AUG. 27
1932

STATIONS BY FREQUENCIES

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RADIO WORLD

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The First and Only National Radio Weekly

Eleventh Year—544th Issue

SENSATIONAL 4 - TUBE SET

Marconi Makes . . . Ultra Wave Follow Earth's Curvature

RESISTOR SLIDE-RULE FOR COLOR CODE

BODY	END	DOT OR RING
0 BLACK	0 BLACK	.0 BLACK
1 BROWN	1 BROWN	0 BROWN
2 RED	2 RED	00 RED
3 ORANGE	3 ORANGE	000 ORANGE
4 YELLOW	4 YELLOW	0,000 YELLOW
5 GREEN	5 GREEN	00,000 GREEN
6 BLUE	6 BLUE	000,000 BLUE
7 VIOLET	7 VIOLET	
8 GRAY	8 GRAY	
9 WHITE	9 WHITE	

BODY		
0 BLACK		
1 BROWN	END	
2 RED	0 BLACK	
3 ORANGE	1 BROWN	
4 YELLOW	2 RED	DOT OR RING
5 GREEN	3 ORANGE	.0 BLACK
6 BLUE	4 YELLOW	0 BROWN
7 VIOLET	5 GREEN	00 RED
8 GRAY	6 BLUE	000 ORANGE
9 WHITE	7 VIOLET	0,000 YELLOW

With this diagram color-coded resistance values may be determined. See page 5.

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ELEVENTH YEAR

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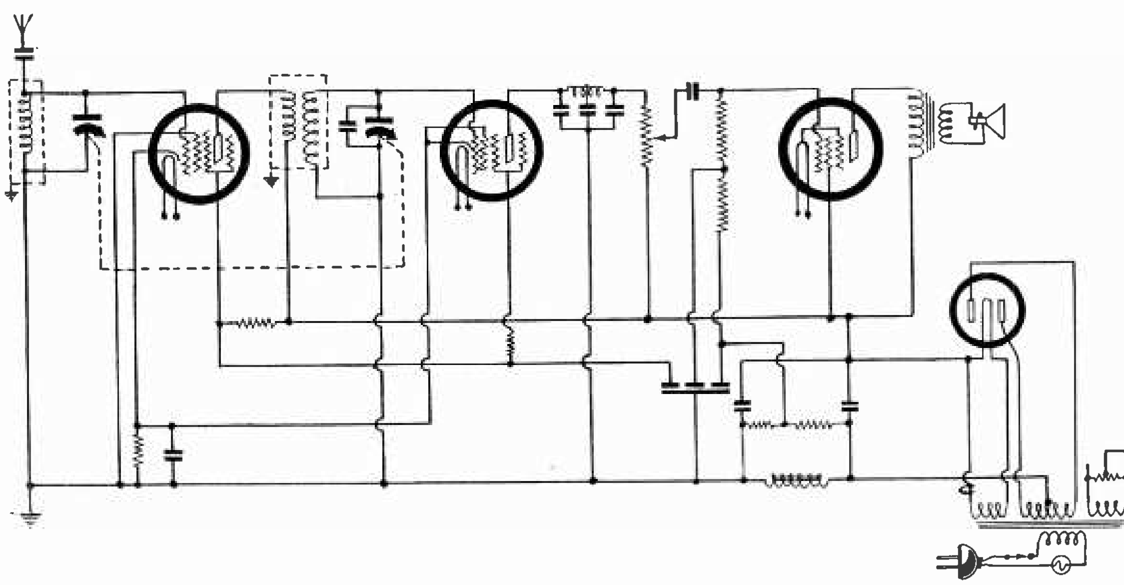
THE 1933 DIAMOND

Only Four Tubes, But Very Effective

REASONS THAT IMPELLED CHOICE OF CIRCUIT AS SHOWN

By Herman Bernard

The 1933 Diamond to be detailed constructionally next week, issue of September 3d, is an effective receiver despite its few tubes. Some of the scientific considerations actuating the selection of the circuit as shown are expounded in the accompanying text by the designer of the circuit.



WITH the advent of the 57, the most sensitive detector tube of the non-gaseous type, and of the 58, the highest-gain radio frequency amplifier, it became obvious that a good receiver could be built consisting of a stage of t-r-f, a tuned detector, and a pentode output tube, resistance coupled audio being used. The reason was that the r-f amplifier could be depended on for a gain of 150, the detector for a gain of 30, and the pentode tube for a gain of 50, these being practical values. Theoretical values are far higher. This represents a practical gain of 225,000, which permits of speaker operation on the broadcast band, using a total of four tubes, including the rectifier.

While the circuit itself is very simple, the solution of the problem was not so easy as may be imagined. Forty or more different hookups had to be tried until there was a completely satisfactory solution of the two principal problems: absence of cross-modulation and presence of a good volume control that produced no detuning difficulties.

Antenna Coupling

The usual connection of a primary in the antenna coupler, to aerial and ground, did not work out well at all. The signals from some locals overloaded the first tube or the detector, or both, and there was cross-modulation, that is, when you tuned in one local station you might also hear some other local station 50 kc removed. as a background. The sensitivity was fine, the selectivity poor.

Then a series condenser was tried in the primary circuit, and while this constituted an improvement, the coupling was too loose, as proved by the too greatly diminished volume of high wavelength stations and difficulty in controlling squealing at the higher frequencies. While higher capacity of series condenser could have been used, to tighten the coupling between aerial and antenna winding, higher capacities would not render the circuit relatively free from detuning by various different lengths of aerial, and it was found that such freedom was a real advantage.

Since we have only two tuned circuits we must get the full measure of selectivity out of them. If the series condenser is connected with one side to the grid of the first tube, the other side to aerial, that condenser may be 20 mmfd., either a fixed condenser of that value, or a 20-100 mmfd. equalizer used a minimum capacity, plates as far apart as possible.

Much Help from Series Condenser

Then the aerial length makes virtually no difference, and when the equalizer on the second condenser is set at its proper value, preferably for some high frequency, the setting holds good independent of aerial length, because the antenna capacity is in series with 20 mmfd., and the capacity effective on the tuned impedance coil therefore is always less than the series capacity. An aerial will have a capacity to ground of around 0.00025 mfd. or more, so the antenna capacity is always more than tenfold the series capacity. Therefore antenna detuning troubles are readily avoided, and in a simple manner.

The series condenser, of course, has a large effect on the first stage tuning, but this effect is taken into account at the beginning by using just the prescribed capacity—20 mmfd.

Really, the series condenser does a lot of good work. It not only makes for that increased measure of selectivity so neces-

(Continued on next page)

(*Continued from preceding page*)

sary where there are only two tuned stages, and no sensitivity loss tolerable, but it also increases the sensitivity of the set itself.

Sensitivity measurements of receivers are made on the basis of a dummy antenna of prescribed electrical values—20 ohms resistance, 0.0002 mfd. capacity and 20 microhenries inductance—but the resultant sensitivity is really greater when a regular outdoor aerial is used. So there is a difference between what may be termed the sensitivity of the receiver itself, and the sensitivity of the receiver plus the great assistance it gets from a real aerial.

Problem of Cross-Modulation

So in the present instance, while the sensitivity of the entire system was greatest when the aerial was connected directly to the primary of the transformer as usual, where, oh, where, was the selectivity, and above all, where was there enough to prevent the unbearable nuisance of cross-modulation?

It is not true, of course, that the new tubes do not cross-modulate, for cross-modulation is a detecting function, probably detection by shock excitation, and moreover the 58 is recommended by the tube manufacturers, and used in present commercial sets, as first detector in superheterodynes. And if a tube does detect it does detect. However, the problem is one of relativity. The detection is relatively low—lower than in other tubes—and while in superheterodynes this means lessened sensitivity, the compensation is the much greater load the first detector will stand.

This corrective is important in superheterodynes because the first detector all these years has been badly overloaded by terrific oscillators. It is nothing remarkable for an oscillator to deliver 50 volts a-c, so means are used to cut down the oscillation voltage supplied to the first detector, and with the 58 used at 10 volts negative bias it is recommended that the oscillation voltage be no greater than 9 volts. The sacrifice of sensitivity is therefore made in superheterodynes that can well afford it in the interest of better selectivity and quality.

The question may be asked: how will such stray detection arise in a first stage of t-r-f, when less than 9 volts of signal will be supplied? And especially as the bias probably will not be 10 volts negative?

Where It Was Tried

The answer is best given in the citation of the experimental fact that there was cross-modulation. The bias was 6 volts negative. The fact was proved that the input had to be cut down, for then the cross-modulation disappeared, and there was good selectivity, at least on a par with three-tuned-stage t-r-f systems. Perhaps it was the detector itself that had cross-modulated. It was no simple matter to discover which was causing the trouble, but it is commonly agreed that more selectivity in the first stage of t-r-f will remedy the defect, and it did here.

At the same time the input was cut down the amplification of the receiver and its selectivity increased. This was easy to understand because of the lessened effective resistance in the first tuned circuit, due to the electrically shorter aerial arising from the series condenser. Regenerative effects begin to mount to considerable magnitude as the r-f resistance is reduced by antenna shortening, either physical shortening of an aerial connected in usual fashion, or electrical shortening by series condenser, the effect being the same electrically. Thus with the series condenser, the set worked excellently in a bungalow on the Atlantic Ocean, in the New York City limits, on a 20-foot indoor aerial around the moulding, and aerial only 2 feet beneath a tin roof. The ground was a cold water pipe.

Volume Control Solution

Highest importance attached to the volume control because, as stated, there are only two tuned circuits, and it is necessary to keep them resonant. No volume control tried ahead of the detector plate had that effect, because all volume controls that change the d-c voltages on r-f amplifier and detector tubes also detune.

The most common form of volume control is one in the cathode leg of one or two r-f tubes, with a limiting series resistor. The volume control may be returned to aerial, for cutting down the input at the same time that it reduces the amplification. Either way the change in frequency is serious at the high frequency end. Reducing the voltage reduced the frequency. For instance, WWRL, Woodside, N. Y., was tuned in, volume control full on, and by turning down the volume one could tune out WWRL and tune in WCGU, Brooklyn, N. Y. WWRL is on 1,500 kc, WCGU on 1,400 kc. The controlled tube was the r-f amplifier only.

Then a potentiometer was tried across aerial and ground, with an antenna primary in circuit. Though cross-modulation was absent without any control in circuit, and there was some squealing on high frequencies, when the control was inserted cross-modulation returned, there was no squealing, sensitivity was much less, even with control at full-on position, and detuning was experienced. Therefore the potentiometer, or any other resistor of practical values, which means small ones that will yield a decent measure of control, are serious "lossers." As much as 30,000 ohms was tried. Of course, all the control was over a few degrees of the total displacement of the knob, for antenna potentiometers are of the order of 5,000 ohms to spread out the effectiveness of control. But the lower the maximum resistance, the greater the damping effect on the circuit.

Effect of Suppressor Variation

Also a series resistor was tried, to much the same effect, particularly as to the absence of change in volume over nearly all of the potentiometer's angular displacement. The suppressor voltage likewise was varied, and while this must be to a negative voltage, there is little choice in the present receiver, as there are only three negative voltages available: ground, which is a 6-volt difference, the bias for the output tube, some 16.5 volts, which wasn't enough, or the full voltage drop in the field coil that is in the negative B lead, some 100 volts, which would require for the most part a negative voltage not well filtered, hence introducing hum, and besides making the receiver quite a squealer at high negative values of suppressor voltage.

Incidentally, it was found that by connecting the r-f suppressor to ground, instead of to usual cathode, some extra stability was gained. Except for this stability gain there was no noticeable difference.

So the volume control could not well be put in series with or in parallel with a tuned circuit or feed to a tuned circuit, nor could it vary the d-c potentials, hence it was necessary to place the potentiometer in the plate circuit of the detector, using the value recommended for plate load of the 57 (250,000 ohms) and connecting the slider to the stopping condenser, the other side of which condenser goes to grid of the pentode tube. Thus the high resistance of the tube is between the control and a tuned circuit, and therefore no detuning trouble arises.

Why Not In A-F Grid Circuit?

Some eight hours were devoted to experiments with volume control alone, and the final selection was made on the basis of necessity. If the control is to be after detection it may as well be in the plate circuit of the detector as in the grid circuit of the output tube, the reason for favoring the detector plate circuit being that the really excellent low-note response of this receiver depends on the introduction of some audio-frequency regeneration, requiring a large value of grid resistance load (5 meg.), and there is no satisfactory volume control of that high resistance value, except very expensive types used as attenuators in sound systems, having no place in a receiver the kit of which is intended to sell for less than $10, including all parts, even speaker, but not cabinet or tubes.

That the receiver really is worth while is a fact, despite the simplicity of the design, and there is even a modicum of distance to be received thereon. I do not desire in any way to overstate the case. And while I know it is hard to believe that anything much can be done with so few parts and tubes, nevertheless the receiver tuned in WGN, Chicago, 720 kc; WTIC, Hartford, Conn., 1,060 kc; WRVA, Richmond, Va., 1,110 kc; KDKA, Pittsburgh, Pa., 980 kc; WSM, Nashville, Tenn., 650 kc, and brought in WTAM, Cleveland, 1,070 kc, only 10 kc from WTIC, without interference, all in that the aforementioned bungalow, these being only some of the distant stations heard between 11:30 Saturday night and 12:15 a. m. Sunday, August 13th and 14th.

Why It's Called the Diamond

This was the kind of performance for which the Diamond of the Air was well-known from 1925 on, and while there has been no new model of the Diamond for about three years, it was decided to give that name to the present circuit, as an encomium well deserved.

The circuit as it now stands is diagramed herewith, a few of the constants have been evaluated, but next week the complete data will be given, in the first of a series of constructional and trouble-shooting articles. Every effort will be made to make the exposition of the construction so simple that any novice can build the 1933 Diamond with perfect safety and assurance of success, and become the proud possessor of a really good set, albeit only four tubes are used, and the total kit is composed of parts that should be purchased for under $10.

It must be admitted that the performance of the receiver surpasses the designer's early expectations, for while it was obvious that from four tubes some fairly good results were obtainable, it was not supposed that results would be anything nearly so good as they proved.

These results are due to the use of good coils in the radio frequency end, proper constants, and voltaging of th tubes, a dynamic speaker and, most important of all, special aerial input treatment.

Resistors to Apportion Bias

By the method of using resistors to apportion the voltage dropped in the field coil of the dynamic speaker used as B supply choke, almost any speaker intended for d-c supply may be used, from, say, 1,500 to 2,500 ohms resistance. The total B voltage available may be somewhat different, with different fields, but that is not serious. The resistor method dispenses with the introduction of bleeder current to produce a sufficient drop in the biasing section, for if a tapped choke is used, the total current requirement covers narrow limits, whereas here we can base our selection of resistance values on even an unknown resistance choke coil, for all we need do is measure the voltage across the field coil with an ordinary voltmeter, and select the resistors by proportion.

For instance, assume that the pentode

grid bias is to be 20 volts negative, which is a satisfactory value, and that the total B voltage, from ground to B plus, is 250 volts. Under the negative—leg—choke system the bias is subtracted from the drop in the choke, so to speak and not from the aforementioned B voltage. Suppose the drop in the choke is 100 volts. Then if we put two equal resistors in series across this choke and return the pentode grid to the joint of the resistors the bias on the pentode is half the total potential across the choke, or 50 volts. That is too high a bias for our present purpose, but the example is cited because the halving principle seems the simplest. In fact, any other proportion is just as simple.

