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The First National Radio Weekly

658th Consecutive Issue—Thirteenth Year

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ALL-WAVE SUPER

STATION SIREN FINDS SHORT-WAVE CARRIERS

NOV. 3
1934

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15c
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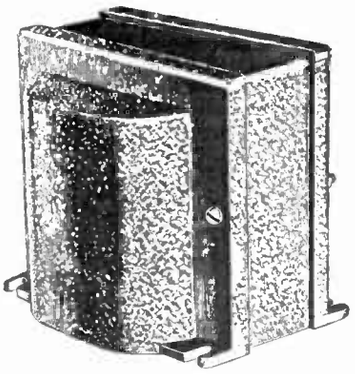

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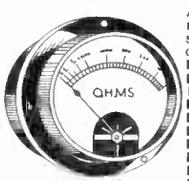

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P-1026—0-100 ma
P-1027—0-300 ma
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If there is any particular meter you desire, and it is not listed, write in for a subscription proposition. In fact, if there is anything in radio that you want as a premium, we will be glad to make you an offer. Write to Premium Editor, Radio World, 145 West 45th Street, New York, N. Y.

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

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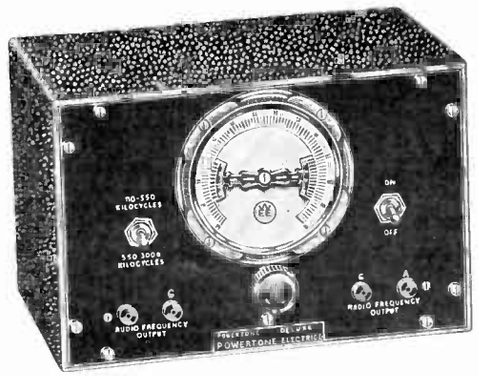
Signal Generators



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Model 336-SG is in a crinkle-finish black shield cabinet, 9" wide, 6" high, 5" front to back, weighs 7½ lbs. complete. It has bar-handle control of volume and modulation. It is useful for lining up superheterodyne i-f channels, also the r-f channels of any receivers, and can be used satisfactorily for peaking on short waves as well. Instruction sheet supplied. Order Cat. 336-SG, wired, complete with 22.5v. B battery, 4.5v. A battery, and tubes, ready to operate. (shipping weight, 8 lbs.) Cat. No. 336-SG. NET **$7.95**

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On the upper on secondary scale the popular intermediate frequencies are clearly marked: 175, 260, 400 and 450 k.c. with 177.5—175—172.5 spotted. Frequencies not marked can be obtained by means of harmonics, by simply dividing the desired frequency by small whole numbers to obtain the nearest scale frequency.

Strong harmonics are present due to the character of the oscillator circuit employed. In actual practice sufficient signal is available for checking purposes up to the 50th harmonic and beyond. In many cases strong steady signals have been obtained up to the 150th harmonic.

Output indicator consists of a built in glow tube, which is extremely sensitive and follows every variation in frequency and intensity of the signal impressed on the indicator. All Models **$10.95**

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The First National Radio Weekly
THIRTEENTH YEAR

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A Voltage-Fed Zepp
Antenna for the Amateur Transmitter

By Russell De Jonge
W8DIB, Zealand, Mich.

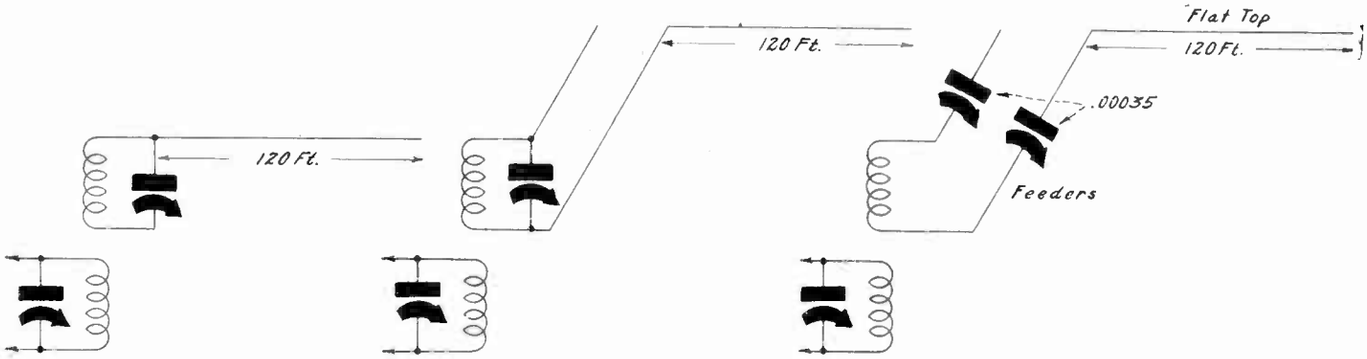

FIG. 1
The output circuit is connected through a transformer with both windings tuned. This method places the radiating antenna too near the operator, the transmitter and the power line.

FIG. 2
The outgoing wires are the feeders. This is an example of a parallel-tuned line. The feeders are connected to a voltage loop of the antenna for voltage feed, or to a current loop for current feed.

FIG. 3
The series-tuned method. This is the one that the author prefers. The variable condensers associated with the output circuits are all 0.00035 mfd. They must have plates spaced to prevent arcing.

NOTE:—The feeder wire at left, going up, Figs 2 and 3, parallels the other, and terminates at an insulator. It is a neutralizer, not connected to aerial.

THE antenna for which W8DIB was designed is a radiating system known as a voltage-fed Zepplin antenna. Energy is fed to the antenna at one of the voltage loops of the antenna, hence the name "voltage-fed" antenna. Having constructed aerials of various types I selected the voltage-fed one in preference to the current-fed or single-wire-fed antenna.

Since the transmitter has been explained (October 20th and 27th issues) I will continue my explanation from the tank circuit of my rig or that of any similar output. The simplest form of voltage-fed intenna is a system where the radiating antenna is coupled directly to the output of the transmiter as in Fig. 1. This system is not used because it places the radiating antenna too near the operator, the transmitter, and the power line.

Tuned Transmission Line

In order that the radiating "flat top" may be used to the best advantage it should be located at a great height, approximately sixty feet from the ground. The "flat top" must be tuned by a method which will be explained. In order that radio energy may be induced to the antenna a tuned transmission line generally called a pair of feeders is employed.

Since there is a voltage loop at the end of the flat top the feeders are connected as shown in Fig. 2. If one desired to use this system in the current-fed arrangement he would connect the feeders to a current loop of the antenna which is located near the center of the flat top.

The antenna flat top is located as high as is convenient in each particular location. The size of the wire and the distance of this system to ground or surrounding objects determine the fundamental wavelength of the aerial. The frequency in kilocycles at which it resonates, sometimes called its natural resonant frequency, taking the inductance of the antenna and its distributed capacity into consideration, is determined by taking the length of the wire in feet and dividing it into the constant 468,000. This formula can be worked out for frequency or wavelength, as long as either the length of the wire is known in feet or the resonant frequency is given in kilocycles. The formulas are:

Length in feet = 1.56 times desired wavelength in meters.

$$\text{Length in feet} = \frac{468{,}000}{\text{frequency in kc.}}$$

Excellent Insulation

Now let us take for example the transmitter which emits a signal of 3,885 kc. In order that the aerial resonate at 3,885 kc it must be according to the second formula 120.5 feet long.

Were it not for the distributed capacity and the inductance of the antenna the natural wavelength of the antenna would be twice its actual lengths in meters. Due to these it varies from 2.1 to 2.06, depending of course upon the frequency used.

The total ohmic and radiation resistance is about 75 ohms. Of course the aerial must have very good insulation at both ends in order that this resistance be not reduced. Pyrex insulators are used, but ordinary glass

(*Continued on next page*)

Byrd Hears Australia via Schenectady, 20,000 Miles

Early risers on a recent Sunday morning had an opportunity of listening to an unusual short-wave radio feat when a 15-minute program, originating in Sydney, Australia, was relayed by General Electric's short-wave station W2XAF, Schenectady, N. Y., to Admiral Byrd and his men at Little America. The distance from Australia to Schenectady is approximately 10,000 miles and the distance from Schenectady to Little America is about the same. Thus the program, originating but 3,000 miles from Little America, traveled a distance equivalent to four-fifths the distance around the world before reaching Admiral Byrd.

The program was broadcast by VK2ME, the short-wave station of the Amalgamated Wireless, Australasia, Limited, on 31.28 meters. It was picked up by General Electric engineers and rebroadcast over W2XAF, on 31.48 meters. It lasted but 15 minutes, from 7 to 7:15 a.m. The signal was exceptionally good and at times the rebroadcast from W2XAF sounded well enough to cause listeners in this country to believe the program was originating in Schenectady. It also gave fans with new all-wave receivers an opportunity of testing the sharp tuning qualities of their sets as Australia was broadcasting on a wave but 0.2 meter from W2XAF.

* * *

DX Talk from Auto

Schenectady, N. Y.

A 10,000-mile chat with Sydney, Australia, from the front seat of a light sedan was the somewhat unscheduled experience of C. H. Lang, manager of the General Electric publicity department. The experiment, which utilized the G-E radio department's police test car, had been vaguely planned prior to its actual happening, but only the fact that Mr. Lang overslept made him a party to it. R. E. Farmer, engineer of VK2ME, Sydney, was the party on the other end of the conversation, also surprised at the way things happened.

The sedan was the experimental model developed by General Electric for the Boston police department. Externally the car looks the same as any sedan, and inside it has a French-type telephone hooked onto the instrument board. The operating equipment is contained in a trunk at the rear of the car.

With this equipment it is possible for passengers to converse steadily with "headquarters" while riding. Two different frequencies are used, and the effect is that of a routine telephone conversation, except that it is carried on by short-wave radio.

Helpful Forgetfulness

Mr. Lang was scheduled to tak to Australia in the morning from 6:30 to 7:30, which is the best time for the broadcast to be run off without interference from electrical conditions. This necessitated a rather early rising, and when the test car called for him he had forgotten his appointment and was delayed in getting ready. To cut matters short and begin the broadcast on time, the engineers at short-wave station arranged to make it a "direct line" from the police car to Sydney. Mr. Lang's words were carried by ultra-short wave below the 10-meter band to the control board of WGY, where incoming signals from Australia, received at the Sacandaga station, were also being relayed.

The incoming and outgoing signals were so regulated by W. J. Purcell, station engineer of WGY, that the two-way conversation could begin before one of the principals had even arrived at the speaking point. Station W2XAF at South Schenectady was used in sending the signal to Australia. At this time it was approximately 10 o'clock at night in Sydney.

New Thrill

Neither listeners in Australia nor short-wave enthusiasts in this country who were listening in were aware of what was happening, as only the usual type of two-way broadcast had been scheduled, with some possibility of working in the police car afterwards. It was a new thrill for the amateurs.

Amendments to List of Broadcast Stations

The following are new alterations and corrections to the edition dated January 1, 1934, applicable to the U. S. Government book, "Radio Broadcast Stations in the United States":

Call	*Studio Location*	*Alterations and Corrections*
KGKL,	San Angelo, Texas.	Power 250w-LS.
KMBC,	Kansas City, Missouri.	Power 2½kw-LS.
WALR,	Zanesville, Ohio.	C. P.-T and studio Toledo.
WFBC,	Greenville, S. C.	Frequency 1300 kc, power 250w, 1kw-LS.
WIBW,	Topeka, Kansas.	C.P., power 2½ kw-LS, quota units 1.02.
WORC,	Worcester, Massachusetts.	Frequency 1280 kc, power 500w, Strike out S.A. Exp.
WSEN,	Columbus, Ohio.	Call letters changed to WCOL, Licensee WCOL, Incorporated.
WSVA,	Staunton, Virginia.	Permittee, Marion K. Gilliam, frequency 550 kc, power 500w, D, quota units 0.3.
WTAW,	College Station, Texas.	S. H.
WWPA,	Clarion, Pennsylvania.	Permittee, Clarion Broadcasting Company, Inc.; frequency 850 kc, power 250w, D, quota units 0.2.

