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RADIO WORLD

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America's First and Only National Radio Weekly

Vol-12 No-13 299

Things Nobody Thought of Before

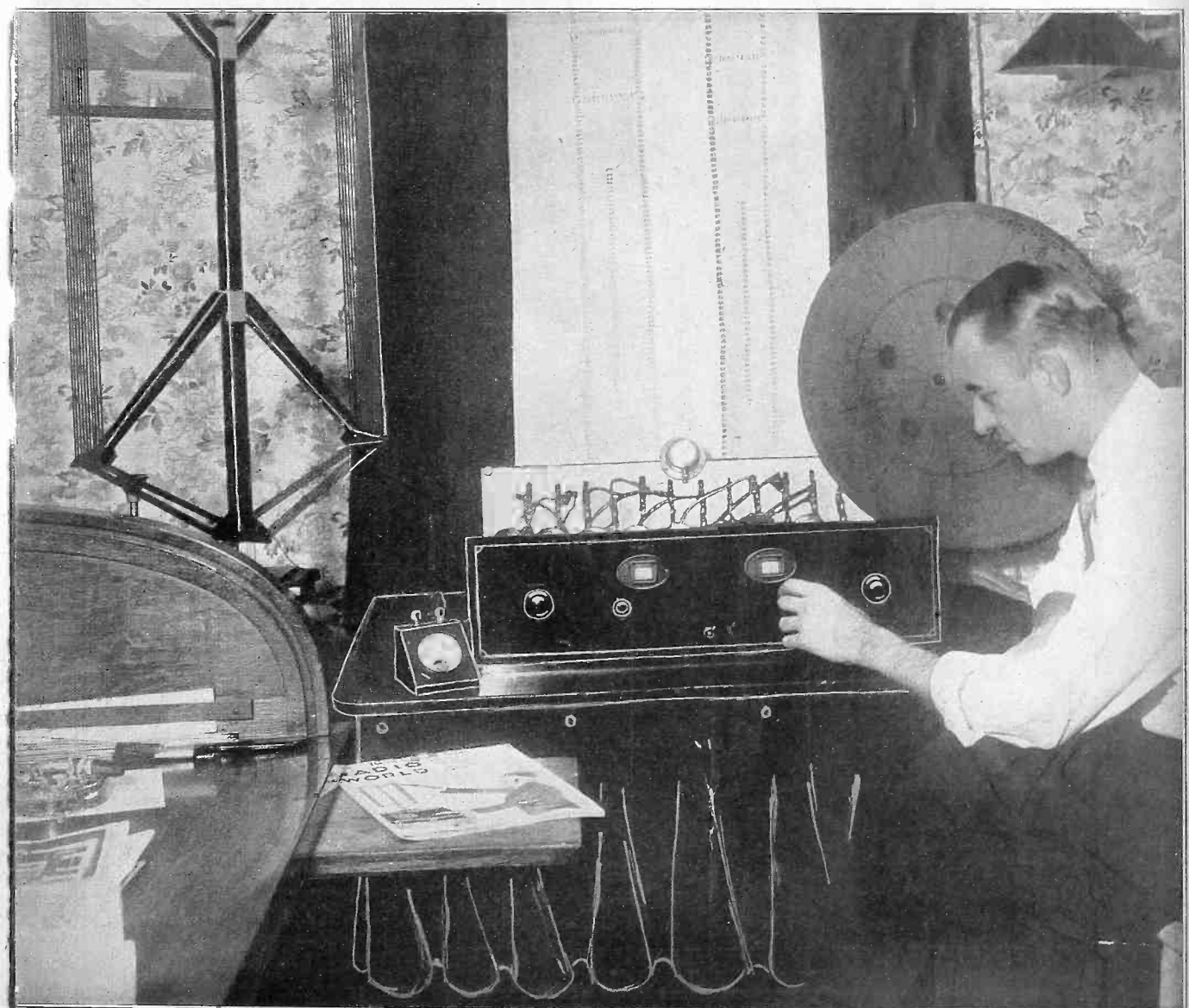
Startling Facts About Harmonics

A Universal Test Meter

Push-Pull's Great Comeback

The G. R. Amplifier and B Supply

HOW I TUNED IN 98 STATIONS IN SIX NIGHTS



THOMAS F. MEAGHER TUNING IN DX. SEE PAGES 14 AND 15 FOR HIS LIST OF STATIONS RECEIVED

THE R IS MADE STRAIGHT LINE!

IN electricity in all its forms, including radio, "R" stands for resistance. Any resistor that is variable should vary directly in proportion to the adjustment. In variable grid leaks this asset of "straight line R" has been missing. But now it is supplied—efficiently, perfectly—in

The New De Luxe Model

BRETWOOD

Variable Grid Leak

The improvements made in the new model—imported from England and released for the first time—are:

(1) Constant readings, (2) even distribution of the resistance element, (3) support provided for optional baseboard mountings.

By using the Bretwood Variable Grid Leak you improve tone quality, by avoiding detector tube overloading, achieved by correct leak setting. Thereafter the leak may be varied for extremely distant stations, or may be left at the original setting.

North American Bretwood Co., 145 West 45th St., N. Y. City.

Gentlemen: Enclosed find $1.75. Send me at once one De Luxe Model Bretwood Variable Grid Leak on 5-day money-back guarantee. (Or $2.25 for leak with grid condenser attached.)

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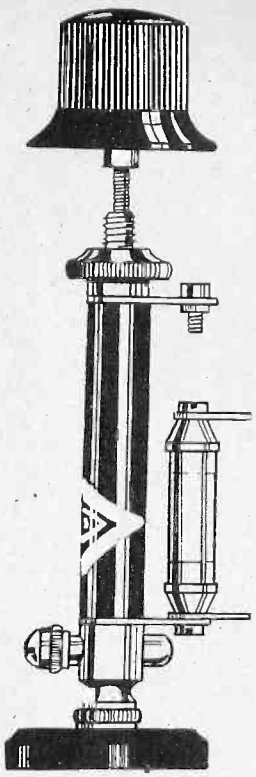

The DE LUXE MODEL with Condenser Attached

The De Luxe Model Bretwood Variable Grid Leak specified by Herman Bernard for Radio World's Four-Tube Universal Receiver.

1. The knob is hard rubber.
2. The shaft is durable brass, and can not jam or stick.
3. The brass lock nut, with milled edge, enables single hole panel mount.
4. The barrel is of hard rubber and houses the the resistnace element and plunger.
5. The lugs are adjustable to any position within the sweep of a circle.
6. The grid condenser is securely fastened to the lower lug and requires no extra room, as it is within the projection of the lugs.
7. The syphon container distributes a constant supply of resistance element, making the reading straight line resistance, and preventing uneven distribution of the resistance element.
8. The hard rubber pedestal affords the option of perpendicular mounting, as on a baseboard.

Each Bretwood Variable Grid Leak and Bretwood Bullet Condenser is guaranteed against mechanical or electrical imperfections and is sold on an absolute five-day money-back guarantee.

If you're not delighted with results, then we're not even satisfied!

SIXTH YEAR

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Why Didn't Anybody Think of These Things Before?

By Homer Camfort Pelletier

THERE are many properties of vacuum tube amplifiers self-evident yet that escape the attention of everybody for a long time. Then when someone does discover one of them everybody else exclaims:

"Why didn't I think of that?"

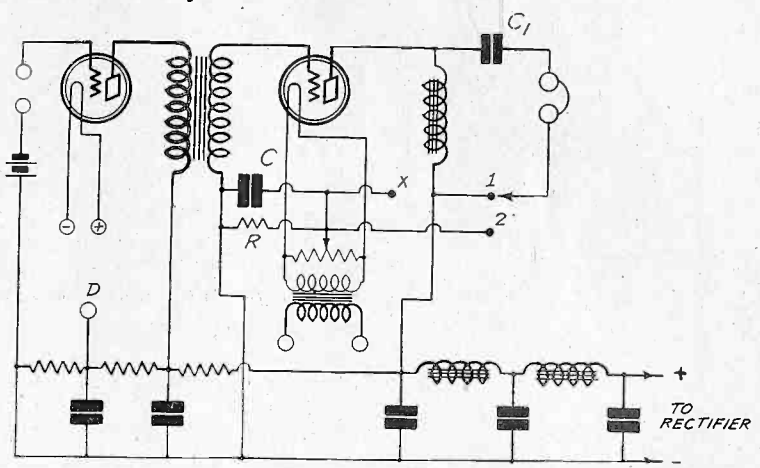
A case in point is illustrated with the attached diagram, Fig. 1.

This diagram shows the tail end of a receiver in which the filament of the power tube is heated with AC, and which derives its grid and plate potentials from an eliminator.

The grid bias is obtained from the voltage drop in resistance R. This is the usual connection; and thousands of amplifiers have been built with it, and scores of manufacturers of battery eliminators, resistors, transformers, choke coils and condensers have shown this connection.

At the same time all these manufacturers have claimed higher amplification and better quality as a result of following some diagram containing this connection. Particular emphasis has usually been laid on the marvelous reproduction of the low notes.

For a tube of the -71 type the value of resistor R is approximately 2,000 ohms.



THIS DIAGRAM ILLUSTRATES THE EFFECTS OF THE GRID BIAS RESISTOR ON THE QUALITY OF REPRODUCTION, AND IT INDICATES THE PREFERRED CONNECTIONS OF BY-PASS CONDENSERS AND THE LOUDSPEAKER TO MINIMIZE THE EFFECTS.

Effect on Frequencies

Some, but not all, of the manufacturers of parts and writers on the subject connect a condenser C across the resistor, and the value of the condenser recommended is either 1 or 2 mfd. A condenser larger than 2 mfd. is rarely recommended, but often one less than 1 mfd. is suggested.

Now, what about the connection, anyway? First, the resistor cuts down the amplification of the tube tremendously and the second, when condenser C is used across R the higher notes particularly are stressed. In other words, the combination R and C as usually recommended often defeats both of the claims made for it—increased amplification and the accentuation of the low notes.

The theory of the effect of R alone on the amplification shows that when the load on the tube is non-reactive and is adjusted for maximum undistorted output, and when R is used in addition to the useful load, then the amplification in a 71 type tube is 6/7 instead of 2. That is, the tube has been changed from a voltage amplifier to a voltage losser.

Analysis of Load

When the load on the power tube is inductive, which it is in all practical cases of broadcast reception, the loss in voltage is greater on the low notes than on the high, because then the inductive load impedance is comparatively higher than the resistance of R. Hence even without condenser C the low notes are handicapped.

When condenser C is connected across the resistor R, the effective impedance of R and C is reduced more for the high notes than for the low. In fact for the higher audio notes the impedance of R and C in parallel is negligible in comparison with the impedance of the inductive load, and there is no reduction in the amplification as a result of R. But on the lower audio notes the impedance of R and C is about the same as the impedance of the load, and there is a great drop in the amplification. The result is poor quality of reproduction even when the very best coupling media are used in the audio amplifier.

Assuming particularly a transformer coupled audio system, as the capacity of the condenser C is increased the impedance of R and C becomes lower, and if the condenser is large enough the impedance of R and C will be negligibly small in comparison with the load impedance even at the lowest audible frequencies and the amplification will rise. Even 0.1 mfd. will have a noticeable effect. But if the audio is resistance coupled, then C must be at least 4 mfd. before there is any appreciable increase in the intensity of the low tones. While it must be of the order of 20 mfd. before frequencies of 50 cycles get an equal chance with the higher frequencies, the human ear detects scarcely any difference above 4 mfd. When the condenser is so large the quality becomes very good, provided that the coupling medium in the amplifier is capable of good quality.

Circuit the Factor

Of course the circuit with which the supply is used is the determining factor. It is usual to bias the power tube in the last stage by the voltage drop in R. Most power packs have a transformer-coupled audio stage. That makes the transformer classification apply, even if the biasing resistor is used for other tubes, which is unlikely, since only the plate current of the last tube is commonly passed through it.

One must remember that often C may be omitted from transformer coupling, because there is theoretically one audio stage too many, and the biasing resistor keeps the volume to within distortionless limits, as well as reducing the percentage of hum by damping.

It will be observed that there are two possible connections for the loudspeaker suggested in Fig. 1, in both of which it is connected in series with condenser C1. In No. 1 position the speaker is connected across the output choke coil. The object some have for making this connection is that in the event that condenser C1 breaks down the speaker winding will not be damaged by the heavy voltage which would be put across it, because this voltage would only be the DC drop in the choke coil L. This is usually negligible. This of course means that C1 may be an inexpensive, low voltage test condenser.

Point No. 2

When the speaker is connected to point No. 2 the entire voltage across the output of the eliminator is put across the stopping condenser. It would therefore have to be

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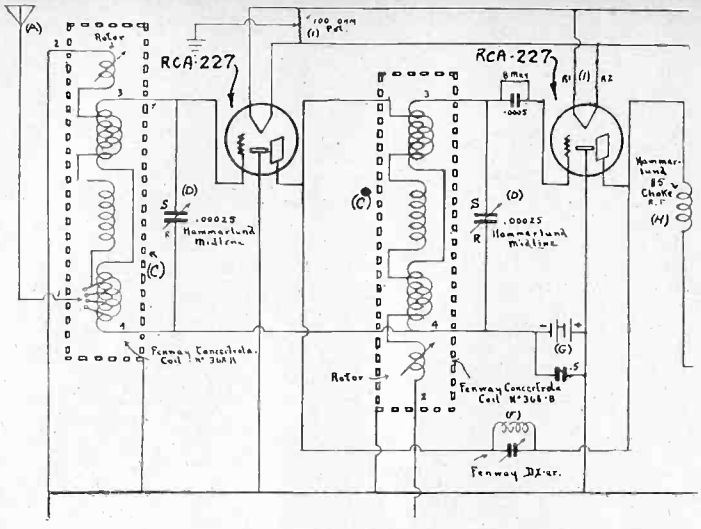


THE FENWAY DX-ER IS AT LOWER RIGHT

(*Concluded from preceding page*)

designed for a fairly high voltage. If the condenser should break down under the electric stress the loud-speaker winding would very likely burn out.

From the points of view of safety and economy all is in favor of using connection No. 1. But what about quality and amplification?

When connection No. 1 is used all the AC delivered by the tube will flow through resistance R. It is the AC component which causes all the damage discussed above, and it is only the DC component which is useful for grid bias.

When the reproducer is returned to No. 2, all the signal current that passes through the speaker is shunted around resistance R and only that part of the AC which is admitted by the choke coil passes through R. That is an improvement because if the choke coil L is of the proper inductance only a negligible AC current can flow through it. Unfortunately, the low frequencies pass more easily than the high, and this causes a slight depression in the amplification of these notes. This effect is relatively greater when condenser C1 is small than it is when C1 is large.

The Four Points

For best quality the grid bias should not be obtained through a drop in a resistance at all, at least not when R carries part or all of the plate current of the tube, but a grid battery should be used. Nevertheless some prefer bias through a resistor.

Hence it is necessary to make the best of the situation.

First, the choke coil L should have a low DC resistance and a very high inductance at the current flowing through it; second, condenser C1 should have a large capacity and a high voltage test; third, connection No. 2 as shown in Fig. 1 should be used; fourth, condenser C across the grid bias resistor R should be large. It need not be designed for high voltage, since the electric stress across it will never exceed 100 volts. A fifth condition may be added, and that is that the drop in R should never be used for a bias on any of the other amplifiers in the receiver unless all trace of AC has been balanced out of the resistor.

The whole problem of rectified AC or utilized line DC for B and A supply is so dependent on constants of individual circuits that general rules need explanatory addenda. For instance, the speaker return in the filtered output should be to No. 1, excepting that the circuit may require grounding of No. 2 to eliminate a peanut whistle. Connection of the speaker return to No. 2 would then be the objectionable cause of reintroducing the whistle, so No. 2, the ground potential, necessarily would have to be selected.

Optional Method

Another method of connecting the filter may be used to advantage, and this method has been used in a few diagrams published. Instead of connecting all the by-pass condensers to the negative side of the rectifier as has been done in Fig. 1, they are connected to the point marked X, that is, to the positive end of the grid bias resistor. There would be no other change in the circuit in so far as the last tube is concerned, but the negative ends of the filaments of all the preceding tubes should be connected in a manner appropriate to this change.

When the filter condensers have been connected in this manner the AC component of the current from the last tube passing through the grid bias resistor is very small, due to the effective by-passing of the many and large condensers in the filter. The DC component of the plate current still flows through the resistance and hence it is effective in giving the grid a bias. The condenser C across the resistor will still help to reduce the AC current in R but its use is not absolutely necessary now.

The amplification would be so much stronger that it might require cutting out one audio stage to keep the output tube within its operating limits.

When this connection is used it is possible to use the drop in R, or part of it, to give the other tubes in the circuit a bias. The grid returns are connected to the appropriate point on R to give the requisite bias.

Fenway's Fine Discovery

The DX-er is another of those things which nobody thought of. But the genius of Leo Fenway developed it. And now many are asking themselves: "Why didn't I think of that trick?"

The DX-er, used for the first time in the Fenway Concertrola, consists of a parallel tuned circuit connected between the plates of the detector and the tube preceding. The condenser is a midget and the coil is a radio frequency choke of 25 millihenrys. When this circuit is tuned to the carrier wave it is equivalent to an extremely high resistance connected from plate to plate. A resistance so connected feeds back energy from the detector plate to the primary of the transformer connected to the preceding tube, and if the leads of the transformer have been connected properly this feedback will cause regeneration.

If the resistance is not too high, oscillation will result just as if a tickler coil were used.

The amount of regeneration in the Concertrola is controlled with the midget condenser across the coil. When the condenser is open the impedance between the two plates is mostly inductive and no current of radio frequency can pass through it. Hence there is no regeneration. When the condenser plates are meshed more radio frequency current can pass and the regeneration is greater. This control of the regeneration is smooth in action and allows a high amplification without spilling over.

Smooth, Easy Control

Since the control of the regeneration with the Fenway DX-er is smooth and steady it is possible and easy to attain critical regeneration with it. That is, to get the highest possible radio frequency amplification without oscillation that can be obtained with the particular tuning system and tubes used. This does not mean an increase of a few percent over the amplification possible in the usual way. It means a manifold increase.

It is well to call attention to the fact that one of the best oscillators known is similar in construction to the DX-er, that is, the energy causing oscillation is fed back through a parallel tuned circuit. The advantages of this oscillator are steadiness of frequency generated and purity of wave form in the output current. These advantages are directly applicable to the DX-er. The condition which accounts for the steadiness of frequency also accounts for the possibility of critical regeneration in the receiver. The condition which brings about purity of wave form in the oscillator also insures against harmonic distortion in the output of the regenerative detector.

Senate Gets Air Treaty; Ratification Expected

Washington.

No opposition to ratification by the United States of the Washington Convention of 1927, the international treaty governing radio, drawn up and signed by delegates to the International Radiotelegraph Conference which concluded its sessions here last week, is expected by the chairman of the United States delegation, Herbert Hoover.

Mr. Hoover, who was also president of the International Conference, declared that a summary of the treaty is being prepared for presentation by the Department of State to the United States Senate. That body, he said, will probably accept the document as finally drawn without any opposition, since it meets virtually every provision stipulated by the American delegation.

The delegation of this country to the conference included Senator Watson (Rep.) of Indiana, and Senator Smith (Dem.) of South Carolina.

Respective plenipotentiaries of the 79 countries represented at the Conference attached their signatures on November 25 to the convention, which provides that it shall remain in the archives of the Government of the United States and one copy given to each government signatory thereto.

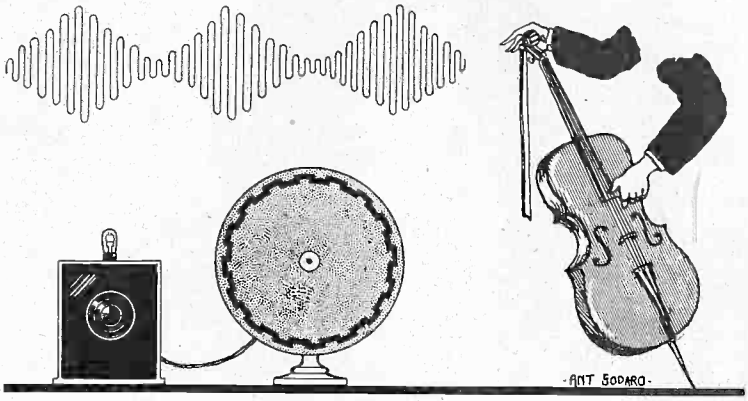
The convention itself will go into effect beginning January 1, 1929, and shall remain in force under its own provisions, for an indeterminate period and until one year from the day whereon a rejection shall take place.

Legislatures of all other signatory countries must also ratify the document.

Some Surprising Facts About Harmonics

By H. B. Herman

Acoustical Expert



THAT THE HARMONICS OF A PLUCKED CELLO STRING ARE NOT EXACT MULTIPLES OF THE FUNDAMENTAL CAN BE PROVED WITH THE AID OF A VACUUM TUBE OSCILLATOR. TUNE OSCILLATOR TO EXACT UNISON WITH THE FUNDAMENTAL OF PLUCKED STRING. THEN COMPARE THE HARMONICS OF THE OSCILLATOR WITH THE HARMONICS OF THE STRING. BEATS WILL BE HEARD. TO AVOID CONFUSION IT MAY BE NECESSARY TO SUPPRESS THE FUNDAMENTAL OF THE OSCILLATOR TO MAKE THE COMPARISON.

THE statement that harmonics are always exact integral multiples of the fundamental is often made. It is made in high places with the weight of authority behind it. Yet it is not wholly true; it is not even half the truth. Sometimes the harmonics are exact multiples of the fundamental, but in most cases the harmonics differ, sometimes widely, from being exact integral multiples.

The term harmonic is here taken in its mathematical sense, which makes the fundamental the first harmonic. By the term overtone is meant here a harmonic higher than the fundamental, and the first overtone is the second harmonic. These definitions are not accepted universally, either in musical or scientific circles, but they seem the most logical. Harmonics are not always simple harmonic either in music or in mathematics, that is, such that the various overtones bear an integral multiple relationship to the fundamental, not even approximately so. In drums the ratios are very complex.

Let us first consider the vibrations in a piano string. It is usually said that the harmonics are exact multiples of the fundamental in this instrument. This is only approximately true. The only condition under which the harmonics of the piano string could be exact multiples of the fundamental is that the damping on the string be zero. But that can never be, or no sound would come from the string.

Difference Depends on Damping

As long as the string is radiating sound there is considerable damping and the harmonics differ from being exact multiples of the fundamental by an amount which depends on the degree of damping.

The same thing holds true of all stringed instruments in which the strings are struck or plucked and then left to vibrate. In some cases the harmonics are so far off that the sound emitted lacks "harmony." A case in point is the sound emitted by a plucked 'cello string.

The peculiar quality of the xylophone is also due to great damping of the reeds and the consequent lack of exact harmonic relationship between the harmonics.

In the case of bells, drums and cymbals the harmonics are not even approximately integral multiples of the fundamental, even when there is no damping. The lack of musical quality of these instruments is directly due to this fact. The harmonics are mutually discordant.

In the case of sustained vibrations the situation is different. The sustaining force neutralizes the damping so that when a string is vibrating with a constant amplitude the harmonics are exact integral multiples of the fundamental. Properly bowed strings and properly excited organ pipes give off complex sounds in which the harmonics are exact multiples, but only when the amplitude is constant, or when exciting force remains constant.

Holds in Electricity, Too

The harmonics radiated in a damped electric circuit also differ from being exact multiples of the fundamental frequency, and the deviation depends on the amount of the damping, just as in the case of the damped vibrating string.

But the harmonics generated in an electric vacuum tube oscillator are exact multiples because the vibration is sustained and the damping neutralized.

The harmonics generated in a detector tube or amplifier tube also are exact multiples of the fundamental frequency impressed on them, because the action is sustained.

But it is probable that while the amplitude of the impressed frequency changes up or down that the exact relationship does not exist between the fundamental and the harmonics. The same undoubtedly holds also in the oscillator while the oscillations are building up or dying down, or while changing from one amplitude to another.

It is not necessary to rely on mathematics to show that the harmonics are not exact multiples of the fundamental. It can be proved experimentally quite easily.

Can Hear Difference

In some cases it is possible to hear the lack of harmony between the various harmonic components of a complex sound, such as that radiated from a plucked 'cello string or a struck piano string. A more exact way of testing it is to set up an electrical oscillator employing vacuum tubes. This can be tuned to exact resonance with the fundamental of a certain musical string by the method of zero beat.

