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RADIO WORLD

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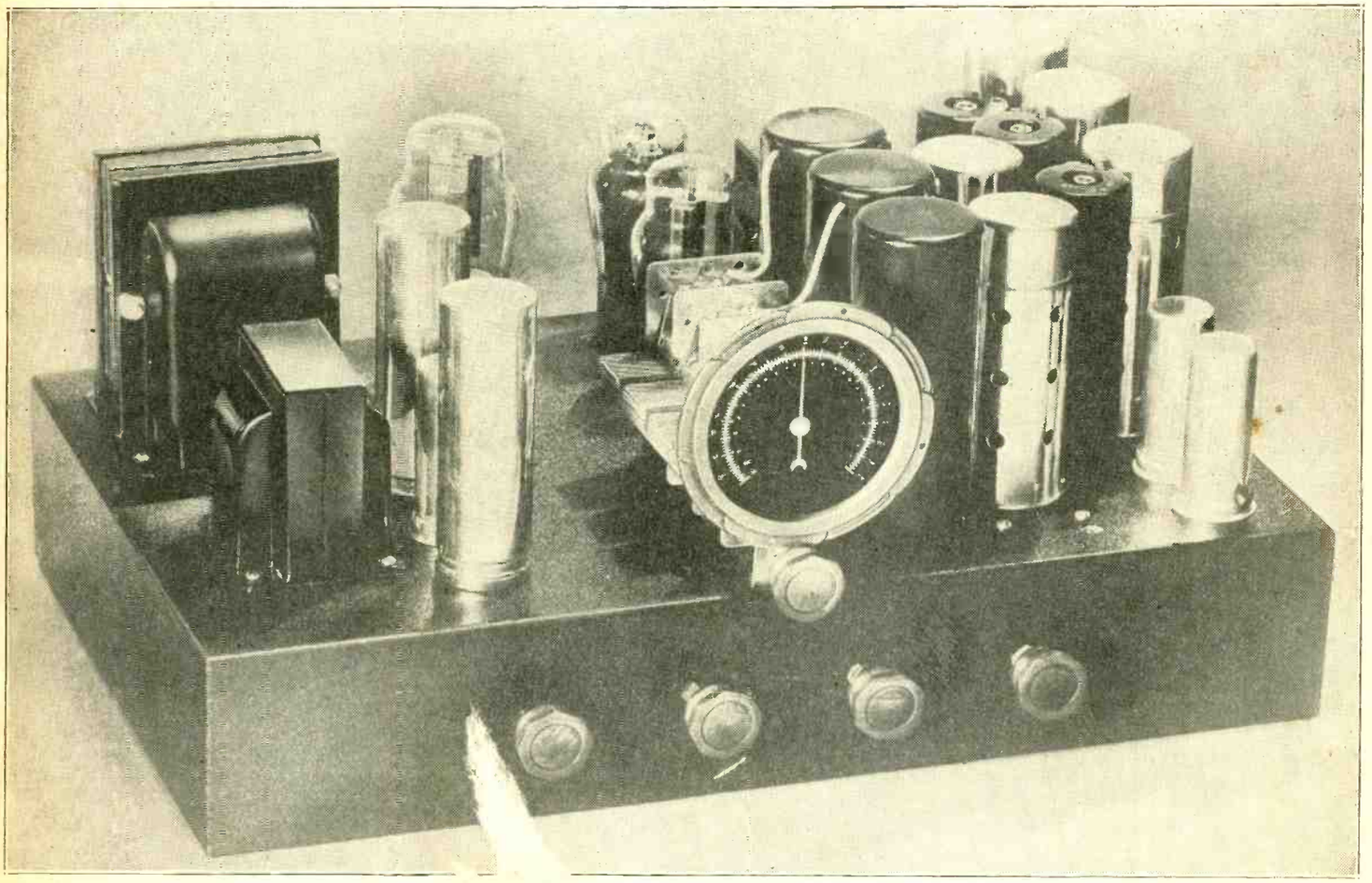
The First National Radio Weekly

652nd Consecutive Issue *Thirteenth Year*

TRIODE POWER OUTPUT MEASURED WITH A RULE

NEW 5-METER BOOSTER ANTENNA

DUAL-BAND CALIBRATED RECEIVER



For covering the broadcast band, and the most important short-wave band, this a-c receiver gives splendid results. The dial is frequency-calibrated. See page 15.

SEPT. 22 1934

Constructional Directions for B. G. Valentine's DeLuxe Superheterodyne

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BIG NEWS

The new Bernard Universal Test Oscillator, fundamentals 132-380 kc, for lining up intermediate frequencies, 132 to 500 kc, and broadcast band, from a direct-reading dial. Special method permits calibrating short-wave frequencies.

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(4)—Output attenuation permits close alignment of sets using automatic volume control.

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(6)—On a.c. the hum frequency is the modulation, always present at resonance. On d.c. or batteries a separate modulator neon tube is used, with choice of modulated-unmodulated service by switching. The neon tube preserves selectivity and prevents wobbly output in all uses.

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Chapter III: Different Types of Supers Explained.
Chapter IV: Functions of Individual Parts of Super.
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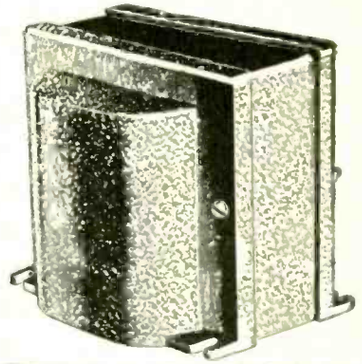

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THIRTEENTH YEAR

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Economy Signal Generator

Model 336 Works on Small Batteries and Has Separate Modulator

By Herman Bernard

HERE is a very simple signal generator for battery operation. It covers fundamentals of 135 to 380 kc, read directly from the calibrated dial, and also, by fourth harmonics, the broadcast band, 540 to 1,520 kc, imprinted on the dial. There are a 34 r-f oscillator, with attenuator, and a 30 audio oscillator, with optional modulation by switching.

Filaments of the two tubes are connected in series. Negative of the 4.5-volt C battery used as A supply is connected to negative filament of the 34, positive filament of the 34 to negative filament of the 30, and positive filament of the 30 to positive of the A battery. A minus and B minus are joined. The only other bat-

(*Continued on next page*)

LIST OF PARTS

Coils

One oscillation transformer (honeycomb) for the 34 circuit.
One audio-frequency transformer, tiny type preferred, for 30 circuit.

Condensers

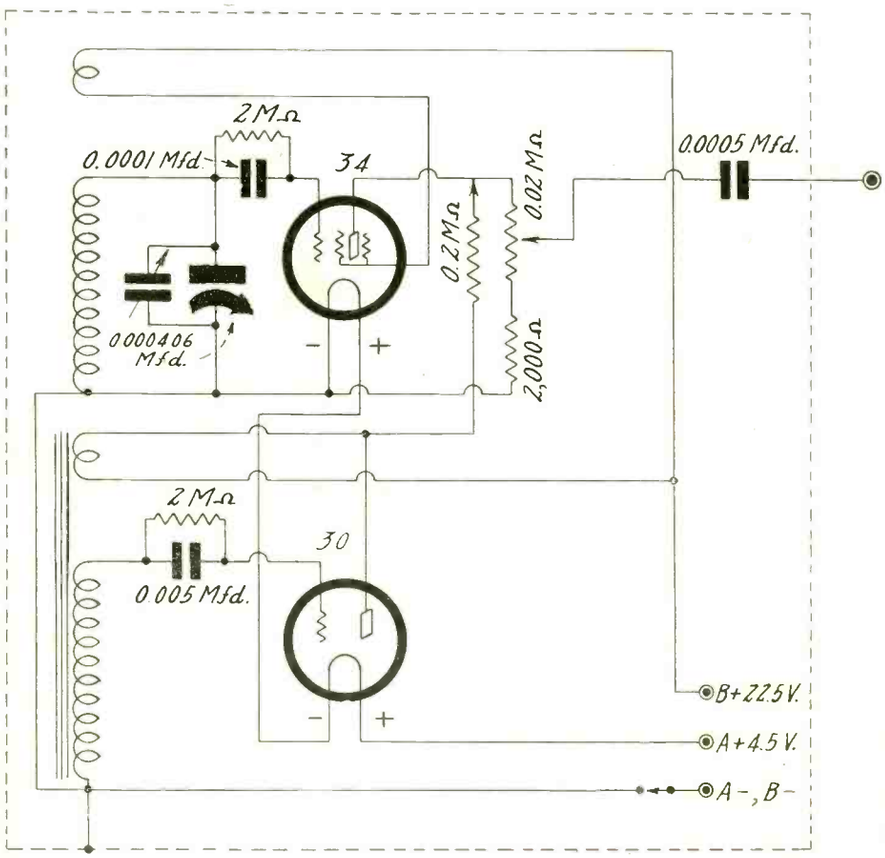
One 0.000406 mfd. tuning condenser with 30 mmfd. trimmer built in (main condenser closes to right).
One 0.0001 mfd. mica grid condenser.
One 0.005 mfd. grid condenser for 30 tube.
One 0.0005 mfd. mica dielectric fixed condenser.

Resistors

Two 2.0-meg. pigtail resistors.
One 0.2-meg. pigtail resistor.
One 2,000-ohm pigtail resistor.
One 0.02-meg. (20,000-ohm) potentiometer with switch attached.

Other Requirements

One frequency-calibrated scale (commercial number 7072).
One double-pointer escutcheon for this scale (commercial number 564).
One grid clip.
One separate rotary switch.
Two UX (four-hole) sockets.
One finished, drilled metal shield cabinet.
One finished, drilled metal chassis.
A length of stranded output wire.
One knob for ¼-inch shaft.
Two bar handles for ¼-inch shaft.
Two index plates, one for modulation switch and one for attenuator.
One 34 tube and one 30 tube.
One 4.5-volt C battery.
One 22.5-volt B battery.



Electron coupling is used between the modulator and the r-f oscillator, as well as between r-f output and the measured circuit, in the Model 336 signal generator, which is battery-operated. The attenuator may be any value, 0.02 meg. up, the limiting resistor one-tenth the potentiometer value

(*Continued from preceding page*)
tery connection is 22.5 volts plus, used both for the r-f and a-f oscillators.

Bias in the Modulator

As the r-f tube has grid-leak-condenser control, there is negative bias on this tube depending on the amplitude of the r-f oscillation, while on the audio oscillator there is a negative bias of 2.25 volts, equal to the drop in the filament of the 34.

For the radio-frequency coil, or oscillation transformer, a honeycomb is used, with secondary inductance of 3.4 millihenries, with a smaller primary, about one-quarter the number of turns that are on the secondary, and with coupling somewhat closer than would be used if there were 90 volts or more on the plates. The distance between centers of primary and secondary, measured along the coil axis, is about ⅜ inch.

The audio oscillation transformer is a small audio transformer of almost any type, and a cheap, poor-grade audio transformer makes a good oscillation transformer for the present purpose, for then the natural frequency is not so low as to create a growling modulation. In the circuit as shown the 30 tube has a 2-meg. leak and a grid condenser of 0.005 mfd. The actual note generated can be controlled. If the grid condenser capacity is made smaller the frequency will be higher, while if the leak resistance is made smaller the frequency changes in the same direction. The constants specified, in conjunction with a small push-pull input transformer, the center-tap of which was snipped off, gave a note of around 2,000 cycles, clear and crisp.

A-F Oscillation Stronger

It is entirely practical, for purposes of raising the frequency, in the event the audio transformer is "too good" and produces an undesirably low note, to use the conventional primary in the grid circuit and put the secondary in the plate circuit.

The audio tube is the readier oscillator. This is common experience. In fact, with a special oscillation transformer, it was possible to get audio oscillations, using no plate voltage from the B battery on the 30 tube, but simply connecting plate return to positive filament. Then the applied plate voltage was only 2.25 volts, and yet the tube oscillated. No such experiences could be developed at radio frequencies. It simply confirms the ease with which audio oscillations can be produced. Of course the frequency is different with these very low plate voltages. The lower the voltage the higher the frequency, all other constants being held constant.

Because it is so easy to produce large audio oscillations, it is not practical to use the full modulation voltage (a-c note) on the r-f tube. That is true because the a-f oscillation amplitude is higher than the r-f oscillation amplitude in the attenuator circuit. So instead of directly connecting the audio generator to the radio generator a limiting resistor of 0.2 meg. is used (200,000 ohms).

Second Limiting Resistor

There is another limiting resistor, the one marked 2,000 ohms. This is about right for preventing the generator from acting as a volume control on the receiver that is being measured. Sometimes, if the resistance between arm and A minus, is too low, compared to the input impedance of the set being measured, the generator attenuator controls the receiver sensitivity, which is exactly what is not desired. If 2,000 ohms does not safeguard fully against this in any instance, increase the resistance somewhat, but no increase to a large value would be necessary, about 5,000 ohms being the limit. The value of this resistor is not critical, but 2,000 ohms has been found generally satisfactory. Those having other values on hand should not use less than 2,000 ohms nor much more than 5,000 ohms.

The 34 tube is used as a triode, with the screen element serving as the true plate, the conventional plate serving as what might be called a pickup grid. There is a potential drop across the load on this pickup grid, or originally-intended plate, which is utilized for output. The method is extremely satisfactory for safeguarding the generator from detuning effects due to the load put on it, that is, connection of the measured circuit to the generator. The current is present in this pickup grid circuit due to impinging electrons, no matter if the modulation switch is on or off, that is, whether there is some B voltage introduced, or zero d-c voltage. Moreover, the tuning characteristics of the r-f generator are not changed whether modulation is introduced or not.

Turn Off Modulator Switch

It should be noted that when the filament switch, lower right, is turned on, both filaments are emitting, and that they are kept thus during all operation. When modulation is to be introduced, the separate switch, upper center, is turned on, and when none is desired, this switch is turned off. But it should be carefully noted that it is not enough to turn off the filament switch, when finished using the generator. The modulator switch must be turned off, likewise, or there will be a circuit completed through tube filaments to A plus to A minus, across the B battery, consisting of 222,000 ohms, resulting in a constant drain on the B battery, even when not in intended use, of about 1 milliampere.

The generator, as stated, covers intermediate frequencies on fundamentals, but of course not all of them. Thus intermediate frequencies higher than 380 kc are taken care of by suitable harmonics, which position are indicated directly on the dial scale in terms of the desired i.f. So coverage to the lower frequency limit of the broadcast band is established. And then the broadcast band is taken care of by a single harmonic order throughout—the fourth—and the accuracy in general is 1 per cent.

The frequency-calibrated dial should be set at 135 when the tuning condenser plates are fully meshed (maximum capacity), then the setscrew is tightened, a check made to see that the tightening process did not shift the dial, and then the dial is turned to read some high frequency, say, 380 to 355, and a second harmonic of the generator used for beating with a broadcasting station. In New York City, for instance, WOR is a suitable test station, on 710 kc, so that the second harmonic of the generator's 355 kc may be used for lining up, or the second harmonic of 380 kc could be used for beating with WJZ's 760 kc.

Only One Adjustment

A receiver, preferably of the t-r-f, type is used, the generator's output lead wrapped around the antenna leading a few turns for coupling. The built-in trimmer on the tuning condenser is adjusted for this purpose. It is the only adjustment necessary for making the scale track the generator.

If the frequency reads too high, reduce the trimmer capacity. If the frequency reads too low, increase the trimmer capacity. The adjustment has to be carefully made to establish the 1 per cent accuracy, and the generator may have to be slid out of its shield box several times before this particular piece of work is completed.

The scale and coil are commercial products. The scale scarcely could be duplicated by the consrtuctor with such accuracy and permanence, as the metal disc is die-cut. The coil is a honeycomb, which few experiments have the facilities for winding.

This is a very satisfactory instrument, weighs only 7 lbs., including tubes and batteries, and costs very, very little to build. The classification number of the instrument is 336.

It is scarcely possible to have a simpler, more highly-accurate and stable oscillator for the compact dimensions of the shield cabinet, 9 inches wide, by 6½ inches high, by 5 inches front to back.

Strong Language Barred to Fire Fighters

Because of the large numbers of possible listeners on short-wave radio sets, United States Forest Service officers are finding it necessary sometimes to tone down their working vocabularies, even under the stress of battle with the flames. Strict orders against "cuss-words" in radio messages have been issued, the Forest Service revealed in reporting that more than 600 radio stations have been installed for emergency communication in the national forests this summer.

Now that short-wave receivers have become so popular, radio gives far less privacy than even the old-fashioned party telephone line, according to the Forest Service. Thousands of listeners are picking up the Forest Service messages, and occasionally getting a real insight into the many difficulties and problems foresters have to meet in quelling fires in the woods.

The Forest Service has been developing specialized equipment, and has used radio somewhat in national forest protection work in the West in the last few years. For the first time radio communications have been provided this year in national forests east of the Mississippi. Portable and semi-portable sets are now in use in the White Mountain National Forest in New Hampshire, and the Cherokee National Forest in Georgia and Tennessee. About 70 additional stations have been installed in the forests of the Pacific Northwest, and others in Montana, California, and the Great Basin States. The boat patrol of the national forests in Alaska has installed some sending and receiving equipment.

Radio is used by the Forest Service only as a supplement to its established telephone system, but it has already proved extremely valuable for rapid communication during outbreaks of fire or other emergencies. It was used extensively in fighting the recent severe fires that raged in the Northwest.