FEVER MACHINE ACCELERATES CURE

Philadelphia, Pa.

How the recovery of sufferers from certain ailments can be expedited by the fever machine was outlined before the Congress of Physical Therapy by Drs. A. Halphen and Jules Auclaire, both of France. They cited an instance of a patient in a hospital, placed between the electrodes charged with the high-frequency voltage, having his temperature raised to 104 degrees for 100 hours steadily, after which he was completely cured. Ordinarily the complete cure takes six weeks, they said. The fever machine is used where medication alone does not give sufficient results.

RADIO SET GADGETS

Remote control apparatus for radio sets consists of a mechanism to tune the receiver from a distance. Usually mechanical methods are introduced and the distance is measured in feet. Automatic timing devices permit setting a switch-clock for tuning in given stations automatically, at selected times. As many as nine stations over a 12-hour period may be selected.

Transmission Line Tuning for Ham Set

(*Continued from preceding page*)

will serve well enough. And for the line tuning. Either of two methods of tuning the transmission line may be used. One, called the parallel-tuned method, is shown in Fig. 2 and is used a great deal, yet I prefer the series method shown in Fig. 3. With this typical arrangement the feeders should be either sixty or ninety feet, depending upon the height of the flat top.

In order that the flat top alone shall radiate, the antenna feeders are tuned to the frequency of the radiated signal by a method to be described. The condenser in the plate circuit of the final amplifier is tuned to resonance, with the secondary of L8 coupled quite closely to the primary. The antenna series condensers are set at maximum with the transmitter on and emitting a signal. The condensers are tuned simultaneously from maximum to minimum until the antenna feeder current read on the current meter is maximum. In the event that this radiating system is coupled directly to an oscillator the following precodure is followed.

In order that this system shall not draw too much current to make the oscillator unstable at this peak the condensers are adjusted so that capacity is increased until the radiated current just begins to decrease again. The feeder or transmission line consists of two No. 10 wires evenly spaced, let us say 10 to 18 inches apart. The separators or insulators are made of Pyrex or they are sometimes made of wooden dowels.

An antenna such as this one should work perfectly with any transmitter whether it be a simple oscillator, a master oscillator power amplifier or a crystal-controlled, temperature-regulated transmitter such as was published in the October 20th issue.

Previous articles in this series by Russell De Jonge were:

October 20th: "An Up-to-Date Transmitter."

October 27th: "A Ham Speech Amplifier."

Literature Wanted

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

Budd D. Stine, York, Penna.
J. F. Baron, 2706 Maple, Detroit, Mich.
Lawrence Pickerell, 608 G. Ave., W., Oskaloosa, Iowa.
Frank Dougherty, 3327 DeSota Ave., Cleveland Heights, Ohio
E. B. Larsen, 85 Colvin St., Battle Creek, Mich.
Wm. E. Nye, 150 Albert St., Ottawa, Can.
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Margaret Harris, Blue Springs, Mo.
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Eugene Klempt, 5231 McKean Ave., Germantown, Philadelphia, Pa.
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Paul A. Mettin, 1720 W. 5th St., No. Platte, Nebr.
H. W. Meuser, Pigeon, Mich.

Slick Capacity Measurement

Coil of 25.33 Millihenries or 253.3 Microhenries Used

By Raymond L. Butterworth

AS the factor 25,330, or 253.3, appears in a formula relating inductance, capacity and frequency, the decimal point being selected on the basis of the order of the other quantities, it is possible to obtain the capacity value by a simple calculation, if the inductance is given such series value. It is of course practical to have a honeycomb coil of an inductance of 25.33 millihenries, which is the same as 25,330 microhenries. Suppose that we use the value in microhenries, with the unknown capacity C being in mmfd., and the frequency being in kilocycles.

The formula is:

$$C = \frac{1}{F^2}$$

where C is the unknown in micro-microfarads and F is in kilocycles. One example will suffice. Suppose that the frequency generated, or frequency to which the tuned system is responsive as an acceptance circuit, is 50 kc. What is the capacity of the condenser used across the 25,330-microhenry coil? The square of the frequency is 2,500, and 2,500 goes into 1 just 0.0004 times. So 0.0004 mfd. is the unknown capacity.

Ascertaining the Inductance

This is very simple because a squared term is introduced. There is no need to find a square root, which to some might mean an arduous long-hand task. But there is one rub. How can one obtain the inductance? One way would be to buy a honeycomb coil of 30 millihenries (30,000 microhenries) inductance. Some radio stores have them. Then borrow a calibrated condenser, put it across the coil, and set the condenser at 400 mmfd. Get a generator that will emit 50 kc. The frequency of the generator can be checked by beating an harmonic of the generator with any station that is on a multiple of 50 kc., listening to the beat in a receiver. For instance, 600, 650, 700, 750 kc etc. The generator, by zero beating, for the while can be as accurate as the station in its own frequency of emission.

Now loosely couple the tuned circuit consisting of the honeycomb and the 400 mmfd. and put a current meter in series with the generator plate circuit. Take turns off the honeycomb coil, until a noticeable change in the meter reading begins to appear. At some inductance value the generator will stop oscillating, because of the absorption by the trap circuit. Then the inductance may be accepted as correct, that is, 25,330 microhenries.

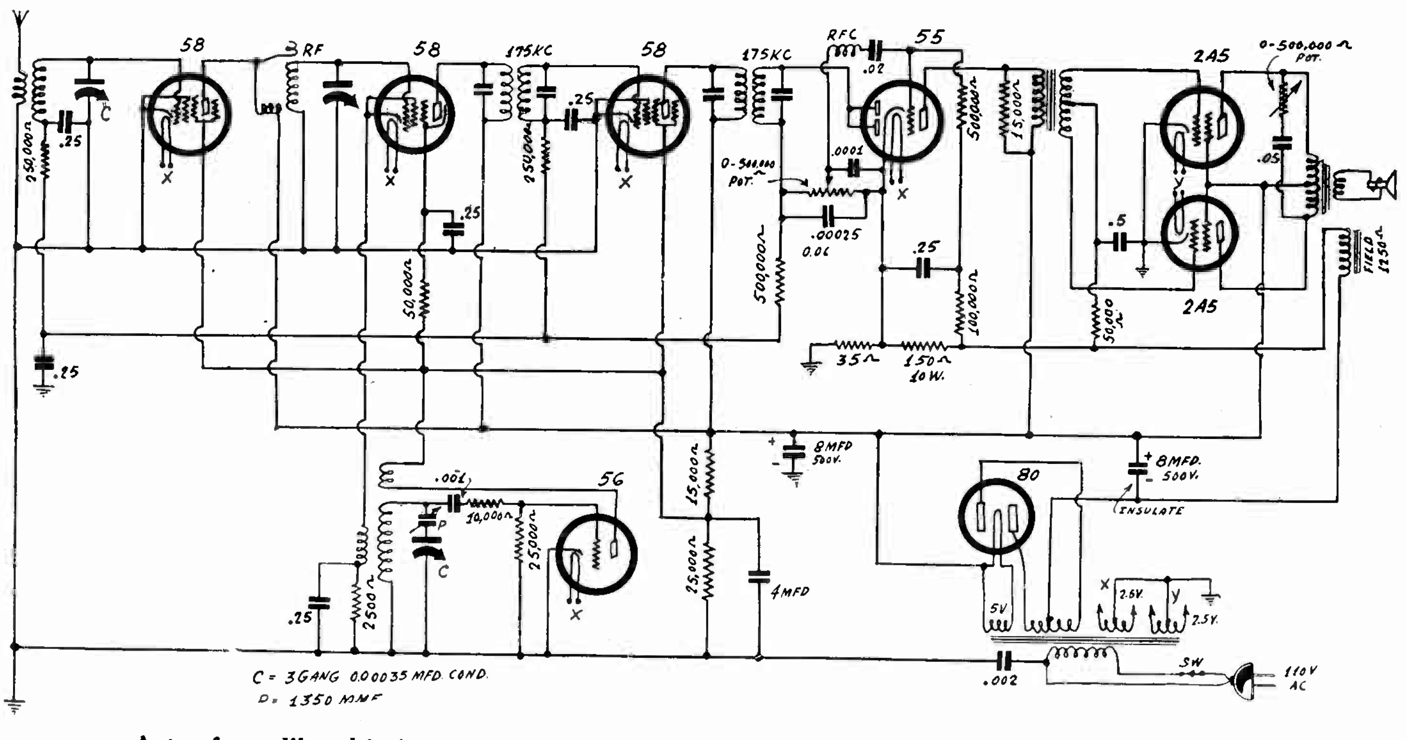
If you do not care to go to that trouble you may purchase a commercial coil of known inductance. 25,330 microhenries, or, for broadcast-band testing, using fundamentals, 253.3 microhenries. It must be said, however, that the low-frequency coil will be preferable, because it is serviceable on the broadcast band, too, as a test circuit with the generator, for the trap will stop the generation of harmonics as well as the generation of the fundamental. This follows because the whole outfit stops oscillating.

Safeguards Taken

The method of coupling may consist of loosely wrapping a few turns of wire around the test coil, and also connecting an extreme of this wire to a critical point of the generator. A turn or two around a wire going to grid of the generator will provide adequate coupling. Detuning effect on the generator is offset by the zero-beating check method. The capacity introduced into the test circuit by the wire used for coupling need not be considered, as the capacity for testing is 400 mmfd., and the other is small compared to it, so the inductance can be fairly accurately established. When the known inductance is to be used with unknown capacities, various frequencies of generation will be used, from a signal generator. There is need for the modulation, if audible results in a set are to be used. The generator has to be frequency-calibrated. Depending on generator frequencies alone for the range, the unknown capacities may be determined without limit in the direction of large capacities. Since the coil itself has a very low capacity, perhaps a few micro-microfarads, low unknown capacities may be measured, down to, say, 20 mmfd. or so. The generator, to enable measurements of unknown capacities in the manner described, will be of perfect assistance for values of unknown C from 20 to 400 mmfd., with the high-inductance honeycomb coil, if the generator frequencies go from 50 to 200 kc on fundamentals.

While the generator's harmonics may be used for the next lower order inductance, 253.3 microhenries, to trap out those harmonics from the receiver when the trap circuit is loosely coupled to antenna input post of the set, the frequencies of the trap are in the broadcast band, in general. The same 400 mmfd. capacity of the calibrated condenser could be used, and since the inductance has been decreased to one one-hundreth of its former value, the frequency will be increased to ten times its former value. So the frequency resulting from the correct inductance, with 400 mmfd. across it, will be 50 x 100 or 500 kc.

The various frequencies for both inductances may be obtained also from a frequency-wavelength-capacity chart, such as the large one supplied with the coil book, "The Inductance Authority," comprising mainly a series of charts for determining numbers of turns on solenoids for achieving any inductance without resort to any computation.