Proportion Worked Out

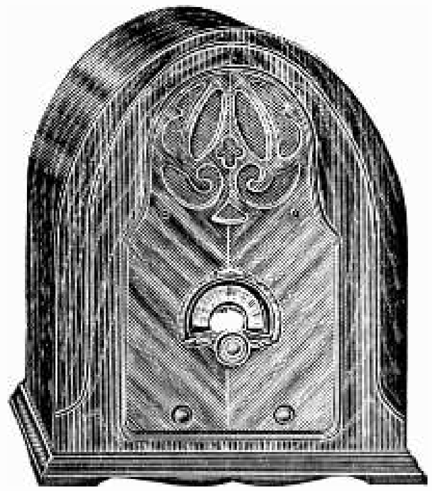
Take, then, the 20-volt assumption. The bias voltage is to be one-fifth of the total voltage. The bias is between the grounded side of the choke and the joint of the resistors, because the center of the power transformer's heater-filament 2.5 volt secondary is grounded. The resistors should bear the proportion of 1 to 4, because the relationship is that of one-fifth to four-fifths. The only requirement is that the resistors be of sufficiently high value to prevent any considerable direct current flowing through them, as such current would not be filtered between resistor juncture and either end of the choke field coil.

Thus we may select 25,000 ohms and 100,000 ohms, putting the 25,000 ohms one side to ground, other side to joint, and the 100,000 ohms one side to joint and other sideto B minus of the power transformer.

Current Basis of Resistors

We might select 50,000 and 200,000 ohms, except that resistors of 200,000 ohms are not generally available commercially. Nevertheless, we were assuming a 20-volt negative bias, which is a commercial expediency, although the tube manufacturers recommend 16.5 volts. So if we used 250,000 ohms on one side and 50,000 ohms on the other side we would have the proportion of 1 to 5, and the bias would be one-sixth of 100 volts, or 16.4 volts.

In point of fact one need not know exactly the resistance values used. Being certain of the plate voltage between ground and B plus, one may apportion the resistors so that the recommended plate current flows. If the plate voltage is 250 volts applied, the recommended plate current is 32 milliamperes. The screen current is 7.5 ma, but the bias rule stated depends on the plate current only. Screen is returned to the same voltage, 250 volts, as is supplied to the plate load (primary of output transformer). Apportion the resistors so that about 32 milliamperes flow, and if the resistors do not readily yield that result, make such choice as produces a lower rather than a higher current. Excellent results are obtainable on 30 milliamperes.



The 4-tube 1933 Diamond will fit into a standard midget cabinet, such as this, or may be installed in a console.

While the 57 tube is used as detector, its circuiting and voltaging have not been included among the problems, because so easily solved. The voltage applied through 250,000 ohms in the plate circuit was 250, with 100 volts on screen load. The proper bias will result when the plate current alone in this tube equals 0.2 ma. This must be measured in the plate circuit, and not in the cathode circuit, as the cathode circuit handles the sum of the plate and screen currents. However, merely as a matter of information, when the plate current was 200 microamperes the screen current was only 16 microamperes (0.000016 ampere).

The resultant bias was 6 volts, and as it was caused by the potential difference across a resistor common to detector and r-f tubes. The r-f tube took the bias it got, the detector the one it required. Then the r-f circuit had to be gaited to the existing bias, and as there was still some squealing at high frequencies, the bias was not too high for the r-f tube. The resistance that had to be used was 800 ohms, so the total of screen and plate currents was 7.5 milliamperes, and as the detector drew 36 microamperes the r-f tube drew 7,464 microamperes (0.007464 ampere).

Why Two Were Tied Together

The reason for using the same bias element for two tubes was that every precaution should be taken to reduce the detector wobble. Since the 57 is extremely sensitive—and those who have not used it yet should try it by all means—the plate current changes sharply with small differences in signal voltage input. If this same changing condition is to affect the bias, then the bias will change from the steady value of 6 volts at no signal input to perhaps 20 volts, since increase of signal increases the plate current. While it is true the plate current would cut off at around 7 volts negative bias at no signal input, since the plate current then is not changing, practically it does not cut it off in operation in a set, due to positive changes in effective bias produced by the signal's plate current effect.

The r-f tube, on the other hand, suffers only slight changes in plate current due to signal, and as almost the entire current through the biasing resistor is contributed by the r-f tube, a state of relative steadiness results. This is not to deny that the plate current still changes markedly in the detector, for isn't that the very sign of an excellent detector? It is only to say that what is intended to be the application of a steady bias is utilized as steadily as possible.

MEASUREMENT OF GAIN OF R-F CHANNEL

PLEASE TRY to devise some way that I may judge the gain of radio frequency amplifier, and also how I may measure selectivity in a fairly good manner. My equipment consists of a radio frequency oscillator (modulated-unmodulated), and an output meter.—J. G., Waco, Texas.

The gain may be determined in relative values by setting the oscillator at a given frequency, introducing modulation, and tuning the receiver to that frequency, meanwhile taking the deflection reading of the output meter connected across the primary of the output transformer, if the meter has a high impedance (4,000 ohms or so). A stopping condenser is virtually necessary, so that only a-c will flow through the meter. Thus the meter and condenser would be in series and the combination in parallel with the primary. Now move the oscillator input to the plate circuit of the tube ahead of the detector and again note the reading of the meter. The difference is caused by removal of the effect of the amplification of the r-f ahead of the detector. A slight difference may arise due to the ratio of transformation, and this may be checked by having the oscillator input made to detector control grid, but the control grid connection would cause a little detuning, and the other method may be preferable for that reason. Thus the gain of the r-f amplifier may be measured in relative values for different radio frequencies and a sensitivity curve plotted. You may expect that the sensitivity will increase with frequency. As for measuring the selectivity, all you need do is to use an oscillator that covers a sufficiently narrow range of frequencies so that relatively small differences may be read. Then, tuning oscillator and receiver to the same frequency, and using modulation, connect oscillator to the antenna post of the set. The only variation that need be introduced is detuning the oscillator.

SLIDE-RULE FOR DECIPHERING COLOR CODE

THE Standard R. M. A. resistance color code can be put into a convenient sliderule form as indicated in the tabular arrangement of the colors and numerals. Cut three equal strips of heavy cardboard and rule off eleven equal rectangles on each strip. At the top of one write "Body," and the top of the next write "End" and at the top of the third write "Dot or Ring." Write the colors and the corresponding numbers in the other rectangles below the top rectangles "Body" and "End," in the order given. In the third strip write the same colors up to blue, but instead of writing numerals write ciphers as indicated. Place the three strips from left to right in the given order, that is, body, end, dot. Slide the strips up or down, one with respect to the other, until the desired color combination is obtained in a horizontal line and read the resistance in the same line.

At left the strips are lined up with equal colors in rows. This is the proper arrangement for resistors of 110, 2,200, 33,000, 440,000, 5,500,000, and 66,000,000 ohms. For other combinations the colors in the rectangles in a row are different. At right is shown the combination of the strips for a resistance of 7,500 ohms, which is written in bold letters. Other resistances read with the same arrangement are 53, 640, 86,000 and 970,000 ohms. The colors on the resistance in question determines the row to be read as well as the colors to place in a row.

It is clear that with this arrangement it is easy to find the resistance value of any resistor marked with the standard code or to find the proper color combination for any given resistance (See p. 1).

Key to the Code

Of Color-Identifying Fixed Resistors

By Enslen Varick

THE standard Radio Manufacturers Association resistor color code has been arranged in an orderly and consistent manner so that it can easily be remembered. All we have to do is to remember the order of the colors in the rainbow. Each of the ten digits has been assigned a color and the colors have been arranged in the order of the rainbow, as far a tshis is possible. In the infra-red region of the spectrum no color is visible and everything is perfectly black. Hence in the color code black has been assigned to 0. Brown can easily be regarded as lying on the border line between black and red, in that part of the spectrum where color is first visible. Therefore brown has been assigned to 1. The red is the first visible color, and that has been assigned to 2. Next comes orange, which has been assigned to 3. Next comes yellow and 4, then green and 5. After green comes blue which in the code stands for 6. At the end of the rainbow is violet and that stands for 7. At this point the rainbow colors cease, but we still have two digits to be accounted for. Since black stands for 0 it is appropriate that 9 should stand for white, and that is just the case. Anything short of white is gray, so this shade has been assigned to 8. It is a light gray with a hint of blue, which fits well into the color scheme as well as in the digit order.

Extension of Rainbow Scheme

These colors are used for the body of a resistor and also for the end. The body indicates the first significant figure and the end the second significant figure.

But the orderly arrangement does not end here. We also have a dot or a ring color, which indicates the number of ciphers following the second significant figure. If we know the digit represented by a given color we also know the number of ciphers, for they are the same. Thus blue stands for 6 and also for six ciphers. Brown stands for 1 and also for one cipher. Black stands for 0 and for no cipher at all. Since we cannot very well express zero ciphers with a 0 without confusion with brown, which is represented by one 0, we express no cipher by .0, or simply with a blank.

Now suppose we have a resistor with a green body, a black end, and blue dot. What is the value of that resistor? The first significant figure is 5, the second is 0, and the number of ciphers is 6. Hence the resistance is 50,000,000 ohms. Again, suppose the body is violet, the end green, and the dot red. What is the resistance? The first significant figure is 7, the second is 5, and the number of ciphers 2. Hence the value of the resistance is 7,500 ohms. Once more, suppose the body is brown, the end black, and the dot black. What is the resistance? The first figure is 1, the second is 0, and there is no cipher. Hence the resistance is 10 ohms. This is the lowest value of resistance expressible by the color code.

Highest Value Expressible

The highest value of resistance expressible by the code is much higher than any practical resistance would be. The resistor would be all white, that is, the body would be white, the end would be white, and the dot would be white. The resistance would be 99 followed by nine ciphers, or it would be 99,000 megohms. The practical code actually stops with six ciphers so that the highest resistance expressible would be 99 megohms, and that would be all white except for a blue dot.

It is clear that not all values of resistances can be expressed by the code because it does not admit expressing significant figures in the third or higher places.

If need be the code could be used for expressing resistance values between 1 and 10 ohms. For example, the body of the resistor could be made black. In that case the first significant figure would be omitted and the end color would really indicate the first significant figure since zero has no significance when it stands in from a whole number. Thus if we wanted to express 1 ohm, the body would be black, the end would be brown, and the dot would also be black. To express a resistance of 5 ohms we would make the body and dot black and the end green. The main code, however, extends only from 10 ohms to 99 megohms, with all possible combinations of two digits in the first two significant places.

The purpose for which the code was devised is served admirably, for it allows for one per cent accuracy of expression in any range, and that is greater than the accuracy of the resistors on which the code is used.

Let us repeat, that to remember the code we have only to recall the order of the colors in the rainbow, adding gray and white when the colors are exhausted, beginning with zero and black in the infra-red and ending with white and 9.

Remote Control

By C. H. Stoup

Baseball games cannot be played in radio studios, nor can wrestling and boxing contests be held there. These interesting programs and others outside the studios are brought to you by means of remote control.

It is difficult to imagine the mechanical and electrical devices lying back of broadcasting unless you are technically minded. Remote control broadcasts are made possible by careful technical arrangements. Painstaking check-ups must be made by the station operators to insure perfect reception.

Previous to the time scheduled for a remote control broadcast the remote operator goes to the scene of the event, hooks up an amplifier and mixing panel, places the microphones in the proper positions for the best balance and pick-up, and then calls the operator on duty at the station. A private audition is then given, with the station operator as critic, listening with an ear for noise, balance, etc. When the reception is apparently excellent the station operator gives the remote operator an O. K.

A few minutes before the time scheduled for the remote broadcast the station operator throws a switch which feeds the studio program, then being broadcast, to the remote control operator, by telephone, and by this means the man in charge of the pick-up knows exactly when to start feeding his remote control program to the station.

Switching from station announcer to the remote is just as simple as switching from one studio to another. Of course, longer lines are used between an outside pick-up and the transmitter than between studio and transmitter. The longer lines have considerable more electrical resistance and therefore require an extra amplifier at the remote point, to boost up the program to a level that will overcome the added resistance in the lines, yet still have a high enough volume to properly operate the transmitter.

The longer lines must also be carefully equalized so they will pass the required frequencies.

A remote control may be located just a few doors away from the studios and transmitter, or thousands of miles away. The long telephone lines require additional amplifiers, or boosters, approximately every hundred miles. Considerable time is spent testing and equalizing the lines to keep them in condition for the broadcasts. In the local remote control events the telephone connections are maintained between remote and station operators, while for the long lines printers or the telegraph are used for communication between pick-up and studio control room.

Countless remote control programs are broadcast from radio stations every day so that baseball games, speeches, dance orchestras and church programs may be brought into your home.

5,000 Messages Sent via Olympic W6USA

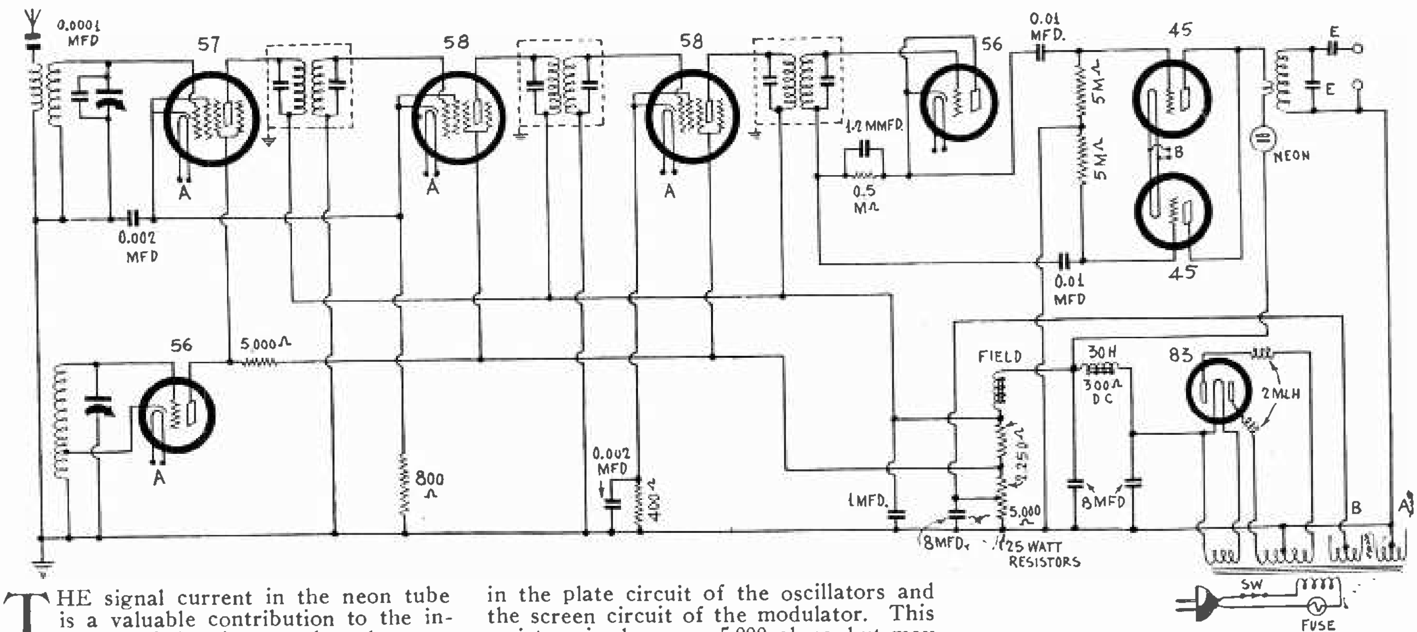
Los Angeles

Immediately after each event at the Olympic stadium there was intensive use of W6USA, the amateur radio station set up in Olympic Village by members of the American Radio Relay League under the direction of Walter Lippman, Jr. The athletes jubilantly radioed news of their performances to their homes in all parts of the world. First messages filed were by M. C. Dhawan, of India, and Juan Carlos Zabala, Argentina. Zabala won the marathon. About 5,000 messages to dozens of different countries have been sent.

