FROM 10 METERS *DOWN!*

JULY
18
1931

RADIO WORLD

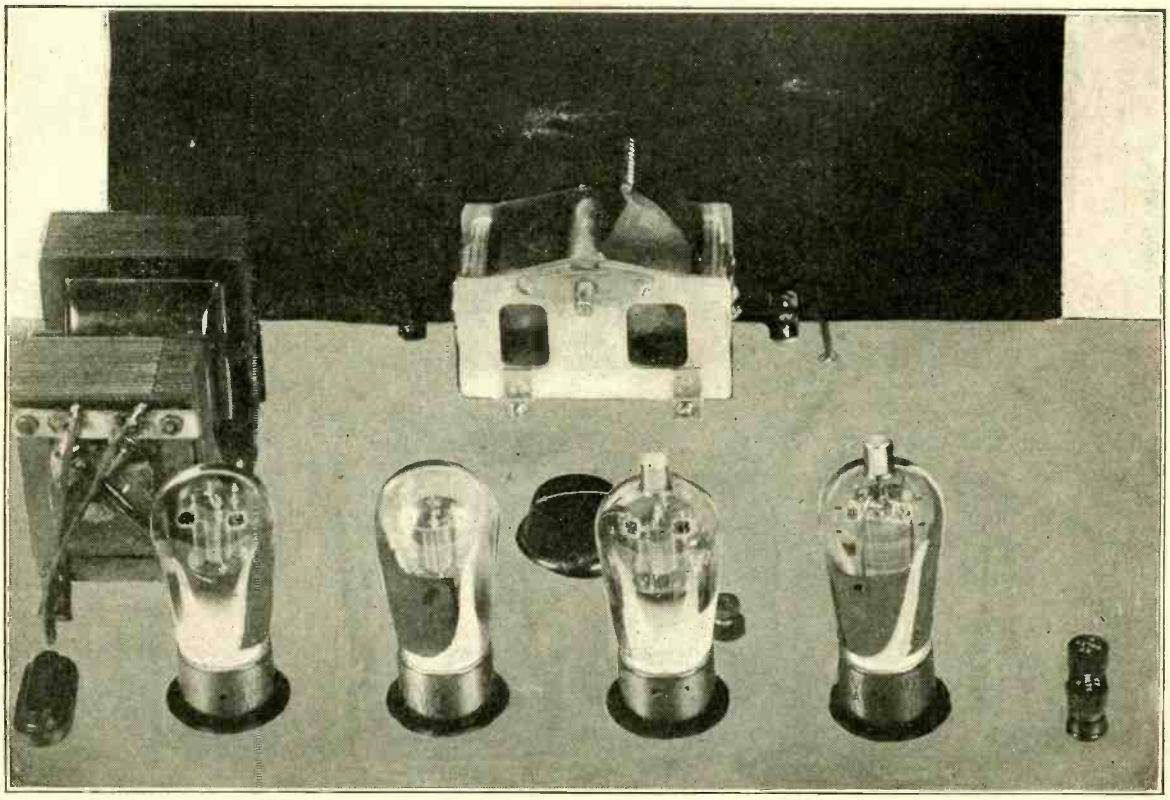
REG. U.S. PAT. OFF.

The First and Only National Radio Weekly

486th Consecutive Issue—TENTH YEAR

Price
15c
Per Copy

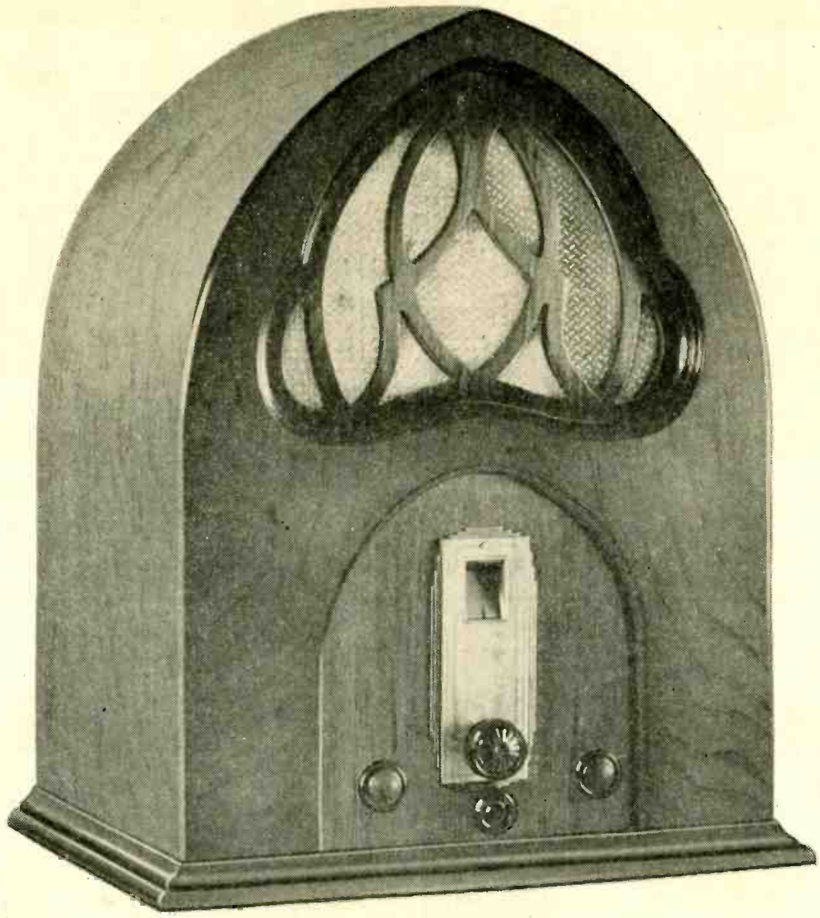
SHORT-WAVE EARPHONE TUNER



A stage of R.F. Amplification, Regenerative Detector, a stage of Audio and a Rectifier Are Used for Short Waves.

POLO AW-5

All-Wave AC Midget Receiver



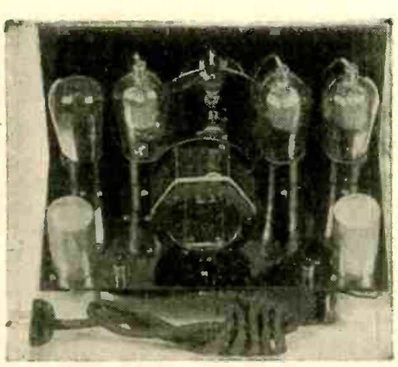
Wavelength Range Is 15 to 550 Meters. Front Panel Band Selector Switch Used.

Vari-Mu Radio Frequency Amplification With Pentode Output.

POLO'S new mantel type midget AC receiver, in a Gothic cabinet, affords wave coverage from 15 to 550 meters, with the broadcast band being tuned in completely without switching. Band selection for broadcast or short waves is made simply by turning a single front panel knob. This all-wave set has 235 radio frequency amplification, 224 detector, 227 first a. f., 247 output, 280 rectifier. Volume control and sensitivity control are afforded. For 110 v., 50–60 cycles. Wired model in cabinet, complete with tubes, Cat. AW-5 @......... **$55.00 NET PRICE**

Complete kit of parts, speaker, cabinet, diagram, less tubes, Cat. AW-5-K @..........**$45.00**

NEW VARI-MU SHORT-WAVE CONVERTER



A neat and efficient layout of parts marks the DX-4-VM, Polo's new highly sensitive converter.

A HIGHLY sensitive short-wave converter for use with any broadcast set to bring in stations 15 to 200 meters, is the new DX-4-VM, using one 224, two 235 and one 280. It has complete power supply built in, and front panel switch for selection of wave bands. Stations may be logged, an exclusive feature of the new converter.

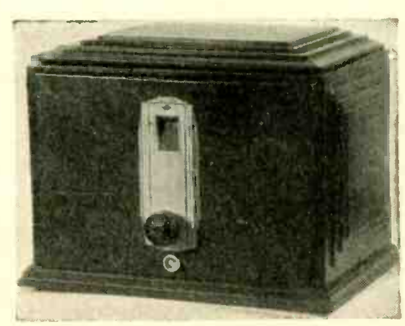
The circuit consists of the two mixer tubes, one intermediate stage and rectifier.

The converter has six tuned circuits, affording high sensitivity without instability.

Wired model chassis, Cat. DX-4-VMW (less tubes, less cabinet)....**$31.00**; Kit, **$26**

Standard model is for 110 v., 50-60 cycles; special voltage and frequency models quoted on application.

Walnut finish modernistic design wood cabinet, Cat. CBT @................ **$5.00**



The cabinet, obtainable separately, is executed in a modernistic design in keeping with the escutcheon of the dial used for tuning.

POLO ENGINEERING LABORATORIES

125 WEST 45TH STREET **NEW YORK, N. Y.**

Our Entire Line on Exhibition at Our Office ***Telephone BRyant 9-8093***

Vol. XIX No. 18 Whole No. 486
July 18th, 1931
[Entered as second-class matter, March, 1922, at the Post Office at New York, N. Y., under act of March, 1879]
15c per Copy. $6 per Year.

TENTH YEAR
Technical Accuracy Second to None
Latest Circuits and News

A weekly Paper Published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y.
(Just East of Broadway)
Telephone, BRyant 9-0558 and 9-0559

RADIO WORLD, owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.; Roland Burke Hennessy, editor; Herman Bernard, managing editor; J. E. Anderson, technical editor; L. C. Tobin, Advertising Manager

Short-Wave Circuits

A Fundamental Discussion of Receivers

By J. E. Anderson and Herman Bernard

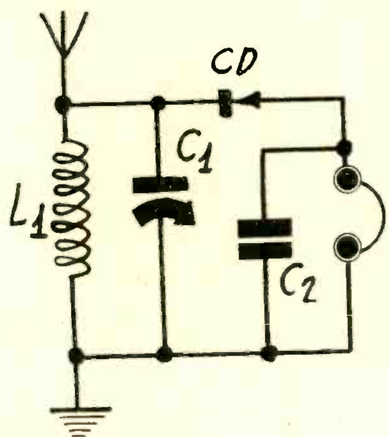


FIG. 1
A crystal receiver, with coil L1 in the antenna — ground circuit and tuning condenser C1 across the coil. C2 is a bypass condenser to shunt the radio frequencies around the phones.

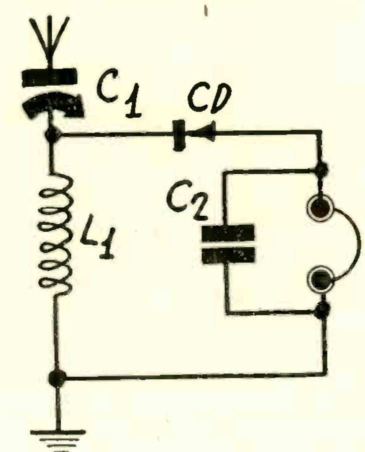


FIG. 2
The tuning condenser C1 is in series with the aerial in this circuit. The frequency range (kilocycle difference between maximum and minimum settings of C1) is not so large, but selectivity may be better, volume less.

MANY will laugh at the idea of a crystal set in these days. Residents of countries in which radio broadcasting is highly developed, and where there is a multiplicity of stations, know that the simple crystal set or the complicated crystal set is certainly not selective enough and lacks sufficient sensitivity for good service. The crystal set was the first one in use for broadcast reception, but it is still the most popular one in many countries, especially as it is so economical and requires no power for operation save that tiny quantity obtained from the aerial itself. Moreover, it is not only the oldest set, it is the newest as well.

Now that reception is a fact on short waves not so far removed from the light frequencies, the limitations of commercial tubes, particularly capacity effects between elements, leave only the crystal set as a readily practical means of reception in that region. Special tubes may solve the problem and if the frequency difference from the light realm is great enough, tubes serve the purpose well, as in a transmission-reception experiment with voice modulation in the Spring of 1931 from Dover to Calais on a wavelength of 18 centimeters, 7.08 inches, or a frequency of 1,660,000 kc.

Distance Limited to Vision Range

The distance between Calais, France, and Dover, England, across the English Channel, is 21 miles. The radio waves of frequencies in the micro-ray region are influenced much as are light waves, hence opaque obstructions cause the wave to go around the impediment, or even become totally dissipated by the obstruction. As would be expected, the range of transmission and reception is about the same as the range of vision, so that approximately 25 miles constitutes the greatest distance over which reliable operation may be expected. Therefore a crystal set is not disadvantageous because of lack of sensitivity, as there is no necessity for getting distance. The problem of selectivity is met in part by beam transmission, whereby the carrier wave is sent in a particular direction, instead of in all directions.

Fig. 1 shows a crystal circuit. A coil (L1) is connected between aerial and ground, across the coil is a tuning condenser (C1), while a series circuit consisting of the crystal detector (CD) and earphones are across the coil. A bypass condenser (C2), across the phones, keeps radio frequency currents out of the phones, since these currents will flow instead through the condenser.

By this method short waves can be received, although poorly, if the inductance of the coil, the maximum capacity of the tuning condenser and the aerial-ground capacity are small enough. It is impractical with such a circuit to receive waves much less than about 20 meters, or 14,991 kc, because of the unavoidably high minimum capacities. Where frequencies are of the order of micro-rays, as in the Dover-Calais experiment, the inductance consists of a small piece of wire, actually a rather stout, short rod, and the capacity naturally present is the auxiliary tuning device.

Use of Tube as Detector

The tuning condenser in Fig. 1 is in parallel with the coil, but it is practical to use the tuning condenser in series with the coil and the aerial, as in Fig. 2. The frequency range is reduced—not the geographical range of reception—and the signal strength may be less, although selectivity improves, due to looser coupling.

Instead of a crystal, a tube may be used as a detector (Fig. 3). Considering battery-operated tubes, the grid is connected to aerial and to stator of the tuning condenser, while a grid leak and condenser connect from this juncture to grid. The coil's other extreme, as well as the rotor of the tuning condenser, is returned to A positive. Thus the grid is positive in respect to negative filament (F —). This is called a positive grid return. The sensitivity is enhanced when the grid return is positive for types of tubes intended primarily for battery operation.

The grid leak is R1, the grid condenser is C2. A filament resistor (R2) serves to reduce the electromotive force of the battery to the voltage required for the filament of the tube.

While the sensitivity is greater than that of the crystal hookups, the selectivity is scarcely any better, and the circuit as a

(*Continued on next page*)

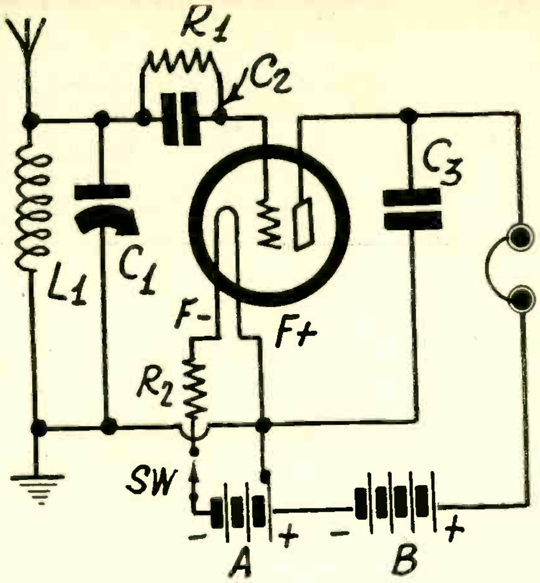


FIG. 3
A tube hooked up for detection, with grid leak R1 and grid condenser C2 producing detection. The grid is returned to positive of the A battery.

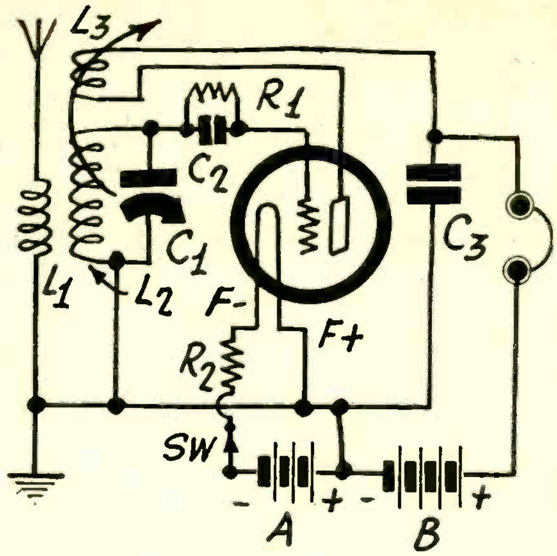


FIG. 4
Regeneration is introduced by the tickler coil L3, in variable inductive relationship to the tuned secondary L2. Also a primary coil L1 is in the antenna-ground circuit, to improve selectivity by looser coupling.

(*Continued from preceding page*)
whole is not suitable for use today. With some changes, however, its utility can be made actual.

A Practical Tube Circuit

Fig. 4 shows two principal changes. First, instead of the aerial being connected to the winding across which the tuning condenser is shunted, it is connected to a small winding (L1) called the primary, while the coil (L2) with the tuning condenser in parallel with it, is less than an inch away, at the adjacent terminals of the two coils. The primary is inductively coupled to the larger secondary. This step-up ratio increases the secondary voltage and reduces its current proportionately, in respect to the voltage and current in the primary. Second, another coil (L3) has been introduced. This is on a rotatable form. L3 is in the plate circuit of the tube, and thus radio frequency voltage from the plate circuit is returned to the grid circuit, to reinforce the grid voltage.

This method of feeding back impulses is called regeneration. Its effect is to lower the radio frequency resistance of the tuned circuit, composed of tube and tuning adjunct. Moreover, the detector becomes an effective amplifier as well, contrasted with the crystal, which has no amplifying properties, and the tube circuit in Fig. 3, which has small amplification.

Since resistance in a tuned circuit in inimical to selectivity, reduction of the effective resistance constitutes an increase in the selectivity. So Fig. 4 becomes a thoroughly workable circuit, having sensitivity and selectivity of passable magnitude; in fact, being able to tune in signals from far-distant stations on occasions, on suitable frequencies.

Methods of Regeneration

Radio waves behave differently on different frequencies. This is obvious from the fact that micro-waves at present are found to be limited approximately to the range of vision, while higher waves travel around the earth, even to be received at the sending station. However, when lower frequencies are involved, and the time of day or night and other conditions are propitious, the circuit shown in Fig. 4 will give excellent results. In daylight, for instance, around 20 meters, or at night, from 40 to 80 meters, good reception can often be accomplished.

However, the short-wave bands are crowded with stations, and selectivity of a higher order is necessary, especially if foreign reception is to be included, so we shall have to look to other circuits to provide the type of results that present-day users require.

Before taking up the more practical and productive circuits, let us consider some other methods of obtaining regeneration. We have found that a rotatable plate coil, in inductive relationship to the grid coil, will provide regeneration. This is true only if the voltages are phased properly. The problem is solved if the rotable coil can describe an angle of 180 degrees, as then the regenerative action will be encompassed by less than half of the total angular ratotion, so the moving coil, or tickler, is manipulated in the effective region. In the other half of the semi-circular displacement it would act as a damper on the circuit.

Where Reversal May Be Necessary

If the tickler turns only 90 degrees, or a little more, then it is necessary to connect the plate and B plus leads to the tickler in a given manner. If regeneration is not present, reverse these connections, that is, remove the two connections to the tickler, and put to the plate the lead that formerly went to the one side of the phones, and to one side of the phones the lead that formerly went to plate.

Instead of the previously discussed tickler being a moving coil, it may be a fixed one, in which case the regeneration can Fig. 5. The rheostat R3 is in series with the plate coil. It be controlled by a high resistance rheostat in the plate circuit, is also practical to have the resistor in parallel with the plate coil, as in Fig. 6.

Smoothness and No Body Capacity

Another method is to have the fixed tickler in inductive relationship to the secondary, with a variable condenser connected between one terminal of the tickler coil and the grid return. The preferred position of the condenser is the one shown in Fig. 7, because then the rotor is grounded, and there is much less likelihood of body capacity.

Since a condenser is used to control feedback in Fig. 8, this method is often referred to as capacity feedback and is also called parallel feed. Another method is shown in Fig. 8, where a rheostat is used for control of regeneration by its effect on radio frequency voltages only. C3 in Figs. 7 and 8 must be small compared to C4, otherwise the circuit may not oscillate.

The method of feedback used is not so important as are smoothness of control and absence of body capacity. Smoothness is a relative term, since in all regenerative systems, particularly on weak signals, the feedback setting may be expected to be critical. Absence of body capacity may become a fact if feedback condensers and tuning condensers have their rotors grounded, or, if a moving coil is used, the coil is sufficiently far removed from the hand, and preferably has an insulation shaft. Regardless of the type of circuit used for feedback, the coil should be at a distance of at least several inches from any possible position of the hand in making any adjustments for sensitivity or tuning or volume control. The higher the frequencies to be tuned in, the greater this separation should be, and at 15 meters the coil well may be a foot from the hand.