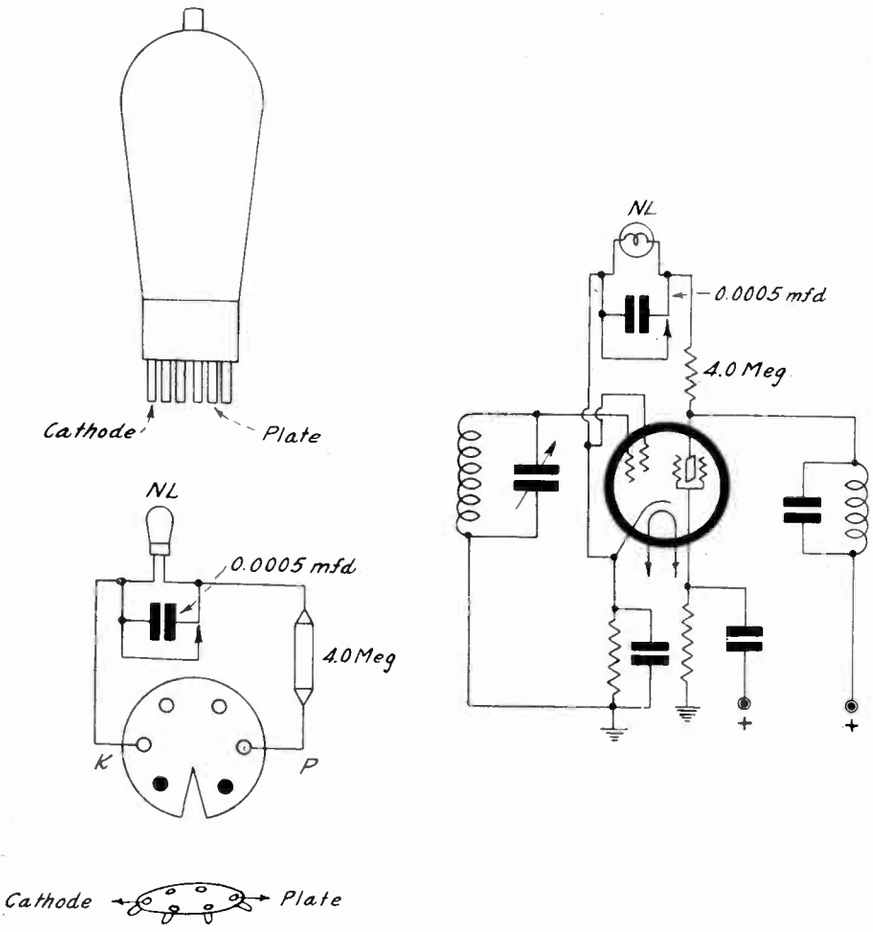


A t-r-f set like this is more satisfactory than a super for the capacity measurements.

Here Comes the Station Siren

Lures In the Short-Wave Program by Local Signalling

By Harvey Sampson



Removing a tube from a socket, placing a wafer between tube and socket, bringing out the plate cathode leads from the wafer, enables insertion of a neon audio oscillator network for service as a "station siren." The case of the six-pin tube is cited.

THE tremendous interest in short-wave reception, coupled with the difficulty of tuning in such stations, compared to broadcasting stations in the standard band, has led to a demand for types of equipment that facilitate finding stations.

For instance, it is all too easy to pass over a station, and yet that same station, if tuned in carefully and accurately, would come in at least like half a ton of bricks, not to exaggerate.

Any Stations Ever?

Well, to help out the users there have been various vernier devices, the most popular being a dual-ratio type, which may work at a reduction of 6 to 1 and, when a shaft is pushed in or out, works at a reduction ratio of around 40 or 50 to 1 or even more. So the user, who knows that he is subject to the nervous habit of rapidly turning the dial, is simply deprived of that fruitless joy. He has to turn the condenser rotor plates slowly even if he turns the tuning knob rapidly. That helps him to find stations.

But it seems that the final solution, if ever there is to be a final solution, will not be found in the dual-ratio mechanism. That helps, of course, but it does not create a certainty. Besides being nervous of fingers, the user is nervous of ear. He can fail to hear or appreciate an ordinary warning of a station is tuned in, just as well as he can move a pointer around so rapidly that he is made to wonder if there are really any short-wave stations ever on the air.

So the beat frequency oscillator came into sets. This consists of generator of a frequency slightly different from the intermediate frequency, and whatever the difference frequency, that is the frequency of the note heard when a carrier is tuned in. The operation is as follows: With the beat frequency oscillator turned on, any carrier worth mentioning will have its frequency lowered in the usual manner in the superheterodyne, to the intermediate frequency. Then, as the i-f beat oscillator is going, and coupled somewhere to the i-f circuit, this new carrier at the intermediate level encounters a frequency that is mixed with it, to create a new additional frequency, which is made audible in the second detector, and amplified along with whatever modulation may be on the carrier due to what the station put on in the way of a program. But even if this station sent out only a carrier, there would be a beat, and therefore the fact that a station is there would be recognized.

Use for C-W Works

Of course, the principal reason for the beat oscillator was for the reception of unmodulated carrier telephony, the type of continuous-wave sending that is interrupted at definite intervals, the interruptions caused by the keying. When the beat oscillator is going, this type of c. w. can be heard, and the audio frequency of the note is equal in frequency to the difference between the beat oscillator and the intermediate frequency. Hence, the tone may be changed to suit one's purpose, by slight tuning. This is the way the audibility in produced. But those not interested in such c-w reception, because they can not read code, will use the beat oscillator for station-finding. The frequency of the station is not determined that way, only the fact that there is a station, and so one is put on his guard.

Instead of a beat oscillator of this type, it is practical to set an audio-frequency oscillator going, and to couple it to one of the radio-frequency or intermediate-frequency tubes. Then when there is no carrier being received the audio tone will be heard slightly, although when a carrier is "crossed," as the saying is, the sound will be much, much louder. Since the tone finally becomes interference, when one has the station tuned in and is ready to hear the program, it is necessary to switch off the audio oscillation, just as it was necessary to switch off the beat oscillator when the station-finding purpose of the beat was fulfilled.

Simple Accomplishment

The audio tone may be produced in a simple manner by using a neon tube. As is well known, the neon tube has a negative resistance characteristic. That means that the current decreases as the applied voltage increases. It also means that the condition for oscillation is present, as negative resistance and oscillation go hand in hand. However, the condition for oscillation at a particular frequency has to be created. This is easily done by using a high resistance, 4 meg. up, and putting a condenser of 0.0005 mfd. or higher either across this limiting resistor or across the lamp. If the condenser is across the resistor the resultant sound will be louder, but an originally loud sound would not be wanted in a sensitive receiver, so putting the condenser across the lamp usually suffices.

The neon lamp meant need not by a large one at all, in fact, the smallest type made, about half the width of the nail on your little finger, and scarcely much longer than that nail, serves the purpose excellently. The lamp should be of the type without limiting resistor built in, for if the resistor is built

in it deprives one of access to one side of the lamp proper. This is not to say that oscillation may not be produced even if the resistor is built in, but there is less trouble getting audio oscillation if the resistor is not built in.

Voltage for Neon Lamp

Now, the tube must have a limiting resistor of no less than 100,000 ohms to safeguard it from being called upon to pass excessive current. Therefore do not put an unprotected lamp across the "raw" intended voltage, say, 100 volts or so. The lamp, whatever the limiting resistor within reason, will strike at a bit above 60 volts, but it is well to use 100 volts or more. Therefore it becomes convenient indeed to obtain the voltage from the receiver.

In sets using the 58 series tubes the screen voltage is around 100 volts usually, at least that is the recommended voltage on the screen for a plate voltage of 250 volts. So between cathode and screen there is a suitable voltage. However, the screen is bypassed, and the capacity of the bypass condenser, especially with that condenser across a high resistance as normally found in series with the screen circuit, is sufficient to detour the very tone created by the neon lamp and associated network. So the screen circuit does not prove so promising.

The plate circuit is more acceptable. It is true that the voltage is more than twice as high as the screen voltage, but we need not worry about that, because the limiting resistor is a great deal more than twice as high as that which would be necessary for a 100-volt supply. We are using megohms so can stand the extra voltage.

Does Not Change Set

Now we have the plate as one access point. The cathode may be the other. It is conceivable also that the connection could be made between screen proper and plate. The voltage difference then would be nearer standard, about 150 volts.

Taking the 58 tube, or the 78, 6C6, 6D6 and other six-pin tubes, we find that we can buy or make an adapter, often appearing as a circular insulating wafer, with holes in it to pass the tube-base pins, and having connectors for any selected elements. We may select the type that has connectors for the plate and cathode.

Now, if we remove the tube from the socket, we know that the plate and cathode pins are at bottom, in positions corresponding to the two marked on the socket in the diagram under the tube. If our connecting wafer has conductive paths leading from K and P, representing cathode and plate, and of course it has two insulated outleads for this purpose, we may connect the lamp and limiting resistor as a series circuit in itself, the total in paralled with plate and cathode, without changing the sensitivity, selectivity or the voltages of the receiver. The current through the neon lamp is negligible, a few microamperes, and the resistance across the plate circuit due to what we have done is so large, a medium order of megohms, that there is no shunting effect to reduce the impedance of the load on the plate circuit. Nor is the cathode or bias voltage changed, because of the microscopic current through the lamp-resistor circuit.

Check for Audio Tone

Therefore we are in a position to restore the tube to its socket. The wafer is thin, and will not raise the tube so high that there will be any trouble due to control grid cap touching the tube shield, or failure of the wire at the end of which the connecting grid clip is connected, to reach its intended destination.

So all we have to do is to check up on whether there is audio oscillation. If there is, we hear it, because we have in effect a Heising system of modulation. The amplifier tube—the one in the set—will act as a modulating device, even though it is not hooked up as a detector. The modulation efficiency may not be high, but it need not be high. The total signal is going to be subjected to tremendous radio-frequency amplification, and then quite some audio-frequency amplification, so we really don't want to put much in or get much out at the start.

The connection is assumed to be made to the first radio-frequency amplifier. If the receiver is a t-r-f set of course this is the connection to use. If the set is a superheterodyne, it must have an r-f tube if an r-f tube is to be used for the present purpose. Practically all modern supers of the better grade have such an r-f stage, some have two such stages. But for a super that lacks an r-f stage, the connection may be made at the first i-f tube instead. Still the condenser may be left across the lamp for audio tone, although, as stated, if for any reason you want a louder result, put the condenser across the high resistance instead.

Mechanical Connections

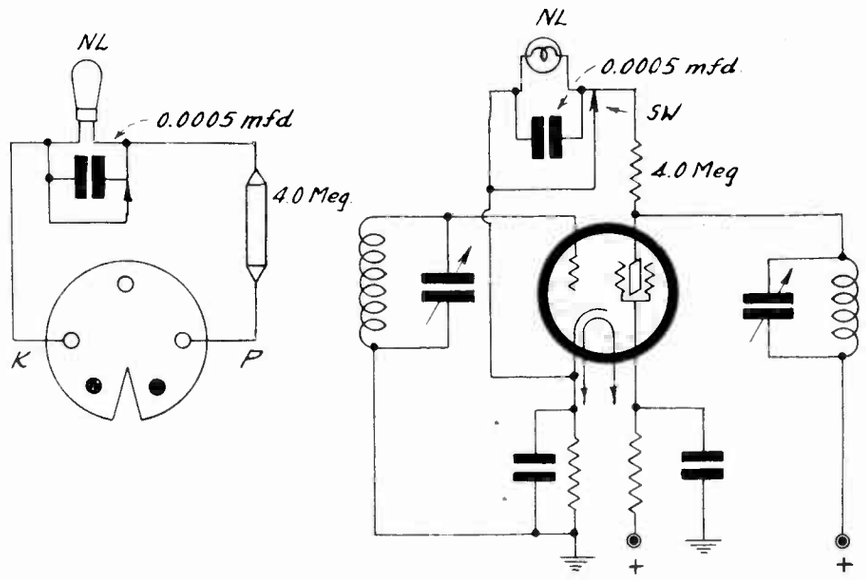
The switch may be on the front panel, or may be simply at the end of a twisted pair, as the condenser is large enough for r-f bypassing. If there is any trouble from body capacity the condenser may be made larger —much larger than 0.0005 mfd.—but the resistance then would have to be proportionately lower.

The first diagram shows the tube at top, out of socket, then the intervening wafer with the audio oscillator connected, and below is the socket from which the tube has been removed. The wafer comes between the tube and the socket in the final result, as suggested in the drawing.

The foregoing discussion of connections has to do with tubes of the six-pin base type. Quite a few receivers still too good to discard have tubes with five-pin bases, using the 35 and 51 tubes for instance. The only difference for the present purpose lies in the wafer. It still has plate and cathode leads made conductive, but there are five holes instead of six, and everything else remains the same.