There was a radio amateur in the events, too, and an Olympic champion, at that. Bill Miller, Leland Stanford, Jr., University, champion pole vaulter, is an amateur, W6ECH.

NEON CURRENT

By Capt. Peter V. O'Rourke



THE signal current in the neon tube is a valuable contribution to the intensity of the picture, when that current is high, and the two methods to use to obtain high values of signal current are to have a sensitive receiver and to use an output system that multiplies the current at the expense of the voltage. At the output the interest in voltage virtually ceases, as all that is required is enough voltage across the neon lamp to light it, whereas great interest attaches to the signal current through the lamp, because the lamp is a current-operated device.

For sensitivity the superheterodyne circuit should be used. If the modulator and the oscillator are separately tuned there is no padding problem. and it might indeed become a problem at a high intermediate frequency, say, 1600 kc. Two stages of such intermediate frequency amplification are shown, requiring three coils, and as both primary and secondary are tuned it looks like considerable selectivity for a television receiver, but this is not so, for the coils individually tune very broadly.

Effect of Selectivity

When two were hooked up code reception from stations on five different frequencies could be heard at the same time, and as still more amplification was desirable, the extra selectivity from the second stage was not too much. In fact, the defects of present transmitting systems are such at it is not a bit harmful to have more selectivity than theory would require. The test is easily made on any of the t-r-f sets used for television, as they may be made to squeal, and not until the tubes spill over does the regeneration pattern appear on the screen. This, by the way, may be a beautiful though shifting design, and those aesthetically inclined might get a kick out of it, but the televisionist wants pictures that are pictures, and not patterns like hyperbolated crossword puzzles.

The oscillator and modulator are coupled by electron coupling. This form of coupling is excellent for frequency stability. While the exactions of frequency stability are nowhere near as high as with ultra-frequency receivers using oscillators, nevertheless it is an advantage to have the oscillator as steady as possible.

If one regards the oscillator and the first detector just above it in the diagram one sees that there is a common resistor in the plate circuit of the oscillators and the screen circuit of the modulator. This resistors is shown as 5,000 ohms, but may be less if a larger voltage is desired on screen and plate, the only limit in the other direction being that it should not be so high that the oscillator won't oscillate. However, as up to 50,000 ohms were tried in the plate circuit, there should be no absence of oscillation. If there is, and one can not use a lower value resistor, the voltage applied to the resistor will have to be raised. The Hartley oscillator, as shown, is a modification contributed by Shiepe, and if any oscillator will oscillate without use of extra-special tubes, this one will.

The electron coupling arises from the fact that there is a commingling of space currents. Thus the screen current of the first detector flows in part through the space charge of the modulator, and the plate current of the modulator flows in part through the screen space charge of the modulator or first-detector. There is no coupling therefore except such as is produced by this inter-relationship, hence Dow, who developed the idea in a special oscillator of unique stability of frequency, calls it electron coupling.

The common load resistor must not be regarded as a coupling agency, but the resistor may be regarded as a decoupler rather than as a coupler. It is simply a load resistor to permit a suitable impedance for signal frequencies. While the voltage drop will be higher the higher the resistor, this works in the direction of reducing oscillator plate and modulator screen voltages, and such reduction is in the direction of decoupling or lessened sensitivity or absolute value of association.

56 Used As Diode

It is in the detector circuit that the first really important television adjunct is seen. The tube is a 56 used as a diode. Thus the cathode does not have to be grounded, for there is no B voltage, and we have a cathode load resistor, of 0.5 meg., across which only a very small by pass condenser may be placed, otherwise the high signal frequencies will be cut off too much. For 100,000 cycle cutoff the condenser may be 1.2 mmfd.

With a cathode load resistor that at any instant has at its extremes opposite signal voltages, though equal in their respective cycles, we have the very requirement for full-wave input. Simply put the stopping condensers from one and the other sides of the cathode resistor in the detector circuit, to the grids of the output tubes. Then the voltages at input to the output tubes are equal and opposite. True, they have been halved, for it can be seen that of the total voltage drop, one-half is between grid and ground. That is, the two resistors in the power tube grid circuits are in parallel with the cathode resistor. Only one output tube at a time gets the voltage, hence the halving. Yet the power is unchanged, hence the current is doubled.

The output, however, is not full-wave, otherwise we would have push-pull. There does not seem to be any way to obtain push-pull, using resistance at the output, because of the grounding to signal frequencies (if not to actual ground). No one ever has shown such a circuit and we have never read of any one ever claiming there could be one. If the output load is a resistor, one side to one plate, other side to the other plate, center would have to go to B plus, the same effect would be obtained as with the parallel plate connection shown, except that a lot of power would be lost in the resistor.

Current Through Lamp

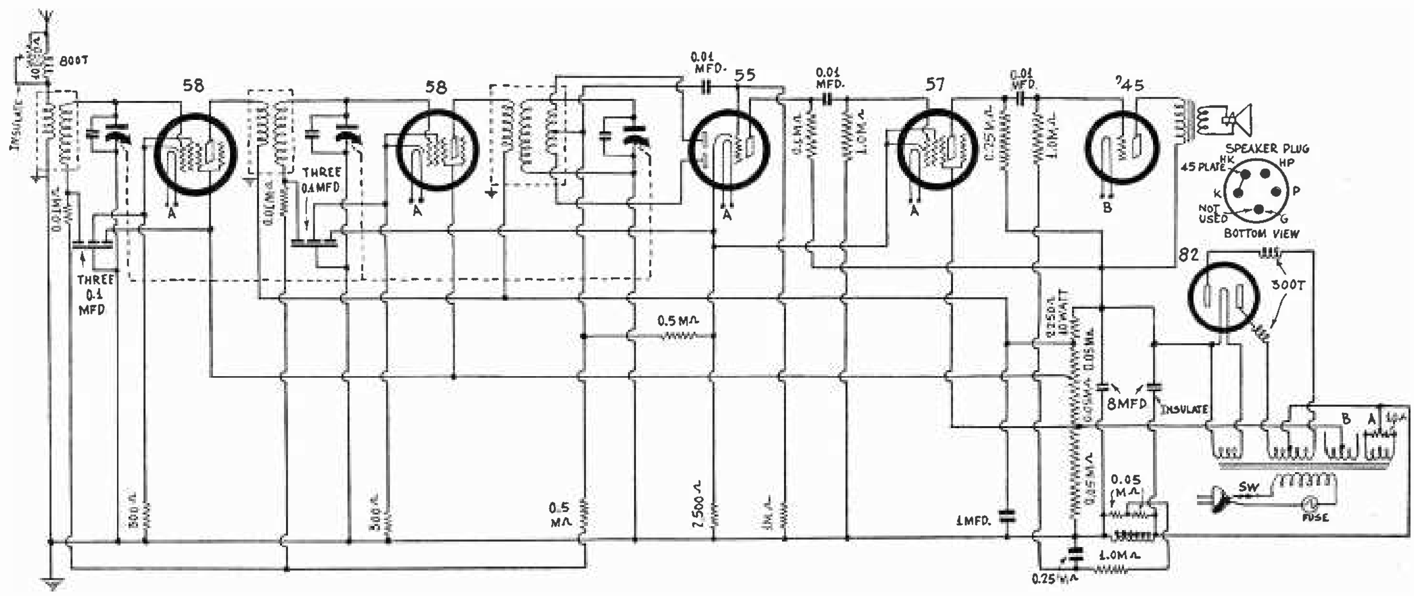
Therefore the neon lamp is put in series with the common plates, and the amount of current flowing through the lamp will depend on the resistance of the lamp principally, as the output impedance of the two tubes is of the order of 2,000 ohms. Lamps that find wide use for television have resistance values of around 10,000 and 15,000 ohms, although there are new experimental lamps of lower resistance in laboratories, that permit much greater current flow.

No series resistor is shown for limiting the current through the lamp, as it is quite practical to dispense with this. If the current is more than intended for the lamp, the negative bias on the output tubes may be increased until the current through the neon tube is as low as desired. This assumes that at least 15 milliamperes will flow, as when the present neon tubes are put in such a circuit the current is around that, for one-tube output, and around 20 ma for two-tube output.

Full Atonement for 55's Lack of Sensitivity

Three-Stage Audio Needed in T-R-F Receiver

By Heinrich von Prittwitz



STANDARD COLOR CODE

Resistance		Color		
Megohms	*Ohms*	*Body*	*Dot*	*End*
0.0003	300	Orange	Black	Brown
0.0025	2,500	Red	Red	Yellow
0.01	10,000	Brown	Orange	Black
0.05	50,000	Green	Orange	Black
0.1	100,000	Brown	Yellow	Black
0.25	250,000	Red	Yellow	Green
0.5	500,000	Green	Yellow	Black
1.0	1,000,000	Brown	Green	Black

OF the two detector tubes, one, the 55, falls into the class of least sensitivity and the other, the 57, into the class of greatest sensitivity.

A six-tube tuned radio frequency circuit was described last week, using the 57, and providing automatic volume control by utilizing the effect of detector grid current on resistors. This week also a six-tube tuned radio frequency set is presented, but the least sensitive detector tube is used, however, the one that reproduces the best quality. The overall sensitivity of the two circuits is about the same, for here we now have three stages of audio, instead of two, the first stage utilizing the triode unit of the 55, the second stage the 57 and the last stage the '45.

There are several other differences. This week's circuit has a high resistance voltage divider, B choke consisting of speaker field coil in the negative B leg, bias for the power tube obtained from the voltage drop in this choke, through equal resistors in series with each other and in parallel with the choke; and the usual two 8 mfd. condensers, one next to the rectifier.

Diode Choke

To use the diode detector in full-wave fashion it is necessary to have a center-tapped winding. This must not have any point grounded, therefore the tuned winding can not be used. An exception would exist in the special case of the diode-biased triode unit of the 55, but this method has not proved very satisfactory for the present set.

A diode choke may be inserted inside the form of the last r-f transformer, the choke connected with extremes to the respective anodes, and center to one side of the 0.5 meg. resistor, the other side of which resistor goes to the cathode. Of course the cathode is substantially grounded to radio frequencies, as there is a resistor of 2,500 ohms between cathode and ground. But the cathode load resistor must not have its anode side grounded, hence the need for the diode choke.

This coil is wound on a diameter smaller than the inside diameter of the tuned coil's form, and fastened to a strip of bakelite just wide enough to fit inside that form. Thus the diode choke may be moved up or down until the desired degree of coupling obtains, although it will be found that the best degree is maximum coupling, and this results when the coil is pushed down as far as possible.

Bringing Out Leads

The leads from the coil have to be brought out, and this is done by carrying the wires attached to the three terminals of the diode choke, up over the top of the main coil form and down through the inside of the shield, through the larger holes that result from the stamping out of the brackets for holding the coil forms in place. Thus the high potential side of the tuned winding goes to the stator of the tuning condenser, but not to anode. There is a grid connection brought up through the detector coil, but it is for the grid of the triode unit of the 55. This connects to a grid leak of 1.0 meg. and a stopping condenser of 0.01 mfd.

There is no bypass condenser across the 0.5 meg. resistor in the cathode leg of the rectifier, because volume was slightly greater when it was omitted. If included, it should not exceed 0.0001 mfd. However, the diode choke has sufficient distributed capacity so that no extra capacity is needed. If the capacity is 20 mmfd. the attenuation is good enough up to 10 kc, which is as much as needed. Though the diode choke thus has considerable distributed capacity, it is not such as to affect the tuned circuit much, and the circuit hardly requires any re-adjustment of the trimmer condenser whether the choke is in or out, a test made on two different hookups purposely tried on the same chassis to develop this point.

Question of Overload

One of the first points that will be raised by any one who has familiarized himself with the data on the new tubes—data published in condensed form in the August 13th issue—would be that the tubes in the audio channel appear in inverted order of voltage handling capabilities. The first a-f tube will take 9 volts negative bias, with resistance coupling (20 volts with transformer coupling), whereas the recommended minimum bias for the 57 as an amplifier is 3 volts negative, under the normal 250-volt plate supply applying to these tubes. Moreover, the 57 is not specifically listed for a-f amplification.

The real point is that the audio tubes should not be overloaded on any but the strongest locals, in which case the volume control will provide the corrective and the retarded volume will be more than sufficient. The diode does not amplify. Compared to the 57 you have a case of no amplification from the diode, as against a gain of 30 in the detector with the other, so if a common bias of around 5 volts negative is applied, the first a-f tube gets that, equivalent to 135 volts negative bias were the 57 the detector, judged from a viewpoint of overload.

A. V. C. Assists, Also

However, the 135 factor applies to the

LIST OF PARTS

Coils

Three shielded t-r-f transformers for 0.00035 mfd. tuning condensers (coil data given last week).
One diode center-tapped r-f choke coil.
Two 300-turn honeycomb coils.
One 800-turn honeycomb coil.
One power transformer (primary 105-120 volts, 50-60 cycles; secondaries, 2.5 volts at 6 amperes, 2.5 volts at 3 amperes, 2.5 volts at 3 amperes. (If rectifier filament winding is center tapped, use center instead of one side of winding for B plus.)

Condensers

One gang of three 0.00035 mfd. condensers, with trimmers.
Two shielded blocks three 0.1 mfd. in each block.
Three 0.01 mfd. mica fixed condensers.
Two 8 mfd. electrolytic condensers, one with insulators and extra lug.
One 1 mfd. bypass condenser (250 volts continues d-c rating).

Resistors

One 10-ohm center-tapped reisstor omit if winding that serves the heater tubes is center-tapped).
Two 300-ohm pigtail resistors.
Two 0.01 meg. pigtail resistors.
One 2250 ohm 10 watt resistor.
One 5000 ohm pigtail resistor.
Five 0.05 meg. pigtail resistors.
One 0.1 meg. pigtail resistor.
One 0.25 meg. pigtail resistor.
Two 0.5 meg. pigtail resistors.
Four 1.0 meg. pigtail resistors.
One 10,000-ohm potentiometer used as rheostat, a-c switch attached.

Other Requirements

One dynamic speaker for '45 tube, with field coil of 1800 ohms. If coil is tapped ignore tap. If you have speaker with other resistance of field winding, consult text. The output transformer is built into the speaker. Speaker plug included.
One vernier dial of travelling light type, with bracket and lamp, scale and escutcheon.
One knob for volume control rheostat.
One chassis 14x3x8.5 inches, drilled for seven sockets (seventh is at rear wall for speaker plug).
Four six-pin wafer sockets, two UX wafer sockets, and one UY wafer socket (for speaker plug).
Three special tube shields for the two 58 and one 57 tubes, one regular tube shield for the 55.
Four grid clips.
One insulation shelf, about 7x3 inches, with two brackets, used for mounting resistors and fixed condensers.
One 2-ampere fuse with holder.
One a-c cable with male plug.

second stage of audio, really, because that is the one to be watched, the bias method being common to first and second a-f. The strongest signal put into the first a-f tube is a small fraction of a volt, therefore at a practical gain of 6 in the first a-f tube and 100 in the second a-f tube, only strong locals will overload the second audio tube, and it is true of all sensitive sets that somewhere in the circuit strong locals can cause overload, which is one reason not only for a manual volume control but also for its location ahead of the tube likely to overload first.

No account has been taken of automatic volume control, but this is an additional precaution, and virtually prevents overloading even on strong locals, for the greater the amplitude of the wave received the lower the amplification of the r-f tubes, the less input to the a-f channel.

The circuit uses audio regeneration. The impedance in the audio channel is lowered by regeneration to less than it would be were 32 mfd. of extra capacity used.