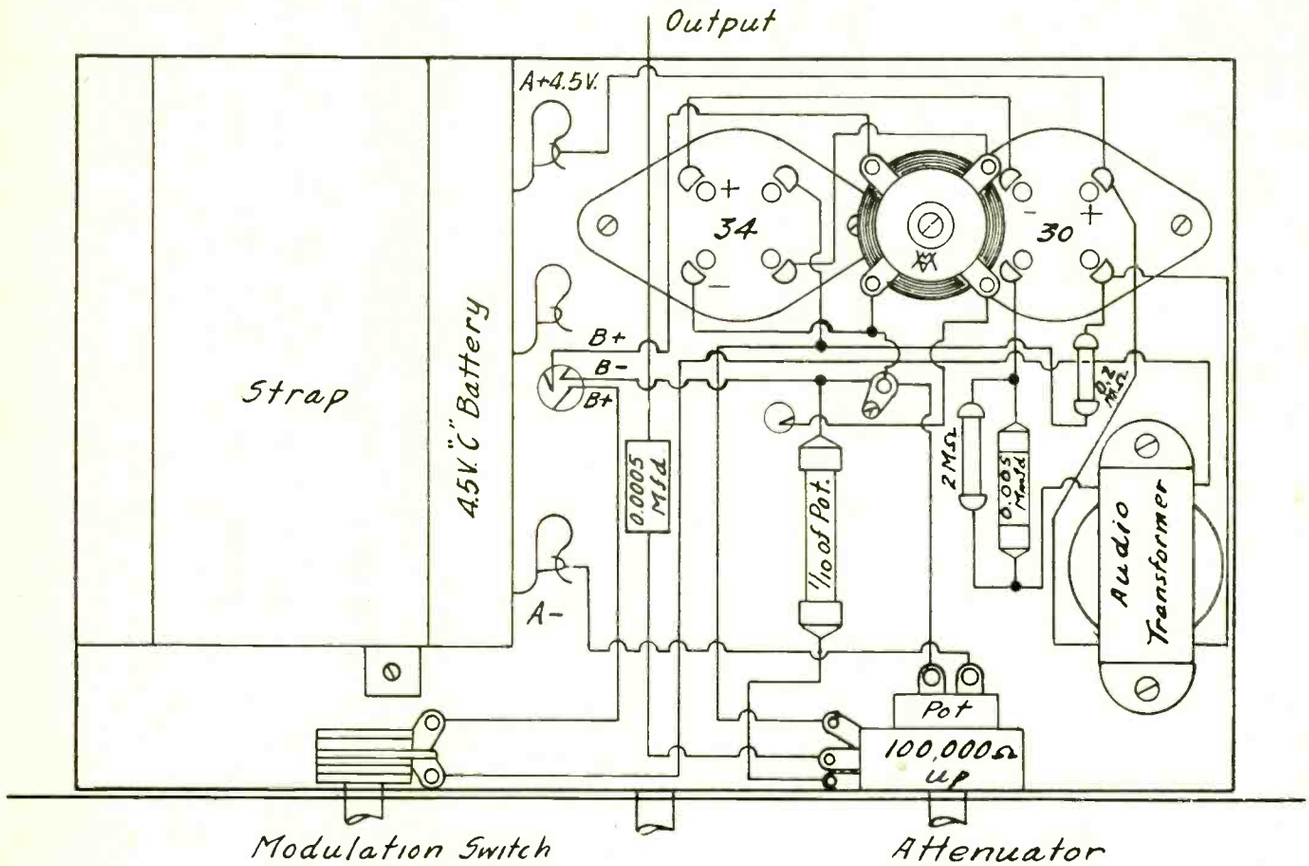
Weight, performance, and durability are the three major factors in radio equipment construction for Forest Service use. Portable code sets weighing as little as 10 pounds have been developed, but the "smoke chasers" usually use sets capable of both sending and receiving voice. Some of these latter are as light as 16 pounds, complete with batteries and antenna, and Forest Service engineers and the manufacturers are almost constantly improving them.

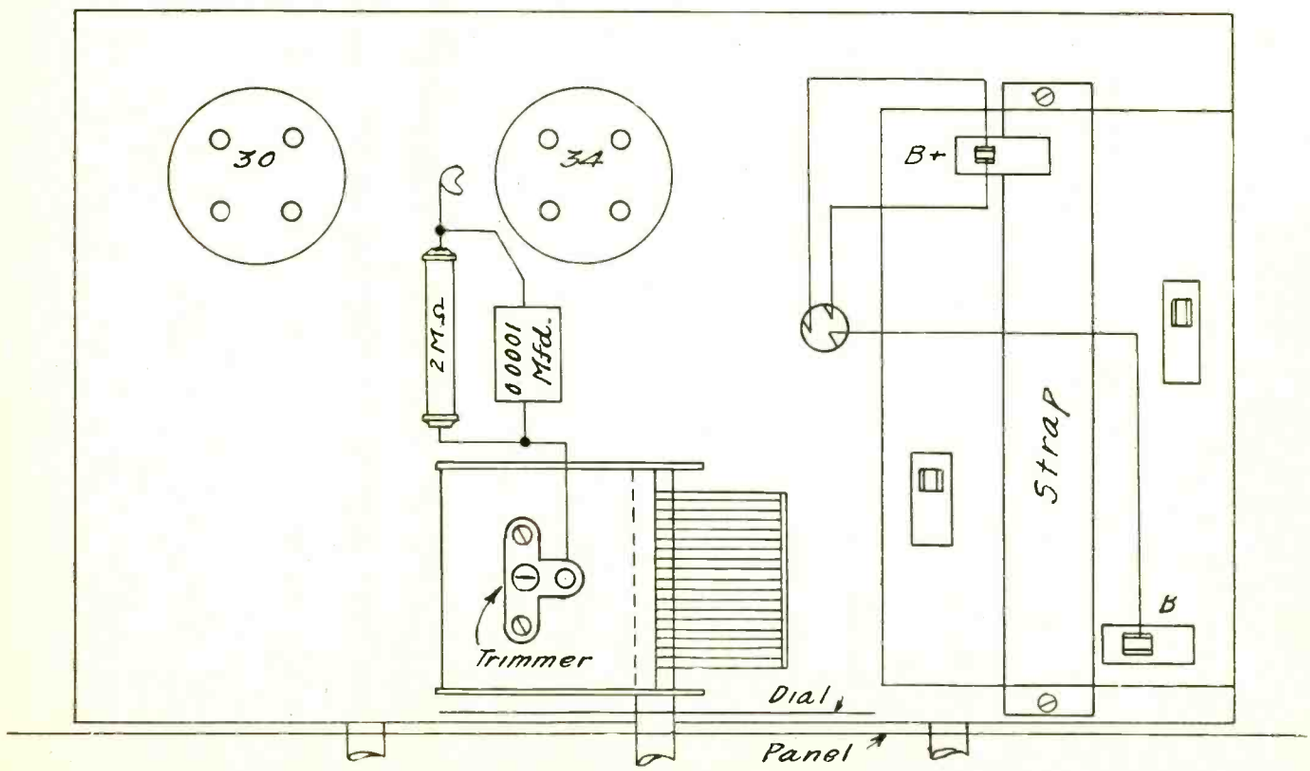
A very recent experimental model, which operates below the static level of storms, gives promising results, especially for communication between sectors of the line in fighting large fires.

Representatives from each national forest region attended a special course of training by the Forest Service radio specialists last spring, as an aid to fitting radio into the scheme of communications and fire reporting for their respective forests.

Radio communication in the national forests at present is limited to use in case of emergency.

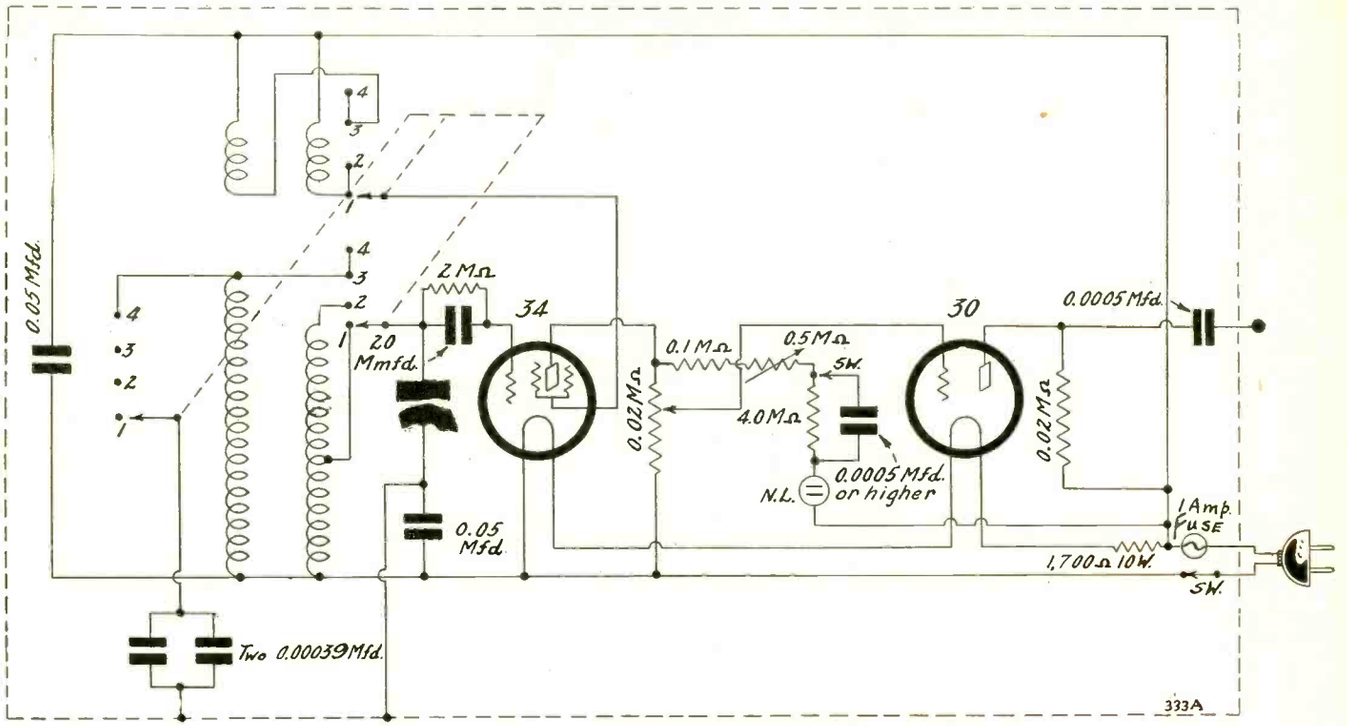
Pictorial Circuit of the 336 Signal Generator





An Amplifier Stage

In a Switch-Type Signal Generator



Circuit diagram of the wiring. The blueprint diagram corresponds to this.

THE 333-A is a switch-type signal generator with an amplifier stage and works on a.c., d.c. or batteries. The 333 has been described (September 8th and 15th issues), and the present model differs from it mainly in respect to the amplifier stage.

The circuit diagram of the wiring appears on this page. The pictorial layout is on the following page.

The front panel has two openings for double-pointer escutcheons, so that four scales are exposed on the same dial. On one side are 83 to 99.9 kc and the wavelength equivalent, 3,010 to 3,600 meters. On the other side are the broadcast and intermediate bands. Since the same switch stop accounts for both the frequencies and wavelengths of the first range, there is an extra switch stop to total four, and this is devoted to 1,650 to 4,800 kc, simply by reading the broadcast scale and multiplying the reading by 3.

The Bars on the Scales

The low-frequency scale will serve some occasional intermediate frequencies in old sets, but the range referred to above as "intermediate frequency" is 140 to 500 kc. So far everything is represented by fundamentals, no harmonics used.

The 83 to 99.9 kc range is in steps of not more than 0.5 kc, and toward the high-frequency end, in steps of 0.1 kc. The metrical equivalent in wavelengths is in steps of not less than 10 meters and down to steps of 1 meter. The broadcast band is in steps of 10 kc and, toward the end, 50 kc. The high-frequency band is therefore in steps of 30 kc and toward the end, 150 kc.

However, any closer readings may be obtained as desired by methods outlined last week, issue of September 15th.

The highest accuracy obtains on the broadcast band. The stated accuracy is 1 per cent., but the actual coincidence of the scale to the generated frequency in this band is nearer ¼ of 1 per cent. This is possible because the inductances are held very accurately and there is no trimmer across the tuning condenser, particularly none of the compression type. The accuracy on the 140-500 kc range varies a little, sometimes being much better than 1 per cent.

For the low frequencies, or the wavelengths as plotted, since two precision fixed condensers of 0.00039 mfd. are cut into the circuit in parallel with the tuning condenser, an adjustment is permissible for this band in the 0.05 mfd. capacitv between rotor of the tuning condenser and negative filament of the 34. The adjustment is made after one concerning the broadcast band, to be discussed later.

Broadcast Adjustment

With such a large capacity for tuning, around 1,200 mmfd. to 400 mmfd., naturally a series capacity even of 0.05 has a reduction effect on the net tuning capacity. So if the scale reads off, the series capacity may be changed accordingly. If the frequencies read too high, reduce the series capacity. This may be done by putting 1 mfd. or somewhat less in series with the 0.05 mfd., or by using smaller than 0.05 mfd. and making up the difference by paralleling with mica fixed condensers of 0.00025 mfd. or the like. If frequencies read too low, put small capacities across the 0.05 mfd. until the pointer has to be turned back to the very frequency generated. Those tests should be made at the low-frequency end or near it. and tenth harmonics of the generator may be used for beating with stations on 830 kc, 840 kc, 850 kc or 860 kc. It is not well to go much above 86 on the dial to make this adjustment.

The high-frequency end of this range will take care of itself if a preliminary adjustment has been made for the broadcast band. alteration. The "plate" is really used as a pickup grid, as the screen is used for feedback, so electron coupling prevails in all three connections: (1) from audio oscillator to radio-frequency oscillator; (2) from radio-frequency oscillator to amplifier tube, and (3) from generator to measured circuit, as the 30 amplifier does not alter the fact that electron coupling intervenes.

LIST OF PARTS

(For Switch-Type Generator, Model 333A)

Coils

One r-f oscillation transformer, secondary inductance 3.3 microhenries.
One r-f transformer, secondary inductance 230 microhenries, tapped at 25.55 microhenries.

Condensers

One 406 mmfd. tuning condenser.
One 0.0001 mfd. mica grid condenser.
Two 0.05 mfd. fixed condensers.
Two 0.005 mfd. fixed condensers.
Two 0.00039 mfd. precision mica fixed condensers.

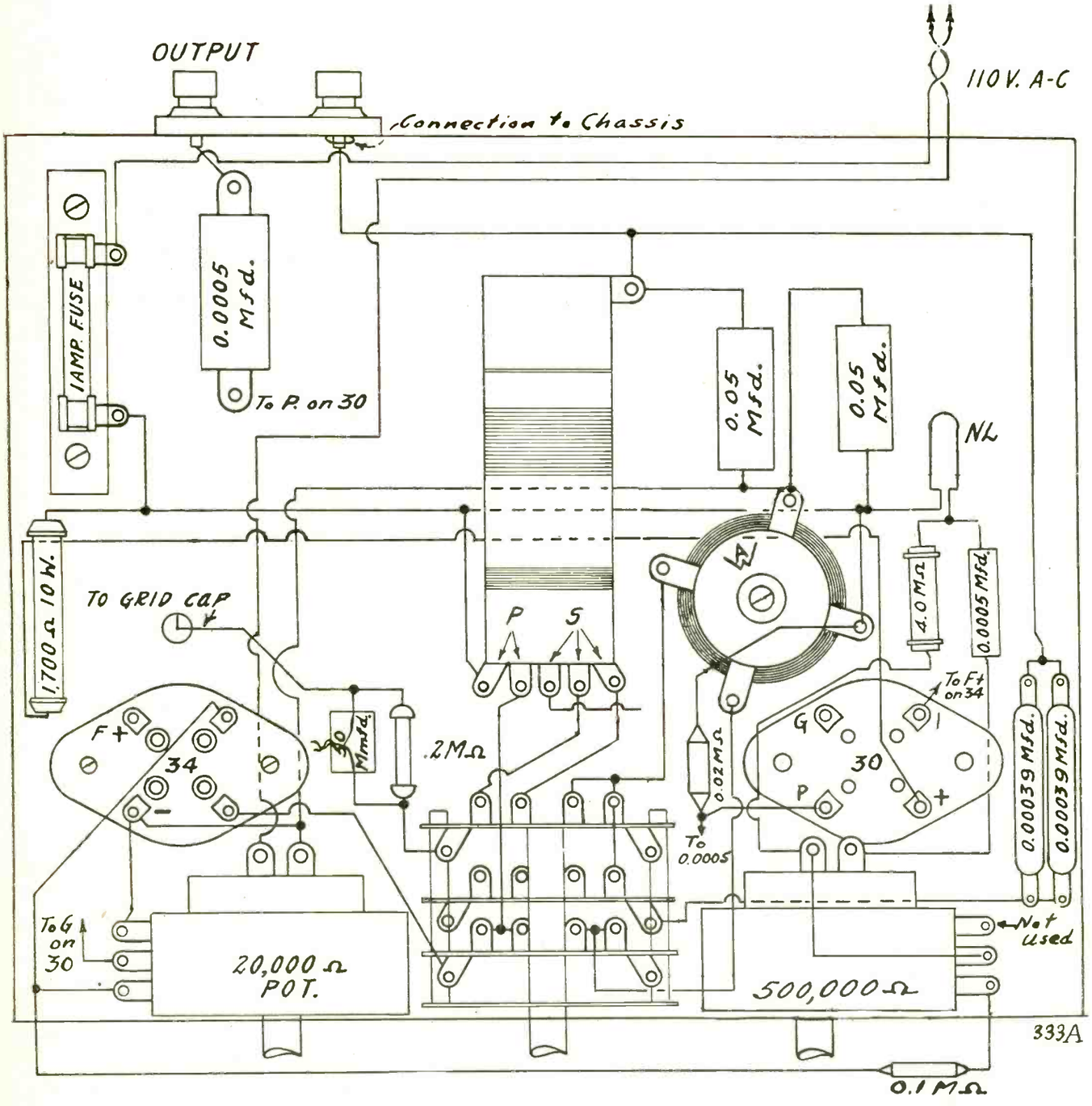
Resistors

One 2.0-meg. pigtail resistor.
One 0.1-meg pigtail resistor.
One 0.02-ohm pigtail resistor.
One 4.0-meg. pigtail resistor.
One 1,700-ohm, 10-watt resistor.
One 20,000-ohm wire-wound potentiometer, shaft-insulated type; a-c switch attached.
One 500,000-ohm potentiometer with switch attached.

Other Parts

One crinkle-finish metal box and chassis, punched.
Two escutcheons.
One calibrated dial.
Two UX (four-prong) sockets.
One a-c cable and plug.
One 1-ampere fuse and holder.
One output twin post assembly (ground post included, need not be used).
Three bar handles for ¼-inch shafts.
One round knob for ¼-inch shaft.
One 0.100 scale plate.
One frequency-band—index scale plate for lower center of panel.
One volume-direction index plate.
One three-deck, four-position switch.
One screen-grid cap.
One 34 tube, one 30 tube and one neon tube (¼ watt type without limiting resistor built in).

Architectural Diagram of the 333A Generator



Pictorial diagram of the actual location of parts and wiring of the 333A Signal Generator

Harmonic Differentials

Applied in Using Low-Frequency Oscillator to Measure Unknown High Frequencies

By Rex E. Lovejoy

President, Southwestern School of Radio Theory

THOSE who own and employ calibrated oscillators seldom realize the wide possible application. Since the trend is toward short waves and ultra-high frequencies, an oscillator calibrated from broadcast stations is invaluable, and herein is described a simple method of determining any unknown frequency higher than that of such a standard.

While application is simple, most experimenters wish to understand just *why* a certain formula is true, so herein, also, is given the derivation of the formula that we hope is as interesting as the formula itself.