To the right of these representations are shown the circuits in usual wiring form, including that part of the receiver circuit applying to the tube in question, as well as the extra network to be introduced for audio-frequency single audio tone.

Device for Five-Prong Socket



The same principle of a neon-tube audio oscillator, used for station-siren purposes, applied to a tube having a five-pin base. The control grids in both instances are brought out at top of the tubes. The same system, different wafer, may be applied to four-pin tubes.

How Come It Works?

The method just presented is a very simple one, and of course is inexpensive. It represents nothing new to radio, except the application to the purpose of denoting that a carrier has been tuned in, even though one does not hear the program. Why does one hear the tone and not the program? Because the receiver may not be nicely tuned to the station, or the station may be so weak that it is hard or impossible to hear the moduation that the station offers to an awaiting world. But the carrier can be caught and amplified greatly in the receiver, and anything in the way of a strong audio tone modulating that carrier, or its lower-frequency counterpart at the i-f level, will be heard more loudly than when no carrier was tuned in, because to this carrier or its successor we have added more voltage—our audio oscillation. It is easy to tune in carriers, tune them in without enough strength to bring out the modulation, but we are at an advantage when we are aided in spotting the carrier, for then we can work our bag of tricks to try to bring out the program, and it will surprise many of the newcomers to the ranks of short-wave listeners how successfully the reception of the station can be developed by scientific use of a receiver.

The method is more assisting even than a tuning needle, because more sensitive, hence in performance transcends even the "shadow" devices found on numerous sets. And since it is an audio device to warn one—this time of pleasure that awaits and not of danger ahead— it is called a "station siren."

WHEN TUBE CAPACITY COUNTS

Tubes have different input and output capacities, particularly important to remember for short-wave work. The suppressor type tubes have smaller capacities than the types that permit of secondary emission. For instance, the capacities are small in the 34, 58, 78, 2A7, 6A7, 6C6 and 6D6.

Cathode-Ray Peaking

New "Visual" Not Marred by Extraneous Light

C_1 = Main Tuning Condenser
C_2 = Frequency-Sweep Condenser
C_3, C_4, C_5, C_6 = Frequency-Range Condensers
C_7 = 0.5 mfd.
C_8 = .0001 mfd.
C_9 = .0002 mfd.
C_{10} = 0.1 mfd.
C_{11} = 1.0 mfd.
C_{12} = 2.0 mfd.
C_{13} = 4.0 mfd.
C_{14} = 8.0 mfd.
C_{15} = 16.0 mfd.
R_1 = 50 ohms
R_2 = 300 ohms
R_3 = 1,000 ohms
R_4 = 5,000 ohms
R_5 = 10,000 ohms
R_6 = 11,000 ohms
R_7 = 14,000 ohms
R_8 = 15,000 ohms
R_9 = 25,000 ohms
R_{10} = 50,000 ohms
R_{11} = 100,000 ohms
R_{12} = 120,000 ohms
R_{13} = 200,000 ohms
R_{14} = 300,000 ohms
R_{15} = 500,000 ohms
R_{16} = 1 megohm
R_{17} = 5 megohms
L_4 = 40 henries
M = Motor, 1/20 h.p.—1800 r.p.m.
S_1 = Power-Supply Switch
S_2 = Frequency-Range Switch
S_3 = Test-Signal-Range Switch
P_1 = 50,000 ohms, Brilliance-Control Potentiometer
P_2 = 200,000 ohms, Focussing-Control Potentiometer
P_3 = 50,000 ohms, Time-Sweep-Control Potentiometer
P_4 = 200,000 ohms, Centering-Control Potentiometer
P_5 = 400 ohms, Test-Signal-Control Potentiometer

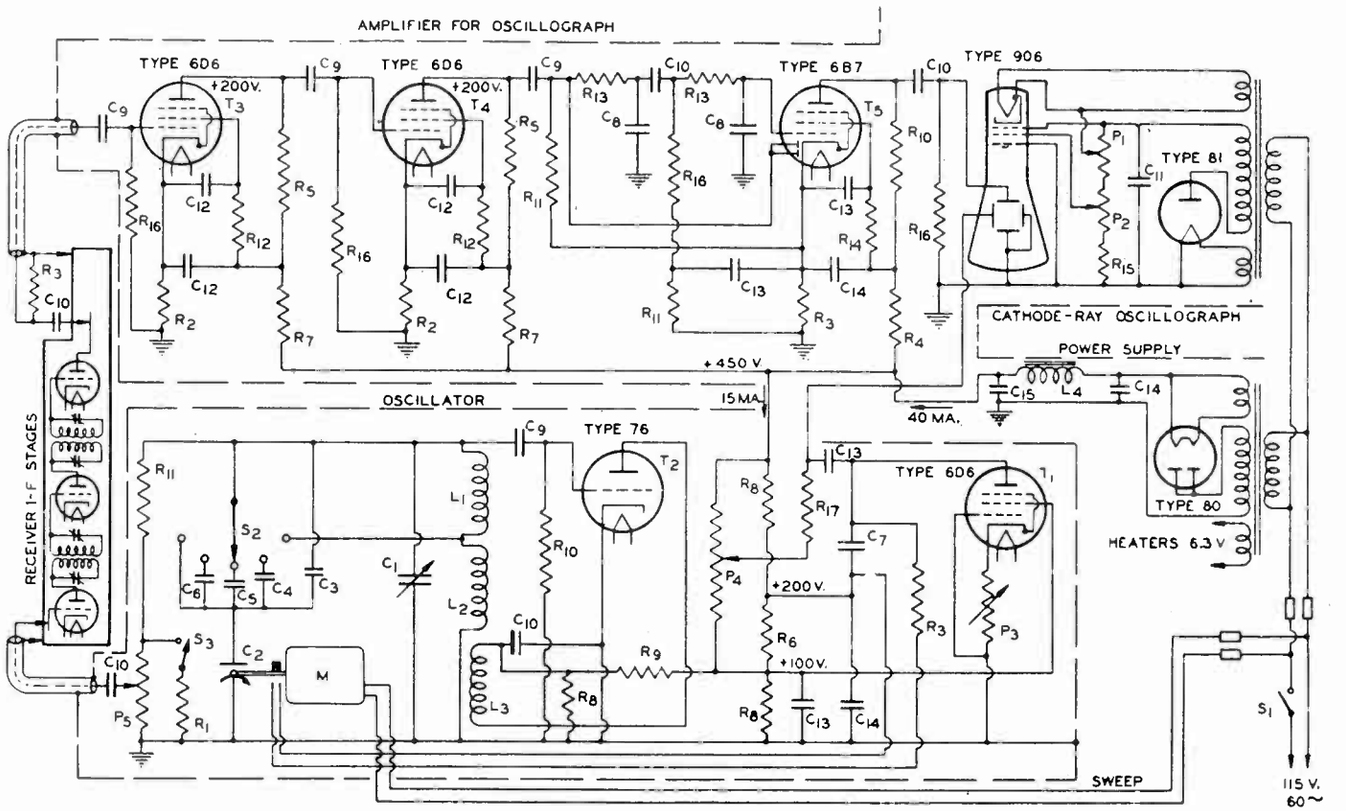


FIG. 1
Curve-tracing circuit using cathode-ray oscillograph tube.

"VISUALS," or curve-tracing devices for showing the resonance curves of the intermediate- or radio-frequency stages of broadcast receivers, have been in use for some time. Some manufacturers have installed enough "Visuals" to align their entire production. Others have installed one or more for aligning part of the production and for checking the work of aligners equipped with meter indicators.

The "Visual" is particularly useful where coupling is such that a double-peaked resonance curve is obtained, since the depth of the valley between the peaks is difficult to determine unless a plot of the curve can be examined. Such a plot is, of course, constantly before the "Visual" aligner so that the effect of coupling or tuning adjustments can be observed during the adjusting process. However, the cost of these curve-tracing devices has in many instances made their use impracticable and has made it necessary to resort to slower methods of checking the design and production of the intermediates. In contrast to high-priced apparatus employing the string galvanometer cathode-ray apparatus is comparatively inexpensive and will give better results.

Advantages Stated

Some of the advantages of a cathode-ray "Visual" over the string-galvanometer type are:

1. The trace is more brilliant and does not require an awkward hood for observations in daylight.
2. Overload does not damage the apparatus but merely causes the beam to deflect off the screen.
2. The apparatus can be made portable.
4. The cost of the apparatus is low.

A resonance curve tracer employing the type 906 cathode-ray tube has been set up and operated in the laboratory of the RCA Radiotron Co. This device is designed to cover a range of intermediate frequencies of 100 kc to 500 kc and has an amplifier-detector section which is practically flat over the entire range. Since it is believed that a "Visual" of this type will be of distinct value to many laboratories as well as to manufacturers and service men who desire to improve their testing facilities, a detailed description of the instrument is given. Fig. 1 is the schematic circuit diagram while Fig. 2 shows the functional layout and a suggested arrangement for a portable resonance curve tracer. It should be borne in mind that the principles and methods involved in this application can be applied to obtain the curves of any form of tuned circuit and that the frequency range is not limited to the 100-500 kc of the apparatus illustrated.

A resonance curve is a plot of the voltage output of a tuned stage for a given frequency band. To obtain this curve, it is necessary to have a voltage source, which in this instance is the oscillator T_2 of Fig. 1, and to have a source of variable frequency covering a range which extends above and below the resonant frequency. The frequency variation to sweep across the fre-

quency range of the tuned circuit can be accomplished manually by hand manipulation of a condenser or it can be speeded up to thirty times a second as is done in this case by means of an 1800 RPM motor. The fluctuating output voltage of the stage is then amplified, rectified, and again amplified, and finally applied to one set of the deflecting plates of a cathode-ray tube. The other set of deflecting plates is supplied with the sweep-frequency voltage.

Motor for Sweeping

The frequency sweep is produced by a motor of about 1/20 hp or more, driving a rotating condenser C_2 of maximum capacitance of 0.00035 mfd. A range switch S_2 connects different values of capacitance C_3, C_4, C_5, etc., in series with C_2 to adjust the sweep for different frequency ranges. The oscillator is tuned by adjusting C_1.

A contactor on the motor shaft controls the linear-sweep voltage by periodically short-circuiting condenser C_7. Condenser C_7 charges linearly with time during the half revolution that condenser C_2 sweeps the frequency. During the remaining half revolution, condenser C_7 is short-circuited and C_2 returns to the initial position.

The rheostat P_3 in the cathode circuit of Tube T_1 controls the rate of charge of condenser C_7. When P_3 is properly adjusted, the contactor on the motor causes the voltage of condenser C_7 to return to zero somewhat before the condenser becomes fully charged. When P_3 is adjusted for too slow a charging rate, the sweep, as viewed on the screen of the cathode-ray tube, returns to zero before the full width of the screen has been traversed. On the other hand, if P_3 is adjusted so that the charging rate is too high, the sweep terminates with the condenser fully charged before the contactor has returned it to zero. Considerable distortion of the resonance curve traced on the screen results from this latter adjustment due to non-linearity at the end of the sweep.

Centering Potentiometer

The proper adjustment of P_3 causes a full sweep across the screen without any bright spot occurring at the end of the sweep. The appearance of a bright spot is due to the beam remaining in one position for a greater length of time than in other positions. A bright spot should appear at the beginning of the sweep since the beam remains there for one-half of the cycle. At the end of the sweep, no spot should appear when P_3 is properly adjusted.

The centering of the pattern on the screen is accomplished by adjusting the knob of potentiometer P_4.

The frequency-range switch S_2 and the tuning condenser C_1 should be adjusted so that the resonance characteristic appears in the center of the sweep on the screen. As condenser C_1 is varied, the resonance characteristic is shifted along the sweep axis. The best value of C_1 is that which centers the resonance curve on the sweep range.