Due to the common biasing resistor of the first and second audio tubes there is feedback through that, also due to the high resistance B choke there is feedback concerning detector and power tubes, and this feedback will cause oscillation, and will affect the 57 also through the screen. The solution is to apply just enough remedy to remove the oscillation, leaving the audio channel at a high level of amplification.

Adjusting for A-F Regeneration

The method of doing this is as follows:

Build the circuit with the 0.1 mfd. condenser shown across the 57 screen resistor omitted. The oscillation should be at a high frequency, around 8,000 cycles, or even higher. Then connect 8 mfd. across the biasing resistor, if you have this extra capacity handy, and the frequency of oscillation will be shifted to around 5, the familiar motorboating. This proves that the circuit is amply keen on low notes, and is made too keen by the 8 mfd., which therefore can not be used in this position. Now if you will put a relatively small capacity across this screen resistor, the ground, and remove the 8 mfd., trying various smaller capacities, you will get one that just removes the higher frequency oscillation that has been reinstituted. The condenser shown is 0.1 mfd., as that capacity surely will do the trick. However, 0.01 mfd. is almost as certain to do it, and it is of no particular advantage to use a larger condenser than necessary to establish complate stability. It is suggested that a capacity of 0.002 mfd. be tried first, and then higher capacities, although full assurance is given that 0.1 mfd. will provide the remedy without fail.

The use of audio regeneration not only assures you of a good audio channel but also of one with high gain. It is estimated that the overall a-f gain approaches 2,400.

R-F Oscillation

On the subject of oscillation, the r-f side has to be considered also. At a bias of 3 volts negative the first r-f tube might oscillate at the higher frequencies radio, but with the a.v.c. doing service this tendency should be corrected, and if it is not, the biasing resistor in the cathode leg of the first r-f tube should be made as high as necessary to accomplish the purpose. If there is no sign of oscillation, but a suspicion of inadequate sensitivity, which may arise due to overeffectiveness of the a.v.c., then the resistor should be made less, down to 150 ohms.

There should be enough leakage current in the two 58 tubes to cause a voltage drop in the 0.5 meg. resistor common to the controlled circuits, and in the 0.01 meg. filter resistors in the grid circuits, to compensate for the positive of the diode cathode to which the controlled grids are returned. This cathode voltage is positive, in relation to ground, by 5 volts, but in practice this difference is made up by the drop in the 0.25 meg. resistor. If this were not so the grid returns of the controlled tubes would be to a positive voltage, no current flowing assumed the resistors in the control circuits. But, as stated, current does flow. Tube engineers report 10 microamperes per tube, or a 5-volt drop would result across the 0.5 meg. leading to grid returns of controlled tubes. Besides, any grid current on the 58's becomes self-correcting.

How to Accommodate to T-R-F

The circuit is the result of many hours of labor with a tuned radio frequency set using the duplex diode-triode and automatic volume control.

When the diode was first announced it was pictured as a tube for superheterodynes, as it must have been foreseen that relinquishing amplification in the detector stage would put a severe damper on sets of the sensitivity level of the t-r-f variety. However, later additional data were given, concerning bypass condensers across cathode resistors in the rectifier circuit, suggesting one value for t-r-f (0.006 mfd.) and another for superheterodynes of the usual intermediate frequencies (0.01 mfd.). While these values are cited as an example of recognition of possible use of the 55 in t-r-f sets, we do not agree that the capacities should be so high, as the high audio frequency cutoff is altogether too great.

Thus the remaining question was how to get around the absence of amplification in the diode, especially as the triode section would not make up the complete difference. Obviously an extra stage of audio was needed. It was assumed by the writer that a 56 would turn the trick, but it did not afford sufficient sound volume of final output, and the 57 was found necessary, or a '24 could be used, if a UY socket is in the second audio position, no change being required in the constants.

Conditions will be quite different if a '47 tube is used as output, and indeed the '47 then will overload before any other tube, which would be all right, except that the output of the second a-f tube is gaited to a '45, and the full 50 volts expressed by the negative bias are easily developed on nearly all locals.

Different Choke Values

The bias for the '45 tube may be obtained as shown, whether the field coil has a resistance of 1500 or up to 2500 ohms, the difference being that with resistance values higher than 1800 ohms the bias will be raised and with lower resistance than 1800 ohms it will be lowered. No account need be paid to the difference between 1500 and 1800 ohms, as, due to accompanying current change the bias difference will be only 6 or 7 volts or so, which is immaterial, whereas if a 2500-ohm field coil is used, the two resistors, shown as 0.05 meg., should be dissimilar, that between ground and joint being 0.05 meg. and that between joint and B minus being 0.75 meg.

If there is more hum than you think justified, reverse the connections to the primary of the output transformer, which should be done at the speaker socket. The diagram for connecting this socket is shown, but polarity of the primary of the output transformer is not identified, as the outleads do not have consistent identities, and you will have to experiment to this slight extent.

Extra Filters

You notice a resistor-capacity filter in the grid circuit of the power tube, represented by 0.25 mfd. and 1.0 meg. The resistance is of the same value as that in the upper part of that grid circuit. In the plate circuit of the 55 triode an extra filter unit may be added, 0.02 meg. and 1 mfd., the resistor between the 0.1 meg. and B plus, and the condenser between the joint and ground, for further hum reduction if this is deemed advisable. The hum was not objectionable when the circuit was built as shown.

The 82 tube is shown as rectifier. It has two r-f chokes in the plate leads. This tube, please remember, takes a 2.5-volt filament voltage. If you have a transformer affording 5 volts, use the 83 mercury vapor rectifier. Or if you have an '80 tube and 5-volt winding, use that tube, in which case the two r-f chokes may be omitted. Their purpose is to safeguard mercury vapor rectifier tubes from modulation by radio frequencies, and thus present a smooth wave front to a rectifier sensitive to such modulation.

ULTRA WAVES

Follow Earth's Curvature!

MARCONI SENDS 167 MILES WITH OWN DEVICE

By Neal Fitzalan

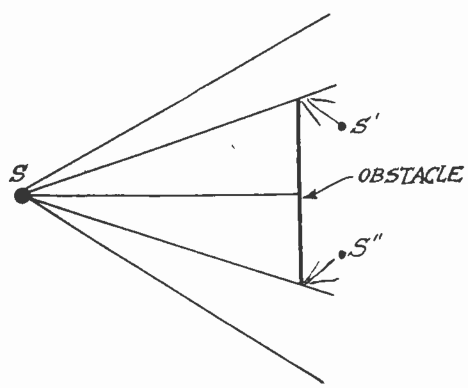


FIG. 1

This illustrates diffraction of a wave around the edges of an obstacle. S is the source and S' and S'' are secondary sources which diminish the intensity of the shadow.

GUGLIELMO MARCONI, inventor of practical wireless telegraphy, has announced the "bending" of ultra-short radio waves and the use of 57-centimeter waves in communicating, both by telephony and telegraphy, over a distance of 167 miles. The transmission took place from Rocca di Papa to Capo Figari in Sardinia.

Heretofore ultra-short radio waves have been regarded in the same way as light waves and subject to the same laws of transmission. If the waves follow the laws of light waves it would be possible to transmit in straight lines only. They would not pass around or through obstacles such as trees, buildings, hills, and the like, and they could not be transmitted over long distance because of the curvature of the earth. They would be transmitted in a beam parallel to the earth at the point of transmission, but the beam would be tangent to the earth so that the farther away from the transmitter a receiver is located the higher above the earth the beam would be, thus requiring a higher antenna to intercept it.

Bending of the Waves

Longer waves follow the earth, or bend with its curvature. Many attempts to make the ultra-short waves follow the earth have failed but the latest Marconi announcement reports success. If the waves can be made to follow the earth's curvature they can also be made to bend around other obstacles, and the discovery would open up a great field of useful..ess of the ultra-short waves.

No technical details are available at this time, and radio engineers are averse in commenting on the announcement until they will have received additional details of the method and apparatus used.

"If the press reports correctly interpret Signor Marconi's achievement," says Charles W. Horn, general engineer of the National Broadcasting Company, "the inventor has done a wonderful thing, something not believed possible heretofore, and an achievement that will rank with his original development of wireless. It is also possible that he has developed some new principle unknown to radio engineers in this country."

A. B. Chamberlain, chief engineer of the Columbia Broadcasting System, says that if the discovery of "bending" ultra-short waves proves of practical utility, it will be an epoch-making step in the development of radio. He says:

"Although many problems exist insofar as the use of ultra-short waves is concerned, such as the design of transmitting and receiving apparatus, with special reference to the design of vacuum tubes, the control of these short waves has been one of the stumbling blocks. Senator Marconi's reported discovery makes possible the control of such waves.

Other Experiments

"The possibilities of the ultra-high frequency band are unlimited. It will be possible eventually for many of the present radio services, such as broadcasting, television, radio-telephony and radio-telegraphy, to occupy this relatively unexplored region of the electro-magnetic spectrum. The available knowledge of this practically unused frequency band indicates that its penetration will result in a great saving of power and equipment."

Many experiments with waves less than one meter in length have been conducted, but in all cases the quasi-optical nature of the waves has been emphasized by the results. Telephonic communication across the English channel between Dover and Calais was established on a wave seven inches in length. Paraboloidal mirrors were used at both ends, two at each, with the transmitting and receiving antennas located at the foci. In this experiment the optical nature of the waves was clearly demonstrated, for they responded to the reflectors just as light waves would have done.

Manipulation of Waves

In this country ultra-short waves have been used in several places. For a number of years experiments on 68 centimeters between Riverhead and Rocky Point, Long Island, have been going on and the experience has been that the waves travel in straight lines. Another attempt at short wave communication was that between one of the Long Island stations and the Empire State building in New York City. A short wave collecting system was installed on top of the building, over 1,000 feet above the street level, but reception failed because the beam was much higher than the antenna. When a receiver was installed in an airplane and that plane was 2,000 feet above the building reception began, the plane just entering the beam. At 2,400 feet the received signals were the strongest, the plane being in the center of the beam. Thus, in a distance of about 100 miles the beam rose to a height of 2,400 feet due to the curvature of the earth. In that distance the curvature would account for about 1.25 miles, which is somewhat greater than the actual height of the beam.

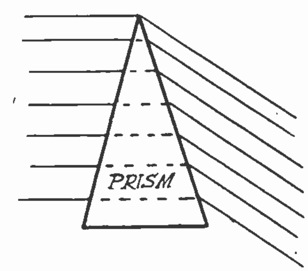


FIG. 2

A prism illustrates the principle of refraction. The direction of the wave is changed by the difference in speed of the wave outside and inside the prism.

We know that light waves can be subjected to refraction, diffraction, reflection. Refraction is the changing of the direction of a wave in passing from one medium to another when the speed of light is different in the two media. Diffraction of a wave is the changing of direction of a wave in passing around an obstacle. Reflection is the changing of the direction of a wave in striking a surface through which it cannot pass and into which it cannot enter. Refraction and reflection of a wave are closely related. For example, when a light wave strikes a surface of water or of glass there is both refraction and reflection. Part of the wave enters the new medium and part goes back into the original medium, the proportion depending on the angle at which it strikes. But the direction of each component, in general, is changed.

A mirror reflects a light wave and if the mirror is large enough in comparison with the wavelength it also reflects a radio wave. A paraboloidal mirror, of which the automobile headlight is an example, will send out a beam if the source is placed at the focus, or it will collect a beam and send all the light to the focus. If the reflector is large enough, for a given length of wave, it will subject the radio wave to the same changes as the light wave. That is why paraboloidal reflectors are used at both the transmitter and receiver of ultra-short waves.

It is well known that a prism or a lens refracts a light wave. Either behaves exactly the same way toward a very short radio wave, as has been demonstrated experimentally. Some of the very earliest experiments by Hertz on radio waves dealt with refraction by paraffine lenses and prisms and reflection from metal surfaces. It was these experiments which demonstrated experimentally the existence of radio waves. This was some years before Marconi applied the waves to communication.

Refraction in Atmosphere

The atmosphere may be regarded as a prism because it is denser near the surface than higher up. Because of the difference in density there is also a difference in the speed. The upper part of a beam will travel at a greater speed than the lower part. Hence there is a tendency for the wave to bend downward, toward the "thicker edge of the prism." This may be one reason why the beam referred to above was only 2,400 feet above the Empire State building instead of 6,600 feet. But the distance given was only approximate and may have been less than 100 miles and the beam may have started out with a downward direction.

Diffraction would enter only when a wave passes around an obstacle. We know that light will not easily pass around an obstacle but leaves a clearly defined shadow, but we also know that sound waves bend around quite easily. Yet behind every sound obstacle there is a shadow, especially if the sound wave has a short length, that is, if the pitch of the sound is high. A long broadcast wave will leave a shadow, but it will not be nearly as well defined as the shadow left by a short wave. Thus, if we are behind an obstacle we have a much better chance of receiving a long wave station than a short wave station. A hill is a natural obstacle to a radio wave. Practically no energy will go through the hill and the only energy that will be received is that coming over the top, or around the sides. Close to the hill, on the "shady" side, very little could be received even on long waves, but at some distance away, on the same side, such more could be received.

Atmospheric Prism

If the change in speed of a radio wave and the change in atmospheric density were proportionate the radio wave would follow the earth indefinitely because the upper part of a beam would travel just fast enough to keep up with the lower part. The wave would neither run into the ground nor would it shoot off tangentially into space, provided that it started out horizontally. But the change in speed is relatively small and the curvature of the earth great. For that reason it does not bend toward the earth rapidly enough and the beam shoots off into space. Obviously, in a narrow beam the atmospheric density is very nearly the same at the upper and lower edges so there can be practically no difference in speed. Hence there is no appreciable refraction.

Just what principle comes into play in the latest method announced by Senator Marconi is not known and will not be until he will have explained it in detail. As Mr. Charles W. Horn suggests, he may have discovered a previously unknown principle, possibly one that makes it possible to control the bending of the wave at the transmitter.

No information was contained in the news dispatches as to the height of the transmitter and the receiver. Presumably the two points were separated by the sea. If we assume this to be the case, and if the sending and receiving apparatus was at the same height above the sea, the height of each would have to be 4,600 feet in order that the beam at the half way point should just graze the surface of the earth.

Had the transmitting and receiving antennas been at such altitudes there would have been no occasion for the announcement, so we must conclude that the altitudes were much less.

Advantages of Short Waves

The importance of the reported discovery is realized when it is considered that all the present radio services could be crowded into the ultra-short wave band with much room to spare. To say "crowded" is not strictly correct, for there would be no crowding. It would be more nearly correct to say that all the services could be dumped into the short wave region without taking more than a small fraction of the available channel space.

Another important consideration is the economy of communication on the short waves. It required only a few watts to flash messages across the English channel, a distance of about 25 miles. This wattage is comparable with that of a small pocket flash light. In all ultra-short wave experiments the power has been very small. This, perhaps, is not because more radiated power is not desirable but because it has been difficult to radiate more power due to the limitations of the tubes. An intense effort is now being made to build tubes that will handle more power efficiently.

Although the tubes that have been used were inefficient, the fact remains that messages over considerable distances can be transmitted with very little radiated power. This is mainly due to the fact that the beam system is used, whereby the power available is concentrated and directed to the receiver.

