto, Ontario, Can.; Dominion Battery Co., Ltd.; 500 W. (Uses call CFCL on Sundays), 500 W.
CKUA—Edmonton, Alberta, Can.; University of Alberta; 500 W.

590 KILOCYCLES—508.2 METERS

WGCM—Gulfport, Miss.; T—Mississippi City, Miss.; Great Southern Land Co.; 1 KW.
WEEI—Boston, Mass.; T—Weymouth, Mass.; Edison Electric Illuminating Co. of Boston; 1 KW.
WKZO—Berrien Springs, Mich.; WKZO (Inc.); 1 KW.
WCAJ—Lincoln, Nebr.; Nebraska Wesleyan University; 500 W.
WOW—Omaha, Nebr.; Woodmen of the World Life Insurance Association; 1 KW.
KHQ—Spokane, Wash.; Louis Wasmer (Inc.), 2 KW.*
CMW—Havana Cuba; Columbus Commercial & Radio Co.; 1400 W.

595 KILOCYCLES—503.9 METERS

CJGC—London, Ontario, Can.; T—Strathburn, Ontario, Can.; London Free Press & Ptg. Co., Ltd.; 5 KW.
CNRL—London, Ontario, Can.; T—Strathburn, Ontario, Can. (Uses Transmitter of CJGC); Canadian National Railways; 5 KW.

600 KILOCYCLES—499.7 METERS

WICC—Bridgeport, Conn.; T—Easton, Conn.; Bridgeport Broadcasting Station (Inc.); 250 W.
WCAC—Storrs, Conn.; Connecticut Agricultural College; 250 W.
WCAO—Baltimore, Md.; Monumental Radio (Inc.), 250 W.
WREC—Memphis, Tenn.; T—Whitehaven, Tenn.; WREC (Inc.), 1 KW.*
WMT—Waterloo, Iowa; Waterloo Broadcasting Co.; 500 W.
KFSD—San Diego, Calif.; Airfan Radio Corporation (Ltd.); 1 KW.*
CNRO—Ottawa, Ontario, Can.; Canadian National Railways; 500 W.

610 KILOCYCLES—491.5 METERS

WJAY—Cleveland, Ohio; Cleveland Radio Broadcasting Corporation; 500 W.
WIP—Philadelphia, Pa.; Penna. Bdcg. Co., Inc.; 500 W.
WDAF—Kansas City, Mo.; Kansas City Star Co.; 1 KW.
KFRC—San Francisco, Calif.; Don Lee (Inc.); 1 KW.
WFAN—Philadelphia, Pa.; Keystone Broadcasting Co.; 500 W.
XETR—Mexico, D. F.; Cia Difusora Mexicana, S. A.; 2½ KW.

620 KILOCYCLES—483.6 METERS

WLBZ—Bangor, Me.; Maine Broadcasting Co. (Inc.); 500 W.
WFLA-WSUN—Clearwater, Fla.; Clearwater Chamber of Commerce and St. Petersburg Chamber of Commerce; 2½ KW.*
WTMJ—Milwaukee, Wis.; T—Brookfield, Wis.; The Journal Co. (Milwaukee Journal), 2½ KW.*
KGW—Portland, Oreg.; Oregonian Publishing Co.; 1 KW.
KTAR—Phoenix, Ariz.; KTAR Broadcasting Co.; 1 KW.*

630 KILOCYCLES—475.9 METERS

KGFX—Pierre, S. D.; Dana McNeil; 200 W.
WMAL—Washington, D. C.; M. A. Leese Radio Corp.; 500 W.*
WOS—Jefferson City, Mo.; Missouri State Marketing Bureau, 500 W.
KFRU—Columbia, Mo.; Stevens College; 500 W.
WGBF—Evansville, Ind.; Evansville on the Air (Inc.); 500 W.

630 KILOCYCLES—475.9 METERS (Continued)

CFCT—Victoria, British Columbia; Victoria Broadcasting Asso..; 50 W.
CJGX—Winnipeg, Manitoba; T—Yorkton, Saskatchewan; Winnipeg Grain Exchange; 500 W.
CHCS—Hamilton, Ont., Can.; T—Fruitland; Spectator; 1 KW.*
CKOC—Hamilton, Ont., Can.; T—Fruitland; Wentworth Bdcg Co.; 1 KW.*
CKTB—St. Catherine's, Ont.. Can.; T—Fruitland; Taylor & Bate, St.; 1 KW.*
CNRA—Moncton, New Brunswick; Canadian National Railways; 500 W.
CMCJ—Havana, Cuba; Rafael Rodriquez; 250 W.
XETA—Veracruz, Ver., Mex.; Manuel Espinosa Tagle; 500 W.
XETF—Veracruz, Ver., Mex.; Manuel Angel Fernandez; 500 W.
CMQ—Havana, Cuba; Jose Fernandez; 250 W.

640 KILOCYCLES—468.5 METERS

WAIU—Columbus, Ohio; Associated Radiocasting Corp.; 500 W.
WOI—Ames, Iowa; Iowa State College of Agriculture and Mechanic Arts; 5 KW.
KFI—Los Angeles, Calif.; Earle C. Anthony (Inc.), 50 KW.

645 KILOCYCLES—464.8 METERS

CHRC—Quebec, Quebec, Can.; CHRC, Ltd., 100 W.
CKCI—Quebec, Quebec, Can. (Uses transmitter of CHRC); Le Soleil, Inc.; 100 W.
CKCR—Waterloo, Ontario, Can.; Wm. C. Mitchel & Gilbert Liddle, 100 W.

650 KILOCYCLES—461.3 METERS

WSM—Nashville, Tenn.; National Life & Accident Insurance Co.; 50 KW.
KPCB—Seattle, Wash.; Queen City Broadcasting Co.; 100 W.

660 KILOCYCLES—454.3 METERS

WEAF—New York, N. Y.; T—Belmore, N. Y.; National Broadcasting Co. (Inc.); 50 KW.
WAAW—Omaha, Nebr.; Omaha Grain Exchange; 500 W.
CMCO—Havana, Cuba; J. L. Stowers; 250 W.
CMDC—Havana, Cuba; Juan Fernandex de Castro; 500 W.

665 KILOCYCLES—450.9 METERS

CHWK—Chilliwack, British Columbia, Can.; Chilliwack Broadcasting Co., Ltd.; 100 W.
CJRM—Moose Jaw, Saskatchewan; T—old city Moose Jaw, Can.; James Richardson & Sons, Ltd.; 500 W.
CJRW—Winnipeg, Manitoba; T—Fleming, Saskatchewan, Can.; James Richardson & Sons, Ltd.; 500 W.

670 KILOCYCLES—447.5 METERS

WMAQ—Chicago, Ill.; T—Addison, Ill.; WMAQ (Inc.); 5 KW.

675 KILOCYCLES—444.2 METERS

VOWR—St. John's, N. F.; Wesley United Church; 500 W.

680 KILOCYCLES—440.9 METERS

WPTF—Raleigh, N. C.; Durham Life Insurance Co.; 1 KW.
KFEQ—St. Joseph, Mo.; Scroggin & Co. Bank; 2½ KW.
KPO—San Francisco, Calif.; Natoinal Bdcg. Co.; 5 KW.
XFG—Mexico City, Mex.; Sria de Guerra y Marina; 2 KW.

685 KILOCYCLES—437.7 METERS

VAS—Glace Bay, Nova Scotia, Can.; Canadian Marconi Co.; 2 KW.

690 KILOCYCLES—434.5 METERS

CFAC—Calgary, Alberta, Can.; The Calgary Herald; 500 W.
CFRB—Toronto, Ontario, Can.; T—King, Ontario, Can.; Rogers Majestic Corp., Ltd.; 10 KW.
CJCJ—Calgary, Alberta, Can.; Albertan Pub. Co., Ltd.; 500 W.
CNRX—Toronto, Ontario, Can.; T—King, Ontario, Can. (Uses transmitter of CFRB); Canadian National Railways; 4 KW.
XET—Monterrey, N. L., Mex.; Mexico Music Co., S. A.; 500 W.

700 KILOCYCLES—428.3 METERS

WLW—Cincinnati, O.; T—Mason, Ohio; Crosley Radio Corporation; 50 KW.

710 KILOCYCLES—422.3 METERS

WOR—Newark, N. J.; T—Kearny, N. J.; Bamberger Broadcasting Service (Inc.); 5 KW. (50 KW. C. P.)
KMPC—Los Angeles, Calif.; R. S. MacMillan; 500 W.
XEN—Mexico City, Mex. (Actual frequency 711 KC., 421.9 Meters); Cerveceria Modelo, S. A.; 1 KW.

720 KILOCYCLES—416.4 METERS

WGN-WLIB—Chicago, Ill.; T—Elgin, Ill.; WGN, Inc.; 25 KW.

730 KILOCYCLES—410.7 METERS

CHLS—Vancouver, British Columbia (Uses transmitter of CKCD); W. G. Hassell; 50 W.
CHYC—Montreal, Quebec, Can.; T—St. Hyacinthe, Quebec, Can. (Uses transmitter of CKAC); Northern Elec. Co., Ltd.; 5 KW.
CKAC—Montreal, Quebec, Can.; T—St. Hyacinthe, Quebec, Can.; LaPresse Pub. Co.; 5 KW.
CKCD—Vancouver, British Columbia, Can.; Vancouver Daily Province; 100 W.
CKFC—Vancouver, British Columbia, Can.; United Church of Canada; 50 W.
CKMO—Vancouver, British Columbia, Can.; Sprott-Shaw Radio Co.; 100 W.
CKWX—Vancouver, British Columbia, Can.; Western Broadcasting Co., Ltd.; 100 W.
CNRM—Montreal, Quebec, Can.; T—St. Hyacinthe, Quebec, Can. (Uses transmitter of CKAC); Canadian National Railway; 5 KW.
XER—Villa Acuna, Coah., Mex. (Actual frequency 735 KC., 408.1 Meters); Compania Radiodifusora de Acuna, S. A.; 75 KW.
CMK—Havana, Cuba; Cuban Bdcg. Co.; 3150 W.

740 KILOCYCLES—405.2 METERS

WSB—Atlanta, Ga.; Atlanta Journal Co.; 5 KW. (50 KW.—C. P.).
KMMJ—Clay Center, Nebr.; The M. M. Johnson Co.; 1 KW.
WHEB—Portsmouth, N. H.; Granite State Bldg. Corp.; 250 W. C. P.

(Continued on next page)

745 KILOCYCLES—402.4 METERS

CJCA—Edmonton, Alta., Can.; Edmonton Journal; 500 W.

750 KILOCYCLES—399.8 METERS

WJR—Detroit, Mich.; T—Sylvan Lake Village, Mich.; WJR, The Goodwill Station (Inc.), 10 KW.
KGU—Honolulu, Hawaii; M. A. Mulroney and Advertiser Pub. Co., Ltd.
XEQ—C. Jaurez, Coah., Mex.; Feliciano Lopez Islas; 5 KW.

760 KILOCYCLES—394.5 METERS

WJZ—New York, N. Y.; T—Boundbrook, N. J.; National Broadcasting Co.; Inc.); 30 KW.
WEW—St. Louis, Mo.; St. Louis University; 1 KW.