Then the electric oscillator can be made to emit a note which is the exact second harmonic of its first note.

If this is compared with the note emitted from the musical string it should harmonize with the second harmonic of that. But it does not. A beat is heard between the two second harmonics, although the two fundamentals are in exact unison. In the same way the higher harmonics can be compared also and found to differ.

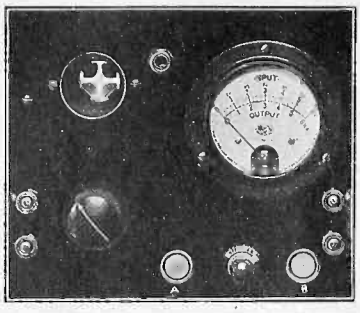
Electric Examples

The stepping up of low frequencies by the harmonic method in radio for measuring radio frequencies is done under conditions which make the harmonics exact multiples, and hence the values obtained are correct. A hundred cycle tuning form is often used as the source of the fundamental. The sound from this is impressed on an electric harmonic producer which multiplies the frequency by 2, 3, 4 and so on up to as high a value as is desired.

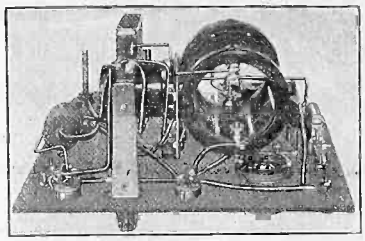
If a plucked 'cello string or a struck piano string is used for calibrating an electric oscillator and direct comparison is made with the harmonics of the standard used, the higher frequency calibration of the electric oscillator will not be correct.

A Universal Tester of

Handy Device Also Gives Audio Transformer Ratios, Tells When a Valve Should Be Discarded and Quickly Solves Trouble Shooting Problems



A PHOTOGRAPH OF THE FINISHED PANEL OF THE ADELMAN UNIVERSAL TESTER.



SIDE VIEW OF THE INTERIOR OF ADELMAN UNIVERSAL TESTER.

By Leon L. Adelman

Chief Engineer
A. M. Flechtheim & Co., Inc.
Associate, Institute of Radio Engineers

THERE is an almost endless assortment of types of meters used for test purposes in conjunction with radio receivers and apparatus. Each meter has been designed for a specific function or group of functions and no doubt fulfills its duty with entire satisfaction. Often it is possible to use an instrument in a number of different tests, but often, too, it is not possible to use it for more complex and intricate tests.

Working on the assumption that one single meter can do as much as three or more, the author, in collaboration with A. R. Marcy, chief engineer of WFBL, evolved a circuit which more than exceeded all expectations. Owing to the flexibility of the device—the numerous tests that can be made with it—every set builder, service man and radio technician should be interested.

What the Meter Will Do

The instrument is compact and portable.

There are three distinct functions which are performed by the device:

1.- DC Voltmeter test for A, B, C batteries and for A, B, C eliminators and trickle chargers.

2.- Tube tester: measures the direct plate current consumption of the tube when it oscillates at radio frequency, and thus gives the actual efficiency of the tube in a relative way.

3.- Circuit tester: for open, shorted and grounded circuits on coils, condensers, transformers, choke coils, rheostats, loudspeakers, etc.

In a large number of trouble-shooting cases the meter will find ready use.

The testing procedure involved in obtaining the characteristics of vacuum tubes in order to ascertain the particular use for which the tubes are best suited has been boiled down to a very simple method which has been found infallible.

Gives Practical Information

Where the laboratory requirements are exacting it is advisable to use the roundabout method of finding the amplification constant, the plate impedance, the mutual conductance and other important characteristics. In other words, the meter described in the following paragraphs gives only the information which would be required by the practician and not by the laboratory engineer anxious to find out the number of electrons which leave the filament every second, or to learn the extent of electrolysis in the glass bulb when the tube is operating at definite voltages and frequencies. The meter answers a purpose very nicely in that it gives the exact relative value of the tube and denotes its particular use as an amplifier for radio or audio frequencies or use as a detector.

The 99, 01A, 12, 71 and other such tubes can be tested.

The panel, which is of Micarta, is laid out according to the sketch. Care should be taken not to mar the beautiful polished surface by scratches.

The large holes are cut either with an extension bit or else with a small scroll or coping saw. This task, too, must be done with pains, else the mistakes will prove costly.

The meter is fastened in place by three small machine screws and nuts. The push buttons are forced into their holes, fitting snugly. The binding posts are locked tightly and the rheostat, which is a Carter 50-ohm Midget, the phone jack and the cam switch are mounted in the single-hole mounting manner. Two machine screws hold the socket in place.

What Holds Multiplier

What parts are not mounted on the top of the panel are fastened to it on the under side. In a word, all the parts are placed together in one single unit, making the device very compact and adaptable for quick check-up.

When the instruments and parts have been placed on the top of the panel, the radio frequency inductance coil, the radio frequency choke coil and the 1 mfd. bypass condenser are mounted by means of the fiber strip and brass strip respectively. A type 112 amperite is attached to the under side of the panel by means of a small machine screw.

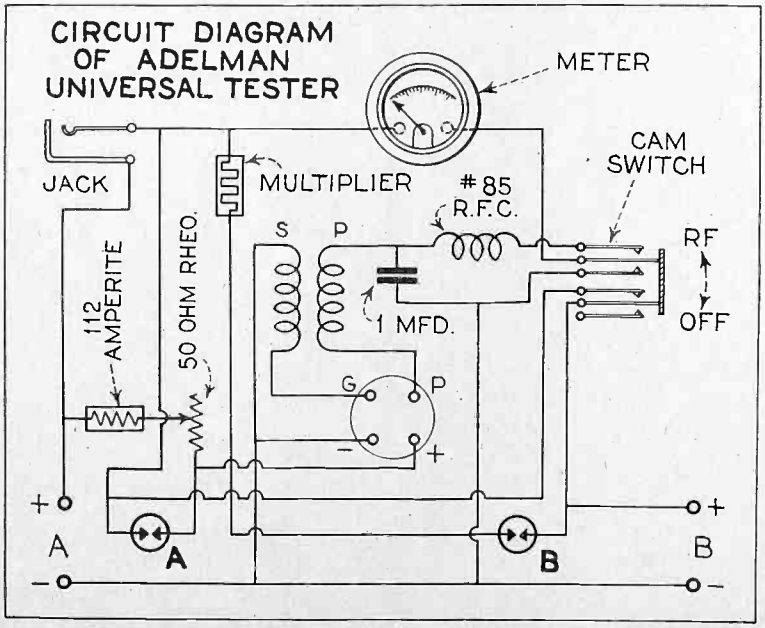
It will be noted from the photograph that the multiplier for the meter is held in position by the connecting wires which pass through its central core. Thus, all strain is taken off the coil connections and accidental breakage of the fine wire leads from the multiplier resistance is prevented.

Soldering lugs have been provided for every terminal, so that all connections and joints can be properly soldered. No mechanical means of making an electrical connection should be relied on, for continued handling may loosen these connections and give cause for trouble.

The parts have been arranged so as to provide the shortest leads consistent with proper disposition.

Supply Voltages Measured

Before the instrument is placed into service the wiring should be checked and as a final precaution, rechecked. This will avoid needless spilling of tears when the meter is accidentally burned out by a nice fresh B battery because the multiplier had been left out of the proper circuit, or avoid the loss of a tube due to some incorrect connection. As the in-



THE CIRCUIT DIAGRAM OF ADELMAN UNIVERSAL TESTER.

Tubes and Sets

strument itself is wired, it is quite impossible to do any damage to it or to any instrument connected with it, if the proper procedure is followed.

The panel has been engraved with the letters A and B. These denote the A and B battery connections. Since the meter range is 6 volts for the A battery and up to 120 volts for the B battery, never use more than these potentials connected to their respective binding posts.

If in doubt as to the output voltage of a B eliminator, test it step by step, that is, by measuring the detector voltage, then, the amplifier and finally the power amplifier voltage if you believe it safe. Otherwise, test the voltage output between terminals and add them together to obtain the total. This is really the better test. Since the meter is a rather sensitive one, any fluctuations in the supply can be noted quite readily.

166 Ohms Per Volt

In this manner, A, B and C voltages from batteries or eliminators can be ascertained with accuracy. However, make sure that you do not reverse the polarities of the voltage supply leads to the terminals. Making this mistake causes the needle pointer to develop a powerful kick which results in a badly bent pointer. The marked leads of the telephone cords plainly show the polarity and should not be disregarded or forgotten when making connections. Remember—it requires one single mistake to undo plenty of time and labor.

Since the meter has full scale deflection of 6 volts and 6 milliamperes, it is easy to understand that at 6 volts the meter consumes 6 milliamperes and thus the resistance of the meter must be 1,000 ohms.

Following the same line of thought, the resistance of the multiplier, in order that the full scale reading of the meter be 120 volts, is 19,000 ohms.

It will be seen, therefore, that the meter consumes very little current and is thus capable of giving a very accurate measure of the voltage output of an eliminator or trickle charger.

Tubes can be tested quickly, accurately and safely. Let us first consider the type 99. First connect a source of filament supply to the A terminals on the tester. Either 4 or 6 volts can be used. However, be sure that the rheostat is in the "off" position.

Rule Is 45 Volts

Keep in mind to use 45 volts on the plate of the tubes when testing them, excepting only the -71 tube. If a higher potential is employed, say 90 volts, the tube may be found to be so exceptionally good, when tested for radio frequency oscillations, that the needle of the meter may go off the scale. Besides, the curves plotted for tubes with 45 volts on the plate will of course be different from those using 90 volts.

Therefore, connect 45 volts of B battery potential to the B terminals. Place the tube in the socket. Then turn on the rheostat slowly, keeping your finger pressed down on the A push button and with your eyes on the pointer of the meter. You will notice the needle start to move very slowly at first and then accelerate with every small increment in filament voltage. Stop turning the rheostat when the needle points to 3.3 volts, for that is the proper filament operating potential for 99 type tubes. (Cunningham data).

Push and Press

Then take your finger off the A push button and press the B push button, merely to ascertain the proper plate voltage for the tube. When the upper scale of the meter has been read and found to be 45 volts, the direct current input characteristics of the tube have been met with. The grid return of the tube has been made to the negative side of the A battery, making the circuit more difficult of oscillation and putting the tube to a harder test than if the grid return were made to the positive side of the A battery.

Plate Current Reading

It will be noticed, too, that no grid leak and grid condenser is used, nor even a by-pass condenser across the secondary of the radio frequency inductance.

These conditions have a tendency to enhance the severity of the test, so that if the tube oscillates under these conditions, it certainly will work properly when placed in a regular radio circuit, be it the radio frequency amplifier, audio frequency amplifier or detector circuit. Just where or in what position the tube will function best will be taken up shortly.

Now when it has been ascertained that the tube is properly fed with the required voltages, do not touch anything else, but turn the cam switch to its "on" position. Note the meter reading. It should be anywhere from 1.5 to 2.5 milliamperes, for the 99 type of tube.

If the reading is very low, the tube is evidently a poor one and should not be used as radio frequency amplifier or detector. Even as an audio frequency amplifier it may not function with much success, but if it must be used, it should be placed in the audio frequency amplifier circuit, preferably the first stage.

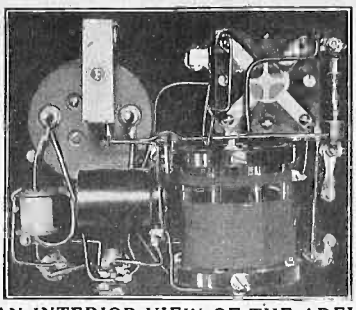
Test of Oscillation

However, the low reading may be due to the tube not oscillating. This condi-

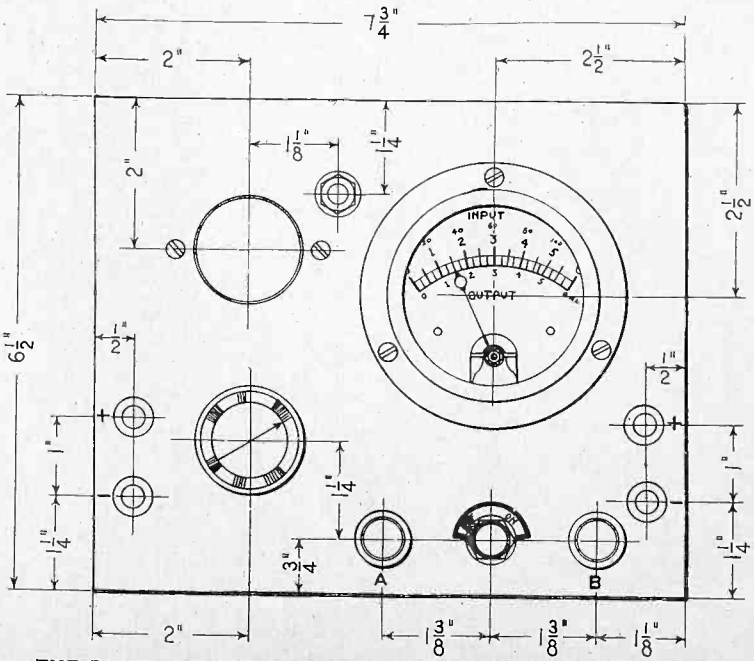
(*Concluded on next page*)

LIST OF PARTS

One Micarta Panel 7 3-4x6 7-16x1-8.
One Combination Roller-Smith meter—0-6 volts, 0-120 volts, 0-6 milliamps.
One Carter jack switch.
One Hammarlund No. 85 RF choke.
One Bruno No. 99 RF coil.
One Carter jack.
One standard socket.
One Carter 50-ohm rheostat.
One Type 112 amperite and mounting.
One Cabinet 8 1-2x7x7 3-8 inches.
Four All metal binding posts.
Two Pearl-head push buttons 5-8 inch diameter.
One Roll of Acme Celatsite wire.
One Fiber strip 2 1-2x1 inch.
One Brass angle "L" 1x1-2x1-2 inch.
One Brass strip "L" 3x1-2x1-2 inch.
One Weston plug.
Three Single Flexible 6 foot Phone Cords (Spade tips at one end and plug tips at the other).
One Flechtheim 1 mfd. by-pass condenser.
One small bakelite knob for rheostat.



AN INTERIOR VIEW OF THE ADELMAN UNIVERSAL TESTER SHOWING THE PLACEMENT OF THE DIFFERENT PARTS. THE ELECTRIC METER IS SHOWN AT THE UPPER LEFT CORNER, THE TUBE SOCKET AT THE RIGHT. IN THE LOWER TIER THE VOLTAGE MULTIPLIER IS AT THE LEFT, THEN THE RADIO FREQUENCY CHOKE COIL AND AT THE RIGHT, THE OSCILLATING COIL. ON THE PANEL ARE SEEN THE TELEPHONE JACK, THE FILAMENT RHEOSTAT AND THE SWITCH.



THE PANEL LAYOUT OF THE ADELMAN UNIVERSAL TESTER.

tion may result from an improper connection of the plate coil in the oscillatory circuit. Try reversing the leads to the plate coil and then take the RF reading. Whether the tube is oscillating can quickly be determined by placing a finger on the grid terminal of the inductance coil or socket. The meter reading should fall off appreciably when the finger is placed on the high potential post. If it doesn't then one can be reasonably sure that the tube is not oscillating.

One thing to be kept in mind is that one can increase the RF reading by increasing slightly the filament potential. Yet it must also be remembered that an increase of 10 per cent in filament potential results in a marked decrease in the life of a tube. Thus, if the filament potential is adjusted to 5.5 volts for a type 01A tube, it may be found that the plate current may be increased 50 per cent or more, than when operating the tube at 5 volts.

The radio frequency choke coil and bypass condenser augment the chances for self-oscillation in the circuit and keep the radio frequency currents out of the meter and batteries. This insures accurate tube characteristic readings.

Chart Gives Rating

The wavelength at which the tube is made to oscillate is approximately 130 meters. The inductance of the secondary winding together with its self or distributed capacity, which is extremely low, afford the high frequency conditions (about 2,300,000 cycles) at which the tube responds. This value of oscillation is far greater than that at any frequency within broadcasting range.

Since the meter range is but 6 mils, and since the type 12 tube makes a very good detector tube when operated at the proper characteristics, do not connect 90 volts of plate current to test the tube, because the needle pointer of the meter may run off the scale too far and get badly bent. Rest assured that if the tube proves to be a good detector, it certainly will operate very efficiently as an audio amplifier. Use 45 volts with the 112 on test. As for the —71, use only 22½ volts when testing with this device.

Here is a chart which gives information concerning tubes generally used and what should be expected from them when tested by the meter.

(Plate Voltage of 45 Volts, except for —71)				Input Characteristics	
Type	Poor	Good	Very Good	Volts	Amps.
39	1.50 MA.	2.0 MA.	2.5 MA.	3.3	.06
00A	1.0	1.50	1.75	5.0	.25
01A	3.50	4.0	4.50	5.0	.25
12	5.0	5.75	6 0	5.0	.50
71*	3.0	3.25	3.50	5.0	.5[illegible]

* Only 22½ plate volts.

It will be noted that 45 volts of B battery potential has been used for testing all the tubes, except the —71, even though some require more and others less. However, the values of the RF readings as given in the above chart have taken this into consideration and represent the results of averaging together the readings found during the testing of a large number of the various types of tubes. Thus one has the means of ascertaining the actual value of a tube and for what purpose it should be used in a radio receiver circuit. Only "good" tubes should be employed as radio frequency amplifiers and detectors. The audio amplifier may use those found slightly below par, although a wise man permits none but "good" tubes in a receiver.

Means Something

No longer will the layman who wants to buy a tube or a set of tubes have to listen to the man behind the counter proclaim in seemingly unintelligible terms the value of mutual conductance, amplification constant, plate impedance and whatnot, which really mean nothing to either. The meter can tell—in one syllable—how good the tubes are.

THE ADELMAN UNIVERSAL TESTER OPENED UP AND READY FOR USE.

A type 112 amperite has been incorporated in the circuit. This is used to provide the proper amount of filament potential when testing the type 112 and —71 tubes. Naturally, the rheostat arm is turned to its maximum position, so that no current will traverse the resistance wire. Otherwise, one-half ampere through the wire may burn it out.

The experienced trouble shooter, merely by listening to the imperfect reproduction of a defective radio receiver, sometimes can tell the cause of trouble. But often he cannot tell unless he tries first one thing, then another. Or again, if the tubes don't light, or there is no sound in the reproducer, or one of the thousand and one possibilities of trouble manifests itself, the Universal Tester finds immediate use and renders invaluable service, where it would be a matter of guess-work otherwise. And wise service men don't guess.

A systematic method of procedure in testing a radio circuit is always the best. And, regardless of the type of circuit, the same general idea should be carried out.

The Three Steps

Here are the steps which will solve even the most complex cases of seemingly insurmountable difficulties.

FIRST.—Ascertain whether the source of supply of current to the receiver is proper and of accurate voltages. Test either the batteries or eliminator or both, as the case may be. The meter will tell readily whether the A battery is down, or the B eliminator is defective or whether or not the supply is functioning perfectly.

SECOND.—The tubes should next be tested. A visual inspection of the tube prongs and socket contacts should be made. Take no chances with the little things. They are the big things in a radio set.

THIRD.—Turn the receiver on and disconnect one terminal of the loudspeaker. The connection should be made and broken a few times. If a loud click is audible, then, since no signals are reproduced, there must be something wrong with the wiring of the set. Possibly a connection is broken. If there is no loud click in the speaker there is room for further complications, such as a broken cord lead or a burned-out speaker.

Service Man's Tasks

Before taking the set out of its cabinet, see that the antenna and ground connections are good. Also, test the current supply voltages at the binding posts on the receiver itself, to insure whether trouble is being experienced from broken leads. When these precautionary tests have failed to coax the set into operation, and further maledictory comment is of no avail, take the chassis gently out of its cabinet.

To the man who knows radio, all sets are not alike. This means that what is a peculiar ailment for one type of set, is not at all common to another. Thus, give the set a thorough visual inspection to see that there are no broken leads or loose connections. See to it that the variable condenser plates do not touch at any setting of the condenser, but that the plates are evenly and uniformly centered over the entire range. Remove all dust.

The visual inspection is to locate mechanical trouble in a radio set. Even a short-circuit is classed under this heading, for a mechanical accident is no doubt responsible for an electrical discrepancy.

Shorts and Opens

Connect an A battery or, if not available, the source of A battery voltage used by the receiver, to the A terminals of the meter. Then plug in the trusty jack and momentarily touch the long flexible wire leads together. If a full scale deflection is obtained, then everything is all right. Remember that a full scale deflection means six (6) milliamperes through the meter. Quite sensitive, and enough for all practical purposes.

The audio frequency transformers should be tested first. The primary and secondary readings are taken. By comparing these readings it will be possible to obtain in a fair manner the ratio of the transformer assuming the same size wire is used on each winding, which is usual. If a full-scale deflection is obtained, then the winding—primary or secondary—may be short-circuited, internally or more presumably, externally. It is possible that the leads from the transformer are touching, or else, a fixed condenser across the winding may be defective.

Continuity Test

Test the windings for a ground and for interconnection between them. A complete working knowledge of the circuit facilitates this test, for it takes longer to describe than to make the test.

All the fixed condensers, grid, by-pass and filter should be tested next, for shorts and grounds. If a sudden but very slight deflection is noted when testing fixed condensers, it should be borne in mind that the phenomenon is merely the condenser charge.

The direct current resistance of radio frequency inductances is practically negligible, hence the meter will read full scale when the primary and secondary of these units are tested. Should no reading be manifest, then look at the leads. They may be broken, even though the insulation remains intact. This is one source of the most exasperating types of troubles.

Offset the chances for trouble of this baffling nature by testing the plate leads, grid circuits and filament circuit by holding one terminal of the meter lead on the binding post of the circuit to be traced. Thus, for example, there should be a reading from the plate post on the first and second and, if there be a third, radio frequency amplifier tube to the plate voltage binding post to which these leads are connected.

The Solder Problem

One of the most troublesome sources of difficulty is the cold-soldered joint, which very often appears to be a perfect connection but is in reality a high resistance contact. The troubles arising therefrom are very hard to remedy, especially when the joints are overlooked in the hasty visual inspection given a receiver.

There can be no doubt as to the efficacy of the meter test, though the human element plays an important part in determining what seems to ail the radio set.

Weak Sets Strengthened

By Paul R. French

THERE are thousands of receivers in use which do not give satisfactory service because they have not been designed for present conditions. Many of them are designed for use with a high outdoor antenna and with a great deal of regeneration. These are usually not selective enough notwithstanding the regeneration used, and if they are used on short antennas they are selective enough but lack volume. Some of these receivers work very well in one location but fail utterly when moved to another.

For example, one such receiver gave good results on an indoor antenna when located on the third floor of a stone building, where there was little interference. When it was moved to the first floor of a concrete building and connected to a similar indoor antenna it failed to bring in any stations but one which was only a few blocks away. In this case the failure was mainly due to countless other antennas all around the receiver.

It Is Better Higher Up

When this receiver was moved up one flight in the same concrete building and connected to an indoor antenna exactly like the one that had failed on the first floor, it brought in all the local stations with fair volume. But reception was not satisfactory because too much regeneration had to be used on the more desirable stations. More straight radio frequency amplification had to be introduced into the receiver before reception would be satisfactory in that location, or else an outdoor antenna had to be erected.

Neither an outdoor antenna nor another tuner was desired because of the inconvenience which they would introduce. Hence a radio frequency amplifier was added in the manner shown in Fig. 1.

The connection between G and —A was first cut and G was connected to the 45 volt tap on the plate voltage supply. The antenna terminal on this coil was connected to the plate of the added tube and the antenna binding post was joined to the grid of the new tube. An amperite 1A was put in the negative leg of the filament to control the heating current.

The resistor R should have a high value—1 megohm or over—because the volume is greater when it is not used at all. The only object of using it is to prevent the possibility of grid blocking. Since the signal level at this point is very low and since the antenna has some leakage to ground, the probability of blocking is extremely small, and a very high value of leak can be used.

Great Increase in Volume

By this arrangement the volume was increased by a factor of 5 or 6, a sufficient gain to give satisfactory reception on all local stations without the use of any regeneration. In fact there was enough gain to throw away with the volume control.

The circuit became more selective, for the same amount of regeneration, than it was before, because the antenna was no longer a part of the primary circuit of the first R.F. transformer. And the tuning did not become any more difficult since no extra tuner was added.