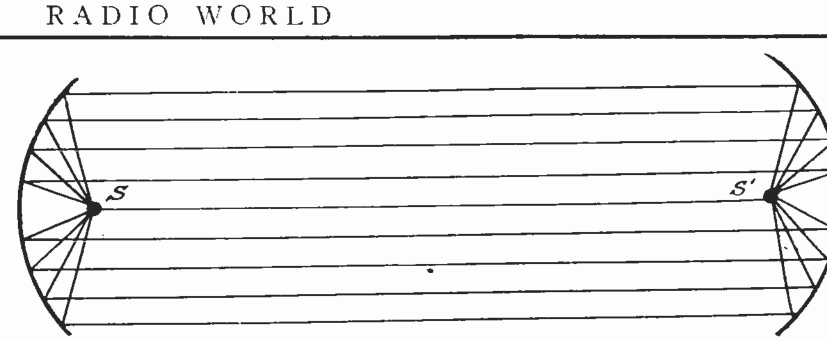


FIG. 3

Paraboloidal reflectors, exemplified by the automobile headlight, are often used for transmitting and receiving beams of radio, sound, and light.

Laws of Light Illustrated

In Figs. 1 to 3 we have geometrical representations of the meaning of diffraction, refraction and reflection. In Fig. 1 S is a source of some kind of wave disturbance. It may be a light, radio, sound, or a water wave. An obstacle is placed in its path. On the right of the obstacle there is a shadow as determined by the straight lines emanating from the source. These lines indicate the direction of the wave. At the edges of the obstacles are two secondary sources of disturbance, S' and S". New waves are set up at these points, and these waves travel as indicated by the short lines radiating from the edges. They move mostly into the shadow, or sheltered region, behind the shadow. The least disturbed region, or the point of deepest shadow, is at the middle of the obstacle. The only energy from the original waves that enters the shadow region is that which comes from the two secondary sources. This bending of the wave, or the setting up of secondary waves, is called diffraction.

In Fig 2 we have a case of prismatic refraction. The prism changes the direction of the wave because the speed of the wave is lower in the material of which the prism is made than in the medium outside. It takes a longer time for a ray near the base of the prism to pass through than it takes a ray at the apex. The amount of bending can be computed from the speed of light, or other disturbance, through the prism material and from the angle of the prism. It is conceivable that the prism could be made of a material in which the speed is greater than the speed in the medium outside the prism. The direction of the wave would still be bent, but in the opposite direction. That is, it would be bent toward the apex of the prism.

The Lens Situation

A lens is essentially a prism except that it has circular symmetry. In a convex lens the apex is at the periphery and the thick part at the center. In a concave lens the apex is toward the center and the thick base toward the periphery. However, there is a difference in that the refracting surfaces are no planes but usually spherical. The point is that light waves that strike the lens will be refracted toward the thick part, that is, toward the axis in a convex lens and away from the axis in a concave lens.

Fig. 3 illustrates the action of paraboloidal mirrors. The paraboloids may be either cylindrical or paraboloids of revolution. A cylindrical paraboloid is generated by the movement of a straight line moving in a parabola and perpendicular to the plane of that parabola. A paraboloid of revolution is generated by revolving a parabola about its axis. An automobile headlight reflector is a paraboloid of revolution. So is that of a searchlight. In radio both types are used. For waves of moderate length cylindrical paraboloids are used and they are made by erecting vertical antennas on a parabola drawn on the level ground. For very short waves a paraboloid of revolution is used, as near as the material can be shaped thus.

Where Wave Strikes

Suppose that S in Fig. 3 is a source of a radio wave, a light or a sound, and that S is located at the focus of the reflector. The wave will strike all parts of the reflector. Wherever it strikes it will be reflected in a ray parallel to the axis of the reflector and the transmitted beam will be one of parallel waves. That part of the total disturbance which is not reflected will not be parallel and even though part of the wave is parallel the beam will spread out. But this portion is greatly reduced by using a larger portion of the paraboloid. Only a very small part of it is shown in Fig. 3, much less than that used in a headlight or in a searchlight.

At the right in Fig. 3 is a similar paraboloid with S' as its focus. All the parallel light, or other wave motion, that strikes the reflecting surface will be collected at the focus. If this system is used for transmission and reception of short radio waves, the transmitting antenna is put at S and the receiving antenna at S'. It is clear that the two reflectors must be arranged so that the waves reflected from one will fall on the other. If the beam is very narrow it is necessary to align the two reflectors almost as closely as the sights of a rifle and the target.

Standard RMA Color Code for Fixed Resistors

Body color indicates first significant figure.
End color indicates the second significant figure.
Dot or ring color indicates the number of ciphers after the second significant figure.

0	**Black**	**.0**
1	**Brown**	**0**
2	**Red**	**00**
3	**Orange**	**000**
4	**Yellow**	**0,000**
5	**Green**	**00,000**
6	**Blue**	**000,000**
7	**Violet**	
8	**Gray**	
9	**White**	

The first column gives the numerals and the second column the color corresponding. The third column gives the ciphers if ring or dot has color opposite.

TWO 89'S IN PUSH-PU
D-C T-R-F SET

By J. E.

WE HAVE published direct-current operated superheterodynes several times, but many who live in sections where the power is d-c prefer to build t-r-f sets. One reason for their preference is that they do not feel sure of balancing up a superheterodyne properly. In most cases this is because they lack the equipment for tuning the intermediate amplifier and for padding the oscillator condenser. Some choose the t-r-f because it is less expensive, although the difference in cost is slight.

Right now those who want t-r-f circuits want them for the latest tubes. They are preparing for the day when the new tubes are available, which is not far distant. To meet the requests of those who want t-r-f receivers for d-c operation we publish the circuit diagramed in Fig. 1. This is six-tube, five-stage receiver utilizing the automobile tubes. Two of these tubes are the 239 suppressor-equipped super-control r-f amplifier, one is the 85 duplex diode triode detector-amplifier, one is the 237 three element tube, and two the 89 pentode power tube.

The R-F Tuner

The r-f tuner is a typical three-gang assembly. There are three identical r-f transformers T1, T2 and T3, the secondary of each being tuned with a 350 mmfd. condenser.

There is nothing unusual about the tuner until we come to the input of the detector. In order to allow grounding of the tuning condenser of the coil feeding the diode rectifier the condenser and coil are placed on the ground side of the load circuit. The load consists of a 0.5 megohm resistor and a 100 mmfd. condenser connected in parallel, and this combination is placed between the diode plates, which are tied together, and the tuned circuit. The rotor of the condenser is tied to ground, or the chassis, in the usual way, but the coil is connected to the cathode of the tube so as to eliminate the bias voltage from the rectifier circuit. The resonant circuit is therefore completed by the 0.25 mfd. by-pass condenser across the 2,500 ohm bias resistor for the triode part of the 85 tube. Of course, the 0.25 mfd. condenser is so large that it does not appreciably affect the tuning of the last tuned circuit.

The audio voltage developed across the 0.5 megohm load resistance is transferred to the control grid of the 85 through a 0.01 mfd. stopping condenser and grid leakage is provided by a 0.5 resistor connected between the grid and the chassis. A rather strong r-f signal is also impressed on the grid and this will be amplified together with the audio signal. In order to eliminate the radio component from the audio signal we put a 0.00025 mfd. condenser from the plate of the 85 to the cathode. In view of the fact that the resistance in the plate circuit is high, this condenser is very effective in reducing the r-f component.

The Audio Amplifier

The diode detector is not nearly as sensitive as a biased screen grid tube detector, but this lack of sensitivity is made up for by improved quality and by more amplification in the audio amplifier. There are three stages of audio amplification. The first is the triode part of the 85, which delivers its output to a resistance coupler. While the recommended load resistance on the 85 is 20,000 ohms, the resistance used in this circuit is 250,000 ohms. A considerably higher voltage gain is obtained with the higher resistance. There is no particular reason why one should adhere to the recommended value of 20,000 ohms because the tube is a triode and any triode amplifies more the higher the load resistance.

The 2,500 ohm bias resistance is the recommended value for a load of 20,000 ohms. When the load has a higher value the drop in the bias resistance will be less than the 20 volts recommended. Again there is no reason why we should adhere to the recommended value, for we shall have more gain if we make the bias less. Of course, we must not make the bias so low that the signal will drive the grid positive. There is no danger of doing that if we use a 2,500 ohm bias resistor, because the signal voltage will be comparatively low at this stage of the circuit. The second audio amplifier is a 237 which is used because it is desired to us[e] push-pull in the output. The 237 tube i[s] the best in this series for working int[o] a transformer. This tube is biased wit[h] a resistor of 1,500 ohms in the cathod[e] lead, and the resistor is shunted with [a] condenser of one microfarad to reduc[e] reverse feedback.

When there are two audio amplifier[s] the even order harmonics generated i[n] one tube are partly balanced out by th[e] next amplifier. This is true even thoug[h] the tubes are dissimilar and if they ar[e] working under different conditions, as i[n] this case. Of course, the elimination o[f] even order harmonics is not complete but there is a marked improvement.

The output stage is push-pull and th[e] even order harmonics generated in on[e] of these tubes are balanced out by th[e] other tube. Therefore, although the audi[o] amplifier contains three stages it is i[n] effect an even circuit in so far as th[e] elimination of harmonics is concerned.

The 89s in the output stage are operated as pentodes in order that the gai[n] may be high. In this application of th[e] 89 the screen is given the same voltage a[s] the plates and the suppressor grid is tie[d] to the cathode.

The grid bias is provided by a 600 ohm resistor in the common cathode lead o[f] the two tubes. This resistor is shunte[d] by a condenser of 2 mfd. Theoretically [a] by-pass condenser across the bias resisto[r] of a push-pull stage should not be neede[d] but in practice it will be found that considerably more volume and better qualit[y] will be obtained if one is used. While [a] 2 mfd. condenser is specified there is n[o] reason why a larger one should not b[e] used.

LIST OF PARTS

Coils

T1, T2, T3—Three shielded radio frequency transformers for 350 mmfd. condensers.
T4—One push-pull input transformer.
One 30-henry choke coil.

Condensers

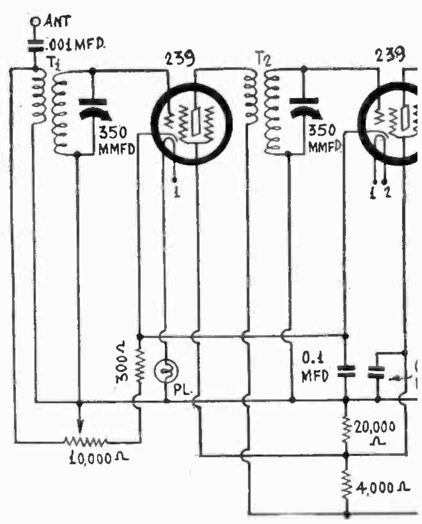
One gang of three 350 mmfd. tuning condensers.
Two 0.1 mfd. by-pass condensers.
Two 0.25 mfd. by-pass condensers.
One 0.001 mfd. condenser.
One 100 mmfd. condenser.
One 0.00025 mfd. condenser.
One 0.01 mfd. condenser.
One 1 mfd. by-pass condenser.
One 2 mfd. by-pass condenser.
Two 8 mfd. electrolytic condensers.

Resistors

One 10,000 ohm volume control potentiometer with switch.
One 300 ohm bias resistor.
One 600 ohm bias resistor.
One 1,500 ohm bias resistor.
One 2,500 ohm bias resistor.
One 4,000 ohm resistor.
One 20,000 ohm resistor.
Three 0.25 megohm resistors.
Three 0.5 megohm resistors.
One 284 ohm, 3 watt resistor.
One 185 ohm, 30 watt resistor.

Other Requirements

Three five-pin sockets.
Three six-pin sockets.
Five grid clips.
One 2.5 volt pilot light.
One fuse and holder.
One line plug and cord.
One chassis.
One antenna binding post.
One dynamic loudspeaker.

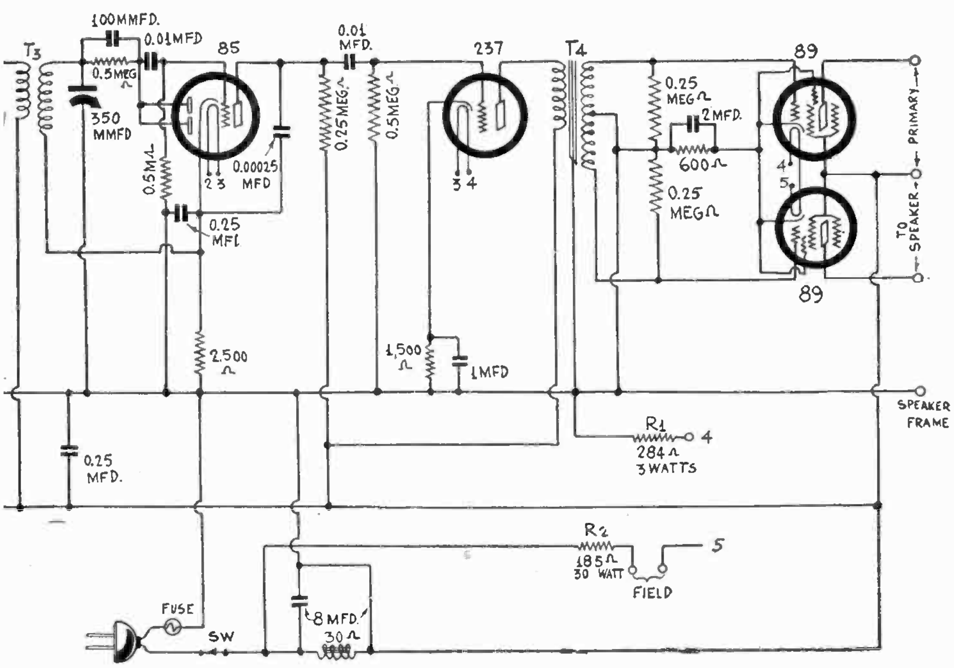


STANDARD RESISTOR CODE

Resistance	Body	End	Dot
300 ohms	Orange	Black	Brown
600 ohms	Blue	Black	Brown
1,500 ohms	Brown	Green	Red
2,500 ohms	Red	Green	Red
4,000 ohms	Yellow	Black	Red
20,000 ohms	Red	Black	Orange
0.25 meg.	Red	Green	Yellow
0.5 meg.	Green	Black	Yellow

.L OUTPUT; HAS 85 AS DETECTOR

Anderson



Another important feature about the power stage is the 0.25 mehohm resistance across each half of the secondary of the push-pull input transformer. These resistances eliminate much of the noise that is often heard on d-c operated receivers. They do cut the volume a little, but this no more than compensated for by the elimination of noise. Besides, the quality is improved aside from the noise elimination.

All the filaments are connected in series as is customary when heater tubes are used on a d-c line. In the same series is also the pilot light. This light should be rated at 2.5 volts but when it is connected in the series the voltage drop across it will be 3.2 volts.

The 89 tubes require a filament current of 0.4 ampere whereas the others and the pilot light require only 0.3 ampere. For this reason it is necessary to put in a resistor in shunt with those tubes which require only 0.3 ampere and adjust the resistance so that the extra current of 0.1 ampere will flow through it. The pilot light is connected to the chassis and to the heater of the first tube. Thereafter the heaters are connected as indicated by the numbers at the heater terminals, those having the same numbers being connected together.

The 0.3 ampere circuit begins with the chassis and terminates at the heater marked (4). The shunt resistor, therefore, should be connected between the chassis and terminal (4). This resistor is R1, one terminal of which is also marked (4).

The value of this resistor is determined from the voltage drop across it and the current which is to flow through it. The voltage drop is equal to the drop in four heaters and the pilot light. The drop in each heater is 6.3 volts and the drop in the pilot light is 3.2 volts. Hence the total drop, or the drop across R1, is 28.4 volts. Since the current is to be 0.1 ampere, the resistance should be 284 ohms. The wattage rating of this resistor is best arrived at by multiplying the voltage across it by the current through it. Thus the wattage is 2.84 watts, and a 3-watt resistor should be adequate. Of course, a resistor of much higher rating could be used and it would be better. A resistance of 284 ohms can be obtained by taking a 300 ohm wire-wound resistor and removing some of the wire, or shorting some of the turns. The adjustment to the right value can be done with the aid of a voltmeter or an ammeter.