770 KILOCYCLES—389.4 METERS

KFAB—Lincoln, Neb.; KFAB Broadcasting Co.; 5 KW. (25 KW. C. P.).
WBBM-WJBT—Chicago, Ill.; T—Glenview, Ill.; WBBM Broadcasting Corp. (Inc.); 25 KW.

780 KILOCYCLES—384.4 METERS

WEAN—Providence, R. I.; Shepard Broadcasting Service (Inc.); 500 W.*
WTAR-WPOR—Norfolk, Va.; WTAR Radio Corporation; 500 W.
WMC—Memphis, Tenn.; T—Bartlett, Tenn.; Memphis Commercial Appeal, Inc.; 1 KW.*
KELW—Burbank, Calif.; Magnolia Park, Ltd.; 500 W.
KTM—Los Angeles, Calif.; T—Santa Monica, Calif.; Pickwick Broadcasting Corporation; 1 KW.*
CKY—Winnipeg, Manitoba, Can.; Manitoba Telephone System; 5 KW.
CNRW—Winnipeg, Manitoba, Can. (Uses Transmitter of CKY); Canadian National Railways; 5 KW.
XEZ—Mexico, D. F., Joaquin Capilla; 500 W.

790 KILOCYCLES—379.5 METERS

WGY—Schenectady, N. Y.; T—South Schenectady, N. Y.; General Electric Co.; 50 KW.
KGO—San Francisco, Calif.; T—Oakland, Calif.; National Broadcasting Co. (Inc.); 7½ KW.
CMBT—Havana, Cuba; E. Perera; 500 W.
CMBS—Havana, Cuba; Enrique Artalejo; 150 W.
CMHC—Tuinucu, Cuba; Frank H. Jones; 250 W.

800 KILOCYCLES—374.8 METERS

WBAP—Fort Worth, Tex.; Carter Publications (Inc.); 10 KW.
WFAA—Dallas, Tex.; T—Grapevine, Texas; Dallas News and Dallas Journal A. H. Belo Corporation; 50 KW.

810 KILOCYCLES—370.2 METERS

WPCH—New York, N. Y.; T—Hoboken, N. J.; Eastern Broadcasters (Inc.); 500 W.
WCCO—Minneapolis, Minn.; T—Anoka, Minn.; Northwestern Broadcasting (Inc.); 5 KW. (50 KW. C. P.)
VOAS—St. John's, N. F.; Ayre & Sons, Ltd.; 75 W.
XFC—Aguascalientes, Ags., Mex.; Gobierno Edo. Aguascalientes; 350 W.

815 KILOCYCLES—367.9 METERS

CHNS—Halifax, N. S., Can.; Maritime Bdcg Co., Ltd.; 500 W.
CNRA—Halifax, N. S., Can.; Can. Natl Railways; 500 W.

820 KILOCYCLES—365.6 METERS

WHAS—Louisville, Ky.; T—Jeffersontown, Ky.; The Courier Journal Co. and The Louisville Times Co.; 25 KW.
XFI—Mexico City, Mex.; Sria Ind. Com. y Trabajo (Actual frequency 818.1 KC—366.7 Meters); 1 KW.

830 KILOCYCLES—361.2 METERS

WHDH—Saughas, Mass.; T—Gloucester, Mass.; Matheson Radio Co. (Inc.); 1 KW.
WRUF—Gainesville, Fla.; University of Florida; 5 KW.
KOA—Denver, Colo.; National Broadcasting Co. (Inc.), 12½ KW.
WEEU—Reading, Pa.; Berks Broadcasting Co.; 1 KW.

840 KILOCYCLES—356.9 METERS

CJBC—Toronto, Ontario, Can.; T—Bowmanville, Ontario, Can. (Uses transmitter of CKGW); Jarvis St. Baptist Church; 5 KW.
CKGW—Toronto, Ontario, Can.; T—Bowmanville, Ontario, Can.; Gooderham & Worts; 10 KW.
CKLC—Calgary, Alberta, Can.; T—Red Deer, Alberta, Can.; Alberta Pacific Grain Company; 1 KW.
CNRD—Red Deer, Alberta, Can. (Uses transmitter of CKLC); Canadian National Railways; 1 KW.
CPRY—Toronto, Ontario, Can.; T—Bowmanville, Ontario, Can. (Uses transmitter of CKGW); Canadian Pacific Railway Co.; 5 KW.

842 KILOCYCLES—356.1 METERS

CMC—Havana, Cuba; Cuban Telephone Co.; 500 W.
XEFD—Tiajuana, Mex.; Carlo de la Sierra; 300 W.

850 KILOCYCLES—352.7 METERS

KWKH—Shreveport, La.; T—Kennonwood, La.; Hello World Broadcasting Corporation; 10 KW.
WWL—New Orleans, La.; Loyola University; 10 KW.

860 KILOCYCLES—348.6 METERS

WABC-WBOQ—New York, N. Y.; T—West of Cross Bay Blvd., Queens Co., N. Y.; Atlantic Broadcasting Corporation; 5 KW.
WHB—Kansas City, Mo.; T—North Kansas City, Mo.; WHB Broadcasting Co.; 500 W.
XFX—Mexico City, Mex.; Sria de Educacion Publica; 500 W.

870 KILOCYCLES—344.6 METERS

WLS—Chicago, Ill.; T—Crete, Ill.; Agricultural Broadcasting Co.; 50 KW.
WENR—Chicago, Ill.; T—Downers Grove, Ill.; National Broadcasting Co., 50 KW.
XFF—Chihuahua, Mex.; Estado de Chihuahua; 500 W.

880 KILOCYCLES—340.7 METERS

WGBI—Scranton, Pa.; Scranton Broadcasters (Inc.); 250 W.
WQAN—Scranton, Pa.; E. J. Lynett, prop., The Scranton Times, 250 W.
WCOC—Meridian, Miss.; Mississippi Broadcasting Co. (Inc.); 1 KW.*
WSUI—Iowa City, Iowa; State University of Iowa; 500 W.
KLX—Oakland, Calif.; The Tribune Publishing Co.; 500 W.
KPOF—Denver; Colo.; Pillar of Fire; 500 W.
KFKA—Greeley, Colo.; The Mid-Western Radio Corporation; 1 KW.*
CHML—Mount Hamilton, Ontario, Can.; Maple Leaf Radio Co., Ltd.; 50 W.
CJCB—Sydney, Nova Scotia, Can.; N. Nathanson; 50 W.
CKCV—Quebec, Quebec, Can.; Vandry, Inc.; 50 W.
CKPC—Preston, Ontario, Can., Cyrus Dolph; 100 W.
CNRQ—Quebec, Quebec, Can. (Uses transmitter of CKCV); Canadian National Railways; 50 W.

890 KILOCYCLES—336.9 METERS

CMX—Havana, Cuba; Francisco Lavin; 1 KW.
WJAR—Providence, R. I.; the Outlet Co.; 500 W.
WKAQ—San Juan, P. R.; Radio Corporation of Porto Rico; 500 W.*
WMMN—Fairmount, W. Va.; Holt-Rowe Novelty Co.; 500 W.*
WGST—Atlanta, Ga.; Georgia School of Technology; 500 W.*
KGJF—Little Rock, Ark.; First Church of the Nazarene; 250 W.

890 KILOCYCLES—336.9 METERS (Cont.)

WILL—Urbana, Ill.; University of Illinois; 500 W.*
KARK—Little Rock, Ark.; Ark. Radio & Equip. Co.; 250 W.
KFNF—Shenandoah, Iowa; Henry Field Co.; 500 W.
KUSD—Vermillion, S. Dak.; University of South Dakota; 750 W.*
KFNF—Shenandoah, Iowa; Henry Field Co.; 1 KW.*
CFBO—St. John, New Brunswick, Can.; C. A. Munro, Ltd.; 500 W.
CKCO—Ottawa, Ontario, Can.; Dr. G. M. Geldert; 100 W.
CKPR—Port Arthur, Ontario, Can.; Dougall Motor Car Co., Ltd.; 50 W.
XES—Tampico, Tams., Mex.; Difusoral Portena; 500 W.
CMCF—Havana, Cuba; Raoul Karman; 250 W.

900 KILOCYCLES—333.1 METERS

WBEN—Buffalo, N. Y.; T—Martinsville, N. Y.; WBEN, Inc.; 1 KW.
WKY—Oklahoma City, Okla.; WKY Radiophone Co.; 1 KW.
WJAX—Jacksonville, Fla.; City of Jacksonville; 1 KW.
WLBL—Stevens Point, Wis.; State of Wisconsin, Department of Agriculture and Markets, 2 KW.
KHJ—Los Angeles, Calif.; Don Lee (Inc.); 1 KW.
KSEI—Pocatello, Idaho; Radio Service Corp.; 250 W. C. P. 500 W.
KGBU—Ketchikan, Alaska; Alaska Radio and Service Co. (Inc.), 100 W. (500 W., C. P.).

910 KILOCYCLES—329.5 METERS

CFQC—Saskatoon, Saskatchewan, Can.; The Electric Shop, Ltd.; 500 W.
CNRS—Saskatoon, Saskatchewan, Can. (Uses transmitter of CFQC); Canadian National Railways; 500 W.
XEW—Mexico City, Mex.; Mexico Music Co.; S. A.; 5 KW.

915 KILOCYCLES—327.7 METERS

CFLC—Prescott, Ontario, Can.; Radio Association of Prescott; 100 W

920 KILOCYCLES—325.9 METERS

WBSO—Needham, Mass.; Babson's Statistical Organization (Inc.); 500 W.
WWJ—Detroit, Mich.; The Evening News Association (Inc.); 1 KW.
KPRC—Houston, Tex.; T—Sugarland, Texas; Houston Printing Co.; 2½ KW.
WAAF—Chicago, Ill.; Drovers Journal Publishing Co.; 500 W.
KOMO—Seattle, Wash.; Fisher's Blend Station (Inc.); 1 KW.
KFEL—Denver, Colo.; Eugene P. O'Fallon (Inc.); 500 W.
KFXF—Denver, Colo.; Colorado Radio Corporation; 500 W.

925 KILOCYCLES—324.1 METERS

CMCD—Havana, Cuba; Angel Bertematy; 250 W.
CMCN—Havana, Cuba; Antonio Ginard; 250 W.

930 KILOCYCLES—322.4 METERS

WIBG—Glenside, Pa.; St. Paul's P. E. Church; 25 W.
WDBJ—Roanoke, Va.; Times-Royal Corp.; 500 W.*
WBRC—Birmingham, Ala.; Birmingham Broadcasting Co. (Inc.); 1 KW.*
KGBZ—York, Nebr.; Dr. George R. Miller; 1 KW.*
KMA—Shenandoah, Iowa; May Seed & Nursery Co.; 1 KW.*
KFWI—San Francisco, Calif.; Radio Entertainments (Inc.); 500 W.
KROW—Oakland, Calif.; T—Richmond, Calif.; Educational Broadcasting Corporation; 1 KW.*
CKX—Brandon, Manitoba, Can.; Manitoba Telephone System; 500 W.
CFCH—North Bay, Ontario, Can.; Northern Supplies, Ltd.; 100 W.
CFRC—Kingston, Ontario, Can.; Queens University; 250 W.*
CMJF—Camaguey, Cuba; John L. Stowers; 225 W.