An attempt was made to employ a loop in the grid circuit of the added tube and to tune this with an external condenser. The result of this was that the volume became uncontrollably great, the selectivity became too keen, and the tuning became too difficult.

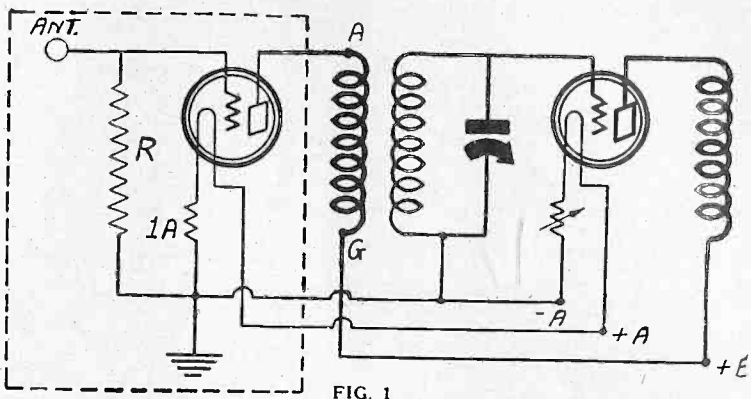


FIG. 1
IF THE VOLUME IS NOT GREAT ENOUGH IN YOUR SET, IT CAN BE BOOSTED TO A SATISFACTORY LEVEL BY THE ADDITION OF AN UNTUNED STAGE AS SHOWN IN THIS DRAWING. THE ADDED STAGE IS INCLOSED IN THE DOTTED LINES.

High Mu Tubes as Detectors

By John Murray Barron

Contributing Editor

The subject of high mu tubes is so important and so wide in its scope that it deserves a special and complete treatise. But we shall not undertake such a pretentious discussion at this time. It will be enough to indicate why a high mu tube is a better detector than a low mu tube, and under what conditions advantage can be taken of the greater detection efficiency.

It has been shown mathematically, and the theory has been verified experimentally, that high mu tubes are more efficient detectors than are low mu tubes. Thus E. L. Chaffee in a paper in Proc. I. R. E. for November, 1927 calculates the voltage detection coefficient of various tubes and shows a circuit whereby the coefficient can be measured accurately. He gives experimental curves, which closely check the theory, between the voltage detection coefficient and the effective grid bias.

The curves show that for maximum detecting efficiency the effective grid voltage is rather critical, both for plate circuit rectification (grid bias detection) and for grid circuit detection (with grid condenser and leak). For both types of detection, experiment and theory show that the high mu tube is superior to the low mu tube in detecting efficiency.

It is also shown that, contrary to general experience and belief, the negative bias method of detection is effectively superior to the grid leak and condenser method. This comparison was made with both method adjusted to a maximum detecting efficiency and with due regard to the decrease in the detector input voltage due to the flow of grid current when the grid leak and condenser method is used.

It is definitely shown by the curves for both methods of detection that the high mu tube is greatly superior. But the greater voltage detection coefficient of a high mu tube is not always made use of in a circuit. To take full advantage of it the load impedance on the tube must be high. This fact can be readily demonstrated in receivers, particularly in a super-heterodyne receiver. Insert a high mu tube in the first detector socket. The volume goes up a little as compared with the volume of a UX-201A tube.

Then put a high mu tube in the final detector socket in place of a general purpose tube. The volume shoots away up. The difference is due to the fact that the impedance of the audio transformer connected to the second detector is much higher than the impedance of the first intermediate transformer. The difference is not always so great because the intermediate frequency is high and it does not require much inductance to make a high impedance. But the volume goes up in both cases.

The greater detecting efficiency of the high mu tube is particularly noticeable when the coupling between the detector tube and the first audio amplifier is a high resistance. The gain in volume is very great.

In making the test suggested above be sure that the tube used is high mu in fact and not merely by assumption. We have tested some tubes supposed to have a high amplification constant which did not amplify as much as a general purpose tube of mu 8 when used under conditions favoring the high mu tube. Make sure of the constant of a tube by substituting it in a resistance or impedance coupled stage in which a tube of known high mu has been operating. Increase in volume shows that the mu of the tube is high.

Now Push-Pull Stages a and

By J. E. Anderson

Technical Editor

ON some sides one hears surprised comment that push-pull amplification should have staged a comeback. Why did it pass out of vogue if it was as good as claimed to be, and why is it now coming back if it did not satisfy the public taste when it was with us before? These are some of the pertinent questions tossed about.

The ebb and flow in the popularity of push-pull have many underlying causes. The promise of unexcelled tone quality and high volume attracted many to the push-pull a few years ago. The lack of fulfilment of the promise turned most of them away from the system. The distortion actually met in the push-pull amplifiers and the depression in volume turned still others away from it. The high cost of getting the distorted signals also turned some away.

And all that deserted the push-pull were attracted to other forms of amplification which held out more desirable qualities at a lower cost. Some of these systems of amplification were resistance, impedance, and double impedance coupled circuits, and still others were regular transformer coupled circuits in which the modern transformers are used.

Why Push-Pull Is Coming Back

The push-pull system of audio amplification is coming back because of its inherent good quality. It is coming back although other forms of amplification have been developed to a very high point of quality. It is coming back because what was lacking a few years ago is being supplied now.

The failure of the first public visit of push-pull was due to the fact that no good push-pull transformers were available. Now we have them. Transformer makers have come to realize the requirements of good quality, and they have met them. They have met them in straight amplification as well as in push-pull. And push-pull is coming back.

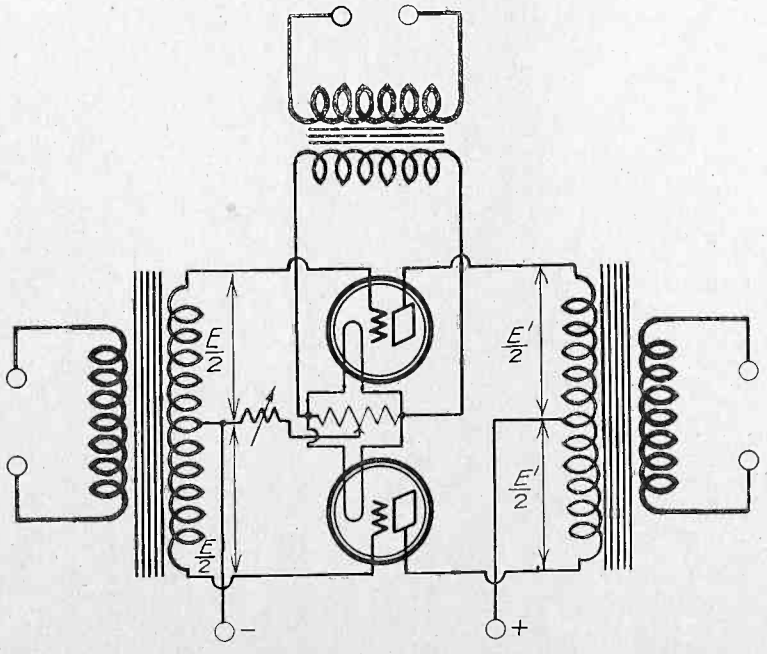
Push-pull is symmetrical amplification, and as in all symmetry, even things are balanced out. Odd things are not. In push-pull all the even harmonics introduced by the tubes are balanced out, or nearly so. The odd harmonics are not. If anything, they are accentuated a bit.

The signal desired is made up of many harmonics, odds and evens. But these evens are not balanced out by the push-pull stage. When the signal reaches the grid circuit of the push-pull stage every component, odd or even harmonic, becomes the first harmonic as far as the final stage is concerned. If the stage is faithful, all the components come through in just the same proportion they went in. No additional harmonics are introduced.

Where Harmonics Appear

But in every practical case some harmonics are introduced by the last stage. Each tube introduces all the harmonics there are. Suppose a pure tone goes into the grid circuit of the push-pull stage. In the plate circuit of each tube countless harmonics of this tone appear. The first few are strong. Only the first harmonic is desired.

Now if the push-pull stage is really well balanced all the even harmonics in one tube are balanced by the even harmonics in the other tube. None appears across the terminals of the output transformer, or in the secondary of that transformer.



ONE STAGE OF PUSH-PULL AMPLIFICATION WITH AC HEATED FILAMENTS. THE INPUT VOLTAGE E IS DIVIDED EQUALLY BETWEEN THE TWO TUBES. EACH AMPLIFIED HALF E½ APPEARS ACROSS HALF OF THE PRIMARY OF THE OUTPUT TRANSFORMER, AND THE TOTAL OUTPUT VOLTAGE IS E'. R SUPPLIES THE GRID BIAS WITHOUT DETRIMENTAL EFFECTS.

But the odd harmonics are not balanced out, because they act in opposite directions. One tube pushes the odd harmonic currents around the output circuit and the other pulls them around in the same direction. In other words, their effects add up for the odd harmonics.

The total input voltage was divided equally between the two tubes; in the plate circuit they are added again. But only the odd harmonics are added, the evens are bucking each other.

The Output Is Increased

What has been the gain in the push-pull stage? The elimination of the even harmonics, that is all. But that is a great deal, for most of the distortion in the output of a tube lies in the second, third, fourth and fifth harmonics, and the second is greater than the third, and so on. Hence when the second and fourth harmonics have been eliminated, as well as the higher evens, there is not much distortion left in the circuit. The third, fifth and seventh are not so important as the second.

The advantage of the push-pull stage is not that it amplifies more, but that a greater output may be obtained from two tubes with a certain minimum of distortion than if the two tubes were connected in parallel. When the tubes are connected in parallel and the proper load impedance is used, the maximum undistorted output is about twice that of a single tube. But when the same two tubes are used in push-pull the maximum undistorted output is from 5 to 7 times as great as with a single tube. That is because of the elimination of the even harmonics. When distortion does become appreciable with this arrangement, it is the third harmonic which is at fault. The fifth adds a bit to it, but not enough to worry over.

To take advantage of the greater output of a push-pull stage it is necessary to use more amplification ahead of the stage. The increased amplification can be obtained either at audio or radio frequency, or the signal intensity can be increased by the use of a more effective detector.

Accurate Balance Is Necessary

In wiring up a stage of push-pull it is not sufficient to use commercial units and rated values haphazardly. The actual values are not the same as the rated values. Commercial units with the same designation are not identical. To take full advantage of the push-pull system they must be identical. The plate, grid and filament voltages on the two tubes must be the same. The input voltages to the two grids must have the same value. The tubes themselves must be as nearly identical as it is possible to find them.

If the two sides of the symmetrical amplifier are not equal, the even harmonics will not be completely eliminated. But it is not difficult to build a push-pull amplifier in which the sum of the even harmonic currents is small as compared to the sum of the odd harmonic currents, and that means a considerable improvement.

It has been stated that if a vacuum tube is operated at the proper point on the grid voltage, plate current characteristic no even harmonics will be generated

Phenomenal Comeback—Why

by the tube, and that in such cases it is useless to employ the push-pull system. It would eliminate only the harmonics which are not present anyway. That is true when the curve of the tube is symmetrical about the operating point. No such point can be found for the vacuum tubes in use. In most cases the operating point has to be far to the left of the point about which the curve is most nearly symmetrical in order to prevent the grid from going positive.

Another Advantage of Push-Pull

One very real advantage of the push-pull system of amplification, one which is usually overlooked, is that disturbances in the power supply system are balanced out. Thus residual ripple in the plate voltage derived from a B battery eliminator does not appear in the output of a push-pull stage. Similarly battery noises which arise in a B battery when one is used are balanced out. Similar disturbances arising in the grid bias battery or substitute are also eliminated from the signal when the circuit is well balanced.

The same applies to the filament system whether DC or AC is used. It follows that line noises, which are disturbances in the power supply system, are not reproduced as strongly in a push-pull amplifier as in a one sided circuit.

It Works Both Ways

The converse of this proposition is also true. The impedance of the power supply system and grid voltage supply does not have as great influence on the amplification as it does in a non-symmetrical circuit. The common grid or plate impedance cannot give rise to amplification peaks or depressions, or to oscillation. That is, a push-pull circuit does not "motorboat" as readily as a one sided circuit.

This applies only to the push-pull stage, and only to the extent to which it is balanced.

The advantage of this balance is particularly great in connection with grid bias when this is obtained from the drop in a resistor in the plate return circuit. When such a resistor is used for a single tube to obtain the proper bias for that tube, the amplification in it is greatly depressed.

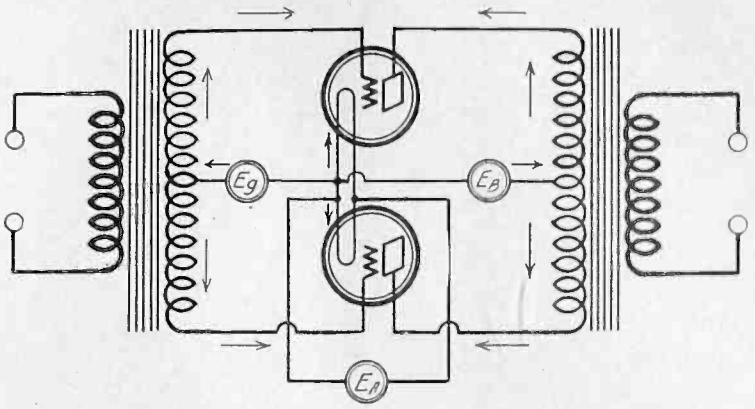
If a condenser is connected across the resistor this depression is minimized in proportion to the capacity of the condenser.

Ordinarily only 1 mfd. is connected across it. This is wholly inadequate and has the effect of depressing the amplification of the low notes and letting the high notes through unhampered. Thus the little resistor is sufficient to change the best receiver into one of poor quality, unless a very large condenser is connected across the resistor.

Now if the grid bias of preceding tubes is also obtained from the same resistor, the situation is greatly complicated. The amplification may be increased and decreased in different regions of the spectrum. Even oscillation may result at some frequency.

In a stage of push-pull there is no AC current in the grid bias resistor, provided it is well balanced. Hence the resistor has no effect in either increasing or decreasing the amplification. The plate current of the preceding tubes is not supposed to flow through the resistor. Since there is no AC in the grid bias resistor and none will be introduced if the grid returns of the other amplifiers are connected to it, the grid bias can be obtained for all the tubes without detrimental effects.

There are many reasons why push-pull amplification is coming back, and there are many more why it should come back strong. And there is every reason why push-pull is back to stay.



A PUSH-PULL CIRCUIT ILLUSTRATING HOW DISTURBANCES IN THE POWER SUPPLY ARE BALANCED OUT. THE ARROWS INDICATE THE DIRECTION OF THE CHANGES IN THE CURRENTS OR THE POTENTIALS DUE TO A DISTURBANCE. NOTE THAT THE CURRENT ARROWS IN THE TWO HALVES OF THE PRIMARY OF THE OUTPUT TRANSFORMER ARE IN OPPOSITE DIRECTIONS. HENCE THE DISTURBANCE DOES NOT APPEAR IN THE SECONDARY. IT MAKES NO DIFFERENCE WHETHER THE DISTURMANCE APPEARS IN EG, IN EB OR IN EA.

Some Hints on AC Tubes; Don't Use Bias Detection

(From E. T. Cunningham, Inc.)

To compete successfully with battery receivers it is essential that sets employing AC filament tubes compare favorably with the battery operated tubes in all important operation characteristics including tone quality, volume, sensitivity and selectivity and in freedom from hum, power line disturbance and service troubles.

With respect to tone quality and volume the AC filament supply does not introduce any new problems so far as the output tube alone is concerned, since type CX-371 or CX-112 will give the same performance in the output stage whether the filaments are operated from battery supply or from alternating current. The tone quality may be affected by other factors such as the presence of hum, a subject which will be discussed below.

The sensitivity and selectivity of the radio frequency stages is essentially the same with CX-326 tubes as with type CX-301A tubes. The higher mutual conductance of the AC tube is partly offset by the necessity for using a grid bias.

When type C-327 is used, grid leak detection is practical so that equal detector sensitivity as compared with battery operated receivers is obtained. When it is necessary to use grid bias detection the AC operated recievers is at a disadvantage because the sensitivity is greatly reduced. This latter method of detection gives only about 20 per cent of the audio volume given by the grid leak method.

With respect to the freedom from hum, the combination of CX-326 tubes for the amplifiers, the C-327 for the detector and the CX-371 or CX-112 for the output affords very satisfactory results if the proper precautions with respect to the circuit design are followed.

To obtain freedom from line disturbances precautions must be taken to prevent the direct pick-up of line disturbances by the tubes and associated equipment. Power transformers should be shielded if placed in the same cabinet with the receiver; and an electrostatic shield between the primary and secondary windings of the transformers is also necessary.

The rugged design of both types of AC tubes insures freedom from service troubles so far as the tubes themselves are concerned.

In accomplishing the elimination of all batteries and devices requiring corrosive liquids the possibility of corroded connections disappears and it is evident that with proper care in circuit design, and the use of high grade materials and parts, a greater measure of freedom from service troubles can be secured than has been possible with previous designs.

With respect to the cost and bulk of component parts this combination of AC tubes is particularly satisfactory since the use of a heavy A filter system or A supply unit is avoided.

Instead the only accessory required by the AC tube is a few extra turns of wire on the B eliminator transformer or a small separate transformer to supply the low voltage AC for the filaments.

The G. R. Push-Pull

By Stuart S. Bruno

FOR those who have a radio receiver which they believe gives good tonal reproduction and plenty of volume, but who wish to improve the quality of reproduction, and for the fan not satisfied with reception as now obtained, due to his audio amplifier stages overloading or distorting, the G. R. Push-Pull Amplifier and Power Supply was designed. It has many desirable features. These include simplicity, compactness and small cost.

Push pull amplification is used. By this means two power tubes in the last stage permit far more distortionless amplification than the usual standard method of employing one tube in this stage, or by connecting two tubes in parallel. The tubes in push-pull are connected so that their power outputs are added. However, the fan must remember that while connecting the tubes in such a manner does not increase the signal strength, it does allow a greater input without delivering a distorted signal at its output.

How Quality Is Improved

Distortion in the last stage of an amplifier is usually caused by impressing on the grid of the last tube a voltage high enough to make the grid positive, thereby making the tube rectify, instead of amplify. That distorts the wave form. By using the push-pull method of amplification, the grid voltage swing resulting from the impressed signal is divided between the two tubes. This is done by center tapping the secondary winding of a transformer (second stage) and bringing this center to the required grid bias, while the two outside ends connect to respective grids.

Another desirable advantage of this type of amplifier is that when using alternating current for filament supply, hum voltages cancel out to a great extent and make the amplifier itself quiet in operation.

The unit to be described is intended to be used with the CX-371 or UX-171 power tube, CX-112 or UX-112 or the UX-226 or CX-326 type of tube.

If one has a receiver that delivers ample output, such as a receiver containing about two to three tuned stages of RF amplification, tuned detector, and one stage of audio amplification, or a Super-Heterodyne receiver, two -71 power tubes should be used. Where a set does not deliver so much amplification, the 112 or -26 type of tubes are recommended.

The Transformer

In the completed unit is a power transformer with three windings—the primary, which is to connect to the 110 volt AC mains, a secondary, delivering 7.5 volts to operate the filaments of the power tubes, stepped down to 5 volts, if necessary, by inserting a 3 ohm fixed resistance in series with the filaments, and a high voltage winding tapped at center and delivering 225 volts on each side of center.

After the transformer steps up the voltage and current to the required value these must be converted to direct current and voltage, which is done by the 85 milliampere rectifier tube. From the tube the current passes on to the filter system, composed of two high inductance choke coils, both in one container, and several large capacity condensers, in one unit.

After the voltage is filtered and is suitable for receiver operation, it is divided into lower values so that each relative portion of the receiver can get its correct value. This is done by connecting a series of variable and fixed resistances across the output. The variable resistors afford easy adjustment of these voltages assuring the maximum of satisfactory operation. Another small bank of fixed resistances give us several grid bias voltages that may be required by the receiver. The C bias for the power tubes is obtained from a 5,000 ohm variable resistance placed in the return of these tubes and by manipulating this, the C voltage may be varied from 9 to 45.

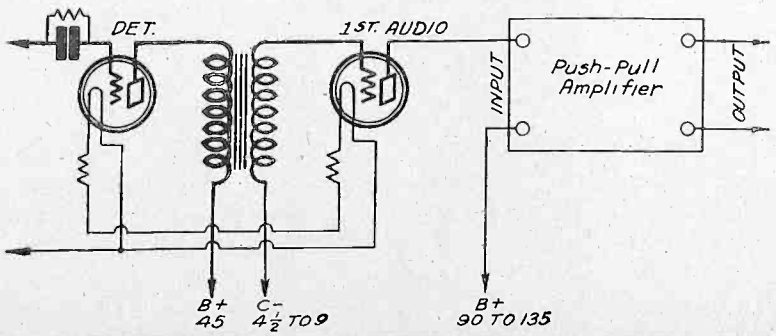
The 441 Already Assembled

The push-pull amplifier is purchased in complete form. This is on a metal baseboard and contains the tapped input transformer, tapped output transformer, the two sockets for the -71, 112 or -26 type of tubes, a 1.5 ohm variable filament rheostat and a center tapped resistance placed across the filament terminals. The unit is completely wired and the connections to it are made through the binding posts on the base.

The complete unit may be placed away from the set and can be concealed in a console cabinet.

First procure a wooden board measuring about 9 by 17¼ inches and about ½ inch thick. Place rubber or felt pads in each corner so as not to scratch any polished surface. Better still, the parts can be mounted on a Micarta 3/16 inch panel measuring about 9x18. One can place supporting strips along the edges. This also enables the fan to do some of the wiring beneath the panel.

On the extreme right hand side of the baseboard, mount the push-pull amplifier unit. The binding posts should face the left side of the board. To the left of this, leaving about ½ inch of space, mount the choke coil unit. This is to be placed in back and should have its terminals facing away from the amplifier. In front of the choke coil unit and to the left of the amplifier situate the condenser block, with its terminals also facing away from the amplifier.



HOW THE OUTPUT OF A STAGE OF TRANSFORMER COUPLED AUDIO FREQUENCY AMPLIFICATION IS HOOKED ON TO THE INPUT OF THE GENERAL RADIO TYPE 441 PUSH-PULL AMPLIFIER IS DIAGRAMMED ABOVE.

LIST OF PARTS

L1, L2—One General Radio type 366 Filter Choke.
T—One General Radio type 365 Rectifier Transformer.
One General Radio Standard Tube Socket.
One Polymet No. F 1,000 volt Condenser Block (14 mfd).
C3—One Polymet Buffer Condenser, Type C (.1 mfd. and .1 mfd.).
C1, C2—Two Polymet Type A ½ mfd. Condensers.
R1, 3—Two Centralab P. P. 6,000, 6,000 ohm Potentiometer.
R2—One Centralab P.F. 6,000, 6,000 ohm 4th terminal Potentiometer.
R4—One Centralab F.T. 3,464 Fixed Resistor, 3,464 ohms.
R5—One Centralab F.T. 350, Fixed Resistor (tapped) 350 ohms.
RT—One Q.R.S. 85 mil Rectifier Tube.
Eight Eby Binding Posts, marked (See Text).
R6—One ½ ohm Fixed Resistor (De Jur).
One General Radio Type 441 Push-Pull Amplifier, already wired.
One Sterling R415, 0-300 Voltmeter.
Two rolls Corwico Braidite (1 red, 1 black).
One Bottle Silva Flux.
One Box Silva Solder.

Some Tips on Placements

The socket for the rectifier tube is placed to the left of the choke coil unit and its two filament terminals should face the left side of the baseboard. On the extreme left rear side of the board, place the power transformer. This should have its high voltage winding terminals facing the rectifier tube.

Directly in front of the power transformer support the two variable resistances R1 and R2. This can be easily done with the aid of two large brackets. Mount these resistances so that the control knobs are opposite each other. To the right of the variable resistances R2 place the two fixed ½ mfd. condensers These can be mounted on top of each other and clamped down. Near to these the buffer condenser unit is to be mounted.