The Process Analyzed

Suppose we take an ultra-high frequency to start with:

$f = 7{,}000$ kc

Now, 7,000 kc can be produced as the *seventh* harmonic of an oscillator set at a fundamental frequency of

$f'' = 1{,}000$ kc

It can be produced, also, as the *eighth* harmonic of an oscillator set at

$f' = 875$ kc

Setting these into algebraic form;

$$\frac{f}{f'} = 8 \qquad \frac{f}{f''} = 7$$

We can combine these two equations into one equation taking the form:

$$\frac{f}{f'} = \frac{f}{f''} + 1$$

Clearing and solving for f:

$$\frac{f}{f'} - \frac{f}{f''} = 1$$

$$\frac{ff'' - ff'}{f''\,f'} = 1$$

$$f\left(\frac{f'' - f'}{f''\,f'}\right) = 1$$

$$f = \frac{1}{\dfrac{f'' - f'}{f''\,f'}}$$

$$\left[f = \frac{f'' \times f'}{f'' - f'}\right]$$

Where f = ultra-high harmonic frequency
f′ = *lower* fundamental frequency
f″ = *higher* fundamental frequency

Through the use of this formula, if we know any two of f, f′ or f″ we can calculate the unknown.

Example Cited

Suppose a short-wave receiver is set at an unknown frequency we wish to determine.

Listening in the receiver, turn on the calibrated oscillator and adjust until a signal is heard. Record the oscillator setting in terms of fundamental frequency and call it f′. In a hypothetical case it may be, for example, 800 kc.

Leaving the receiver undisturbed, turn the oscillator toward a higher fundamental frequency until another response is heard in the receiver. Be very careful. Turning the oscillato dial slowly lest an harmonic is overlooked. Record the second oscillator setting in terms of frequency and call it f″. For our hypothetical case, let's say it is 1,200 kc.

Then substitute in the formula the values of f′ and f″ and perform indicated operations as follows:

$$f = \frac{1{,}200 \times 800}{1{,}200 - 800} = \frac{960{,}000}{400} = 2{,}400 \text{ kc}$$

Then the receiver is set exactly at 2,400 kc.

Frequency Predetermination

By use of the same formula a receiver or any resonant circuit equipped with an audibility device may be set at any predetermined frequency.

For example, suppose we wish to set a short-wave receiver at exactly 8,000 kc. Then

$$f = 8{,}000 \text{ kc.}$$

Obviously, this can be produced at the oscillator as the *eighth* harmonic of 1,000 kc. Then

$$f' = 1{,}000 \text{ kc.}$$

Since f′ produces an *eighth* harmonic at 8,000 kc, then f″, whatever it is, produces a *seventh* harmonic of the same frequency. To calculate the value of f″, divide f (8,000) by 7 thus:

$$f'' = \frac{f}{7} = \frac{8{,}000}{7} = 1{,}142.85 \text{ kc}$$

Too High or Too Low

Setting the oscillator at 1,000 kc, turn on the receiver and adjust to zero beat. Then leaving the receiver undisturbed, slowly turn the oscillator dial toward a higher frequency and 1,142.85 kc.

If another signal is heard *before* the oscillator reaches an indication of 1,142.85 kc, then the receiver is set *above* 8,000 kc in frequency. If another signal is not heard until the oscillator dial indicates a fundamental frequency *higher* than 1,142.85 kc, then the receiver is set at two low a frequency, or below 8,000 kc in frequency.

The adaptability of this formula is wide. Its accuracy is absolute though it may be offset slightly by error in reading the oscillator dial and inaccuracy in adjusting signals to zero beat.

After one studies the derivation and readily understands the relationship that takes place, it becomes apparent that there are several methods of application. It is best, however, to adhere to one precedure alone in order to avoid confusion.

JUGOSLAVIA RADIO SHOW

The annual radio show in Jugoslavia will be held at Belgrade in October and the RMA has been requested by the Radio Club of Belgrade to advise American manufacturers with a view to exhibition of their products. Communications should be addressed to the Radio Klub Beograd, Brankova ul. 16, Jugoslavija, Beograd.

Hammarlund Announces Low-Priced Plug-In Coils, New Dielectric

A dielectric compound known as XP-53 is used in the new low-priced short-wave coil forms released by the Hammarlund Manufacturing Company, 424 West Thirty-Third Street, New York City.

This material is a natural light tan color, thus eliminating losses due to coloring compounds. The forms are groove-ribbed for air spacing of windings. There are also flange grips, and meter-index inserts for wavelength indications. A threaded shelf is molded inside to permit mounting of a trimming or padding condenser, for tuning the coil to a fixed frequency, or for bandspread arrangement.

The coil forms come with 4, 5 or 6 prongs.

Complete kits of wound coils to cover the entire range of frequency from 17 to 560 meters are also available. One kit, known as the SWK-4, contains four, 4-prong 2-winding coils, with a range of from 17 to 270 meters. Another, known as the SWK-6 kit, consists of four, 6-prong, 3-winding coils, with also a range of from 17 to 270 meters. Then, there is the BCC4, which is a 4-prong, 2-winding coil for the broadcast band, or from 250 to 560 meters, and last, there is one more broadcast coil, known as BCC-6, which is a 6-prong, 3-winding affair, also covering the 250 to 560 meter band. The secondaries of the 17 to 41 and 33 to 75 meter coils are of heavy silver-plated wire, affording minimum skin resistance losses. The secondaries of the other coils are of heavy gauge enameled copper wire. The boardcast coils are bank wound litz.

Combination Earpiece and Mike for 5 Meters

Universal Microphone Co., Inglewood, Cal., announces a combination earphone and microphone which is mounted similar to French phone hand-sets. It has been designed for five-meter transmitters and also the new five-meter transceivers. Since such equipment is necessarily portable, the new combination weighs only nine ounces.

Calibrated Airplane Dial

On Harmonic Type Generator That Marks New Epoch

AS in the case of the switch type oscillator discussed on preceding pages, the harmonic type oscillator may have an amplifier stage, and thus the 334, discussed in the September 8th issue, becomes the 334A.

Including an amplifier stage of course increases the output, but also enables freeing the connection between the total generator system and the measured circuit of any variable control, e.g., attenuator. It has been found that when output is taken from the plate circuit of the 34 there is no detuning, though a potentiometer is used, the only possible objection being that at very low settings of resistance between arm and minus the generator attenuator might act as a sensitivity control of the measured circuit, e.g., receiver. This may be cured by using a limiting resistor.

But if the attenuator is put between stages, then no limiting resistance is needed, for the high resistance of the amplifier tube is between the generator and the measured circuit. Ordinarily this would not be a good position for the control, because if it were in an effective plate circuit—say, the screen leg here used as effective plate for feedback—there would be some detuning by the control. But, as stated, with this electron-coupled methed there is no deturning, hence the combination in excellent and preferable just as presented.

Covers 100 to 200 kc Fundamentally

The fundamental frequencies are 100 to 200 kc, and due to the use of harmonics in an understanding way, higher frequencies may be measured, almost without limit. The old question is bound to come up: When do harmonics stop? And the answer must be given that, for present purposes of consideration they never stop. And indeed they go on and on, and are valuable, if only one has some means of identifying and interpreting them.

The Model 334A uses an airplane dial. The top row reads in kilocycles, 100 to 200, almost straight frequency line, in steps of 1 kc. The next row reads from 200 to 400 kc, in 5 kc steps. The next one reads from 400 to 800 kc, still in 5 kc steps, and the fourth row on the upper part from 800 to 1,600 kc in 10 kc steps. So from 100 to 1,600 kc are covered, which includes intermediate and broadcast frequencies. But of course the fundamental always is the same, 100 to 200 kc, and the value of the harmonics lies in the methods of identifying them. It is possible to eliminate all confusion due to the use of harmonics.

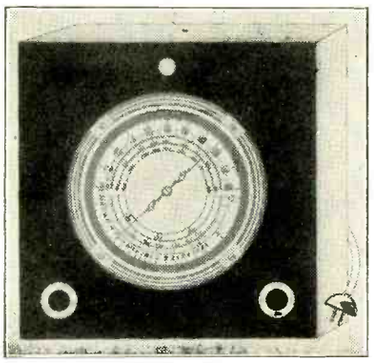
Airplane Dial Explained

The dial has a double pointer. The extreme bottom scale for the lower part of the dial reads from 2 to 20 mgc, using the harmonic counter system developed by the author. The pointer may be set to read the highest frequency of the fundamental that is recorded, e.g., 200 kc, and a response obtained in a circuit to be measured. Then readings are obtainable of high frequencies, in megacycles, in steps of 0.2 mgc (200 kc), from 2 to 10 mgc, and in full megacycle steps from 10 to 20 mgc. The method pursued is to register the first response in the receiver or other device being measured, not to count this first response, but to count the other responses heard as the dial is slowly turned to lower frequencies, until the total counted, including the final response, is nine. Then the frequency in megacycles is what the pointer indicates: 2, 2.2, 2.4, 2.6 etc. mgc.

If it is desired to run over the topmost (upper scale), and pick out two adjoining frequencies that fall exactly on bars of the calibration, e.g., 187 and 188, or 124 and 125, then the unknown frequency may be computed simply by multiplication. The adjoining responses, remember, must fall on consecutive bars, and fall accurately so. The higher the frequencies of the unknown, the closer to the high-frequency end will the two consecutive numbers appear. The following list accounts for all these consecutive numbers in terms of the unknown:

Responses on Generator Fundamental	Unknown Frequency Then Is in Mgc	Responses on Generator Fundamental	Unknown Frequency Then Is in Mgc
100 and 101	10.1	150 and 151	22.65
101 and 102	10.302	151 and 152	22.95
102 and 103	10.506	152 and 153	23.256
103 and 104	10.712	153 and 154	23.56
104 and 105	10.92	154 and 155	23.87
105 and 106	11.13	155 and 156	24.18
106 and 107	11.34	156 and 157	24.5
107 and 108	11.556	157 and 158	24.8
108 and 109	11.772	158 and 159	25.12
109 and 110	11.99	159 and 160	25.44
110 and 111	12.21	160 and 161	25.76
111 and 112	12.432	161 and 162	26.18
112 and 113	12.656	162 and 163	26.40
113 and 114	12.882	163 and 164	26.73
114 and 115	13.11	164 and 165	27.06
115 and 116	13.34	165 and 166	27.39
116 and 117	13.472	166 and 167	27.72
117 and 118	13.806	167 and 168	28.06
118 and 119	14.042	168 and 169	28.49
119 and 120	14.28	169 and 170	28.73
120 and 121	14.52	170 and 171	29.07
121 and 122	14.762	171 and 172	29.41
122 and 123	15.006	172 and 173	29.76
123 and 124	15.252	173 and 174	30.10
124 and 125	15.52	174 and 175	30.45
125 and 126	15.75	175 and 176	30.8
126 and 127	16.002	176 and 177	31.15
127 and 128	16.256	177 and 178	31.5
128 and 129	16.522	178 and 179	31.86
129 and 130	16.77	179 and 180	32.22
130 and 131	17.03	181 and 182	32.94
131 and 132	17.29	182 and 183	33.3
132 and 133	17.556	183 and 184	33.67
133 and 134	17.82	184 and 185	34.14
134 and 135	18.09	185 and 186	34.41
135 and 136	18.36	186 and 187	34.78
136 and 137	18.63	187 and 188	35.15
137 and 138	18.906	188 and 189	35.53
138 and 139	19.18	189 and 190	35.91
139 and 140	19.46	190 and 191	36.21
140 and 141	19.74	191 and 192	36.67
141 and 142	20.02	192 and 193	37.05
142 and 143	20.306	193 and 194	37.44
143 and 144	20.59	194 and 195	37.78
144 and 145	20.88	195 and 196	38.22
145 and 146	21.17	196 and 197	38.91
146 and 147	21.46	197 and 198	39.00
147 and 148	21.756	198 and 199	39.4
148 and 149	22.05	199 and 200	39.8
149 and 150	22.35		

Due to the tuning characteristic the very high frequencies naturally are crowded, perhaps unavoidably so for any system that uses a tuning ratio of 2 to 1 or higher. However, another method then is applicable, that of determining the unknown frequency by computation, using two frequencies as obtained from the direct-reading dial. Get a response in the receiver at any setting of the generator and note the frequency. Call that Frequency A. Then get a response at the next following point as the generator dial is slowly turned in either direction. Note that frequency. Call it Frequency B. These frequencies are read from the top scale (upper part of the dial). The unknown frequency is the product of the two (A times B) divided by the difference between the two (A minus B, or B minus A, depending on which whether A is less or greater than B). This method has been independently developed in laboratories. Two instances known to the author are independent work of Edward M. Shiepe



Front-panel view of the 334 and 334A signal generators, disclosing the frequency - calibrated airplane dial.

So far, therefore, we have three forms to apply, as we desire or prefer. First, using the harmonic counter system, counting nine responses (ignoring the first) and reading the frequency in megacycles directly. Second, using the product divided by the difference, of two consecutive-response frequencies, a method of simple calculation. Third, by confining ourselves to response on adjacent bars we can obtain unknown values from the foregoing table, if the responses fall on even kilocycle bars that also adjoin.

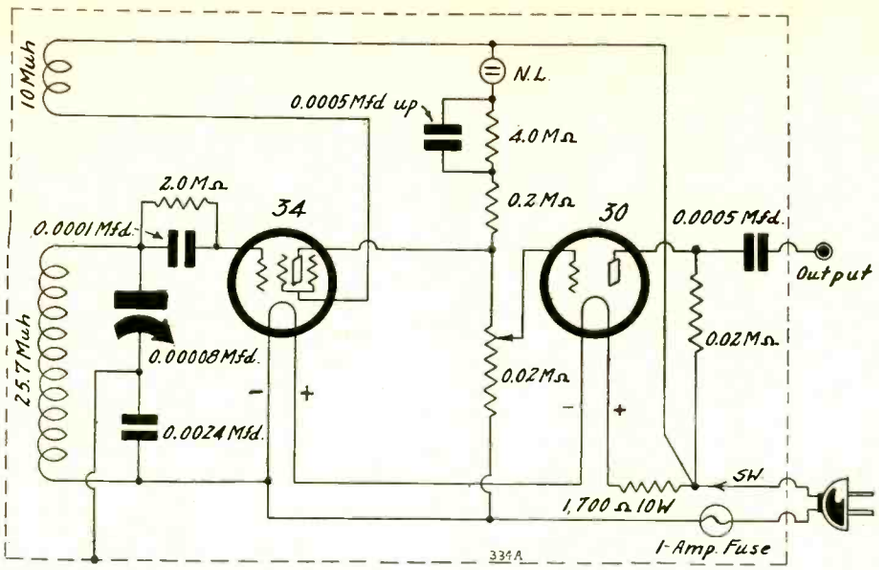
Besides the scales already treated of, there are two more. One represents popular intermediate frequencies and eliminates any and all confusion as to them, because when any particular frequency is wanted, say, 465 kc, the pointer is set for either of two positions marked 465 kc, and when the response is obtained in the i-f channel, the dial is turned until the pointer falls on the second 465 kc position. Now there must be the second response. If there is, then the frequency is 465 kc and can not be anything else. Either position may be used for actual measurement or peaking, and indeed the harmonic order being used may be determined by dividing into 465 kc the frequency read on the fundamental.

Determination of Harmonic Order

Say there are two positions for 465 kc. Read the lower pointer for one of them and divide the frequency indicated by the upper pointer into 465. Suppose the upper pointer reads something a bit more than 116. Then the fundamental really is 116.25 and the harmonic order is 465/116 .25 or fourth. If the reading is 155 then the harmonic order is 465/155 or the third harmonic. A double check may be made, although it really is a repetition of what has just been done. Multiply 155 by 116.25 and divide by the difference. The product is 18,018.75 and the difference is 38.75. The division of 1,801,875 by 3,875 gives the answer, 465.

There is still another scale, that of wavelengths, 3,000 to 1,500 meters. This may be used directly for determining wavelengths

(Continued on next page)



The harmonic type generator, Model 334A, follows the above circuit diagram. The blueprint will appear next week.

(*Continued from preceding page*)
along the fundamental, or, by noting consecutive responses, determining the wavelength of an unknown by the difference in the wavelengths read, a method due to Mr. Shiepe.

Aid of Amplifier Tube

Thus the frequencies may be read by the harmonic system, with various degrees of gradation, from 2 mgc to 20 mgc, and by the computation method determined from 10.1 to 39.8 mgc. The wavelengths may be determined from 10 meters to 3,000 meters.

Of course to enable readings there must be responses, and while it has been stated that the harmonic orders keep right on going, nevertheless the receivers keep right on losing sensitivity as the frequencies are increased. Therefore it is imperative that the receiver be sensitive enough to enable a response, but this is nothing to worry about, certainly not if a modern receiver is used, and most certainly not if there is an amplifier stage in the generator, for that has the effect of making audible a response of a frequency eight times as high as where responses might cease if there were no amplifier stage.

The 334 and 334A use a brass-plate precision type tuning condenser and the inductances are so accurately selected that there is no need of any adjustment save to be sure that the grid condenser is 0.0001 mfd.

Tracking Method

If tracking can not be accurately established at once, use this method:

Set the plates for practically total capacity and have the pointer read 100 kc. Then turn to the high-frequency end and check on some broadcasting station, using a generator fundamental frequency from 200 to 180 kc. A station frequency of 1,200 or 1,400 kc would be highly acceptable for 200 kc setting of the generator (sixth or seventh harmonic). If the reading on the dial is too low, add grid condenser capacity until when the pointer exactly indicates 200 the beat is heard as near to zero as practical. No other adjustment need be made, although for the low-frequency end, if the series condenser is much too small, there might have to be some capacity added here, too, although if the series condenser is much larger than 0.0024 mfd., that is all right.

The tuning condenser is of small capacity —80 mmfd.—and was selected after careful removal of plate after plate of a larger capacity condenser until the frequency span slightly exceeded 2 to 1, thus enabling the calibration of the scale over the desired 2-to-1 span. For any system using harmonics there is small advantage of using a higher ratio, in fact, a higher one may become disadvantageous because of attendant confusion.

Specialty for Battery Operation

While the instrument will work from 90 volts of B battery, this method is wasteful, as of course the 60 milliamperes for the filaments would be obtained from the B block. No separate A supply would be used. Such a heavy drain may have to be stood for a short while to make a test on any servicing job, but as a general practice is taboo. However, any who desire battery operation may bring out two leads for the filament, from negative of the 34 (to negative A of battery) and positive of the 30 (to positive of battery), and use a 4.5-volt C battery for the A supply. Then the 90 volts can be applied from the B battery by connecting B minus to A minus, and B plus of battery to the positive side of the cable plug. The 1,700-ohm resistance connection has to be opened if the foregoing battery use is to be enjoyed economically. In a commercial model there is provision for applying batteries economically, by using a battery cable with plug that fits into a socket at the rear wall of the chassis.

Directions for Use

Connect the cable plug to 90-120 volts a.c. or d.c. If a.c. is used the connection direction is immaterial. If line d.c. is used, and no oscillation is obtained, remove the plug and after turning the plug around 180 degrees so that a different polarity will become right, re-insert the plug in the outlet.

Turn on the switch attached to the attenuator and turn the attenuator completely to the right.