940 KILOCYCLES—319.0 METERS

WAAT—Jersey City, N. J.; Bremer Broadcasting Corporation; 300 W.
WCSH—Portland, Me.; T—Scarboro, Me.; Congress Square Hotel Co.; 1 KW.
WFIW—Hopkinsville, Ky.; WFIW (Inc.); 1 KW.
WHA—Madison, Wis.; University of Wisconsin; 750 W.
WDAY—Fargo, N. Dak.; T—West Fargo, N. Dak.; WDAY (Inc.); 1 KW.
KOIN—Portland, Oreg.; T—Sylvan, Oreg.; KOIN (Inc.); 1 KW.
XEO—Mexico City, Mex.; Partido Nacional Rev.; 5 KW.

950 KILOCYCLES—315.6 METERS

WRC—Washington, D. C.; National Broadcasting Co. (Inc.); 500 W.
KMBC—Kansas City, Mo.; T—Independence, Mo.; Midland Broadcasting Co.; 1 KW.
KFWB—Hollywood, Calif.; Warner Bros. Broadcasting Corporation; 1 KW.
KGHL—Billings, Mont.; Northwestern Auto Supply Co. (Inc.); 2½*.
VONA—St. Johns, N. F.; Lane, Gillard & Avery; 30 W.
CMHD—Caibarien, Cuba; Manuel Alvarez; 250 W.

960 KILOCYCLES—312.3 METERS

CHCK—Charlottetown, Prince Edward Island, Can.; W. E. Burke & J. A. Gesner; 100 W.
CHWC—Regina, Saskatchewan, Can.; T—Pilot Butte, Saskatchewan, Can.; R. H. Williams & Sons, Ltd.; 500 W.
CJBR—Regina, Saskatchewan, Can. (Uses transmitter of CKCK); Saskatchewan Co-operative Wheat Producers, Ltd.; 500 W.
CKCK—Regina, Saskatchewan, Can.; Leader Publishing Co., Ltd.; 500 W.
CKNC—Toronto, Ontario, Can.; Canadian National Carbon Co.; 500 W.
CNRR—Regina, Saskatchewan, Can. (Uses transmitter of CKCK); Canadian National Railways; 500 W.
XED—Reynosa, Tams., Mex. (Actual frequency 965 KC—310.8 Meters); Cia. Int. Dif. Reynosa, S. A.; 10 KW.

965 KILOCYCLES—310.7 METERS

CMBC—Havana, Cuba; Domingo Fernandez; 150 W.
CMBD—Havana, Cuba; Luis Perez Garcia; 150 W.

970 KILOCYCLES—309.1 METERS

WCFL—Chicago, Ill.; Chicago Federation of Labor; 1½ KW.
KJR—Seattle, Wash.; Northwest Broadcasting System (Inc.); 5 KW.

980 KILOCYCLES—305.9 METERS

KDKA—Pittsburgh, Pa.; T—Saxonburg, Pa., Westinghouse Electric & Manufacturing Co.; 50 KW.

985 KILOCYCLES—304.4 METERS

CFCN—Calgary, Alberta, Can.; T—Strathmore, Alta., Can.; W. W. Grant & H. G. Love; 10 KW.

987 KILOCYCLES—303.8 METERS

CMGF—Matanzas, Cuba; Bernabe R. de la Torre; 50 W.

990 KILOCYCLES—302.8 METERS

WBZ—Springfield, Mass.; T—East Springfield, Mass.; Westinghouse Electric & Manufacturing Co.; 25 KW.
WBZA—Boston, Mass.; Westinghouse Electric & Manufacturing Co.; 1 KW
XEK—Mexico City, Mex.; Arturo Martinez; 100 W.

1000 KILOCYCLES—299.8 METERS

WHO—Des Moines, Iowa; Central Broadcasting Co.; 5 KW. (C. P. 50 KW.)
WOC—Davenport, Iowa; Central Broadcasting Co.; 5 KW. (C. P. 50 KW.).
KFVD—Culver City, Calif.; Los Angeles Broadcasting Co.; 250 W.
XEA—Guadalajara, Jal., Mex; Alberto Palos Sauza; 100 W.
XEC—Toluca, Mex.; Jesus R. Benavides; 50 W.
XEE—Oaxaca, Oax., Mex.; Alfonso Zorrilla B.; 105 W.
XEFE—N. Laredo, Tams., Mex.; Rafael T. Carranza; 100 W.
XEFI—Chihuahua, Chih., Mex.; Feliciano Lopez Islas; 100 W.
XEFS—Queretaro, Quer., Mex., Salvador Sanchez, 40 W.
XEI—Morelia, Mich., Mex.; Carlos Gutierrez; 100 W.
XEJ—C. Juarez, Chih., Mex.; Juan G. Buttner; 100 W.
XEL—Saltillo, Coah.; Antonio Garza Castro; 25 W.
XETC—Jalapa, Ver., Mex.; Juventino Canchez; 100 W.
XETG—Torreon, Coah., Mex.; Feliciano Lopez Islas; 100 W.
XEU—Veracruz, Ver., Mexico.; Fernando Pazos; 100 W.
XEV—Puebla, Pue., Mex.; Ciro Molino; 100 W.
XEY—Merida, Yuc., Mex.; Partido Socialista S. E.; 105 W.

1010 KILOCYCLES—296.8 METERS

WORK—York, Pa.; York Bdcg. Co.; 1 KW.
WQAO—New York, N. Y.; T—Cliffside, N. J.; Calvary Baptist Church; 250 W.
WHN—New York, N. Y.; Marcus Loew Booking Agency; 250 W.
WPAP—New York City; Palisades Amusement Park; 250 W.
WRNY—New York, N. Y.; T—Coytesville, N. J.; Aviation Radio Station (Inc.); 250 W.
KGGF—Coffeyville, Kans.; Hugh J. Powell and Stanley Platz, doing business as Powell & Platz; 500 W.
WNAD—Norman, Okla.; University of Oklahoma; 500 W.
WIS—Columbia, S. C.; South Carolina Broadcasting Co. (Inc.); 1 KW.*
KQW—San Jose, Calif.; Pacific Agricultural Foundation Ltd.; 500 W.
CHCS—Hamilton, Ontario; T—Fruitland, Ontario (Uses transmitter of CKOC—630 KC. temporarily); Hamilton Spectator; 1 KW.*
CKIC—Wolfville, Nova Scotia; Acadia University; 50 W.
CKOC—Hamilton, Ontario; T—Fruitland, Ontario (Uses 630 KC temporarily); Wentworth Radio Broadcasting Co., Ltd.; 1 KW.*
CKTB—St. Catharines, Ontario; T—Fruitland, Ontario. (Uses transmitter of CKOC, 630 KC., temporarily); Taylor & Bates, Ltd.; 1 KW.*
CMBZ—Havana, Cuba; Manuel y G. Salas; 150 W.

1017 KILOCYCLES—293.73 METERS

CMJH—Ciego de Avila, Cuba; Luis Marauri; 15 W.

1020 KILOCYCLES—293.9 METERS

WRAX—Philadelphia, Pa.; WRAX Broadcasting Co.; 250 W.
KYW-KFKX—Chicago, Ill.; T—Bloomingdale Township, Ill.; Westinghouse Electric & Manufacturing Co.; 10 KW.
XEFD—Tijuana, B. C., Mex.; Carlos de la Sierra, 300 W.

1030 KILOCYCLES—291.1 METERS

CFCF—Montreal, Quebec, Can.; Canadian Marconi Co.; 500 W.
CNRV—Vancouver, British Columbia, Can.; T—Lulu Island, British Columbia, Can.; Canadian National Railways; 500 W.
CMHI—Santa Clara, Cuba; Lavis y Paz; 30 W.

1034 KILOCYCLES—290 METERS

CMKC—Santiago de Cuba; M. P. Martinez; 150 W.

1,040 KILOCYCLES—288.3 METERS

WMAK—Buffalo, N. Y.; T—Grand Island, Buffalo, N. Y.; Buffalo Broadcasting Corporation; 1 KW.
WKAR—East Lansing, Mich.; Michigan State College; 1 KW.
KTHS—Hot Springs National Park, Ark.; Hot Springs Chamber of Commerce; 10 KW.
KRLD—Dallas, Tex.; KRLD Radio Corporation; 10 KW.
CMGH—Matanzas, Cuba.

1050 KILOCYCLES—285.5 METERS

KFBI—Albilene, Kans.; Farmers & Bankers Life Insurance Co.; 5 KW.
KNX—Hollywood, Calif.; T—Los Angeles, Calif.; Western Broadcast Co.; 5KW.
XEFC—Merida, Yuc., Mex.; Hugo Molina Font.; 10 W.
CMJG—Camaguey, Cuba; Pedro Nogueras; 50 W.

1060 KILOCYCLES—282.8 METERS

WBAL—Baltimore, Md.; T—Glen Morris, Md.; Consolidated Gas, Electric Light & Power Company of Baltimore; 10 KW.
WTIC—Hartford, Conn.; T—Avon, Conn.; Travelers Broadcasting Service Corporation; 50 KW.
WJAG—Norfolk, Nebr.; Norfolk Daily News; 1 KW.
KWJJ—Portland, Ore.; KWJJ Broadcast Co. (Inc.); 500 W.

1070 KILOCYCLES—280.2 METERS

WTAM—Cleveland, Ohio; T—Brecksville Village, Ohio; National Broadcasting Co. (Inc.); 50 KW.
WCAZ—Carthage, Ill.; Superior Broadcasting Service (Inc.); 50 W.
WDZ—Tuscola, Ill.; James L. Bush; 100 W.
KJBS—San Francisco, Calif.; Julius Brunton & Sons Co.; 100 W.
XEG—Mexico, D. F.; Miguel Yarza; 250 W.
CMBG—Havana, Cuba; Francisco Garrigo; 225 W.
CMCB—Havana, Cuba; Antonio Capablanca; 150 W.

1080 KILOCYCLES—277.6 METERS

WBT—Charlotte, N. C.; Station WBT (Inc.); 5 KW.
WCBD—Zion, Ill.; Wilbur Glenn Voliva; 5 KW.
WMBI—Chicago, Ill.; T—Addison, Ill.; The Moody Bible Institute Radio Station; 5 KW.

1090 KILOCYCLES—275.1 METERS

KMOX—St. Louis, Mo.; Voice of St. Louis (Inc.); 50 KW.

1100 KILOCYCLES—272.6 METERS

WPG—Atlantic City, N. J.; WPG Broadcasting Corporation; 5 KW.
WLWL—New York, N. Y.; T—Kearny, N. J.; Missionary Society of St. Paul the Apostle; 5 KW.
KGDM—Stockton, Calif.; E. F. Peffer; 250 W.

1110 KILOCYCLES—270.1 METERS

WRVA—Richmond, Va.; T—Mechanicsville, Va.; Larus & Brother Co. (Inc.); 5 KW.
KSOO—Sioux Falls, S. Dak.; Sioux Falls Broadcast Association (Inc.); 2½ KW.