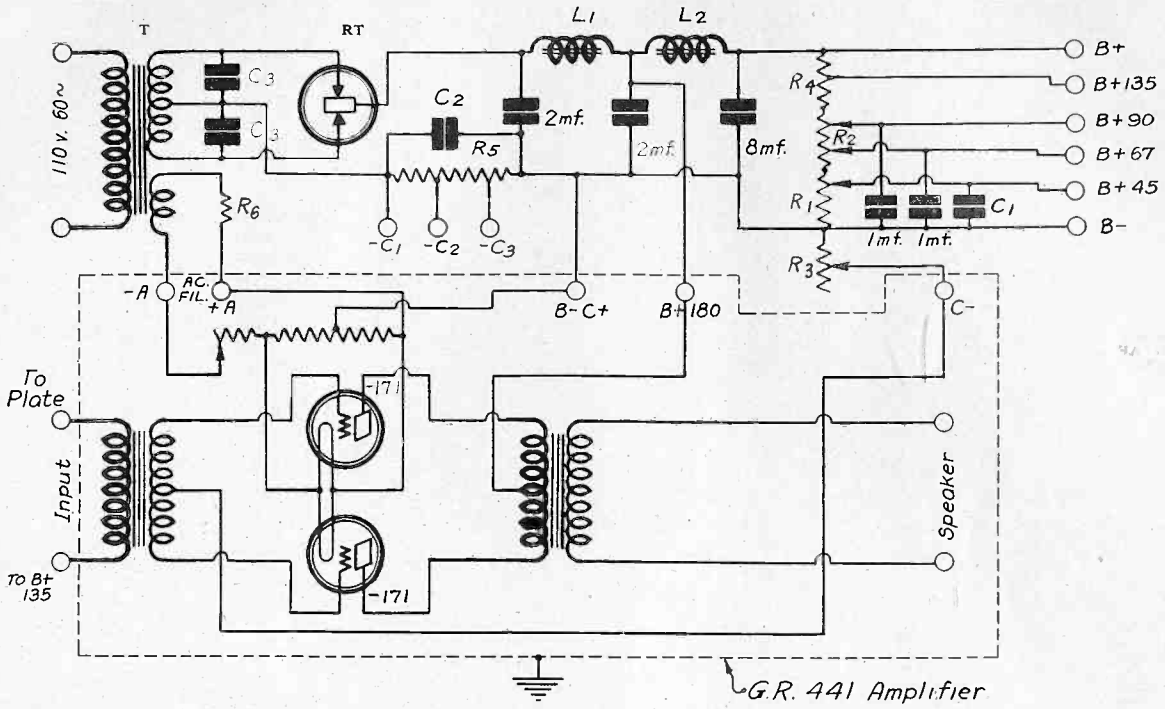
In front of the buffer condenser, mount the grid resistor, R3.

This can be supported in the same fashion as the two other variable resistors R1 and R2. The control knob is to face the constructor. The two resistance strips R4 and R5 are placed parallel to each other and are to be situated to the left of R3. On the extreme left hand front edge of the baseboard, support the resistance strip which is to contain 8 marked binding posts and is to be 7 inches long. This can be fastened to the baseboard with two brass angle brackets.

Use of Two Colors

Flexible Braidite wire is used throughout to wire the unit. The constructor will follow a good plan if he purchases the Braidite wire in two colors, such as red and black, and use the red wire for all high voltage leads and the black wire for all the low voltage leds. This will make it easier to check the completed unit. The fan must be careful and see that all joints are correctly soldered. We used a soldering fluid and solder that

Amplifier and Power Supply



seemed to make the task much easier. We noticed that the iron would not clog and that the joints were quite strong and electrically good.

From the 7.5 volt AC winding of the power transformer run two wires twisted together to the A—, A plus terminals of the amplifier. The 3 ohm fixed resistor is placed in series with the A plus post. The twisted wires can be tacked along the edge of the baseboard.

When wiring the rest of the unit, the fan should remember first to study the layout and mentally place where the different leads are to be run. This way he can be sure that the wires will be short and the completed unit will look neat.

The binding posts on the strip are marked and from left to right read, B Neg., B45, B67, B90, B135, C1, C2, C3.

Voltmeters

When the unit is completed connect to the house current and insert the rectifier and power tubes. Before connecting to receiver, with a 0-300 volt high resistance voltmeter, the negative lead of which is connected to the B-post, connect the positive end to the 45 volt post and adjust the control of R1 until the voltage reads about 60 volts. Do the same at the other B terminals and set them to a value about 20 volts over the marked voltage. Now connect to receiver and finally adjust the various B voltages and also the C voltage for the power tube.

An 0-10 volt AC voltmeter will come in handy to check the terminals voltage of the filaments of the power tubes. This should be kept at 5 volts.

As Hatry Sees It

A jibe is directed at the writers of advertisements for the new AC radio receiving sets, by L. W. Hatry, in the Hartford, (Conn.) Times. Mr. Hatry bemoans the fact that the advertisements convey the idea that the AC set is a sort of magic box, containing nothing more than a few tubes and a little wire, which miraculously extracts concerts and anything imaginable out of the ether, by way of a wall plug. This despite the fact that the AC operated set is fundamentally no different than any other set.

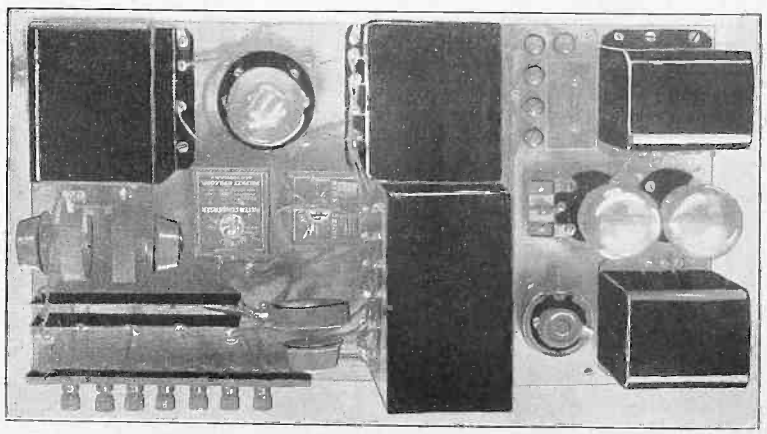
He says some ad writer could have poetically expressed it:

A book of calls underneath the set.
A light-socket, a tube or two—and yet,
Beside me singing to the neighborhood,
Is KFI. That's paradise, I bet!

It might seem strange, at first thought, that he should use the call letters of KFI, but not when it is realized that the powerful western station is tuned in almost at will from coast to coast, and has become the favorite DX station in the country.

CALDWELL EXPLAINS CHANGE

The recent shaking up of the stations in the 600-1000 kilocycle band was not made for the sole purpose of bettering distance reception, stressed Orestes H. Caldwell, Federal Radio Commissioner, in a recent statement. Instead, it was made for the improvement of reception of local stations and to provide more stations to the listeners in, especially persons living in rural districts.



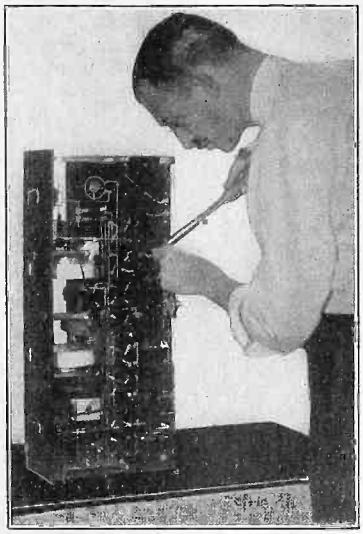
LAYOUT FOR THE G. R. PUSH-PULL AMPLIFIER TYPE 441, AT RIGHT, WHEN USED WITH A POWER AMPLIFIER, AT LEFT, USING THE GENERAL RADIO TYPE 365 RECTIFIER TRANSFORMER AND TYPE 366 CHOKE COIL, IN CONJUNCTION WITH THE Q. R. S. 85 MIL RECTIFIER TUBE, POLYMET HI-VOLT CONDENSERS AND CENTRALAB VARIABLE RESISTORS.

A DX Hound Reports

98 Stations, 43 Cities in Six Nights with Loop Aerial

LIST OF CALL LETTERS COPIED ON MAGNAFORMER 9-8 DURING 6 NIGHTS, ALL BEFORE 11 P. M.

WHO	156	166	Des Moines
KYW	145	155	Chicago
WNYC	145	155	New York City
WIP	140	146	Philadelphia
WOO	140	146	Philadelphia
WEAF	125	135	New York City
WSB	125	127	Atlanta
KFI	119	124	Los Angeles
WRC	119	124	Washington, D. C.
KRLD	116	121	Dallas
WJZ	110	117	New York City
WJR	107	111	Pontiac
WLW	106½	108½	Cincinnati
WOR	100	106	Newark
WHT	98	102	Chicago
CFCF	95	100	Montreal
CHYC	95	100	Montreal
WCCO	93	98½	St. Paul
WFI	93½	97½	Philadelphia
WLIT	93	98	Philadelphia
WTAM	92	96	Cleveland
WHN	89	94	New York City
WPAP	89	94	New Jersey
WQAO	89	94	Cliffside
KWKH	86	93	Shreveport
WBBM	85	90	Chicago
WWJ	73	77	Detroit
WMCA	79	84	New York City
WLWL	79	84	New York City
WEBH	76	72	New York City
WSAI	75	80	Cincinnati
WGBS	70	74	New York City
WAAM	70	74	New York City
WCBD	70	73	Zion
WLS	70	73	Chicago
WSM	65	70	Nashville
WWLA	65	70	Wheeling
WOQ	64	69	Kansas City
WBZA	63	68	Boston
WABC	60	64	Richmond Hill
WBOQ	60	64	Richmond Hill
WGHP	59	61	Mount Clemons
KDKA	56	60	Pittsburg
WPCH	52	57	New York City
WRNY	52	57	New York City
WGN	51	55	Chicago
WLIB	51	55	Chicago
WGR	50	56	Buffalo
WADC	47	51	Akron
WGDA	45	50	Paterson
WGL	45	50	New York City
CJYC	43½	48	Scarboro
CKCX	43½	48	Scarboro
WBET	43	47	Boston
WKAR	40	45½	East Lansing
WEAO	39	44	Columbus
WGCP	42	47	Newark
WNJ	42	47	Newark
WHAM	37½	42	Rochester
WPG	36	41	Atlantic City
WBKN	40	45	Brooklyn
WIBI	40	45	Flushing, L. I.
WWRL	40	45	Woodside, L. I.
WBMS	40	45	Union City
WSEA	30	34	Va. Beach
WLTH	38	39	Brooklyn
WEBJ	38	39	New York City
WBBR	38	39	Rossville
WMBB	20	25	Chicago
WEVD	18	23	Woodhaven
WGBB	18	23	Freeport, L. I.
WAAT	18	23	Jersey City
WMSG	17	21	New York City
WBNY	17	21	New York City
WSDA	15	14	New York City
WARS	15	14	Brooklyn
WBBC	15	14	Brooklyn
WIAD	35	37	Philadelphia
WKBQ	10	12	New York City
WFRL	10	12	Woodside
WCGU	10	12	Coney Island
WICC	24	29	Bridgeport
WBRS	7	8	Brooklyn
WCDA	7	8	Cliffside
WMRJ	5	7	Jamaica
WTIC	154	165	Hartford
WLBX	3	5	Long Island City
WMBQ	3	5	Brooklyn
Stations below were copied after Dec. 1, 1927			
WJ8T	85	90	Chicago
WOW	140	146	Omaha
WBAP	134½	140½	Fort Worth
WCFL	125	129	Chicago
CKCL	75	79	Toronto
WOS	101	105	Jefferson City
WBZ	63	69	Springfield
KMOX	50	54	St. Louis
KLDS	34	38	Independence
WBMA	1	5	Newport



THE AUTHOR DECIDED TO BUILD A CERTAIN RECEIVER, AND HERE YOU SEE HIM SOLDERING THE LAST JOINT BEFORE "HOOKING HER UP"

Herewith is another radioist's report on the Magnaformer 9-8. Thomas F. Meagher's report is absolutely accurate and has been verified by RADIO WORLD. *Last week a seven-page article on the construction of the receiver, with a report on experiences also, was published. It was "My Three Months With the Magnaformer 9-8," by J. E. Anderson, Technical Editor.*

By Thomas F. Meagher

ALL who will read this article are not troubled with the one bad disadvantage that I am saddled with, for I live in a hot bed of local stations. My home is in Glendale, in New York City.

I haven't anything up my sleeve nor do I carry any confederates, I tell the street and house number—7765 75th street, Glendale, N. Y. City, but even in this hotbed I can do tricks with my radio set. To begin at the beginning.

For the past four years or more, fans who live in New York City have been able to attend one or more radio shows a year where they can feast their eyes upon many radio sets and parts, get new ideas and learn where and how and on what they can spend some more money.

I visited New York's show, this year, as usual, in search of something new, and something else, that certain something for which my DX heart yearned. I did not want to sit up half of the night to get far-distant stations.

Meets the Magnaformer

After casting about for something new I ran across some Magnaformer 9-8 descriptive literature. I was (to state it my way) again on the road to being burnt with a 1928 model radio circuit. I was told I couldn't get burnt, that this circuit would do this and do that and the only thing it couldn't do was get two stations at once.

Now, when I left that show I was so sold on Magnaformer that, after collecting every piece of printed matter I could lay my hands on during four hours, I found I had left all the circulars in some display booth. I felt that I had lost everything. But Magnaformer stayed in my head.

For the next few days I kept saying to myself: "Wait. Take your time. Don't rush." But even when I went into a radio store to buy some equipment I heard: "My Magnaformer this," and "My Magnaformer that." Magnaformer was ringing in my ears. Every radio magazine printed articles on it. Magnaformer worked on me like a drug. Well, I tinned up the old soldering iron and built the Commander-in-Chief of the Air.

The first literature and demonstration of the transformers were like reading a page out of "Brewster's Millions."

The set is really acrobatic. Friends come in and suggest feats they scarcely deem possible, but my Magnaformer, like the good performer it is, performs. Folks visiting me think it is a 1928 edition of Aladdin's Lamp. First you rub it, then you wish, and then collect.

Built His Share

I've built many radio sets, all the way, beginning with Flewelling and Reinartz, up to this, but this is the only one that packs the three essentials necessary into a he-man's set. And they are selectivity, quality and volume. When I think of them I am again reminded of "Brewster's Millions." I will try to amplify each essential separately.

I live three-quarters of a mile from WABC; WWRL, Woodside, is about a mile away; WBBC is about two and half miles away. WBRS is less than that distance off. WMRJ is a mile away and WMBQ is two miles away. Then there are stations in Flushing and Long Island City, two or three miles away, and four or five miles are all that separate me from certain stations on Manhattan Island.

In my home I have 4 other sets. One is a 4 tube, one a 5 tube, one a six tube and the other a nine tube.

But any and all of them on an outdoor antenna won't do what my Magnaformer 9-8 will do on a loop!

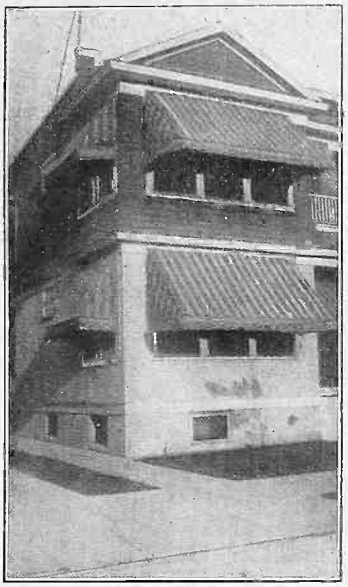
Gets In Between

Now, keep in mind that with stations WNYC and WEAF both working, I can get WOO or WIP, both Philadelphia; go between WEAF and WJZ and tune in three stations, all DX—not one but three, whereas most sets can't get one. Well, I can listen to WRC, WSB or KRLD (Washington, D. C., Atlanta and Dallas). The locals all round me are going full-blast all the while, remember. Between WJZ and WOR I get two more—WJR and WLW (Detroit and Cincinnati), in the order mentioned.

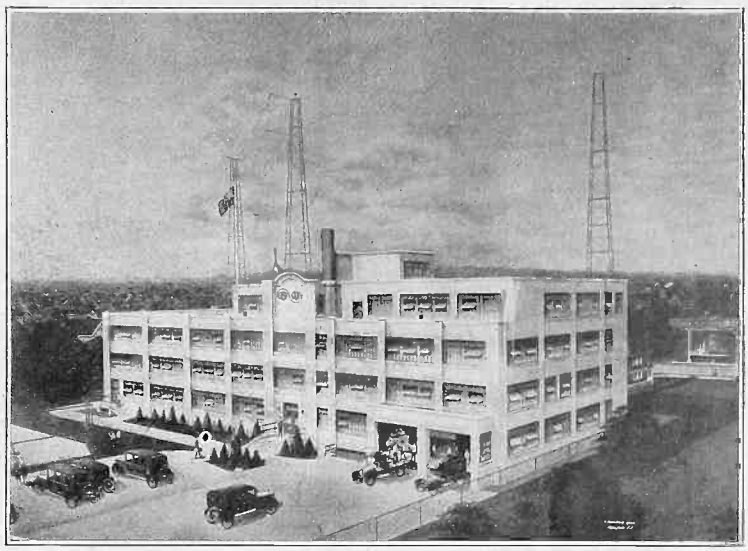
Next I can go between WOR and WHN and get five out-of-town stations. They are WHJ, CFCF, WCCO, WFI and WTAM. Now to give one more indication of a set that is a go-getter. With WABC working on 2,500 watts three-quarters of a mile away from me, WSM, Nashville, Tenn., directly above WABC, and directly below WABC, I can copy WGHP, Mount Clemons, Mich. All of this is before 11 p. m. I want to record right here that any set that can ride through those four horsemen of the air —WNYC, WEAF, WJZ and WOR, is certainly Commander-in-Chief of the Air.

I came home very early one Sunday morning in a heavy rain and electrical

on How He Does It



THE AUTHOR'S HOME IN GLENDALE, N. Y. IT IS IN A HOTBED OF LOCALS, THROUGH WHICH HE TUNES WITH IMPUNITY TO BRING IN FAR-DISTANT STATIONS, DUE TO THE EXTREME SENSITIVITY, SELECTIVITY AND AMPLIFICATION OF HIS RECEIVER



THE AUTHOR, A DX HOUND, LIVES WITHIN THREE-QUARTERS OF A MILE OF THE WABC TRANSMITTER. HE LISTENS WITH DELIGHT TO PROGRAMS FROM THAT STATION, BUT WHEN THE DX URGE COMES UPON HIM, WHAT WOULD HE DO, DID HE NOT HAVE A SUPER-SELECTIVE RECEIVER, ONE THAT COULD TUNE OUT A NEIGHBORING STATION OF 2,500 WATTS POWER TO BRING IN CHANNEL NEIGHBORS FROM REMOTE DISTANCES? THE PHOTOGRAPH SHOWS THE TRANSMITTING PLANT OF WABC

storm. I sat at my Magnaformer for one half hour just to get the Coast. I copied KFI, KWKH and KRLD. I wouldn't take that long if some of the station announcers would give the call letters, as required by law. But Los Angeles, Texas and Shreveport on loop aren't anything to snicker at. And I wasn't charged one cent for the electrical storm back ground. So much for selectivity.

Volume and Quality

Difference of opinion will always arise here on volume and quality because ears are like radio tubes. No two pair of them are exactly alike. But I think you will agree with me that the quality and volume certainly are all there. I can tune in five or six DX stations, all members of the WEAF chain, and match them in volume and quality with the same program as it comes directly from WEAF. One can't tell the difference. WSM with WEAF programs are just as loud and just as good in quality as WEAF, etc. The same holds true for the WJZ and WOR chains.

A flute solo, whether it is from WJZ or one of its chain stations, is still a flute solo and not a tin whistle.

A tenor of the opera variety received from one of the WOR chain stations doesn't come in like one of the burlesque variety. Any instrument, piano, organ, bass drum, kettle drum, vibraphone, oboe—is reproduced with true fidelity.

The Circuit

The audio end and the parts used will stand on their merits. The circuit as a whole has been tried and proved.

The intermediate frequency coils—the Magnaformers—are the heart of the circuit. The Magnaformers are really the result of years work on the part of the best engineers. The results of their work stand out like a national hero.

Suffice to say that DX and locals can be brought in very easily by my wife. As a comparison she can't really tune in DX on a regenerative set. Very often she will call me up at night at the office and state that she has had Canada, Chicago, Cincinnati, Tennessee, etc., on the Magnaformer.

Then again there is one advantage you have with a Super-Heterodyne that can't be found in any other circuit, that is you can tune a station in at two different points on the oscillator dial.

When I say this is an advantage I mean this:

Suppose you are tuned in on WOR and with the program you must take a whistle (and right now one must, on most sets). On the Magnaformer you leave the loop or left-hand dial where it is and turn the righ-hand dial down any where from 7 to 10 channels lower (numerically), at which point you will again hear WOR, but without the whistle. This is called repeat tuning and is very advantageous.

Then again, the loop has many good points that an ordinary antenna has not. One of them is its directional qualities. If two stations are working on the same wave but in different directions, each can be brought in separately by a twist of the qualitone loop.

For anyone building this set I would advise use of parts as specified in the instruction sheet and in the December 10 edition of RADIO WORLD.

Furthermore, I feel that anyone who can turn a screw driver and a socket wrench can build this Super., and that doesn't go for many Super-Hets. This is explained in part by the fine layout of all the parts, the separation of the first detector and the Unicoupler stage, and then again by the instruction sheet and X-ray drawings. I will be glad to supply an instruction sheet to anyone addressing at RADIO WORLD, or one may be obtained, also complimentary, from Radiart Laboratories, 19 S. Lasalle St., Dept. 68, Chicago, Ill. One could almost close his eyes and wire the set.

Simple Diagram

One thing that makes the construction especially simple is that the official diagram is printed in X-ray form.

When looking at the under side of the sub-panel diagram all the parts physically mounted there are shown in full lines, as are all the parts which are not concealed by the sub-panel.

The outlines of all the parts above the sub-panel—which are hidden by the sub-panel—are shown in dotted lines.

The connection leads, which are shown in heavy distinct lines therefore can be traced to the exact terminals of the parts connected.

This type of diagram is of inestimable value to home constructors in that it insures against erroneous connections.

The entire work of assembling and wiring takes a surprisingly short time to do, considering a circuit of this type.

Tips on Soldering

It is strongly advised that all the connections which are not securely fastened with nuts be soldered, and soldered well. It is not sufficient to touch the bare wire terminal to the soldering lug and then expect a little solder to hold the two together.

Strip the insulation of the connecting wire far enough that it can be wrapped around the terminal lug, and then flow the solder around the hole.

Will Try for Japan

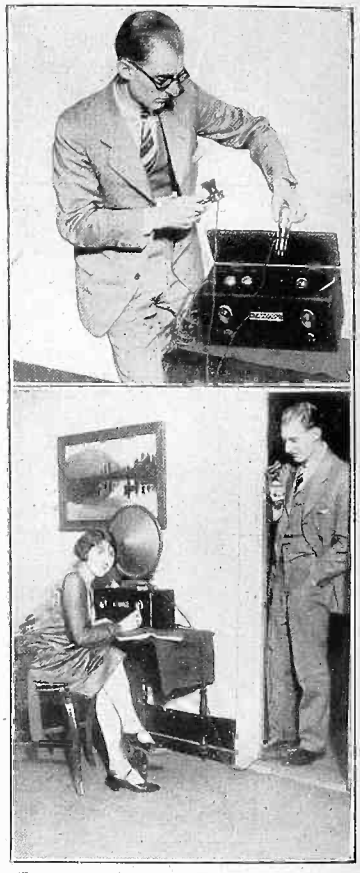
In conclusion let me promise you that sometime when I get caught up on my sleep I will sit up long enough to try for JOAK, Japan.

TREE WON'T SUPPORT RADIO GIFTS TODAY

(Underwood & Underwood)

TIME WAS WHEN RADIO CHRISTMAS GIFTS COULD BE HUNG ON THE TREE. NOT SO TODAY, WITH EVEN REPRODUCERS BEING OF GENEROUS SIZE AND WEIGHT. FANCY A POWER PACK DANGLING FROM THE TOPMOST LIMB!

LOTS O' FUN



(International Newsreel)

YOU CAN NOW TRANSMIT YOUR VOICE THROUGHOUT YOUR HOUSE VIA THE RADIO SET. THIS NEW DEVICE (HOMKASTER) CONSISTS OF A SMALL MICROPHONE, ATTACHED TO THE DETECTOR TUBE BASE. AT BOTTOM, LOUISE LOCKE TUNING IN, IS SURPRISED TO HEAR "STATION XYZ IN CHINA" ANNOUNCED.