For lining up or peaking at intermediate frequencies, short-circuit the local oscillator tuning condenser, remove the antenna wire from the receiver, and connect an insulated wire from output of the generator to plate of first detector tube when that tube remains in socket. Turn the generator dial to read the desired frequency, trim the intermediate coils by adjusting the condensers on them, until maximum response or needle deflection or maximum illumination is obtained (depending on whether you are listening, watching an output meter needle, or a glow lamp) and then check for correctness of the frequency by turning to the second response point. If there is no second response point when the generator dial is moved over its entire span, you are working on the fundamental. After the check for frequency correctness the lining up of the i-f channel is completed.

Those receivers requiring flat-top peaking may be so peaked by using the bars on either side of the frequencies marked 465 and 175, that is, first bar to left of 465, then bar to right of 465, but not using 465 at all. The same holds for 175, the only other frequency so treated on the scale, although the flat-topping may be followed by using positions equally spaced from the mean frequency, with the eye serving as guide for the distance from that mean, when observing the markings for 465 and 175 kc flat-top peaking as clues.

For broadcast frequencies, and zero beating, the antenna may be restored. A short length of wire from generator output post may be wrapped around the antenna lead-in anywhere. This is abundant coupling. For very sensitive sets even this wrapping may be dispensed with.

For high frequencies (short waves), to gain reliable response, it is often necessary to make the connection to antenna from generator to the antenna post of the set conductive, that is, connect both antenna and output wire to that post.

A zero beat may be obtained with any station being brought in, or if no station is being received, a response may be heard in the receiver due to modulation, which is present on a.c., d.c. or batteries. Always there is modulation, for the neon tube oscillates at an audio frequency, hence is the modulator, whenever d.c. is applied, from line or batteries, of correct voltage.

The device therefore is a service instrument of extensive use and also is a station-finder. Moreover, it enables determination of both wavelengths and frequencies, and affords an accuracy of 1 per cent.

LIST OF PARTS

Coils

One honeycomb coil, 25.7 millihenries inductance (used as secondary)
One honeycomb coil, 10 millihenries inductance (used as tickler)
[One of above coils is attached to the other by using an 8/32 machine screw ½-inch long, for which the cores of the forms are threaded.]

Condensers

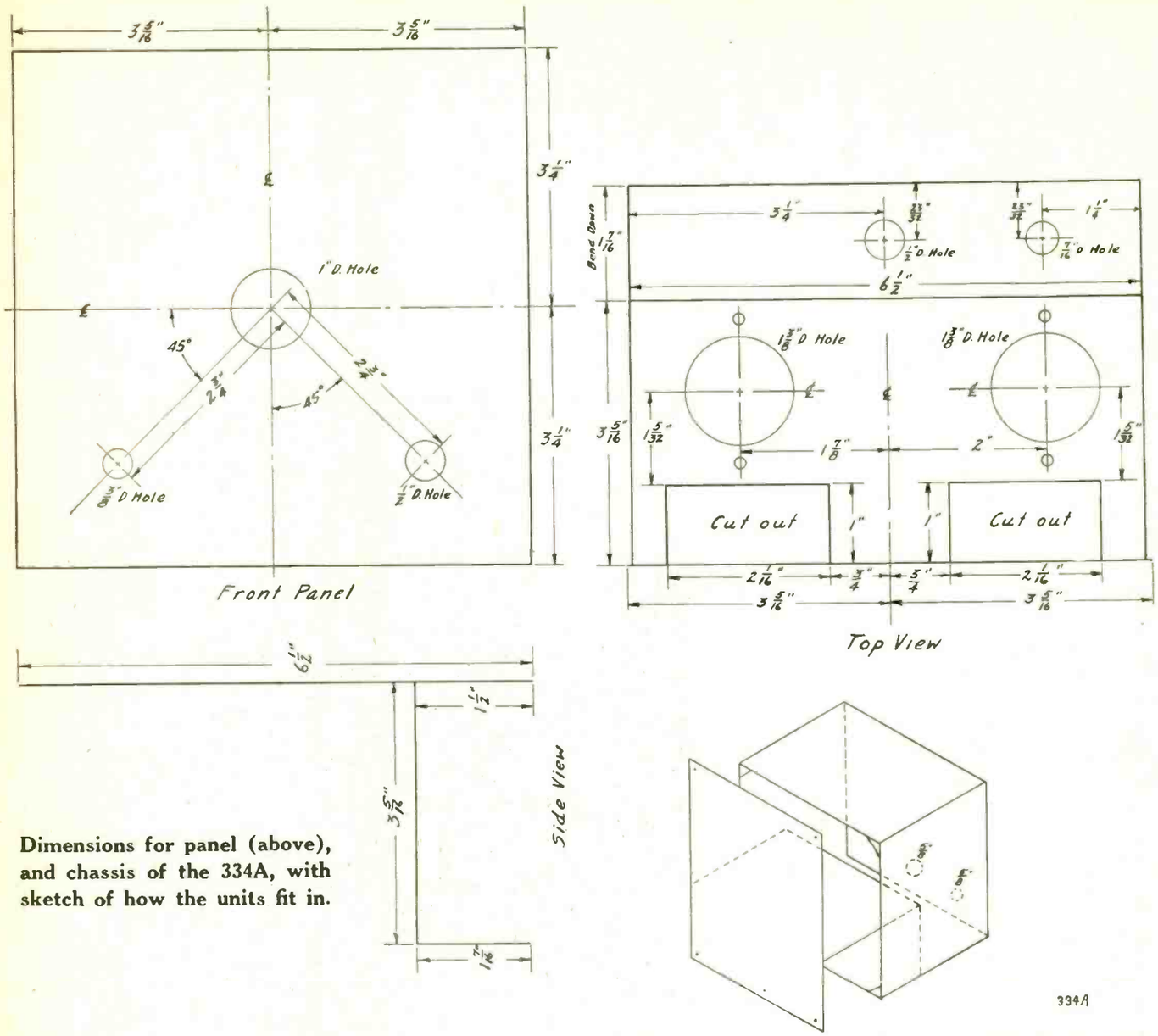
One 80 mmfd. tuning condenser
One 0.0024 mfd. mica fixed condenser (precision type)
One 0.0001 mfd. grid condenser
Two 0.0005 mfd. fixed condensers

Resistors

One 2.0-meg. pigtail resistor
One 4-0-meg. pigtail resistor
One 0.2-meg. pigtail resistor
One 0.02-meg. pigtail resistor
One 0.02-meg. potentiometer with a-c switch
One 1,700-ohm 10-watt resistor

Other Requirements

One shield cabinet
One frequency-calibrated airplane dial
Two knobs
One output jack
One a-c cable and plug
One 8/32 machine screw, ½-inch long
One chassis, attached to front panel
Two UX (four-prong) sockets
One grid clip
One 1-ampere fuse and holder.



Dimensions for panel (above), and chassis of the 334A, with sketch of how the units fit in.

Radio Plea for Baby Brings Transfusion That Saves Child's Life

A baby was dying in a charity ward in Cook County hospital, Chicago.

Her mother was desperately ill at home. The child's father waited near her bedside, hopeful, helpless.

A grave-faced doctor left the bedside and approached the father.

"Only an immediate blood transfusion can save her life," he said. "It must be done right away before it is too late."

Transfusions cost money. Sadly the father wondered how it could be done. His own blood was not of the right type. He telephoned a neighbor near his home, told her the doctor's verdict. How would they manage it? Time was precious and the minutes were slipping past.

The neighbor suddenly had an inspiration. The radio! She hurriedly telephoned WLS, told an employe the tragic story. Typewriter keys rattled, a hurriedly written announcement was rushed to the studio, where the Bundesen Hour was being broadcast. Dr. Herman N. Bundesen took the note, scanned it hurriedly and interrupted the program. Briefly he made his appeal. And within five minutes the first volunteer arrived at the hospital. His blood was of the proper type and he was rushed to an operating table. The baby's life was saved.

Tremendous Increase in Short-Wave Interest Noted by Westinghouse

Twice daily, at 12:30 and 5:15 P.M. Eastern Daylight Saving Time, W1XAZ broadcasts the latest stock market flashes to American listeners in many parts of the world. This special feature, which is broadcast only over W1XAZ and not on the regular WBZ-WBZA circuit, was initiated when it was discovered that many Americans in foreign lands had no other way of keeping in prompt contact with financial changes in the United States.

This stock market news information is the result of arrangements between the Westinghouse Company and the firm of Paine & Webber, stockbrokers, of Boston, Mass.

W1XAZ, recently redesigned and moved to Missis, Mass., is operating at a power of about 5 kilowatts on 9.570 kc and is regularly heard in practically all countries of the world.

Recently when the service was interrupted, during installation of the new transmitter, hundreds of letters were received requesting the service be continued. Most of the letters came from South America but many were from listeners in the United States. Short-wave listeners have increased tremendously in the past year, many preferring short-wave to standard-wave reception of the same program.

Construction of Valentine'

Circuit, Parts, Theory and Actual

a Superb Sup

By B.

EIGHT tubes are used in my de-luxe superheterodyne tuner, and there is no rectifier in the tuner, either, for the B voltage is taken from a separate power supply. Exceptional care was taken in both electrical and mechanical directions. The layout was shown in photographs printed in last week's issue (September 15th), and now the circuit is presented, with some data on both practice and theory.

The antenna connections are unusual. A single connection as normally found would not support sensitivity well enough all over the broadcast band, and also, despite care taken to establish the same tuning capacities in the main condensers themselves, inductance and other considerations made the inclusion of manual trimmers an advantage. It is admittedly not a great advantage, but the gain helps when needed, and the result is as fine a tuner as I have ever used.

Antenna Switching

The object was to establish the selectivity as high as practical, consistent with best quality, and this has been achieved, even though the circuit is a superheterodyne, and has two intermediate-frequency stages peaked at 175 kc, which is in general a more selective i.f. than any higher frequency found in multi-range receivers.

There is a fixed series condenser of 0.0001 mfd. which may be switched in or out, it being of assistance to higher broadcast frequencies when in, from the viewpoint of selectivity. The variometer inclusion also aids. When the condenser is in, so is the variometer, whereas the antenna may be connected directly either to the primary of the first coil or to a choke coil of 300 turns, when the coupling is by adjustable capacity (35 mmfd.) This coupling is particularly for the lower broadcast frequencies.

Of course these pains and precautions are not usually taken, and would not be acceptable for commercial production, but are advantageous to those constructors who are particular indeed, and like to have their work produce results of a higher order than normally obtainable.

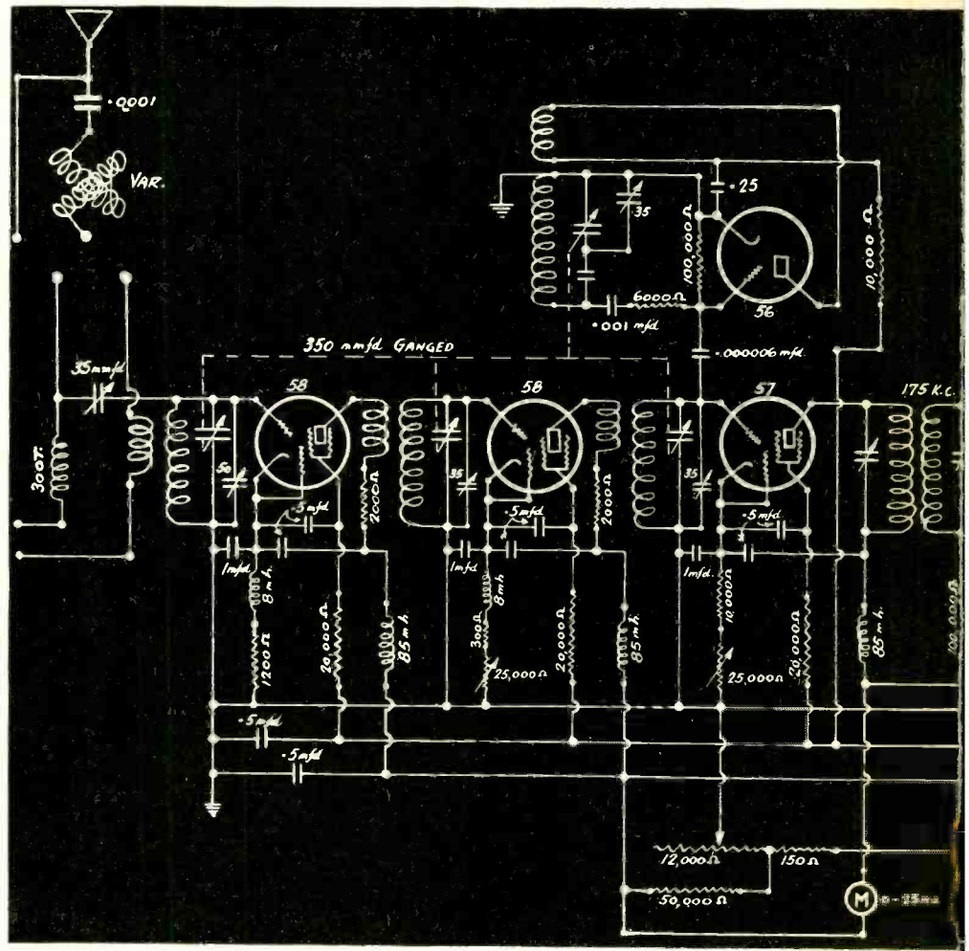
Separate 56 Oscillator

To capitalize on the gain possibilities the filtering is done with a vengeance, all plate and screen leads being filtered. Chokes and bypass condensers in the plate legs are included, the series-resistor-capacity filter for the screens is sufficient, while the use of large bypass capacity in the cathode legs is perhaps more important even than the plate-leg method, so 1 mfd. is used throughout the r-f level.

Four single condensers are used, two each ganged on either side of the drum dial, so, if the oscillator is included, and the primaries and secondaries of i-f coils, there are ten tuned circuits, which account for the main reason of selectivity, while the manual trimmers and special antenna treatment contribute to the tracking.

Kinks Removed

The two r-f stages are worked with 58 tubes, the local oscillator is a separate 56 tube, coupled to the 57 modulator by means of a 6 mmfd. condenser from grid to grid.



A splendid superheterodyne tuner, to which the author devoted electrical aspects were

The oscillator has the usual padding, except that a fixed capacity of 1,250 mmfd. is used, and there is a 6,000-ohm grid limiting resistor and a 10,000-ohm plate limiting resistor that improve the stability.

It is well-known that the leak-condenser type of oscillator has some kinks in its amplitude curve, and the object of the unbypassed 6,000 ohms and the 10,000 ohms in the plate leg is to straighten these out, so the amplitude at the higher frequencies of tuning is no greater than that at the lower frequencies. This is a way of checking on frequency stability.

The plate legs of the r-f tubes also have limiting resistors for approximately the same reason. The rising characteristic that marks the oscillator also marks the r-f tuner. So the limiting plate-leg resistors, while having the effect of reducing a little the selectivity that would be present otherwise at the higher frequencies of broadcast tuning, approximately level out the amplification. The selectivity is about the same, then, for the entire broadcast band, and, as stated, it is high enough at all times, the object being to prevent selectivity ever from becoming so high that sidebands are attenuated, and higher frequencies of the audio component (modulation) diminished. That is, selectivity is considered in its relationship to tone quality as well as to exclusion of unwanted signals or suppression of images.

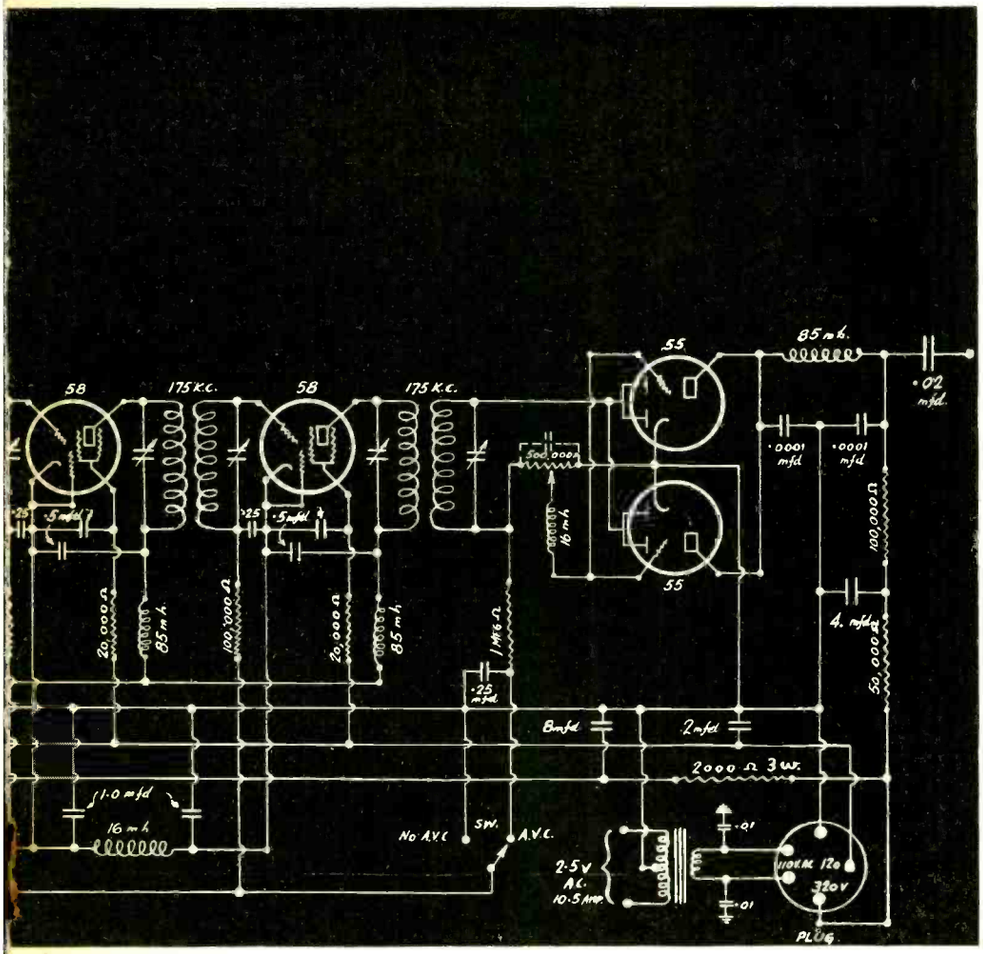
Volume Control Distribution

The two stages of r.f. are sufficient for image suppression and like selectivity considerations, and it is worth noting that there

s 8-Tube Broadcast Tuner

Building Revealed by Designer of erheterodyne

. Valentine



much pains to achieve extraordinary results. Both mechanical and given close attention.

are no commercial receivers with more t-r-f stages of amplification.

Volume is controllable at several levels. The second r-f stage and the modulator have 25,000-ohm rheostats, in connection with the fixed resistors for biasing, and the second detector circuit has the total resistance of a 500,000-ohm potentiometer as the load resistance. Besides, the modulator has a second voltage-bias-voltage control, the 12,000-ohm rheostat.