Dynatron Screen Grid Circuit

There are other feedback methods and other circuits for one-tube receiver sets for short waves, but the only one substantially different is that of the screen grid tube, with plate circuit tuned, constituting the dynatron oscillator. The screen voltage is higher than the plate voltage, while the variation of detecting efficiency by negative grid bias adjustment may control regeneration. Unless the coupling to this type of circuit is very loose, regeneration may fail.

The system is used principally for oscillators only, that is, circuits that are continuously in a state of oscillation, such as oscillating wave meters or frequency meters, but for other purposes the oscillation may be controlled, to constitute regeneration, by variation of direct current voltages or other means.

Detection therefore may arise from suitable negative grid bias. This applies to any tube, except variable mu tubes. One of the other means of regeneration control is rheostat control of the filament voltage, but this method is not used much, because it lacks fineness. It has been said that regeneration reduces the effective radio frequency resistance of the tuned circuit. The reduction may be greater than 100 per cent. Then the circuit has a negative resistance, and the tube oscillates.

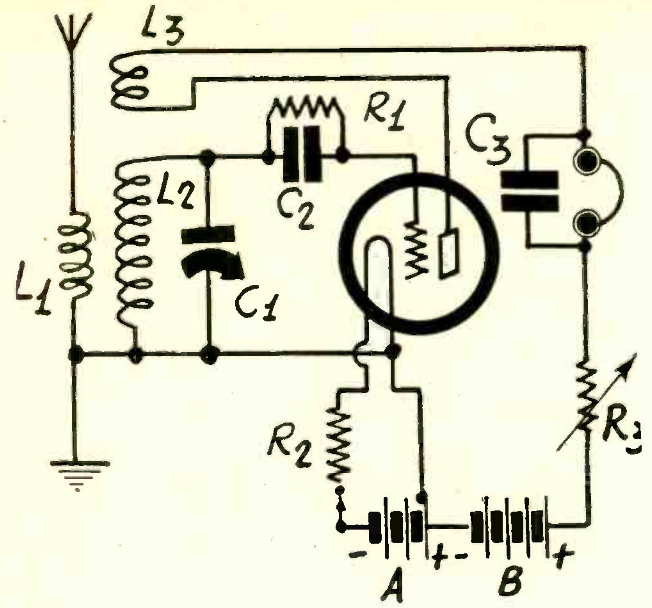


FIG. 5
Regeneration control by a high resistance rheostat R3 in series with the plate circuit, to alter the plate voltage. No bypass condenser need be placed across such a resistor. The feedback coil is a fixed one. Plate voltage is varied.

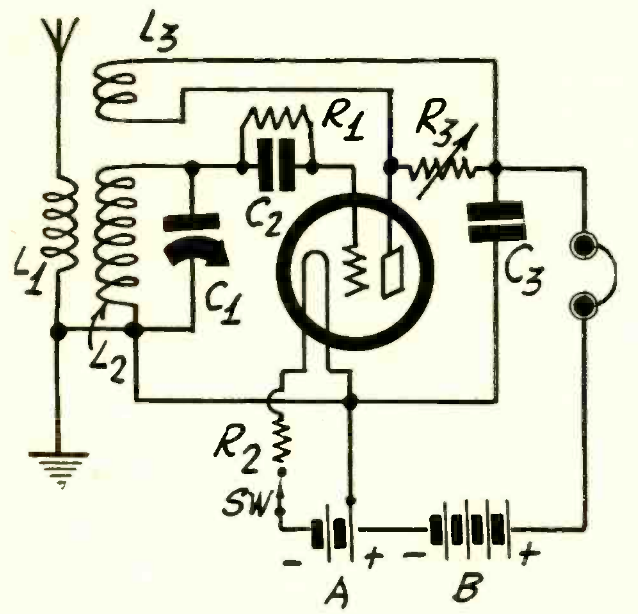


FIG. 6
A high resistance rheostat R3 is in shunt with a fixed tickler and controls regeneration. This method does not alter the plate voltage.

Such a condition is effected, of course, in the dynatron oscillator. Control is afforded when means are provided for increasing the radio frequency resistance or decreasing the emission or amplifying property of the tube by voltage or other adjustments.

Negative Resistance

In general, a tube acts in the manner commonly described as oscillating, which means the generation or radiation of waves, when the resistance of the tuned circuit is negative. Only through the property of a tube to oscillate does broadcasting become possible, since waves are radiated in that way. However, in using a tube for reception, where the tube is coupled to the aerial, as in the tube diagrams so far alluded to, save one, this radiation becomes objectionable.

The purpose of a receiver is to receive, and not to transmit. When the tube goes into oscillation, or "spills over", the circuit is a transmitter, as well as a receiver, and it may be more effective as a transmitter. The greatest sensitivity is just under the oscillating point. Therefore if regenerative one-tube circuits are to be used, great care must be taken to avoid radiation, for radiation causes interference to reception by others usually in the form of piercing squeals which, on short waves particularly, may be heard for many miles.

The method of careful operation is to set the feedback control at a position that affords no feedback at the highest frequency, and then as the tuning is manipulated, gradually introduce feedback for any particular frequency, never attain-

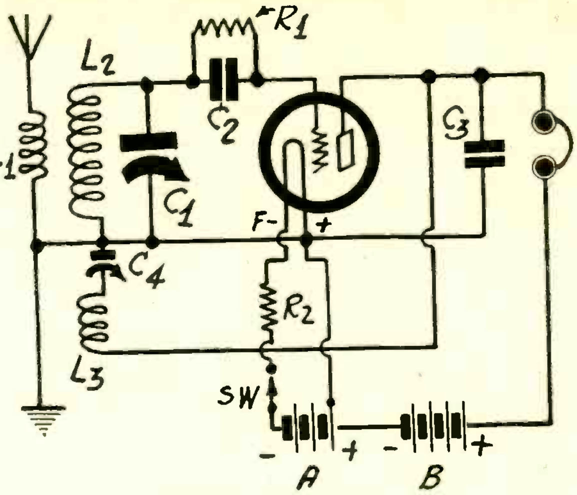


FIG. 7
Capacity feedback, so-called because a variable condenser C4 is used for regeneration control. L3 is in inductive relationship to L2. C3 must be small compared to C4.

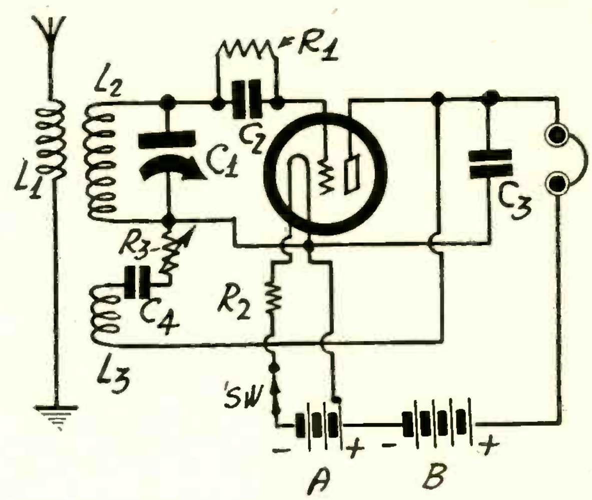


FIG. 8
Another form of resistance control of regeneration. R3 is the variable, while C4 is fixed. Otherwise the circuit is the same as that in Fig. 7.

ing the point where the tube spills over. The tickler should be retarded for each retuning to avoid accidental oscillation.

Skill can be acquired in tuning a regenerative set, and little interference will be caused, but in actual practice there is a great deal of carelessness, the result being much squealing interference on the short-wave bands, so much so, in fact, that the United States Department of Commerce has had to issue a warning on the subject.

One reason why there is so much squealing is that persons tuning in for short waves set their receivers so that one of the tubes oscillates and locate the carriers of stations by listening for the squeals resulting from the oscillating receiver beating with the incoming waves. Then they adjust the receiver either to reduce the oscillation to the allowable limits of regeneration, and retune slightly, or they listen for a squeal, tune so that they get the highest pitched whistle at two dial points always close together, and then turn the dial back a little so as to attain the in-between point where there is no squeal.

"Fishing" by the Squeal Method

The first method, of listening for stations' squeals, is naturally a simple way of locating stations on the dial, although at considerable possible discomfort to other listeners. The second method, which has the same objection as to interference, consists of an oscillating receiver ultimately tuned exactly to the frequency of the carrier, when there is no beat, but causing squeals prior to the final setting. The second method is known as zero beat reception. Signals may or may not be heard by that method, and if heard they usually are mushy. Both methods consist of "fishing" for stations by locating squeals. Retuning is constantly done on regenerative sets when the tickler is adjusted because of the tickler's slight detuning effect.

Regeneration has an extraordinary effect in increasing selectivity and sensitivity, therefore it is used considerably. It may be regarded as feedback below the point of oscillation. We have observed that oscillation is that condition of the tube that causes it to transmit. There is a well-understood

(*Continued on next page*)

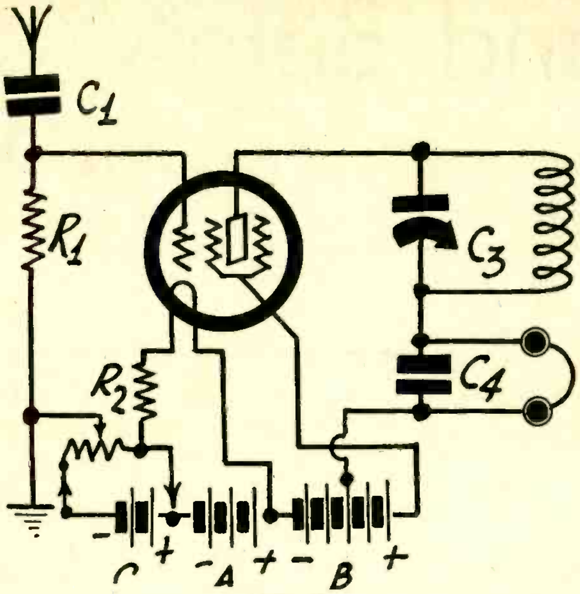


FIG. 9
A dynatron negative bias detector, using a screen grid tube.

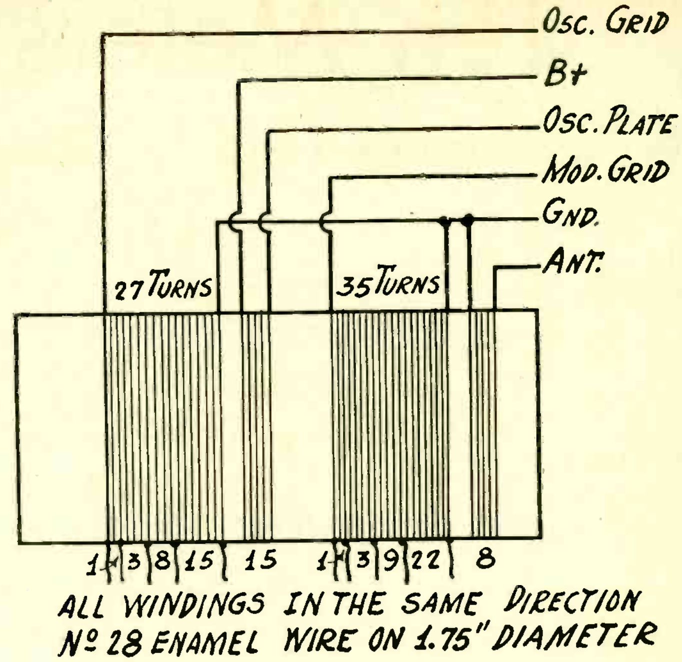


FIG. 10
Plug-in coils, or tapped coils with switch control, can be used for short-wave work.

(Continued from preceding page)
dividing line between the radiating and the practical non-radiating condition. The radiating condition causes one's receiver to beat with another frequency, as that of a carrier, to produce a squeal of a frequency equal to the difference between the two. The non-radiating condition in general does not produce any squeals, even though the circuit may be regenerating; that is, there is some feedback, but not enough to make the circuit's radio frequency resistance negative.

Disagreement on Definitions

There is another aspect of the situation. Some do not distinguish between regeneration and oscillation, holding that they are the same thing. If there is any feedback there is a proportional amount of oscillation, and while no squeal may be heard, this would be due simply to the feebleness of the oscillation, not to the fact that there is no oscillation. Regeneration then would be considered as oscillation within the region that does not produce squeals that can be heard, due simply to insufficient power of oscillation, not to absence of oscillation. Failure to hear the squeals then may be ascribed to the limited sensitivity of the detector, whereas amplification at audio frequencies, following the detector, might render the squeals audible.

In any event, the power below the so-called oscillation point would be so low that no interference to other listeners would result, and if this nuisance is avoided, the process may be utilized.

R. F. Stage Ahead

It has become popular to put a stage of tube amplification ahead of the detector, which reduces very greatly the amount of radiation that reaches the aerial or that gets into the ether by any other route. Sometimes such a stage is untuned, and the avowed purpose of including it, despite little gain in amplification, is consideration for others. Such a tube is called a blocking tube. To serve its intended purpose, of course, this tube must not oscillate. If the radio frequency amplifying stage is untuned, there is little likelihood that it can oscillate. If tuned, it may oscillate, unless special precautions are taken.

Short-Wave Club

ARE you interested in short waves? Receivers, transmitters, converters, station lists, trouble shooting, logging, circuits, calibration, coil winding—what not? If so become a member of Radio World's Short-Wave Club, which you can do simply by filling in and mailing attached coupon. As many names and addresses as practical will be published in this department, so that short-wave fans can correspond with one another. Also letters of general interest on short-wave work will be published. Besides, manufacturers of short wave apparatus will let you know the latest commercial developments. Included under the scope of this department is television, which is spurting forward nicely. Fill out the coupon and mail at once.

If you prefer, send in your enrolment on a separate sheet or postal card.

Short-Wave Editor, Radio World, 145 West 45th Street, New York, N. Y.
Please enroll me as a member of Radio World's Short-Wave Club. This does not commit me to any obligation whatever.

Name ....

Address ....

City .... State ....

☐ I am a subscriber for Radio World.

☐ I am not a subscriber, but buy copies at news-stands.

Some New Members of the Short-Wave Club:

G. M. McGuire, Box 12, Acadia Valley, Alta., Canada
W. F. Hanchet, 14 Lewis St., Ottawa, Ont., Canada.
Earl F. Clowes, 12283 Flanders Ave., Detroit, Mich.
F. Bignell, 809 Athol St., Regina, Sask., Canada.
Robert A. Shafer, Shafer-Ozark Radio Co., McCracken, Kans.
Robert S. Alter, c/o The American Tool Works Co., Cincinnati, Ohio
George Vogel, Jr., N. 1219 Monroe St., Spokane, Wash.
John Shaffer, 1607 17th St., N. W., Washington, D. C.
Willis S. Clayton, Jr., 1132 Cherry Ave., San Jose, Calif.
E. Mather, 717 Grandville Ave., Grand Rapids, Mich,
M. L. Barash, 1072 Teller Ave., Bronx, N. Y.
Boris Beckmann, 2 West 120th St., New York City
George E. McMahon, Guadalupe, Calif.
S. C. Lee, c/o American Can Co., P. O. Box 209, Honolulu, Hawaii
M. Takehchi, 1488 Dillingham Blvd., Honolulu, Hawaii
Glenn Hickman, Corning, Calif.
Alexander J. Dojcsak, 2143 Caledonia St., Toledo, Ohio
Frank Ramon, 346 Mercy St., Philadelphia, Pa.
J. Donald Magnuson, Route 2, Box 66, Lansing, Iowa
Vernon Munson, Radio Service, 817 Sycamore Ave., Modesto, Calif.
Dan Georgevich, 820 West Diamond St., Butte, Mont.
W. K. Wilkins, P. O. Box 52, Minot, No. Dak.
Alvin Michelis, 8251 Bingham Ave., Detroit, Mich.
A. W. Hjorth, K.P.R.C., Sugarland, Texas.
John J. Carlin, 1322 Amsterdam Ave., New York, N. Y.
Julius Ferrari, 111 East 54th St., New York, N. Y.
Henry S. Bradbury, 135 No. 7th St., Fall River, Mass.
A. J. Kendrick, 916 Cypress, Duncan, Okla.
Fred W. Kuenstler, 4259 Ellenwood Ave., St. Louis, Mo.
Francis Coupal, Brebeuf, Co. Terrebonne, P. Q., Canad
Glen P. Heffron, Burtrum, Minn.
Russell Lindstrom, 2224 6th St., Berkeley, Calif.
Bert Fattig, 392 1-2 So. 1st St., W., Cedar Rapids, Iowa
Thos. B. Davis, Jr., 1821 Corcoran St., N. W., Washington, D. C.
Abraham Resue, 3 Newark St., Sodus, N. Y.
Louis Meterier, Jr., 202 W. Forest Ave., Ypsilanti, Mich.
Ralph Krum, 815 Fox Street, Bronx, New York City
George Stronach, 10 Robbins Drive, Wethersfield, Conn.
William W. Sampson, 6217 Indiana Ave., Chicago, Ill.
Ernest W. Kanelakos, 358 Westminster St., Providence, R. I.
Chas. Kosters, 29 Spencer Place, Brooklyn, N. Y.
L. McMillan, 4207 Spaulding Ave., Chicago, Ill.
Frank E. Lord, 11 Meshaka St., West Roxbury, Mass.
Everhart S. C. Turner, 3754 So. Michigan Ave., Chicago, Ill.
David Hensley, 2285 Valentine Ave., New York, N. Y.
Eric Palmer, 305 Ave. C West, Brooklyn, N. Y.
Harold Olson, 210 North Orchard St., Madison, Wis.
M. A. Gomes, Room 502 Windsor Station, Montreal, Canada
Arthur C. Wylie, 1011 Central St., Lowell, Mass.
J. W. Cope, Box 139, Kelowna, B. C., Canada
John Kitchiner Hopkins, 238 Bowman St., Hamilton, Ont., Can.

Ten Meters and Below

A Fascinating Field Is Opening Up—How to Utilize It

By J. E. Anderson

INTEREST in short waves below 10 meters (frequencies above 30,000 kc) is world-wide and is increasing daily. There is scarcely a single country, or section in any country, where experiments are not going on.

But the field is so vast that although there are thousands of experimenters, they are lost in the immensity of the unexplored region. If there were a single high power station operating regularly on a frequency in this region, millions would become interested where there are now thousands.

High power on these short waves does not have the same significance as high power on broadcast waves. A high power broadcaster might radiate 50 kilowatts; a high power set below 10 meters might well be one radiating 50 watts, or even less.

The range of waves below 10 meters is very uncertain. As a rule the waves do not travel far. They are not sent back to earth by the Kennelly-Heaviside layer like waves in the 200-10 meter band. When they strike the layer they keep right on into space beyond, or they are dissipated.

But they are both interesting and useful while they still are within reach of the surface of the earth.

These short waves are often referred to as quasi-optical waves because they are short enough to follow the laws of light waves. They can be refracted, reflected, focused, and possibly diffracted by means similar to the means used in optics and of dimensions that are not impossibly large.

Measurements of Wavelength

Before such waves can be either transmitted or received on any definite frequency it is necessary to have some means of measuring the wavelength. The field is too wide to employ a hit-or-miss method of tuning, for there would hardly be anything but misses. Wavemeters calibrated below 10 meters are available commercially in case it is desired to buy them. But the experimenter will undoubtedly find more pleasure and certainly more experience in making his own, which is a comparatively simple matter.

The absolute wave meter ordinarily used below ten meters is a pair of Lecher wires together with a resonance indicator and a meter stick. A meter stick may not be available outside school laboratories in this country, but a yardstick or a steel tape graduated in inches can be used just as well, for inches may be converted to centimeters by multiplying by 2.54, which is the number of centimeters in an inch.

Fig. 1 illustrates the Lecher wire hook-up for measurement of wave-length. Two heavy copper wires about 20 feet long are stretched horizontally and parallel to each other a few inches apart. They are left open at one end and at the other end a suitable coil L2 is connected. A and C are two short-circuited bars across the wires like two bridges. They may be made of two heavy, bare copper wires. B is a similar bridge but instead of being a short circuit it contains in series a neon glow lamp.

Principle of Lecher Wires

Suppose high frequency oscillations exist in the resonant circuit CL1. L2 is coupled to the coil L1 and therefore there is a voltage induced in L2. The coil L2 and the two parallel wires form a circuit, closed by the capacity between the wires. The current will not be uniformly distributed in the Lecher wire circuit but will be in the form of a wave. Neither will the voltage distribution be uniform. At one point there may be no voltage at all across the wires while at another point it may be very high. If the bridge containing the neon tube be placed across the wires at a point where the voltage is high, it will glow, provided the circuit is excited adequately by the oscillator. At any other point there will be no glow.

Now suppose that the short-circuited bridges A and C are not in place, the neon bridge alone riding the wires. By means of a long wooden stick move the neon tube bridge very slowly along the wires, keeping the bridge at right angles to the wires. A point will be found where the tube glows. Adjust carefully until it glows most brightly. Do not disturb it in this position. Start from the coil and move toward the open end of the wires.