How to Read Time Signals As Sent by Arlington

By W. A. Schudt

The Arlington Time Signal Service sent out daily by the United States Government through the medium of the powerful Naval radio station, NAA, at Arlington, Va., is the most accurate check on time that can be had. However, the fact that these time signals are transmitted on a frequency of 112 kilocycles makes their reception impossible on the average broadcast radio receiver.

Realizing the great demand for an accurate check on time, some few years back, when radio broadcasting was very young, A. H. Grebe & Co. conceived the idea of rebroadcasting these signals on a wavelength within the broadcast band. At that time the new service was started over WAHG, later, to be continued on WABC and WBOQ of the Atlantic Broadcasting Corporation.

At present many thousands of radio fans, ship radio operators and amateurs tune to either WABC or WBOQ daily to correct their timepieces.

The Naval station at Arlington has a distinctive and characteristic system of time signal broadcasting.

Time signals are transmitted twice daily, beginning at 11:55 A. M. and 9:55 P. M., Eastern Standard Time, and consist of a group of dots each transmitted to represent the length of one second.

The string of audible dots begins at precisely 9:55 P. M. and 11:55 A. M., ticking off the seconds until the 28th is transmitted. At this point there is a silence for a duration of one second following which the string of dots again starts, entering the second half of the first minute. Dots are transmitted at intervals of one second until the fifty-fifth second is sent. Following this there is a five second stop before the second minute is transmitted. The next three minutes are sent out in exactly the same manner as the first, just described.

So it is seen that the last five seconds in each of the first four minutes preceding the hour is silent.

The last minute is sent by the same system except that there is a ten second stop just before the dash, which represents the hour, is transmitted. This dash is exactly three seconds in length.

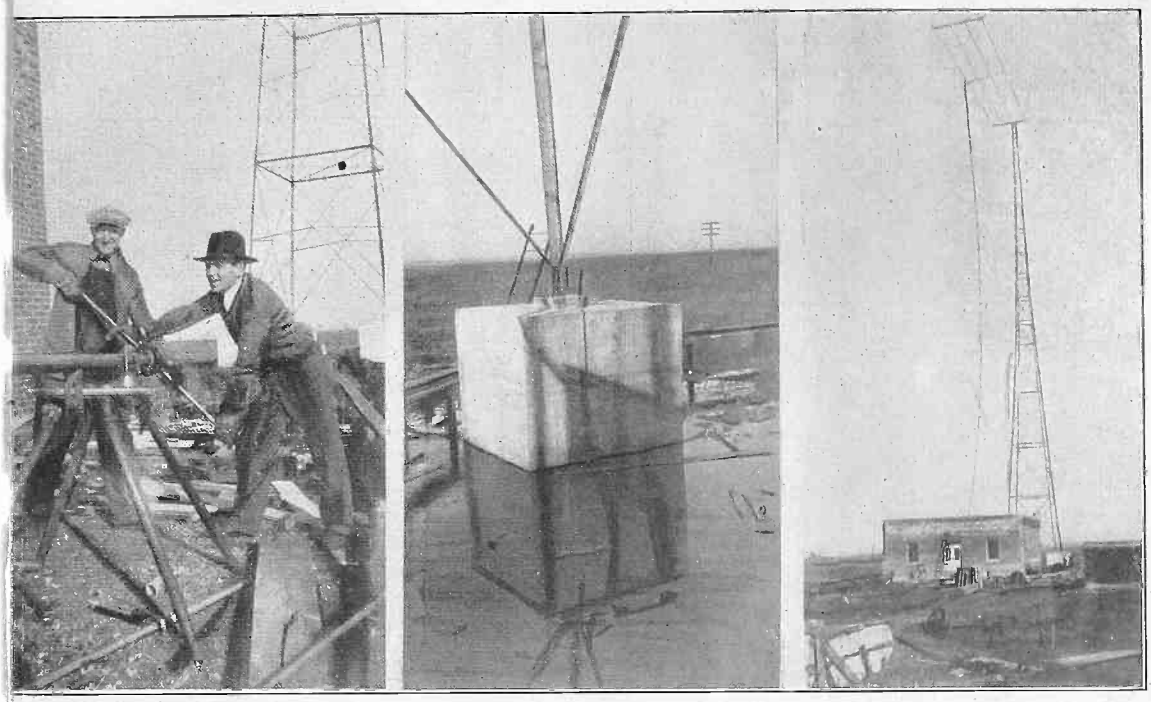
The beginning of the last dash occurs at exactly 12:00 noon or 10:00 P. M. Eastern Standard Time.

In the operating room of WABC at Richmond Hill, New York, a receiver capable of receiving the wavelength on which the Arlington station is tranmitting was installed for the sole purpose of time signal reception. The receiver at all times is kept tuned to 112 kilocycles.

The output of the receiver, which under ordinary conditions would be connected to a loudspeaking device or a pair of telephones, is connected through a small transformer to the input amplifier of the powerful WABC transmitter, where it is sent out on 970 kilocycles (309.1 meters).

Thousands of persons set their clocks by the retransmitted signals.

WLWL LOCATES IN MARSHES AND USES 5,000 WATTS



(Kaufman)

WLWL, PAULIST FATHERS' STATION, HAS OBTAINED PERMISSION FROM THE FEDERAL RADIO COMMISSION TO USE 5,000 WATTS. THE TRANSMITTER IS IN ARLINGTON, N. J. AT THE LEFT WE SEE ELECTRICIANS INSTALLING THE POWER LINES ON PERMANENT SUPPORTS BECAUSE THE LAND IS MARSHY. CENTER PHOTOGRAPH SHOWS THIS, WITH MAINS IN BACKGROUND. ONE OF THE HUGE BASES WHICH SUPPORT THE MASSIVE ANTENNA MASTS IS SHOWN ALSO. AT RIGHT IS THE TRANSMITTER, WITH AERIAL PLAINLY VISIBLE. THE NEW TRANSMITTER IS NOW IN USE.

Senator Couzens Suggests Board of Communication

Washington.

Senator Couzens (Rep.), of Michigan, a member of the Senate Committee on Interstate Commerce, announced that he will introduce a bill proposing the creation of a Communications Commission to have jurisdiction over radio communication, telephone, telegraph, and cables.

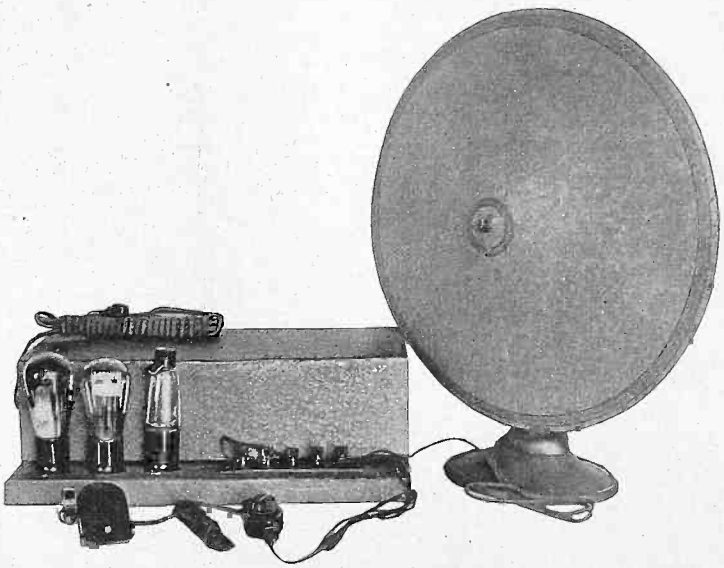
The Senator declared it is his belief that the regulation of radio by one body and of the telephone by another, as at present, is an inefficient method, particularly so in view of the interrelation between the two means of communication in the case of nation-wide hookups involving the use of both the telephone and the radio.

WHEN DETECTOR BLOCKS

A high shriek in the loudspeaker is usually caused by blocking of the detector grid. It is caused by too great input to the detector, and it may be due to the signal or to an oscillation at radio frequency. The cure is to stop the oscillation, reduce the amplification at radio frequency, or to put in a grid leak with a higher conductance, that is, a lower resistance.

GRID LEAK FUNCTION

Grid leaks permit excess electrons to escape, hence prevent detector tube block-ing



A POWER AMPLIFIER AND B SUPPLY, WITH PHONOGRAPH PICKUP [PHONOVOX] INTRODUCED IN A SPECIAL WAY, HAS BEEN DEVELOPED BY LOUIS G. PACENT. AN ADVANCE VIEW OF THE EXTERIOR IS SHOWN. SOON THE CONSTRUCTION WILL BE DESCRIBED. THE TUBES USED ARE ONE 281 (RECTIFIER) ONE 227 OR KELLOGG OR McCULLOUGH, AND ONE 210. IT IS ESPECIALLY ADAPTABLE FOR HOUSING IN PHONOGRAPHS.

A THOUGHT FOR THE WEEK

A BURGLARY was committed. The housebreaker had a forty minute start of the police in Kansas City. A description of him was broadcast. Twenty minutes after his description had been sent out he was reclining, quite unhappily, in the arms of two lusty policemen.
O, Sherlock Holmes, where is thy prowess!
O, locust club, where is thy sting!

SIXTH YEAR

RADIO WORLD

The First and Only National Radio Weekly

Radio World's Slogan: "A radio set for every home."

TELEPHONES: BRYANT 0558, 0559
PUBLISHED EVERY WEDNESDAY
(Dated Saturday of same week)

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Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address; also state whether subscription is new or a renewal.

ADVERTISING RATES

General Advertising

1 Page, 7¼"x11"	462 lines	$300.00
½ Page, 7¼"x5½	231 lines	150.00
½ Page, 3¼" D. C.	231 lines	150.00
¼ Page, 4½" D. C.	115 lines	75.00
⅛ Page, 4½" S. C.	57 lines	37.50
1 Column, 2¼"x11"	154 lines	100.00
1 Inch		10.00
Per Agate Line		.75

Time Discount

52 consecutive issues	20%
26 times consecutively or E. O. W. one year	15%
13 times consecutively or E. O. W.	12½%
4 consecutive issues	10%

WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

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Ten cents per word. Minimum 10 words. Cash with order. Business Opportunities ten cents per word. $1.00 minimum.

Entered as second-class matter March 23, 1922, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

Carlin and McNamee Pick Football Team

Phillips Carlin and Graham McNamee, football announcers for stations WEAF and WJZ, have selected an all-Eastern football team, based on their observations at the games which they have announced. The selected men are: Ends, Scott, Yale, and Born, Army; tackles, Pratt, Harvard, and Sprague, Army; guards, Webster, Yale, and Hammack, Army; center, Charlesworth, Yale; quarterback, Baruch, Princeton; halfbacks, Caldwell, Yale, and Flanagan, Notre Dame, and fullback, Wittmer, Princeton.

Once a Year— *or Perennial?*

CHRISTMAS is coming again. Yes, its Spirit once more envelops us in its atmosphere of peace and goodwill. As bad or as good as we are, we take on new life and meaning. . . . All of which is a nice way of commencing an editorial on Christmas. RADIO WORLD has asked me to do a piece about Christmas. They want me to want you to enjoy a right smart merry Yuletide.

Yeah.

I'm supposed to write something that will delight you as much, as much as a certain little red automobile is delighting a little youngster, who is walking up and down the sidewalk across the street from the window of my office. I'm sitting here in the window, playing with this typewriter. Really. I can look out over the avenue and see that little kid, with his little red auto. Lucky devil!

I'll bet he isn't a day over six years old. Certainly he doesn't look older than that, as he drags his little toy across the pavement. See, he smiles at every passerby. Some of them smile back at him. Some of them don't. Anyway, it's nothing in my life, because I'm writing an editorial for RADIO WORLD.

Spirit the Year 'Round

At least they expect me to devote this space to telling you, and you, and you, that all this talk about Christmas coming but once a year is the bunk. They mean it's the bunk if you own a radio set. I'm supposed to pass along to you the thought that long after the red berries have fallen from the holly wreaths, the Christmas Spirit still lives in the hearts of those who have made it a radio Christmas for others. Give your pa or your ma or your wife or your sweetie a radio set for Christmas—that's the idea.

What'll you use for money?

Ho, hum. That little kid across the street is hanging around a big hole that leads down and down into the earth. Some guy is digging a huge tube or tunnel under Eighth Avenue. Yeah. It's a subway. Boy! That's a swell place to be in when you're loaded to the muzzle with Christmas bundles! I mean, down in the subway. Try to picture yourself down there trying to get through a train door with a Christmas tree! You squirm this way and that way, all the time edging the tree further and further into the car. Suddenly your Christmas bouquet pokes some guy in the eye . . . be nonchalant . . . light a cigarette. The cigarette, mild and mellow, the finest you've ever smoked, clears your throat. You pick yourself up, that is, you crawl out from under the tree, and wait for the next train.

DX as Near as Your Dials

Three hundred and sixty-five days—not one day only—can be devoted to good cheer, good humor, warm glow, and perfect radio reception if you build or buy a set before December 25. Receiving conditions were never so good as right now. The air is full of wonderful things you should not miss. DX is no farther away from you than your dials.

A three tube set, a four, five, six or twenty. What's the difference at Christmastide? So long as it is a set. Again that kid . . . how he's leaning over the hole! Someone ought to grab him by the collar. The unconstrained, natural ease in the manner of the man of good breeding is never hampered by his comfortable, right-fitting, easy-to-grasp collar—someone should pull that kid away from that subway entrance. There . . . someone **did** pull him away. His mother. He's crying now. I guess he must have dropped his little red auto down in that big hole. No, she found it. His mother found it. I wonder where that kid lives? I wonder if his mother has a radio? There's a thought. Think of all the poor people who haven't got radio sets. Then think of all the sets you've got hanging around the house, doing nothing. I've got a dozen or more here in the office. Perhaps I could fix one up a bit and give it to the kid's mother for Christmas. It wouldn't take me long to connect it up, with a good aerial on the roof, a good ground, connected to the cold water pipe. . . . Maybe a couple of 210 tubes. . . . No, that's out. If I had a couple of 210 tubes it would be Christmas myself! Yeah. And how.

Simply Marvelous

But, at that, this is Christmas, isn't it? Think of all the simply marvelous things that Santa has given us this year. New eliminators, new electric sets, new speakers, new phonograph units, new parts, new circuits, new tubes, new, new, new, new everything. If some of the poor devils who have gone west were only around to enjoy all that radio offers us this year. Of course, they're not here. Probably out there in the cemetery they do know all this.

Cemetery?

Boy, that's a gruesome word. Makes me think of the place where they'd put that little kid, if he had fallen down in that subway shaft. But he didn't fall in. No, sir. He's back on the sidewalk, now, rolling his little red automobile up and down. Up and down. Life is pretty much like that. Up and down. Only at Christmas everything is up. Prices. Trees. But radios are selling for a song, these days. Good ones can be built at home without much knowledge and at a reasonable price. Circuits in RADIO WORLD are good ones to get started on.

Why not build a little red auto . . . no, no, no! This won't do. I'm supposed to write an editorial about Christmas.

RADIO WORLD said to me: "Surely you can do a piece for us about Christmas." Imagine the nerve of them. As if everything that could be written about Christmas hasn't already been written. There's Dicken' "A Christmas Carol." If any radio announcer was the originator of that, he'd be some originator. Or some announcer. Perhaps both.

Those Bargain Eliminators

Anyway, if you've got exactly one dollar to spend on father, why not buy him a B eliminator? Some corkers are offered in the New York retail market for 98 cents. These are marked down from $45. Do you want to know what else you can buy for $45? Well, you can send RADIO WORLD to eight of your friends for that amount. There's a Christmas gift for you. It's one Christmas gift that lasts—one that says "Merry Christmas" on December 25 and means it, and continues to repeat that cheery message throughout the fifty-two weeks of the year. A Christmas Gift Subscription to RADIO WORLD, even for one year—even to only one of your friends—will carry with it all the gaiety, happiness, cheerfulness and glow for which Christmas stands. It will keep your friend abreast of radio, and keep the Christmas spirit alive for an entire year. The season is a great time

YASHA BUNCHUK, EMINENT 'CELLO VIRTUOSO, WHO RECENTLY APPEARED AS SOLOIST IN A CONCERT GIVEN BY THE CAPITOL GRAND ORCHESTRA, WHICH WAS BROADCAST BY WEAF AND ITS ASSOCIATED STATIONS.

for advertisers. Buyer interest in radio is thoroughly aroused. The approach of Christmas will accelerate sales for all RADIO WORLD advertisers who go after sales. Radio is a home interest. Christmas is the home interest. It is the home interest that influences the buying of all radio equipment.

Resolution

Anyway, my little friend with the little red auto has gone home. And while thousands of people are still walking up and down the avenue, it now seems deserted. I'll bet, by this time that little youngster is packing away a mean dinner. Or, maybe, he calls it his supper. Well, it's starting to snow. It's growing darker. Darkness always brings peace and quiet. Also DX stations. The sun upon the streets has disappeared. The wild birds have hushed their call. It's time I went home also.

Guess I'll hop out to Long Island, pick a cozy spot near the fire, and rest. Perhaps I'll write a bit. Yes, that's a good thought. When everything is K O, I'll just turn on a little soft music, take my typewriter in hand, so to speak, and write. I'll write something that will delight the readers of RADIO WORLD.

I'll write an editorial.—LEO FENWAY.

Gifts Well Worth Receiving

But That Can't Be Brought In On Any Set

By Cassem Drielba

If it were not for the ordeal of selecting appropriate gifts for frends and relatives Christmas would be 100% happy. But "What shall we get for him or her?" is an annually recurring question which must be answered before the Christmas cheer is complete.

This ordeal will be lightened just a bit by including radio parts and accessories in the list of possible gifts. There are hundreds of pieces of radio merchandise which are appropriate gifts to every member of the family, or to the family as a whole, gifts which are useful or ornamental or both.

Not Sentimental

There is not much sentiment in a vacuum tube, but certainly it would make a useful gift. If that tube were accompanied with a change in the circuit which would improve the quality and increase the quality it would be much more useful and welcome. A set of audio frequency transformers of the latest and best design, if properly installed in an old receiver, would constitute a splendid gift and a welcome one. Similarly, a resistance coupled amplifier of correct design would make a welcome gift, provided the donor would also see that it was in proper working condition.

A good B battery eliminator would constitute a suitable gift to a family living in an AC neighborhood and which did not have that modern accessory. But the gift would not be welcome unless the giver saw to it personally that the eliminator worked perfectly with the receiver for which it was intended. If the family already has an eliminator, a replacement rectifier tube would be suitable and useful.

Welcome Speaker

A loudspeaker of the best type would be most welcome, particularly if that speaker is difficult to procure. But the giver would have to exercise his judgment as to the suitability of the speaker for the set it was intended for. The best speaker will not be welcome if it is connected to an ancient receiver.

A complete radio installation is a dandy gift, especially if any part of it is home made. Any troubles with that receiver would be blamed on the giver and not on the manufacturer or on the operator of the set. Make such a gift if you pretend to know anything at all about radio, or if the beneficiaries think you know something. That gift would make you a steady service man.

If you know that the family which you would remember with a Christmas gift has a radio receiver but not a suitable table for it, that would be a useful and appropriate gift. Similarly, a cabinet for a poorly housed receiver would make a useful gift, if it could be given diplomatically.

Filter Suggested

A tone filter enabling the beneficiary to employ a power tube for greatly augmented volume and improved tone quality would be welcomed in most homes, especially if the giver attended to the necessary alterations in the receiver.

Just as a tone filter is useful so is a ripple filter when the object of the gift is troubled from ripple noises in his receiver. This filter may constitute a single condenser of large capacity, or choke coil of high inductance, or a combination of the two, or a combination of several chokes and several condensers. Whatever the giver thinks will remedy the trouble he knows to exist in the home of the object of the Christmas spirit is a suitable gift.

Ah! Those Meters

Every man or boy will no doubt welcome measuring equipment—a voltmeter for measuring the filament voltage, a high resistance voltmeter for measuring the output of a battery eliminator, a DC milliammeter for measuring plate current, an AC voltmeter or ammeter for measuring the voltages and currents in AC filaments and heaters—anyone of these would put the recipient in a merry mood that would last indefinitely. That this would be most welcome is obvious from the fact that nearly everybody who tinkers with a radio set or an eliminator is continually saying "I wish I had a meter."

Reception on Trains Prophesied by Hiler

Why should an individual enroute from one point to another and traveling by train be without his evening radio entertainment? Fight reports, musical concerts, etc., are of as much interest to the individual when traveling, as when at home. Perhaps even more so, to relieve the monotony of a long and tedious journey.

Experiments are now being carried out to perfect radio installations for use on trains, according to E. E. Hiler, the inventor of the tuned double impedance system of audio amplification.

"We are co-operating," says Mr. Hiler, of the Hiler Audio Corporation, "in the experimental work and have completed several installations tuned double impedance audio amplification on railroad trains. The time is not distant when every through limited train will carry a radio installation in every parlor car, and every compartment will be individually equipped.

"With the large number of broadcasting stations in operation and the high powered transmission, a moving train is always within the zone of some good broadcasting station and very satisfactory reception is available."

Farmer Badly Needs Good Radio, says Pickard

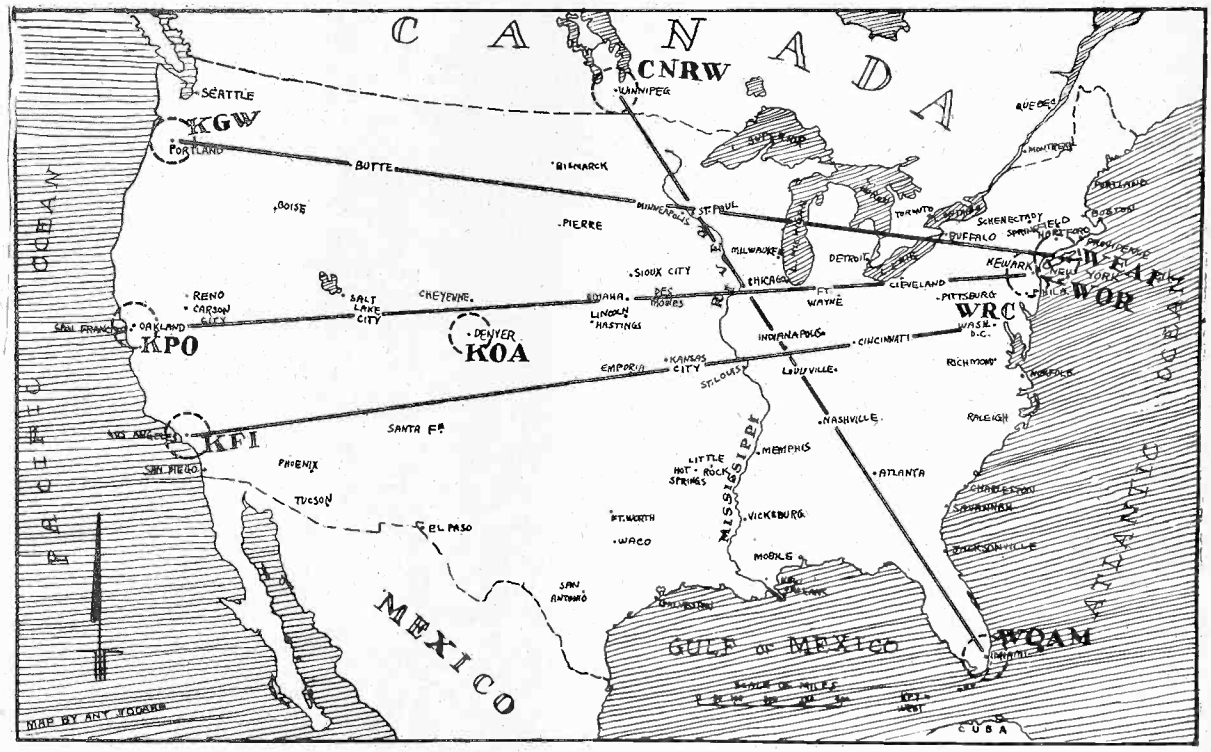
There is no reason why the farmer and the small town listener-in should not get the same service as his urban neighbor, according to Sam Pickard, member of the Federal Radio Commission.

"In the business centers and densely populated districts where most broadcasting stations are located, listeners get good service," Pickard stated. "Outside the larger cities, however, where distant stations must be relied on, particularly in the South and parts of the Middle West, reception often has been poor.

"To the farmer, radio means more than an appreciated form of entertainment. Most farmers depend upon radio market reports for their business information, so it is vital that they receive without interference."