Parallel 55's

The two 55 tubes at the second detector are in parallel, for they stand more that way, and since the joined cathodes are grounded (B minus), the mu amplifier part of these tubes is diode-biased. That is, the rectified voltage due to the signal constitutes the bias, hence in general the bias is equal to the signal, although precautions were taken so that the signal would not be so high that the bias would be sufficiently negative to introduce distortion, due to approach to plate-current cutoff.

Automatic volume control is applied to the two i-f stages, but there is a switch enabling one to omit this control. The positions are marked on the diagram "A.V.C." and "No A.V.C."

A filament transformer is included, to avoid long leads which would introduce some voltage drop, due to the high current, and also a tuning meter is in the modulator and intermediate B circuits. This meter helps establish resonance "right on the nose," for

(*Continued on next page*)

LIST OF PARTS

Coils

One variometer
One 300-turn r-f honeycomb choke coil
Three radio-frequency transformers for t.r.f.
One oscillator coil.
Two 8-millihenry r-f choke coils
Two 16-millihenry r-f choke coils
Six 85-millihenry r-f choke coils
One 2.5-volt, 10-ampere filament transformer (center-tapped secondary)
Three aid-dielectric intermediate-frequency transformers, 175 kc.

Condensers

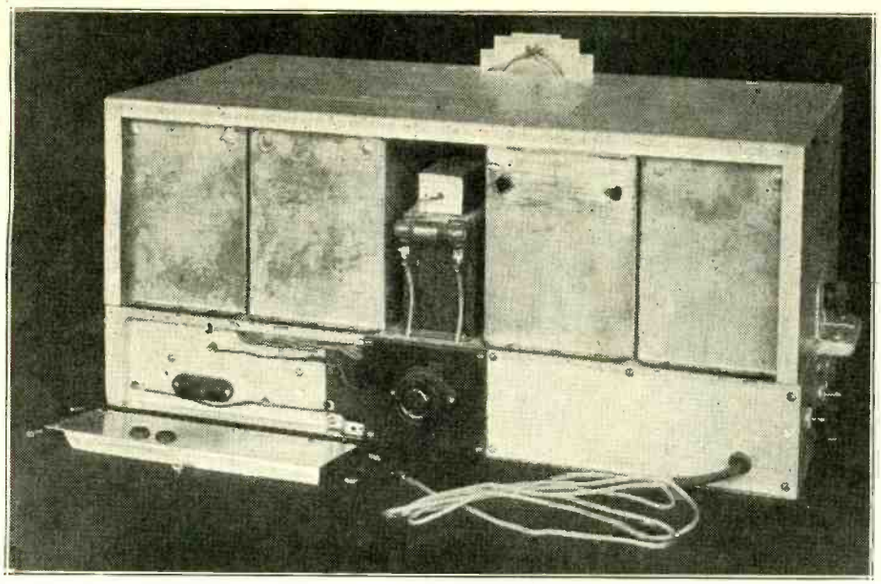
Four 0.00035 mfd. single condensers, with two coupling units to unite shafts in pairs.
Three 0.0001 mfd. mica fixed condensers
Four 35-mmfd. air dielectric trimming condensers
One 50-mmmfd. air-dielectric trimming condenser
Twelve 0.5 mfd. bypass condensers
Four 0.25 mfd. bypass condensers
Two 0.01 mfd. mica fixed condensers
One 0.001 mfd. mica fixed condenser
One mfd. fixed condenser mica fixed condenser (used for padding)
Five 1 mfd. bypass condensers
One 20 mmmfd. mica fixed condenser (may not be necessary; shown as dotted line across the 55 load-resistance potentiometer)
One 0.02 mfd. mica fixed condenser
One 2 mfd. bypass filter condenser
One 8 mfd. filter condenser
One 4 mfd. filter condenser

Resistors

One 1,200-ohm pigtail resistor
Two 2,000-ohm pigtail resistors
One 6,000-ohm pigtail resistor
Two 10,000-ohm pigtail resistors
Five 20,000-ohm pigtail resistors
One 150-ohm pigtail resistor
One 300-ohm pigtail resistor
Two 50,000-ohm pigtail resistors
One 12,000-ohm rheostat or potentiometer used as rheostat
Two 25,000-ohm rheostats or potentiometer used as rheostat
Four 100,000-ohm pigtail resistors
One 2,000-ohm, 3-watt resistors
One 1-meg. pigtail resistor
One 500,000-ohm potentiometer

Other Requirements

One special chassis (see illustrations in last week's issue)
One drum dial, with pilot lamp and bracket
One tuning meter, 25 milliamperes
Seven grid caps
Seven knobs for ¼-inch shafts
One double-pole, triple-throw switch (antenna)
One single pole double throw switch
Seven six-hole sockets
Two five-hole sockets (one for 56 oscillator, other for B cable plug)
Eight tube shields
Eight tubes as follow: Two 55's, one 56, one 57, four 58's



Rear view of B. G. Valentine's superheterodyne tuner

(*Continued from preceding page*)

when the needle swing is greatest resonance is established. It is sometimes hard to disclose resonance otherwise, because with a.v.c. the quantity of sound is about the same some hundreds or even thousands of cycles off resonance as at resonance. But the meter discloses resonance accurately.

The connections to the B supply of the power amplifier are obtained through a plug. The socket is shown at lower right of the circuit diagram.

Result of Long Tests

Considerable experimental work was done on a similar circuit during 1932 and the early part of 1933 which taught me quite a few things. The conventional chassis was left full of holes. This prompted me to build a tuner that would be selective, sensitive and, perhaps most important of all, be careful as of as nearly perfect reproduction as possible, consistent with reasonable selectivity, and in conjunction with an audio amplifier.

The present layout was decided on, giving due regard to reasonable size, complete interstage shielding and to facility of moulding the chassis. As cast, this weighs 18 lbs. An aluminum alloy as free as possible of iron is used. Top and bottom were disc-ground and grooves milled in the top surface for B plus leads, and for the unavoidably long lead from coil to second r-f plate. This lead has a groove to itself.

I think the total length of the exposed plate leads in the tuner is about 3 inches. A full shield is put on the under side with lots of screws to prevent rattling. Coil shields were made on a wooden mandrel from 1/32" copper sheet.

Coil Data

The oscillator coil was originally independently shielded like the r-f coils, but the minimum capacity in the oscillator then proved too high, so the shield was discarded. A little experimenting was done with the size and location of the tickler. The tuning range (carrier level) is now 540 to 1,720 kc.

The r-f coils have 131-turn secondaries of No. 32 gauge, and 21-turn primaries, No. 34 gauge. The separation is 0.031". The primaries are wound over the secondaries at the ground end. So far as I recall, the oscillator secondary had 115 turns and the circuit was padded using a fixed mica condenser of about 1,250 mmfd., and juggling turns and minimum capacities until good tracking was obtained.

All coils were wound on bakelite tubing of 1 inch outside diameter and matched with their respective condensers in an oscillatory circuit. The condensers are National Equitune and the capacities matched closely. Some plate-filing had to be done, however. Insulated couplings were tried between the condensers but results did not justify their inclusion.

Ninth Tube Omitted

All tuned circuits are completed independently of the chassis. Air-dielectric condensers are used throughout. The photographs printed last week, which were taken of the receiver last May, showed second and third i-f transformers of the mica compression-type condensers, but these have been replaced with National air-tuned intermediates, as in the first stage.

The photographs showed nine tubes, the extra one being a 57 second detector which could be switched in instead of the 55's. The object was to test for more sensitivity. However, a few trials demonstrated that there was an abundance of sensitivity with the 55's, and so the extra 57 and its associated switches, which took long hours to manufacture, were discarded.

Some persons possibly would take exception to the number of controls. Although only one dial knob and a volume control-switch knob are actually needed for usual operation, the other controls are not altogether superfluous, and may be used as needed or desired. Reliance on the simpler method can be followed by any who want to tune that way, but the more fastidious radioist will get pleasure from the extra results attained by working the extra controls.

On the same line of reasoning that simplicity is the thing, the whole outfit might appear to be involved, but I get great pleasure in making things in such a way that results are extraordinary.

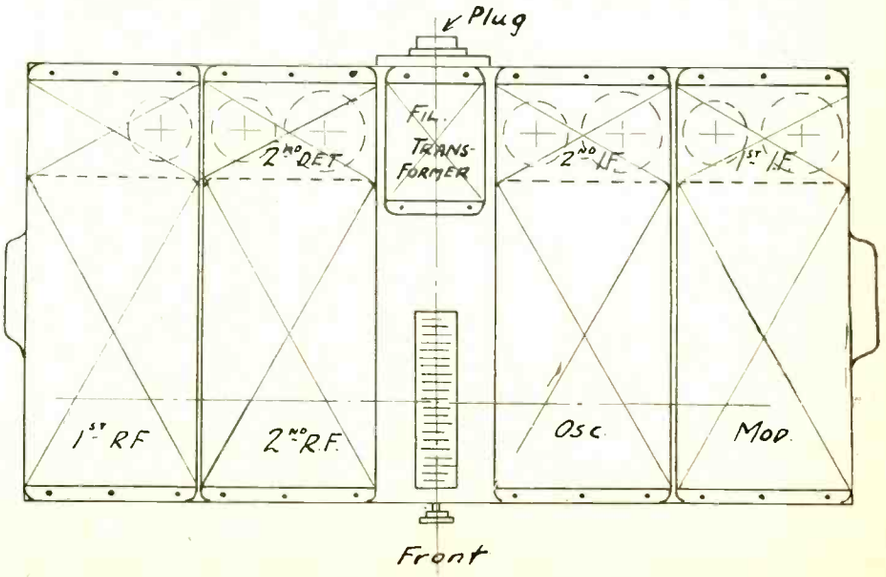
A Word About the Audio

The filament transformer was included in the tuner because the power-supply is 40 inches away. The tuner sits on top of a cabinet 42 inches high, made of ¾-inch oak, and with a baffle of 23 square feet. This houses the amplifier and speaker.

The amplifier chassis incorporates a power supply for the tuner and a separate one for the driver and output tubes. An 80 is the rectifier tube used in both instances. The driver is a 59 with parallel plate feed, having a resonated choke in the plate circuit (4,500 cycles). Bass notes were easy to get but the highs needed some encouragement.

Two 45's are used in the push-pull output stage, with high semi-fixed bias obtained from an Amer-tran No. 710 choke, and a 650-ohm speaker field in the negative leg. I intend to install a fixed-bias system, using a separate rectifier C supply, although results from the semi-fixed bias method are satisfactory. The present speaker equipment consists of two reproducers, one with 11-inch cone, the other with 8-inch cone. These speakers are at 45-degree angles to the upright dimensions of the baffle, the two speaker rims joining at the rear point of the V thus formed.

Where R-F and I-F Stages Are Located



Location of some of the parts and circuits is detailed

Refinements Count

In Modern Receiver—Example of Dual-Eight

By Leonard J. Faulkner

CIRCUITS become practically standard, eventually. However, the refinements do not become standard. In the eight-tube receiver illustrated on the front cover the usual fundamental basis of circuiting is followed, but with some unusual precautions.

The circuit is that of the familiar superheterodyne, for operation on the broadcast band, and also to tune in short waves. It is a dual-band receiver, the short waves receivable being those that have the most interesting programs, representing the foreign stations most eagerly sought.

Attention was paid to the fact that a considerable part of the short-wave spectrum, starting from 1,600 kc and going to 20 mgc, holds little of interest to the average listener. But the focal points are important, and these are included in the short-wave band. So on 19, 25, 31 and 49 meters the tuning is made quite easy, and besides the dial is frequency-calibrated for both the broadcast and the short-wave bands.

Hiss Eliminated

A stage of radio-frequency amplification has been included, because it was found that without it there would be a hissing sound due to the oscillator action. With the added gain and selectivity occasioned by the inclusion of the r-f stage that hiss is not heard, and quiet reception is enjoyed, a goal sought at great experimental pains in several directions.

The r-f tube is a 58, the mixer is a 2A7, and in line with the desire for quietness of operation the oscillator is limited in its amplitude so that it can not overload the modulator, and is itself further removed from the possibility of generating noise. Besides, unevenness of reception, due to oscillator drifting at the higher frequencies of short waves, is avoided by a simple method of stabilization. This consists of increasing the negative bias somewhat beyond what is normally used, and inclusion of a bypassed limiting resistor in the effective plate leg of the triode section of the 2A7. Since the resistor itself is constant, the percentage of change becomes small enough to be rated negligible.

Dial Calibration Holds

Moreover, not until oscillator drift was solved was it practical to calibrate a dial where the calibration in respect to the frequencies of reception would stay put. On the broadcast band there was no difficulty, but on short waves there was, and the limiting resistor helped solve the problem. So the short-wave calibration holds better than it does on most other sets. Besides, there is considerable spreadout, as for a displacement of 180 degrees of the tuning condenser rotor there is a dial pointer movement of 270 degrees.

Ease of operation is therefore furthered, in line with the general goal in this direction. In addition there is facility for easy tuning by the optional use of a bandspread device which is in the receiver, so that the most important stations will be found on dial positions that are not "crowded."

Two I-F Stages

And after a station is picked up it has to be heard plainly and clearly. Admittedly there is plenty of noise on short waves, but something can be done in the way of correction, and in this eight-tube dual-range set it has been done. The noise-reducing control is so effective that it enables enjoyable reception of a station that, without this control properly set, would scarcely be enjoyable to hear. Together with this noise control is a sensitivity control, also important, as the noise level of course is usually closely directly related to the sensitivity.

Following the mixer tube are two stages of i-f amplification, well filtered and stable, with transformers specially made for high gain at low noise, a feat formerly regarded as almost impossible, as it was not deemed even last year that this could become a fact, though proper coil construction certainly does cut down the proportion of noise increase to signal increase, as has been found from experience with this set.

The i-f tubes are 58's and they feed a 55 diode detector. The advisability of eliminating distortion in the second detector is beyond question. So a practically linear—that is, distortionless—detector really ought to be used. Other detectors were tried, but the 55 was found the most acceptable. Besides, it has a triode in the same envelope as the diode, and this triode is used as the audio-frequency driver for transformer coupling to the push-pull 2A5 output stage.

The eighth tube is the rectifier.

Uses Airplane Dial

The airplane dial has no backlash. The dial face is 3 inches, thus affording high legibility and ease of frequency determination. Either the conventional Marconi (grounded) antenna may be used, or a transmission line, as the antenna connections afford this option. So noise-reducing antenna systems, with their transposed leadins and the like, may be used with the set without necessitating any receiver changes whatever.

The power transformer and audio coil are in heavy shield cases, and in capabilities are over-large for the requirements placed on them, as a safeguard against transformer troubles in the future. So many sets have inadequately-wattaged transformers for the power supply that this mistake was conscientiously avoided in the present receiver. And there is abundant fusing throughout, in conformity to the requirements of the Board of Fire Underwriters.

The speaker, a Wright de Coster, has larger power-handling capabilities than the receiver ever will commit to it, being conservatively rated at 10 watts, and will handle this amount of power continuously. Perhaps a fair rating of the set's output would be 8 watts, though some ascribe 10 watts to it. Either way, the speaker, you can see, fulfills requirements without question. Also excellent tone quality results, without manipulation of tone-correction devices.

The receiver, as built on a heavy-gauge welded steel chassis, black crystalline finish, is a one-unit open frame.

Tests of the receiver show a maximum possible sensitivity of 0.4 microvolts per meter, absolute.

Selectivity shows capability of receiving a weak distant station in the broadcast band, 10 kc removed from a powerful local.

The overall audio fidelity, judged by sound-pressure tests, which includes of course the audio amplifier and the speaker in joint performance, is uniform to 10 decibels from 30 cycles to 4,000 cycles with absolute uniformity over the fundamental musical range.

Equipped with A.V.C.

Automatic volume control is included, so circuited that the output sounds uniform to the ear for all signals of 20 microvolts or greater, hence by setting the manual volume control to a given level all possibility of blasting when tuning from one station to another is avoided.

Just a glimpse of some of the refinements have been given. The publication of the circuit diagram will be accompanied by a fuller discussion of the technical and constructional phases of this receiver, the MJ-Dual Eight, and something will be told of the really remarkable performance that it has given over a considerable period.

(*To be continued*)

Use of the Color Code for Fixed Condensers

Solar Manufacturing Corporation, 599 Broadway, New York City, has issued a new service leaflet, No. 5-S, in which some new condenser developments are featured.

In this leaflet is a description of the color code as applied to mica fixed condensers. The explanation of the use of the color code follows:

"The following color code is useful for the capacity marking of mica condensers for manufacturers' use.

"The code includes the use of a distinct color for every numeral from zero to nine, inclusive. The colors are those adopted as standard in the Radio Manufacturers Association Resistance Code, as follows:

Numeral	*Color*	*Numeral*	*Color*
0	Black	5	Green
1	Brown	6	Blue
2	Red	7	Violet
3	Orange	8	Gray
4	Yellow	9	White

"A prerequisite to the use of this code is that capacity first be expressed in terms of micro-microfarads, as .00025 mfd. = 250 mmfd.

"The three color rings on the face carrying the Solar name are used as follows, reading from left to right:

1. The first dot indicates the first digit.
2. The second dot indicates the second digit.
3. The third dot indicates the number of zeros which appear after the first two digits.

"Examples:

.000025 mfd.	=	25 mmfd.	= Red	Green	Black
.00005 mfd.	=	50 mmfd.	= Green	Black	Black
.0001 mfd.	=	100 mmfd.	= Brown	Black	Brown
.00025 mfd.	=	250 mmfd.	= Red	Green	Brown
.0005 mfd.	=	500 mmfd.	= Green	Black	Brown
.00075 mfd.	=	750 mmfd.	= Violet	Green	Brown
.001 mfd.	=	1000 mmfd.	= Brown	Black	Red
.01 mfd.	=	10000 mmfd.	= Brown	Black	Orange

"The above covers practically all requirements, but if three numbers exclusive of zero appear in the capacity, such as 1250 mmfd., then the marking is as follows:

"1. The first two digits are indicated in first and second dots, as usual.

"2. The third dot is left blank, which indicates the remaining code is on the reverse side of condenser.