A series limiting resistor is also needed to cut the excess voltage. This is marked R2 in the circuit diagram. The value of this resistance is determined by the current that flows through it and the voltage that must be dropped. We already have a voltage drop of 28.4 volts. There will also be a voltage drop of 12.6 volts in the filaments of the two 89 tubes. Hence the total voltage drop in the filament circuit will be 41 volts. If the line voltage is 115 volts the drop in R2 should be 115—41, or 74 volts. Now the current through R2 is 0.4 ampere. Hence its value should be 74/0.4, or 185 ohms. The wattage rating, as before, is determined by the voltage drop multiplied by the current. We have 74 x 0.4, or 29.6 watts. Hence a 30-watt resistor is specified. This is the minimum rating.

If the field coil is not to be connected in the series, the free end of R2 should be connected to the heater terminal marked (5), and the other end of the positive side of the line. If the field winding is to be connected in the series, as indicated by the terminals marked "field," the value of R2 should be diminished by the amount of resistance in the field winding. Thus if the field winding resistance is 125 ohms R2 should be 60 ohms. The wattage rating can be reduced in proportion to the reduction in the resistance, as wattage is current squared times resistance.

Speaker Field

There is at present a speaker with a field winding of 125 ohms which requires a current of 0.3 ampere. This cannot be used safely in this circuit because the field winding might overheat due to the greater current. Undoubtedly, speakers will be put out which can be used on 0.4 ampere. In case a 0.3 ampere winding is available it can be used if it is shunted by a suitable resistance which takes up the extra 0.1 ampere. For the 125 ohm, 0.3 ampere speaker this shunt should have a resistance value of 375 ohms, approximately. If the heater winding does not overheat without the shunt after the current has been on about an hour, the shunt is not needed.

In case it is not desired to put the speaker field winding in series it can be connected directly across the line, that is, it may be given 115 volts. Speakers designed for this connection usually have a field winding resistance around 1,200 ohms.

Control of Volume

The volume is controlled in the usual manner when variable mu tubes are used in the radio frequency amplifier. A 10,000 ohm potentiometer is connected between the antenna and the cathode returns of the two controlled tubes and the slider is connected to ground, or to the chassis. A limiting resistor of 300 ohms is employed to fix the lowest bias. In case there is no oscillation when the volume control is set at maximum sensitivity it is permissible to use 150 ohms for this resistance.

The voltage on the screens of the two 239 tubes should be about 80 volts when the plate voltage is 115 volts. Approximately the proper voltage division is obtained by using a 20,000 ohm resistance next to ground and a 4,000 ohm resistance between the screens and the positive side of the plate supply. These resistors are subject to variation both relatively and absolutely, relatively because the screen voltage is not critical, and absolutely because the bleeder current is not critical either.

The wattage ratings of the 20,000 and 4,000 ohm resistors should be one watt or more each.

B Supply Filter

The filtering of the B supply is thorough and it should leave no ripple to cause a hum. There are two 8 mfd. electrolytic condensers across the line and between them, in the positive lead, is a 30 henry choke coil. There is also a 0.25 mfd. condenser in shunt with one of the electrolytics to take care of radio frequency currents. This condenser should be placed as near the radio amplifier as practical.

The switch is placed in the positive side of the line in the diagram but it may be put on the same side as the fuse. In most cases the "hot" side will be the negative, and the fuse as well as the switch should be put in that lead.

(Continued on next page)

DIODE VEXES SOME

Complaints of Lack of Both Sensitivity and Selectivity

By C. W. J. Marlin

THERE HAVE already been many complaints about the efficiency of the duplex diode triode tubes. There are two main complaints, namely, that a circuit is less sensitive and that it is less selective. What is the trouble? Could it possibly be that the coils used are not correct, or that the voltages are not correct, or that a by-pass condenser has the wrong value? It may possibly be that all these things are wrong but it is more likely that the complainant has failed to notice the statement that when these tubes are used a lower sensitivity and a lower selectivity should be expected, even when everything else is as it should be.

It is not fair to the new tube to charge it with lower detecting sensitivity than that of a 57 tube. The diode has no amplification. It only rectifies. The 57 has a very high amplification factor. Take any diode whatsoever and connect it in a rectifying circuit and the sensitivity will be less than when a tube having high amplification is used.

Amplification in 55

Now, the 55 and the 85 duplex diode triodes also amplify because an amplifier tube is built into the same bulb as the diode part. It would seem that that amplifier would offset the loss in the detector. But the triode built in has a comparatively low amplification constant. It is not high enough to compensate for losses when it is compared with a tube like the 57. But it compares very favorably with a tube having an amplification constant of the same order of magnitude as the 55 or the 85.

If we are to use a duplex diode triode tube we must be prepared to accept its results. The results are lower efficiency and less selectivity. We should not put in one of these tubes where it does not belong and then ask irrelevant questions about the possible causes of the inferior results, inferior in respect to sensitivity and selectivity. One of the proper places for the 55 or the 85 is as second detector in superheterodyne where there is plenty of amplification and selection in front of it and where automatic volume control is to be used. That was the main purpose for which these tubes were designed.

The duplex diode triode tubes have advantages as well as disadvantages. They are capable of first rate quality and they can stand a great deal of volume without overloading. The quality will be better, within certain wide limits, the higher the signal level. But it is futile to expect these advantages in a set which does not have much amplification in front of the detector, nor in one that does not have enough selection to offset the lack of selectivity in the diode circuit.

To Improve Selectivity

Just why there should be so much loss in selectivity in the diode detector is not evident. We have a tuned circuit working into a high resistance load, the greatest part of which is the load resistance from which we obtain the audio signal. When a three element tube is used as a grid leak detector we have essentially the same thing. The grid leak is the load and the condenser across it is the filter condenser. The grid-cathode is the diode elements. There is about as much current in one case as in another and it is the current drawn from the tuned circuit that determines the selectivity. The greater the current the less the selectivity. It is customary in grid leak detector to use a load resistance, that is, grid leak, of about 2 megohms whereas in diode detection it is customary to use 0.5 megohm. The difference in the load resistances may account for the difference in sensitivity and selectivity. But there is no reason why we should not use the 2 megohm load on the diode. That should increase both the sensitivity and the selectivity.

If we do use this high load resistance we should use a smaller condenser, for if we do not the high audio frequencies will not come through well.

Amplifying Audio Component

When grid leak detection is used the grid serves both as diode plate and control grid. Since the grid must be positive in order that grid current may flow it is necessary to select a plate voltage such that the grid automatically assumes the bias that makes the tube the best amplifier. Ordinarily this plate voltage is 45 volts. When we use either the 55 or the 85 we can operate the grid at a negative bias with a high voltage on the plate. This is an advantage over the simple grid leak detector.

When half wave diode detection is used it would be possible to use regeneration because there is a considerable component of carrier current in the plate circuit of the triode. By means of a tickler coil this could be returned to the tuned circuit feeding the diode and thus boost the input. This is not recommended for superheterodyne use but it might be used on a t-r-f set. Of course, there must be a good control of the regeneration or it might become a nuisance rather than a benefit.

Midget Sets

When a midget set is to be built, that is, a set in which the greatest possible sensitivity with the least number of tubes is to be obtained, the diode is hardly the detector to choose. The 57 is the logical tube in such circuits. It is necessary to sacrifice the advantages of diode detection for sensitivity. It is also necessary to retain selectivity as far as possible. This the 57 does because it is biased negatively and no current can flow in the grid circuit.

Many a circuit is an experimental superheterodyne utilizing the 55 as a detector, amplifier, and automatic volume control. The load resistance on the diode detector is 0.5 megohm and the condenser across it is 250 mmfd. We can make this circuit more sensitive and more selective by making the load resistance 2 megohms for with that value the current in the detector circuit will be less. When the load resistance is increased the by-pass condenser should be decreased in about the same proportion, or at least to 100 mmfd.

Since the triode part of the 55 has a low mu it will give best results if it is followed by a transformer. The gain will be low if it is followed by a resistance coupler. Its output will be great enough to load up a pair of power tubes working in push-pull, but to get this output we must have plenty of amplification ahead of the detector.

The 58 is a very good radio frequency amplifier and one of them should be sufficient in the intermediate amplifier but two will make a much more sensitive circuit, provided that it can be stabilized. Usually there is difficulty doing that. Whether or not a single 58 in the intermediate amplifier will give sufficient amplification depends on the efficiency of the mixer. The mixer shown in the present circuit is the experimental part of this receiver and its performance has not been thoroughly explored.

New Tubes in D-C T-R-F Set

(*Continued from preceding page*)

The fuse is used only as a protection against accidental short circuit. A one-ampere fuse would be large enough but it is all right to use a 3-ampere.

The fuse does not protect the electrolytic condensers against possible application of the voltage in the wrong direction. This is best guarded against by testing the polarity of the voltage and then plugging into the outlet so that the positive is applied to the anodes of the condensers.

Sometimes a buzzer is used in series with the positive line as a protection. This is adjusted so that when the plug is inserted the correct way the buzzer will be inoperative because the plate current alone is not enough to work it, and so that it will buzz when the plug is inserted the incorrect way, the buzzing being due to the current that flows into the electrolytic condensers when the polarity is wrong. The correct position for this buzzer is in the positive lead between the first 8 mfd. condenser and the junction of the heater lead to the positive line. The buzzer will function instantly so that it is not necessary to leave the polarity on wrong more than a fraction of a second. Suitable buzzers are usually available in radio parts stores and electrical supply houses.

The 0.001 mfd. condenser in the antenna lead is a safeguard against the possibility of a short circuit of the line should the antenna touch some grounded object. No ground is needed on the set, for the line is grounded on one side, and that serves. It is also safer to avoid grounding the set.

The Secret of Peak Results

CAPITALIZING '39's VIRTUES

The Vari-Mu Advantage Real, Despite False Tests

By Farrington Enright

SHORTLY after the automobile tubes came out, including the 236, the 237, and the 238, the 239 was added to the line. This particular tube was to be a considerable improvement over the 236 in radio frequency circuits, but direct substitution did not show the tube up favorably. It is perhaps for this reason that it did not gain favor. The direct substitution test is unfair to the 239 because the improvements in the results do not show up readily. Yet these improvements are considerable.

The 239 is a super-control tube in the first place. That is, it has a remote cut-off and hence it can be used where minimization of cross-modulation is important, and that includes practically all cases of radio frequency amplification. In the second place, the tube has a suppressor grid, just like the 58, although the suppressor grid is not represented on the base of the tube by a separate terminal. It is connected inside the tube to the cathode. A suppressor grid, even when permanently connected to the cathode, has many advantages. It enables the use of a much higher screen voltage without danger of distortion from secondary emission of electrons from the screen or the plate. And the increased screen voltage will increase the gain considerably. When a 239 is substituted in the socket for a 236 this fact is not taken account of, for the same screen voltage is left.

Curves Tell How Best to Use the '39 Automotive Tube

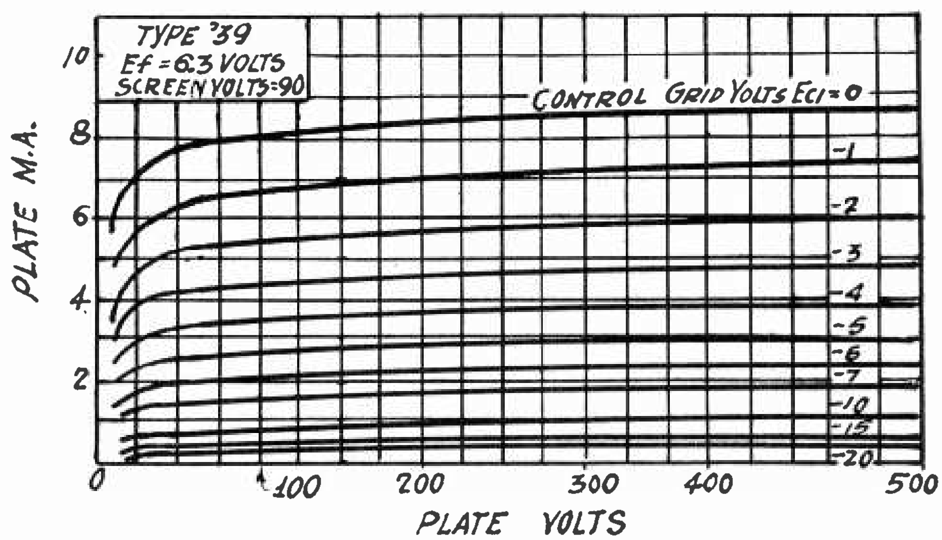


FIG. 1

Average plate characteristics of the 239 pentode with a screen voltage of 90 volts. The suppressor grid built into the tube accounts for the absence of irregularities at low plate voltages.

Use as Detector

As a detector working into an audio amplifier the tube is not good because it has been designed so that it will not detect. Therefore, the worse the tube is as a detector the better the tube for the purpose it was designed, provided there is no defect to account for its characteristics. But as a frequency changer in a superheterodyne, that is, as a first detector, the tube is good provided it is properly biased. It may not be quite as sensitive in this application as a 236 but it will stand much higher signal and oscillator voltages without overloading. Hence in a practical case the effective sensitivity may be greater because of the possibility of applying a higher oscillator voltage.

As an audio voltage amplifier the tube is excellent when used in a resistance-coupled circuit. The presence of a suppressor grid extends the range of usefulness of the tube in respect to input voltages. The ordinary screen grid tube, like the 236, requires a very low screen voltage if it is to amplify without distortion over an appreciable range of signal voltages. This low screen voltage reduces the effective amplification of the tube and makes it little better than a three-element tube. If the plate load resistance is reduced so that a higher screen voltage can be used without encountering distortion, the amplification is reduced just the same.

Higher Gain Realized

In the 239 it is not necessary to use such a low screen voltage to avoid distortion. Neither is it necessary to reduce the plate load resistance. Hence the high gain theoretically possible can be realized in practice. Still, the tube is of the screen grid type and the output will be distorted if the effective plate voltage is allowed to fall much below the applied screen voltage. This is likely to happen if a very high plate load resistance is used, or if the applied screen voltage approaches in value the applied plate voltage. Therefore, in a resistance-coupled voltage amplifier, the screen voltage should be less than when the same tube is used with negligible d-c resistance in the load in a radio frequency amplifier. The other alternative is to use a very high applied plate voltage. The use of a very high applied plate voltage is usually not practical. But we can always use the highest available.

There is one other way of preventing the distortion due to the high screen voltage, and that is to put a high resistance in the screen lead, by-passing it with a suitably large condenser. The effect of this resistance is to keep the screen voltage less than the effective plate voltage. This arises from the fact that the screen and the plate currents are in phase. That is, they rise and fall together with changes in the grid voltage. Therefore as the plate current increases, simultaneously reducing the effective plate voltage, the screen current rises too and the resistance in the screen lead causes the effective screen voltage to reduce.

The effect of the resistor in the screen lead is to reduce the gain of the tube and this reduction is greater the higher the resistance. But it is much better to have a moderate voltage gain without distortion than a large gain and mostly distortion. When a resistor is used in screen lead, the applied screen voltage might be somewhat higher than when no resistance is used.

Tube List Prices

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

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

Bias for the 57

WHAT IS THE VALUE of biasing resistor that should be used with the 57 for self-bias, connected between cathode and B minus, to afford the 6 volts for detection, when the plate voltage is 250 volts, as usual, and the plate load resistor is 0.25 meg.?—J. W., Kalamazoo, Ark.