1120 KILOCYCLES—267.7 METERS

WDEL—Wilmington, Del.; WDEL (Inc.); 350 W.*
WTAW—College Station, Tex.; Agricultural and Mechanics College of Texas; 500 W.
KTRH—Houston, Tex.; Rice Hotel; 500 W.
WISN—Milwaukee, Wis.; American Radio News Corp.; 250 W.
WHAD—Milwaukee, Wis.; Marquette University; 250 W.
KFSG—Los Angeles, Calif.; Echo Park Evangelistic Association; 500 W.
KRKD—Inglewood, Calif.; Dalton's (Inc.); 500 W. (1 KW. C.P.).
KRSC—Seattle, Wash.; Radio Sales Corporation; 100 W.
KFIO—Spokane, Wash.; Spokane Broadcasting Corporation; 100 W.
CFCA—Toronto, Ontario, Can.; Star Publishing & Printing Co.; 500 W.
CFJC—Kamloops, British Columbia, Can.; S. D. Dalgleish & Sons, Ltd.; 100 W.
CHGS—Summerside, Prince Edward Island, Can.; R. T. Holman, Ltd.; 500 W.

1120 KILOCYCLES—267.7 METERS (Cont.)

CJOC—Lethbridge, Alberta, Can.; H. R. Carson; 100 W.
CNRT—Toronto, Ontario, Can.; (Uses transmitter of CFCA); Canadian National Railways; 500 W.

1125 KILOCYCLES—266.6 METERS

CMHJ—Cienfuegos, Cuba; Arturo Hernandez; 40 W.

1130 KILOCYCLES—265.3 METERS

WOV—New York City; T—Secaucus, N. J.; International Broadcasting Corporation; 1 KW.
WJJD—Moosehart, Ill.; WJJD, Inc.; 20 KW.
KSL—Salt Lake City, Utah; Radio Service Corporation of Utah; 5 KW. (50 KW.—C. P.).
XEH—Monterrey, N. L., Mex.; Constantino Tarnaca; 1 KW. (Actual frequency 1,132 KC.—265 Meters).

1140 KILOCYCLES—263.0 METERS

WAPI—Birmingham, Ala.; WAPI Broadcasting Corp.; 5 KW.
KVOO—Tulsa, Okla.; Southwestern Sales Corporation; 5 KW. (25 KW.—C.P.).
CMBW—Havana, Cuba; Modesto Alvarez; 150 W.
CMCQ—Havana, Cuba; Andres Martinez; 1 KW.
XETA—Mexico, D. F.; M. E. Taglo; 500 W.

1150 KILOCYCLES—260.7 METERS

WHAM—Rochester, N. Y.; T—Victor Township, N. Y.; Stromberg-Carlson Telephone Manufacturing Co.; 5 KW.
CMGI—Colon, Cuba; Armando Lizama; 30 W.

1160 KILOCYCLES—258.5 METERS

WWVA—Wheeling, W. Va.; West Virginia Broadcasting Corporation; 5 KW.
WOWO—Fort Wayne, Ind.; Main Auto Supply Co.; 10 KW.

1170 KILOCYCLES—256.3 METERS

WCAU—Philadelphia, Pa.; T—Byberry; Universal Broadcasting Co.; 10 KW.

1180 KILOCYCLES—254.1 METERS

WINS—New York, N. Y.; T—Astoria, L. I., N. Y.; American Radio News Corp.; 500 W.
WDGY—Minneapolis, Minn.; Dr. George W. Young; 1 KW.
KEX—Portland, Ore.; Western Broadcasting Co.; 5 KW.
KOB—State College, N. Mex.; New Mexico College of Agriculture and Mechanic Arts, 20 KW.
WMAZ—Macon, Ga.; Southern Broadcasting Co., Inc.; 500 W.
CMJE—Camaguey, Cuba; Manuel Fernandez; 30 W.

1190 KILOCYCLES—252.0 METERS

WOAI—San Antonio, Tex.; T—Selma, Tex.; Southern Equipment Co.; 50 KW.

1200 KILOCYCLES—249.9 METERS

WRBL—Columbus, Ga.; WRBL Radio Station Inc.; 100 W.
WABI—Bangor, Me.; Universalist Society of Bangor; 100 W.
WNBX—Springfield, Vt.; First Congregational Church Corporation; 10 W.
WCAX—Burlington, Vt.; Burlington Daily News; 100 W.
WORC-WEPS—Worcester, Mass.; T—Auburn, Mass.; Albert Frank Kleindeinst; 100 W.
KERN—Bakersfield, Calif.; Bakersfield Bdcg. Co.; 100 W.
WIBX—Utica, N. Y.; WIBX (Inc.); 300 W.*
WFBE—Cincinnati, Ohio; Post Publishing Co.; 250 W.*
WHBC—Canton, Ohio; St. John's Catholic Church; 10 W.
WLBG—Petersburg, Va.; T—Ettrick, Va.; WLBG Inc.; 250W.*
WNBO—Washington, Pa.; John Brownlee Spriggs; 100 W.
WCOD—Harrisburg, Pa.; Keystone Broadcasting Corporation; 100 W.
WNBW—Carbondale, Pa.; WNBW, Inc.; 10 W.
KMLB—Monroe, La.; J. C. Liner; 100 W.
WABZ—New Orleans, La.; Samuel D. Reeks; 100 W.
WJBW—New Orleans, La.; C. Carlson; 100 W.
WBBZ—Ponca City, Okla.; C. L. Carrell; 100 W.
WFBC—Knoxville, Tenn.; Virgil V. Evans; 50 W.
KGHI—Little Rock, Ark.; O. A. Cook; 100 W.
KBTM—Paragould, Ark.; W. J. Beard, Beard's Temple of Music; 100 W.
WJBC—La Salle, Ill.; Wayne Hummer & H. J. Dee, doing business as Kaskaskia Broadcasting Co.; 100 W.
WJBL—Decatur, Ill.; Commodore Broadcasting Corporation; 100 W.
WWAE—Hammond, Ind.; Hammond-Calumet Broadcasting Corporation; 100 W.
KFJB—Marshalltown, Iowa; Marshall Electric Co. (Inc.); 250 W.*
WCAT—Rapid City, S. Dak.; South Dakota State School of Mines; 100 W.
KGDY—Huron, S. Dak.; Voice of South Dakota; 100 W.
KFWF—St. Louis, Mo.; St. Louis Truth Center (Inc.); 100 W.
KGDE—Fergus Falls, Minn.; Jaren Drug Co.; 250W.*
WCLO—Janesville, Wis.; WCLO Radio Corporation; 100 W.
WHBY—Green Bay, Wis.; T—West De Pere, Wis.; St. Norbert College; 100 W.
WIL—St. Louis, Mo.; Missouri Broadcasting Corporation; 250 W.*
KGFJ—Los Angeles, Calif.; Ben S. McGlashan; 100 W.
KGVO—Missoula, Mich.; Mosby's (Inc.); 100 W.
KFXD—Nampa, Idaho; Frank E. Hurt, trading as Service Radio Co.; 500 W.
KWG—Stockton, Calif.; Portable Wireless Telephone Co. (Inc.); 100 W.
KGEK—Yuma, Colo.; Elmer C. Beehler, trading as Beehler Electrical Equipment Co.; 100 W.
KGEW—Fort Morgan, Colo.; City of Fort Morgan; 100 W.
KVOS—Bellingham, Wash.; KVOS (Inc.); 100 W.
WFAM—South Bend, Ind.; South Bend Tribune; 100 W.
WBHS—Huntsville, Ala.; The Hutchens Co.; 100 W.
CKOV—Kelowna, British Columbia, Can.; J. W. B. Browne; 100 W.
10AB—Moose Jaw, Saskatchewan, Can.; Moose Jaw Radio Assn.; 25 W.
10AK—Stratford, Ontario, Can.; Classic Radio Club; 10 W.
10BJ—Prince Albert, Saskatchewan, Can.; Prince Albert Radio Club; 25 W.
10BP—Wingham, Ontario, Can.; Wingham Radio Club; 15 W.
10BQ—Brantford, Ontario, Can.; Telephone City Radio Assn.; 5 W.
10BU—Canora, Saskatchewan, Can.; Canora Radio Association; 15 W.

1205 KILOCYCLES—248.8 METERS

CMGB—Matanzas, Cuba; Jose Anorga; 30 W.

1210 KILOCYCLES—247.8 METERS

WMRJ—Jamaica, N. Y.; Peter J. Prinz; 100 W.
WJBI—Redbank, N. J.; Monmouth Broadcasting Co.; 100 W.
WGBB—Freeport, N. Y.; Harry H. Carman; 100 W.
WCOH—Yonkers, N. Y.; T—Greenville, N. Y.; Westchester Broadcasting Corporation, 100 W.
KGY—Olympia, Wash.; KGY Inc.; 100 W.
WOCL—Jamestown, N. Y.; A. E. Newton; 50 W.
WLCI—Ithaca, N. Y.; Lutheran Association of Ithaca, N. Y.; 50 W.
WPAW—Pawtucket, R. I.; Shartenberg & Robinson Co.; 100 W.
WSEN—Columbus, Ohio; Columbus Broadcasting Corporation; 100 W.
WJW—Mansfield, Ohio; John F. Weimer (owner Mansfield Broadcasting Association); 100 W.
WALR—Zanesville, Ohio; WALR Broadcasting Corp.; 100 W.
WBAX—Wilkes-Barre, Pa.; T—Plains Township, Pa.; John H. Stenger, Jr.; 100 W.
WJBU—Lewisburg, Pa.; Bucknell University; 100 W.
WBBL—Richmond, Va.; Grace Covenant Presbyterian Church; 100 W.
WMBG—Richmond, Va.; Havens & Martin (Inc.); 100 W.

(Continued on next page)

1210 KILOCYCLES—247.8 METERS (Cont.)

WSIX—Springfield, Tenn.; Jack M. and Louis R. Draughon, doing business as 638 Tire and Vulcanizing Co.; 100 W.
WSOC—Gastonia, N. C.; WSOC (Inc.); 100 W.
WJBY—Gadsden Ala.; Gadsden Broadcasting Co. (Inc.); 100 W.
WQDX—Thomasville, Ga.; Stevens Luke; 50 W.
WRBQ—Greenville, Miss.; J. Pat Scully; 250 W.*
KWEA—Shreveport, La.; Hello World Broadcasting Corporation; 100 W.
KDLR—Devils Lake, N. Dak.; KDLR (Inc.); 100 W.
KGCR—Watertown, S. Dak.; Greater Kampeska Radio Corp.; 100 W.
KFOR—Lincoln, Nebr.; Howard A. Shuman; 250 W.*
WHBU—Anderson, Ind.; Anderson Broadcasting Corp.; 100 W.
WEBQ—Harrisburg, Ill.; Harrisburg Bdcstg Co.; 100 W.
—Troy, Ala.; Troy Bdcg. Co.; 100 W.
WSBC—Chicago, Ill.; World Battery Co. (Inc.); 100 W.
WCRW—Chicago, Ill.; Clinton R. White; 100 W.
WEDC—Chicago, Ill.; Emil Denemark (Inc.); 100 W.
WCBS—Springfield, Ill.; Chas. H. Messter and Harold L. Dewing; 100 W.
WTAX—Springfield, Ill.; WTAX (Inc.); 100 W.
WHBF—Rock Island, Ill.; Beardsley Specialty Co.; 100 W.
WOMT—Manitowoc, Wis.; Francis M. Kadow; 100 W.
WIBU—Poynette, Wis.; William C. Forrest; 100 W.
KGNO—Dodge City, Kans.; Dodge City Broadcasting Co. (Inc.); 100 W.
KGRS—Amarillo, Tex.; E. B. Gish; 1 KW.
KFXM—San Bernardino, Calif.; J. C. & E. W. Lee (Lee Bros. Broadcasting Co.); 100 W.
KFVS—Cape Girardeau, Mo.; Oscar C. Hirsch, trading as Hirsch Battery & Radio Co.; 100 W.
KPPC—Pasadena, Calif.; Pasadena Presbyterian Church; 50 W.
KFJI—Klamath Falls, Ore.; KFJI Broadcasters, Inc.; 100 W.
WPRO—Providence, R. I.; Cherry & Webb Broadcasting Co.; 100 W.
KGMP—Elk City, Okla.; Bryant Radio & Electric Co.; 100 W.
KGY—Olympia, Wash.; KGY, Inc.; 100 W.
CFCO—Chatham, Ontario, Can.; John Beardall; 100 W.
CFNB—Fredericton, New Brunswick, Can.; Jas. S. Neill & Sons, Ltd.; 50 W.
CJOR—Vancouver, British Columbia, Can.; T—Sea Island, British Columbia, Can.; G. C. Chandler; 500 W.
CKMC—Cobalt, Ontario, Can.; R. L. MacAdam; 100 W.
XEX—Mexico City, Mex.; Excelsior; 500 W.