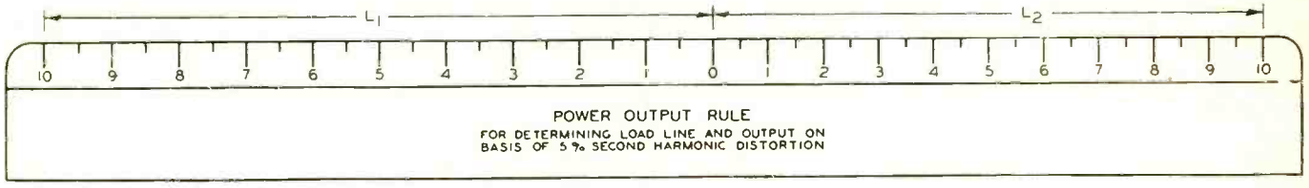
"3. Use is then made of the two code rings on the reverse side of the condenser from the trademark, the dot on the left indicating the third digit, and the dot on the right indicating the number of zeros which appear after the first three digits, as

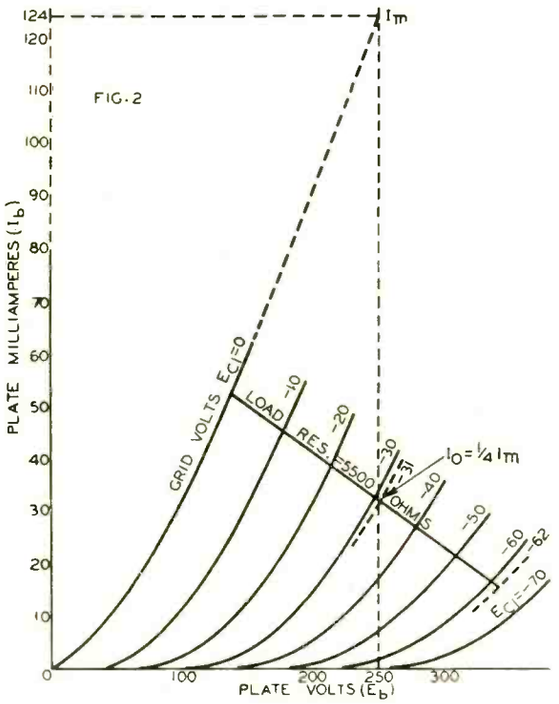
.00125 mfd. = 1250 mmfd. = Brown Red o Green Brown

.000375 mfd. = 375 mmfd. = Orange Violet o Green Black

Triode Power Output

Determined by Graphical Method, Applying Rule to Curve





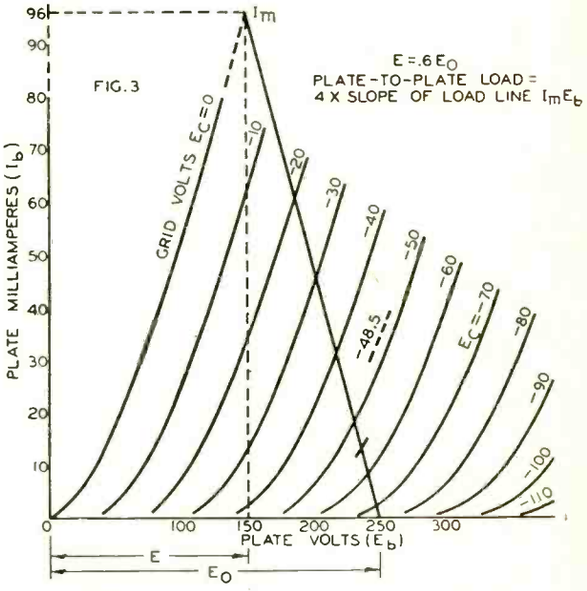


FIG. 1 (top), power output rule.

Fig. 2 (left), plate characteristics curves of a triode, with Io the operative point.

FIG. 3 (above), the case for push-pull operation.

THE approximate operating conditions for output triodes can be readily obtained by graphical methods. In this Application Note, the Power Output Rule is described and simple formulas are given for obtaining the operating current, bias, and load for both single and push-pull triodes. Other formulas are included for converting power output, load, and plate current from one set of plate voltage conditions to another. These formulas are based upon the assumption that the $E_c = O$ curve of the plate family follows the three-halves power law.

The Power Output Rule

The Power Output Rule (frequently referred to as the Distortion Rule) is used to obtain the plate load and the corresponding power output. This rule was first described by K. S. Weaver in QST of November, 1929. It is the double-scaled rule illustrated in Fig. 1. L_1 and L_2 have a ratio of 11 to 9, since this is the ratio corresponding to 5% distortion. The zero of the rule is placed at the point on a plate family corresponding to the values of plate voltage and plate current or grid bias under consideration. The slope of the rule is then adjusted so that the reading of the rule at one extreme of the assumed grid swing is the same as that at the other extreme of the grid swing. The slope of the rule when so adjusted corresponds to the load line for 5% distortion.

The plate circuit load for a triode is determined from its plate characteristics curves. If the operating point I_o of Fig. 2 is known, the distortion rule can be used directly to obtain the load. If I_o is not known, it can be determined from the simple relation, $I_o = \frac{1}{4} I_m$. I_m is obtained by drawing a vertical at the desired operating plate voltage and extending the $E_c = O$ curve until it intersects the vertical line. One-quarter of this value, I_m, locates I_o, the operating point. The Distortion Rule is then applied with its zero placed at I_o and adjusted until L_1 reads for the intersection with the zero bias the same as L_2 reads for the intersection with the curve for twice the operating bias. The slope of this line represents the load resistance. The power output can be obtained from the formula:

$$P = \frac{(I_{mnx} - I_{mtn}) \quad (E_{mnx} - E_{mtn})}{8}$$

The only limitation to the general use of this method is that conditions should not be chosen which exceed recommended maximum plate dissipation of the tube. The best guide to this value is the product of the maximum recommended plate voltage and the maximum recommended plate current. When a value of I_o giving too high a plate dissipation is obtained, I_o should be arbitrarily lowered to bring the plate dissipation within limits. Tubes such as the 112A, 71A, 45, and 2A3 are generally operated with control-grid voltages somewhat greater than the theoretical bias value for their maximum plate voltage rating in order that plate dissipation may be kept down. The operating points (I_o values) obtained by this method will be found to check the established operating points for types 10, 31, 50, and 89 with triode connection, and to be fairly close for the 112A and the 71A. Some readjustment of the grid bias is required for the 45 and 2A3 when used above 180 plate volts.

Other Examples

When a set of conditions for single or push-pull operation of power triodes is known and when operation under some other plate voltage condition is desired, the power output, load resistance, and plate current

can be quickly computed by means of the following conversion formulas:

For power output

$$P = A(E)^{5/2}$$

where

P = the power output for the new operating conditions,
A = the power output for the old operating conditions,
E = the ratio of the old and the new plate voltage.

For load resistance

$$R = B(E)^{-1/2}$$

where

R = the load resistance for the new operating conditions,
B = the load resistance for the old operating conditions,
E = the ratio of the old and the new plate voltage.

For plate current

$$I_b = C(E)^{3/2}$$

where

I_b = the plate current for the new operating conditions,
C = the plate current for the old operating conditions,
E = the ratio of the old and the new plate voltage.

The practicability of these formulas is shown by the following example of a triode-connected 89.

	Known Values	Conversion Factors	Calculated Values	Actual Values
Plate Volts	180	1.39*	250	250
Grid Volts	22.5	1.39	31.4	31
Plate Milliamperes	20	$(1.39)^{3/2}$	32.7	32
Plate Load (ohms)	6,500	$(1.39)^{-1/2}$	5,500	5,500
Power Output (watts)	0.4	$(1.39)^{5/2}$	0.91	0.9

*250/180 = 1.39

Limitations of Formulas

For filament types of tubes, such as the 10, 45, 50, 71A, and 2A3, the plate characteristics curves are given for d-c filament excitation, although operating characteristics are generally shown for a-c filament excitation. For these types, conversion calculations are made on a d-c excitation basis. To adjust a-c excitation bias values to corresponding d-c values, reduce the a-c values by ½ the peak value of the rms filament voltage. To adjust d-c values to a-c values, add ½ the peak value of the rms filament voltage to the d-c value of grid bias.

The conversion formulas are accurate except for over-biased operation. Thus, for the 45 and 2A3 at voltages greater than 180 volts, these conversion formulas can not be used unless adjustment is made to keep plate dissipation within limits.

To obtain the proper load for triodes in push-pull, the relation $E = 0.6E_c$ is used (see Fig. 3). Plate characteristics curves for the triode are required. An operating plate voltage E_b is then selected. A vertical is erected at $E = 0.6E_c$ and the intersection of this vertical with the $E_c = 0$ curve determines one end of the load line. The other end is at E_b, the operating plate voltage. The slope of this line multiplied by four is the correct value of plate-to-plate load for two triodes operating in a Class A push-pull amplifier. Thus, for the 45 (see Figure 3), the plate-to-plate load is equal to

$$\left(\frac{250 - 150}{0.096}\right) \times 4, \text{ or } 4{,}160 \text{ ohms.}$$

This simple method for determining the plate-to-plate load is applicable to all power output triodes. The operating point can be anywhere between the bias voltage specified for single-tube operation and the bias voltage obtained by taking one-half of the control-grid bias at plate current cut-off for a plate voltage value of 1.4 E_c. Fig. 3 shows the plate family of a 45 tube. The recommended operating point as a single triode is —50 volts. The maximum bias that can be used without departing from Class A operation is —55 volts. Plate current cut-off at 1.4 × 250 volts, or 350 volts, occurs with a control-grid bias of —110 volts. One-half of this value is —55 volts, the maximum bias. Operation beyond this value of grid bias will be accompanied by rectification and will no longer be representative of a Class A amplifier.

Power Output Formula for Push-Pull Triodes

The method just described of determining the plate-to-plate load also makes it possible to determine the power output for push-pull triodes by means of the following simple formula:

$$P = \frac{I_m E_c}{5}$$

Thus, for the 45's of Fig. 3, power output is equal to

$$\frac{0.096 \times 250}{5}, \text{ or } 4.8 \text{ watts.}$$

HENRIETTE HARRISON APPOINTED

Henrietta Harrison has taken the position as radio programs director for the New York City Y. M. C. A. succeeding Evalyn Wells. Miss Harrison, former program director of WINS in New York and WCAU in Philadelphia, has had ten years experience in radio.

Longest Leads for Low Frequencies in Switching

The desire to get away from plug-in coils is strong, although the general experience undoubtedly has been that better results have been obtained with such coils. Perhaps that was due to the switchmakers having turned out a bad job, until now, and also to the fact that when switch operation is tried it is expected that shorting part of the inductance or moving switch points to pick up taps on coils will do the trick as well as plug-in coils, which, in receivers, simply is not so.

Still retaining plugging in, one manufacturer uses a type of drawer which at least affords access from the front panel, a convenience. However, another method is to have the switch rotary, and move a disc to which the coils are fastened. It would be even possible to put the coils in a drum, which would also be the shield, and thus rotate the proper coil to position. This method, like the drawer type and regular plug-in, makes for very short leads, but the usual switching arrangement often causes some of the leads to be long. If these are not overlong, and if the long ones are for the lower frequencies, good operation is obtainable.

Robert Hertzberg Doing Short-Wave Publicity

Robert Hertzberg has resigned as secretary-treasurer of Standard Publications, Inc., 192 Lexington Avenue, New York City, and has withdrawn as editor of "Short Wave Radio," published by that firm. He founded the magazine a year ago.

Mr. Hertzberg has established a technical publicity-advertising service, specializing in copy and promotion on short-wave receivers, transmitters and accessories. Temporary offices are at 3965 45th Street, Long Island City, N. Y.

NEW 5-METER ANTENNA GIVES 40-FOLD GAIN

West Hartford, Conn.

Ultra-high-frequency radio waves, the newest playthings of radio scientists, are nightly being transmitted from a hill on the edge of the residential section of this city to amateur stations located in Boston and throughout middle New England. For the first time in radio history wavelengths as low as five meters are being used for regular communication between ground stations not at high elevations over distances greater than 100 miles.

The method of achieving these results lies in the use of a newly-developed reflective antenna system, similar to that used in international commercial radio communication, but possessing certain essential modifications fitting it for work in the relatively unexplored ultra-short-wave region. Orthodox low-powered transmitters and simple receivers constitute the remainder of the equipment used. They perform entirely satisfactorily, since the new antenna system gives the effect of increasing power more than 40 times.

Work of Ross A. Hull

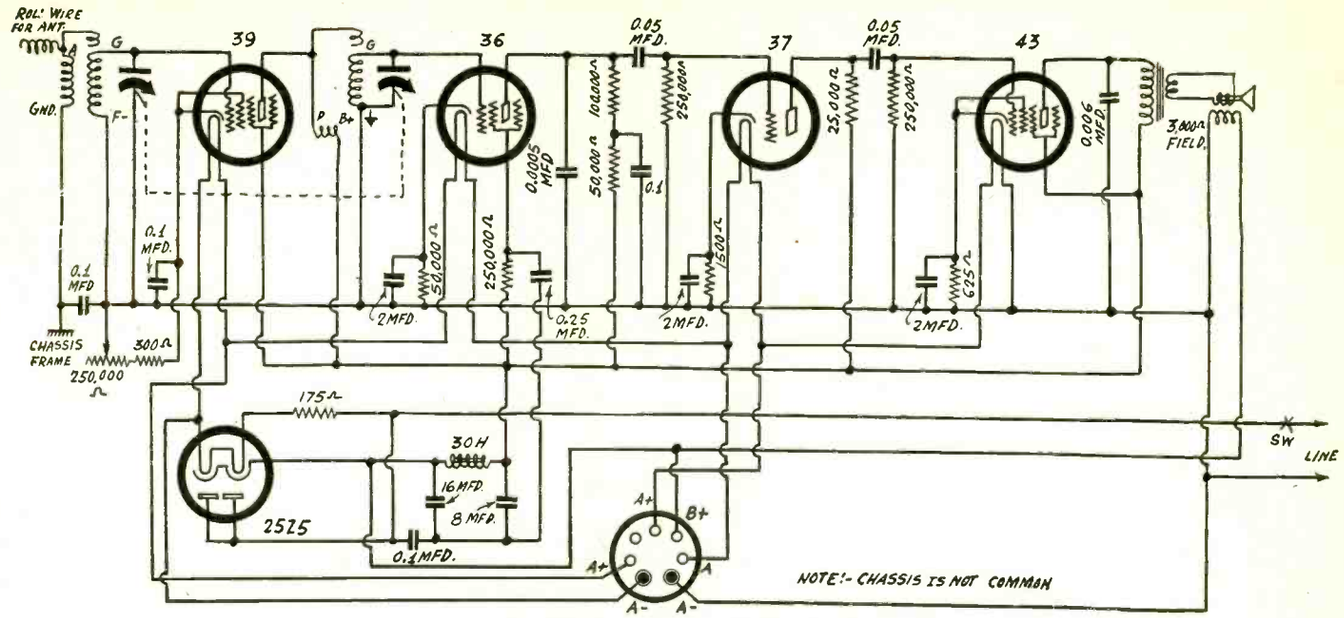
This important new development is the work of Ross A. Hull, of the technical staff of the American Radio Relay League, the national organization of radio amateurs, which has its headquarters here. Radio authorities agree that its importance is comparable to the triumphs of early amateurs who discovered the utility of the present short wave region of radio, more than ten years ago. At that time, a few isolated experimenters, inspired and guided by the League, opened up the field which in present days is the most valuable in radio, enabling communications possibilities undreamed of before they were demonstrated by radio amateurs.

Amateur work in the ultra-high-frequency region began shortly after the more orthodox short waves were explored, but it was not until 1930 and 1931 that practical communications possibilities were demonstrated. At that time, it was shown by the League's technical staff that the ultra-short waves were useful for communications over limited distances, ordinarily determined by the "line of sight" distance, in view of the similarity of behavior between the ultra-short radio waves and light waves. To increase ranges, they resorted to higher and higher locations. Hull, and others of the staff, described the results of this work in the League's official organ, of which he is associate editor.

Beam Is Successful

Television, radiotelephone, police and other services immediately saw the advantages of this form of communication, and widespread applications have developed during the ensuing three years. Thousands of amateurs make regular use of the five meter band for limited range communication—across town, over water, between airplanes for increased distances.

The new development continues the analogy between light waves and ultra-short radio waves, in that the use of a carefully devised reflector system apparently reflects, refracts, concentrates and "beams" the radio frequency energy toward the desired point. Similar effects have been achieved with the longer wavelengths, but the apparent refraction or bending of the radio waves is a new phenomenon which represents the immediate point of attack for future research.



A simple tuned-radio-frequency of the "universal" type.

Radio University

The Special Hartley

CAN THE SYSTEM of paralleling a coil in a Hartley oscillator be used for practically unlimited frequency coverage? You discussed this idea briefly some time ago, and I was struck by the simplicity of the circuit, since only one switch arm has to be moved, a marked contrast to all other systems, except the dynatron.—J.K.C.

The idea presented was to set up a low-frequency oscillator, using a single tapped winding, and connect one terminal of the coil toward the grid, tap to the cathode, and other terminal of the coil to grid return. Thus when the total winding is tuned there is a suitable oscillator. Now if smaller inductances are cut in across the total winding, the frequencies generated increase. However, this method can not be pursued without limit, because that part of the circuit through which the plate current always flows is between tap and grid return, and for the original low frequencies this inductance is substantial, since it is comprised of about one-quarter the total number of turns. So the system ceases to function for higher frequencies when that part of the low-frequency coil between tap and grid return becomes a choke to these high frequencies. That stops oscillation, just as any such choke would. Within its limits the system is useful. At left below is a diagram applicable to the local oscillator of a superheterodyne, with capacity coupling between grid of oscillator and (not shown) grid of modulator. This capacity is extremely small, a few micro-microfarads. At right the system is shown for a signal generator, with attenuator.

* * *

Two-Tube Short-Wave Set

PLEASE SHOW pictorially the circuit for a regenerative 79 detector and a 25Z5 rectifier in a universal receiver.—I.K.

Diagram on next page. The values of the constants are imprinted on the diagram. The antenna series condenser is shown as the postage-stamp type. This would have to be separately adjusted for each band. However, if desired, a manually-controlled air-dielectric condenser of 50 mmfd. or so may be put on the front panel instead, as a matter of convenience.

* * *

Simple T-R-F Set

ARE TWO TUNED stages practical for a simple t-r-f set, using the "universal" principle?—H.C.V.

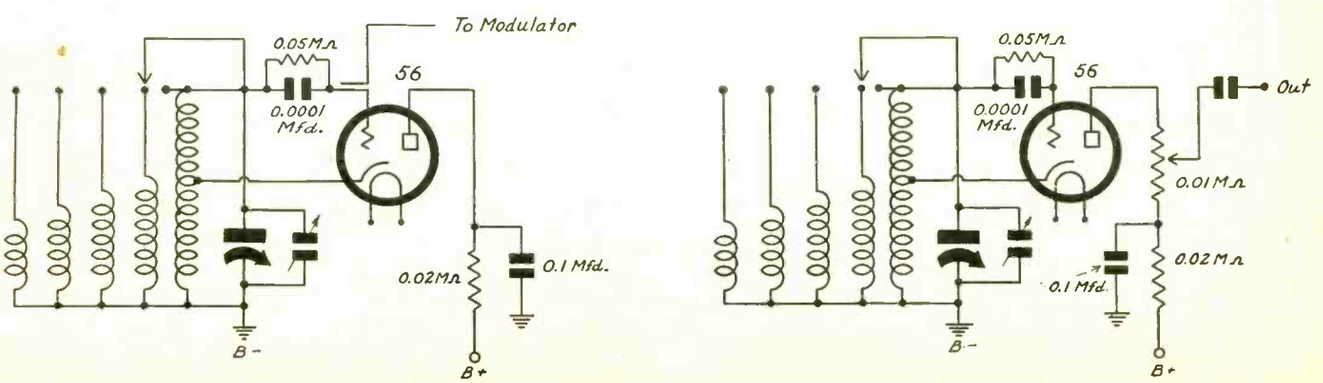
That depends on what you expect of the set. For the reception of local stations with good quality and sufficient volume, the receiver is acceptable. For any real selectivity requirements the circuit is out of question. In fact, it has been difficult indeed to establish the required selectivity in any t-r-f system, regardless of the number of stages, due to tracking troubles that tend to defeat the end. Therefore regeneration has been used, but this is now unpopular for broadcast-band purposes. The diagram of such a receiver as you suggest is printed herewith. Care should be taken to distinguish chassis, which is grounded, from the grid returns, which are not grounded.