The input to the grid of the i-f stage to be tested is connected to the contact terminal of potentiometer P_5. The test signal can be adjusted by means of P_5 to give a suitable height of resonance curve. The range switch S_3 reduces the signal when an overall test of two or more i-f stages is made.

Blocking Condenser Used

When intermediates are to be aligned, the output voltage from the plate of the tube following the i-f stage is connected through a blocking condenser in series with a low resistance, approximately 1,000 ohms, to the amplifier circuit as shown in Fig. 2. When the tube following the i-f stage is a diode detector, the resistance can be eliminated. In this case, the input lead is connected to the high-potential end of the diode load resistance. Sufficient i-f voltage is generally present across the by-pass condenser of the diode load resistor to give a deflection on the cathode-ray tube. Since the diode load is by-passed, there is no capacity effect from the connecting leads and the resonance adjustment does not change with their removal. The resonance curve obtained on the screen of the cathode-ray tube represents audio frequency and, hence, appears not as a modulation envelope but as a single-line curve above the zero axis.

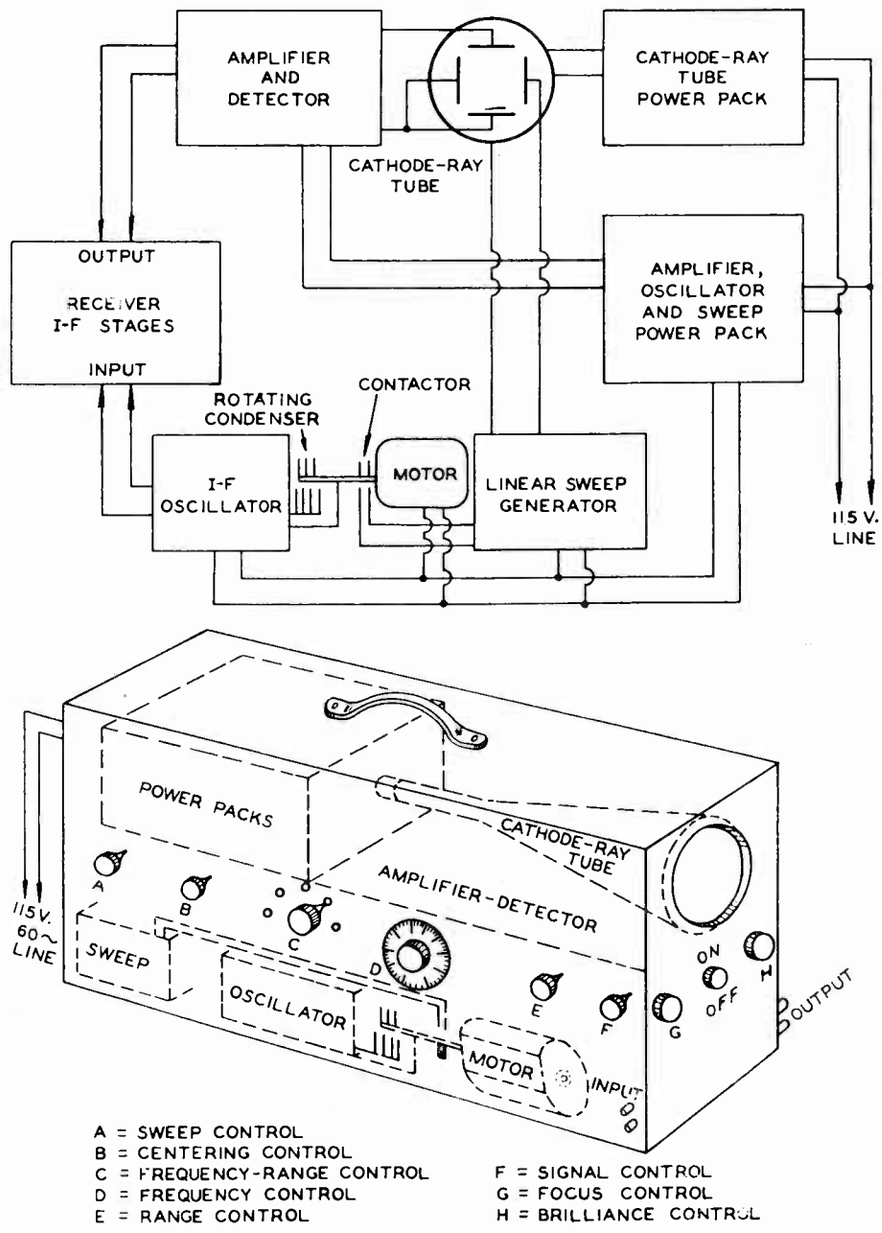


FIG. 2

Layout of parts and other physical formations.

Low Minimum Condensers

The constants of the oscillator circuit will depend somewhat upon the arrangement of the wiring, distributed capacitance, etc. In order to realize the full operating range of frequencies from 100 kc to 500 kc it is important to have tuning condensers with low minimum capacitances, and to keep wiring capacitances at a minimum. The exact values for the constants of the oscillator circuit are best determined by actual test after the apparatus is in operation. Suggested values for these constants are as follows:

C_1 = 150 mmfd. maximum
C_2 = 350 mmfd. maximum (Ball-bearing type)
C_3 = 0.00005 mmfd.
C_4 = 0.00005 mmfd.
C_5 = 0.0001 mmfd.
C_6 = 0.00035 mmfd.
L_1 = 2.0 millihenries
L_2 = 2.0 millihenries
L_3 = 5.0 millihenries

The inductances are closely coupled.

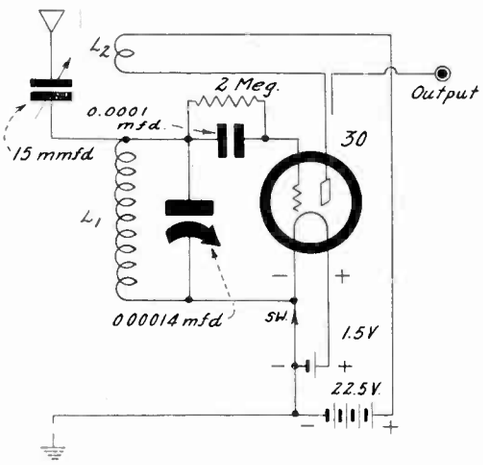
Desirable characteristics for the oscillator are uniform voltage output, especially throughout the sweep range, and frequency change proportional to the angular rotation of the frequency-sweep condenser C_2. This condenser should preferably be one of the straight-line-frequency type, although an ordinary semi-circular plate condenser is easier to balance mechanically in order to avoid vibration. The latter, however, is satisfactory for the usual alignment purposes; that is, with it no distortion of the resonance curve is noticeable to the eye, although it could not be depended upon for precise measurements.

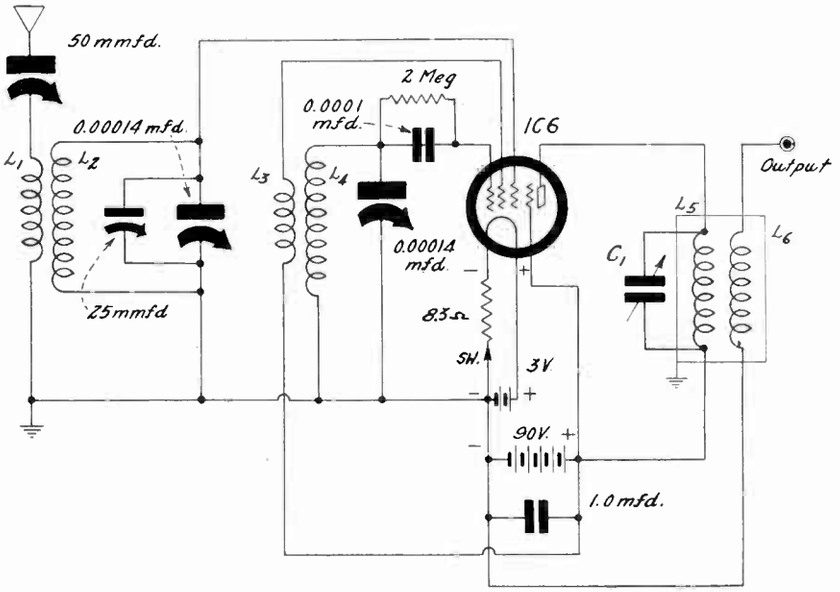
Care should be taken to select a variable condenser that is rugged in construction and revolves on ball bearings. Contact with the rotor can be made by means of a brush or other smooth-riding pressure contact on the condenser shaft. The short-circuiting contactor is a standard automotive ignition breaker. It is operated by a cam on the motor shaft. A bakelite drum having a metal insert in its periphery can be used as a shorting device.

Hearing Images Wane

Test of Effect of One Pre-Selection Stage

By Jack Tully





The simple circuit shown above serves as a short-wave converter of no consequence. It is well to build this little device, just so that one may appreciate what image interference is.

A tuned stage ahead of the generator is the only known method of tending to suppress images. This is also a battery-operated device and may be accepted as one yielding good results. The output is tuned to the frequency used in the receiver for the second level of amplification. L5L6 therefore may be a broadcast coil used backwards, as it wer, with C1 the usual 0.00035 mfd. tuning condenser.

A RECENT article discussing short-wave converters has led numerous readers to ask for some simple method of appreciating the value of eliminating image interference.

Some report that the circuit we said did produce a lot of that type of interference nevertheless enabled them to receive foreign stations clearly. No doubt that is true. The image interference arises principally when there are two waves to which the receiver is sensitive enough to respond, that are separated in frequency by twice the intermediate frequency.

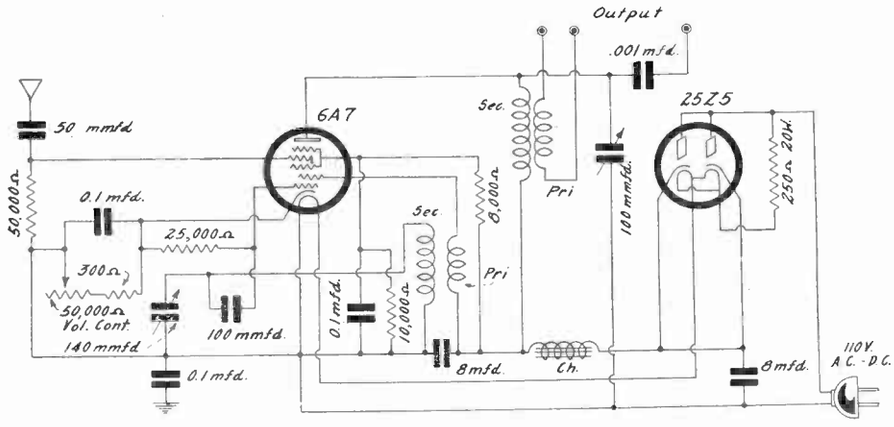
Now, this condition often exists. Also it is true that in some isolated instances it does not exist, that is, for some few frequencies, but it can not be well argued that satisfactory service is obtained generally, when so much of the interference is actually present over so much of the bands covered. The fact that there is no such interference suffered when one is tuned to a particular frequency does not prove there is no such interference if the set were tuned to some other frequency.

Chirps Heard

Probably the best method is to build a one-tube oscillator. Have it cover some selected band. Pick the frequency to which the receiver itself is to be tuned for use as the intermediate amplifier. Then the frequencies of the little outside oscillator should be over a range equal to the sum of the signal-carrier frequencies and the intermediate frequency. Thus, to cover from 3,000 to 6,000 kc the broadcast-set frequency being, let us say, 1,000 kc, the oscillator would have to cover 4,000 to 7,000 kc.

Now tune the short-wave converter, which this oscillator becomes, so that you go from one extreme to the other of the tuning. Do this during a time when reception is good on the band covered. For the band stated that would be nighttime reception. For frequencies above 10 mg in general it would mean daylight reception.

Listen carefully to the audible result. You will hear chirps. These are largely due to image interference. Something is doing on the air not only at the frequency intended to be tuned in, but at a frequency lower than that, lower by 1,000 kc in the stated instance. And both inputs yield response.