1220 KILOCYCLES—245.8 METERS

WCAD—Canton, N. Y.; St. Lawrence University; 500 W.
WCAE—Pittsburgh, Pa.; WCAE, Inc.; 1 KW.
WDAE—Tampa, Fla.; Tampa Publishing Co.; 1 KW.
WREN—Tanganoxie, Kans.; Jenny Wren Co.; 1 KW.
KFKU—Lawrence, Kans.; University of Kansas; 500 W.
KWSC—Pullman, Wash.; State College of Washington; 2 KW.*
KTW—Seattle, Wash.; First Presbyterian Church; 1 KW.

1225 KILOCYCLES—244.8 METERS

CMBY—Havana, Cuba; Callejas-Cosculluela; 350 W.

1230 KILOCYCLES—243.8 METERS

WNAC-WBIS—Boston, Mass.; T—Quincy, Mass.; Shepard Broadcasting Service (Inc.); 1 KW.
WPSC—State College, Pa.; The Pennsylvania State College; 500 W.
WSBT—South Bend, Ind.; South Bend Tribune; 500 W.
WFBM—Indianapolis, Ind.; Indianapolis Power & Light Co.; 1 KW.
KGGM—Albuquerque, N. Mex.; New Mexico Broadcasting Co.; 500 W.*
KYA—San Francisco, Calif.; Pacific Broadcasting Corporation; 1 KW.
KFQD—Anchorage, Alaska; Anchorage Radio Club; 250 W.
XETQ—Mexico City, Mex.; Carlos G. Caballero; 100 W.

1235 KILOCYCLES—242.8 METERS

CMCA—Havana, Cuba; Manuel Cruz; 150 W.

1240 KILOCYCLES—241-8 METERS

WXYZ—Detroit, Mich.; Kunsky-Trendle Broadcasting Corporation; 1 KW.
KTAT—Fort Worth, Tex.; T—Birdville, Tex.; S. A. T. Broadcast Co.; 1 KW.
WACO—Waco, Tex.; Central Texas Broadcasting Co. (Inc.); 1 KW.
KGCU—Mandan, N. Dak.; Mandan Radio Assn.; 250 W.
KLPM—Minot, N. Dak.; John B. Cooley; 250 W.
KTFI—Twin Falls, Idaho; Radio Bdcg. Corp.; 500 W.

1249 KILOCYCLES—240 METERS

CMAB—Pinar del Rio, Cuba; Francisco Martinez; 20 W.

1250 KILOCYCLES—239.9 METERS

WGCP—Newark, N. J.; May Radio Broadcast Corporation; 250 W.
WODA—Paterson, N. J.; Richard E. O'Dea; 1 KW.
WAAM—Newark, N. J.; WAAM (Inc.); 2 KW.*
WDSU—New Orleans, La.; T—Gretna, La.; Joseph H. Uhalt; 1 KW.
WLB—Minneapolis, Minn.; T—St. Paul, Minn.; University of Minnesota; 1 KW.
WRHM—Minneapolis, Minn.; T—Fridley, Minn.; Minnesota Broadcasting Corporation; 1 KW.
KFMX—Northfield, Minn.; Carlton College; 1 KW.
WCAL—Northfield, Minn.; St. Olaf College; 1 KW.
KFOX—Long Beach, Calif.; Nichols and Warriner (Inc.); 1 KW.
XEFA—Mexico City, Mex.; Manuel F. Murguia; 250 W.

1260 KILOCYCLES—238.0 METERS

WLBW—Erie, Pa.; Broadcasters of Pennsylvania, Inc.; 1 K*
KWWG—Brownsville, Tex.; Frank P. Jackson; 500 W.
WTOC—Savannah, Ga.; Savannah Broadcasting Co., (Inc.); 500 W.
KRGV—Harlingen, Tex.; KRGV (Inc.); 500 W.
KOIL—Council Bluffs, Iowa; Mona Motor Oil Co.; 1 KW.
KVOA—Tuscon, Ariz.; Robert M. Riculfi; 500 W.

1270 KILOCYCLES—236.1 METERS

WEAI—Ithaca, N. Y.; Cornell University; 1 KW.
WFBR—Baltimore, Md.; Baltimore Radio Show (Inc.); 500 W.
WASH—Grand Rapids, Mich. (Uses transmitter of WOOD); WASH Broadcasting Corporation; 500 W. (1 KW.—C.P.).
WOOD—Grand Rapids, Mich.; T—Furn-Kunsky-Trendle Broadcasting Corp.; 500 W.
WJDX—Jackson, Miss.; Lamar Life Insurance Co.; 1 KW.
KWLC—Decorah, Iowa; Luther College; 100 W.
KGCA—Decorah, Iowa; Charles W. Greenley; 100 W.
KOL—Seattle, Wash.; Seattle Broadcasting Co. (Inc.); 1 KW.
KVOR—Colorado Springs, Colo.; Reynolds Radio Co., Inc.; 1 KW.
CMCU—Havana, Cuba; Jorge Garcia Serra; 150 W.

1280 KILOCYCLES—234.2 METERS

WCAM—Camden, N. J.; City of Camden; 500 W.
WCAP—Asbury Park, N. J.; Radio Industries Broadcast Co.; 500 W.
WOAX—Trenton, N. J.; WOAX (Inc.); 500 W.
WDOD—Chattanooga, Tenn.; T—Brainerd, Tenn.; WDOD Broadcasting Corporation; 1 KW. (5 KW.—C.P.).
WRR—Dallas, Tex.; City of Dallas, Tex.; 500 W.
WIBA—Madison, Wis.; Badger Broadcasting Co.; 500 W.
KFBB—Great Falls, Mont.; Buttrey Broadcast (Inc.); 2½ KW.*

1285 KILOCYCLES—233.4 METERS

CMCW—Havana, Cuba; Jose Lorenzo; 150 W.

1290 KILOCYCLES—232.4 METERS

WNBZ—Saranac Lake, N. Y.; Earl J. Smith and William Mace, doing business as Smith & Mace; 50 W.
WJAS—Pittsburgh, Pa.; T—North Fayette Township, Pa.; Pittsburgh Radio Supply House; 2½ KW.*
KTSA—San Antonio, Tex.; Lone Star Broadcasting Co. (Inc.); 2 KW.*
KFUL—Galveston, Tex.; News Publishing Co.; 500 W.
KLCN—Blytheville, Ark.; Charles Leo Lintzenich; 50 W.
WEBC—Superior, Wisc.; Head of the Lakes Broadcasting Co.; 2½ KC.*
KDYL—Salt Lake City, Utah; Intermountain Broadcasting Corporation; 1 KW.

1300 KILOCYCLES—230.6 METERS

WBBR—Brooklyn, N. Y.; T—Rossville, N. Y. (Staten Island); Peoples Pulpit Association; 1 KW.
WFAB—New York, N. Y.; T—Carlstadt, N. J.; Defenders of Truth Society (Inc.); 1 KW.
WEVD—New York, N. Y.; T—Forest Hills, N. Y.; Debs Memorial Radio Fund (Inc.); 500 W.
WHAZ—Troy, N. Y.; Rensselaer Polytechnic Institute; 500 W.
WIOD—WMBF—Miami, Fla.; T—Miami Beach, Fla.; Isle of Dreams Broadcasting Corporation; 1 KW.
WOQ—Kansas City, Mo.; Unity School of Christianity; 1 KW.
Corporation; 1KW.
KFH—Wichita, Kans.; Radio Station KFH Co.; 1 KW.
KFJR—Portland, Ore.; Ashley C. Dixon, trading as Ashley C. Dixon & Son; 500 W.
KALE—Kale, Inc.; 500 W.
KTBR—Portland, Ore.; M. E. Brown; 500 W.
KFAC—Los Angeles, Calif.; Los Angeles Broadcasting Co.; 1 KW.
XEM—Mexico City, Mex.; Maria T. de Gutierez; 250 W.