Board's Order Improves and Increases

By Richardson



THIS MAP SHOWS FOUR OF THE CHANNELS WHICH HAVE BEEN CLEARED. THE CLEARING DOES NOT MEAN THAT ONLY ONE STATION OPERATES ON EACH CHANNEL, BUT THAT STATIONS WHICH DO OPERATE ON THE SAME CHANNEL, EVEN SIMULTANEOUSLY, ARE SO FAR REMOVED FROM EACH OTHER THAT THEY DO NOT INTERFERE. THE DISTANCE BETWEEN ANY TWO OPERATING SIMULTANEOUSLY IS AS GREAT AS THE UNITED STATES IS WIDE OR LONG, WHEREVER SUCH SEPARATION IS POSSIBLE. THIS APPLIES TO THE CHANNELS SHARED WITH CANADA AS WELL AS THE CHANNELS USED EXCLUSIVELY BY THE UNITED STATES. TIME DIFFERENCE MAKES IT EASIER FOR THOSE ON THE EAST TO TUNE IN THE WEST COAST AFTER MIDNIGHT E.S.T. ONLY FOUR CHANNELS AR SHOWN ON THE MAP BUT ALL THE CHANNELS BETWEEN 600 AND 1,000 KC HAVE BEEN CLEARED IN THE SAME MANNER.

The order of the Federal Radio Commission clearing the band of frequencies from 600 to 1,000 kc [300 to 500 meters] from all heterodyning went into effect and has already resulted in an improvement in broadcast reception.

The Commission considered the facts that about 50 per cent of all the inhabitants of this country live in rural communities and in small towns and cities having no local broadcasting facilities, that these citizens must depend on reception of radio programs from remote points, and that reliable radio reception is just as vital to these persons, if not more vital, than in the case of residents of cities.

The larger and more attractive broadcasting stations are always located in or near the larger centers of population so that their programs will reach the greatest number of people in the best possible way. This distribution of stations leaves many rural sections uncovered by first class radio transmission, and all those who live in the country must depend on distant stations.

The Structure Collapsed

Ever since the control of the radio situation was adjudicated not to be a lawful duty of the Department of Commerce there has been chaos in the ether. No one living at a remote point from a broadcaster could receive many, if any, stations without heterodyne interference. Even some of those living close to the stronger stations could not receive clear signals from those stations without heterodyne disturbances.

The order of the Federal Radio Commission which went into effect Dec. 1 has changed that situation regarding the 600 to 1,000 kc belt. A clear ether from 600 to 1,000 kc was the object of the order, and that means that in that frequency band there will be practically no interference from heterodyne whistles. Slight possibilities of interference still exist but they are not serious.

Virtually the order restores the situation in this belt that existed before the structure built up by the Department of Commerce broke down in 1926. Stations operating in the same district within the belt are now separated by at least 50 kc. and no two stations are operating simultaneously on the same frequency unless they are separated by long distances. This applies to the "cleared" band from 600 to 1,000 kc but not to the bands above and below that band. Thus in New York city and vicinity there are WEAF on 610, WJZ on 660, WOR on 710, WHN-WQAO-WPAP on 760, WMCA-WLWL on 810, WGBS on 860, WPCH-WRNY on 920, and WABC-WBOQ on 970

Quality, Aids Farmers DX

arville

kc. In every case the separation is 50 kc. or more.

Examples of Clearing

In other congested localities the same arrangement has been carried out with another series of frequencies within the 600 to 1,000 kc band. This arrangement prevents direct interference between stations in one district, provided reasonably selective receivers are used; but it does not prevent heterodyning between stations if two are operated at nearly the same frequency at the same time, though they may be separated by hundreds of miles.

But in the "cleared" band no two stations are allowed to operate on the same frequency at the same time unless they are so far separated that no serious interference can occur. Thus WGBS in Astoria, N. Y., WIP and WOO in Philadelphia on the East coast share time on the 860 kc. channel and stations KVOO at Bristow, Okla., KJR and KXA at Seattle, Wash., share time on the same channel in the Southwest and the Northwest. The legs on the triangle connecting these districts are so great that even when one station in each district is operating on the 860 kc. frequency there will be no serious interference within the regular service areas of these stations.

The Oklahoma station KVOO is operating on Central Standard Time, which gives listeners one free hour between that station and any one of the Eastern stations operating on 860 kc. The Seattle stations are on Pacific time which is three hours later than Eastern Standard Time, and thus the listeners are free from possible interference for at least three hours as far as the stations on the Atlantic and the Pacific coasts are concerned, assuming that each station is operating on the same schedule but on local time. There is a period of two hours between the Oklahoma and the Seattle stations during which there will be no interference, assuming the same schedule as before.

How It Works Out

A practical outcome of this arrangement is that all listeners, no matter where located, will be insured against heterodyning during the hours a single station is operating. It also insures the listeners east of a station a period of clear ether for tuning in Western DX.

The 860 kc. channel was merely taken as a sample of clearing. The same applies to all the other channels in the cleared band as far as it is geographically and mathematically possible to carry out the scheme. Thus WEAF at Bellmore, N. Y. and KGW at Portland, Oregon operate on the 610 channel.

These two stations may heterodyne at midway points, but at these points both would be so weak that few persons would be interested in either of them in preference to closer stations. In the regular service area of either of the stations the signal from the other station would be so weak that it would not cause an objectionable or even audible heterodyne.

Then, as was explained above, the Eastern station is operating on a time schedule three hours ahead of the Western. It signs off in absolute time three hours earlier, on an average, than the Western station, and thus fans throughout the continent will have free access to the Western station. During the hours when the schedules of the two stations overlap, the sun has not been down long in the West and transmission is not so good. That leaves the local listeners to WEAF and KGW free from interference.

Signals, Not Squeals

What applies to stations WEAF and KGW also applies to stations WOR, Newark, N. J. and KPO, San Francisco, Cal., both of which operate on a nominal frequency of 710 kilocycles. And again it applies to stations WRC, Washington, D. C., and KFI, Los Angeles, Cal., both of which are on the 640 kc. channel, and to WJZ and KFRC on 660 kc.

Another case is that of WRNY, New York, and KOA, Denver, Col., both of which are on the 920 kc channels. These two stations are not separated as far as most of the previously mentioned pair, but about 1,000 miles less, and their time separation is only two hours, since Denver is on Mountain Time. This leaves KOA only two hours clear after WRNY signs off. But WRNY is radiating only 500 watts, and it will therefore not interfere seriously. Steps have been taken, though, according to Hugo Gernsback, owner of WRNY, to synchronize this station with KOA so that all heterodyning will be eliminated, the work being done by the Bureau of Standards with the co-operation of several trained listeners in the Central West territory.

Thus everybody is assured of clear reception in the band 600 to 1,000 kilocycles —500 to 300 meters—and any one in the rural parts with a set sensitive enough to pick up signals from remote stations can select one without interference from heterodyne whistles. Altogether there are 35 cleared channels.

Board's Ruling

The reason given by the Commission for not extending the "cleared" belt to 550 kc was that the 550 to 590 kc channels are already spoiled by code from ships and that clearing up a little heterodyning would not help much.

The band between 1,000 and 1,500 kc at present is in chaos. But it is gradually being cleared. There are so many small stations in this band that it is impossible to clear up heterodyning. Many stations divide time to enable several stations to operate in the same district, but this does not eliminate heterodyning since there are many stations that operate simultaneously at no great distances apart.

The only way to eliminate the heterodyning is to eliminate some of the stations. And that the Commission has decided to do. It is planned to begin the elimination of all unnecessary stations on Feb. 1 and to continue it until the interference has been cleared up in all channels, or until the present status of the Commission expires on March 15. The deletion of stations, about 300 in all will not be done with one sweeping order, but will be done gradually by the refusal of renewal of the short term licenses under which the stations are now operating. According to a statement by the Commission, it is planned to clear next the band between 1,000 and 1,200 kilocycles.

What Map Shows

The map shown on other page illustrates four of the channels in which interference has been eliminated. The long straight lines from one end of the country to the other connect stations which transmit at the same time on the same frequency. The great distances represented by these lines insure freedom from interference because the signals of either station are so greatly attenuated that when they reach the regular service area of the other they are not strong enough to cause a ripple of audible intensity.

Note that one of these lines extends from New York to Portland, Oregon, connecting WEAF, and KGW both on 610 kc. Another line extends from Washington, D. C. to Los Angeles, California and connects stations WRC and KFI, both on 640 kc. Still another connects station WOR, in Newark, N. J. with station KPO, in San Francisco, Calif. which operate on 710 kc. These three pairs of stations are three hours apart due to their difference in longitude.

Another line extends from Miami Beach, Florida to Montreal, Canada and connects stations WQAM and CNRW, both of which operate on the 780 kc channel. These stations are one hour apart in time.

Hence, as examples, when WEAF signs off at midnight, listeners in Eastern time have about three hours of clearway to get KGW. So, too, WOR listeners get a good chance at KPO, while WRC listeners may try for KFI. Then, too, all East Coast listeners have about an equal chance of getting the West Coast—KFI, KPO, KGW etc.

Engineers Like Plan

Radio engineers and others who understand the radio situation thoroughly are generally in accord with the Commission on the necessity of eliminating at least 300 broadcasters before service will be satisfactory and reception free from heterodyning. They hold that this offers the only immediate solution to the congestion in the ether.

However, in some quarters hope is expressed that the reduction in the number of stations will not be too extensive because a certain measure of relief can be expected from the operation of chain stations carrying the same program on the same frequency, thus leaving many channels available for other broadcasters. That the operation of two or more stations simultaneously on the same frequency is feasible has been demonstrated in a number of cases, and particularly in the case of WBZ, Springfield, Mass., and WBZA, Boston, Mass. But just how many stations can be operated on the same frequency at the same time is not known.

Dr. Lee De Forest, inventor of the three

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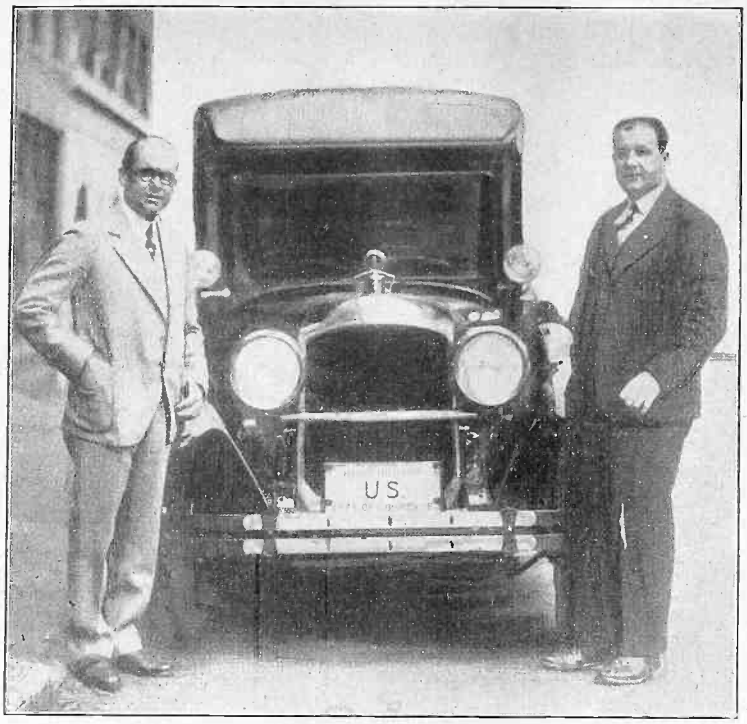
RADIO SLEUTHS DO SNIFFING WITH LOOP



(Underwood & Underwood)

THE "DETECTIVE CAR" OF THE DEPARTMENT OF COMMERCE, FITTED WITH RADIO DETECTING APPARATUS FOR DISCOVERING USERS OF UNAUTHORIZED WAVELENGTHS. THE CAR IS THE ONLY ONE OF ITS KIND IN EXISTENCE, AND HAS THE RIGHT OF WAY OVER ALL OTHER TRAFFIC.

(*Concluded from preceding page*)

element vacuum tube which has made broadcasting possible, favors a reduction in the number of stations to about one half of the present number.

More on One Wave

"I am confident," he said, "that both cities and rural communities, which are greatly interested in programs of a local nature as well as in entertainment from large centers of population, could be adequately served by not more than 300 broadcasting stations, and I earnestly recommend its accomplishment as soon as possible.

"On the other hand, a large number of stations can be operated on one wavelength and carry the same identical program, if synchronization is effectively carried out and the present congestion relieved somewhat. However, we should not lose sight of the fact that the present number of stations in this country is absolutely not needed."

Hogan and Grebe Views

John V. L. Hogan, a pioneer radio inventor, past president of the Institute of Radio Engineers, said:

"One of two things must certainly be done—either a general reduction of the power of stations all over the country or a material reduction in the number of stations. The operation of chain stations on one wave is possible, having already been done successfully by WBZ and WBZA, at Springfield and Boston, Mass. but for a large number of stations it would be a very expensive experiment."

Alfred H. Grebe, president of A. H. Grebe Radio Company of Richmond Hill, L. I., said:

"It looks to me as if a major operation will be necessary to alleviate the trouble from the broadcasting system, that is, a substantial reduction in the number of broadcasters in this country."

Broadcasting stations throughout the country, however, are not entirely satisfied with the results of new allocation according to a telegraphic symposium conducted by the Freed-Eisemann Radio Corporation.

"There is no solution except reducing the number of stations so that no more than one station of 5,000 watts or more shall operate on a channel, although the present situation is much improved over former commission assignments," said Frank W. Elliott of WOC, Davenport, Iowa, former president of the National Association of Broadcasters.

Mentions Cold Weather

WOWO, Fort Wayne, Ind., one of the Columbia Broadcasting System stations, reported: "Cold weather permits stations above and below us to increase interference.

"Outside of a seventy-mile radius a station with less than 5,000 watts power and exclusive channel cannot be heard to be of any practical value. For any station to be of natural service and value with any degree of consistency it must have high power and exclusive channel. We could increase our service if granted license with more power and exclusive channel."

John Shepard, owner of WNAC, Boston, said: "A change of about twenty kilocycles in our present wave length would be desirable to allow us to operate further away from WJZ. Favorable action by the Radio Commission on our application for 5,000 watts would also be of assistance, but because of conditions in New England, a high wave length is essential."

Interference in West

Western reception is still being interfered with by heterodyne howls, KIF, Los Angeles, Cal., reported.

WHT, Chicago, which is on a lower wave length, said: "Early indications show that reception is apparently improved because of new wave lengths, especially on distance. We are particularly anxious for intensive coverage in a 300-mile radius and will judge eventually the desirability of present power and wavelength on that basis."

WJR, Detroit, Mich., "now experiences some interference from heterodynes, but believes that with all stations adhering to assigned frequencies we will be happy with our present allocations, otherwise our former wave of 517 meters would be preferred."

The Public's View

The listening fans already have experienced relief since the order of the Radio Commission went into effect. Scores with whom the staff of RADIO WORLD have spoken about the change are enthusiastic about the DX possibilities and the greatly improved reception at points in the frequency scale where stations crowded each other too closely before the change.

One fan reported that he had received so many distant stations without interference that he grew tired of counting them; and he said they were comparable to local stations in respect to volume and quality. All who had formed any definite opinion on the subject agreed that many of the stations should be made to sign off permanently in order that clearer reception could be had from the remaining stations.

Great Chance

The DX fans in the Eastern territory got an unusually good opportunity for pulling in distant stations during the late afternoon and evening of Sat. Dec. 3 when most of the stations in the East signed off for several hours on account of an SOS. The East was not only clear of local stations during those hours but the reception conditions were otherwise also very good. The result was that many who had sensitive receivers were able to reach out beyond the Middle West and pull in the stations there as if they were locals.

Amateur's Call for Help Saves Girl In Alaska

Anchorage, Alaska.

Assistance for Bessie Howe, Government school teacher in the isolated native village of Ninilchic, 115 Miles west of Anchorage on Cook Inlet, came through the air while a terrific gale was blowing which prevented rescue by sea.

Miss Howe accidentally shot herself in the abdomen while she was cleaning a rifle. No physician nor expert medical attention was available in the little native Indian village, and there were no regular channels of communications between it and the white settlements.

Makes Landing

Government radio men at Anchorage and Seldovia caught weak amateur signals of distress asking for immediate aid. These signals evidently originated from a spark coil. No boats from Seldovia, the nearest port, would set out for Ninilchic village in the face of the raging storm.

A. D. Haverstock, a Government physician, and Pilot Russel Merrill decided to take a long chance and set out for the Indian village in a plane equipped with skis. Their trip was successful and Miss Howe was brought back to Anchorage, the landing there being effected after dark with the aid of flares and the headlights of an automobile.

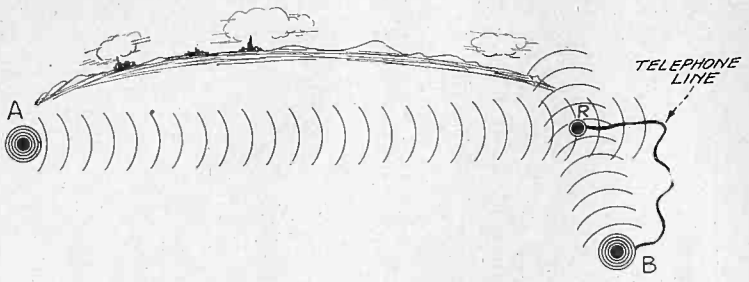
In a Bad Way

The wounded girl is now in a critical condition in the hospital, with a fighting chance for life against blood poisoning which had set in. She arrived in Alaska in September from the middle West, and her home is thought to be in Kansas.

Stations on Same Wave Synchronize Readily

By Capt. Peter V. O'Rourke

Contributing Editor



ORIGIN OF HETERODYNE INTERFERENCE

The diagram illustrates a method for synchronizing two broadcast stations A and B, located several hundred miles apart, so as to eliminate heterodyne interference. A receiver, R, located five miles from B and connected to it with a telephone line, is permanently tuned to the normal frequency of the two stations.

It primarily picks up the signals of B, but if the frequency of A differs from that of B by an audible amount, the beat is heard in the receiver as heterodyne squeal. This squeal, together with the signal, is transmitted over the land line to station B and the operator of that station is enabled to change the frequency of B until the squeal disappears.

This eliminates the squeal between the two stations in all receivers tuned to the frequency of the two stations A and B. The adjustment now is manual but engineers are working out an automatic adjustor which will not permit a deviation of frequencies more than 10 cycles. The heterodyne frequency will probably be made to actuate a relay which will in turn control the temperature of the oscillating quartz crystal which controls the frequency of station B.

THE method of heterodyne interference elimination now popular is exactly analogous to the tuning for zero beat between a transmitting station and an oscillating receiver. Practically everybody who has played with a regenerative set has done exactly the same thing that the synchronizing operator does.

For example, a radio listener is trying to tune in WGY with a regenerative receiver and he is so far away from the station that he is compelled to use maximum regeneration to get the signals. The regenerative tube breaks into oscillation, and the fan tries to tune the receiver accurately to the incoming signal by means of zero beat. He succeeds in setting down the condenser so that there is no audible beat between his own oscillator and that of the transmitting station.

As long as he is able to hold the zero beat adjustment he does not hear any squeals; neither do his neighbors, unless one of them is operating an oscillating receiver and has not tuned to zero beat. But the operator finds great difficulty to hold the zero beat adjustment. The circuit seems to break into oscillation without provocation. In fact the adjustment is so unstable that he has to keep adjusting continuously in order that the beat may keep at zero.

Variety of Causes

Now this instability may be due to one of many causes, or to a combination of many causes. The fluctuation may be caused by a variation in the carrier frequency from the transmitting station; it may be due to a variation in the frequency of the oscillating receiver, or it may be due to changes in other circuits in the vicinity of the oscillating receiver, which are really changes in the receiver, so that there are only two main possible causes of the variation. There are countless contributory causes at each end, and they are the same at both the sender and the receiver. Changes in the temperature, changes in the filament, plate, and grid voltages, changes in the radiation are some of them.

Now the transmitting station mentioned has been stabilized as to frequency. All the conditions which might vary and cause a change in the frequency have been stabilized. The frequency of the station does not vary at any time by more than a small fraction of one per cent of one percent. Hence we conclude that most of the unstability in the beat between that station and the oscillaing receiver is due to changing conditions in and about the receiver.

It would be possible by means of a quartz crystal oscillator to stabilize the receiver so that there would be no variation in the beat once the quartz crystal had been ground to synchrony with the crystal or other stabilizer used at the transmitting station.

Need Weaker Intensity

Of course, it is not practical in a broadcast receiver to grind a crystal since it must be flexible enough to tune to any station. But between one broadcasting station and another working in the same channel it is practical since there is only one frequency involved. One of the stations simply has to adjust its frequency controller until the carriers of both stations are exactly the same frequency. For example, the younger station, or the less powerful, tunes its crystal to that of the other.

But why is it necessary to leave the control room of one station in order to pick up the beat? Would it not be easier to set up a receiver in the control room?

It is desirable to get away from the local station to a point where the signal intensity is not so strong and to a point far enough away that the distant station might cause an audible beat note. Hence the receiver is set up some miles from the station which will do the synchronizing and the signal with the beat is sent back to the station by way of a telephone line.

(Wide World)

CHRISTY MATHEWSON, JR., SON OF THE FAMOUS BASEBALL PITCHER, IN THE LABORATORY OF THE GENERAL ELECTRIC COMPANY, WHERE HE IS EMPLOYED AS A STUDENT ENGINEER, MAKING SOME SPECIAL TESTS WITH VACUUM TUBES.

The Slow Beat

Even when the frequencies of two stations are controlled by two accurately ground and synchronized quartz crystals, there might be a slight variation between the two frequencies, a slow beat which may approach audibility.

These variations are due to the manner in which the crystals are used, slight differences and variations in the driving amplifier, and changes in the temperature. It may not be possible to keep the temperatures of the crystals the same at all times, and if there is an appreciable deviation in the temperatures of the two crystals there is a small difference in the frequencies also.

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Complete Official Call Book and Log

Herewith is the complete list of stations in the United States and its possessions, corrected up to December 15. All the changes ordered by the Federal Radio Commission effective December 1 have been included. Changes ordered effective December 15 are anticipated, hence included. The stations are arranged inversely according to their frequencies and directly according to wavelengths. The call letters and location also are given. The dashes underneath the frequency and wavelength are for the dial settings, thus making it possible to keep a complete log of the stations received. This is the first national publication of this up-to-date complete, official call book and log.

550 kc.—545.1 m.

KSD, St. Louis, Mo.
KFUO, St. Louis, Mo.
WMAK, Lockport, N. Y.
WPTF, Raleigh, N. C.
WFAA, Dallas, Texas
WDAY, Fargo, N. D.
KFDY, Brookings, S. D.

560 kc.—535.4 m.

WCAC, Mansfield, Conn.
WHO, Des Moines, Iowa.
KFBK, Sacramento, Cal.
WTIC, Hartford, Conn.

570 kc.—526.0 m.

WNYC, New York City.
KFKX, Chicago, Ill.
KYW, Chicago, Ill.
KMTR, Los Angeles, Cal.

580 kc.—516.9 m.
(Canadian Shared)

WMC, Memphis, Tenn.
WWVA, Wheeling, W. Va.
WFLA-WSUN, Clearwater, Fla.
WTAG, Worcester, Mass.

590 kc.—508.2 m.

WOW, Omaha, Nebr.
KLX, Oakland, Cal.
WEEI, Boston, Mass.

600 kc.—499.7 m.

WBAP, Fort Worth, Texas.
WOAI, San Antonio, Texas.

610 kc.—491.5 m.

KGW, Portland, Ore.
WEAF—One transmitter at Bellmore, N. Y.
WEAF—One transmitter at New York City.

620 kc.—483.6 m.

WJAR, Providence, R. I.
WCFL, Chicago, Ill
WLTS, Chicago, Ill.
WEMC, Berrien Springs, Mich.
KUSD, Vermilion, S. D.
WTAW, College Station, Tex.
KFDM, Beaumont, Tex.
KFBU, Laramie, Wyoming.

630 kc.—475.9 m.
(Canadian Shared)

WSB, Atlanta, Ga.
WSUI, Iowa City, Iowa.

640 kc.—468.5 m.

WRC, Washington, D. C.
KFI, Los Angeles, Cal.

650 kc.—461.3 m.

WNAC-WBIS, Boston, Mass.
KRLD, Dallas, Tex.
KFNF, Shenandoah, Ia.
WCAE, Pittsburgh, Pa.
WRR, Dallas, Tex.
KUOM, Missoula, Mont.

660 kc.—454.3 m.

WJZ, Bound Brook, N. J.
KFRC, San Francisco, Cal.