Now place one of the short-circuit bridges across the wires, say A. The lamp will go out because the voltage distribution has been changed so that the lamp is no longer at a voltage maximum. Starting bridge A near coil L2, move it very slowly toward B with the long wooden stick. A point will be found for A where the neon tube glows again. Find the point for A where the tube glows most brightly, keeping the wire representing A at right angles to the long parallel wires. Now the distribution of the voltage has been restored to that existing before

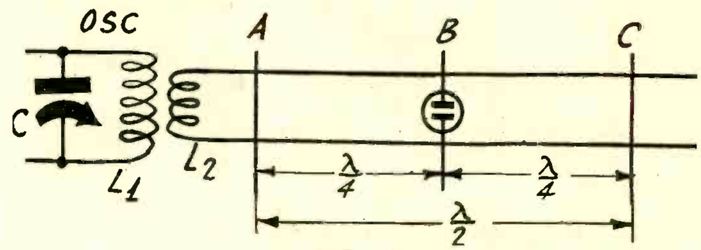


FIG. 1
A diagram showing the use of Lecher wires for the measurement of short waves generated by an oscillator.

A was put across the wires. A is at a voltage zero, or node, while B is at an antinode, or voltage maximum.

Finding the Half Wavelength

Now, without disturbing either A or B, put the other bridge C across the wires. Start it near B and move toward the open end of the wires. As soon as C is put across the wires the lamp will go out. But a point will be found beyond the neon tube which, when C is placed there, will cause the lamp to glow again. Keep the bridge wire at right angles to the long wires and move very slowly or the point may be passed without noticing the flare-up of the neon tube. Now the lamp glows with both A and C across the wires. The voltage distribution is exactly the same as it was before either was placed across the wires. B is at a voltage maximum and A and C are at voltage nodes.

The wave on the wire is what is known as a stationary wave, and in all such cases the distance between a node and an antinode is equal to one-quarter wavelength. Therefore in the case of the Lecher wires, the distance between A and B is a quarter wavelength and that between B and C is also a quarter wavelength. Hence the distance between A and C is a half wavelength, and to find the wavelength it is only necessary to measure the distance with a meter stick or equivalent and multiply by 2. This is the wavelength which would be obtained by dividing the speed of the wave in free space by the frequency.

In case the condenser C is provided with a good vernier dial, it is possible to calibrate the oscillator, or the circuit CL1, in terms of wavelength or frequency by means of the Lecher wires. This is done by measuring the wavelength as described above for many different settings of condenser C, beginning with zero and ending with 100. Of course, it may be that the longest wavelength generated by the circuit is greater than twice the length of the Lecher wires, in which case twice the length of the wires determines the limit of the calibration.

Having obtained readings of wavelengths for about 10 settings of the condenser, the data should be transferred to cross section paper and a curve drawn. This will make all intermediate settings of the condenser available without the necessity of making further measurements on the Lecher wires. It is clear that this method is available for rather long waves if room can be found for stretching long enough wires. But the method is seldom used for waves longer than 10 meters because there are other methods of measuring frequency or wavelength.

Lower Limit of Lecher Wires

There is no definite lower limit of the Lecher wires, but the lowest waves that may be measured are very short. The limit depends largely on the dimensions of the neon indicator and the short-circuiting bridges. But as far as dimensions are concerned it is quite practical to go down to lengths of a few centimeters. It is much more difficult to produce these short waves than to measure them after they hav been produced.

The short wave limit of tube oscillators is in the neighborhood of 2 meters, but in order to get a wave as short as this with a tube it is necessary to take many precautions. Usually it is necessary to put radio frequency choke coils in all the supply leads, such as the two filament leads, the plate lead and the plate return lead. Also, it is usually essential to remove the base of the tube and to solder the various leads directly to the wires leading out of the tube. This is necessary for two reasons: first, to reduce as much as possible distributed capacity, and second, to minimize losses in insulators. If the wave to be generated is not to be the shortest possible with a tube, the

(Continued on next page)

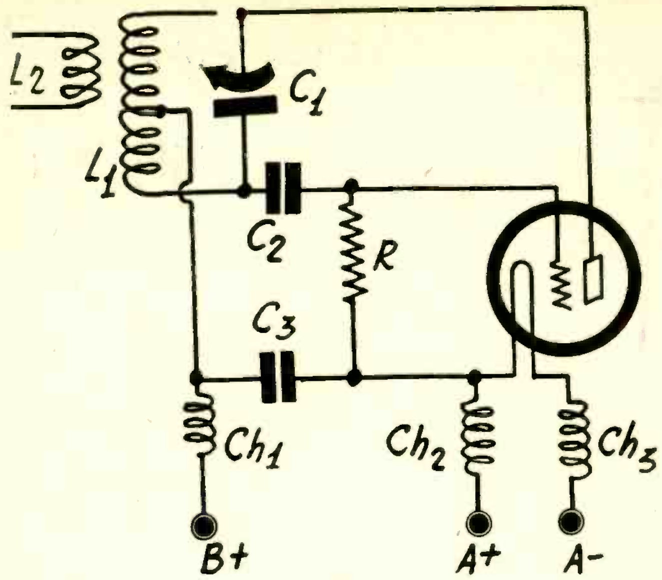


FIG. 2
A simple Hartley oscillator circuit that may be used for frequencies between 10 and 2 meters.

(*Continued from preceding page*)
supply leads may be soldered to the prongs on the base of the tube, without removing the base.

The necessity for minimizing distributed capacity in order to generate very short waves becomes evident when we calculate the product of the inductance and capacity required for a wave of say one meter. One meter is equivalent to 300,000,000 cycles per second, so that if we express the inductance in microhenries and the capacity in micromicrofarads, the product is only 0.281. The grid to filament capacity alone is often as high as 10 micromicrofarads, which would make the inductance only 0.0281 microhenries, or 28.1 centimeters. It is difficult to get inductances so small. Of course, by taking precautions it is possible to lower the capacity of the tube so that a practical inductance may be employed.

Short Wave Oscillators

In Fig. 2 is a Hartley type oscillator, which is one of the simplest, although it is not rated as one of the best oscillators for this purpose. The oscillating inductance is L1, which may consist of a single turn of heavy wire with the tap to the B supply connected to the middle point of the turn, or a little closer to the plate end of the turn. The tuning condenser C1 should be the smallest variable condenser obtainable. In some short wave circuits it is a 20 or 50 mmfd. maximum condenser while in others it consists of two small circular plates facing each other, one of which may be moved toward or away from the other by means of a fine-thread screw. The frequency coverage will not be great when the tuning condenser is so small, because its maximum capacity is of the same order of magnitude as the distributed capacity. But wide coverage is not desirable because the absolute frequency change is so great that it would be next to impossible to reset the oscillator at any one frequency if the condenser were larger. If the tuning condenser is of the ordinary rotatable type a slow motion dial is essential. The

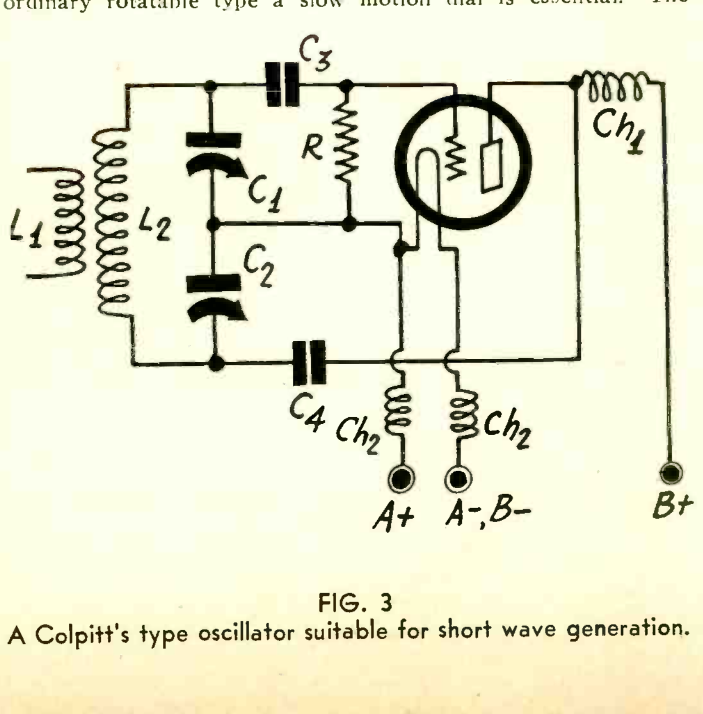


FIG. 3
A Colpitt's type oscillator suitable for short wave generation.

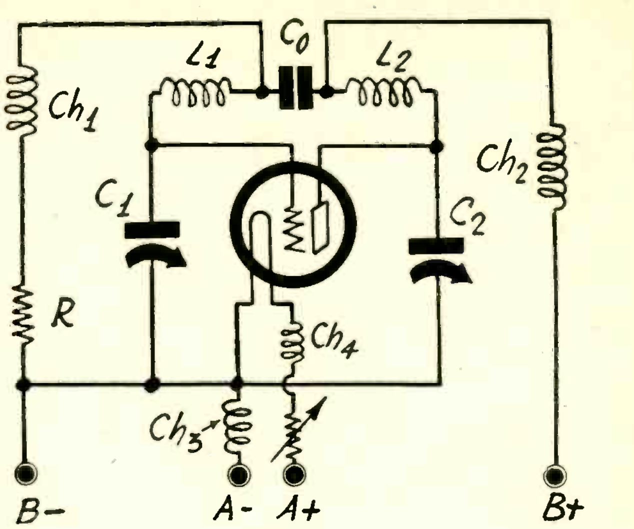


FIG. 4
A modified form of Colpitt's oscillator designed especially for ultra-short waves.

fine-threaded screw serves the purpose of slow motion admirably, especially when the movable plate is not too close to the fixed plate.

Incidentally, when the two circular plates are used it is essential that the mechanical work be done accurately, for the two plates should remain parallel all the time and there should be no wobble in the moving plate. Insurance against wobble will be obtained if the screw moves in a long threaded sleeve and the plate attached to the screw is accurately at right angles to it.

Values of Other Parts

C2 may be a condenser of 0.0001 mfd. and C3 one of 0.001 mfd. R may have any value from 10,000 to 100,000 ohms. The radio frequency choke Ch1 depends entirely on the frequency that is to be generated. For waves below ten meters and above two meters it may consist of 100 turns of No. 28 double cotton-covered wire wound on an insulating form the diameter of a lead pencil, or it may have still more turns provided that it is long and narrow. Ch2 and Ch3 are similar coils, but they should be wound with heavier wire for they will carry the filament current. Each may consist of 50 to 100 turns of No. 22 double cotton covered wire on a form about ¼ inch in diameter.

A rheostat of 10 ohms might be connected between the filament battery and the A minus lead.

The coil L2 is only a coupling coil either for connection in the antenna circuit or in the Lecher wire circuit. A single turn will do for either, and this turn should be of about the same diameter as the tuning coil.

Colpitt's Circuits

In Fig. 3 is Colpitt's type oscillator in which the tuning condenser is split up into two sections, C1 and C2, which are connected in series. One of these condensers is in the grid circuit and the other in the plate circuit. There is a single coil across these two condensers. Both condensers are made variable because the efficiency of the circuit as an oscillator depends on the relative values of the two. Either condenser may be used for varying the frequency generated or they may be put on the same shaft and varied simultaneously, in which case they should be arranged so that they change in the same direction.

The grid leak in this circuit may have the same value as the leak in the preceding circuit, and C3 and C4 may have the same values as C2 and C3, respectively, in the preceding circuit. The chokes Ch1, Ch2 and Ch3 may also have the same values as the corresponding chokes in the circuit in Fig. 2. The coupling coil L1 and the oscillator coil L2 may also have the same values. It is not possible to give exact values of the inductances because they are closely dependent on the distributed and tuning capacities in the circuit, as well as on the wavelength.

The Colpitt's circuit is rated as good for short wave generation.

Balanced Circuit, Colpitt's Type

In Fig. 4 is another form of Colpitt's circuit. In this the oscillating circuit consists of C1, C2, Co, L1 and L2, all connected in series. The grid to filament capacity is in parallel with C1, the plate to filament capacity with C2, and the grid to plate capacity with the two coils and Co, but due to the special connection the effect of the tube capacities is small. Hence this circuit is capable of oscillating at a high frequency. The coils L1 and L2 should be one turn coils and they should be coupled in the proper direction. In this case the two chokes Ch1 and Ch2 should be wound as Ch1 in Fig. 2 and chokes Ch3 and Ch4 like Ch2 and Ch3 in Fig. 2.

As in the case of Fig. 3, C1 and C2 may be tuned indepen-

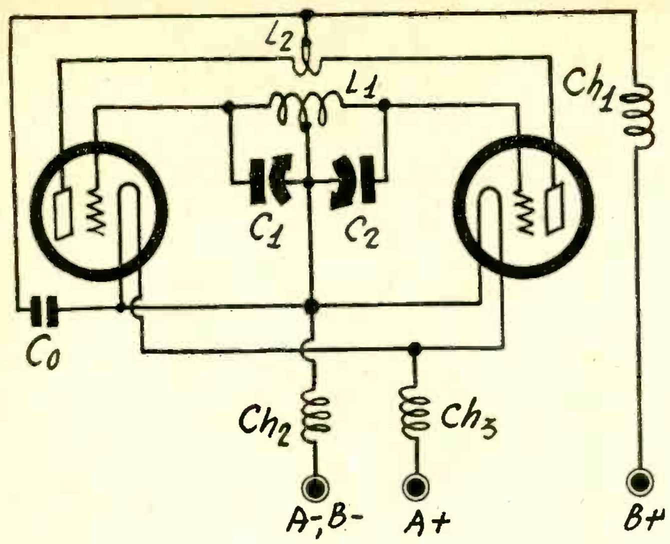


FIG. 5
A push-pull type of oscillator, with tuned grids, that may be used for short wave generation.

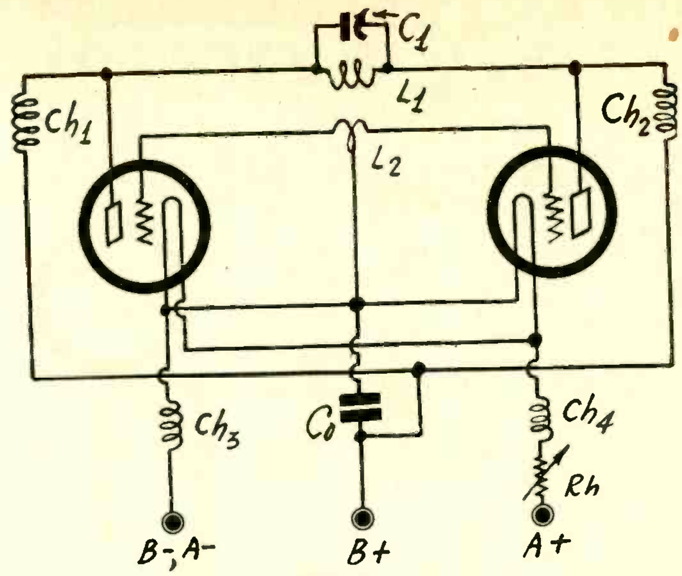


FIG. 6
A push-pull type of oscillator, with tuned plates, which is suitable for the generation of short waves.

(*Continued from preceding page*)
dently or simultaneously. If they are mounted on the same shaft for simultaneous tuning the common rotor should be grounded, and they should be so arranged that both vary in the same direction. Co may have a value of 0.001 mfd. It merely acts as a circuit closer and its value is not critical.

Push-Pull Oscillator

Fig. 5 shows a push-pull oscillator in which the radio frequency chokes have the same values as in the other circuits, as have the two tuning condensers C1 and C2. The two coils L1 and L2 also are the same except that in Fig. 5 both the tickler and the grid coil is tapped at the center. This circuit has the advantage that the two plate to filament capacities are in series.

Still another push-pull oscillator is shown in Fig. 6. In this the tickler is tuned with a single variable condenser. The two plate chokes and the two filament lead chokes have the same values as the corresponding chokes in the other circuits. Since this is a push-pull circuit it is essential that the two tubes be equal and also that the two chokes, Ch1 and Ch2, be equal. The grid coil is untuned and has a tap at the middle for the filament connection. I should consist of a single turn of heavy wire and L1 also should be a single turn. The tuning condenser C1 should be mounted on a good insulator and the rotor should be turned by means of a long insulating shaft so that the hand will not come closer than about 8 inches from either the coils or the condenser. It is essential that the connections be phased properly or there will be no oscillation at any frequency.

Test for Oscillation

A test for oscillation is to set the circuit up near a radio receiver, preferably a short wave set, and turn the dial. If there is oscillation the fundamental frequency will beat with harmonics of the signal received by the set and squeals may be heard when the condenser C1 is turned. It may be necessary to try several signal frequencies before loud squeals are heard.

Another way of testing for oscillation is to put a thermocouple milliammeter of low resistance in the oscillating circuit and note whether there is a deflection. There will be no D. C. in the circuit so that any deflection will be due to oscillation current.

The beat method of detecting oscillation is safer and more certain.

In case no receiver covering the desired range is available a simple short-wave oscillator such as that in Fig. 2 may be hooked up and a by-passed headset connected in its plate supply. The auxiliary oscillator need not oscillate at as high frequency as the other so that there will be no difficulty in setting up oscillations.

Another way of detecting oscillation is to use the Lecher wires described in Fig. 1, but to make the neon tube glow at the voltage maximum, the plate voltage on the oscillator must be considerable. If there is no oscillation there will not be any point at which the neon tube glows.

Lamp Indicator

If there is considerable power in the oscillator it is possible to detect oscillation by means of a small electric lamp, for example, a lamp requiring 2.5 volts and 0.25 ampere. Connect the terminals of this lamp to a turn of wire similar to the turns used for inductances. Hold the circuit thus formed near the oscillating coil. The lamp will light up. If it is too close to the oscillating coil the lamp might burn out or it may stop the oscillation. Hence hold it at a respectable distance first and then move it closer if necessary. To detect oscillation it is not necessary that the lamp glow brightly, for a dull red will do just as well. In using this method it is well to remember that the angle that the coils make with each other also determines the brightness. If the turn that is connected to the lamp is at right angles to the oscillator coil there will be no current in the lamp, and a slight change in the angle might cause it to glow brightly.

Super-Regenerator

The superregenerative circuit has been found to be useful in the reception of ultra-short waves when other types of receiver are quite useless. There is no good explanation for this at this type, and indeed there is no good explanation for the operation of the superregenerative receiver itself.

In Fig. 7 is a diagram of one of the simplest superregenerative receivers that has been brought out, consisting of single tube. It may be well to explain the theory of the circuit, for it has not appeared in radio journals for many years.

It is well known that as the regeneration is increased toward the oscillating point the sensitivity of the circuit increases, but the instant the circuit breaks into oscillation the sensitivity goes down, sometimes disappearing entirely. If it were not for the self-oscillation the sensitivity would increase rapidly beyond the breaking point because the resistance in the tuned circuit would decrease.

Oscillation does not build up instantaneously, but requires some time. If, therefore, we had some means of breaking up the oscillation periodically just as fast as it builds up, or a little faster, we would have a circuit which was extremely sensitive without sustained oscillation. Such is the theory of the superregenerative circuit.

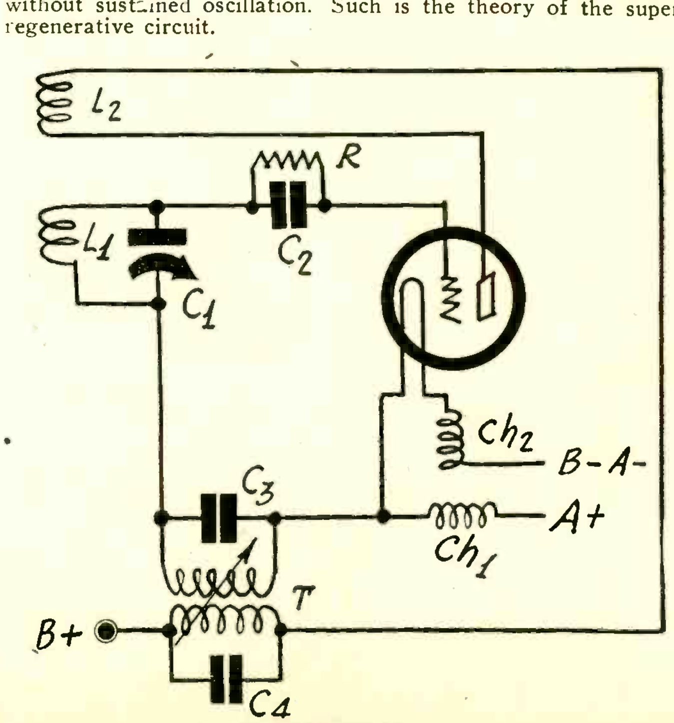


FIG. 7
A superregenerative circuit.

A Converter's Output

Transformer May Be Used—Optional Connections

TWO intermediate frequency transformers are built into the DX-4-VM short-wave converter, as shown in Fig. 1, so that there is a stage of intermediate frequency amplification built in, while the output therefrom is tuned.