1310 KILOCYCLES—228.9 METERS

WKBS—Galesburg, Ill.; S. E. Yaste and Burrell Banash; 100 W.
WKAV—Laconia, N. H.; Laconia Radio Club; 100 W.
WEBR—Buffalo, N. Y.; Howell Broadcasting Co. (Inc.); 250 W.*
WMBO—Auburn, N. Y.; WMBO, Inc.; 100 W.
WNBH—New Bedford, Mass.; T—Fairhaven, Mass.; Irving Vermilya, trading as New Bedford Broadcasting Co.; 100 W.
WOL—Washington, D. C.; American Broadcasting Co.; 100 W.
WGH—Newport News, Va.; Hampton Roads Broadcasting Corporation; 100 W.
WEXL—Royal Oak, Mich.; Royal Oak Broadcasting Co.; 50 W.
WFDF—Flint, Mich.; Frank D. Fallain; 100 W.
WBEO—Marquette, Mich.; Lake Superior Broadcasting Co.; 100 W.
WHAT—Philadelphia, Pa.; Independence Broadcasting Co.; 100 W.
WTEL—Philadelphia, Pa.; Foulkrod Radio Engineering Co.; 100 W.
WJAC—Johnstown, Pa.; Johnstown Automobile Co.; 100 W.
WFBG—Altoona, Pa.; William F. Gable Co.; 100 W.
WRAW—Reading, Pa.; Reading Broadcasting Co.; 100 W.
WGAL—Lancaster, Pa.; WGAL, Incorporated; 100 W.
WSAJ—Grove City, Pa.; Grove City College; 100 W.
WBRE—Wilkes-Barre, Pa.; Louis G. Baltimore; 100 W.
WKBC—Birmingham, Ala.; R. B. Broyles, trading as R. B. Broyles Furniture Co.; 100 W.
WTJS—Jackson, Tenn.; Sun Pub. Co.; 100 W.
WTSL—Laurel, Miss.; G. H. Houseman; 100 W.
WROL—Knoxville, Tenn.; Stuart Broadcasting Corporation; 100 W.
KRMD—Shreveport, La.; Radio Station KRMD, Inc.; 100 W.
WSJS—Winston-Salem, N. C.; Winston-Salem Journal Co.; 100 W.
KTLC—Houston, Tex.; Houston Broadcasting Co.; 100 W.
KFPM—Greenville, Tex.; Dave Ablowich, trading as The New Furniture Co.; 15 W.
KTSM—El Paso, Tex.; Tri-State Bdcstg Co., Inc.; 100 W.
WDAH—El Paso, Tex.; Tri-State Bdcstg Co., Inc.; 100 W.
KFPL—Dublin, Tex.; C. C. Baxter; 100 W.
KFXR—Oklahoma City, Okla.; Exchange Avenue Baptist Church; 250 W.*
WKBS—Galesburg, Ill.; Permil N. Nelson; 100 W.
WCLS—Joliet, Ill.; WCLS (Inc.); 100 W.
WKBB—Joliet, Ill.; Sanders Brothers Radio Station; 100 W.
KFGQ—Boone, Iowa; Boone Biblical College; 100 W.
KGFW—Ravenna, Nebr.; Central Nebraska Broadcasting Corporation; 100 W.
WBOW—Terre Haute, Ind.; Banks of Wabash (Inc.); 100 W.
WJAK—Marion, Ind.; Marion Broadcast Co.; 50 W.
WLBC—Muncie, Ind.; Donald H. Burton; 50 W.
KGBX—St. Joseph, Mo.; KGBX (Inc.); 100 W.
KFBK—Sacramento, Calif.; James McClatchy Co.; 100 W.
KCRJ—Jerome, Ariz.; Charles C. Robinson; 100 W.
KGCX—Wolf Point, Mont.; First State Bank of Vida; 250 W.*
KGEZ—Kalispell, Mont.; Donald C. Treloar; 100 W.
KFXJ—Grand Junction, Colo.; R. G. Howell and Charles Howell, doing business as Western Slope Broadcasting Co.; 100 W.
KMED—Medford, Ore.; Mrs. W. J. Virgin; 100 W.
KXRO—Aberdeen, Wash.; KXRO (Inc.); 100 W.
KIT—Yakima, Wash.; Carl E. Haymond; 100 W.
KFYO—Lubbock, Tex.; Kirksey Bros.; 250 W.
WIAS—Iowa Bdcstg Co., Ottumwa, Ia.; 100 W.

1320 KILOCYCLES—227.1 METERS

WADC—Akron, Ga.; Allen T. Simmons; 1 KW.
WSMB—New Orleans, La.; Saenger Theatres (Inc.) and Maison Blanche Co.; 500 W.
KID—Idaho Falls, Idaho; KID Broadcasting Co.; 500 W.*
KGHF—Pueblo, Colo.; Curtis P. Ritchie and Joe E. Finch; 500 W.*
KGMB—Honolulu, Hawaii; Honolulu Broadcasting Co. (Ltd.); 250 W.

1330 KILOCYCLES—225.4 METERS

KMO—Tacoma, Wash.; KMO, Inc.; 250 W.
WDRC—Hartford, Conn.; T—Bloomfield, Conn.; WDRC (Inc.); 500 W.
WSAI—Cincinnati, O.; T—Mason, Ohio; Crosley Radio Corporation (lessee); 1 KW.*
WTAQ—Eau Claire, Wis.; T—Township of Washington, Wis.; Gillette Rubber Co.; 1 KW.
KSCJ—Sioux City, Iowa; Perkins Brothers Co.; 2½ KW.*
KGB—San Diego, Calif.; Don Lee, Inc.; 500 W.

1340 KILOCYCLES—223.7 METERS

KGIR—Butte, Mont.; KGIR (Inc.); 500 W.
WSPD—Toledo, Ohio; Toledo Broadcasting Co.; 1 KW.
KFPW—Fort Smith, Ark.; Southwestern Hotel Co.; 50 W.
WCOA—Pensacola, Fla.; Pensacola Bdcg. Co.; 500 W.
KFPY—Spokane, Wash.; Symons Broadcasting Co.; 1 KW.

1345 KILOCYCLES—223 METERS

CMCR—Havana, Cuba; Aurelio Hernandez; 150 W.
CMCY—Havana, Cuba; M. D. Autran; 250 W.

1350 KILOCYCLES—222.1 METERS

WAWZ—Zarephath, N. J.; Pillar of Fire; 250 W.
WMSG—New York, N. Y.; Madison Square Garden Broadcast Corporation; 250 W.
WCDA—New York, N. Y.; T—Cliffside Park, N. J.; Italian Educational Broadcasting Co. (Inc.); 250 W.
WBNX—New York, N. Y.; Standard Cahill Co. (Inc.); 250 W.
KWKK—St. Louis, Mo.; T—Kirkwood, Mo.; Greater St. Louis Broadcasting Corporation; 1 KW.

1350 KILOCYCLES—222.1 METERS (Cont.)

WEHC—Emory, Va.; Emory & Henry College; 500 W.
KIDO—Boise, Idaho; Boise Broadcasting Station; 1 KW.

1360 KILOCYCLES—220.4 METERS

WFBL—Syracuse, N. Y.; Onondaga Radio Broadcasting Corporation; 1 KW.
WQBC—Vicksburg, Miss.; Delta Broadcasting Co. (Inc.); 500 W.
WCSC—Charleston, S. C.; South Carolina Broadcasting Co., Inc.; 500 W.
WJKS—Gary, Ill.; Johnson-Kennedy Radio Corporation; 1¼ KW.*
WGES—Chicago, Ill.; Oak Leaves Broadcasting Station (Inc.); 1 KW.*
KGER—Long Beach, Calif.; Consolidated Broadcasting Corp.; 1 KW

1370 KILOCYCLES—218.7 METERS

WRDO—Augusta, Me.; WRDO, Inc.; 100 W.
WQDM—St. Albans, Vt.; A. J. St. Antoine and E. J. Regan; 100 W.
WLEY—Lexington, Mass.; Carl S. Wheeler, trading as Lexington Air Stations; 250 W.*
WSVS—Buffalo, N. Y.; Elmer S. Pierce, principal, Seneca Vocational High School; 50 W.
WBGF—Glens Falls, N. Y.; W. Neal Parker and Herbert H. Metcalfe; 50W.
WCBM—Baltimore, Md.; Baltimore Broadcasting Corporation; 250 W.*
WBTM—Danville, Va.; L. H., R. G. and A. S. Clarke, doing business as Clarke Electric Co.; 100 W.
WLVA—Lynchburg, Va.; Lynchburg Broadcasting Corporation; 100 W.
WHBD—Mount Orab, Ohio; F. P. Moler; 100 W.
WHDF—Calumet, Mich.; Upper Michigan Broadcasting Co.; 250 W.*
WJBK—Highland Park, Mich.; James F. Hopkins (Inc.); 50 W.
WIBM—Jackson, Mich.; WIBM (Inc.); 100 W.
WRAK—Williamsport, Pa.; Clarence R. Cummins; 100 W.
WHBQ—Memphis, Tenn.; Broadcasting Station WHBQ (Inc.); 100 W.
KGFG—Oklahoma City, Okla.; Oklahoma Broadcasting Co. (Inc.); 100 W.
KCRC—Enid, Okla.; Enid Radiphone Co.; 250 W.*
WMBR—Tampa, Fla.; F. J. Reynolds; 100 W.
KMAC—San Antonio, Tex.; W. W. McAllister; 100 W.
KFJZ—Fort Worth, Tex.; Ralph S. Bishop; 100 W.
KONO—San Antonio, Tex.; Mission Broadcasting Co.; 100 W.
KGKL—San Angelo, Tex.; KGKL (Inc.), 100 W.
KFLX—Galveston, Tex.; George Roy Clough; 100 W.
WGL—Fort Wayne, Ind.; Fred C. Zeig (Allen-Wayne Co.); 100 W.
KGDA—Mitchell, S. Dak.; Mitchell Broadcasting Corporation; 100 W.
KFJM—Great Forks, N. Dak.; University of North Dakota; 100 W.
KWKC—Kansas City, Mo.; Wilson Duncan, trading as Wilson Duncan Broadcasting Co.; 100 W.
WRJN—Racine, Wis.; Racine Broadcasting Corporation; 100 W.
KGAR—Tucson, Ariz.; Tucson Motor Service; 250 W.*
KRE—Berkeley, Calif.; First Congregational Church of Berkeley; 100 W.
KOOS—Marshfield, Ore.; H. H. Hansetly (Inc.); 100 W.
KFBL—Everett, Wash.; Otto Leese and Robert Leese, doing business as Leese Bros.; 50 W.
KVL—Seattle, Wash.; KVL, Incorporated; 100 W.
KGFL—Raton, N. Mex.; KGFL, Inc.; 50 W.
KUJ—Walla Walla, Wash.; KUJ, Inc.; 100 W.
WRAM—Wilmington, N. C.; Wilmington Radio Asso.; 100 W.
WJTL—Tifton, Ga.; Oglethorpe University; 100 W.
WPFB—Hattiesburg, Miss.; Hattiesburg Bdcg. Corp.; 100 W.
CMGH—Matanzas, Cuba; Alberto Alvarez; 150 W.

1375 KILOYCLES—218 METERS

CMAC—Pinar del Rio, Cuba; Oscar S. Mechoso; 30 W.
CMGE—Cardenas, Cuba; Genaro Sebater; 30 W.

1380 KILOCYCLES—217.3 METERS

WSMK—Dayton, Ohio; Stanley M. Krohn, Jr.; 200 W.
KQV—Pittsburgh, Pa.; KQV, Inc.; 500 W.
KSO—Clarinda, Iowa; Iowa Broadcasting Co.; 500 W.
WKBH—LaCrosse, Wis.; WKBH (Inc.); 1 KW.
KOH—Reno, Nev.; The Bee, Inc.; 500 W.
KQV—Pittsburgh, Pa.; KQV Broadcasting Co.; 500 W.
XETB—Torreon Coah., Mex.; Jose A. Berumen; 125 W.

1382 KILOCYCLES—217.25 METERS

CMJC—Camaguey, Cuba; Feliciano Isaac; 75 W.

1390 KILOCYCLES—215.7 METERS

WHK—Cleveland, Ohio; T—Seven Hills, Ohio; Radio Air Service Corporation; 1 KW.
KLRA—Little Rock, Ark.; Arkansas Broadcasting Co.; 1 KW.
KUOA—Fayetteville, Ark.; Southwestern Hotel Co.; 1 KW.
KOY—Phoenix, Ariz.; Nielsen Radio & Sporting Goods Co.; 500 W.

1395 KILOCYCLES—215 METERS

CMCG—Havana, Cuba; Jose Justo Moran; 30 W.

1400 KILOCYCLES—214.2 METERS

CMCH—Havana, Cuba; Hernani Torralbas; 20 W.
CMCM—Havana, Cuba; Martinez-Madicu; 15 W.
WCGU—Brooklyn, N. Y.; United States Broadcasting Corporation; 500 W.
WFOX—Brooklyn, N. Y.; Paramount Broadcasting Corporation; 500 W.
WLTH—Brooklyn, N. Y.; Voice of Brooklyn (Inc.); 500 W.
WBBC—Brooklyn, N. Y.; Brooklyn Broadcasting Corporation; 500 W.
KOCW—Chickasha, Okla.; Oklahoma College for Women; 500 W.*
WCMA—Culver, Ind.; General Broadcasting Corporation; 500 W.
WKBF—Indianapolis, Ind.; T—Clermont, Ind.; Indianapolis Broadcasting (Inc.); 500 W.
WBAA—West Lafayette, Ind.; Purdue University; 1 KW.*
KLO—Ogden, Utah; Peery Building Co.; 500 W.
XEP—N. Laredo, Tams., Mex.; Asociacion Radiodifusora Latino-Americana, S. A.; 200 W.