From experimental work we have found that 30,000 ohms is highly satisfactory for the mere purpose of affording an excellent detecting bias. But it should be remembered that the tube is not recommended for use with exclusively self-bias, but some bleeder current, or otherwise obtained current, should be used. The reason is that B current changes abruptly with grid voltage changes, and as the signal actually changes the grid bias, a strong signal will not only drive the grid considerably off the desired detecting point but actually send it to a positive voltage value. One method is to take the 6 volts from the drop in a resistor through which the set's total B current flows. Thus for a 60-ma set the resistance would be 100 ohms. Another way would be to obtain a 6-volt drop from a resistor in the cathode leg of an r-f tube that draws B current of several milliamperes, returning grid to a tap on this resistor to afford the lower bias for the amplifier, and returning detector grid to B minus to afford the 6 volts. As the detector plate current is a fracion of a mil the much higher current of the r-f tube acts as a bias stabilizing agency, especially as this current changes little with signal amplitudes.

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55 Diode-Biased

PLEASE LET ME KNOW how to use the 55 duplex diode-triode tube, tell me what it is, and say how the bias for the triode is obtained from the diode.—U. S.G., Allentown, Pa.

The 55 is three tubes in one glass envelope. These tubes are the two diode units and the triode unit. The diodes and the triode have the cathode as common d-c potential point, although the cathode is not electrically common to the three tubes. The detailed uses of the tube can not be repeated in the short space available, but the tube may be used for full-wave or half-wave detection, and in either instance with automatic volume control additional, whereas the triode unit, equivalent to a '27 tube, serves to help make up for the sensitivity lost in the detector. The diode does not amplify, but it may be a true linear detector, the only really good detector tube. The load resistor in the cathode leg should be high. It is connected between cathode and the anode return of the input r-f coil. A value of 0.5 meg. is suggested. Across it a bypass condenser is usually necessary, but should not exceed 0.0001 mfd. The diode-biased triode consists of the following connection: anode return of the input coil is connected to the grid of the triode (metal cap of tube). Then the grid is negative in respect to the cathode by the voltage drop in the 0.5 meg. resistor, which also serves as grid leak. Besides, the cathode may be grounded. We do not recommend the diode-biased triode, as our experiments with this hookup so far have developed only conditions of incorrect bias, resulting in choking of the triode unit, especially as the signal changes the bias a lot. While this condition might be remedied a little by changing the resistance value in the cathode leg, such value might have to be increased or decreased impractically, resulting in negation of other and more important objectives. We recommend a mica stopping condenser between anode return of cathode resistor and grid cap of triode, with grid leak of 1.0 meg. from cap to B minus, the bias applied as usual.

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Fuzzy Reception

FOR SEVERAL YEARS I have been getting real pleasure from my radio set, but just now I hear a fuzzy sound on high notes of a program, or on any loud passages, and I am at a loss to remedy this. I have suspected, from time to time, an ornament that reposed atop the console and that had a loose part; loose tube shields, vibration of condenser plates and insecure bolting of electrolytic condensers, but on applying the intended remedy the nuisance was not removed at all, indeed it seems to be getting worse. I will be greatly indebted to you if you will tell me what is the matter with the set.—J. W. Q., Omaha, Neb.

Probably there is nothing the matter with the set itself, but the cone of your speaker is loose. This trouble often develops in a set after a few years. If you will examine the speaker carefully you will probably find that the edge of the cone (paper or other material) adheres to a piece of felt or paper for most of the circumference, and is intended so to adhere for the entire circumference, but part of the cone has lost its adhesion, due to the glue drying up. Put your finger under the loose part and gently move the finger along the edges supposed to be glued together. In that way you can trace the extent of the dislodgment. Perhaps nearly the entire periphery is loose or too weakly attached. Recoat the members with cement or glue, put on as a sizing, and let this dry before trying to stick the two pieces together. Then put on another coat and this time press the cone against the other surface. You may find that one part of the cone has a tendency to warp out of place when the other part is held in proper position, in which case treat the adhering part separately, and after the cement or glue has dried, adhere the other part in the same manner. Then the rattle you complain of probably will be gone.

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Inductance Value

PLEASE GIVE ME suitable values of inductance to tune in the broadcast band, using 0.00035 mfd. condensers, and state what the primary should be.—T. E., Annapolis, Md.

For 0.00035 mfd. tuning an inductance of 245 microhenries is suitable. Assuming that a shielded coil is to be used, wind 127 turns of No. 32 enamel wire on 1 inch diameter. The primary may be wound over the secondary, 1/32 inch insulation between, and consist of 30 turns of No. 40 single silk wire wound near the bottom of the other winding. It is assumed this coil will be used with screen grid tube, where the primary is in the plate circuit. The same kind of coil may be used for antenna coupler in t-r-f sets, but for supers the wire of the primary may be larger and the turns may be 20 instead of 30. This difference, however, is not very important.

* * *

Ground Sensitivity

DO YOU THINK that my ground changes its electrical characteristics, basing your opinion on the following: I built a set with a diode detector, trying to use push-pull resistance coupling, and while I got fairly good results (cathode not grounded, of course), the sensitivity was not what it should be, or at least not what was desired, and I found that using the ground had a very considerable boosting effect on signal strength. When I tried the same aerial and ground on a t-r-f set, your own Star Midget, 5 tubes (and it is a dandy), the ground connection seemed to make very little difference. Do you think, therefore, that my ground is at a varying potential, or what?—Y. T. F., Vera Cruz, Mexico.

The difference exists in the receivers and not in the ground. It is characteristic of the diode detector with ungrounded cathode that the ground connection to the antenna coil and chassis should have a strong boosting effect, whereas with t-r-f sets the ground's effect is much in the nature of a stabilizing agency, without considerable increase in signal strength always noted. Sometimes there is quite an increase, even in the second example, but that would rather indicate an excellent ground. Please note that ground connections to radiators aren't much good, that ground connections to gas pipes of any kind are utterly taboo, and that it is a healthy sign as to ground condition when there is a decided increase in volume when ground is connected to any set. With the diode detector you talk about the increase would be greater than in most other circuits.

* * *

Series Connection

I HAVE a three-gang condenser, and as I would like to build a circuit that requires one capacity of half the value of the present sections, may I not tie two sections in series, using the resultant half-capacity as required, and the other section at full capacity?—H. P. C., New Rochelle, N. Y.

No, this can not be done, because the condenser has a common rotor, and this is consequently coupled to the frame and goes to ground. Therefore one side of the condenser you'd like to put in series with the other is grounded, and one side of the other is grounded, leaving the option of using each condenser separately, or if they are interconnected, the two remaining free terminals alone may be connected, since the other two are common, therefore only parallel connection is practical, and that would add the two capacities. You would have to use two separate condensers, and may tie them together mechanically with a flexible insulated coupling.

* * *

Screen Resistor

IS IT ALL RIGHT to use a series resistor in the screen circuit of the 57 tube? Is the sensitivity better when there is no resistor?—A. C. F., Akron, O.

You may use a series resistor. The effect depends largely on the voltage to which the resistor is returned. Sensitivity will depend on that voltage rather than on the resistor. The screen current is very low—around 20 microamperes—so only large resistors would have any appreciable effect.

STATIONS BY FREQUENCIES

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

Corrected to August 16th, 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 expected.

—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. (temporary frequency. See 1120 kc).
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.; C. P. only: see 1210 KC.
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.

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.); 1 KW.
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.*
WDBO—Orlando, Fla.; Orlando Broadcasting Co. (Inc.); 250 W. Temporarily on 580 kc.
WTAW—College Station, Tex.; Agricultural and Mechanics College of Texas; 500 W.
KTRH—Houston, Tex.; Rice Hotel; 500 W.
WISN—Milwaukee, Wis.; Evening Wisconsin Co.; 250 W.
WHAD—Milwaukee, Wis.; Marquette University; 250 W.
KPSG—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—Mooseheart, 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.; C. F. Schiessler and M. E. Stephens, doing business as Home Cut Glass & China Co.; 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.

[Two more full pages, completing the list, will be published next week, issue of Sept. 3d.]

A THOUGHT FOR THE WEEK

IF YOU HAVE any idea of starting a new political party and expect to depend on the efficacy of broadcasting to win the votes, remember that you can get an hour of full coverage on a good coast-to-coast network for the tidy sum of $16,000.

Or, if you prefer, 100 *hours for* $1,600,000. *Who says the cost of living has been reduced!*

RADIO WORLD

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Eleventh Year

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Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. E. Anderson, technical editor; J. Murray Barron, advertising manager.

The President's Speech

MORE persons heard President Hoover's speech of acceptance than heard any other political utterance in history. This was due of course to the radio, to the fact that the President is the President, and to ample notice in advance as to the time. Franklin D. Roosevelt's acceptance speech was delivered to the Democratic convention that nominated him and the time of its commencement was not ascertainable until the candidate actually started speaking, owing to the special circumstances, including his flight from New York to Chicago by plane. So it may be a mere accident of politics, and is no reflection on Governor Roosevelt, that fewer heard him than heard his opponent.

To be able to hear such speeches is indeed an advantage, though no longer a privilege. Tributes to radio for the encompassing of such opportunities are so common as to be rote. More to the point is the fact that the personalities of the candidates are conveyed to the electorate this way better than by any other, and intellectual contact between voter and candidate is established in an almost personal manner, and the government is felt to be as close to the individual who listens as to the individual who speaks.

But there is another side. The speeches are in English. We well know from hearing and reading political speeches of the past that all candidates are foresworn to the upholding of the traditions of our government, those sturdy, basic principles laid down by the founders of this nation. But one of the traditions, not civic in character but of some importance nevertheless, is that concerning our speech.

Strictly speaking it is not our language by origin, but only ours by virtue of adoption, yet we have invested our share of this borrowing with an individuality of its own, and established our own standards. These are not ideals, in any sense, for ideals are never actualities, nevertheless they are basic principles and standards, and the more these widely-disseminated speeches of candidates subscribe to those standards, the greater will be the improvement of American speech.

In political life such speech is altogether too bad to deserve encomiums. Of all the living political speakers of national prominence whom we have ever heard, only three struck us as adhering strictly enough to the regularities of pronunciation to deserve approbation, and they were James M. Beck, who was Solicitor-General in the Coolidge administration, Senator Shortridge and Dr. Henry Van Dyke. Some others are rated as highly as these three, in that respect, although we did not happen to hear them.

President Hoover, in the main, did well enough by the science of pronunciation, judged by political standards, but not well enough judged by ethical standards. He has some mannerisms of pronunciation that are not supported by respectable authority.

Radio listeners may have noted that he repeatedly pronounced maintain as if it were mentain, that he twice pronounced the word women as if it were woman and that once he pronounced horizon as if it were hor'-i-zun, with the *i* as in is, an archaic pronunciation that went big in Shakespeare's day, but the modern dictionaries will confirm the correct pronunciation is ho-ri'-zun, with *i* as in ice. Moreover a few other mispronunciations were heard, as well as some bad grammar, e.g., "Either of them are intolerable," referring to the saloon and the bootlegger.

There does not seem to be any good reason why the political lights of the country should not submit their speeches to competent editors and to rehearse the delivery before linguists for the correction of any personal misguidance as to how words should be uttered, because when the speech is delivered to many millions of persons it is quite likely to be accepted as standard of excellence in grammar and pronunciation, and bear the semblance of literary and linguistic authority that it does not necessarily possess.

This consideration is quite apart from the political aspects of any such speeches, which, despite solecisms, may strike a high factual and actual level nevertheless.

New Tubes Stand Up

EXCELLENT results are being obtained in the first instance from a group of tubes announced during the past few months, which is an experience rather new to radio. In the past considerable experimenting had to be done, sometimes was done at the consumer's expense, before the right way to use the tubes was determined. This time, however, the tube announcements have been accompanied by extensive explanations of how to use the new tubes, including warnings as to how not to use them. The information was not in all senses complete, but it was comprehensive. It would be rash to assume it could be complete, so soon, or ever for that matter, otherwise one would have to admit that nothing new could be learned about them through experience.

Some of the points concerning which there will be interesting discussions in the radio press no doubt will include the use of different suppressor voltages on the 57 and 58 tubes, a point not covered in the announcement data, although for present purposes it is recommended that the suppressor be tied to cathode, while admitting the possibility of other connections for special circuits. One supplemental announcement dealt with variation of the suppressor voltage from zero to negative values for manual volume control. Conceivably the suppressor could be tied also to an automatic volume control.

The voltage to be applied to the screen, when using the 57 and 58, is another subject concerning which more enlightenment would be appreciated by prospective users. Then there may be additional data concerning the power tubes, although this subject seems to be fairly well covered. Meanwhile it is a pleasure to report that so much experimental work in actual circuits has preceded the release of new tubes that a fine contribution has been made to the stability of the radio business from a technical and engineering viewpoint.

Experimenters have found the new tubes to be all that was said for them. Newer information may reveal that they are even better than was claimed at first. At least the experiences with the 222, the first screen grid tube, will not be repeated. The tuned plate circuit will not be chased, as for gang tuning it is recognized as virtually impractical. It will not take two years to find out that a tube is not to be used as a detector, as was true with the 222.

The negative uses of the new tubes are expressed in definite terms, or at least no mention is made of some uses that at first blush might seem desirable. For instance, the 57 and the 58 are not mentioned as oscillators, not because they won't oscillate, but because the 56 is given oscillator honors, and is to be preferred over the two others. And as an audio frequency amplifier the 57 gets no rating in the characteristics chart, although the textual data accompanying the notice of the new tube broaches the practicality, on the basis of low signal input. And the circuits using the new tubes keep fairly within the boundaries laid down by the early data released. This is much better than theorizing about the tube first and recalling sets and circuits later.

The outstanding tube from our viewpoint is the duplex diode-triode, for it is a fine contribution to tone quality, when such quality is supported by the rest of the circuit and the constants are properly chosen. For the triode section, transformer coupling, 250 volts applied in the plate circuit, the recommended bias is 20 volts negative, whereas for resistance coupling, with plate load not critical, but suggested at 100,000 ohms, the recommended bias is 9 volts negative, suggesting that the effective plate voltage is relied on as the basis of bias determination, which, if true, represents a new method of attack for a tube that is not of the screen grid type.

We sincerely counsel our readers to utilize the new tubes. They are better in almost every respect, and the radio frequency amplifiers and detectors are quieter. Even old circuits can be made to accommodate the new tubes, and in some instances no other change is necessary save the substitution of six-pin sockets, and tying of suppressor grid to cathode. The warning against the use of new tubes as replacements for old ones has its merits, but it is not totally excluding in its scope, and many such replacements can be made to excellent advantage.

Resistance Measurement

A METHOD of testing radio receivers, in which the set need not be operative to make the complete test, is growing in favor, and is based on the idea of resistance measurement. In general, to make this method effective the diagram of the receiver should be at hand, and this diagram, or a code that is a part of it, should disclose the resistance values. Manuals are published that contain diagrams with the full information on resistance values. These values of course have to do with all parts save fixed condensers, for even radio frequency coils are treated on a resistance basis.

The measurement of resistance has not progressed very fast with service men. The difficulty lies in the provision for measurement of high and low values, whereas in between the measurement is simple and accurate. For instance, resistance meters may measure resistances theoretically from 200 ohms to 150,000 ohms, but there is scarcely much enlightenment obtained from the crowded low and high resistance ends of the scale, particularly the high end, where a difference of thousands of ohms scarcely can be noted on the meter.