Since normally the output of the converter will be connected to the antenna post of the receiver, from which aerial was removed to be connected instead to the converter, a small condenser, E, helps to maintain the tuning characteristic of the output despite a different impedance in the input to the broadcast set. In other words, loose coupling is assured. E may be an equalizer of from 20 to 100 mmfd. capacity, set once and left thus, usually near or at maximum capacity setting.

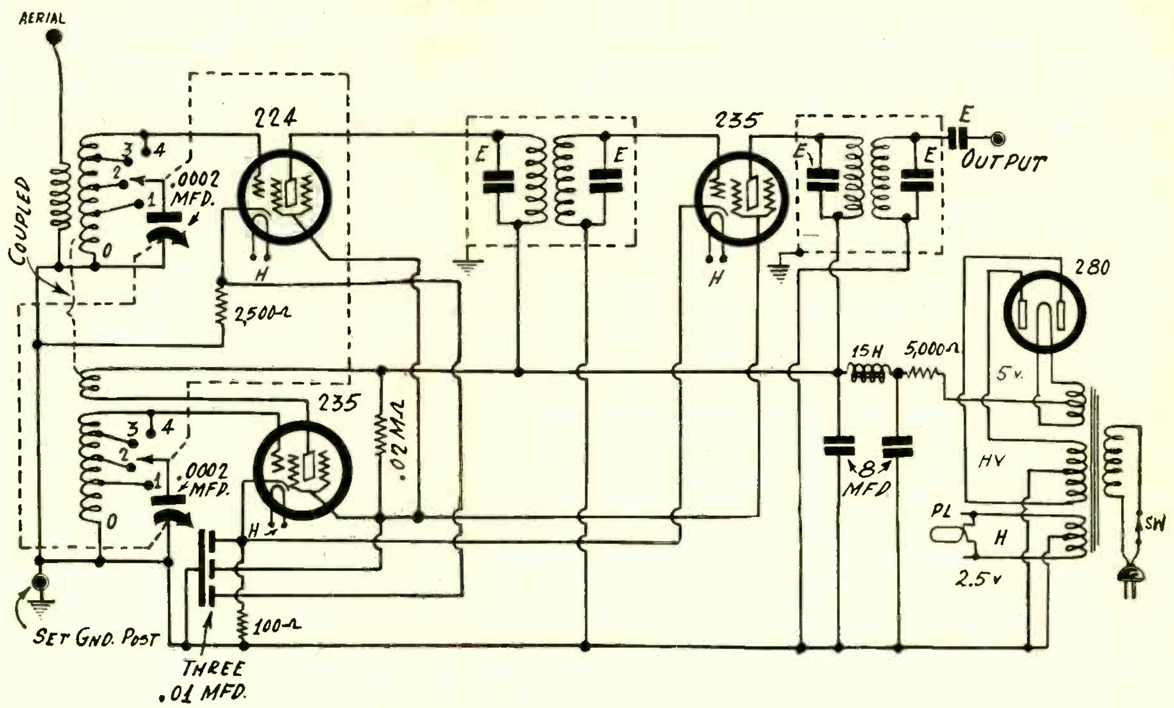


FIG. 1

An output transformer, consisting of an intermediate frequency coupler, is included in this short-wave converter, while a small condenser is put in series with the output to maintain loose coupling, so the tuning of the output will remain effective, if connection is made to the set's antenna post.

If it is desired to connect the output instead to the grid circuit of the set's first r.f. stage, this condenser E (extreme right) should be shorted out.

The circuit was described in last week's issue, dated July 11th, except for the output transformer, and two minor parts, now included. If the voltage of the power transformer secondary for the B supply is higher than desired, it may be cut down by a resistor in series with the center-tap output of the 5-volt winding of the rectifier. This resistor is shown as 5,000 ohms, assuming the voltage is 300 volts and the desired voltage is around 180 volts, although up to 200 volts may be used.

Diverse Tuning

It will be noticed that the converter is grounded, and of course the receiver itself is grounded. These conditions sometimes make for better stability and also for stronger pickup.

Changing of the wave band is done exclusively from the front panel by the manipulation of a single switch.

One tuning condenser is across the oscillator and is actuated by the vernier dial. The other tuning condenser, across the modulator, has a knob. It will be found that when the full secondaries are in use (position 4 of the dual switch) that the oscillator condenser is not totally out of mesh by the time that the modulator condenser is totally out of mesh, for response at the required different frequencies.

Therefore for this position the oscillator can be tuned, say, from 100 to 40 on the dial, and that's all, because of the limitation introduced by the modulator, resulting from the intermediate frequency used, which is actually around 600 kc. The 450 kc transformers are tunable, and may be adjusted to some such frequency as 600 kc in the broadcast band, since it is necessary that the built-in intermediate frequency be one that is within the frequency range of the receiver with which the converter is to be worked.

How System Works

For the rest of the taps the intermediate frequency, say, 600 kc, is a considerably smaller percentage of the total frequencies involved, so that the knob and the dial will run pretty close together. They are almost identical as to numerical displacement for tap 3, while taps 1 and 2 show identity of angular displacement, so far as the eye can tell.

It should be borne in mind that the whole system works because of the fact that the oscillator is tuned to a frequency higher than that of the modulator frequency by the amount of

(*Continued on next page*)

LIST OF PARTS

Coils

- **Mixer coils on one tubing, including two secondaries tapped in three places, a primary and a tickler**
- **Two 450 kc shielded transformers**
- **One power transformer, primary, 110 v. 50-60 cycles; secondaries, all center-tapped, 2.5 volts at 8 amperes; 5 volts at 2 amperes and high voltage to afford 300 v. d. c. at 15 ma.**
- **One 15 henry B supply choke coil**

Condensers

- **Two .0002 junior midline tuning condensers**
- **Two 20-100 mfd. equalizers, E (two others are built into intermediate transformer)**
- **Three 0.1 mfd. condensers in one case**
- **Two 8 mfd. condensers, electrolytic condensers with brackets.**

Resistors

- **One 2,500 ohm flexible biasing resistor**
- **One 100 ohm flexible biasing resistor**
- **Two 0.1 meg. pigtail resistors (100,000 ohms)**
- **One 0.02 meg. pigtail resistor (20,000 ohms)**
- **One 5,000 ohm 3-watt resistor**

Other Parts

- **One modernistic disc type vernier dial, with pilot lamp and socket**
- **One drilled front panel, 7x10 inches**
- **One drilled subpanel with three UY and one UX sockets**
- **One a. c. toggle switch**
- **One dual selector switch for band changing, with knob**
- **One knob for .0002 mfd. condenser in modulator circuit**
- **Three binding posts**
- **Three grid clips**
- **One roll of hookup wire**
- **One length of high insulation wire for B plus leads**
- **Hardware, including one dozen 6/32 machine screws and nuts; two right angles; four 6/32 flathead machine screws**

Noises in Sets Defined

Hissing, Howling, Popping and Other Interference

By Fred D. Rowe

Radio Interference Investigator, Pacific Radio Trade Association, San Francisco

THE classification of noises has recently been made after an exhaustive study of various kinds of interference. The following is a list with definitions that can be made to suit any particular type of noise:

1. GRINDING—like the sound of gears running. (Not in a set but in some kind of machine.) This may be from motors in general, but possibly originates in some types of electrical equipment. It may also be "atmospherics," or more generally known as static. Some phonograph records also cause this noise.

2. ROARING—sounds quite a bit like an airplane making a power dive. Oil burning furnaces cause this particular sound, and also diathermy equipment, when such equipment is fairly close to the receiver. The oil-burner noise will vary in time, on which may be from 30 seconds to 90 seconds or more, approximately.

3. HISSING—like the sound of steam escaping. This is especially true of diathermy apparatus, heard at a distance from the interfering source. The effect is a background "hiss" with a distant station or low power local, and after a certain distance away from the apparatus this "hiss" is perceptible only with the station being received riding in on its carrier wave and not on a dead spot on the receiver. What is known as a power leak may sound quite a bit the same but will generally have a lower pitched note and contain a faint "roar."

4. POPPING OR SPUTTERING—No definition need be required. It is just as the name implies. An occasional "pop" is generally caused by a circuit somewhere being turned on or off. A series of "pops" in rapid succession may be from street car trolleys or rough track or the controller being operated on the car. Flashing signs also will cause this unless properly filtered. Keying of code transmitters can cause it also.

5. HUM—This effect is often more or less confused by the layman with a so-called "power leak." It is commonly known to radio men as an "A. C. hum." Its pitch is a sound something like a steamship's whistle and of course continues as long as the set is turned on, regardless of the volume adjustment or any station being received at all. Some sets have more or less hum on account of their design. Others that normally do not hum, and such developments may be due to defective tubes, parts, etc., or occasionally from a poorly grounded or ungrounded neutral service wire. This hum "rides in" with one or more stations and is generally not heard on a "dead spot."

6. BUZZ sounds like a bumble bee. Characteristic of "power leaks on high powered lines. Also may originate at several other sources of most any power. The effect may have a varied pitch, depending on the voltage and source, but will generally be a combination of "hissing," "roaring" and "humming" all in one.

7. GRATING sounds like the scraping of sand paper on some object. The bare aerial wire swinging in the wind against some metal object may cause it, or high resistance connections or defective condensers and resistors in the set.

8. SINGING such as one hears on long distance and sometimes local telephone lines. This may be prevalent on a transcontinental broadcast and sometimes elevator motors in apartment buildings may sound quite a bit the same, but much louder. Street car motors have also been heard creating the same effect.

9. HOWLING—This should not require a definition. Generally is caused by defective (especially gassy) tubes, or can be other defects in the set itself. May also be from improperly operated receivers, or occasionally originate in the microphone at the broadcasting station.

10. WHISTLING may come from (a) weak tubes, (b) defective condensers, (c) heterodyning of two stations, (d) weak batteries of a battery-operated set, (e) regeneration receiver in the vicinity or (f) one's own set.

(From "Pacific Radio Trade Association News," a section of the San Francisco "News.")

"Recording Detective" to be Used for Evidence Against Suspected Stations

INSTEAD of using stenographic service, which is expensive and sometimes open to attack for the possible error factor, the Federal Radio Commission will use phonograph recordings in gathering evidence against stations suspected of abusing their broadcasting license.

A portable recording device made by RCA Victor Company on specifications and order of RCA Photophone, Inc., was demonstrated before the Commission and proved highly satisfactory. The device is AC operated. The turntable revolves 33 1/3 times a minute, as in talking movies and transcriptions for radio program service. The outfit cost $1,000 to build, but this is not the production price.

A receiving set, very selective, a recording microphone, an engraving head, two turntables, a high-gain audio amplifier, and blank records are used. The overlap is considerable, so that nothing will be missed, and programs of indefinite duration may be recorded.

"We believe the operation of this device will solve many of the problems that have been confronting us for several years," said Acting Chairman E. O. Sykes, following the demonstration.

"With it we will be able to record radio broadcasts in any section of the country and have a permanent record for use in any emergency.

"Heretofore we have been obliged to resort to stenographic reports and oftentimes they have proven unsatisfactory. Now we shall have an absolutely perfect record which, if need be, can be introduced at hearings before the Commission's Examiners to support the allegations in the Commission's bill of complaint.

"With this new device in operation we shall be able to maintain close contact with all broadcasting activities and when it becomes generally known that we have installed the apparatus, we believe it will be the means of lessening the number of infractions against the Commission's rules and regulations.

"The portability of the apparatus, which can be transported in three small cases, will make it possible for it to be transported, when necessary, to remote places where it will be operated by a radio engineer who shall be competent to qualify as an expert at any necessary hearings.

James Baldwin, secretary of the Commission, said that use of the new apparatus should result in increased efficiency and economy in the conduct of radio hearings. Instead of sending for affidavits in support of complaints against particular stations under investigation, he explained that recordings will be made, providing a complete report on the particular station's activity, at a fraction of the cost of hiring stenographic reporters. In several instances the cost of stenographic transcriptions, he said, has equalled or exceeded the cost of the apparatus itself, due to completeness of the record.

Range of Improved Converter, 15 to 200 Meters

(Continued from preceding page)

the intermediate frequency. It can be realized, of course, that where an original carrier frequency of 15,000 kc is concerned (30 meters), 600 kc is only a drop in the bucket, and the two circuits, from a mechanical viewpoint, are tuned almost the same, although the same frequency difference prevails of course all the way through.

The range of frequencies is from a little below 1,500 kc to around 30,000 kc, or about 200 to 15 meters.

It simplifies the tuning considerably not to have to accommodate the broadcast band, because of the large percentage of difference in frequencies and also because the chosen intermediate frequency will be within the broadcast band, which is necessary if an intermediate stage is to be built in. Besides, the set itself will give better service on the broadcast band than would the converter on that band.

A Short-Wave Ear

Stage of Untuned R. F., Detector,

By Henry B.

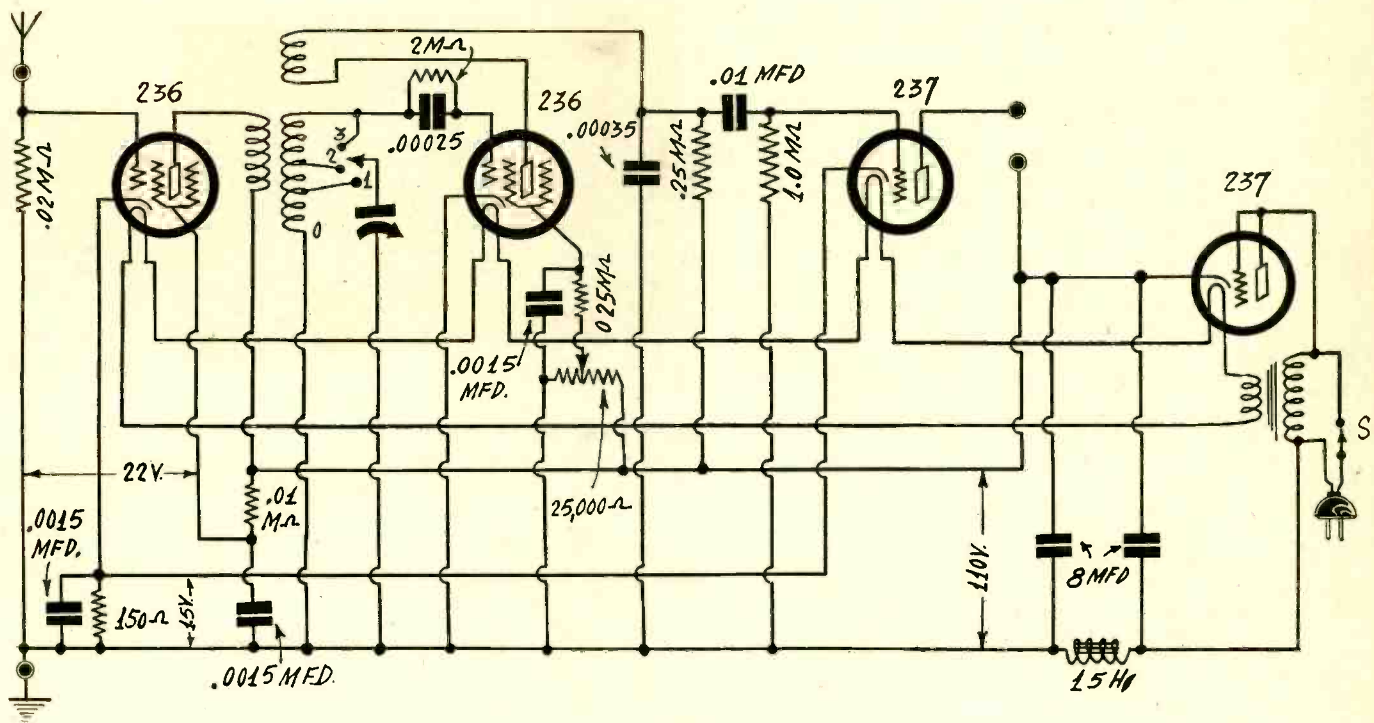


FIG. 1
Circuit diagram of the short-wave earphone set.

THE standard short-wave receiving device of other days was a detector and one-step. The one-step did not represent a dance, but a stage of audio frequency amplification. The receiver was battery-operated. Plug-in coils were used.

Here is a more modern adaptation. There is a stage of untuned radio frequency amplification that frankly does not contribute much, but it reduces the radiation almost to zero, and this is important. The consideration of public welfare should prompt one to use this stage, as should perhaps a selfish motive, which is that others will be so considerate and therefore will not spoil our enjoyment of reception by squealing interference.

New Tubes Used

The regenerative detector and the stage of audio are there, as in the old days, but now we construct the receiver so that it is totall AC operated. The tubes used are the screen grid and general purpose valves of the automotive series. The 236 is the screen grid tube while the 237 is the general purpose tube. The construction is of the heater type, and for AC operation even 7.5 or 8 volts may be used, though for battery operation the specified voltage is 6.3 volts. That lower specification is due to the actual voltage of a freshly and full-charged storage A battery being 6.3 volts. The voltage may be from a little less than 6 volts to not more than 8 volts.

For heating the heaters we may use a 7.5 volt transformer, even one intended for one or two 281 tubes or 250 tubes, with heaters of the present set connected in parallel, as the current at 7.5 volts is only .375 ampere for one tube or 1.4 amperes for all four tubes.

However, series connection of heaters is all right. No fear need be felt concerning this, as the main complications that arise when filament type tubes are connected with filaments in series are absent.

Approximate Values

A transformer that serves the purpose well is one of the 20 to 30-volt secondary type. Since the current is less than the transformer was intended to furnish, the voltage will be a little higher than expected. Assume a 20-volt secondary. This type is used commonly for supplying voltage to the rectifier of a dynamic speaker. At 1.75 ampere, resulting from the use of six 227 tubes with heaters in series, the voltage across each tube's heater was 2.4. The transformer got rather hot.

So at a drain of 1.75 amperes, for six tubes, the voltage across the secondary was 14.4 volts. As the current decreases the voltage increases, due to the regulation curve of the transformer. Here we would be using only .375 ampere at most, so at least the rated 20 volts may be expected, rather than 14.4 volts or any similar voltage present when the drain is excessive.

LIST OF PARTS

Coils

One three-circuit coil for .00035 mfd. tuning, 200 to 15 meters, tapped in two places
One 20-volt filament transformer

Condensers

One .00035 mfd. tuning condenser
One .00025 mfd. fixed grid condenser with clips
Three .0015 mfd. fixed condensers
Two 8 mfd. electrolytic condensers with brackets
One 0.01 mfd. fixed condenser
One .00035 mfd. fixed condenser

Resistors

One 0.01 meg. pigtail resistor (10,000 ohms)
Two 0.25 meg. pigtail resistors (250,000 ohms)
One 1.0 meg. pigtail resistor (1,000,000 ohms)
One 2.0 meg. tubular resistor, not pigtail, for grid leak (2,000,000 ohms)
One 25,000 ohm potentiometer with AC switch attached
One 150 ohm flexible biasing resistor
One .02 meg. pigtail resistor (20,000 ohms)

Other Parts

One AC cable and plug
One single pole three-point switch
One front panel
One subpanel with four sockets affixed
One roll of hookup wire
One dozen 6/32 machine screws and nuts
One vernier dial
Four binding posts
Ten 7/32 insulators for three posts, inductance switch and potentiometer
One 15 henry choke

phone Set for AC

One Step" and Rectifier

Herman

The transformer was tested at no drain, and the voltage reading was 30 volts (on a vacuum tube voltmeter, which draws no current from the measured circuit). So it can be seen that the total secondary voltage may be 30 volts at no drain, although the transformer is marked and rated at 20 volts, while at a considerable load, 1.75 amperes, the voltage is 14.4 volts. Since the regulation curve is approximately a straight line, the voltage may be considered inversely proportionate to the current, within the limits of 0-30 volts. We can roughly estimate what the voltage will be, under those conditions. At 1.75 amperes the voltage is 14.4 volts. At no current drain (save the tiny self-current in the secondary, which may be disregarded), the voltage is 30 volts.

Limits Stated

Hence the limits are 0 current 30 volts, and 1.75 amperes 14.4 volts. The change is 15.6 volts over a span of 1.75 amperes, or a trifle more than 9.3 volts per ampere. The voltage will be less than 30 volts, as there will be some draw. We must assume a voltage or a current from the foregoing. We can readily assign .3 ampere. The reduction from 30 volts is therefore .3 x 9.3 or about 2.79 volts, hence there will be about 27.2 volts for four tubes, or 6.8 volts per tube.

Another way of looking at the problem is to consider the resistance of the heater. It is the voltage divided by the current that is, 6.3 volts by /.3 ampere, or 20 ohms. So four heaters in series will have a resistance of 80 ohms. The current drawn by 80 ohms from a source of 27.2 volts is .34 ampere, which is about 10 per cent. too high, due to omission of consideration of the secondary's impedance, so .3 is nearer the correct answer.

These approximate and somewhat assumptious computations merely show why the voltage will be satisfactory from the standard type 20-volt transformer.

The input to the radio frequency tube is taken across a resistor of .02 meg. (20,000 ohms), although a higher value may be used, but should not exceed 0.1 meg. (100,000 ohms), because of the capacity effect in a high resistance where the extremely high frequencies are concerned.