In this circuit, as in the first one shown, there is no tuning ahead of the generator, and practically the only substantial difference is that here the frequency of generation is not affected by antenna conditions. In the previous diagrams the series antenna condenser has an effect on tracking. The circuit is for universal operation.

Fewer Whistles

Now, the next thing to do is to add an r-f stage that also is tuned. Of course tracking enters. But if the tuning condensers are separate you can take care of the tracking from the front panel.

Now you will notice as you repeat the previous performance that there will be fewer whistle, chirps, birdies and the like. That means there has been a consderable reduction in image interference, and in fact the t-r-f stage is the only known method of effectuating such reduction.

Some sets or even one converter has two such t-r-f stages, but in general it is desired that the coil system be not too complex, if switching is to be used, hence one r-f stage is almost standard. As for plug-in coils, it would also become troublesome indeed to insert three coils for each band shift.

The second diagram shows the t-r-f stage, also for battery operation, and in addition shows an output coupling transformer, with the plate circuit tuned to the broadcast set's frequency, whatever it is, we having assumed it at 1,000 kc.

It makes no difference if the converter is of the universal type, or battery operated, or a-c operated, the same considerations apply to the need of t-r-f amplification. So in the universal type of converter shown in the third diagram there is no pre-selection, whereas the fourth diagram the rest of the diagrams have it.

I-F Stage Built In

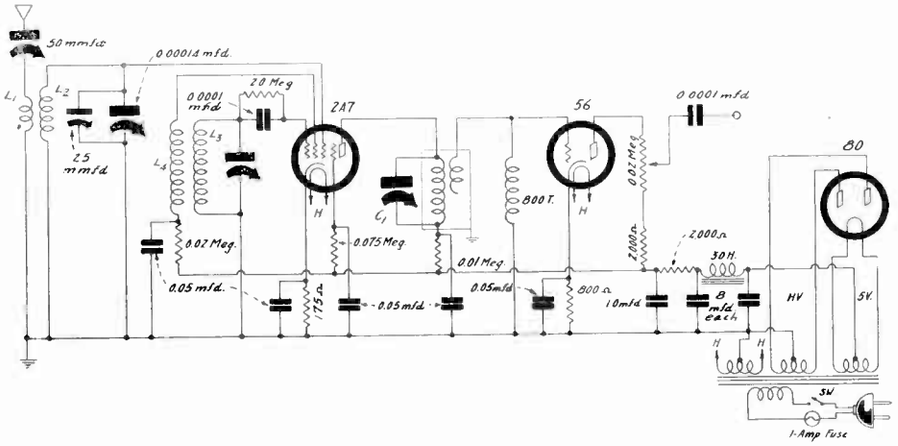
Sometimes an intermediate amplifier stage is included, as in the diagram at top of this page, and that helps some. If i-f stages are to be used, they may be served by a mixer having separate tubes, as in the next to last diagram, the i-f stages being in the direction indicated. Buth whether there is i-f amplification or not, the images are not concerned. Only pre-selection refers to curing them.

The last diagram is an excellent one, having only the possible disadvantage that if the broadcast set is not well stabilized it may be thrown into oscillation by so much gain ahead of it. Therefore for one precaution use a low i-f, say, around 550 to 650 kc. Also, the output wire, connecting to broadcast set, may be shielded wire, if the conductor insdie is ½ inch from the shield, and shield grounded.

Getting Better

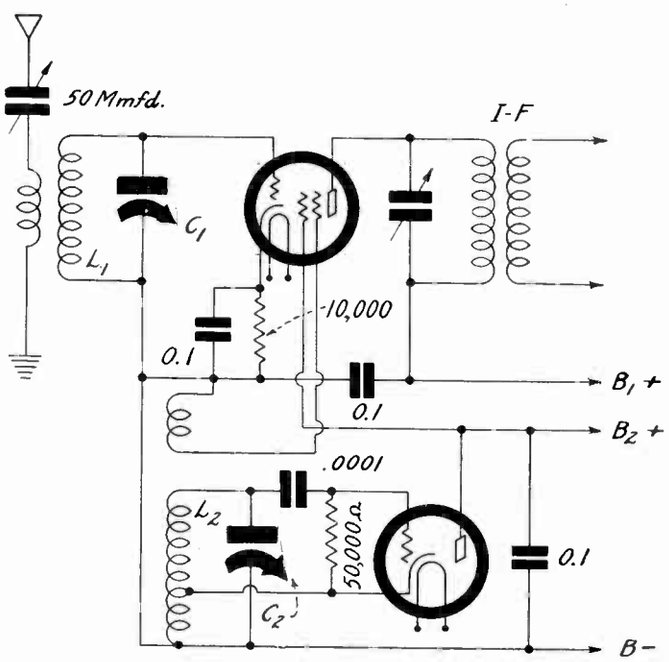
The short-wave converter has not always proved satisfactory, but the designs are improving all the time. The best results are obtained if there is some i-f amplification in the converter. The previous attempts to get fine results, with practically no provision for assuring them, worked out no better than one would have expected. To-day there are few converters on the market, in fact, fewer than the demand would suggest that there ought to be, but that is because not many manufacturers want to run the risk of putting out a converter, since they feel they are making an unknown quantity. It is an unknown quantity in the sense that it has to be worked with a receiver the sensitivity and selectivity of which are unknown, and therefore any shortcomings in the receiver might redound on the manufacturer who is no way to blame.

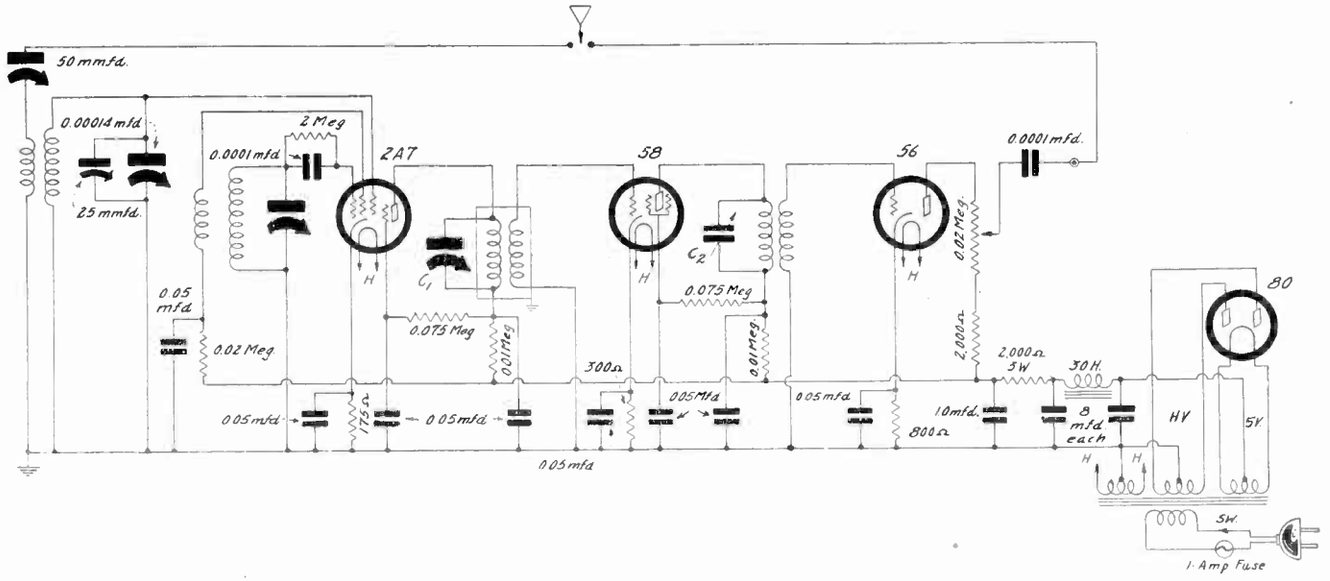
One short-wave converter recently demonstrated to a short-wave club in New York City yielded a performance on a fair broadcast receiver that equalled the performance of a good all-wave receiver.



Here the operation is from a.c. The advisable pre-selection is included. In general, converters do not have more than one t-r-f stag, as the coil system then becomes rather complex.

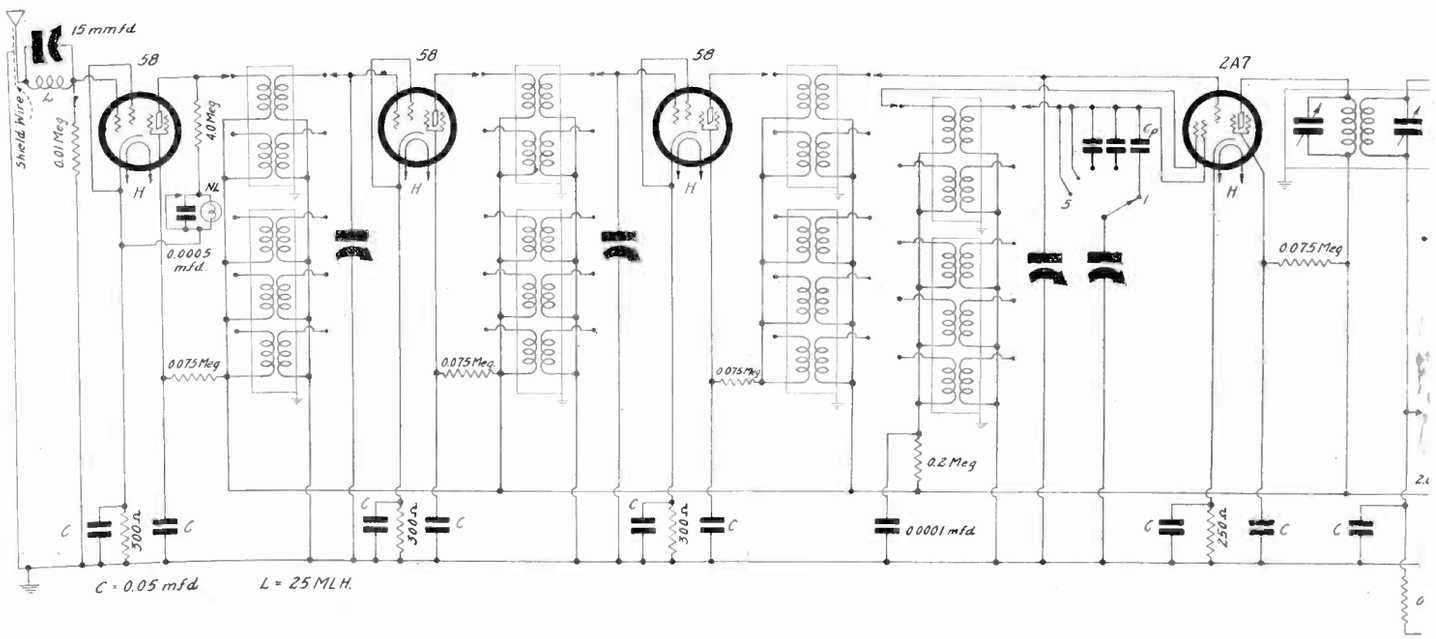
Instead of using the pentagrid converter tube, as in the three previous examples, oscillator and modulator may be in separate envelopes. The lower tube is a Hartley oscillator. It is complete because of the cathode to tap. The winding above the oscillator's tuned coil is a pickup coil for coupling to the tube above, or modulator, which may be a 58, with pickup in suppressor leg.





After some experimenting with converters it is well to build one like this, a real performer, with two stages of low radio-frequency amplification built in.

ALL-WAVE SUPER WITH



A ten-tube all-wave superheterodyne. It ually eliminates the noise, which is a novel has a tone control that increases the volume audio frequencies are attenuated by this co vided. Besides, there is a selectivity control, served, if ir

SOME weeks back we promised that an all-wave superheterodyne would be worked out and the constructional details presented to our readers, and since then, as nothing has been printed, we have received numerous letters asking whether we had forgotten about the promise. No, it was not the promise that was forgotten but the fulfilment thereof that was remembered. And fulfilment means that the circuit has to work perfectly. That it may do so the coils must be just right, as they constitute the major problem. Or, at least, the coils and the padding are the crux of the problem.