670 kc.—447.5 m.

WMAQ, Chicago, Ill.
WQJ, Chicago, Ill.
KFOA, Seattle, Wash.

680 kc.—440.9 m.

WJR-WCX, Pontiac, Mich.
WIBG, Elkins Pk., Pa.
KFSD, San Diego, Cal.
WAAW, Omaha, Nebr.

700 kc.—428.3 m.

WLW—One transmitter at Harrison, N. J.
WLW—One transmitter at Cincinnati, Ohio.
WMAF, So. Dartmouth, Mass

710 kc.—422.3 m.

WOR, Newark, N. J.
KPO, San Francisco, Cal.
WOS, Jefferson City, Mo.

720 kc.—416.4 m.

WGN-WLIB, Chicago, Ill.
WLIB-WGN, Near Elgin, Ill.
KHJ, Los Angeles, Cal.

740 kc.—405.2 m.

WLIT, Philadelphia, Pa.
WFI, Philadelphia, Pa.
WCCO, Minneapolis, Minn.

750 kc.—399.8 m.

WEAR, Cleveland, Ohio.
WTAM, Cleveland, Ohio.
WSBT, South Bend, Ind.

760 kc.—394.5 m.

KMA, Shenandoah, Iowa.

WHN, New York City.
WQAO-WPAP, Cliffside, N. J.
KTW, Seattle, Wash.
KWSC, Pullman, Wash.
KWKH, Shreveport, La.
KOB, State College, N. M.

770 kc.—389.4 m.

WBBM, Glenview, Ill.
WAAF, Chicago, Ill.
WJBT, Chicago, Ill.
WABI, Bangor, Me.

780 kc.—384.4 m.
(Canadian Shared)

WOAM, Miami, Fla.
WMBF, Miami Beach, Fla.
KGO, Oakland, Cal.
WBSO, Wellesley Hills, Mass
KTHS, Hot Springs, Ark.

790 kc.—379.5 m.

WCAJ, Lincoln, Neb.
WGY, So. Schenectady, N. Y.

800 kc.—374.8 m.

KNRC, Santa Monica, Cal.
WOC, Davenport, Ia.

810 kc.—370.2 m.

WDAF, Kansas City, Mo.
KHQ, Spokane, Wash.
WLWL, Kearney, N. J.
WMCA, Hoboken, N. J.

820 kc.—365.6 m.

WEBH, Chicago, Ill.
WJJD, Mooseheart, Ill.
KMJ, Fresno, Cal.
WCSH, Portland, Me.

830 kc.—361.2 m.

WSAI, Cincinnati, Ohio.
KFWB, Los Angeles, Cal.

850 kc.—352.7 m.

WWJ, Detroit, Mich.
WEW, St. Louis, Mo.

860 kc.—348.6 m.

WOO, Philadelphia, Pa.
WGBS, Astoria, Long Island, N. Y.
WIP, Philadelphia, Pa.
KVOO, Bristow, Okla.
KJR, Seattle, Wash.
KXA, Seattle, Wash.

870 kc.—344.6 m.

WLS, Chicago, Ill.
WCBD, Zion, Ill.
KWG, Stockton, Cal.
KFQD, Anchorage, Alaska.

880 kc.—340.7 m.
(Canadian Shared)

WAPI, Auburn, Ala.
WJAX, Jacksonville, Fla.
WHB, Kansas City, Mo.
WOQ, Kansas City, Mo.

890 kc.—836.9 m.
(Canadian Shared)

WSM, Nashville, Tenn.
KNX, Los Angeles, Cal.

900 kc.—333.1 m.

KFQB, Fort Worth, Texas.
WJAD, Waco, Texas.
WBZ, East Springfield, Mass.
WBZA, Boston, Mass.
KSAC, Manhattan, Kan.
KFJM, Grand Forks, N. D.
KSEI, Pocatello, Idaho.
WHA, Madison, Wis.
WLBL, Stevens Point, Wis.

920 kc.—325.9 m.

KOA, Denver, Colo.
WRNY, Coytesville, N. Y.
WPCH, Hoboken, N. J.

930 kc.—322.4 m.
(Canadian Shared)

WRHF, Washington, D. C.
WHAS, Louisville, Ky.
KICK, Atlantic, Iowa.
WIAS, Ottumwa, Iowa.
WKA, San Juan, Porto Rico.

940 kc.—319.0 m.

KOIL, Council Bluffs, Ia.
KFAB, Lincoln, Nebr.
KOIN, Portland, Ore.

950 kc.—315.6 m.

KDKA, Pittsburgh, Pa.
KPSN, Pasadena, Cal.

970 kc.—309.1 m.

KYA, San Francisco, Calif.
WABC, Richmond Hill, N. Y.
WBOQ, Richmond Hill, N. Y.

980 kc.—305.9 m.

WHT, Chicago, Ill.
WIBO, Desplaines, Ill.

WHAZ, Troy, N. Y.
KOMO, Seattle, Wash.

990 kc.—302.8 m.

WGR, Buffalo, N. Y.
KSL, Salt Lake City, Utah.

1000 kc.—299.8 m.

KFWO, Avalon, Cal.
KMOX, St. Louis, Mo.
WPSC, State College, Pa.
WBAK, Harrisburg, Pa.

1010 kc.—296.9 m.

WWMC, Asheville, N. C.
KUOA, Fayetteville, Ark.
WEPS, Gloucester, Mass.
WSHK, Dayton, Ohio.
KQW, San Jose, Cal.
WDEL, Wilmington, Del.
KGFW, Ravenna, Nebr.
WSMB, New Orleans, La.
KLZ, Denver, Colo.
(Canadian Shared)

1029 kc.—293.9 m.

WODA, Paterson, N. J.
WTMJ, Milwaukee, Wisc.
KPRC, Houston, Texas.
WLBW, Oil City, Pa.
KGCH, Wayne, Nebr.
WGL, Secaucus, N. J.
KGDW, Humbolt, Nebr.
KGEZ, Kalispoll, Mont.

1040 kc.—288.3 m.

WDBO, Orlando, Fla.
WENR, Chicago, Ill.
WBCN, Chicago, Ill.
KTBI, Los Angeles, Cal.
WNAT, Philadelphia, Pa.
KGBX, St. Joseph, Mo.
WKY, Oklahoma City, Okla.
WSSH, Boston, Mass.
WBET, Boston, Mass.
WIAD, Philadelphia, Pa.

1050 kc.—285.5 m.

WBAL, Baltimore, Md.
KFAU, Boise, Idaho.
WJAG, Norfolk, Nebr.
KLCN, Blytheville, Ark.
KMMJ, Clay Center, Nebr.
WCAL, Northfield, Minn.
WDGY, Minneapolis, Minn.

1060 kc.—282.8 m.

WAIU, Columbus, Ohio.
KFXF, Denver, Colo.
KFJR, Portland, Ore.
KTBR, Portland, Ore.
WRAK, Escanaba, Mich.
WEAO, Columbus, Ohio.

WDRC, New Haven, Conn.
KFUM, Colorado Springs, Colo.

1070 kc.—280.2 m.

WHAM, Rochester, N. Y.
KTAB, Oakland, Cal.

1080 kc.—277.6 m.

WGHP, Mt. Clemens, Mich.
WKAR, E. Lansing, Mich.
KWWG, Brownsville, Texas.
WDZ, Tuscola, Ill.
WNAX, Yankton, S. Dak.

1090 kc.—275.1 m.

WEAN, Providence, R. I.
WTAS, Elgin, Ill.
KFSG, Los Angeles, Cal.
KFPL, Dublin, Texas.
KFBB, Havre, Mont.
WFBM, Indianapolis, Ind.

1100 kc.—272.6 m.

WHAR, Atlantic City, N. J.
WPG, Atlantic City, N. J.
WRM, Urbana, Ill.
WBAA, La Fayette, Ind.
KFJF, Oklahoma City, Okla.
KFAD, Phoenix, Ariz.
WFBJ, Collegeville, Minn.
KSMR, Santa Maria, Cal.
WFDF, Flint, Mich.
WSKC, Bay City, Mich.

1110 kc.—270.1 m.

KLDS, Independence, Mo.
WJAS, Pittsburgh, Pa.
KQV, Pittsburgh, Pa.
WGST, Atlanta, Ga.
WMAZ, Macon, Ga.
WSOE, Milwaukee, Wisc.
KOAC, Corvallis, Oreg.
KFLX, Galveston, Texas.
KGU, Honclulu, Hawaii.
WHAD, Milwaukee, Wisc.

1120 kc.—267.7 m.
(Canadian Shared)

WBAO, Decatur, Ill.
WDAE, Tampa, Fla.
KSBA, Shreveport, La.
KFLV, Rockford, Ill.
WAAM, Newark, N. J.
WNJ, Newark, N. J.
WGCP, Newark, N. J.
WLAP, Louisville, Ky.
KFWI, San Francisco, Cal.
KFIZ, Fond du Lac, Wisc.
WOBU, Charleston, W. Va.
WFPG, Altoona, Pa.

1130 kc.—265.3 m.

WNOX, Knoxville, Tenn.
WOI, Ames, Iowa.
WHK, Cleveland, Ohio.
KTSA, San Antonio, Texas.
KKP, Seattle, Wash.
WBES, Takoma Park, Md.
WICC, Easton, Conn.
WCWS, Danbury, Conn.

1140 kc.—263.0 m.

WSEA, Virginia Beach, Va.
WJAZ, Mt. Prospect, Ill.
WMBI, Chicago, Ill.
WDAG, Amarillo, Texas.
KGHP, Hardin, Mont.
KGEF, Los Angeles, Cal.
WJBO, New Orleans, La.
KFPW, Carterville, Mo.
KGEK, Yuma, Colo.
WJBI, Red Bank, N. J.
WEAM, N. Plainfield, N. J.

1150 kc.—260.7 m.

WCMA, Culver, Ind.
WDWF-WLSI, New Bedford, Mass.
WRHM, Fridley, Minn.
WOOD, Grand Rapids, Mich
KGA, Spokane, Wash.
WHBA, Oil City, Pa.
WCAU, Philadelphia, Pa.
WFIW, Hopkinsville, Ky.

1160 kc.—258.5 m.

WFBL, Syracuse, N. Y.
WEBW, Beloit, Wisc.
WNAL, Omaha, Nebr.
KOCH, Omaah, Nebr.
KFOX, Omaha, Nebr.
KFUL, Galveston, Texas.
KYDL, Salt Lake City, tah.
WIL, St. Louis, Mo.
WBT, Charlotte, N. C.
WSBF, St. Louis, Mo.

1170 kc.—256.3 m.

KTNT, Muscatine, Iowa.
WCSO, Springfield, Ohio.
KRE, Berkeley, Cal.
KFUS, Oakland, Cal.
WBER, Rossville, N. Y.
WASH, Grand Rapids, Mich.
WEBJ, New York City.
WLTH, Brooklyn, N. Y.

1180 kc.—254.1 m.

KGFX, Pierre, S. Dak.
WRVA, Richmond, Va.
WREN, Lawrence, Kans.
KFKU, Lawrence, Kan.
KMO, Tacoma, Wash.
WTAQ, Eau Claire, Wis.
WCAX, Burlington, Vt.
KFHA, Gunnison, Colo.
KGDA, Dell Rapids, S. Dak.
WHEC-WABQ, Rochester, N. Y.

1190 kc.—252.0 m.

WORD, Batavia, Ill.
KPLA, Los Angeles, Cal.
WMBB-WOK, Homewood, Ill
WSAR, Fall River, Mass.
WKJC, Lancaster, Pa.
WGAL, Lancaster, Pa.
WKBF, Indianapolis, Ind.
WMBR, Tampa, Fla.
WKBT, New Orleans, La.
WFOM, St. Cloud, Minn.
KOCW, Chickasha, Okla.

1200 kc.—249.9 m.
(Canadian Shared)

KFKA, Greeley, Colo.
WBAX, Wilkes-Barre, Pa.
WBRE, Wilkes-Barre, Pa.
KFRU, Columbia, Mo.
WCOA, Pensacola, Fla.
KFQU, Holy City, Cal.
KFJI, Astoria, Oreg.
WIBR, Steubenville, Ohio.
KFJZ, Ft. Worth, Tex.
WHBY, West de Pere, Wisc.
KMED, Medford, Oreg.
KFYR, Bismarck, N. D.
WCAZ, Carthage, Ill.
WBBY, Charleston, S. C.
KFUT, Salt Lake City, Utah.
WSAZ, Huntington, W. Va.
WREC, Memphis, Tenn.
WSIX, Springfield, Tenn.

1210 kc.—247.8 m.
(Canadian Shared)

WFKD, Frankford, Pa.
WABW, Wooster, Ohio.
WABY, Philadelphia, Pa.
WCAT, Rapid City, S. Dak.
WIOD, Miami Beach, Fla.
KFEL, Denver, Colo.
KFBC, San Diego, Cal.
WEBE, Cambridge, Ohio.
KFJB, Marshalltown, Iowa.
KGCA, Decorah, Iowa.
WLCI, Ithaca, N. Y.
WRAM, Galesburg, Ill.
WFBZ, Galesburg, Ill.
KWLC, Decorah, Iowa.
KOW, Denver, Colo.
WKDR, Kenosha, Wisc.
WLBT, Crown Point, Ind.
WJBA, Joliet, Ill.
WTAX, Streator, Ill.
WRRS, Racine, Wisc.
WLBR, Belvedere, Ill.
WNBH, New Bedford, Mass.

1220 kc.—245.8 m.

WGBB, Freeport, N. Y.
WAAT, Jersey City, N. J.
WEVD, Woodhaven, N. Y.
WHDI, Minneapolis, Minn.
WLB, Minneapolis, Minn.
KFH, Wichita, Kans.
KZM, Oakland, Cal.
KLS, Oakland, Cal.
WFBE, Cincinnati, Ohio.
KFPY, Spokane, Wash.
KFIO, Spokane, Wash.
WKRC, Cincinnati, Ohio.
WWL, New Orleans, La.

1230 kc.—243.8 m.

KWUC, LeMars, Iowa.
KSCJ, Sioux City, Iowa.
KGY, Lacey, Wash.
KGRS, Amarillo, Tex.
KFCB, Phoenix, Ariz.
KGCX, Vida, Mont.
WMBC, Detroit, Mich.
WFBR, Baltimore, Md.
WDOD, Chattanooga, Tenn.
WCAD, Canton, N. Y.
WCAO, Baltimore, Md.

1240 kc.—241.8 m.

WFCI, Pawtucket, R. I.
KFKB, Milford, Kans.
WEDC, Chicago, Ill.
WGES, Chicago, Ill.
KFON, Long Beach, Cal.
WEBR, Buffalo, N. Y.
WEBC, Superior, Wis.
WNBX, Springfield, Vt.
WMAL, Washington, D. C.
WBRC, Birmingham, Ala.

1250 kc.—239.9 m.

WOAN, Lawrenceburg, Tenn.
WJAM, Cedar Rapids, Ia.
KWCR, Cedar Rapids, Ia.
WNAD, Norman, Okla.
KEX, Portland, Oreg.
WIBA, Madison, Wis.
KGCU, Mandan, N. Dak.
WBBP, Petosky, Mich.
WOAX, Trenton, N. J.
WCAP, Asbury Park, N. J.
WTAL, Toledo, Ohio.
WBAW, Nashville, Tenn.

1260 kc.—238.0 m.

WRAW, Reading, Pa.
WLBI, Wenona, Ill.
WRBC, Valparaiso, Ind.
WJBW, New Orleans, La.
KFVI, Houston, Texas.
WIBX, Utica, N. Y.
WJBB, Sarasota, Fla.
WQBA, Tampa, Fla.
WABZ, New Orleans, La.
WADC, Akron, Ohio.

1270 kc.—236.1 m.

KHMC, Harlingen, Tex.
KFDX, Shreveport, La.
WGBF, Evansville, Ind.
KFMX, Northfield, Minn.
KFWM, Oakland, Cal.
WHAP, Carlstadt, N. J.
WPUB, New York City.
WTAR-WSUF, Norfolk, Va.
WBBW, Norfolk, Va.
WTAD, Quincy,, Ill.
WBNY, New York City.
WSRO, Middletown, Ohio.
WHBC, Canton, Ohio.

1280 kc.—234.2 m.

WMAY, St. Louis, Mo.
KWK, St. Louis, Mo.
KFQA, St. Louis, Mo.
WMBS, Lemoyne, Pa.
KVI, Tacoma, Wash.
WMPC, Lapeer, Mich.
WMAN, Columbus, Ohio.
WJBY, Gadsden, Ala.
KGAR, Tuscon, Ariz.
WJAK, Kokomo, Ind.
WFBC, Knoxville, Tenn.
WDAH, El Paso, Texas.
WCAH, Columbus, Ohio.
WBBL, Richmond, Va.

1290 kc.—232.4 m.

WNBZ, Saranac Lake, N. Y.
WJKS, Gary, Ind.
WSBC, Chicago, Ill.
WBRL, Tilton, N. H.
KUT, Austin, Tex.
KFQZ, Hollywood, Cal.
KFPR, Los Angeles, Cal.
WMBJ, Monessen, Pa.
WHBQ, Memphis, Tenn.
KFEY, Kellegg, Idaho.
WLBH, Farmingdale, N. Y.
KFMR, Sioux City, Ia.
KFJY, Ft. Dodge, Ia.

1300 kc.—230.6 m.

KFEQ, St. Joseph, Mo.
KGCL, Seattle, Wash.
KPCB, Seattle, Wash.
WQAN, Scranton, Pa.
WGBI, Scranton, Pa.
KFPM, Greenville, Tex.
WDBJ, Roanoke, Va.
WCOC, Columbus, Miss.
WIBZ, Montgomery, Ala.
KDLR, Devils Lake, N. Dak.
WLBM, Boston, Mass.
WAFD, Detroit, Mich.
WAAD, Cincinnati, Ohio.

1310 kc.—228.9 m.

WOWO, Ft. Wayne, Ind.
WMBL, Lakeland, Fla.
KWJJ, Portland, Oreg.
WKBE, Webster, Mass.
KTAP, San Antonio, Tex.
WHBP, Johnstown, Pa.
WNBR, Memphis, Tenn.
KGBU, Ketchiken, Alaska.
KELW, Burbank, Cal.
KPPC, Pasadena, Cal.
WGBC, Memphis, Tenn.

1320 kc.—227.1 m.

WWAE, Chicago, Ill.
KSO, Clarinda, Iowa.
WCLO, Camp Lake, Wis.
WJBC, La Salle, Ill.
KGEU, Lower Lake, Cal.
WARS-WSDA, Brooklyn, N.
WJAY, Cleveland, Ohio.
WBBC, Brooklyn, N. Y.
WFJC, Akron, Ohio.
WCBE, New Orleans, La.
KFUP, Denver, Colo.
WAIZ, Appleton, Wis.
KXRO, Aberdeen, Wash.
WTHS, Atlanta, Georgia.
KGHB, Honolulu, T. H.

1330 kc.—225.4 m.

WSYR, Syracuse, N. Y.
WMAC, Casenovia, N. Y.
WLAC-WDAD, Nashville, Tenn.
KFIU, Juneau, Alaska
WCOT, Olneyville, R. I.
WAGM, Royal Oak, Mich.
KFVG, Independence, Kans.
KGEN, El Centro, Cal.
KFKZ, Kirksville, Mo.
KFUR, Ogden, Utah.
WCBM, Baltimore, Md.

1340 kc.—223.7 m.

WFAN, Philadelphia, Pa.
KFXR, Oklahoma City, Okla.
WCAM, Camden, N. J.
WFKB, Chicago, Ill.
WCRW, Chicago, Ill.
KGFH, La Crescenta, Cal.
KMIC, Inglewood, Cal.
KFBL, Everett, Wash.
WKAV, Laconia, N. H.
WSAJ, Grove City, Pa.
KGFB, Iowa City, Ia.
KGDP, Pueblo, Colo.
WNRC, Greensboro, N. C.
KGFK, Hallock, Minn.
WEBQ, Harrisburg, Ill.
KFVS, Cape Girardeau, Mo.
WOCL, Jamestown, N. Y.
WPCC, Chicago, Ill.

1350 kc.—221.1 m.

KFWC, San Bernardino, Cal
WSAN, Allentown, Pa.
WCBA, Allentown, Pa.
WHBD, Bellefontaine, Ohio.
WHBF, Rock Island, Ill.
KWKC, Kansas City, Mo.
WOMT, Manitowoc, Wis.
KGFL, Raton, N. Mex.
KWTC, Santa Ana, Cal.
KGBY, Columbus, Nebr.
WAMD, Minneapolis, Minn.
KFOY, St. Paul, Minn.

1360 kc.—220.4 m.

KGCI, San Antonio, Tex.
KGRC, San Antonio, Tex.
WKBH, La Crosse, Wis.
KXL, Portland, Ore.
WTAZ, Richmond, Va.
WHBW, Philadelphia, Pa.
WJBK, Ypsilanti, Mich.
WHBU, Anderson, Ind.
KRAC, Shreveport, La.
WMBO, Auburn, N. Y.
KGFI, San Angelo, Tex.
KJBS, San Francisco, Cal.
WMBG, Richmond, Va.

1370 kc.—218.8 m.

WGWB, Milwaukee, Wis.
WKBQ, New York City.
WKBO, Jersey City, N. J.
WCGU, Sea Gate, Coney Island, N. Y.
KGEW, Ft. Morgan, Colo.
WKBC, Birmingham, Ala.
WLBQ, Atwood, Ill.

(Concluded on next page)

(Concluded from preceding page)

1380 kc.—217.3 m.

WKBW, Buffalo, N. Y.
KGDM, Stockton, Cal.
KFQW, Seattle, Wash.
WRES, Quincy, Mass.
WKBV, Brookville, Ind.
WKBS, Galesburg, Ill.
WLBO, Galesburg, Ill.
KFOR, Lincoln, Nebr.
WIBU, Poynette, Wis.

1390 kc.—215.7 m.

WKBB, Joliet, Ill.
WCLS, Joliet, Ill.
WEHS, Evanston, Ill.
WHFC, Chicago, Ill.
WPEP, Waukegan, Ill.
KGER, Long Beach, Calif.
KRLO, Los Angeles, Calif.
WQAA, Parkesburg, Pa.
KFDZ, Minneapolis, Minn.
KGCB, Oklahoma City, Okla.
KGFG, Oklahoma City, Okla
KFXJ, Edgewater, Colo.
WOKO, Peekskill, N. Y.
WLEX, Lexington, Mass.
WKBI, Chicago, Ill.

1400 kc.—214.2 m.

KFIF, Portland, Ore.
KFEC, Portland, Ore.
WAIT, Taunton, Mass.
WKBN, Youngstown, Ohio.
WMBW, Youngstown, Ohio.
WLBG, Petersburg, Va.
KFWF, St. Louis, Mo.
WJBU, Lewisburgh, Pa.
KPJM, Prescott, Ariz.
WCWK, Ft. Wayne, Ind.

1410 kc.—212.6 m.

WRAX, Philadelphia, Pa.
KGBZ, York, Nebr.
KTUE, Houston, Texas.
WJBL, Decatur, Ill.
WKBP, Battle Creek, Mich.
KFHL, Oskaloosa, Ia.
KGFP, Mitchell, S. D.
KGDX, Shreveport, La.
KGGH, Cedar Grove, La.

1420 kc.—211.1 m.

KRSC, Seattle, Wash.
WCDA-WBRS, Cliffside, N. J
WRST, Bay Shore, N. Y.
WNBO, Washington, Pa.
WMES, Boston, Mass.
WLOE, Chelsea, Mass.
WBMH, Detroit, Mich.
KPNP, Muscatine, Ia.
KFCR, Santa Barbara, Calif.
KGFM, Yuba City, Calif.
KFYO, Breckenridge, Texas.

1430 kc.—209.7 m.

KGHC, Slayton, Minn.
WOKT, Rochester, N. Y.
KVOS, Bellingham, Wash.
WPRC, Harrisburg, Pa.
WRCV, Norfolk, Va.
WLBC, Muncie, Ind.
WMBM, Memphis, Tenn.
WLBF, Kansas City, Mo.
WCBS, Springfield, Ill.
KSOO, Sioux Falls, S. D.
WLBY, Iron Mountain, Mich
KFGQ, Boone, Iowa.
WTFI, Toccoa, Ga.
KGHF, Pueblo, Colo.

1440 kc.—208.2 m.