1410 KILOCYCLES—212.6 METERS

WRBX—Roanoke, Va.; Richmond Development Corporation; 250 W.
WBCM—Bay City, Mich.; T—Hampton Township, Mich.; James E. Davidson; 500 W.
KGRS—Amarillo, Tex.; E. B. Gish (Gish Radio Service); 1 KW.
WDAG—Amarillo, Tex.; National Radio and Broadcasting Corporation; 1 KW.
WODX—Mobile, Ala.; T—Springhill, Ala.; Mobile Broadcasting Corporation; 500 W.
WSFA—Montgomery, Ala.; Montgomery Broadcasting Co. (Inc.); 500 W.
KFLV—Rockford, Ill.; Rockford Broadcasters (Inc.); 500 W.
WHBL—Sheboygan, Wis.; Press Publishing Co.; 500 W.
WAAB—Boston, Mass.; Bay State Broadcasting Corp.; 500 W.
WHIS—Bluefield, W. Va.; Daily Telegraph; 250 W.

1420 KILOCYCLES—211.1 METERS

WTBO—Cumberland, Md.; Associated Broadcasting Corporation; 210 W.*
WILM—Wilmington, Del.; T—Edge Moor, Del.; Delaware Broadcasting Co. (Inc.); 100 W.
WMAS—Springfield, Mass.; Albert S. Moffat; 100 W.
WPAD—Paducah, Ky.; Paducah Broadcasting Co., Inc.; 100 W.
WJMS—Ironwood, Mich.; WJMS, Inc.; 100 W.
KWCR—Cedar Rapids Bdcg Co.; Cedar Rapids, Ia.; 250 W.*
WERE—Erie, Pa.; Erie Dispatch-Herald Broadcasting Corporation; 100 W.
WMBC—Detroit, Mich.; Michigan Broadcasting Co.; 210 W.*
WELL—Battle Creek, Mich.; Enquirer-News Co.; 50 W.
WFDW—Anniston, Ala. T—Talladega, Ala.; Raymond C. Hammett; 100 W.
WJBO—New Orleans, La.; Valdemar Jensen; 100 W.
KGFF—Shawnee, Okla.; D. R. Wallace (owner KGFF Broadcasting Co.); 100 W.
KABC—San Antonio, Tex.; Alamo Broadcasting Co. (Inc.); 100 W.
WSPA—Spartanburg, S. C.; Virgil V. Evans, trading as The Voice of South Carolina; 250 W.*
KICK—Red Oak, Iowa; Red Oak Radio Corporation; 100 W.
WLBF—Kansas City, Kans.; The WLBF Broadcasting Co.; 100 W.
WMBH—Joplin, Mo.; Edwin Dudley Aber; 250 W.*
WEHS—Evanston, Ill.; WEHS (Inc.); 100 W.
WHFC—Cicero, Ill.; WHFC, Inc.; 100 W.
WKBI—Chicago, Ill.; WKBI, Inc.; 100 W.
KFIZ—Fond du Lac, Wis.; The Reporter Printing Co.; 100 W.
KFXY—Flagstaff, Ariz.; Albert H. Scherman; 100 W.
KGIX—Los Vegas, Nev.; Los Vegas Radio Corp.; 100 W.
KGIW—Trinidad, Colo.; Leonard E. Wilson; 100 W.
WMBH—Joplin, Mo.; W. M. Robertson; 250 W.*
KGKX—Sandpoint, Idaho; Sandpoint Broadcasting Co., 100 W.
KGGC—San Francisco, Calif.; The Golden Gate Broadcasting Co.; 100 W.
KXL—Portland, Ore.; KXL Broadcasters, Inc.; 100 W.
KBPS—Portland, Ore.; Benson Polytechnic School; 100 W.
KORE—Eugene, Ore.; Frank L. Hill and C. G. Phillips, doing business as Eugene Broadcast Station; 100 W.
WJMS—Ironwood, Mich.; Morris Johnson; 100 W.
WDEV—Waterbury, Vermont; Harry C. Whitehall; 50 W.
WENC—Americus, Ga.; Americus Broadcasting Co.; 100 W.
WAGM—Presque Isle, Me.; Aroostock Broadcasting Corp.; 100 W.
WHDL—Tupper Lake, N. Y., Tupper Lake Bdcg. Co., Inc.; 100 W.

1430 KILOCYCLES—209.7 METERS

WHP—Harrisburg, Pa.; T—Lemoyne, Pa.; WHP (Inc.); 1 KW.*
WBAK—Harrisburg, Pa.; Pennsylvania State Police, Commonwealth of Pennsylvania; 1 KW.*
WCAH—Columbus, Ohio; Commercial Radio Service Co.; 500 W.
WNBR—Memphis, Tenn.; Memphis Broadcasting Co.; 500 W.
KGNF—North Platte, Nebr.; Great Plains Broadcasting Co.; 500 W.
KECA—Los Angeles, Calif.; Earle C. Anthony, Inc.; 1 KW.
WFEA—Manchester, N. H.; New Hampshire Broadcasting Co.; 500 W.
WHEC—Rochester, N. Y.; WHEC, Inc.; 500 W.
WOKO-WABO—Albany, N. Y.; T—Mount Beacon, N. Y.; WOKO (Inc.); 500 W.

1440 KILOCYCLES—208.2 METERS

WCBA—Allentown, Pa.; B. Bryan Musselman; 250 W.
WSAN—Allentown, Pa.; Allentown Call Publishing Co. (Inc.); 250 W.
WBIG—Greensboro, N. C.; North Carolina Broadcasting Co. (Inc.); 1 KW Daytime.
WTAD—Quincy, Ill.; Illinois Broadcasting Corporation; 500 W.
WMBD—Peoria Heights, Ill.; E. M. Kahler (owner Peoria Heights Radio Laboratory); 1 KW.*
KXYZ—Houston, Tex.; Harris County Broadcast Co.; 250 W.
KLS—Oakland, Calif.; E. N. and S. W. Warner, doing business as Warner Bros.; 250 W.
WMBD—Peoria Heights, Ill.; Peoria Bdcg. Co.; 1 KW.
WTAD—Quincy, Ill.; Ill. Bdcg. Corp.; 500 W.
KDFN—Casper, Wyo.; Donald L. Hathaway; 500 W.
CMBI—Havana, Cuba; Francisco Mayorquim; 30 W.
CMBN—Havana, Cuba; Armado Romeu; 30 W.
CMBL—Havana, Cuba; Julio C. Hidalgo; 20 W.

1450 KILOCYCLES—206.8 METERS

WSAR—Fall River, Mass.; Doughty & Welch Elec. Co., Inc.; 250 W.
WBMS—Hackensack, N. J.; WBMS Broadcasting Corporation; 250 W.
WNJ—Newark, N. J.; Radio Investment Co. (Inc.); 250 W.
WHOM—Jersey City, N. J.; New Jersey Broadcasting Corporation; 250 W.
WSAR—Fall River, Mass.; Doughty & Welch Electric Co. (Inc.); 250 W.
WGAR—Cleveland, Ohio; WGAR Broadcasting Co.; 500 W.
WTFI—Athens, Ga.; Liberty Broadcasting Co.; 500 W.
KTBS—Shreveport, La.; Tri State Broadcasting System (Inc.); 1 KW.

1460 KILOCYCLES—205.4 METERS

WJSV—Alexandria, Va.; T—Mt. Vernon Hills, Va.; Old Dominion Broadcasting Co.; 10 KW.
KSTP—St. Paul, Minn.; T—Westcott, Minn.; National Battery Broadcasting Co.; 10 KW.

1470 KILOCYCLES—204.0 METERS

WLAC—Nashville, Tenn.; Life and Casualty Insurance Co.; 5 KW.
KGA—Spokane, Wash.; Northwest Broadcasting System (Inc.); 5 KW.

1480 KILOCYCLES—202.6 METERS

WKBW—Buffalo, N. Y.; T—Amherst, N. Y.; Buffalo Broadcasting Co.; 5 KW.
KFJF—Oklahoma City, Okla.; National Radio Manufacturing Co.; 5 KW.

1490 KILOCYCLES—201.2 METERS

WCKY—Covington, Ky.; T—Crescent Springs, Ky.; L. B. Wilson (Inc.): 5 KW.
WCHI—Chicago, Ill.; T—Batavia, Ill.; Midland Broadcasting Co.; 5 KW.

1500 KILOCYCLES—199.9 METERS

WFDV—Rome, Ga.; Rome Broadcasting Corp.; 100 W.
WMBA—Newport, R. I.; LeRoy Joseph Beebe; 100 W.
WLOE—Boston, Mass. T.—Chelsea, Mass.; Boston Broadcasting Co. 250 W.
WNBF—Binghamton, N. Y.; Howitt-Wood Radio Co. (Inc.); 100 W.
WMBQ—Brooklyn, N. Y.; Paul J. Gollhofer; 100 W.
WLBX—Long Island City, N. Y.; John N. Brahy; 100 W.
WWRL—Woodside, N. Y.; Long Island Broadcasting Corporation; 100 W.
WSYB—Rutland, Vt.; H. E. Seward, Jr., and Philip Weiss, doing business as Seward & Weiss Music Co.; 250 W.
WKBZ—Ludington, Mich.; Karl L. Ashbacker; 50 W.
WMPC—Lapeer, Mich.; First Methodist Protestant Church of Lapeer; 100 W.
WPEN—Philadelphia, Pa.; Wm. Penn Broadcasting Co.; 250 W*.
WWSW—Pittsburgh, Pa.; Walker & Downing Radio Corp.; 250 W Daytime.
WOPI—Bristol, Tenn.; Radiophone Broadcasting Station WOPI (Inc.) 100 W.
KNOW—Austin, Tex.; A. P. Miller; 100 W.
WRDW—Augusta, Ga.; Musicove (Inc.); 100 W.
KGFI—Corpus Christi, Tex.; Eagle Broadcasting Co. (Inc.); 250 W*.
KGKB—Tyler, Tex.; East Texas Bldg. Co.; 100 W.
KGIZ—Grant City, Mo.; Grant City Park Corporation; 100 W.
KGKY—Scottsbluff, Nebr.; Hillard Co. (Inc.); 100 W.
WKBV—Connersville, Ind.; William O. Knox, trading as Knox Battery & Electric Co.; 150 W*.
KGFK—Moorehead, Minn.; Red River Broadcasting Co. (Inc.); 50 W.
KPJM—Prescott, Ariz.; Scott and Sturm; 100 W.
KXO—El Centro, Calif.; E. R. Irey and F. M. Bowles; 100 W.
KDB—Santa Barbara, Calif.; Santa Barbara Broadcasters, Ltd.; 100 W.
KREG—Santa Ana, Calif.; J. S. Edwards; 100 W.
KPQ—Wenatchee, Wash.; Wescoast Broadcasting Co.; 50 W.
WMIL—Brooklyn, N. Y.; Arthur Faske; 100 W.
XETZ—Coyoacan, D. F., Mex.; Manuel Zetina; 100 W.
CMBQ—Havana, Cuba; Gali-Sardinas; 50 W.
CMBR—Havana. Cuba; Tomas Basail; 15 W.