Lest there be any further misgivings by our readers, however, we are showing the circuit informatively only, as it has been worked out to date. You can see that the number of tubes has been increased to ten.

Noise Elimination

One of the first considerations was to work out a noise eliminator, because when a receiver is very sensitive, it seems to become more sensitive to noise than to signal, and in a mild measure this is true. If it were true flatly, of course high sensitivity would be a vice. But whenver there is a vestige of noise the speaker will let you know faithfully, and so the control is there. It removes noise, virtually any sort of noise that comes in as radio frequency, and that includes noise resulting from operation of rotating electrical and mechanical devices that laymen can't realize have any relationship to radio frequencies. But the relationship is well appreciated by engineers.

The second novelty, reading from left to right, is the station siren, this being a neon-tube affair, adequately described elsewhere in this issue, so nothing further need be said about it now.

Third, there is a selectivity control. It may be desired to build the circuit as a high-fidelity receiver, and such special treatment would apply to the output circuit. There would be two speakers, the usual dynamic and a "tweeter."

Between the output tubes and the speakers would be two filters, one a low-pass to serve the dynamic, the other a high-pass, to serve the "tweeter," which is a reproducer of high frequencies of the audio realm, generally. The combination of the two, with suitable other provisions, makes for high fidelity, provided the receiver proper permits it, and this one does.

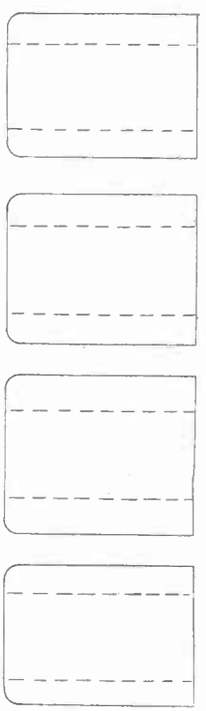
The Tone Control

For high fidelity the selectivity can not be enormous. So there is a selectivity control. Three positions of a switch, connected to a resistance network, make for medium, high and very high selectivity. For DX-hunting the highest selectivity is used. Besides, the sensitivity is then highest, too, within the capabilities of this particular control.

The main sensitivity control is of course the volume control. This is found in the grid circuit of the amplifier portion of the 55.

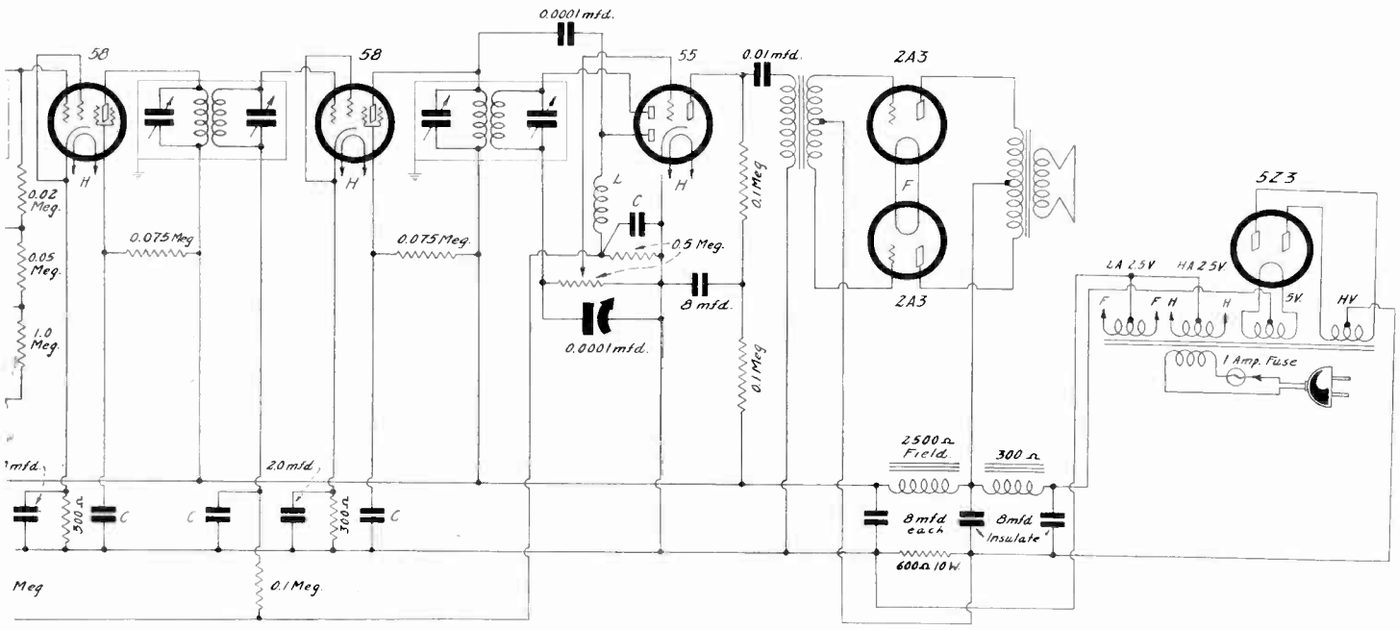
There is a separate rectifier, one of the diodes of the 55, for automatic volume control, so the signal may be completely eliminated for the a-v-c circuit. Across the load resistor of the real signal detector of the 55 is a variable condenser. The capacity across 0.5 meg. need not be high to begin to

Coil and Switch



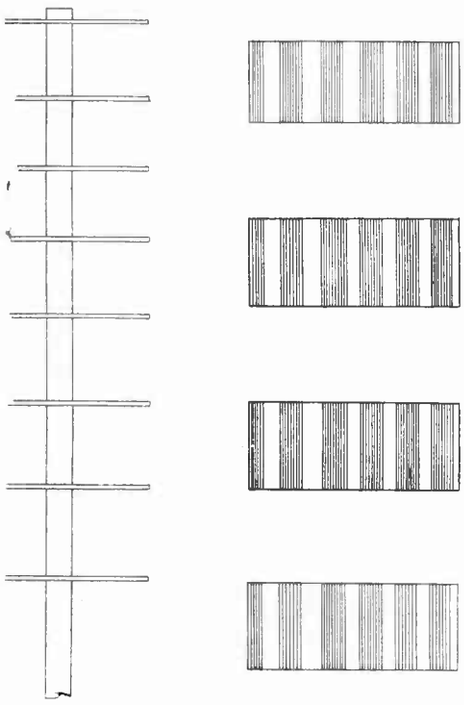
Looking at the chassis from the bottom the compartments at left are the broadcastan other bands are covere

H FOUR NOVEL POINTS



as a noise-eliminating circuit that act-
. Besides the usual volume control it
of reproduction, even though the high
ıtrol. Automatic tone control also is pro-
so high-fidelity reproduction can be pre-
.roduced.

ı Arrangement



coils are arranged this way. In the shield
ł first short-wave band coils. The three
:d by coils at right.

have an attenuating effect on the higher audio frequencies. So as the condenser is turned the "highs" are cut down. This serves as a tone control, also aids in putting a further quietus on noise, if any more of such reduction is wanted, or possible, because these erratic noises result in high acoustical frequencies finally. But instead of the total volume of sound decreasing, as is true with nearly all tone controls, when the highs are attenuated the total volume does not decrease, and in fact increases somewhat. How is that? Well, the increased capacity across the load resistor increases the detecting efficiency, and it was found that a rectified voltage of 22 volts at 20 mmfd. capacity across this resistor was built up to 80 volts when the capacity was 350 mmfd. And yet the "highs" had been attenuated!

Coil Layout

The layout of the coils is as shown. The broadcast and first short-wave band coils work very well indeed. The other coils are subject to experiment, as they do not measure up quite to the required performance, as yet, but will, of course, before the constructional article is published.

The problem associated with the coil system for the higher frequencies hasn't anything to do with mere performance of some sort, but with performance of a high degree and permanent nature. That is, coils put in did work. But it was hard to have their inductances just the same, and even when made just the same, to have the inductance stay put over a period.

It is no secret that the coil problem on short waves is a difficult one. The generally accepted but expensive method of precision manufacture is to have coils wound on threaded forms. That is about the only known way of obtaining exactly the right inductance desired, having the inductance just the same for all coils made, and have the inductance remain the same.

Suggestions Welcome

But it is a problem even to get the spacing just right, provided one does go to the extreme, now obviously necessary for superlative work, of having threaded forms. And of course the dielectric has to be considered. There never can be a dielectric quite good enough for the 10 to 20 mgc band, perhaps, to mention nothing of any higher frequencies. And it is practical to tune the set to 9 meters. At present there isn't much doing in this region, but the day may come when 9 meters may mean something in an all-wave receiver.

A good deal of the circuit is standard. Special precautions against i-f oscillation were taken despite the absence of r-f chokes. The 2 mfd. bypass condensers across the biasing resistors provided the solution. The fewer parts the better, if a good deed can be turned.

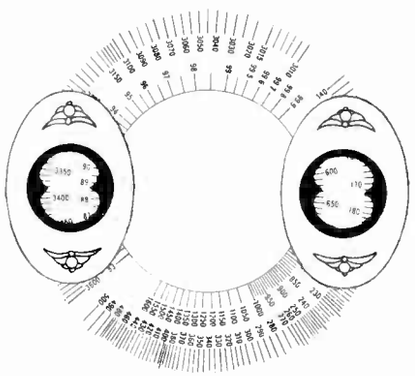
Although the diagram appears large, the chassis is relatively small, though high. Absence of coils from the top partly accounts for this.

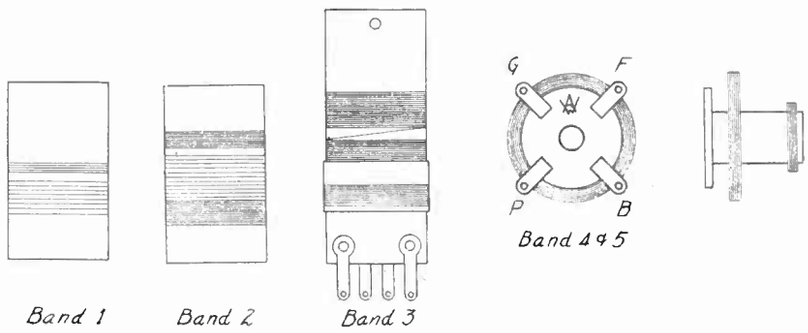
The circuit has been changed mostly for laboratory reasons, but partly for reasons associated with kind suggestions sent in by readers. It may be remembered that we invited suggestions. We still invite them. If you will write in saying what you think should be included, perhaps it will be included, if you write at once. Address All-Wave Editor, RADIO WORLD, 145 West Forty-fifth Street, New York, N. Y.

A Decimal Scale System

Applied to Range Extension of Generator

By Herman Bernard





At left the scale and the two escutcheons are shown. Left-hand escutcheon, left pointer is for 3,010 to 3,600 meters, right pointer for equivalent frequencies, 83 to 99.9 kc, both at switch position 5. Right-hand escutcheon, left pointer is for broadcast band (switch position 3) and for high-frequency band (switch position 5), where scale readings are multiplied by 10. Right pointer is for intermediate frequencies (switch position 4) and for intermediate short waves (1,400 to 5,000 kc), by multiplying scale by 10. The coils are shown next, high to low frequencies. The honeycomb coil is shown in two views.

IT has been found possible to coincide low-frequency scales calibrated on a signal-generator direct-reading dial, with frequencies ten times as high. Thus it is possible to use a calibration for 140 to 500 kc for actual frequencies of 1,400 to 5,000 kc. Also the broadcast calibration of 540 to 1,600 kc may be used for 5,400 to 16,000 kc.