Information on Coils

The primary requires only 8 turns of No. 28 wire on a 1.75 diameter tubing, and is connected in the plate circuit of the radio frequency tube. The secondary, which may consist of 28 turns, tapped at the 20th and 27th turns from the grid end, may be wound of No. 28 enamel wire also, or of somewhat larger diameter wire, if preferred. The secondary inductance has been made large enough, if No. 28 wire is used, so that even the lesser inductance resulting from the use of the same number of turns of larger wire will be enough to reach a little above 200 meters with .00035 mfd. The tickler consists of 15 turns of any kind of wire, wound in the same direction as the secondary. The grounded end of the secondary and the B plus connection of the tickler adjoin on the winding. The antenna winding is at the opposite end of the secondary.

Regeneration is controlled by screen voltage through a potentiometer. The screen voltage should be lower than the plate voltage, and will be, except for a small part of the arm rotation. Therefore a series resistor is connected from screen to the moving arm of the 25,000 ohm potentiometer. The value of this limiting resistor is given as 0.25 meg. in the diagram, but it is not imperative to use this value. Should the set be too much of a high-stepper in regeneration, then the value of this limiting resistor may be larger. In another hookup as high as 1.0 meg. (1,000,000 ohms) was used before regeneration became impossible. Another check on too lively a set is using a smaller value of grid leak.

The Potentiometer

The potentiometer value is not critical. Anything from 25,000 ohms up may be used. The higher the value of resistance of the potentiometer the less the current drawn by this device, but it is relatively small current even at 25,000 ohms (less than 5 milliamperes).

The detector screen current, by the way, is about 0.1 milliampere, so the drop in an 0.25 meg. limiting resistor is 25 volts, at maximum voltage setting of the potentiometer, while when the arm is near the opposite end of the potentiometer the screen current virtually disappears, but the voltage taken from the potentiometer is low, too, and there is no necessity for a drop in the limiting resistor. The point is that the limiting resistor and the potentiometer work in the right direction.

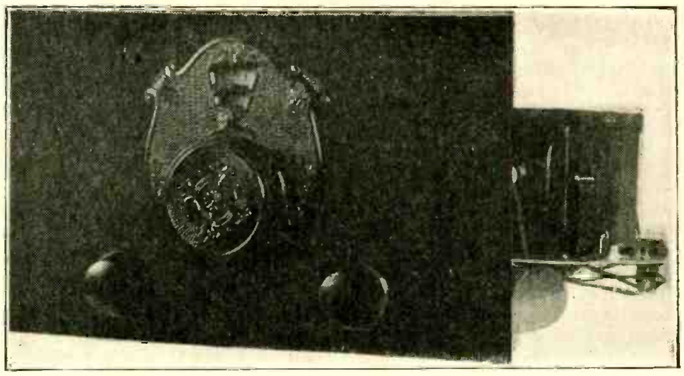


FIG. 2
Front panel view. The knobs are for wave band switch and regeneration control. The AC switch is built into the regeneration control potentiometer.

Obviously for part of the potentiometer settings, at and a little below maximum, the screen voltage is actually higher than the effective plate voltage.

Pointers on Measurements

The drain of the potentiometer is relatively large compared to that of a high-resistance voltmerer (say of 1,000 ohms per volt); therefore the screen readings have significance.

However, next to no importance can be attached to readings obtained from plate of the detector to B minus or across the plate load, since the current is so tiny that the meter itself may draw as much current or more. In fact, under conditions like this about all you read is the meter error, that is, the current flowing through the meter. A common reading to obtain is "5 volts," but this does not disclose any definite voltage.

If the meter has 1,000 ohms per volt it is a 0-1 milliammeter with a multiplier. Therefore on a scale representing 300 volts, 5 volts equals .6 per cent of the total current, or .06 milliampere, or 60 microamperes. The current in the measured circuit must be substantially greater than that in the meter circuit before the meter reading begins to have any accuracy or real meaning, therefore about the only readily obtainable instrument to measure this voltage, or the drop in the .25 meg. plate resistor, is a vacuum tube voltmeter, because that device draws no current from the measured circuit.

Current and Voltage

The rest of the measurements can be taken all right.

The total drain on the rectifier will be about 17 milliamperes, which is well within the allowable limit. The drop at the voltage at the rectifier output under this condition will be slightly less than the AC line voltage. For instance, when the AC line voltage was 117 volts the DC voltage at the rectifier output, at full drain, was 111 volts.

Current List Prices on Receiving Tubes

The following table gives the prevailing price lists of the various tubes

Tube	Price	Tube	Price	Tube	Price
227	@ $1.25	551*	@ $2.20	WD-11	@ $3.00
201A	@ $1.10	171A	@ $1.40	WX-12	@ $3.00
245	@ $1.40	112A	@ $1.50	200A	@ $4.00
280	@ $1.40	232	@ $2.30	222	@ $4.50
230	@ $1.60	199	@ $2.50	BH	@ $4.50
231	@ $1.60	199	@ $2.75	281	@ $5.00
226	@ $1.25	233	@ $2.75	250	@ $6.00
237	@ $1.75	236	@ $2.75	210	@ $7.00
247	@ $1.90	238	@ $2.75	BA	@ $7.50
223	@ $2.00	120	@ $3.00	Kino	
235	@ $2.20	240	@ $3.00	Lamp	@ $7.50

*This table comparable to the 235.

Standard Frequency Tests

Directions for Listening to WWV'S Code

*[A receiver for bringing in these signals, described last week, issue of July 11th, must be of the oscillating type.—*EDITOR.]

SEVERAL methods of frequency measurement are possible in utilizing the standard frequency signals transmitted by the Bureau of Standards, according to the Bureau. These methods range from those using very simple apparatus giving results accurate to one or two per cent, to those using complicated and expensive apparatus giving results accurate to 0.01 per cent or better.

Radio Signals of Standard Frequency

The Bureau of Standards transmits radio signals of definitely announced frequencies, on or near the 20th of each month, for adjusting and calibrating frequency standards and other apparatus. The signals are transmitted from the Bureau's station, WWV, at Washington, D. C. The frequencies included are from 550 to 10,000 kilocycles per second.

These monthly transmissions of standard frequency signals from station WWV are by continuous-wave radio telegraphy. The schedule begins at 10:00 p.m., Eastern Standard Time, and consists of eight frequencies approximately equally spaced over the frequency range to be covered.

A single frequency transmission lasts eight minutes. There is then a four-minute interval during which the transmitting set is adjusted for the next frequency. The wording used in the four parts of a single frequency transmission is as follows, sent in International Morse code.

The standard frequency signals are carefully measured during transmission and the frequency sent is very accurately that which is given in the schedule. Consequently a high order of accuracy may be obtained by using these transmissions. If less accuracy is required, however, the transmissions of broadcasting stations may be used. Using several such stations and getting a mean value, the result should not be in error by more than 0.1 per cent.

The measurement of a station frequency may be for either of two purposes, (a) to standardize a piezo oscillator, a frequency meter or other apparatus in terms of the station's frequency, or (b) to determine the station's frequency in terms of standard apparatus. The methods and instruments used are the same for either purpose. The method here outlined will be based on the measurement of the frequency of a piezo oscillator. If the frequency of the piezo oscillator is known accurately the same method can be used to measure station frequencies.

The apparatus necessary is (1) a piezo oscillator, (2) a continuously variable radio-frequency generator which is approximately calibrated, (3) an audio-frequency generator, and (4) a radio receiver. A frequency meter is also very useful but not necessary.

Example of Measurement Method

A piezo oscillator produces from one to three fundamental frequencies, which are fixed by the dimensions of the quartz plate used. The vacuum-tube circuit arrangement in which the quartz plate is connected gives numerous harmonics for each fundamental frequency. The generator, which is continuously variable, can be adjusted to any frequency, and likewise gives a series of harmonics for each fundamental frequency to which it is adjusted. The interaction of a frequency from the piezo oscillator with a corresponding frequency produced by the generator gives in a beat note which may be heard in a pair of head phones in either circuit. The generator may then be adjusted to zero beat, i. e., to the frequency of the piezo oscillator. The harmonics present in the piezo oscillator circuit and generator make it possible to obtain a large number of points. Any frequency present in the piezo oscillator can beat with a corresponding frequency present in the generator and so give a frequency point which is directly related to one of the fundamental frequencies of the piezo oscillator. If f is the fundamental frequency of the piezo oscillator which is being used and F the fundamental frequency of the auxiliary generator which gives zero beat, then

$$af = bF$$

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

In order to explain the method, a specific example will be used rather than a general discussion. Suppose it is required to measure the frequency of a piezo oscillator the approximate frequency of which is 720 kc at a time when the standard frequencies in the band 550 to 1,500 kc are available.

If the radio-frequency generator is set at 60 kc, the 10th harmonic of it (600 kc) will beat with the 600-kc transmission, and the 12th harmonic (720 kc) with the fundamental of the piezo oscillator. If the radio-frequency generator is set to 80 kc the 10th harmonic (800 kc) will beat with the 800-kc transmission and its ninth harmonic (720 kc) will beat with the piezo oscillator. The 1,200 kc signals may be used in a similar manner.

Assume the 600 kc transmission is to be used. The standard frequency signal is received first and identified with the receiving set in the generating condition. The radio-frequency generator is then turned on and adjusted to near 60 kc, which should give a beat note with the frequency generated by the receiving set.

As it is assumed that no shielding is used in either the receiving set or the radio-frequency generator, the receiving set is sensitive enough that telephone receivers connected to it will give the beat note produced by the interaction of the frequencies of the receiving set and the radio-frequency generator. The regeneration of the receiving set is then reduced until the set just stops generating.

A beat note should then be heard which will in general be of less intensity than that previously heard.

This is the beat between the frequency of the radio-frequency generator and the frequency of the incoming wave. This beat note should be reduced to zero by adjusting the radio frequency generator. For most precise work this adjustment should be made by using a beat frequency indicator or other means of indicating exact zero beat. A beat indicator which will operate at any of the harmonics which may be desired is a complicated device. It is questionable whether such a device could be relied upon to give the desired settings in the limited time available. A simpler and equally accurate substitute is to bring in a simple tuning fork as described below.

However, for a simple discussion of the steps involved in the measurement, it will be assumed that an accurate zero-beat setting is obtained.

The radio-frequency generator is therefore precisely adjusted so that it has a frequency of 60 kc. Without changing its adjustment, couple the piezo oscillator to it loosely. A beat should be heard in the telephones in the output of the piezo oscillator unless the piezo oscillator is exactly an even multiple of 60 kc. Suppose, for example, it is 720.520 kc. In this case a beat of 520 cycles per second will be heard. To determine the value of this note, the audio-frequency generator must be used.

The frequency of the beat note and the frequency of the audio-frequency generator may be compared by using single phone units from each source and rapidly interchanging them at the ear. If sufficient intensity is available from the two sources, then the two audio frequencies will combine and beats may be heard by the ear when the audio-frequency generator is closely adjusted. For exact zero beat thte frequency of the adjustable audio-frequency generator gives the difference in frequency between the 12th harmonic (720 kc) of the generator adjusted to 60 kc and the fundamental of the piezo oscillator.

The current schedule follows:

5,000-Kilocycle Transmissions

2 to 4 p.m. and 10 p.m. to 12 midnight, Eastern Standard Time

July	*August*	*September*
..	11	8
21	18	15
28	25	22
..	..	29

Multifrequency Transmissions

Eastern Standard Time		Frequencies in Kilocycles		
		July 7	August 4	September 1
p.m.	p.m.			
2.00	10.00	1,600	3,600	6,400
2.18	10.18	1,800	4,000	7,000
2.36	10.36	2,000	4,400	7,600
2.54	10.54	2,400	4,800	8,200
3.12	11.12	2,800	5,200	8,800
3.30	11.30	3,200	5,800	9,400
3.48	11.48	3,600	6,400	10,000

The frequencies in the 5,000-kc. transmissions are piezo controlled, and are accurate to much better than a part in a million. The frequencies in the multifrequency transmissions are manually controlled, and are accurate to a part in a hundred thousand.

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Answers printed herewith have been mailed to University Members.

Radio University

To obtain a membership in Radio World's University Club, for one year, send $6 for one year's subscription (52 issues of Radio World) and you will get a University number. Put this number at top of letter (not envelope) containing questions. Address, Radio World, 145 West 45th Street, New York, N. Y.

Annual subscriptions are accepted at $6 for 52 numbers, with the privilege of obtaining answers to radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

Polarized Light Waves

WHAT is meant by polarization of light waves? Does it mean that they are changed so that they have north and south poles like magnets, or positive and negative aspects? If light waves can be polarized can radio waves also be polarized?—W. G. B.

Unpolarized light is characterized by vibration in every possible plane passing through the line representing the direction of the waves, and equal vibration in all the planes. This is due to the fact that the radiators are oriented in every possible direction. Polarized light is characterized by vibration in only one plane. Light is polarized by reflection under certain conditions and also by passing through certain crystals. A polarizer suppresses some of the light, or half of it if the polarization is complete. Radio waves are always polarized because there is only one radiator and that is oriented in a certain way. A vertical antenna sends out a wave which is polarized so that the electric force is vertical and the magnetic force is horizontal. A loop antenna sends out a wave in which the two components are exactly reversed, provided the plane of the loop is vertical. If a horizontal wire radiates the wave is polarized so that the magnetic flux is vertical and the electric force is horizontal, provided the wire is not influenced by the earth, which it will be in all practical cases. Two parallel metal plates placed horizontally, or one such plate and the earth, will radiate a wave polarized in the same way as a vertical antenna, provided high frequency current flows between the two plates.

* * *

Change of Frequency With Voltage

WHY is it that the frequency of an oscillator changes as the voltage on the plate of the tube is changed? How can this effect be reduced to a negligible value?—A. B. N.

The frequency of oscillation not only depends on the inductance and capacity of the tuned circuit, but also on the resistance in the circuit and the plate resistance of the tube. The lower the resistance of the tuned circuit the smaller is its effect on the frequency. Also, the higher the plate resistance of the tube the less effect it has on the frequency. This plate resistance of the tube does not consist of the internal resistance alone, but also of any external resistance that may be placed between the plate and the reaction coil. The frequency variation with voltage is due to the fact that the internal resistance of the tube depends on the plate voltage. To make a frequency-stable oscillator, the resistance of the tuned circuit should be as low as possible and the plate resistance of the tube should be as high as possible. When the plate circuit of the oscillator is tuned a high resistance, in series with a larger condenser, should be connected between the plate and the top of the tuned circuit. The other side of the tuned circuit should be grounded. If the resistance is made so large that the circuit will just barely oscillate, and if there is a suitable choke in the plate circuit for feeding the plate, the frequency stability will be good. Another important point is that the feed-back should be phased so that the tuned circuit is made to oscillate at exactly its natural frequency.

* * *

Doubly Tuned Oscillator

COULD a satisfactory oscillator be made by tuning both the grid and the plate windings? If this is practical what should the coupling between the coils be? Should it be similar to the coupling used in superheterodyne intermediate transformers? What advantage, if any, would result from tuning both windings?—R.B.L.

If the oscillator is to generate a single frequency this arrangement is practical, and one advantage would be constancy of frequency. The coupling between the two tuned circuits should be just as loose as possible, still maintaining oscillation, and the two circuits should be adjusted to exactly the same frequency. Besides frequency stability, the generated wave would be free of harmonics. Such an oscillator would not be suitable for a superheterodyne.

* * *

The Skin Effect

WE are told that radio frequency currents travel only in a thin layer on the surface of a conductor and that this layer is thinner the higher the frequency of the current. Does this mean that no current at all travels in the interior of the wire, or does it mean that only a very small part travels in the interior? If the wire travels on the surface of the wire it seems to me that it would be better to use large wire for short waves. Is that a fact? On what principle is Litz wire better than solid?—W.G.V.

Current travels throughout the wire, theoretically, but it decreases so rapidly for high frequencies that practically the entire current is confined to a very thin layer on the surface. The current at the center of the wire may even travel in the opposite direction from that of the main current on the surface. Litz wire is better than solid wire because for a given amount of metal there is more surface on which the current can travel. However, this type of wire is not appreciably superior to solid wire for extremely high frequencies.

* * *

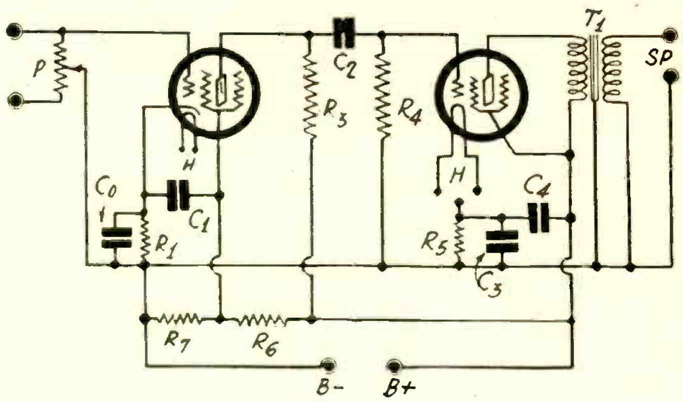


FIG. 936

A two stage audio frequency amplifier using a 235 screen grid tube and a 247 pentode, which may be used either for phonograph playing or audio amplification in a receiver.

Unintelligible Radio Speech

I HAVE heard many radio sets with the quality so distorted that it was impossible to follow speech or conversation. What is the reason for the unintelligibility? Speech from some receivers is quite intelligible. Is the main trouble in the audio amplifier or in the speaker?—P.O.L.

There are many reasons for the unintelligibility. In the first place the selectivity may be too high so that the high audio notes are tuned out, leaving only the low notes. These do not carry the sounds that make up the consonants or the higher harmonics of the vowels. Hence excessive selectivity contributes to the poor articulation. This is probably the principal effect. The audio amplifier may also suppress some of the energy of the high frequencies, and this, too, adds to the poor articulation. The loudspeaker adds more to the same effect. Besides suppression of the high notes, which carry the consonants and the timbre of the vowels, there may be resonance in the audio frequency amplifier and the loudspeaker which brings out certain low tones very strongly. This adds to the effect of making the articulation poor.

* * *

Short Wave Coverage by Tuning Receiver

SUPPOSE the high frequency oscillator of a converter is set at 550 kc and the broadcast tuner is adjusted from 550 to 1,500 kc, what short waves can be tuned in with the broadcast tuner?—W.G.C.

You can vary the frequency by 950 kc. This is true no matter what the frequency of the fixed oscillator. Therefore, when the frequency is very high only a very small relative frequency range can be covered by means of the broadcast tuner.

* * *

Amplifier for Portable Set

I HAVE a portable receiver which gives excellent results as such but I want to use it at home with much greater volume. If it is practical to add two stages of audio frequency amplification with a 247 pentode in the last stage and a 235 in the first, will you kindly publish a diagram of such a circuit?—W.R.R.

Fig. 936 is such a circuit. Whether or not it is practical depends on the audio frequency amplification you now have in your set. There may be audio frequency oscillation if you already have two stages in the circuit. Overloading of the audio amplifier depicted in the drawing is prevented by the input volume control.

RCA COMPANIES FAVOR AN OPEN PATENT POOL

Washington.

For the first time in history the likelihood of an open radio patent pool has arisen, due to the readiness of the principal companies in the present closed pool to discuss the subject, in a co-operative spirit, with Federal Government attorneys.

The Department of Justice brought an anti-trust suit against Radio Corporation of America, General Electric Co., American Telephone and Telegraph Co., Western Electric Co., Inc., Westinghouse Electric and Manufacturing Co., RCA Photophone, Inc., RCA Radiotron Co., Inc., RCA Victor Co., Inc., General Motors Radio Corporation and General Motors Corporation.

Conferences between defendants' counsel and Department of Justice counsel developed the fact that the principal defendants are in a receptive mood.

Ready to Alter Agreements

"It developed at the conferences," says a statement issued by the Department, referring to agreements charged to be illegal, ". . . that the principal defendants were ready to change them so as to make them unobjectionable in the view of the Department."

The suit was filed by the Government on May 13th in the Federal District Court for the District of Delaware. Oral arguments and briefs were to have been presented in the Autumn, but Warren Olney, jr., special assistant to the Attorney-General, in charge of the case, explained that this procedure would not be followed in view of the negotiations for a consent decree.

Text of Department's Statement

The Department's announcement follows in full:

"It was stated today that conferences have been going on for some time between the Department of Justice and the principal defendants in the anti-trust suit brought by the Government against the Radio Corporation of America, General Electric Company, Westinghouse Electric & Manufacturing Company, American Telephone & Telegraph Company and certain other companies.

"The Radio Corporation of America was originally formed by the General Electric Company to acquire the American Marconi Company, which was a British-owned company, owned the Marconi patents and was the principal factor in the wireless communication field in America. In the view of the Department there was nothing illegal in this, but almost immediately upon the formation of the Radio Corporation there began the making of a series of contracts between the defendants as to thte use by them of their respective patents in the radio and allied fields.