To measure low values of resistance the meter should be of a relatively insensitive type, so that the voltage applied should be from a source that will stand the high resultant current, or, if the one meter is used, and it is likely sensitive, the applied voltage should be high. A difficulty about supplying high current is that one can not carry around with him the necessary storage battery or bracket of dry cells hooked up in series-parallel. Perhaps the solution lies in a two-range resistance meter, where the voltage supplied is, say 3 volts in one instance and 30 in another, although this leaves something still to be desired. We are rather inclined to the vacuum tube voltmeter, as the unknown resistance can be determined from values of a fraction of an ohm to millions of ohms. This device could be a-c operated, as to heater and plate supply voltages, with a small battery as the biasing element, and a known series resistor as one part of the load, the unknown as the other part. Then the resistance values could be calibrated in terms of the plate current. We are working on such an instrument and hope to be able to present it to our readers within a few months.

The whole business of testing, or trouble shooting, has been brought up to a more scientific basis than ever before, but there is still room for improvement, especially as to resistance measurement, for at the present writing, not counting the expensive decade boxes, about the safest way to determine the actual resistance, if within the crowded portions of a resistance scale on a meter, is to apply Ohm's law to the current and voltage readings.

An Impatient Public

THE public does not well understand why television does not move along faster. Radio engineers constantly are asked questions about television, department stores and radio stores that hold demonstrations, as well as radio shows where exhibitions take place, draw immense crowds, the public is deeply interested, and yet it can not understand why this thing it wants so much is being withheld from it. Can it be sheer perversity of the radio industry?

The engineers are familiar with the problems, which include scanning at the transmitting end, modulation, transmission, reception, rescanning. The solutions must draw upon various branches of physics, such as optics, electronics, dynamics, and stable radio frequency and audio frequency transmission and amplification. So numerous are the problems that engineers sometimes must wonder what the public expects in a hurry.

But the engineers might take a cue from the public and make some improvements that do not call for much novelty and scope, or much sheer inventive genius.

A splendid mechanical system of scanning, for transmission and reception, has been invented by William Hoyt Peck, and its use improves results greatly; crater lamps that handle much more current are needed at the receiving output, and better receivers are needed right now. It is not enough to have a tuner that is sufficiently broad and an audio amplifier that passes for perfection because it is resistance coupled, although the plate load resistors are so small as to be nearer a short circuit than a desired impedance load, and radio frequency bypass condensers in detector output circuits so large that they attenuate frequencies quite seriously, beginning at 10,000 or 15,000 cycles. More "hop" in the receiver, better glow tubes, and more efficient audio are not very difficult problems at all. And so maybe the public is partly right in wondering if engineers haven't been just a bit slow. The business office should get after the laboratories.

STATION SPARKS

By Alice Remsen

A Spanish Serenade

FOR COUNTESS OLGA ALBANI

WEAF—Fridays, 8:00 P.M.

The candle-light gleamed in the ancestral hall,
It flickered and flamed on the tapestried wall.
The lord of the castle with poise debonair,
Was kissing the hand of a lady so fair.

Lovely daughter of Spain, with bright eyes a'glancing,
Let me hear once again your voice so entrancing.

Then sweetly as bells through the summer night pealing,
An angelic voice was heard, softly stealing
Slowly along by the tapestried wall,
Echoing down through the ancestral hall.

Lovely daughter of Spain with bright eyes a'glancing,
Let me hear once again your voice so entrancing.

It silenced the nightingales out in the trees,
As, wafted along on the quivering breeze,
The beautiful voice of the daughter of Spain,
Sang for the lord of the castle again.

—A. R.

* * *

And the glamorous Spanish Countess Olga Albani will delight you with her exquisite voice if you tune in on the Cities Service program over WEAF. She is a very fine artist, with a beautiful sense of proportion in her dramatic roles, and perfect tone production and rhythm in her singing.

* * *

The Radio Rialto

An evening ramble this time—here we are at WABC and we catch Freddie Rich at his "Revue" rehearsal . . . He's in Studio 3 on the 21st floor . . . Let's take a peek through the glass window. Yes; there's Freddie with a grin on his face; must be warm; he's as red as a beet . . . Those two boys with the rather scanty locks over by the piano . . . are—yes, by golly!—Les Reis and Artie Dunn. And there's Jack McBride, talking to Minnie Blauman, Columbia's indefatigable little voice arranger, who is smiling very amiably at Jack . . . Catches our eye and waves "Hello!" . . . Hearing a familiar voice we turn around and discover, of all things, Colonel Stoopnagle; he tells us a story, much too long to repeat here, but take our word for it, it was good. The Colonel dreams his stories, then tries them out on the first person he meets; if that person laughs, the story goes into the continuity. I happened to laugh, so you're bound to hear the story sooner or later . . . Well, well, well, if that isn't our old friend, Singin' Sam, and does he look nice and brown after his vacation! Just going in to do his evening stunt.

Well, guess we'll meander down Madison and over Fifth to 711 and see what Mr. and Mrs. NBC are doing . . . "Hello!! Francis Kahn, how does it feel to be away from Irving Berlin's and working for another Irving (Caesar?) . . . You like it! . . . that's good . . . a drink of ginger ale . . . all right, ol' deah! . . . Let's pop in here on the corner . . . You liked the way I put over 'I'm Forgetting Myself for You' . . . Thanks. That rates another ginger ale . . . Why, how do you do, Mr. and Mrs. Al Swenson (the Captain Blackstones to radio audiences) . . . What's that! You're celebrating your twenty-sixth wedding anniversary . . . Congrats. It doesn't seem possible, you look too happy . . . You are happy! . . . Guess that's what comes from associating with such an excellent married couple as Julia Sanderson and Frank Crumit" . . . Getting into the elevator at NBC we bump right into Frank Parker, romantic looking chap; just the type to be singing on the Gypsies program . . . "Heard a rumor that you were going to Europe for a holiday, Frank. Is it true? Haven't made up your mind yet! . . . If you do, give my love to dear ol' Lunnon' and be sure to try soft roes on toast for breakfast" . . . Off at the 13th floor . . . My word, what a crowd . . . Mostly musicians . . . Noisiest people . . . All trying to talk at once . . . Through the haze of cigarette smoke, I see the portly form of B. A. Rolfe. He's chatting with Bill Daly; they look like a picture of "before and after taking" . . . "What cheer, Lanny Ross!" We chat a few moments and then the boy makes a wisecrack. Says Lanny: "Opportunity, unlike a columnist, knocks but once." So I get mad and leave him, only to run into those inveterate punsters, Billy Jones and Ernie Hare, and this is what they pulled; sez Billy: "Did you hear about the miser who couldn't get a date with one of the Siamese twins?" Sez Ernie: "No; what happened?" Sez Billy: "He told her she'd have to ditch her sister before he'd spend a cent." . . . I ditched them after that.

A picture of the 13th floor at NBC wouldn't be complete without one or two music publishers . . . There's Billy Chandler, now with the firm of Jack Yellen. Billy is one of the Beau Brummels of songland, with Mel White, Johnny's son, running him a close second . . . The well-dressed, rather silent gentleman over in the corner is Leo Edwards, brother of the famous Gus . . . Leo is with that discriminating publisher, Miller, who put "Mardi Gras" and "Strange Interlude" on the market. Two very fine songs . . . As you probably know, there is a controversy on between the radio moguls and the song publishers, a question of money and copyrights . . . Of course, it will be settled one way or the other, for radio and music are so inextricably mixed that one cannot get along without the other.

* * *

NEWS OF THE STUDIOS

WABC

STATION WBT, Columbia's Dixie key-station, has increased its power from 5,000 watts to 25,000 watts. It celebrated its premiere on August 12th by a 41-hour gala broadcast, with dedicatory exercises by state and municipal officials. A civic holiday was declared in Charlotte, N. C. Barbara Maurel, Columbia concert contralto, flew down from New York to appear as guest star of the program.

* * *

NBC

Gus Arnheim and his celebrated Cocoanut Grove Orchestra recently replaced Wayne King's orchestra on the Sunday afternoon "Lady Esther" broadcasts, for a special four-week engagement.

* * *

Ed Wynn presented two new songs over the air the other night. He called one

(Continued on next page)

Station Sparks

(Continued from preceding page)

the new investment song, "It's a Wise Stock that Knows Its Own Par." The other was the four-wheel brake song, "For We'll Break the News to Mother."

* * *

Alice Joy, the original Prince Albert Dream Girl, is still touring the country in vaudeville. She recently made some shorts, the cast of which included her two children. Alice is an old trouper, having been in vaudeville before she turned to radio.

* * *

Marion Harris, another vaudevillian who made good on the air via NBC, is at present over in England, delighting the listeners of the BBC. The British broadcasters list her as "a model of vocal syncopation."

* * *

Sidelights

LEE SIMS, NBC pianist, is also a composer of note; he has been writing piano solos, all best sellers, for the past ten years. . . . ELLIOT SHAW is back again with his old partners, the Revelers, but is still singing with the Cities Service Cavaliers. . . . D'AVREY OF PARIS, NBC'S French tenor, sings on the air in English; but has quite a bit of trouble reading his lyrics in our language. . . . JANE FROMAN has not missed a daily round of golf in months. . . . BEN GRAUER, NBC announcer, comes from a family of engineers. His father was a consulting engineer on the Hudson Tubes project. . . . TONY CUSUMANO, one of NBC'S veteran page boys, saved a little girl from drowning recently. . . , CHIC JOHNSON, of NBC'S Olsen and Johnson, says that the two most uncertain things in the world are a woman's mind and a grape fruit's squirt. . . . TONY WONS is spending his vacation among the Chippewa Indians of Northern Minnesota. . . . LITTLE JACK LITTLE is making some personal appearances in vaudeville. . . . ANN LEAF is on her way back to New York from California, where she spent a month's vacation. . . . MARCH OF TIME resumes its broadcasting over WABC and Columbia chain on Friday, September 9th. . . . Very glad to hear it. . . . JAY C. FLIPPEN is one of the least self-conscious persons to face a microphone: he thoroughly enjoys broadcasting. . . . DAVID ROSS times soft-boiled eggs with a stop watch when he orders them in a drug store. . . . BING CROSBY has lost almost twenty pounds while on the Coast; he is due back in New York shortly. . . . IDA BAILEY ALLEN, Columbia's expert on home economics, has a fully equipped gymnasium and a professional instructor at her home on Long Island.

* * *

Biographical Brevities

ABOUT GEORGIE PRICE

Georgie Price was born on the East Side of New York thirty years ago. . . . Always loved the stage and everything connected with it. . . . At the tender age of five young Georgie won first prize during an amateur contest. Shortly after that he sang at a party given for Herman Timberg. . . . Gus Edwards was present. Listened to George. Realized he was a clever youngster and signed him on the spot. . . . Thereafter Gus Edwards proceeded to "make" Georgie. . . . He starred him in "Kid Cabaret," "Band Box Review" and the "Song Review" . . . was pulled out of the latter show because of the Gerry Society, which considered Georgie too young to be doing that nasty stage work.

While playing in Washington, D. C., Georgie was stopped on the street by President Taft, who said: "I saw you at the theatre and I think you have a great job." Georgie retorted with a wisecrack: "What must I do to get a job like yours?" . . . At twelve Georgie was the national boy billiard champion. . . . During his teens he played for Ziegfeld, and at twenty wrote the song hit of the day, "Angel Child."

Played in the "Spice of 1923," "Artists and Models," "The Passing Show" and "A Night in Paris," also leading the country in making Victrola records. . . . Last show was "A Night in Spain," after which he went into producing for himself, and took a heavy dramatic part in "The Song Writer." . . . Thought he would retire at 30, but along came radio. . . . Knows, or has known, almost every great artist and is gifted with ability to mimic them. . . . Ambition was to be a jockey.

May be heard every Tuesday and Thursday at 7:35 over WABC, during which program he imitates different well-known stars, singing the song most definitely associated with the celebrity.

Read Next Week's Issue for Sure!

Constructional article on the Sensational 1933 4-Tube Diamond of the Air, by Herman Bernard.

Amazing Scientific Facts that *are* Facts!

Tradiograms

By J. Murray Barron

GROWTH IN GREENWICH STREET

The experimenter and serviceman are finding daily that Greenwich Street in New York City is becoming more and more a good place to do radio shopping. Here one finds a number of radio parts establishments where new and replacements parts for radio receivers, short-wave converters and sets may be had in large varieties, also public address systems and other type amplifiers, in fact, one may shop entirely on this street for radio merchandise from a crystal set to practically a complete broadcasting studio. If one finds it necessary to carry purchases, all transportation is within easy reach, subways, elevated and Hudson terminal all within less than one block.

* * *

W. C. Harter, of Solar Manufacturing Corporation, 599 Broadway, N. Y. C., announces the appointment of the following new district managers for the company's line of electrolytic and mica condensers: William F. Seeman, 763 Tacoma Avenue, Buffalo, N. Y.; Wm. B. Masland, 105 East Franklin St., Baltimore, Md.; Harvey T. Cory, 1712 Carter Street, Dallas, Tex.; J. W. Van De Grift, 623 Charles Bldg., Denver, Col.; Arthur S. Detch, Security Bldg., Portland, Ore.

* * *

The Franklin Transformer Mfg. Co., 607 22nd Avenue, Minneapolis, Minn., has issued an illustrated circular on vibrator type B supply transformers. On account of the big demand for radio receivers for automobiles and call for B eliminators to work off the 6-volt storage battery source, the use of a vibrator and transformer has become popular as a way to develop 200 volts or more a.c.

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* 45*th Street, New York, N. Y.*

Edmund G. Merk, 831 Franklin St., Williamsport, Pa.

R. M. Robertson, care Mr. Schwerstfeger, Chief Electrician, Missouri State Penitentiary, Jefferson City, Mo.

Jos. R. McLaughlin, Santa Fe Radio Shap, 325 San Francisco St., P. O. Box 423, Santa Fe, New Mexico.

Edward Weppler, 5248A Bancroft Ave., St. Louis, Mo.

Edward Schiavane, Room 231, National Press Bldg., Washington, D. C.

Colin D. Murdoch, 6th Ave. at Adams, Tacoma, Wash.

Joseph H. Drerup, 3314 E. Second St., Dayton, Ohio.

John A. Buckbee, 2311 Market St., Camp Hill, Pa.

L. Andruss, De Leon Square, 132-146 Fourth Ave. South, St. Petersburg, Fla.

E. C. Moxley, 733 So. Hull St., Montgomery, Ala.

James H. Russell, 118 Delaware Ave., Charleston, West Virginia.

NEW INCORPORATIONS

Gold Seal Television & Supply Corp., New York. N. Y., transmitting images by electrical means. —Attys., United States Corp. Co., Dover, Del.

Glenwood Radio Shop, Ridgewood, Queens Co., N. Y.—Atty., S. C. Davidson, Ridgewood, N. Y.

Puhlic Service Electric Household Appliance Corp., Brooklyn, N. Y.—Atty., C. Moed, 186 Joralemon St., Broklyn, N. Y.

Wiring Devices Corp., New York, N. Y., electrical appliances—Atty., Scudder, McCoun, Stockton & Kerfoot, 25 Broadway, New York City.

Greenbaum's Radio, Inc., Paterson, N. J., manufacturing radio equipment—Attys., Surosky & Surosky, Paterson, N. J.

Vsri-Lux Corp., New oYrk, electric business—Atty., M. Wieder, 305 Broadway, New York City.

Carlisle Electric Products Co., Newark, N. J., electrical supplies—Atty., Henry Schwartz, Newark, N. J.

G. M. Electric Corp., Wilmington, Del., electrical appliances—Attys., Corporation Service Co., Wilmington, Del.

Refrigerator Display Case Corp., Watertown, N. Y.—Atty., J. H. O'Brien, Watertown, N. Y.

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One shielded block containing three 0.1 mfd. condensers (black, common, to a minus; reds interchangeable) .... .57
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One 0.05 meg. pigtail resistor (50,000 ohms)...... .15
Two 4-ohm filament resistors in series, to constitute 8 ohms (both) .... .20
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One 9 x 7⅝ inch wooden baseboard................ .25
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