WRAF, La Porte, Ind.
WJBZ, Chicago Heights, Ill.
WNBA, Forest Park, Ill.
KFVD, Venice, Calif.
KGFJ, Los Angeles, Calif.
WGM, Jeannette, Pa.
WJPW, Ashtabula, Ohio.
WMBE, St. Paul, Minn.
WLBZ, Dover-Foxcroft, Me.
WRPI, Terre Haute, Ind.
KGCN, Concordia, Kans.
KGCR, Brookings, S. D.

1450 kc.—206.8 m.

WPSW, Philadelphia, Pa.
KGTT, San Francisco, Calif.
KLIT, Portland, Oreg.
WMRJ, Jamaica, N. J.
WTRL, Midland Park, N. J.
WHPP, Bronx, N. Y.
WLBV, Mansfield, Ohio.
WNBJ, Knoxville, Tenn.
WNBF, Endicott, N. Y.
KGDY, Oldham, S. D.
KGGF, Picher, Okla.
KGDR, San Antonio, Tex.

1460 kc.—205.4 m.

WNBQ, Rochester, N. Y.
WKBL, Monroe, Mich.
WMBD, Peoria Heights, Ill.
WABF, Kingston, Pa.
KGEO, Grand Island, Nebr.
KFXY, Flagstaff, Ariz.
KGDE, Barrett, Minn.
KGFF, Alva, Okla.
WRK, Hamilton, Ohio.
WOBT, Union City, Tenn.

1470 kc.—204.0 m.

KFXD, Jerome, Idaho.
WLBN, Chicago, Ill.
WSAX, Chicago, Ill.
WMBA (Portable), Newport, R. I.
WBBZ (Portable), Chicago, Ill.
KGEQ, Minneapolis, Minn.
WHBL (Portable), Chicago, Ill.
WIBW (Portable), Chicago, Ill.
WMBH, Joplin, Missouri.
WIBS, Elizabeth, N. J.
WMBQ, Brooklyn, N. Y.
WLBX, Long Island, City, N. Y.
KGFO (Portable), Terre Haute, Ind.
KGES, Central City, Nebr.
WKEN, Buffalo (Kenmore, (N. Y.).
WOBR (Portable), Shelby, Ohio.
KGGM (Portable), Inglewood, Calif.
WSVS, Buffalo, N. Y.
KHAC (Portable on Aeroplane).

1480 kc.—202.6 m.

WTFF, Mt. Vernon Hills, Va.
KVL, Seattle, Wash.
WHBN, Gainesville, Fla.

1490 kc.—201.6 m.

WCBR (Portable), Providence, R. I.
WHBM (Portable, Chicago, Ill.
WIBJ (Portable), Chicago, Ill.
WIBM (Portable), Chicago, Ill.
WKBG (Portable), Chicago, Chicago, Ill.
WGMU (Portable), New York City.
WRMU (Portable), New York City.
KGEY, Denver, Colo.
WATT (Portable), Boston, Mass.
WALK, Willow Grove, Pa.
KGEH, Eugene, Ore.

1500 kc.—199.9 m.

KWBS, Portland, Ore.
KUJ, Seattle, Wash.
WNBL, Bloomington, Ill.
WKBZ, Ludington, Mich.
KGFN, Aneta, N. D.
WRAH, Providence, R. I.
WBMS, Union City, N. J.
WNBW, Carbondale, Pa.
WGOP, Flushing, N. Y.
WWRL, Woodside, N. Y.
WBKN, Brooklyn, N. Y.

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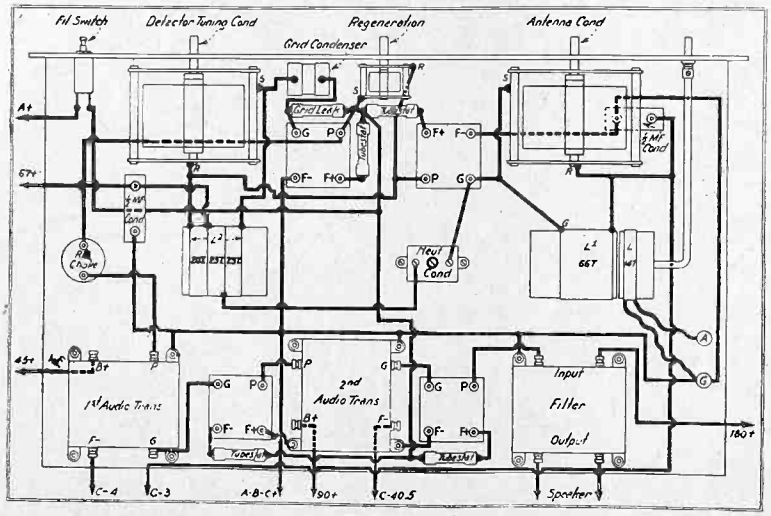

FIG. 584

THE PICTORIAL DIAGRAM OF THE EVERYMAN 4, AS REQUESTED BY GEORGE FRANK.

I DESIRE to build the Everyman 4 as described in the December 3 and 10 issues of RADIO WORLD. In the December 10 issue, there appeared data telling how to correct the December 4 diagram so as to get better results. Would you please show a picture diagram of the set with all the necessary changes made?—GEORGE FRANK, Atlantic City, N. J.

Fig. 584 shows the diagram.

* * *

I AM interested in the 5-tube circuit diagrammed on page 23 of the December 3 issue of RADIO WORLD.

(1)—Could any RF transformer and 3-circuit tuner, both of which are matched up to tuned with .00035 mfd. variable condensers, be used?

(2)—I have a 3-stage resistance coupled audio amplifier. The plate resistors have a resistance of .1 megohms. The first grid resistor has a resistance of 1 megohm the next grid resistor, .1 megohms, and the last grid resistor, .25 megohms. The stopping condensers have a capacity of .25 mfd. Is this all right?

(3)—What does DL mean?

(4)—Do ¼ and ½ near the filament resistors mean that these resistors should pass ¼ and ½ amperes, respectively? Would the 1A and 112 Amperite serve the purpose?

(5)—Is GS a 400 ohm resistor?

(6)—Is it necessary to use the rheostat which in series with the ballast of the first radio frequency tube? What is its value?

(7)—Is it all right to use 201A tubes throughout this set?—ROBERT MALWORN, Jersey City, N. J.

(1)—Yes. The primary of the radio frequency coil should be variable, though. You can fix this up yourself. Procure a 2 inch diameter tubing and wind twenty turns thereon. Then insert it in the stator tubing holding the primary and secondary windings. You can use No. 22 double cotton covered wire for this extra winding. A space ¼ inch can be allowed between each 10 turns for the insertion of a shaft.

(2)—Yes, this is all right.

(3)—These are lights attached to the controls which are used to brighten up the numbers on the scales. However, plain dials with no lights can also be used.

(4)—Yes.

(5)—Yes.

(6)—Yes. This should have a resistance of 20 ohms.

(7)—Yes.

* * *

SOME INFORMATION is requested regarding the addition of an extra stage of radio frequency amplification.

(1)—Would it be advisable to use a coil which had a large primary, say 20 turns?

(2)—If the filament of the first radio frequency tube is controlled by a 20 ohm rheostat, then can I run the plates of

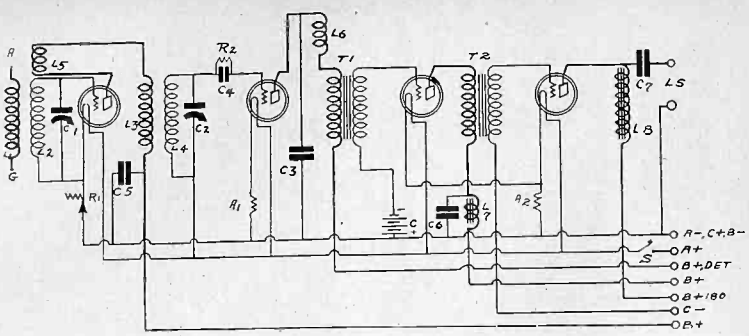

FIG. 585
THE CIRCUIT DIAGRAM OF THE 4-TUBE REGENERATIVE RECEIVER REQUESTED BY WILLIAM SENTER.

the RF tubes, of which there will be two and the first audio plate to a common 67½ volt post? — GERALD M. ANTONUS, Cedar Rapids, Ia.

(1)—It would work better if the primary were variable and contained that number of turns.

(2)—Yes, this will work out all right.

* * *

IS IT all right to control the volume in a receiver wired up for the AC heater type tubes, by shunting a 200,000 ohm variable resistance across the secondary winding of a radio frequency transformer?

(2)—If so, across which secondary would it be best to place it in a set using three tuned radio frequency stages?—ROJERS WORTH, Long Island City, N. Y.

(1)—That is one way it is being done.

(2)—Across the secondary winding of the radio frequency transformer preceding the detector tube is a favorite position.

* * *

I WAS given a 5-tube set about two months ago. The set worked satisfactorily until last week, when the signals suddenly became distorted. I tested my A, B and C batteries, as well as the tubes, antenna and ground, and found them all right. I found, however, that the large fixed condensers across the plus B and the minus A posts were opened circuited. There are three of these; one connected between the plus B 45 and the minus A, one between the plus 67½ and the minus A, and one between the plus B 90 and the minus A. I think that the trouble is right here. If so, what capacity condensers would you suggest inserting in their place?

(2)—I have noticed that sometimes when the plug is inserted, the signals are loud, while at other times they are not. Could this be due to a poor contact being made between the sleeve of the plug and the springs of the jack? — PHILIP MADGSEN, Philadelphia, Pa.

(1)—Suggest you insert 1 mfd. fixed condensers. Be sure that the windings of the audio transformers are not shorted or open circuited.

(2)—The trouble is in the plug.

* * *

I WISH to build a 6-tube set, using three stages of tuned radio frequency amplification, a non-regenerative detector and two transformer coupled audio stages.

(1)—Will it be all right to insert 400 or 600 ohm fixed resistors in series with the grids of the radio frequency amplifiers, to prevent the tubes from spilling over?

(2)—I wish to use four single condensers. Three are to be ganged up to a drum control, while the other one is to be hooked up to another drum control. Can I ground all the rotors and then bring this common terminal to the minus A terminal, bringing the grid leak from the plus A to the G post on the socket? This is, of course, for the 201A tubes.

(3)—A friend of mine has sugested that I use a coupler, built along the following lines: The primary is to consist of 15 turns, tapped at every third turn. The secondary is to consist of 64 turns, broken up into four sections. Two sections are to consist of 32 turns (16 turns in each section). This winding is to be placed on the same form as the primary. The other two sections of the secondary are to be wound on a separate form, also in two sections of 16 turns apiece. The stator form is to be 3 inches in diameter while the rotor form is 2 inches in diameter. No. 22 double cotton covered wire is to be used. The tapped primary is to be ¼ inch away from the secondary. Between the secondary windings on both the stator and rotor forms, there is to be a ¼ inch. —THOMAS YULLY, Fargo, N. D.

(1)—Yes.

(2)—Yes.

(3)—This coil will improve the results, to a great extent.

* * *

I HAVE a couple of three inch diameter tubings, some .00025 mfd. variable condensers, two 3 to 1 ratio audio transformers, a 2 inch diameter tubing, an 85 millihenry radio frequency choke coil, a 10 ohm variable rheostat, a 30 and a 100 henry choke coil, and a 2 mfd. and a 4 mfd. fixed condenser. I would appreciate seeing a circuit diagram of a 4-tube receiver using these parts. I would like to have the radio frequency tube made regenerative. It is also desired to use a 171 tube in the last audio tube.—WILLIAM SENTER, Newark, N. J.

Such a circuit is diagrammed in Fig. 585. On the three inch tubings, the primaries and secondaries are wound. The primaries consist of 10 turns. The secondaries consist of 65 turns. Both are separated ¼ inch, using No. 22 double cotton covered wire. The 2 inch tubing is used for the tickler. This consists of 40 turns. Use No. 26 single silk covered wire. R1 is the rheostat. The detector filament is controlled by a 1A Amperite R1. The filaments of the two audio tubes are controlled by a ¾ ampere ballast. C5 is a 1 mfd. fixed condenser. C6 is the 2 mfd. fixed condenser. C7 is the 4 mfd. condenser. L7 is the 30 henry choke, while L8 is the 100 henry choke. L6 is the RF choke coil. C3 is a .0005 mfd. fixed condenser. S is the filament switch. Use 135 volts on the first audio plate and 9 volts C. Use 40½ volts C for the 171. T1 and T2 are the audio transformers. LS indicates the speaker output posts. To the plate of the radio frequency tube, apply 67½ volts. Use a .00025 mfd. fixed condenser and a 4 megohm grid leak.

* * *

WE HAVE bought all the parts for the Winner, described in the October 1, 8, 15, 22 and 29 issues of RADIO WORLD. Before going ahead with the construction we would like to have some information.

(1)—We are going to use a Corbett cabinet and have noticed that if the controls are placed as per measurements, the small lights on the controls will hit the removable top portion in the front of the cabinet. Will it be all right to lower the controls ⅛ of an inch?

(2)—We have plenty of flat braided cable (No. 18 wire). Could this be used to wire the filaments? With this wire it would be possible to take leads off for connection to the different sockets, running the wire in a groove underneath the subbase, using small brads to hold it in place.

(3)—Some of our friends have told us that we would get better results if we used a 12 or 14 mfd. condenser in the output stage, in place of the 4 mfd. specified. Is this true?

(4)—Could a metal panel be used? We were thinking of grounding this panel. Is this all right?—JAMES AND HENRY WALTON, Butte, Mont.

(1)—It is not necessary to lower the control position, for although it seems as if the controls will hit, they will fit snugly. There will be no harm done, though, if you lower them, but stick to only ⅛ inch. If you place them any lower you will not be able to get the full benefit of the variable primary on the coil, or minimum capacity of the condenser, since the rods controlling the primary will hit the bottom of the board. And if you place the coil so that the rods face upward, then the primary coil will hit the bottom, if the control is shifted downward more than the ⅛ inch.

(2)—Yes, this is a good system.

(3)—The larger the condenser, the readier the passage of the lower frequencies. But 4 mfd. is ample.

(4)—Yes.

Good Back Numbers of RADIO WORLD

The following illustrated articles have appeared in back issues of RADIO WORLD in 1927.

MAY 21.—Part I of a three-part article on the Victoreen Portable receiver, by Capt. P. V. O'Rourke. Data on the new Raytheon cartridge.

MAY 28.—A three-tube reflex, using a special low pass filter system, by Edgar B. Francis. Part II on the Victoreen portable receiver with layout data, by Capt. P. V. O'Rourke.

JUNE 4.—Part III of a three-part article on how to construct an efficient portable Victoreen Super-Heterodyne, by Capt. P. V. O'Rourke. A complete discussion on the RCA AC tubes.

JUNE 11.—Detailed discussion of a four-stage push-pull resistance coupled audio amplifier, by J. E. Anderson. The Suitcase 6, using a tuned RF stage, two untuned RF stages, regenerative detector and two transformer AF stages, by James H. Carroll. Balsa Wood for speakers, an excellent discussion on how this wood may be employed for speakers, by H. B. Herman.

JUNE 18.—The six-tube Equamatic, a neutralized two-stage tuned RF, three-stage AF resistance coupled set, by Herbert E. Hayden. How to get the low notes with transformer or impedance AF, by Dennis J. O'Flaherty.

JUNE 25.—The Lindbergh Plane Speaker, an excellent cone type reproducer, by Herbert E. Hayden. A tube and set tester, by Herman Bernard.

JULY 2.—The Planofier 7, single control super-sensitive set using resistance AF by R. F. Goodwin and S. S. Bruno. Discussion on the new Freshman Equaphase, by Robert Sagala. Data on the six types of units used for loud speaker operation, by J. E. Anderson.

JULY 9.—How to build a DC A supply where the line voltage is 220 or 240, by Frank Logan. Important data on RF choke coils, by Horatio W. Lamson.

JULY 16.—How to use a voltmeter as a milliammeter, by D. Barretti. How to build a 4-tube, 2-control regenerative portable set.

JULY 23.—Building a 7-tube Super for your auto, using Victoreen IFT, by John F. Rider (Part 1). How to build a 6-tube neutralized set, using three tuned RF, two transformer AF, by John F. Rider. Inside dope on motorboating, by J. E. Anderson.

JULY 30.—A 5-tube standard TRF set adapted to AC operation by the use of the QRS 400 mill rectifier tube, with the aid of series filament connections, by RF Goodwin and S. S. Bruno. Shielding the 11-tube Melo-Heald Super-Heterodyne receiver, by Clifford Denton. Part II of the two part article on the Super in the auto by John F. Rider. How to control volume in AC sets by D. Ferrup.

AUG. 6.—A three-tube regenerative portable with portion of the cabinet as the speaker, by M. J. O'Reilly. The Cashbox Unitune, an ingeniously contrived four-tube quality receiver by Wendell Buck. How to use AC tubes by C. T. Burke.

AUG. 13.—Hints on constructing a portable set, by Herbert E. Hayden. A seven-tube, two-control AC operated receiver by Capt. P. V. O'Rourke. Obtaining the C bias in an ABC unit, using the BA Raytheon 85 mill tube.

AUG. 20.—The Four AC, a four-tube regenerative set employing AC tubes. Tim Turkey's argument on why rheostats should not be used as volume controls. The Drum Powertone, a five-tube single control set, using resistance coupled audio.

AUG. 27.—Part I of a four part article on building the 1-Dial Witz, a single control, voluminous selective 5-tube set, by A. Irving Witz. A detailed explanation of the exponential type of born by H. B. Herman. Details on the revolutionary Reisz condenser type of speaker. Constructional data on a special 5-tube, 2-dial regenerative set, with three stages of AF, by Tim Turkey.

SEPT. 3.—Part I of a four-part discussion on the new 1928 Victoreen Universal, a super-sensitive 8-tube Super-Heterodyne, by Capt. P. V. O'Rourke. Complete data on the three types of phonograph pickups, by J. E. Anderson. Part II of the 1-dial Witz, wiring hints emphasized.

SEPT. 10.—The Puratone AC set, a 6-tube duo-control receiver, using AC tubes, by R. F. Goodwin and S. S. Bruno. Part II of the 1928 Victoreen Universal, discussing the placement of parts. Part III of the 1-Dial Witz on the special placement of the coils.

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Standards That Stand Are Hopefully Expected

Efforts of the Radio Manufacturers Association to bring about a single code of standards for the radio industry are at last achieving the desired results, according to an announcement from the Association. The man who builds his own radio set, as well as the manufacturer, will be benefitted by arrangements made toward the establishment of a single industry standard, to be determined with the aid of the American Engineering Standards Committee.

Although the Association has a membership ten times that of any other manufacturer group in the radio field, a minority group has advanced a somewhat different code of standards. Both of these standards were drawn up in good faith, and accordingly reflected some differing opinions, bringing some confusion in the industry. Several attempts have been made to bring about a single set of standards.

Trade Name a Drawback

The Association announced last June that it would not publish any new standards until a very comprehensive plan could be made for the establishment of a single industry standard.

A study of the situation showed that personal differences balked the single standard as long as it bore any trade association name.

In recognition of this situation and as a practical expression of its sincere desire to bring about a single industry standard, the Association arranged last September to drop the use of its name in connection with the standardization, and to lend its efforts and influence toward the formation of a single industry standard, irrespective of what name any other and smaller group of manufacturers might desire to retain.

With the Association taking this posi-

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tion and also desirous of obtaining valuable standardization suggestions from any expert source, a meeting was arranged by Dr. C. P. Agnew, secretary of the American Engineering Standards Committee, and by Dr. Alfred N. Goldsmith, secretary of the Sectional Committee on Radio of that association, with engineering representatives of the radio manufacturing interests to discuss their specific problems and differences.

Complete Reconsideration

The result of this meeting, held recently (with the Association represented by the Chairman of its Engineering Division, H. B. Richmond, of the General Radio Company) was that a complete reconsideration is to be given to the existing codes of standards and their variances. An agreement was reached that all items on which there is no conflict shall be announced as radio industry standards.

On items on which there is a disagreement the American Engineering Standards Committee will endeavor to analyze the situation, hear all evidence, and establish the industry standard with the understanding that any conflicting standards will be brought into harmony and agreement with the radio industry standards as rapidly as possible. The Association will not publish any standards of its own, but will distribute to its members and adhere to the national radio standards as determined and approved by the American Engineering Standards Committee.

New Remler Condenser Universal in Action

To their long list of excellently made apparatus, Remler Division of Gray & Danielson Manufacturing Company, 260 First Street, San Francisco, Calif., has added the Remler Universal twin rotor variable condenser. This condenser is a modified form of the Remler S. L. wavelength twin rotor condenser. It uses a novel adjustment by means of which the dial shaft can be made to rotate in either a clockwise or counter-clockwise direction for an increase in capacity.

The Universal condenser is particularly intended for use when two Remler No. 110 drum dials are used, and when the condensers are driven from opposite sides of the dials. By setting the shaft of the condenser mounted at the right, for instance, for counter-clockwise operation, both dials will be made to rotate in the same direction for an increase of capacity.

Artist "Carries" Pianos But 3 Men Move Them

Los Angeles.

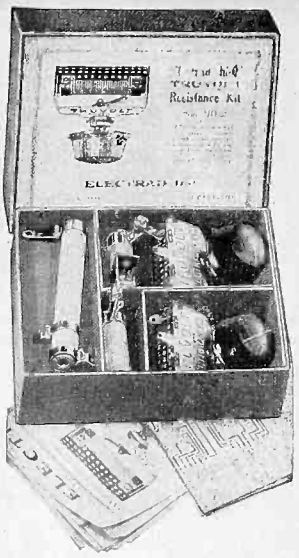
Ignaz Friedman, concert pianist, who recently gave a program over KFI, carries three concert grand pianos with him on his tours, as well as a special bench.

Four handlers care for them.

Truvolt Kit Made for Hi-Q Supply

Truvolt resistors, both fixed and variable, are exclusively recommended for the Hammarlund-Roberts Hi-Q Six B Power Supply Unit.

To meet the demand for Truvolts resulting from this recommendation, Electrad, Inc., manufacturers of Truvolts, have designed a special resistance kit for use with Hi-Q. The kit is in attractive box form and contains four special resistors designated respectively No. 1, 2, 3 and 4. It is the company's intention to carry these designations without values or type numbers in all literature on the Hi-Q Power Unit, because the resistors so designated are especially designed for use only with the Hi-Q.



IF YOU have DC, be sure to get copy of the Nov. 19 issue of RADIO WORLD. Send 15c for this issue or begin your subscription with it. RADIO WORLD, 145 W. 45th St., N. Y. C.

INTERESTING FACTS

Quality is primarily a function of what follows the detector. The receiver is capable of high grade quality if the audio coupling devices are correct, if the loudspeaker can reproduce all notes with impartiality, if the tubes used can handle all the power, if the voltages applied to the circuit are adequate and constant.

Quality does not depend in any appreciable degree on the tuner or radio frequency amplifier, provided that the selector is not super-selective.

Amplifier tubes will not last long if the filament is burned too brightly.

A power tube, or any tube having a low resistance load, will not last long if high plate voltages and insufficient grid bias are used.

No tube will last forever.

When buying new tubes take no substitutes on the promise they are guaranteed and on the insidious claim that the well known tubes are not. Your purchase will probably be a 100% "flop" with no recourse.

A voltmeter of suitable ranges is the most useful instrument you can have around the receiver. With it you can tell whether the filament and plate voltages are up to normal. If either is down, a new tube or set of tubes will not improve reception much. A voltmeter cannot be used safely to measure the grid voltage unless that voltage is supplied by new batteries.

A milliammeter having a range of about 0-25 is the second most useful instrument. With it you can test the tubes for plate current, the audio amplifier tubes for overloading, and in a roundabout way you can also use it for testing the grid voltage.

A hydrometer is a convenient instrument for testing the condition of charge in a storage battery. It is inexpensive.

The electrolyte in a storage battery is extremely active chemically. If spilled on the carpet, on the furniture, on the clothing, on the skin, it will burn a hole unless it is immediately neutralized. It is of no avail to dilute it with water if the diluted acid is permitted to remain. The burning will simply be a little slower but it will be just as serious and extensive.

The electrolyte, which is the sulphuric acid, can be neutralized with ammonium hydroxide, potassium or sodium hydroxide. These substances are found in every home in the form of ammonia water and lyes. Do not use too much nor too strong a neutralizer.

Motorboating is caused by the impedance of the B battery eliminator and by common impedance in the plate or grid circuits. It is an oscillation and not a case of blocking of the grids. It is most common that blocking results from the oscillation.

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