"In the view of the Department, these agreements in a number of their important provisions were illegal as designed to prevent and suppress competition between the parties. It should be said that the defendants as to the use by them of agreements made by them were illegal or had the purpose or effect charged by the Government.

Consider Open Patent Pool

"It developed at the conferences, however, that regardless of the legality or illegality of their contracts, the principal and defendants were ready to change them so as to make them unobjectionable in the view of the Department. It also appeared that the principal defendants would, in addition, consider favorably creating an open patent pool, whereby the use of their patents in the radio and certain allied fields would be open to the public generally upon fair and reasonable terms to be fixed by independent trustees.

"Such a pool would, in the opinion of the Department, if practicable, be of distinct advantage to the public both as opening the patents of the particular defendants to general use and also as serving as the beginning of an open patent pool into which all patents important in the radio field might be brought and their use made open to the public on terms fair and reasonable to patent owners on the one side and the industry on the other and the industry be largely relieved of interminable and expensive disputes over patent rights. In the consideration of these matters the Department has kept in close touch with the representatives of the independents in the radio industry and the creation of such a patent pool is one of the proposals advanced by them as a possible solution.

"The creation of such a pool is a matter that requires careful consideration both as to detail and as to its effect upon the industry in order to determine both its desirability and its practicability, and there has been no definite commitment as yet either by the Department or by the defendants in regard to it. They have agreed, however, that the creation of such a pool warrants earnest consideration and that the parties will genuinely endeavor to formulate an acceptable plan embodying it.

"In order to permit the further consideration by both sides of this proposal for an open patent pool, the conferences have been adjourned until September, when they are to be resumed and pursued without interruption to a conclusion."

More Exchanges by U.S.-Britain

London.

More frequent exchange of radio programs between England and America will take place in the future, said Sir John Reith, director general of the British Broadcasting Corporation, when he returned from a visit to the United States and Canada, where he has been studying radio conditions.

"Negotiations are proceeding along these lines," he said. "America is very keen to have more broadcasts from England."

The broadcasting of American football games with their organized cheering and of the singing of Negro spirituals, it is thought, would be enjoyed by the English listeners while the Americans would like to hear such ceremonies as the delivering of the keys at the Tower of London.

SEPARATE SET PREDICTED FOR EACH LISTENER

An individual receiver for every member of the family is predicted by Joy Elmer Morgan. He said:

"This development will come about gradually as wealth increases, as the cost of receivers decreases, and as school radio teaches to the masses of the people the art of discriminating listening.

"Just as the school, by its use of books, has done more to spread reading habits among the people than any other agency, the school by its use of radio teaching will do more to spread creative listening among the people than any other single agency.

"This is especially true in the rural home and school for there radio means much more than it does in the city, bringing to the remotest home a living contact with the world at large.

"The radio industry will eventually realize that free and independent educational broadcasting is its best friend and will cease its shortsighted policy of trying to kill off stations associated with educational institutions."

WLWL and WPG Cited in Dispute Over Time

Washington.

WLWL, the Paulist broadcasting station in New York City, and WPG at Atlantic City, of the Columbia System, have been cited for a hearing by the Federal Radio Commission for failure to arrive at a time-sharing agreement. Temporary licenses were granted them.

John W. Jones of Newburgh, N. Y., has applied for a new station of 100 watts on the 1210 kc channel with unlimited time. The application requests the facilities of WCOH at Yonkers, WMRJ at Jamaica, WLCI at Ithaca, or WGBB at Freeport. The application was set for hearing.

MORE "STUNTS" ARE IN STORE FOR LISTENERS

Washington.

"Stunt" broadcasts, so popular with listeners, are to be more numerous. Soon there will be scarcely any place from which a description of the event may not be sent to listeners.

Even a parachute jumper can narrate his experiences and describe his feelings, by talking into a microphone posed in front of his nose, and generating radio frequencies from a short-wave transmitter strapped to his back. It has been done.

Also, broadcasts have brought to listeners the descriptions of air maneuvers, the descent of submarines, the penetration of caves and other exotic events that delight the radio fans. New thrills, however, will be provided under the enlarged program.

Frequencies Assigned

The Federal Radio Commission has lent assistance to these endeavors. The two large chains, the National Broadcasting Company, which is an RCA subsidiary, and the Columbia Broadcasting System, which is 50 per cent. owned by Paramount-Publix, have frequencies allotted to them for just such portable short-wave remote broadcasting. The wave is picked up at the key station and after detection is modulated on the regular broadcast wavelength.

The ranges allotted to the National Broadcasting Company are 1,584 to 2,392 kc (189 to 125 meters), while Columbia has 1,544 to 2,476 kc (194 to 121 meters), independent channels being allotted from 1,564 to 2,363 kc (192 to 127 meters).

Foreign programs will be brought in on short waves and retransmitted on regular broadcast waves, as heretofore, but these do not require any extra licenses. For the portable short-wave transmitter, for domestic stunts, more licenses are to be sought by the two large chains.

Only for Emergencies

The Commission's order specifies that such short-wave facilities may be used only in event wire facilities are not available. The procedure usually is for the portable transmitter to be located near to the "pick-up" receiving set, which feeds the program to the network or the regular broadcasting station. The distance to be covered by the short wave portable usually is small, so that the signals picked up will be of sufficient strength and crispness to be amplified with good quality over the broadcasting network.

The Commission also has set aside frequencies of the same character for motion picture companies under extraordinary circumstances. Short-wave channels may be used for communication between the home studios and parties "on location," when wire line facilities are not available, and to expedite the production of the pictures.

A Surprise Rebroadcast

Once in a while the engineers of WGY'S short-wave stations get a real surprise from the mail. For example, a recent letter from Unity, Saskatchewan, reported that at shortly before 4:00 a.m., receiver's time, he picked up 2YA of Wellington, New Zealand, rebroadcasting the combined signals of 3ME of Melbourne, Australia, and W2XAF, Schenectady. This was a sunrise rebroadcast.

World Congress Tells Results

Copenhagen.

At the conclusion of the International Radio Congress at the Christiansborg Palace here it was announced that definite conclusions had been reached on eight points, namely, comparison of frequency standards, standardization of wave meters, reduction of disturbances within common wave bands, methods of annulling foreign currents in receivers, further organization of commercial radio telephone services between movable and fixed stations, stabilization of wave bands of senders for various radio electrical services, recommendations regarding the latest developments of technique, and reduction of radio disturbances general.

The congress will make recommendations to the Madrid congress to be held in 1932 and the results obtained in Copenhagen will serve as a basis for deliberation in Madrid. One of the unsettled problems is more effective utilization of the available wavelengths, which will be considered by the national committees and later to be acted on by the Madrid congress.

0.1 Per Cent. Separation for Short-Wave Band

Washington.

The Federal Radio Commission has adopted a new general order (No. 117) repealing two previous general orders (Nos. 62, 88 and 88 amended) relating to the separation between frequencies in the short wave bands, from 1,500 to 2,300 kc.

By repealing the old orders and adopting the new, the Commission does away with the plan calling for a 0.2 per cent separation. It was pointed out at the Commission in this connection that the International Technical Consulting Committee, meeting at The Hague in September, 1929, recognized that radio telegraph stations could operate on frequencies separated by about 0.1 per cent., which, in effect, would double the number of available frequencies.

The engineering division of the Commission has been engaged for some time in preparing an allocation based on this separation, covering the entire short wave spectrum. The adoption of the new order opens the way for the assignment of many additional stations.

HOW A 10-FOOT IMAGE IS SEEN

The projection of a television image on a screen 10 feet square, by U. A. Sanabria, is accomplished by intensifying the conversion lamp's intensity.

The lamp used by Mr. Sanabria is of the hot cathode type. Neon has been generally used in television, as it is best suited to the rapid response needed for sight reproduction. But previous neon tubes have had a limited amount of illumination.

In the simplest type of television receivers the plate of a neon tube is scanned by a disc drum using a series of fine pin holes for light control, resulting in peep-hole reception. To project pictures a light source confined to a tiny spot rather than a broad plate was required. This resulted in the development of a neon tube with a point source of light, a small aperture in which is concentrated all the light action within the tube.

Mr. Sanabria enlarged on this idea by using a hot cathode. This is a device that heats up to a very high temperature the small space in which the gas usually glows. This causes the gas in the tube to give a much brighter light and the gas breaks down at from 15 to 25 volts instead of the usual 140 volts, making this tube sensitive to weak signals.

The hot cathode is similar to the heating device used in the 227, 224, 235, 236, 237 and 238 type of broadcast receiver tubes, known as the heater type. The possibilities of this departure is foreseen in the fact that operation with a hot cathode enables use of various gases other than neon to give good light response, with the result that lights of various colors can easily be developed. Thus pictures may be seen in white, green and blue, or the familiar pink of neon.

It would be possible, therefore, to have three different lamps, each glowing at one of the primary colors, red, blue and yellow, and combine the output to receive television in colors. There would have to be similar special transmission.

BEADS ARE VETOED

National Broadcasting Company engineers discourage the wearing of beaded dresses around studios. The beads rattle and crackle, and might well give the effect of machine guns or booming cannon over the microphone.

A THOUGHT FOR THE WEEK

THE Metropolitan Opera Company will, in all probability, permit the broadcasting next season of grand opera from its famous home on Broadway, New York City. If this is brought about through the efforts of M. H. Aylesworth, president of the National Broadcasting Company, it will be a distinct triumph for Mr. Aylesworth and a boon to listeners-in all over the world. The Metropolitan directors heretofore have declined, definitely and unqualifiedly, to permit any broadcasting of the regular opera programs from the stage of their temple of music, and the announcement that they might change their minds is one of the most important pieces of broadcasting news that has reached the public in years. It's also fine for the radio trade in general. The season of 1931-32 looks great from where we sit!

RADIO WORLD

Title Reg. U. S. Pat. Off.

The First and Only National Radio Weekly
Tenth Year

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.
Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. E. Anderson, technical editor; L. C. Tobin, advertising manager.

Sanity on Patents

CONSIDERABLE ill-feeling has been generated in the radio manufactur- field because of the closely held patents of Radio Corporation of America and its subsidiary and affiliated companies. Aside from any consideration of legality of the present closed patent pool, it would be highly beneficial to the trade and to the consumer if there were an open pool.

Now it appears for the first time that the likelihood of such an open pool exists, for the principal defendants in the suit by the Federal Government for dissolution of the closed pool expressed a frank willingness to consider a general grouping of patents. By this method, which would have to be carefully worked out, for the patents of various holders are concerned, the dictatorship of who may make radio sets and tubes would not be exercised by the accused companies.

Further negotiations between the Department of Justice and the defendants have been put off until the Fall, following an encouraging start. If the plan succeeds, the defendant companies would consent to the entry of a decree effectuating the compromise. It would be a case of give and take. Certainly RCA and its associates, with some 4,000 radio patents, have a valuable asset. It is true, also, that many radio patent holders are outside the RCA group. Therefore if the patents could be pooled, not only would RCA and its associates gain good will in quarters where none is held toward them now, but all manufacturers, RCA companies included, would feel that a license to manufacture would really guarantee full protection, which it scarcely does now, since here and there a circuit or a method may be used, despite an RCA license, that offends a patent held outside the closed pool.

The automobile industry made a success of an open patent pool, and there is no logical reason why the radio industry can not do likewise, if it will act in a co-operative and unselfish spirit. This it has not the habit of doing.

Pointed Opinions

J. W. CASWELL, secretary-treasurer, Caswell-Runyon Company: "Women are the principal determining factors in the purchase of radio sets. When it comes to buying a radio women first consider the furniture which encases the chassis. Beauty is their chief consideration, for they assume that the mechanism will produece music and other programs. Console cabinets have the preference in some 75 per cent of all selections. This situation has been sensed by radio cabinet manufacturers and they are constantly striving to meet the demand for beauty. Period designs are quite popular, but in the main the women prefer the better American designs."

* * *

E. H. SANDERS, Shell Oil Company: "Advertising is the life-blood of radio today. Private capital makes possible the superb shows heard nightly by millions seeking their entertainment at the dials. Without the competition born of progressive advertising policies, attainment of present radio entertainment standards would have required many more years. Without this keen rivalry an evening at the dials would provide no more than a month-old newsreel. Interrogation of the indignant fans regarding other methods of supporting progress usually brings forth a rather vague suggestion that taxation of receiving set owners would do the trick. Support of radio entertainment by taxation would create another government bureaucracy."

* * *

HOLLIS S. BAIRD, Radio Engineer: "Satisfactory television reception cannot be obtained unless a receiver is especially built for television—first, because of the wave bands that must be covered, and second, because the audio amplifier must cover a frequency band of 10 to 40,000 cycles in order to get a good picture. Ordinary short-wave sets cover an audio frequency band extending only from 100 to 5,000 cycles. I advocate a specially designed audio amplifier, resistance coupled, as this is absolutely necessary for good television pictures and at the same time is the ultimate for voice and music. Regeneration spoils good television pictures."

* * *

AUSTIN H. CLARK, Smithsonian Institution: "The radio can be effectively used only with due and proper appreciation of the characteristics of our American public, and with an adequate regard for the basic requirements of the radio stations."

Missionaries Appreciate Short-Wave Reception

Schenectady, N. Y.

Signals of WGY's short wave stations are greatly appreciated by a little group of American missionaries stationed in Gorei, Ethiopa, or Abyssinia, as it once was called. A letter from Mr. and Mrs. P. R. West, of San Diego, Calif.; Miss Viola Bayne, Pittsburgh, Pa., and Mrs. Ruth L. Walker, Butler, Pa., reports excellent reception.

The missionaries are doing medical and evangelical work at a station five days distant from the nearest river port, on the Sobat River, Egyptian Sudan.

"Post," the missionaries write, "takes seven weeks to reach us, so you may know how much we appreciate receiving your programs of music and news items."

"Radio Frequency Measurements"

"The Theory and Practice of Radio Frequency Measurements," by E. B. Moullin, M.A., A.M.. E.E.. M.I. Rad. Eng., Reader in Engineering Science in the University of Oford. Second Edition, entirely reset and greatly enlarged, with 487 pages and 289 illustrations. Published by J. B. Lippincott Company. Price, $12.50.

This is a great book, both as a text and a laboratory guide, but its excellence can be appreciated in full only by those who have a thorough mathematical training. Advanced students in electrical engineering, radio theory and mensuration, and mathematical physics should find the book especially satisfying, but students of less proficiency are likely to find it too profound. The book does not contain much detail on laboratory technique but discusses thoroughly the theory on which the technique is built and points out the many pitfalls in radio frequency measurements and how to avoid them.

The first chapter is devoted to "The Electromagnetic Field." It contains the fundamental Maxwell's equations in the usual forms, but they are explained in a manner to bring out their vital significance very clearly to the reader. There are also many classical applications of Maxwell's theory high frequency problems, all explained in a lucid and understandable style.

The second chapter is devoted to "Circuit Formulae" and it contains those of both simple and complex combinations of resistances, self-inductances, and capacities, including those of similar recurrent networks like low-pass, high-pass, and band-suppression filters.

The third chapter is devoted to "The Valve Generator," that is, to the vacuum tube oscillator. The theory of many different oscillators is given and formulas for the frequency and the output obtained. There are oscillators for pure output as well as for output rich in harmonics and there are oscillators for audio frequencies as well as for very high radio frequencies.

Then follow chapters on the Measurement of potential difference and current, frequency, resistance, capacity, inductance, antenna characteristics, intensity of radiated fields, and miscellaneous sources. In each division many different methods of measurement are given and a critical discussion of each made, pointing out advantages and disadvantages, applicability in respect to values of the quantity under measurements, the accuracy attainable, and the precautions necessary to obtain reliable results.

Throughout the book frequent use is made of the integral and differential calculus but the results are always given in simple algebraic terms or by means of curves and tables.

It is no book for beginners or others than truly advanced students with mathematical foundations.

Sunday Broadcasts Made from Australia

Schenectady, N. Y.

A special series of Sunday broadcasts is being made by 2ME, Sydney, Australia, on 31.25 meters. The management of the station, the Amalgamated Wireless Australasia Limited, informs WGY that the series will be continued weekly on Sunday during three periods, midnight to 2:00 a.m., 4:30 a.m. to 6:30 a.m., and from 2:00 p.m. to 4:00 p.m., Eastern Standard Time.

2ME is now used chiefly for commercial telephony with Europe, but the transmitter is available every Sunday for broadcast purposes. From the experience of WGY'S engineers, the period from 4:30 a.m. to 6:30 a.m. is the most likely time for successful reception of this transmitter.

INTERNATIONAL PROGRAM LINK IS SANCTIONED

Washington.

Definite steps toward the establishment of an international relay broadcasting service, over which American radio programs will be transmitted by short waves to be picked up directly abroad or rebroadcast in foreign countries, have been accomplished.

The Federal Radio Commission has adopted the recommendation of Ellis E. Yost, chief examiner, sanctioning the plans of the Short Wave Broadcasting Corporation as a union of the short-wave interests of Aviation Radio, Inc., of New York City, and Short Wave & Television Laboratories, Inc., of Boston.

With the commission's authorization the four short waves previously assigned to Aviation Radio, Inc., will be turned over to the new corporation for the projected international service, which has as its purpose particularly the furnishing of programs to Latin-American countries during the next year. Japan, China and the Far East are also to be served, and arrangements are being made for service to certain European countries.

Big New Station

The nucleus of the system will be a new 15,000-watt station to be located somewhere on the Eastern seaboard, which within the next year will be erected to replace the 500-watt station, W2XAL, already licensed to Aviation Radio, Inc., at New York City. The frequencies used will be 6,040, 11,800, 15,250 and 21,460 kilocycles. These are equal to 49.64, 35.4, 19.7 and 14 meters.

In his report Mr. Yost commended the efforts of the promoters of the project and stated that ample financial resources are represented in the newly formed corporation. He also said that there is a need for a short-wave broadcasting station independent of the large chains.

The frequencies assigned to W2XAL are registered with the International Bureau of the Telegraph Union at Berne, Switzerland. There are no other United States stations registered on any of these frequencies. The channel of 6,040 kilocycles is registered for use by a station in India and by another station in Japan. The channel of 11,800 kilocycles is registered for use by a station in Japan and another one in Austria. The channel of 21,460 kilocycles, which is only useful during the Summer daytime, is registered for use by a station in Brazil.

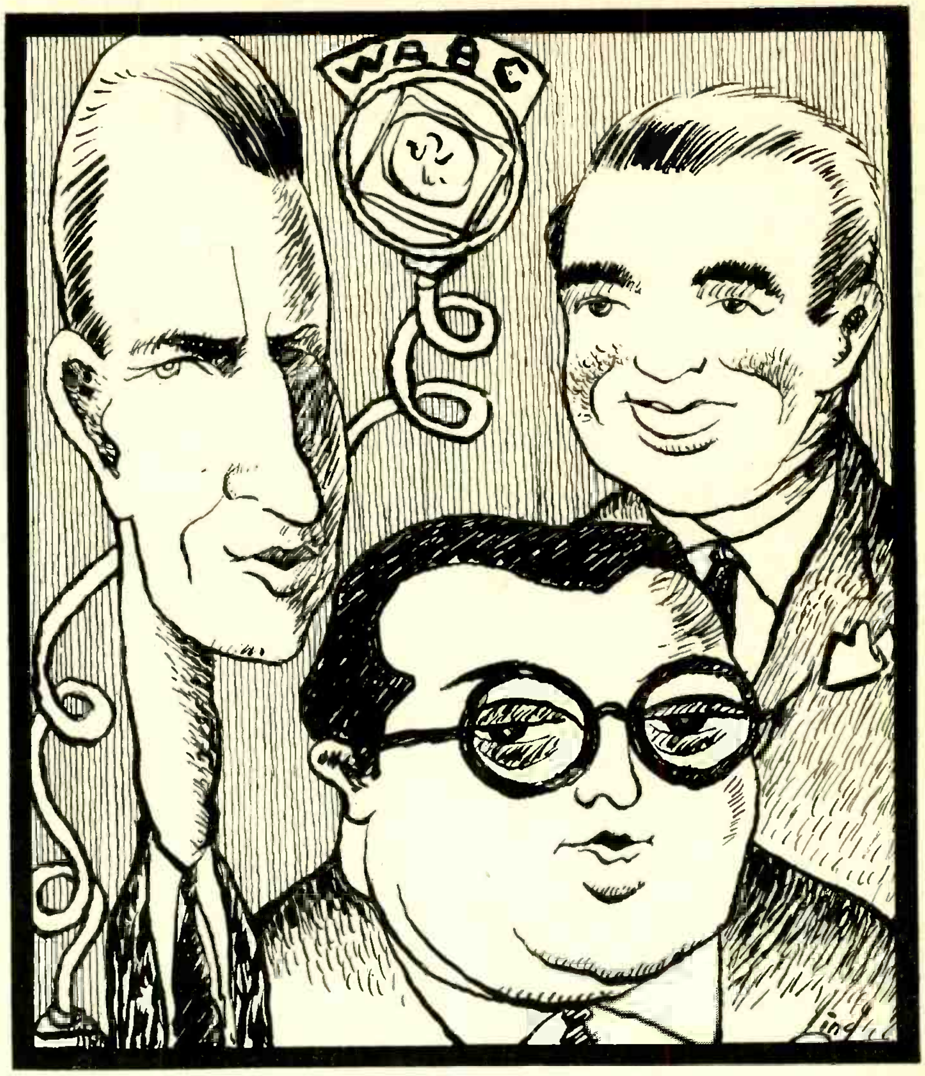
15,000 Watts by July, 1932

Due to the difference in time between India, Japan and Austria and the United States, there is little likelihood of any interference between stations operating at those points and W2XAL. In the event of simultaneous operation of W2XAL and the Brazilian station on the channel of 21,460 kilocycles, it is possible that W2XAL and the Brazilian station on the channel of 21,460 kilocycles could arrange to provide programs within each other's skip distance zone without interference.