* * *

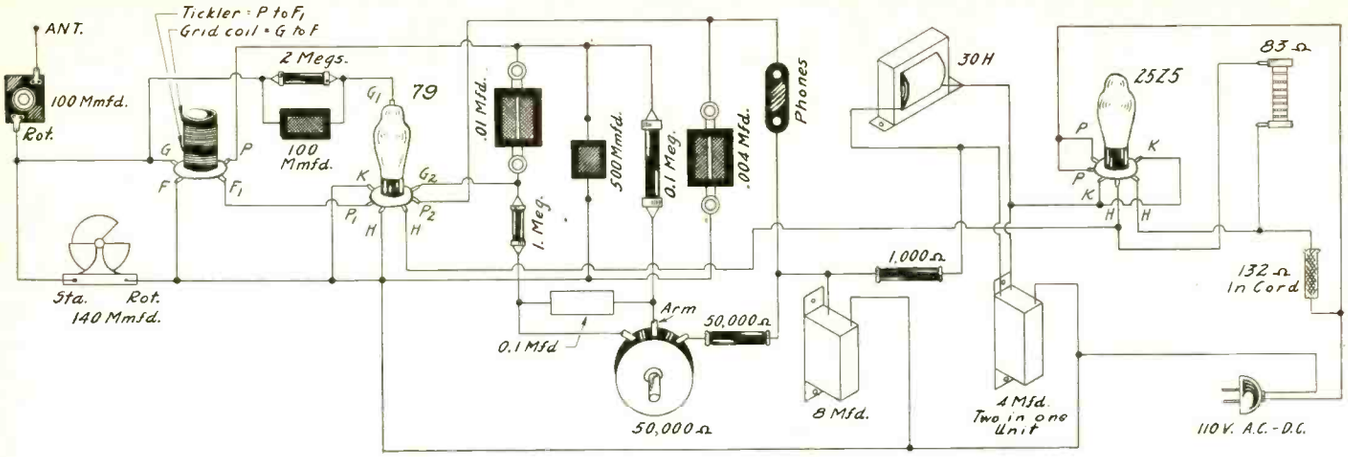
The Ionosphere in a Storm

HAS THE EFFECT of rain, sleet and snow on the Kennelly-Heaviside layers been determined, and what is the result? What about the effect of lightning and thunderstorms?—U.L.

No special measurements under the conditions of rain, sleet and snow have been reported, so far as we know, but J. A. Ratcliffe, of Cambridge, Eng., told the British Association for the Advancement of Science that measurements he made during a thunderstorm showed that the reflection heights changed rapidly. He did not say why, but evidently there was a marked and rapid shift in the degree of ionization. He was sending a wave of around 50 kc. The layer height was 150 kilometers. Then a storm occurred. In general the reflections for the same frequency came from a much lower height, 105 kilometers. There was a second reflection, resembling an echo, from a height of 250 kilometers. These distances are determined by the time lapse method, the velocity of the wave being known. Experiments were made to nearly 3,000 kc,



At left, a local oscillator for a superheterodyne, at right, a signal generator, using a special Hartley.



A two-tube short-wave "universal" receiver.

and the same changes in distances of reflection took place during the storm. When the storm abated the reflections returned to normal. The Kennelly-Heaviside layer, as the electrified region has been called for years, is now more often referred to as the ionosphere.

* * *

Crystal Microphone

YOU HAVE STATED that with the crystal microphone it is advisable to have high amplification, but is it not a fact that the crystal itself partly compensates for this, because developing a voltage of considerable quantity?—T. F. D.

Yes, it is true that the crystal generates a voltage that reduces the need for extremely high amplification, but the point made was that the amplification should be high nevertheless, though not as high as would be necessary if the crystal microphone did not have the voltage-generating property. General experience teaches that the crystal microphone may be expected in most instances to require higher amplification than the carbon microphone, although of course the crystal microphone has superior tonal advantages. We do not know that it has been claimed the crystal microphone is more sensitive than the carbon-granule type.

Freight Rates Cut on Tubes, Saving $80,000

Recent freight rate reductions obtained on tubes will effect savings to tube manufacturers of $80,000 a year, according to a final estimate of the RMA Traffic Committee. The tube rate reductions were obtained by cooperation of traffic managers and representatives of tube manufacturers of the RMA in the presentation recently of the tube companies to the Railroad Classification Committee.

Vice Chairman O. J. Davies of the RMA Traffic Committee estimates that the savings effected will amount to about $10,000 on carload shipments of tube manufacturers, while an additional $70,000 annually will be saved in classification rates.

Government Short-Wave Station List Is Ready

Through the efforts of A. W. Cruse, Chief of the Bureau of Electrical Equipment of the Department of Commerce, the Government has prepared a complete official list of short-wave stations throughout the world. The compilation, with details of frequencies, power and call letters of all short-wave stations throughout the world, is now ready.

Chicago Added by RCA to Message Network

Chicago was added to the new inter-city radio telegraph service of R.C.A. Communications, Inc., making a total of six large cities now in the RCA domestic network. The service previously has connected New York, Boston, Washington, D. C., San Francisco and New Orleans. Within a short time, Seattle, Detroit and Los Angeles will be brought into the system and other important cities will be added later.

Cities included in this domestic radiotelegraph service also have direct radio contact with the international networks of RCA centering at New York and San Francisco.

All collection and delivery facilities of the Western Union in the cities on the inter-city chain, as well as the offices maintained by RCA, are available for the handling of domestic radio messages. This is an extension of the previous cooperative arrangement through which Western Union offices throughout the United States collect and deliver RCA's transatlantic and transpacific radiograms and radiograms exchanged with ships at sea.

Radiotelegraph rates between cities in the United States are based upon fifteen words at the regular wire-line rate for ten, and lettergrams of sixty words for the wire-line rate for fifty.

AMATEURS NEAR 50,000 IN U. S. AS GAINS HOLD

Washington

For the fourth consecutive year the number of federally-licensed amateur radio stations in the United States and its possessions has markedly increased. A recent release from the Federal Communications Commission, which licenses all amateur as well as other radio operation, states that there were 46,390 valid amateur station licenses in existence at the close of the last fiscal year, June 30th, 1934.

During the year 8,782 new station licenses were issued and there were 12,279 modifications, reissues and renewals. The figures follow:

Valid licenses of record July 1st, 1933	41,555
Issued during fiscal year, new and renewed	8,790
Total	50,345
Less cancellations	3,777
Other deletions, due to death, etc.	153
Revocations	25
Total	3,955
Valid of record close of June 30th, 1934	46,390

Authorizations as amateur operators totaled 16,686; operator license indorsements for higher privileges 209; duplicates of lost or destroyed licenses 161, and special authorizations 15, making a grand total of 38,132 authorizations issued during the year, or well over 100 per day, relating to amatuers alone.

Applications for amateur operator station licenses pending July 1st, 1933, were 497, while 33,184 were received during the fiscal year. Of the total, 21,672 were approved; 8,211 were returned, or referred; 3,631 applicants failed to pass required examinations, and 11 were denied formally, leaving 156 cases pending at the close of June 30, 1934.

Return of applications occurred for many reasons such as lack of citizenship, alien control of premises and misconception of the proper use of an amateur station. Many others had only formal defects, curable by amendment of applications.

All Six Continents Contacted on 10 watts in Two-Way Voice

West Hartford, Conn.

An Australian amateur has established two-way voice communication with other amateur stations in each of the six continents of the world using a power of less than 10 watts, according to reports received by the American Radio Relay league.

The record-breaking operator is G. Pollock, owner of VK2XU, at 9 Acacia St., Belmore, New South Wales, Australia.

A comparison of the distances covered, approaching a maximum of 10,000 miles, with the illumination obtained from a 10-watt electric light bulb becomes especially striking when it is considered that commercial radio services use powers a thousand times as great to cover similar distances.

National Council to Discuss Social Aspects of Radio

On October 8th and 9th the annual assembly of the National Advisory Council on Radio in Education will be held in Chicago. Five sessions will be at the Drake Hotel and one in the Hall of Science at the Century of Progress Exposition.

"The Importance of Radio Broadcasting in a Changing Social Order" is to be the general subject of the conference. Among the speakers will be Secretary of the Interior, Harold L. Ickes; Dr. John H. Finley, associate editor of The New York "Times"; Walter Damrosch; John Erskine; Robert M. Hutchins, president, University of Chicago; Walter Dill Scott, president, Northwestern University; Dr. Frederick P. Keppel, president, the Carnegie Corporation of New York; Robert M. Sproul, president, University of California; Lotus D. Coffman, president, University of Minnesota; Colonel Frank Knox, publisher of the Chicago "Daily News"; Dr. Harry Woodburn Chase, Chancellor of New York University and others.

Carl H. Milam, secretary of the American Library Association, is chairman of the committee on program which includes Levering Tyson, director of the N. A. C. R. E., President Hutchins and President Scott. Private versus government control of radio will be one of the live topics of discussion. Robert A. McMillan, president of the Council, will open the conference with greetings transmitted by short wave from London.

HAMS DEPLORE PRESS KILLING NEWS SENT IN

Newspapers jealous of advertising appropriations of manufacturers expended on sponsored programs are censoring or excluding news of radio, says the American Radio Relay League, Inc., even including news of amateurs' activities. In a circular letter addressed to radio editors of newspapers the League, national organization of amateurs, set forth:

"For several years past, and up to this spring, we have been sending you at intervals press releases as a part of our weekly news service. During the past several months the lack of interest in this material on the part of newspaper editors, growing out of the prolonged press-radio controversy, has made the desirability of continued general issuance of these bulletins questionable.

Distinction Overlooked

"This controversy has seemingly resulted in the development of a policy on the part of the major newspaper organizations to restrict, exclude, or censor radio news. The policy was originally aimed at radio broadcasting activities, when broadcasting advertising began to cut appreciably into newspaper advertising revenue. Unfortunately, it seems, many newspapermen have failed to realize that broadcasting is only one branch of the radio art, and they applied the exclusive policy to all radio news.

"We have felt this policy to be highly unjust to amateur radio. There are some 45,000 licensed stations in this country, all operated on a strictly amateur basis without pecuniary benefit of any sort. Their amateur status is ordained and preserved by law.

"The operators of these stations do not realize one cent from advertising revenue or in any other way detract from the income or prestige of the press. On the contrary, they are frequently and consistently of the greatest utility to the press of this nation as well as the world whenever disaster strikes and normal means of communication are disrupted.

Encouragement Sought

"In hundreds of major emergencies since 1913 or thereabouts amateur operators have bridged communications gaps which otherwise would have been left open for days, and gave the press their every attention in handling the news swiftly, voluminously, and accurately. Dozens of incidents in recent years can be recalled where, had it not been for the radio amateur, the newspapers of the nation would have been totally without information.

"The encouragement of amateur radio operation is one of the most farsighted activities in which the press can engage to its own selfish interest."

LOMBARDO BAND A FIXTURE

Guy Lombardo's band hasn't changed its personnel since its organization in London, Ont., ten years ago. In that time, however, there has been an addition. Leibert Lombardo, youngest of the four brothers, having joined the band after it came to New York and conquered. Leibert plays trumpet now but originally was a drummer.

WBZ and WBZA Hold Frequency to 5 Cycles

Measurements taken by Westinghouse on WBZ and WBZA indicate that since March 15th the variations from the assigned frequency of 990 kc has been only five cycles. This is equivalent to five parts in a million or in more familiar terms, it represents an error equivalent to 1 inch in 3.16 miles.

Although, according to the Federal Communication Commission requirements, WBZ is allowed a variation of plus or minus 50 cycles from its assigned frequency, the use of new and improved crystal oscillator unit has permitted great improvement in frequency stability beyond requirement.

The frequency generator is a quartz crystal oscillator located at WBZA in East Springfield, Mass. By a synchronizing circuit the output of this oscillator at 990 kc is stepped down to 13.75 kc, transmitted to Millis and again stepped up to 990 kc for use at WBZ.

By means of this synchronizing system, the stability of both stations has been held within the five cycle variation.

The quartz crystal oscillator responsible for this improved service is a recent development of the Radio Division of the Westinghouse Company in Chicopee Falls. It was first applied to the company's new Type CQ 250-watt police radio transmitter. The device consists of a temperature-controlled quartz crystal plate mounted in an aluminum casting. In this same casting an oscillator tube and its associated tube circuits are also mounted and connected to the quartz crystal plate.

One of these oscillators was installed at WBZA in March under the supervision of W. H. Hauser, plant manager, so operating data over a long period of time could be obtained by the Westinghouse staff of design engineers.

EMPLOYMENT 106% ABOVE 3-YEAR MARK

Radio factory employment, as reported by the Bureau of Labor Statistics of the Department of Labor, increased 2.4 per cent. during June over last May, while June payrolls increased 4.5 per cent. over those of the preceding month. Compared with the three-year average, 1923-1925, June employment showed an increase of 106 per cent. and payrolls an increase of 117.4 per cent.

In June, 1934, fifty-two radio and phonograph establishments reported employment of 35,648 employees, without any wage changes during the month. Employment last June increased 52.6 per cent. over June, 1933, while payrolls increased during the same period by 57.4 per cent.

During June, per capita weekly earnings of the reporting companies were $18.31, an increase of 2 per cent. over May, 1934, and 2.9 per cent. over June, 1933. Average hours worked per week during June were 32.6 per cent., an increase of 3/10 of one per cent. over May, 1934, and a decrease of 21.5 per cent. from June, 1933. Average hourly earnings during June, 1934, were 55.4 cents, an increase of 3.7 per cent. over May, 1934, but 50.1 per cent. over June, 1933.

Detailed statistics regarding operations during May in radio and phonograph factories show that during May, 1934, forty-one radio establishments reported employment of 33,532 employees and eight of these radio establishments reported wage increases affecting 7,002 employees, thirty-three establishments reporting no wage changes.

For the month of May, 1934, per capita weekly earnings reported were $17.98, an increase of 2.8 per cent. over April, 1934, but 6.2 per cent. under May, 1933. Average hours worked per week in May per employee were 32.9 hours, a decrease of 4.4 per cent. as compared with the preceding month of April, and a decrease of 25.5 from May, 1933. Average hourly earnings for employees during May, 1934, were 52.9 cents, an increase of 2.5 per cent. over the preceding month, and an increase of 40.7 per cent. over May, 1933.

RMA Progressing on an Individual Code for the Industry

Special consideration by the National Industrial Advisory Board of the Radio Manufacturers Association application for exemption from the electrical manufacturing code and institution of a separate code for the radio industry has resulted in negotiations with NRA and between RMA and NEMA. Final action by the NRA is expected in this month.

Independent code operation for the radio industry is the objective in the Washington negotiations. The National Industrial Advisory Board intervened in the NRA code proceedings instituted by the RMA, viewing the problem as an important matter affecting the two large industries, radio and electrical. The RMA code committee, headed by William Sparks of Jackson, Mich., and also a committee of NEMA, with NRA officials present, have been holding conferences with the National Industrial Advisory Board. These have delayed action both on the RMA proceeding and also on further revision of the electrical code.

Move to Hurt Sales to Spain Brings Protests

The RMA has been advised both by the U. S. State and Commerce Departments of immediate and active opposition to the pending treaty between Holland and Spain which would greatly reduce exports of American radio apparatus to Spain. Representatives abroad of both Federal departments have been instructed by cable to oppose the pending Dutch-Spanish quota treaty.

The RMA and also individual member companies sent protests to both Secretaries Cordell M. Hull and Daniel C. Roper of the State and Commerce Departments, respectively, when information reached this country that Holland was proposing a treaty with Spain which would give radio interests of Holland 70 per cent. of the Spanish Market, under the quota system, and leave only thirty per cent. for American and other foreign imports. In response to the RMA protests, the State Department advised the RMA as follows:

"The Department has been advised by our Embassy at Madrid, and the Consulate General at Barcelona, of the proposed measures threatening the import of American radio apparatus into Spain, and has instructed the Embassy to keep in touch with the distributors of American radio products in Spain, and to take such steps as seem necessary in order to obtain for imports of American radio equipment as favorable treatment as that accorded to imports of radio apparatus from other countries."

June Exports

Radio exports during June totaled 36,372 sets valued at $942,153, and 470,638 tubes valued at $231,479, according to the monthly report of the Bureau of Foreign and Domestic Commerce Electrical Division, U. S. Department of Commerce.

SALES REDUCED 40% IN 2 YRS.; FEWER PLANTS

The Bureau of Census, U. S. Department of Commerce, has issued the biennial radio census of 1933, showing a marked industry sales reduction of 40.2 per cent. as compared with the last preceding census of 1931.

The number of reporting radio establishments fell from 217 to 145 in the two-year period, a decrease of 33.2 per cent., while the value of radio and phonograph apparatus manufactured in 1933 at f.o.b. factory prices was $112,279,565 as compared with $187,717,880 in 1931. However, the decrease in wage earner employment was only 11.4 per cent., from 36,590 employees in 1931 to 32,339 in 1933. The amount of wages paid fell from $35,145,577 in 1931 to $29.124,981 in 1933, a decrease of 17.1 per cent.

According to the report, the number of receiving sets produced in 1933 was 3,451,112 and tubes 57,042,409.

Summer Tax Collections Show a Big Slump

A sharp midsummer slump in radio operations is indicated by the July report of Federal excise tax collections. U. S. Internal Revenue Bureau collections of the five per cent. excise tax on radio and phonograph apparatus during July, were $92,007.81 as compared with tax collections of $191,074.94 in July, 1933.

The excise tax collections on mechanical refrigerators in July were $1,075,149.98 as against $893,008.57 in July, 1933.

Station Sparks

By Alice Remsen

TOURISTS VISIT NBC

THE NBC STUDIO GUIDE SERVICE did a rushing business over the Labor Day week-end. A total of four thousand six hundred and sixty-two visitors took the tour of the studios on Sunday, September 2nd, and three thousand four hundred and forty-two persons saw the studios on Monday. Most of the people were out-of-town tourists spending the holiday week-end in New York. It is the custom for guides to pilot their charges into a balcony overlooking whatever studio is in use at the moment—sometimes to watch a rehearsal, at others an actual broadcast. After a few moments he takes them out again; it is nothing for one fifteen minute program to have six changes of audience during rehearsal and broadcast. If the program is unusually interesting, the audience may protest a speedy removal, but the guide moves them on just the same. . . .