Agreement Nearer In Trust Case

Washington.

The new proposal of the Radio Corporation of America, its subsidiaries and the two large electrical companies holding stock in RCA, for a reorganization, submitted to the United States Attorney General, has resulted in postponement of the beginning of trial of the defendants. These defendants, besides RCA and subsidiaries, include Westinghouse Electrical Manufacturing Company and General Electric Company, the two electric companies that own large blocks of stock in RCA.

The Department of Justice has been holding conferences with counsel for the defendants, and it is said that the new proposal discussed at these meetings had to do with the relinquishment of stock ownerhip in RCA and subsidiaries by Westinghouse and General Electric, including the disposal of the stock to individual stockholders of the companies. However, due to market conditions, it is expected that two years would be allowed for such disposal. Other features of the plan are likewise in line with avoiding any possibility of violation of the Sherman and Clayton anti-trust laws, either in letter or spirit, and include the cessation of cross- licensing, each company owning licenses to do its own licensing. It is expected an amicable settlement will cause the case finally to be stricken from the calendar.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor, Radio World, *145 West 45th Street, New York, N. Y.*

Short-Wave and Television Laboratories, 1031 West Linden St., Scranton, Penna.
Ira Thernal, 1019 Bayland Ave., Houston, Texas.
Carl E. Bunce, 922 Western Ave., Janesville, Wis.
J. W. Gardner, 828 Heil Ave., El Centro, Calif.
F. W. Bates, 1225 Sheffield St., N. S., Pittsburgh, Pa.
Edward Murah, 129 Garrard St., Rantoul, Ill.
A. Guizar B, Ave. Santa Cruz 249, Col. del Valle-Mexico, D. F., Mexico.
Martineau Radio Lab., E. J. Martineau (photo-electric cell), 218 Main St., Auburn, Maine.
Wm. H. Stevens, Jr., 10 River St., Beverly, Mass.
Hansen Radio Service, Niles, Mich.
Larry Gonzales, P. O. Box 651, Ojai, Calif.
Charles Horne, 9 Riverside Drive, Suffern, N. Y.
John Hamala, Nelson, Nebr.
Phil. H. Williams, Box 874, Longview, Texas.
Leo Freni, 1241 Wolf St., Philadelphia, Pa.
Inocencio Garino, Balatoc Mining Co., P. O. Box 249, Baguio, Phil. Is.
F. J. Pfaffle, 414 Suismon St., N. S., Pittsburgh, Pa.
Clarence W. Evans, W7AXN, Box 226, Orofino, Idaho.
Harold Shaw, Emmett, Idaho.
M. d'Oliveira, P. O. Box 296, Middletown, N. Y.
Chas. E. Holden, (Short Wave radio), Route 3, Arlington, Texas.
Walter E. Marr, 15 Shepley St., Portland, Maine.
G. & C. Radio Labys., H. A. Green, Franklin Ave., Pearl River, N. Y.
Sanford S. Ulrich, 1092 Tiffany Street, Bronx, N. Y.
C. Fischer Radio Service, 560 W. 52nd St., New York, N. Y.
Al. Kievitt (circuits for TONE), 9 Hillside Ave., Newark, N. J.
Jos. H. Stephenson, 140 N. Butler St., Madison, Wisc.
J. E. Moore, 809 Erickson Ave., Columbus, Ohio.
R. O. Paque, Route 6, Green Bay, Wisc.
Fred R. Hockenberger, Radio and Electrical Engineering Service, 1310 Sylvania Ave., Toledo, Ohio.
S. Caiatjas, 5601-6th Ave., Brooklyn, N. Y.
W. D. Espy, 705 McClure Ave., Taylor, Texas.
George Deneke, 48 Pearl St., Mystic, Conn.
Ben. Deakins, Route No. 9, Jonesboro, Tenn.
Howard K. Dunlap, 936 N. Havenhurst Dr., Los Angeles, Calif.

SHORT-WAVE CLUB

Preston Haggard, EM 2-C, U. S. S. Wright, c-o Postmaster, New York City.
R. Flannagan, U. S. S. Wright, c/o Postmaster, New York City.

TRADIOGRAMS

By J. Murray Barron

Radio retail stores and mail order houses should now take advantage of the season to supply the increased demand for good aerial wire and insulators. In cities where there is a number of apartment houses and where there are more than one antenna on the roof, old customers as well as the new ones should be told of the dangers of a poorly constructed aerial, either through danger of falling or of generally impaired reception. Proper installation reduces fire hazards.

* * *

W. C. Harter, Solar Mfg. Corp., 599 Broadway, N. Y. City, announces the new Solar inverter. It is for complete operation of an a-c receiver from d-c line. For illustrated circular address Trade Editor, Radio World, 145 West 45th Street, New York City.

* * *

Morris Metcalf, former president of Radio Manufacturers Association, Inc., announces a new radio corporation, the Essex Radio Corporation, Springfield, Mass. The American Bosch Corporation will merchandise the Essex products.

* * *

What is considered about the most complete self-contained a-c and d-c radio receiver on the market recently made its appearance at first in the jewelry trade and now in the regular channels, including the radio and department stores. It is 100 per cent. portable and is good for distance. Its weight is only 5½ lbs. Those interested are invited to write the manufacturers, International Radio Corporation, 102 William St., Ann Arbor, Mich.

* * *

The Atwater Kent Model 612 console type, using four 58's, one 56, one 57, one 55, two 83's and three 46's and which has a class B amplifier, is causing considerable favorable comment in the downtown section of New York. Here may be seen and heard all the latest radio receivers.

* * *

Those interested in the specifications of the best of the 1933 models of the leading manufacturers should read Radio World, as a series is now running. It began with the issue of October 29th.

* * *

The two-tube two-volt battery-operated short-wave receiver merchandised under the name Powertone by Try-Mo Radio Co., 81 Cortlandt St., N. Y. City, is meeting with success. The equipment and receiver are housed in an attractive crackled finished metal cabinet. The outfit also contains four coils covering a band range from 14 to 200 meters. There is a great number of fans and others who though they have not experienced the thrill of short-wave reception have often figured on owning a receiver some day. The interest and desire were there but the outfits seemed too elaborate. There has been a good market for a simple, efficient and inexpensive short-wave receiver. It is now possible to own a short-wave receiver that has the indorsement of a great number. Low cost is featured.

* * *

A new and startling radio gadget, just over from London, is meeting with success in the United States. It comes with a record of big sales and much publicity from the other side, where station interference is very large. It is called Pix and is sold with the understanding that it will eliminate interference. It may also be used as volume control. It will work on crystal, battery and electric receivers, and is being merchandised by Postal Radio Corp., 135-137 Liberty St., N. Y. City.

New Auto Tube, 41, Out Soon

A new automotive tube, the 41, will be announced soon. It will afford an output of 1 watt for a single-sided circuit and 2.5 watts for push-pull. The tube will be of the heater type, 6.3 volts, hence the car storage battery voltage may be applied directly. With other purposes in mind the tube is also recommended for a-c excitation of the heater.

The plate current at 125 volts on plate and screen, 10 volts negative bias on control grid, will be 11 milliamperes, whereas at 167.5 volts on plate and screen, bias 12.5 volts, the plate current would be 17 ma. The respective screen currents are 2 and 3 ma.

A significant point about the tube is its amplification constant, or mu factor, of 150. The mutual conductance is 1525 micromhos at 125 plate volts and 1800 at 167.5 volts.

The ohms load recommended for the lower voltage is 11,000, but 13,000 ohms may be used, at the same power output, with slightly increased distortion. For the higher voltage the ohms load recommended is 9,500.

The tube has a medium base, six pins, and may be operated at self-bias, provided the biasing resistor is well bypassed, except that for push-pull, even at self-bias, no bypass condenser is needed. For self-bias the grid load resistor should not exceed 0.25 meg., and for battery bias should not exceed 0.1 meg.

Tube List Prices

Type	*List Price*	*Type*	*List Price*	*Type*	*Price List*
11	$3.00	'32	2.35	57	1.65
12	3.00	'33	2.80	58	1.65
112-A	1.55	'34	2.80	59	2.50
'20	3.00	'35	1.65	'80	1.05
'71-A	.95	'36	2.80	'81	5.20
UV-'99	2.75	'37	1.80	82	1.30
UX-'99	2.55	'38	2.80	83	1.55
'100-A	4.00	'39	2.80	'74	4.90
'01-A	.80	'40	3.00	'76	6.70
'10	7.25	'45	1.15	'41	10.40
'22	3.15	46	1.55	'68	7.50
'24-A	1.65	47	1.60	'64	2.10
'26	.85	48	2.80	'52	28.00
'27	1.05	'50	6.20	'65	15.00
'30	1.65	55	1.60	'66	10.50
'31	1.65	56	1.30		

New Incorporations

Radio City, New York City, theatrical business—Atty., J. H. Walters, 1564 Broadway, New York City.
Sphere Syndicate, New York City, radio broadcasting—Atty., E. H. A. Chapman, 420 Lexington Ave., New York City.
Sphinx Acoustical Co., Wilmington, Del.—Attys., Delaware Registration Trust Co., Dover, Del.
B. I. O. W. Broadcasting Corp., Brooklyn, N. Y., stocks, bonds—Attys., Corporation Trust Co., Dover, Del.
Volamo Distributing Corp., New York City, electrical appliances—Atty., C. D. Dimmock, 392 Fifth Avenue, New York City.
J. & J. Kammen Music Co., Brooklyn, N. Y., instruments—Attys., Weinhenker & Weinhenker, 250 West 57th St., New York City.

CORPORATION CHANGES

Designations

N. Y. Metropolitan Broadcasting Corporation, Maryland, 25,000 shares preferred, $10 each; 300,000 common, no par.
Munroe Piano and Radio Co., Queens, L. I., N. Y. —Atty., C. A. Strauss, 270 Broadway, New York City.
Everybody's Supply Corp., Philadelphia, Pa., radios, phonographs—Atty., Louis Zion, Wilmington, Del.
Lowe Electrical Co., New Rochelle, N. Y., electrical devices—Atty., C. P. Andrews, New Rochelle, N. Y.
General Communications Laboratories, Ridgefield Park, N. J., electrical equipment—Attys., Morrison, Lloyd & Morrison, Ridgefield Park, N. J.

CORPORATION REPORTS

National Radio Advertising, Inc., 120 West 42nd St., New York City—Liabilities, $183,463; assets, $282,088.

TO RADIO WORLD SUBSCRIBERS:

Congress recently enacted a law making it compulsory for postmasters to charge publishers two cents for every change of address filed with the post office.

This means an annual expense of a substantial sum of money to Radio World every year unless subscribers immediately notify our subscription Department of changes in address. Please let our Subscription Department hear from you just as soon as you know that there is to be a change in your address. Thank you!

Subscription Dept., RADIO WORLD, 145 W. 45th St., N. Y. C.