The short wave licenses are granted on an experimental basis and the applicant is cooperating in connection with its operation to prevent interference.

The Short Wave Broadcasting Corporation proposes to erect a new high-powered transmitter.

THESE THREE UNITE TO ENTERTAIN; THE BIGGEST SMILE REAPS RICHEST GAIN



Tony Wons (left) is master of ceremonies, Jacques Renard (center) is conductor and violinist, and Morton Downey is the glorified tenor of the Camel Hour, heard every night except Sunday over the Columbia Broadcasting System's network.

STUDIO WALLED BY GLASS WOOL

For the past four months workmen have been busy redesigning, reconstructing and redecorating the studios of KHJ, in the Don Lee Building, Los Angeles.

This work is now completed. The entire second floor, comprising 20,000 square feet, has been given over to the studios and executive offices of the station. Three separate sound-proof studios have been constructed, consisting of one large studio capable of accommodating a 200-piece symphony orchestra, and two smaller studios. Each of these rooms has been sound-proofed to an efficiency of better than ninety-five percent. Each has its own monitoring room and separate broadcasting equipment control units.

These three studios serve to materially increase the broadcasting flexibility of KHJ. It is now possible for the station to broadcast a program locally, release a program to the Don Lee Coast network and conduct a rehearsal simultaneously.

Because of the thick partitions, filled with glass wool, it is impossible for any sound to escape from any of the studios. The walls have all been acoustically treated.

CANADA COURT RULES ON AIR

Washington.

The Supreme Court of Canada has held that control of radio broadcasting is a duty of the Dominion Government rather than of the individual provincial legislatures, according to advice received by the Department of Commerce from Acting Commercial Attache, Oliver B. North, at Ottawa.

The decision, which was rendered by a 3-to-2 vote of the court, is not final, since either side may appeal to the Privy Council.

The decision was rendered after lengthy hearings on the contending argument for provincial or Dominion control of radio broadcasting. The case started in connection with the refusal to grant a broadcasting license to a station which was to put on the air a program sponsored by the Quebec provincial government.

The court's decision is in line with the legal conception of broadcasting in the United States, i. e., interstate commerce. Comment was made on the closeness of the vote, paralleling the 3-to- vote in the recent decision by the Federal Radio Commission in the Clause 9 case.

Forum

Wants Every Detail Stated

I HAVE been a constant reader of RADIO WORLD for more than two years and I look forward to each issue. I sure think it is a great periodical and I have absolutely no criticism to make. However, I would like to offer a suggestion.

We fellows who read Radio are really interested in radio. Nobody makes us read about it. Therefore it naturally follows we tinker with construction. The contents of many of your articles tend toward construction. The designer is, of course, quite familiar with his design; his reader (myself, for instance) is not. Presume the designer is technical. He may unconsciously leave out an explanation of some details seemingly so simple to him, yet this omission may be a stumbling block large as a mountain to the reader.

You know, if I just didn't have the best wishes at heart for your periodical I would not be spending my time right now trying to present the views of just one of your readers.

No one pleases everybody, and I have found no one periodical covering all the various phases of radio.

But the point I am trying to make is, reverting to May 23rd issue, "A Modulated Oscillator," I am quite sure Mr. Anderson knows exactly what he is talking about, but (speaking only for myself) I am not so sure I could go right ahead and build this oscillator without asking some questions. I have no oscillator and I want to build one, not only for its tremendous worth, but for the experience also.

I would like to have been right there with him when he was writing up the description so I could have asked a pile of questions. The article, with questions answered, might have been a third longer, but I am sure I would be the other two-thirds better off. Personally, I am interested in all service problems and this covers a variety of testing instruments, etc.

P. B. KEHOE,
818 West Second Street,
Fort Myers, Fla.

* * *

A Table of Contents

I ENJOY reading RADIO WORLD but there are several points I think could be improved. A table of contents would help a whole lot. Sometimes you want to look up data on a certain subject. Instead of looking through a pile of books, you simply look over the table of contents thereby saving considerable time.

I am sure many of your readers would like more up-to-date super DX circuits, such as the Ultradyne. Show me a real radio enthusiast who doesn't like to pull in that distant station.

LA VERNE SCHEFFLER,
225 West Lancaster Ave.,
Shillington, Pa.

* * *

New to Him

THERE is no direct B plus current flowing in the circuit diagrammed. This is new to me.

F. C. ROTGER,
451 Fifth Street,
Niagara Falls, N. Y.

[*The circuit corresponds to Fig. 7, page 5, this week.—Ed.*]

* * *

The Cathode Coupler

IN RADIO WORLD, issue of June 20th, 1931, you publish and describe, under the name of Herman Bernard, an audio amplifier and diode detector circuit called "The Cathode Coupler," a form of direct-coupled, non-reactive amplification or detection.

The purpose of this communication is to call your attention to the fact that this circuit (cathode coupled) has been worked out and been in use for nearly two years by the author of this letter, using same in audio frequency amplification, radio frequency amplification, resistance and impedance coupling from cathode to ground and several combinations as oscillators, etc.

As to the original diagrams, a photostat copy was dated and attested before a notary public and nearly thirty witnesses at the time of the demonstrations, practically two years ago, and additional data gathered and compiled in the last six months, of which notarized photostat copies have been made and filed with attorney. The data were verified. The title of such an amplifier was "Direct Cathode-Coupled Amplifier and Detector Circuit."

This circuit has been in use in the presence of several hundred technical experts in the engineering field, and diagrams, which are copies from original blueprints, will easily convince you that Cathode-Coupled Amplification was in use two years before Mr. Bernard ever thought of the idea, and since that time, additional data have been added from time to time due to the amplifier being worked in every conceivable circuit arrangement, such as cascade amplifiers, both radio and audio.

In the editor's note of this issue a statement was made that Mr. Bernard had invented this circuit. This certainly cannot be founded upon information from the patent office, as this circuit has been placed in the patent office for some time and a clear search given.

H. MILAN,
Wire Chief, Western Union Telegraph Company, 910 Chestnut Street,
St. Louis, Mo.

* * *

Calls Diagrams Incomplete

WITH many others of the Radio Club in this district, quite some time ago we gave up RADIO WORLD, mainly because the diagrams generally were incomplete.

I bought a copy the other day, the June 20th issue.

In it I find, on page 5, referring to Fig. 3, "R/2, R and 2R," but unless I am blind, there is no 2R shown.

Also one-quarter value of 4RD for RD, no value being stated excepting 25 watt for 4RD, it leaves matters as we have generally found in RADIO WORLD. The center-tapped resistor for the minus on last coil before going to the 800 ohm resistor has no value given.

Resistor marked 4m presume means 4,000 ohms, but when on every other value the totals are given it only leads to uncertainties

E. L. SIEVERS,
Lawrence, L. I.

* * *

"One of the Best"

I FIND RADIO WORLD one of the best radio publications. One finds the very latest developments explained within its covers.

ROBERT J. BRADY,
230 Seeley Street, Brooklyn, N. Y.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor,* RADIO WORLD *145 West 45th Street, New York, N. Y

Otto E. Zieger, 1218 W. 5th St., Austin, Texas.
Sam M. Rothenberg, 415 Wallabout St., Brooklyn, N. Y.
D. C. Ketchein, 32 Water St., Potsdam, N. Y.
S. C. Lee, c/o Amer. Can Co., P. O. Box 209, Honolulu, Hawaii.
A. W. Fawnin, P. O. Box 68, Dunedin, Fla.
Mr. Katz, c/o Mt. Pleasant House Fur. Co., 11716 Kinsman Rd., Cleveland. Ohio.
L. Wurch, 330 4th St., S.W., Puyallup, Wash.
A. Robie Cogswell, 201 Arlington Ave., Daytona Beach, Fla.
F. G. Gamble, P. O. Box 1175, Fort Shafter, Honolulu, T. H.
Carbo Oxygen Co., Oak Hobart Sts., Bayonne, N. J.
Harold Scott, Utility Shop, Marmarth, No. Dak.
R. T. McNulty, 1170 Latham St., Memphis, Tenn.
E. J. Koester, 2370 North Grant Blvd., Milwaukee, Wis.
Jim Richesin, Box 724, Lefors, Tex.
A. Trimm, 523 N. Harding Ave., Chicago, Ill.
Dr. R. R. Vogt, 16515 Euclid Ave., Cleveland, Ohio.
Wm. G. Crawford, 56 Fitzroy St., Charlottetown, P. E. Island, Can.
Frank J. Foley, 961 Madison Ave., Paterson, N. J.
John W. Hill, 326 E. 7th South St., Salt Lake City, Utah.
Allen H. Schooley, Box V, Station A, Ames, Iowa.
Carl Bjorge, Oakdale, Calif.
Thad. B. Johnson, 247 Foundry St., Atlanta, Ga.
E. P. Tabor, 1607 Longmeadow St., Springfield, Mass.
C. E. Schneider, 626 Houston St., Chattanooga, Tenn.
Clarence C. Kaas, R. D. No. 1, East Freedom, Pa.
Geo. A. Barry, 273 Barrington St., Halifax, N. S., Can.
Vernon Farquhar, 1819 39th Ave., Oakland, Calif.
Harold W. Wott, 535 Locust St., Oak Harbor, Ohio.
William D. Collett, care Dr. J. W. Cornell, 6108 Kimbark Ave., Chicago, Ill.
R. B. McKithan, 817 S. 9th St., Temple, Tex.
Orville L. Wright, 508 N. Capitol Ave., Indianapolis, Ind.
William D. Collett, 705 W. Elm St., Urbana, Ill.
H. A. Adams, Box 294, Rutland, Vt.
Thomas Messick, 226 Fredonia St., Peoria, Ill.
Robert A. Shafer, Shafer-Ozark Radio Co., McCracken, Kans.
Oscar Ise, 1517 Coit Ave., East Cleveland, Ohio.
Graham Bros. Radio Service, 312 1-2 W. 119th St., Los Angeles, Calif.
M. A. Gomes, Room 502, Windsor Sta., Montreal, Que., Can.
Ross F. Putnam, San Quentin, Cali.
Harry Pauly, private brand radios, tubes, parts, cabinets, 120 Dorsey St., Cincinnati, Ohio.
G. E. Ralstin, 1049 Hosbroock St., Indianapolis, Ind.
Walter F. Gummere, 1419 25th St., N. W., Canton, Ohio.
Andrew Larson, 908 W. Canfield Ave., Detroit, Mich.
Charles L. Herod, 2136 Sycamore St., Terre Haute, Ind.
F. J. Thames, Beaufort, S. C.
James B. Hager, 215 Ind. Ave., Wichita Falls, Tex.
R. L. Johnson, Texas Power & Light Co., 707 Interurban Building, Dallas, Tex.
The Radio Repair Shop, 321 41st Ave., Gulfport, Miss.
Chas. S. Hopkins, Newark Confectionery Co., Newark, Del.
C. S. Johnson, 121 S. 23rd St., San Diego, Calif.
W. F. Beach, 13973 Woodward Ave., Highland Fork, Mich.
Geo. T. Sperry, Sperry Radio Labs., Washburn, Ill.
Arthur B. Cooney, 409 E. Live Oak St., San Gabriel, Calif.
Tedd S. Cooke, power amplifiers for battery operation, Ronceverte, W. Va.
Donald I. Walker, 30 Lake Ave., Staunton, Va.
John P. Elliott, Nevy, New Mex.
Thomas Yandre, 500 E. Concord Ave., Orlando, Fla.
Louis A. Levine, 1487 St. Marks Ave., Brooklyn, N. Y.
O. L. Bertz, 107 Roxbury Rd., New Britain, Conn.
H. V. MacMillan, 86 Nichols St., Everett, Mass.
Robt M. Damm, 200 South Main St., Oxford, Ohio.

New Corporations

Radio Producers Associates, Inc., New York, N. Y., broadcasting—United States Corporation Co.
Quotations Facilities Corp., Wilmington, Del., transmission by post, telegraph, cable, radio—Corp. Trust Co.
Waters Radio Shop, Cortlandt—Atty. R. T. McMahon, Cortlandt, N. Y.
Moe's Radio and Music Shop—Atty. J. Hermann, 55 West 42nd St., New York, N. Y.
Royal Radio of New York—Atty. M. B. Pomerantz, 117 West 46th St., New York, N. Y.
Hearing Devices Co., telegraphic, radio apparatus—Attys. Deichess, Kaufman, Feldstein & Bernson, 225 Broadway, New York, N. Y.
Television Products, Inc., Scituate, Mass., television—United States Corp. Co.
National Television Corp., New York, television devices—Corp. Trust Co.
International Television Radio Corp., Wilmington, Del., radio, television devices—American Guaranty and Trust Co.
General Radio Finance Corp., Oklahoma City, Okla., radios, radio supplies—Atty. Arley B. Magee, Inc., Dover, Del.

MACKAY OPENS KOLSTER PLANT

Announcement was made by Clarence H. Mackay, president of the Mackay Radio and Telegraph Company, that the two Newark radio factories now controlled by his company have been reopened and a considerable number of new employees will be engaged. These factories had been closed following the failure of the Kolster Radio Corporation. The majority of the additional personnel, said Mr. Mackay, will be directly engaged in the manufacture of the Kolster International Radio Broadcast Receiver, which will be placed on the market early in August.

"Trade response in the United States, South America and abroad has caused the Mackay Company to feel warranted in not only launching an aggressive campaign for this year's business, but also in providing substantial capital investment with the demand of the next several years in mind," said Mr. Mackay.

A large part of the personnel will be engaged in the manufacturing of the Kolster Radio Compass, and radio telegraph communication equipment not only for the International System but for installation on American merchant ships, which comprises the well known Mackay Radio marine services.

A separate department will be maintained for the manufacture of high powered vacuum tubes for transmitting purposes.

In addition to the manufacturing division a laboratory is being established in Newark, which will soon employ a large corps of engineers who will engage in development and research work in all branches of the radio art.

Announces Strike for Five Minutes

Buenos Aires.

All radio announcers in this city went on strike, without warning, for five minutes one night recently, stopping all broadcast stations in the city.

At the end of the five-minute interval broadcasting was resumed with an explanation that the strike was in protest against a local campaign for suppression, or limitation, of radio advertising. Broadcast listeners were warned that if the announcers did not get their support the announcers might make the silence permanent.

"Looking Posts" for CBS Television

W2XAB, the Columbia Broadcasting System short-wave television transmitter, will establish looking-in posts throughout the New York metropolitan area to make reports on the reception of images broadcast from the station.

The Columbia building, on the top of which is located the double variety radiating antenna, is situated on the hill and from the top of the aerial there is a clear view of all the surrounding country. This, it is believed, will aid greatly in the reception of clear images up to fifty miles.

The Columbia system is desirous of receiving reports from television fans as to the clarity and intensity of the signals. The short-wave transmitter is on Manhattan Island, New York City.

Polo Leads with AW-5

Polo Engineering Laboratories vowed that their first receiver would be an all-wave receiver, and a good one, so they set about the construction of a model that was excellent from the start, but was improved, even at that, as experiments continued for more than four months. Then a demonstration was given to a group of important factors who were negotiating for purchase thereof, and they were delighted. The president of the laboratories, Capt. Thomas G. Forshaw, not content yet, sent some sample sets to other engineering laboratories, and compared the reports. He said:

"I was gratified, indeed, to find that they all agreed, and that their results were very satisfactory. There were two main considerations in mind, due to shortcomings discovered in other specimens that would not be tolerated in any product of our laboratories: first, no miss-out on the wave coverage, and, second, enough volume to give satisfactory reception on the far-distant stations that it is possible to tune in."

The circuit is known as the AW-5, and is built into a Gothic type mantel cabinet, with speaker enclosed. Wave band shifting is done from a single front panel knob, while two other knobs are for a trimming condenser and a switch-volume control. Multi-mu radio frequency amplification, 224 detection, 227 first audio (transformer coupled) and 227 output are used, with 280 rectifier.

The set works very well, indeed, and enables one to bring in short-wave stations without trouble. The broadcast band coverage is good, with all broadcast frequencies included without switching.

—Herman Bernard.

GERMANS HEARD FIGHT AT 5 A. M.

Schenectady, N. Y.

WGY's short wave stations, W2XAF and W2XAD, carried a complete description of the Schmeling-Stribling fight to Germany. The fight, which began at 11:00 p.m., E.D.T., was received in Germany six hours later, but it is evident that the fight fans among tthe foreign listeners felt the result compensated them for loss of sleep.

The fight story, furnished by the National Broadcasting Company, was carried from the ringside at Cleveland by special wires to the transmitters in Schenectady. The South German Broadcasting Company, a unit of the Republic's broadcasting system, received W2XAF. The message, signed Suedfunk and sent to WGY from Stuttgart, was as follows:

"Ring report Schmeling relayed on all German stations. Reception of W2XAF R-9. Excellent modulation, no fading. Many thanks of German radio audience."

In radio parlance R-10 indicates perfection. W2XAF's signal at R-9 was, therefore, very close to perfect.

South America apparently did not fare as well as Europe. W2XAW, a third short-wave transmitter of the General Electric Company, was used for the transmission of a Spanish story of the fight. Buenos Aires sent a radiogram reporting as follows:

"Rebroadcast fight fair. Continuous interference from code stations."

WCDA Plea Opposed in Examiner's Report

Washington.

Examiner Elmer W. Pratt has recommended to the Federal Radio Commission that the application of WCDA, of the Italian Educational Broadcasting Company, New York, for authority to install a new 1,000-watt transmitter, but to operate it only at 250 watts for which it is licensed, be denied.

Examiner Pratt pointed out that in January, 1930, the company had been granted authority to erect a 1,000-watt station, but that the company had allowed its construction permit to lapse without erecting the transmitter.

Testimony taken by Examiner Pratt brought out that the company did not desire to increase the operating power of the station but that it merely desired to add another amplifier stage to its present transmitter without changing the 250-watt rating.

"Experimental Radio Engineering"

"Experimental Radio Engineering," by John H. Morecroft, E.E., E.Sc., professor of electrical engineering, Columbia University, and past president of the Institute of Radio Engineers. Published by John Wiley & Sons, Inc., New York. Cloth bound, 345 pages, 6x9, 250 figures. $3.50.

This is a companion book to the same author's "Principles of Radio Communication" and has been written for the laboratory student of the subject. It emphasizes the principles underlying the performance of radio apparatus, rather than the specific operation of such. Fifty-one different experiments are outlined, covering the more important phases of the subject. The theory of each experiment is given in simple language, understandable even by those who have not read the author's "Principles" or those who do not have the mathematical training necessary to understand that book in full.

Professor Morecroft has a knack of presenting difficult subjects in a way which makes them seem simple, and in this laboratory manual he has exercised it in a high degree. Even one who is well versed in the subject on reading this manual will obtain new points of view from which he can regard radio phenomena in a clearer light.

How Superregeneration Works

In a superregenerative circuit the oscillation at the high frequency is broken up by an oscillation of lower frequency. In the superregenerative receivers used for broadcast reception a few years ago, the low oscillation was in the neighborhood of 10,000 cycles, an audible frequency. This caused a continuous high pitch squeal which detracted from the value of the circuits. For a short wave receiver, the breaking-up oscillation could well be above audibility so that there would be no sensible evidence of it.

In Fig. 7, page 9, low frequency oscillation is maintained by the two tuned circuits C3TC4. C3 and the secondary of T are the grid circuits of the tube and C4 and the primary are in the plate circuit. Both are tuned accurately to the same frequency and the coupling between the two windings is adjusted so that the control by the low frequency on the high frequency is satisfactory. The low frequency oscillator must not oscillate so violently that the tube becomes paralyzed, for then the circuit would be no better than if the high frequency adjustment were such as to cause free oscillation.

NEW! for AUTO Radio
Types to Fit All Makes of Cars

LYNCH

Spark Plug and Distributor Suppressors
Metallized principle insures dependability and long life.
Write for illustrated catalog WS.
LYNCH MFG. CO., Inc., 1775 Broadway, N. Y. C.