THE CHARMING DOROTHY PAGE

I remember Dorothy Page when she played the Netherland-Plaza Hotel in Cincinnati with the Seymour Simons Orchestra. At that time I was doing a series of programs at Station WLW. It was two years ago, and Dorothy had not been working professionally for very long. She was a very charming girl, simple and unaffected, even though a great deal of fuss had already been made over her beauty. Listening in to her now, it seems to me that she has improved a hundred per cent as far as singing and diction are concerned, and I am hoping that her head has not been turned by the adulation she is now receiving. Am glad to note that she is now working with another old pal of mine, Jan Garber. Jan, Dorothy and the boys of Jan's orchestra, are being featured on the Yeastfoamers new program, each Monday, at 8:00 p.m. over an NBC-WJZ network. . . . There is a new series of programs coming through from the Coast every Sunday afternoon at 3:30 p.m. over an NBC-WEAK linkup. They are well worth a twist of your dial. Don Mario, a romantic Spanish tenor is the featured star, Jimmie Fidler, Hollywood columnist, dishes out a bundle of film chatter, Harry Jackson's orchestra provides the music, and in addition, celebrated guest stars from the film colony are offered for your entertainment. . . .

MARY PICKFORD AT LAST

At last Mary Pickford has put her signature to a radio contract. The original "Sweetheart of the Screen" will head a radio stock company which will broadcast microphone versions of outstanding stage and screen successes over an NBC-WEAF Coast-to-Coast network each Wednesday at 8:00 p.m. E.S.T., beginning October 3rd, sponsored by the Royal Gelatine Company. This new dramatic series will replace the program starring Jack Pearl, which the same sponsor has been presenting on behalf of Tender Leaf Tea. . . . Did you know that Jessica Dragonette is a gifted dress designer? No! Well, she is—and as a graceful acknowledgement of the petite singing star's ability in this direction, Mme. Lanvin, one of the outstanding designers of Paris, has created a gown which she has named "La Musique" in honor of Jessica Dragonette. . . . The Dorsey Brothers' Band has been added to the NBC roster and is heard each Wednesday at 11:00 p.m. over WEAF; and each Saturday at 12:00 midnight over WJZ. The band plays from the ultra-exclusive Sands Point Bath Club on Long Island. It might interest you to know that the "vocals" are handled by Bob Crosby, brother of the redoubtable Bing. Bob is making his first network appearance. . . . Peter Van Steeden tells a funny story on one of his band boys, and says it is actually true. Peter was looking over the boy's shoulder as the latter was making an entry in a pocket diary and was amused to read "Getting married today—don't forget—very important." The "Don't forget" was underlined. . . . Mabel Albertson, comedienne of Phil Baker's Armour troupe, is vacationing in Bermuda and postcards the fact that she is spending her time horseback riding, bicycling and surf bathing. . . .

FOR THE SMALL CHAPS

And don't forget, kids, that Albert Payson Terhune's Dog Dramas are back on WJZ each Sunday at 5:45 p.m., sponsored by Spratt. And so is Bob Becker's Fireside Chats About Dogs, each Sunday at 2:15 p.m., WJZ. . . . Also Tom Mix's Ralston Straight Shooters, each Monday, Wednesday and Friday at 5:15 p.m. on WEAF. . . . and the Ivory Stamp Club with Captain Tim Healy, each Monday, Wednesday and Friday at 5:45, WEAF. . . . and Red Davis, each Monday, Wednesday and Friday at 7:30 p.m., WJZ. . . . Plenty of wholesome fun for the little lads! . . .

AND FOR THEIR PARENTS

For the grown-ups there are many good programs new to the air; for instance, you might like "Peggy's Doctor," a new romantic series starring Rosaline Greene and James Meighan, each Monday, Wednesday and Friday at 1:15 p.m. over an NBC-WEAF network; sponsored by the Delaware, Lackawanna and Western Coal Company. . . . or "Plantation Echoes" a new musical feature, starring Willard Robison and His Deep River Orchestra, with Mildred Bailey as soloist. I can heartily recommend this. It is sponsored by the Vick Chemical Company, and is on each Monday, Wednesday and Friday at 7:15 p.m. over an NBC-WJZ network. . . . Then there is the "Story Behind the Claim," a new dramatic series based on true life insurance storeis; each Tuesday at 9:15 p.m. Starting on October 2nd, over an NBC-WJZ network; sponsored by the Provident Mutual Life Insurance Company. . . . And Lanny Ross is to have a show of his own—a half-hour musical show, sponsored by General Foods. Lanny will be starred with an orchestra and other soloists. Each Wednesday at 8:30 p.m. Commencing October 3rd, over an NBC-WJZ network. . . .

SIG ROMBERG AND BILLY PHELPS

Another new musical program will feature Sigmund Romberg, the famous composer, and William Lyons Phelps, noted critic. A full hour for this one. Sponsored by Swift and Company. Opens on October 6th and each Saturday thereafter at 8:00 p.m. over an NBC-WEAF Coast-to-Coast network—and that means plenty of cash to be spent! . . . The Smith Brothers will have a new set-up this year, but will still retain the services of their original duo—Billy Hilpot and Scrappy Lambert, who have served them faithfully for a long time. Their augmented program will also feature Rose Bampton, Metropolitan Opera contralto, and Nat Shilkret's Orchestra. Each Saturday at 9:00 p.m. over an NBC-WEAF network commencing October 6th. . . . "Thrills of Tomorrow," another new dramatic series, starts on October 19th; sponsored by A. C. Gilbert Company; each Friday at 6:00 p.m.; first broadcast October 19th. . . . Many old favorites are returning so there'll be no lack of entertainment on cold winter nights! . . .

OVER AT CBS

Over at the Columbia Broadcasting System's studios Waring's Pennsylvanians have already resumed their twice weekly series for the Ford Dealers; each Thursday and Sunday at 9:30 p.m. . . . And, of course, there's Bing Crosby and the Boswell Sisters in a new series, with George Stoll's Orchestra. This program will originate in the studios of KHJ, Los Angeles, California; each Tuesday, at 9:00 p.m.; sponsored by John H. Woodbury Co. . . . Another new series from the Pacific Coast is a dramatized biography of Benjamin Franklin, the many-sided genius of American history. These dramatizations will be written by Edward Lynn, who adapted "Catherine the Great" and "Peter the Great" for the air. I imagine this series will be excellent; each Saturday at 9:30 p.m. over a Coast-to-Coast WABC-Columbia network. . . . The Church of the Air has entered its fourth consecutive year of broadcasting over the WABC-Columbia network. This religious program is presented in two separate periods each Sunday. The morning program is at 10:00 a.m. and a later one at 1:00 p.m. They present services of the Protestant, Catholic and Jewish faiths. . . . The Big Show returns to the air on Monday, September 24th, at 9:30 p.m., starring Block and Sully, Gertrude Niesen, and Lud Gluskin's Continental Orchestra; sponsored by the Ex-Lax Company. . . . Another new series brings an old favorite back to the air. "Whispering Jack Smith," originator of the intimate style of microphone technique, is now heard each Tuesday at 7:30 p.m. over a WABC-Columbia network. . . . And Shell Products is bringing, for the third consecutive season, Eddie Dooley, All-American Quarter, in his thrice-weekly football broadcasts; each Thursday, Friday and Saturday at 6:30 p.m. WABC and network. . . . And won't the bridge hounds be glad to know that "Easy Aces" will be back again on October 3rd. They will be heard regularly on Wednesday, Thursday and Friday at 8:00 p.m.; sponsored, as usual, by the Wyeth Chemical Company. This season, the Aces, who are really "Mr. and Mrs.," in private life, will bring a new idea to their program. Turning the clock back five years they will tell the story of their courtship. . .

KATE SMITH ON DECK

Kate Smith has a matinee hour every Wednesday now at 3:00 p.m. The big gal sings, introduces specialties, and even has a hand in the casting and production end of the program. Kate also has an evening spot on Thursdays at 8:00 p.m. . . . Freddie Martin's Orchestra has been signed for a new series of programs to be known as "Vick's Open House." Starting October 7th, this musical feature will be heard over a nation-wide Columbia network each Sunday at 5:00 p.m. . . . The third radio chain in the East, known as the American Broadcasting System-WMCA network, is progressing mightily. Many new programs have been added to their already crowded schedule, and well-known artists are being used by them in an effort to interest the better type listener. Molly Picon, versatile star of the Yiddish stage, is one of the latest to sign with the ABS. She has launched a series of programs and may be heard each Wednesday from 7:30 to 7:45 p.m. . . . Three new dance orchestras have been added to the ABS dance schedule. They are, Charlie Davis's from the Hollywood Restaurant; Louis Russell, from the Empire, and Charlie Drury from the Casino de Paree. . . . Geraldine Garrick, ex-actress, who left the stage to become one of radio's leading dramatic directors, has been appointed dramatic director of the ABS network, by Burt McMurtrie, director of programs. . . .

SEE IF YOU DON'T

YOU WILL ENJOY: One Man's Family, Saturdays on WEAF, at 6:00 p.m. . . . American Album of Familiar Music, Sundays, WEAF, 9:30 p.m. Three X Sisters, Mondays, WJZ, 6:00 p.m. . . . Kings Guard Quartet, Tuesdays, WEAF, 2:30 p.m. . . . Footlight Echoes, Wednesdays, WOR, 9:00 p.m. . . . Death Valley Days, Thursdays, WJZ. 9:00 p.m. . . . Boake Carter, Fridays, WABC, 7:45 p.m.

Quick-Action Classified Advertisements

7c. per word. $1.00 minimum.

CAST ALUMINUM RADIO CHASSIS. Send 10-cent stamp for blueprint. Valentine, Stewartsville, New Jersey.

WE MAKE TO YOUR SPECIFICATIONS; chassis, shields, panels, test equipment. Chassis 10" x 12" x 3", $3.00. Constructors Supply, 303 Furman St., Schenectady, N. Y.

FLASH SOLDERING IRON—Instantaneous soldering Weld. Burn all light metals. Uses current only when in Contact. Operates on battery or Delco. $1.50. Casa Leon, 1401 West Grand Boulevard, Detroit, Michigan.

HAMS! Kit of all parts for National SW3; eight coils. First $10.00 takes it. J. W. Cullen, 249 Chadron Ave., Chadron, Nebraska.

UP TO $50.00 PAID FOR INDIAN HEAD CENTS; Half Cents, $250.00; Large Cents, $2,000.00, etc. Send Dime for list. ROMANO-COINSHOP, Dept. 304, Springfield, Mass.

SELL BY RADIO. Big profits. New Plan. Start Now. Complete Instructions, $1.00. Nothing Free. Manning's Dept. B, 1229 Park Row Bldg., New York City.

HANDY MEN—Establish much-needed Vacuum Cleaner Repair Service. Very profitable. Write E. G. Brown, 610 Atlantic Ave., Boston, Mass.

LOST KEYS are returned to you promptly when you use our service. Full Ten Year Service for $5.20. Only one cent a week. Send your order today. Velva Service Bureau, Dept. B, Box 546, Lima, Ohio.

PORTRAITS COLORED, 25c dull prints only. Leon C. Roffe, Laurens, N. Y.

"THE RADIO HANDBOOK," including Television and Sound Motion Pictures. By James A. Moyer and John F. Wostrel, both of the Massachusetts Department of Education. For engineers, designers, operators, service men, experimenters. 886 pages, 650 illustrations, flexible. Price, $5.00. RADIO WORLD, 143 West 45th St., New York City.

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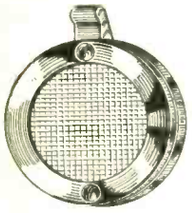

A single-button carbon-granule lapel microphone, impedance 200 ohms, requiring 4.5-volt excitation, of good frequency characteristics, and both handy and inconspicuous. Outside diameter 1⅝ inches. The case is chromium-plated brass. The excitation may be provided by introducing the microphone in a cathode circuit carrying around 20 to 25 milliamperes, or a 4.5-volt C biasing battery may be used. Net price, $1.75.

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SHORT WAVE WORLD RECEPTION A.C. D.C. RECEIVERS

For A-C and D-C Operation

Will work anywhere that 110 volt A-C or D-C is available. U. S. amateur reception is assured on loudspeaker by the use of a 43 power tube in the output.

With headphones the entire world is at your finger-tips. Chassis is completely encased in a beautiful crystal finished cabinet. Covers the short wave, band from 15-200 meters. Uses one 78, one 25Z5 and one 43 tube.

Price Kit.....$8.95

Wired.....**$2.00** extra. Tubes.....**$3.25**

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Generator with Amplifier Stage

IMAGINE a Signal Generator that enables measurement of frequencies from 83 kc. to 99.1 mgc. and wavelengths from 3,010 meters to 0.1 meter.

In several services low frequencies are commonly given only their wavelength equivalents, and for very high frequencies this is true likewise. So a Signal Generator, that enables determinations in both wavelengths and frequencies is the thing. That service is what the new Bernard Signal Generator Model 333 renders.

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The fundamental frequencies and wavelengths are direct-reading. There are no charts to strain the eyes. The dial is accurately calibrated and the Signal Generator accurately adjusted. These fundamentals are: 83 to 99.9 kc. (1 kc. separation); 140 to 500 kc. (5 kc. separation); 540 to 1,600 kc. (10 kc. separation); 1,620 to 4,500 kc. (30 kc. separation); 3,010 to 3,600 meters (25 and 50 meter separation).

The bands are selected by turning a front-panel switch. There are four switch stops. The low-frequency band and the wavelength band cover the same range, the same stop being used, though there are two scales for this band, wavelength and frequency.

Any frequencies or wavelengths as listed above are present as fundamentals and are read directly.

A new method, simple to apply, enables measurements from 4,500 kc. to 99.1 mgc., also wavelengths from 3,010 meters to 0.1 meter. The extension of the fundamental ranges is accomplished by a startling method that opens up new possibilities of extensive and accurate measurements.

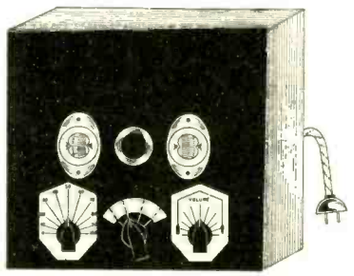
Model 333 Signal Generator, for 90-120 volts a.c., d.c. or batteries; designed by Herman Bernard, accurately calibrated and adjusted, for all-wave service, 83 kc. to 99.1 mgc., 3,600 meters to 0.1 meter; equipped with output attenuator, on-off switch, modulation switch for d.c. and battery use, Chromium-plated control and band-index scales, positive-contact, low-resistance band-selector switch, a.c. cable and plug, black wrinkle-finish shield cabinet, 34 and 30 tubes, neon tube, and instruction sheet included. Ready for immediate use.

Model 333-A (shipping weight, 7 lbs.)

List Price $40.00

NET PRICE **$19.95**

Model SG-333K, instructions (less tubes), complete kit; list price, $32.00. Net price $16.00



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The 115 diagrams, each in black and white, on sheets 8½ x 11 inches, punched with three standard holes for loose-leaf binding, constitute a supplement that must be obtained by all possessors of "Trouble Shooter's Manual." to make the manual complete.

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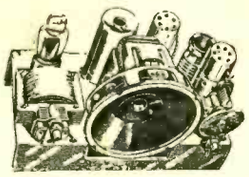

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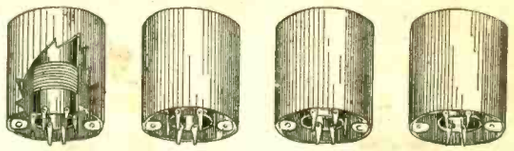

FOR broadcast reception, plus coverage to higher than 4,000 kc, thus yielding a total span of 540 to higher than 4,000 kc. We have an exceptionally precise combination, consisting of three r-f coils, one of which is used as antenna coupler, and one oscillator coil, also the necessary four-gang condenser and the correct padding condenser (Hammarlund adjustable type). The tuning coils for the r-f level have secondaries tapped so that the condenser stator may be switched from full inductance to just enough inductance to pick up the broadcast band where the full inductance left off. The oscillator coil is appropriately tapped, also, for this purpose. A four-pole, double-throw switch would be required (not furnished). Coils aluminum shielded, 2-1/16" outside shield diameter by 2.5 inches high. The four-gang condenser is very compact (5 x 2.25 x 2.75 inches). All material is specially made for this premium offer and is of highest calibre.

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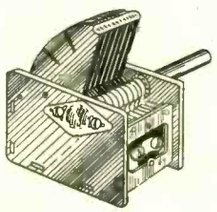
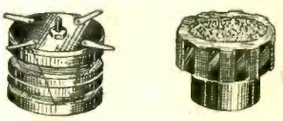
Same as above, same terms, except oscillator is for 175 kc and padder is 850-1,350 mmfd. Order PR-BCTU-175.

TUNING UNIT FOR TEST OSCILLATOR





HERE is your very first opportunity to get the parts for constructing a universal, modulated test oscillator to cover fundamentals from 135 to 380 kc, and read higher intermediate frequencies and the entire broadcast band, by harmonics, all imprinted right on the dial. That is, the oscillator will be direct frequency-reading. The parts consist of one metal-etched scale, one metal escutheon, one 0.000406 tuning condenser with trimmer built in, one oscillation transformer (secondary inductance accurate to 0.1 per cent.), and one knob for condenser. Circuit diagram supplied for universal model modulated test oscillator (90-120 volts a.c., d.c. or batteries, same oscillator works on all three). Instruction sheet for lining up at broadcast and intermediate frequencies included. Line up the oscillator with one adjustment on broadcast band, beating with some station on 1,200 to 1,400 kc. Whole dial then will track. Order PRE-TUTO and send $6.00 for one-year subscription for (52 issues). Sent postage prepaid.

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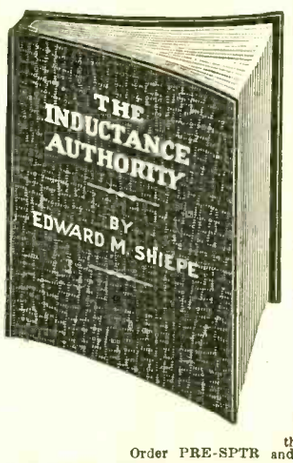

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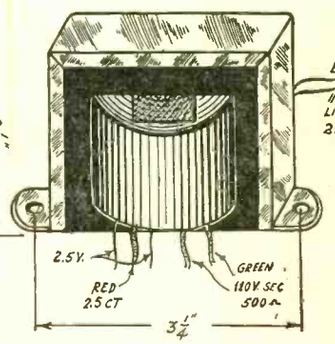

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