Short-Wave Earphone Tuner

[*AC Operated Throughout—Range, 15-200 Meters*]

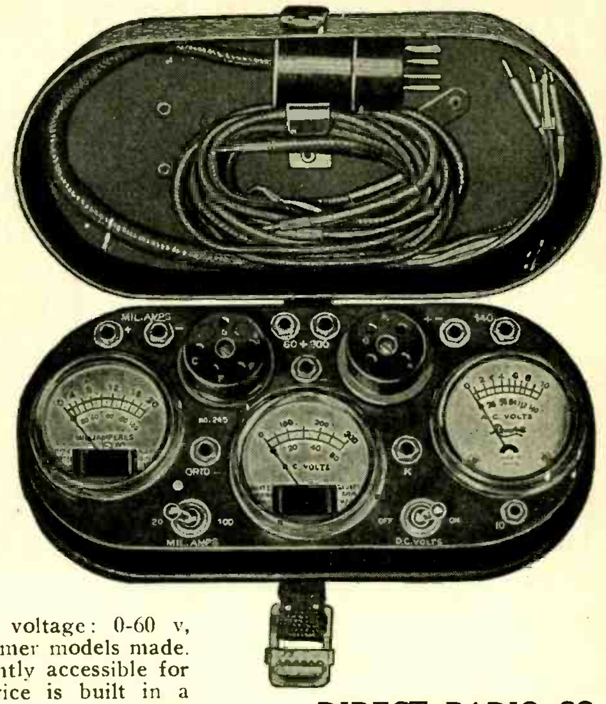
One three-circuit coil for .00035 mfd. tuning, 200 to 15 meters, tapped in two places	$1.00
One 20-volt filament transformer	.65
One .00035 mfd. tuning condenser	.40
One .00025 mfd. fixed grid condenser with clips	.20
Three .0015 mfd. fixed condensers @ .10	.30
Two 8 mfd. electrolytic condensers with brackets @ .95	1.90
One 0.01 mfd. fixed condenser	.20
One .00035 mfd. fixed condenser	.10
One 0.01 meg. pigtail resistor (10,000 ohms)	.20
Two 0.25 meg. pigtail resistors (250,000 ohms)	.20
One 1.0 meg. pigtail resistor (1,000,000 ohms)	.20
One 2 meg. tubular resistor, not pigtail, for grid leak (2,000,000 ohms)	.20
One 25,000 ohm potentiometer	.85
One AC switch, shaft type	.35
One 150 ohm flexible biasing resistor	.20
One .02 meg. pigtail resistor (20,000 ohms)	.20
One AC cable and plug	.25
One single pole three point switch	.50
One front panel	1.25
One subpanel with four UV sockets affixed	2.75
One roll of hookup wire	.22
One dozen 6/32 machine screws and nuts	.10
One vernier dial	.50
Four binding posts	.32
Ten 7/32 insulators for three posts inductance switch and potentiometer	.50
One 15 henry choke	1.00

All parts (order any or all) $14.64

ROLAND RADIO CO.
137 Hewes Street
Brooklyn, N. Y.

Send $8.26! Get This Tester!

HERE is your opportunity to get immediate delivery of the Jiffy Tester at $8.26 remittance with order, balance of $3.50 payable in one year. Your credit is good with us. This Tester will read plate current, plate voltage and filament voltage simultaneously, when plug is put into any set socket and tube in the Tester.



Jiffy Tester, Model JT-N, consists of three double-reading meters, with cable plug, 4-prong adapter test cords and screen grid cable. The ranges are filament, heater or other AC or DC 0-10 v, 0-140 v; plate current: 0-20, 0-100 ma; plate voltage: 0-60 v, 0-300 v. It makes all tests former models made. Each meter is also independently accessible for each range. The entire device is built in a chromium-plated case with chromium-plated slip-cover. Instruction sheet will be found inside. Order Cat. JT-N.

DIRECT RADIO CO.
143 W. 45th St., N. Y. C.

NEW VARIABLE MU TUBE

TO remedy cross-modulation and cross-talk, without circuit changes, a new screen grid tube has been developed. In AC circuits where the volume control varies the grid bias or the screen voltage, or in which there is an automatic volume control, the new tube works wonders. This is the sensational tube developed by Stuart Ballantine. Order VM-51. Price $2.66.

RELIABLE RADIO CO.
143 WEST 45th ST. N. Y. CITY

RECEIVE RADIO WORLD DURING YOUR VACATION

Are you going away on vacation for a week, a fortnight, or a month? You will, of course, want to read RADIO WORLD during that period. Send $1.00 for 8 weeks' subscription, and when you return home we will change your address if you will let us hear from you. RADIO WORLD, 145 W. 45th St., N. Y. City.

Fixed Condensers

Dubilier Micon fixed condensers, type 642, are available at following capacities and prices:

.0001 mfd.	10c	.006	20c
.00025 mfd.	10c	.00025 with clips.	20c
.0003 mfd.	10c		
.00035 mfd.	12c		
001	12c		
0015	12c		
.002	18c		

All are guaranteed electrically perfect and money back if not satisfied within five days.

GUARANTY RADIO GOODS CO.
143 West 45th St., New York, N. Y.

RADIO WORLD and "RADIO NEWS"

BOTH FOR ONE YEAR **$7.00**

You can obtain the two leading radio technical magazines that cater to experimenters, service men and students, the first and only national radio weekly and the leading monthly, for one year each, at a saving of $1.50. The regular mail subscription rate for Radio World for one year, a new and fascinating copy each week for 52 weeks, is $6.00. Send in $1.00 extra, get "Radio News" also for a year—a new issue each month for twelve months. Total, 64 issues for $7.00.

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

Quick Action Classified Ads

Radio World's Speedy Medium for Enterprise and Sales

7 cents a word—$1.00 minimum—Cash with Order

30 HENRY 100 MIL. CHOKES, $.60; 2 and 3 gang condensers, $.95; filter condensers, $.35 per mfd. F. Wolf, David Street, Great Kills, S. I., N. Y.

"RADIO TROUBLE SHOOTING," E R. Haan. 328 pages, 300 illustrations, $3. Guaranty Radio Goods Co., 143 W. 45th St., New York.

"A B C OF TELEVISION" by Yates—A comprehensive book on the subject that is attracting attention of radioists and scientists all over the world. $3.00, postpaid. Radio World, 145 West 45th St., N. Y. City.

BALKITE A-5 RECEIVER, eight-tube, three stages of Neutrodyne RF and two stages audio with push-pull output. Good distance-getter and very sensitive. Has post for external B voltage for short-wave converters. Brand new in factory case. Berkey-Gay walnut table model cabinet. Price $35 (less tubes). Direct Radio Co., 143 West 45th St., New York.

MAJESTIC 181, RADIO-PHONO COMBINATION, 65% off list. Jewell 4-Instrument Analyser, 35% off list. Imported Cameras, 50 Pictures with one loading, $4.50 postpaid. Walter Jaeger, 607 W. 138th St., New York City.

MOUNTED STEER HORNS: For sale, over six feet spread. mounted on panel. Rare opportunity. Texas longhorn cattle now extinct. Lee Bertillion, Mineola, Texas.

U. S. BROADCASTING STATIONS BY FREQUENCY.—The April 11th issue contained a complete and carefully corrected list of all the broadcasting stations in the United States. This list was complete as to all details, including frequency, call, owner, location, power and time sharers. No such list was ever published more completely. It occupied nine full pages. Two extra pages in the April 11th issue were devoted to a conversion table, frequency to meters, or meters to frequency, 10 to 30,000, entirely reversible. 15c a copy. RADIO WORLD, 145 West 45th Street, New York, N. Y.

SOUND PICTURES TROUBLE SHOOTER'S MANUAL, by Cameron and Rider, an authority on this new science and art. Price $7.50. Book Dept., Radio World, 145 W. 45th St., N. Y. City.

BARGAINS in first-class, highest grade merchandise. Phono-link pick-up with vol. control and adapter. $3.32; four-gang .00035 mfd. with trimmers built in. $1.95; .00025 mfd. Dubilier grid condenser with clips, 18c. P. Cohen, Room 1214, at 143 West 45th Street, N. Y. City.

SITUATIONS WANTED

COMMERCIAL OPERATOR with two years' operating experience on nearly all types of equipment. seeks position as operator on any land station. either commercial work or broadcasting. Hold American and British commercial licenses. Also proficient at radio sales; at present with a radio service agency. Norman R. Prickett, 158½ Park Avenue, Rochester, N. Y.

STOP SHOPPING!!

HERE'S a NEW plan, which saves you money. *Stop shopping—the lowest prices are right on this page.* Yes, lower than in our own catalog. Why? Because no house can get out a new catalog every month, but by advertising in this magazine we can bring you the latest and lowest prices *up to the time this ad is printed.* We watch our competitors and *do not allow anyone to undersell* us. We meet ANY price on NEW merchandise. *Order direct from this page and save money. 100% satisfaction on every transaction.*

NEW! NEW! Official Radio Service Kit NEW! NEW!

Several months ago we sent out a questionnaire to 2,000 radio service men and asked them what their ideas were on a radio service kit. 865 answered us, and their ideas are now embodied in the Official Radio Service Kit which we herewith present to you.

This kit is a marvel in compactness, a marvel in price, a marvel in time saving. For the first time you are offered a comprehensive kit that contains **EVERYTHING** that the service man requires in making calls.

ARE YOU A 50 PER CENT SERVICE MAN?

Too often so-called service men go on a job with an analyzer and a pair of pliers. Nine times out of ten they have to run back to the shop to get tools, and thus their usefulness is cut down, as a rule, 50% and over. Why not take along, on every job, a business-looking like service kit that looks just as business-like as your analyzer?

When you call upon a prospect and you arrive with this fine-looking kit, **your prospect knows that you mean business. It gives** you a professional appearance that every service man requires more than anything else today.

AND YOU CAN COMMAND MORE MONEY ON YOUR SERVICE CALLS WITH THIS KIT

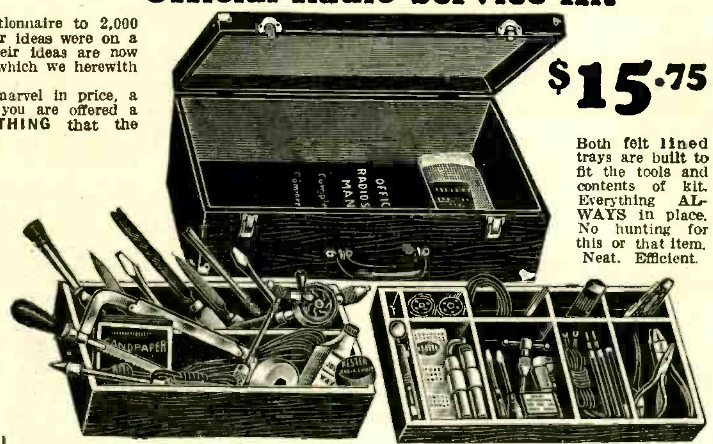
because the prospect will look upon you as a professional, and not as a tinkerer.

When you visit a medical specialist today, you are impressed by his instruments, **for which you pay.** An ordinary doctor commands no such fees. It should be clear to you that if you are a professional, you can get professional prices today too. That is why this marvelous kit will pay for itself inside of three months or less.

Herewith, are the Official Radio Service Kit specifications: Size, small and compact, not larger than a good analyzer; 17 in. long, 6¼ in. wide and 10 in. high.

Construction, wood veneer throughout, entirely covered with black leatherette, all nickel trimmings, giving outfit a beautiful professional appearance.

There are two trays which lift out. Top tray contains the following:



$15.75

Both felt lined trays are built to fit the tools and contents of kit. Everything ALWAYS in place. No hunting for this or that item. Neat. Efficient.

1 Pen Flashlight, complete with magnifying dentist's mirror (to look underneath chassis, etc.).
1 Automatic alcohol blow torch.
1 Box containing 300 assorted screws, nuts, washers, lugs, etc.
1 Nickel Bicycle wrench.
1 Tap holder with one 6/32 tap and one 8/32 tap.
1 Set of Test prods, with 6 ft. cord.
1 Telephone type pliers.
1 Diagonal pliers.
1 Insulated (5,000 volt insulated handle) heavy pliers.
1 Electrician's knife.
1 Set of 8 drill points.
10 Ft. of Phosphor bronze drum dial cable.
1 Neutralizing socket.
1 Pack extra size pipe cleaners (to clean condensers).
3 Small screw drivers.

Lower tray contains:
1 Complete Neutralizing kit with insulated screw driver and five socket wrenches.
1 Electric soldering iron, with 1 extra tip.
1 Large and
1 Medium imported screw drivers.
2 Small files with handles.
1 Large file with handle.
1 ¼ in. Star drill, 11½ in. long.
1 Hand drill, ¼ in. chuck, 10 in. long.
1 Electrician's metal hammer.
1 Hack saw and blade.
1 Package Sand papers and emery papers.
1 Roll 50 ft. solid push back wire.
1 Can genuine Kester radio solder.
¼ lb. of ¾ in. electrician's tape.
1 Bottle Furniture polish.
1 Package Furniture cheese-cloth.
1 Bottle Nujol (for lubricating purposes).
1 Tube special cement (to mend cones, etc.)
1 Socket tool to straighten socket prongs.

IMPORTANT!

There is sufficient room in the bottom of **the kit to place the Official Radio Service Manual,** as well as other data sheets (but at the price quoted Manual is not included).

Both trays, as well as inside cover, are lined with blue felt, **giving** kit a beautiful appearance.

Nothing similar has ever been offered before. Only by buying the various materials in tremendous quantities are we enabled to sell this kit at such an extremely low price.

If you were to buy all of the articles separately, in the open market, you would have to pay between $30.00 and $35.00 for them.

Due to the present depression, we are enabled to buy quantities of these materials at exceedingly low prices. For that reason, our production cost is exceedingly low, but there is no question that this price will have to be increased later.

Size, 17 in. long, 6¼ in. wide and 10 in. high; net weight, 16 lbs.; shipping weight, 18 lbs.

No. 1000—Official Radio Service Kit—Your price...... $15.75

CARRYING CASE

We are prepared to furnish you with the Official Radio Service Case only, without contents, as described above, just the case and the two empty trays, size 17 in. long, 6¼ in. wide and 10 in. high.

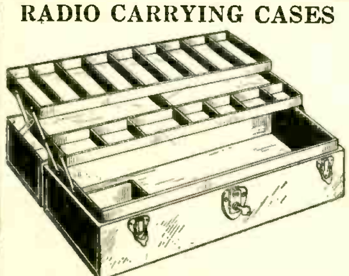
This case is made entirely of light veneered wood, nickel trimmings, covered entirely with leatherette, inside of case covered in blue felt.

Net weight, 4 lbs. Shipping weight, 5 lbs.

No. 1001—Official Radio Service Carrying Case only, your price $4.85

View of kit, closed.

RADIO CARRYING CASES



The cases here shown are a new development. They are made in metal throughout with baked olive green enamel finish. These cases are beautifully and strongly made, and will give you a professional appearance. Lock and side locks are of burnished brass.

The smaller illustration shows dimensions and closed view of the cases. As you open the cover, **two trays automatically fold out in position,** as shown. As you tilt the cover back, the trays fold automatically into the case. The trays are provided with a number of compartments for tools and all other radio appliances that you may wish to carry. The large box accommodates about eight radio tubes in the bottom compartment. The smaller case accommodates about four tubes.

Cases are strong and rugged, and **when closed, nothing can spill.** They are marvels of ingenuity, and will pay for themselves many times over.

Large size measures 21½ in. long, 7¼ in. high and 7 in. wide. Net weight 8 lbs. Shipping weight 10 lbs. List price $8.50. **No. 1002—Carry. Case, your price $4.75**

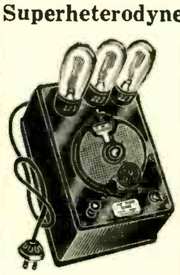
SMALL CARRYING CASE

This case is in all respects the same as the one described above, except that the dimensions are less, otherwise the same in all respects.

Size 12½ in. long, 7¼ in. high and 7 in. wide. Net weight, 5 lbs.; shipping weight, 6 lbs. List price, $6.50.

No. 1003—Carrying Case—Your Price $3.45

NEW! NEW!! Superheterodyne S-W Converter



At last a short-wave converter that converts any broadcast set into a superheterodyne short-wave receiver. Employs three 227 tubes and covers from 20 to 115 meters. No plug-in coils! Coil switch is used to cover all wavelengths. Single dial control, no body capacity, no squeals. This converter has built-in filament transformer to heat the three 227's. All you need to obtain from your receiver is a positive B voltage anywhere from 45 to 180 volts. Voltage is not critical; no molestation of the receiver. So simple a child can operate it. Size 7 x 10 x 5 inches. Shipping weight, 8 lbs. **List Price $25.00.**

No. 1614—Super Converter (less tubes). YOUR PRICE......... $14.69

World-Wide Short-Wave Set NOT A CONVERTER

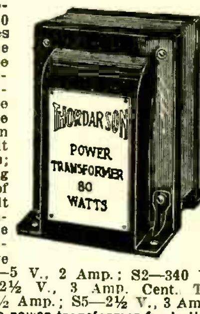
NEW

A perfect radio short-wave receiver for use between 17 and 84 meters. To put into operation, connect antenna, ground, 45-volt "B," and 6-volt "A" batteries, and headphones to the posts provided, plug in a type '01A tube, and tune in! An ingenious circuit makes possible a 4-coil single-winding plug-in design. This little instrument has the same sensitivity as many big, shielded short-wave receivers costing ten times as much. A power amplifier may be added for any degree of volume. Complete with 4 plug-in coils. Has fine vernier dial for precision tuning. **Never has a first class short-wave set sold for so little money.** This short-wave set measures 5½x7x4 in. high, over all. Ship. weight, 3 lbs. List price, $12.50.

No. 1666—World-Wide S.-W. Set. Your price.................. $6.25

THORDARSON "245" Power Transformer

A Miniature Power Plant — Supplies All ABC Voltages — 80 Watts



In addition to supplying a full 250 volts to the plates and 50 volts to the grids of two type '45 tubes in push-pull, this transformer may be used to light the filaments of seven or eight 2.5-volt filament tubes; and by connecting in series two of the three 2.5-volt filament secondaries it is possible to light 5-volt filaments too. Five secondaries: S1—5 V., 2 Amp.; S2—340 V. Cent. T.; S3—2½ V., 3 Amp. Cent. T.; S4—2½ V., 10½ Amp.; S5—2½ V., 3 Amp. Cent. T. **Just the power transformer for building up a high-grade public address amplifier to use a screen-grid A.F. amplifier to boost the output of a microphone or phonograph pick-up;** following this with two stages of push-pull amplification consisting of two '27's in the first stage and two '45's in the second. Bottom of transformer has bakelite panel on which are mounted all taps. **It outperforms ANY similar transformer.** Many Service Men keep this model transformer on hand for emergency replacements in hundreds of makes of radio sets. For 110-120 volts, 50-60 cycles. Size: 5 in. high x 4 x 3½ in. Shipping weight, 8 lbs. **List Price, $15.00.**

No. 1450—Thordarson Power Transformer. YOUR PRICE....... $3.84

High-Voltage Condenser Units

We guarantee these condensers unconditionally. They are ideal for general replacement purposes and can be installed in any new power-pack. All condensers are furnished with 8-inch lengths of tinned "push-back" wire.

600 VOLTS Cat. No.	Mfd. Capac.	Your Price	800 VOLTS Cat. No.	Mfd. Capac.	Your Price
1702	½	$0.25	1706	1	$0.40
1703	1	.30	1707	2	.70
1704	2	.40	1708	4	1.05
1705	4	.60			

New 36 page Summer Edition No. 23

75 New Hook-Ups, etc.
350 Illustrations.

The new Summer Edition of our greatly enlarged **RADIO SERVICE TREATISE** has just come off the press. If you liked the Winter Issue, you will like this one a hundred-fold. It contains some 75 new hook-ups, circuit diagrams; and some 350 illustrations. **POSITIVELY THE GREATEST BOOK EVER PUT OUT BY ANYONE.** Among the new matters listed are:

VACUUM TUBE TREATISE, with many illustrations; full page Vacuum Tube Average Characteristic Chart; How to Take Care of Your Tubes; How to Connect Phonograph Pick-ups; Improving the Tone Quality of Old Sets; Connecting Additional Loud Speakers; all fully illustrated with diagrams.

Other articles: Modernizing Old Radio Sets; How to Convert Battery to Power Sets; Selection of Tubes; Push-Pull Amplifiers; Replacing Audio Transformers; Phono Attachments; How to Choose Power Transformers; Voltage Dividers; Wattage of Power Transformers; Selecting and Installing Replacement Parts in Radio Sets; Filter Condensers; Repairing Eliminators.

WRITE TODAY. Enclose 2 cents for postage. Treatise sent by return mail.

WE ARE A WHOLESALE HOUSE AND CANNOT ACCEPT ORDERS FOR LESS THAN $3.00.

If C. O. D. shipment is desired, please remit 20% remittance, which must accompany all orders.

If full cash accompanies order, deduct 2% discount. Send money order—certified check—U. S. stamps.

Radio Trading Co.
25R West Broadway
New York, N. Y.

ORDER FROM THIS PAGE. You will find special prices from time to time in this magazine. Get our big FREE catalog for the greatest Radio Bargains.

Should you wish goods shipped by parcel post, be sure to include sufficient extra remittance for same. Any excess will be refunded.