The method has been applied to the 333-A type signal generator previously described in these columns to constitute the 333-AB. The alignment method was described in the October 20th issue, pages 12 and 13. The present note has to do only with two coils, one of which is made independent for the intermediate-short-wave band (1,400 to 5,000 kc), and becomes accurate to about 0.5 per cent., while the other takes care of 5,400 to 16,000 kc.

An Harmonic Case

It can been seen there is a slight missout, between 5,000 and 5,400 kc, but this can be taken care of by frequencies of 2,500 to 2,700 kc, using second harmonics. Otherwise, the generator works exclusively on fundamentals, to 16 mgc.

Now, 16 mgc is just a bit below 20 meters, and if it is desired to measure frequencies higher than 16 mgc this may be done by using the 5,400 to 160,000 kc scale, for harmonics, the same accuracy as applies to the fundamental being communicated to the determinations by harmonics. This method is simple and accurate. It will be repeated at the end of this article. The exposition appeared in a previous issue.

As for the coil system as now presented, there are four different coils, one used for the extremely low-frequency band, 83 to 99.9 kc; with a 0.0008 mfd. condenser across the tuning condenser, and the same coil used for 140 to 500 kc with the 0.0008 mfd. condenser removed; second coil for the broadcast band; third coil for the intermediate short-wave band; fourth coil for the short-wave band.

There are five switch positions, though there are only four coils, because one coil is put to two uses for two bands by inclusion of the parallel fixed condenser.

The illustration shows how the scale is used, with one escutcheon on one side and another on the other side. The extremely low-frequency band also is calibrated in wavelengths, 3,600 to 3,010 meters.

Switch Positions

Therefore the switch positions, and associated use of the system, are as follows:

First switch position: Read wavelengths in meters at left-hand pointer of left-hand escutcheon, and equivalent frequencies of the same band, 83 to 99.9 kc, on right-hand pointer of left-hand escutcheon.

Second switch position: Read frequencies indicated by right-hand pointer of right-hand escutcheon, 140 to 500 kc.

Third switch position: Read frequencies indicated by left-hand pointer of high-hand escutcheon, 540 to 1,600 kc.

Fourth switch position: Read frequencies indicated by right-hand pointer of right-hand escutcheon, but multiply the readings by 10, for 140 to 5,000 kc coverage.

Fifth switch position: Read frequencies indicated by the left-hand pointer of the

Facsimile by Radio Gives Speedy Pictures

A new radio facsimile system which reproduces entire messages, maps and pictures directly on ordinary paper at the rate of a full letter-sized sheet every eight minutes ,was described by Charles J. Young, research engineer of the RCA Victor Company and son of Owen D. Young, to members of the Institute of Radio Engineers, in Houston Hall of the Moore School of Electrical Engineering.

While Mr. Young emphasized that it is premature to attempt to evaluate all of the practical uses to which the new development might be put, he suggested that such a simplified system could be used to flash messages in their entirety, from city to city, exactly as written b the sender, to supplant the present method of sending such messages, letter by letter, in the comparatively laborious Morse code.

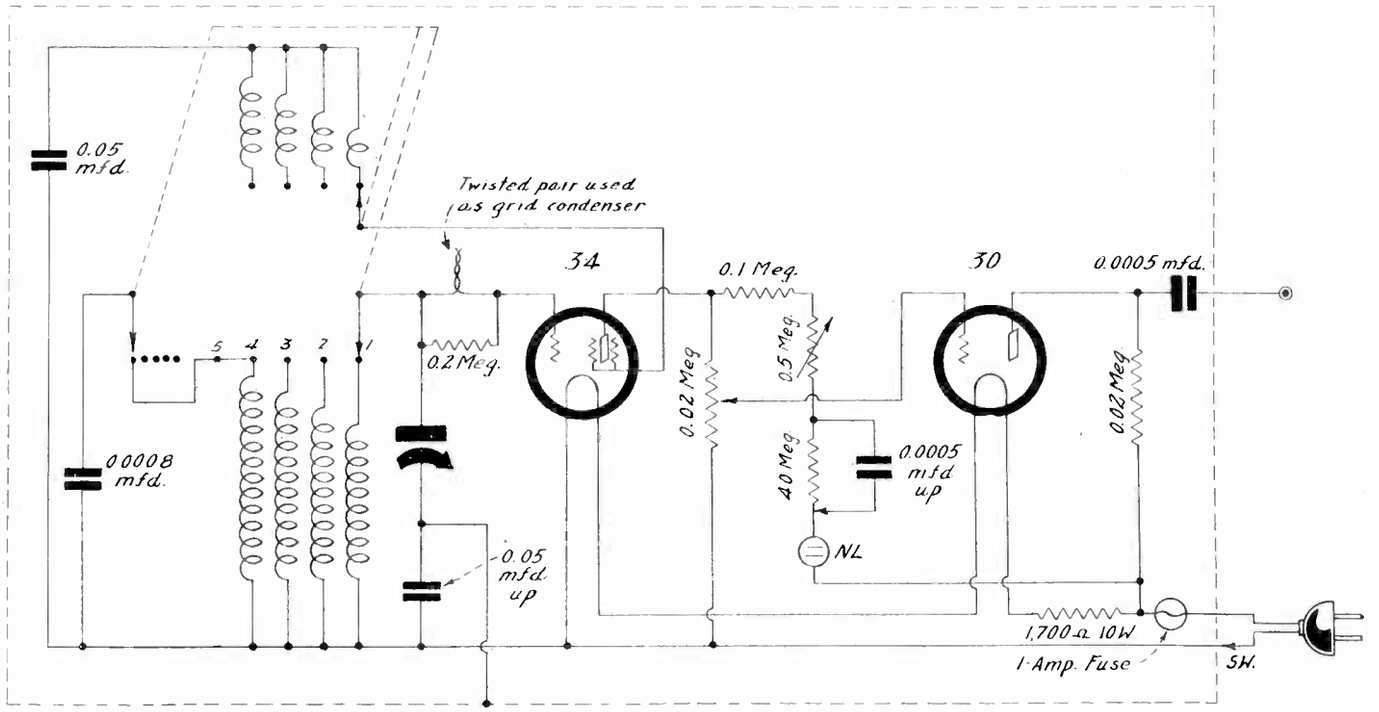
Suggests Police Use

He pointed out that the new facsimile system should prove useful in police and crime detection work. Fingerprints, identifying photographs and other useful information could be exchanged by police departments to aid in the apprehension of criminals. He also described a series of successful experiments conducted between the shore and ships at sea, in which complete weather maps were prepared by observers and sent to the vessels at frequent intervals to aid navigation.

The recorder system developed by Mr. Young in the RCA Victor laboratories dispenses with the cumbersome proceessing, or photo developing, required by other fascimile systems, by utilizing ordinary carbon paper to print directly on ordinar white paper. Continuously feeding reels of both the carbon and the paper are led past a metal cylinder, on which a single spiral of wire projects slightly above the surface.

Exact Reproduction

The fluctuations in the intensity of the incoming signals press the paper and carbon together against this spiral to make marks corresponding to the light and shade of the original at the transmitter. Since the receiver and the transmitter are synchronized, an exact reproduction results. The facsimile recorder described by Mr. Young traverses a standard width letter size page, measuring 8½ by 11 inches, at the rate of 1.2 inches per minute. Thus, a full-sized page filled with single spaced typing is completed in eight minutes, or at the rate of 100 words per minute.



The 333-AB Signal Generator, covering the following on fundamentals: 83 to 99.9 kc; 140 to 500 kc; 540 to 1,600 kc; 1,400 to 5,000 kc; 5,400 to 16,000 kc. This device can be used by an infallible harmonic system for measurements up to ultra frequencies. There is an amplifier stage to provide plenty of kick.

right-hand escutcheon, but multiply readings by 10, for 5,400 to 16,000 kc coverage.

Fundamentals to 16 Mgc.

All of the above are determined on the basis of fundamentals only. To avoid any confusion due to harmonics, even when the intention is to use fundamentals, the safer way when one has no approximate idea of the frequency of the unknown, is to start at the 16 mgc setting, tune through the range to the 5.4 mgc setting, then to the next lower frequency switch position, etc., until a response is strongly heard in the receiver. Then read the unknown.

Harmonic Method

For measurements of frequencies higher than 16 mgc, using the fundamentals of the 5.4 to 16 mgc band for their harmonics, tune the generator to any frequency that yields a response in the receiver, read the frequency, then turn the generator in either direction until one comes to the next consecutive response-creating setting of the generator. Read the second frequency. Subtract the lower from the higher frequency. Divide this difference into one of the read frequencies and the answer is the harmonic order of the *other*. Thus, suppose the readings are numbers 1,000 and 1,200. The scale is multiplied by 10, so the frequencies actually are 10,000 and 12,000 kc, or, in megacycles, 10 and 12. Using megacycles, for simplicity, the difference between 12 and 10 is 2, divided into 10 yields 5, so the unknown is the fifth harmonic (not of 10 but) of the *other*, or 12 mgc, hence 60 mgc is the answer. Check: 2 into 12 yields 6, sixth harmonic of 10 mgc is 60 mgc. In wavelength this would be 5 meters.

MUSIC ROOM EXHIBITION

At Rockefeller Center, New York, a radio music room exhibition opened. Radio sets are displayed as an integral part of the decorative scheme of the home.

Information on Coils for the Model 333-AB

The coil for the extremely low-frequency band, and for intermediate frequencies (the same coil being used for both) has an inductance of 3.3 millihenries, and is a commercial honeycomb coil of about 1 inch outside diameter. There is a tickler on the same form, of about 800 microhenries.

The broadcast coil has a secondary inductance of 250 microhenries, tickler wound over secondary, 35 turns No. 32 s. s. wire. This oscillation transformer is also a commercial product, as it has to be wound to an accuracy of 0.6 per cent It comes in a shield, but shield should be removed and not used.

The short-wave coils can be constructed by the experimenter, especially as an inductance adjustment is necessary anyway.

For the 1,400 to 5,000 kc band the secondary inductance required is 42 microhenries, obtained by winding No. 30 enamel wire on 1-inch o-d form 38½ turns, tight wound. However, for an inductance adjustment it is advisable to wind 30 turns tightly, and space an extra 9 instead of 8½ turns. Then if the frequencies read a bit too high on the scale, press the spaced turns closer and closer together, until the coincidence is perfect at some frequency, 1,400 to 1,500 kc. This can be done when using as the detector a broadcast receiver.

The tickler for this coil may consist of 9 turns of any fine wire, wound next to, not over, the secondary, separation 1-16 inch. If the tickler is somewhat space-wound, a capacity adjustment, as well as a slight inductance adjustment, is at hand, because the tickler turns may be pressed closer to-

(*Continued on next page*)

Portable Used by Board to Check Station Waves

Six new devices to be used in policing radio broadcast stations have just been delivered to the Federal Communications Commission by the Westinghouse Company. Each consists of a highly-stabilized quartz crystal oscillator, a harmonic generator, and a radio receiver. The equipments are suitable for installation on special trucks of the Commission which travel around the country picking up the signals of the various radio stations. The signals received from the stations are mixed with the local signal generated by the quartz crystal oscillator and by a special device having a linear scale, the frequencies of the various stations are checked. These sets are checked regularly for accuracy against the primary standards of the Government.

Each set is mounted in a padded wooden box about 5 feet long with leads and filters extending from the rear. Complete operation is obtained from batteries. The new equipments are the result of intensive development and valuable help from engineers of the Commission since the development started. Without sacrificing quality and accuracy of the measurement, it is possible to take readings on a given station in an extremely short time. A special condenser with micrometer drive was designed and manufactured for each equipment for use in the heterodyne oscillator so that a linear scale could be obtained without the use of correction curves in making readings.

Although the accuracy of these standards is not as high as that of the primary reference standards operated by the Communications Commission at Grand Island, Nebraska, work is accurate as far as ordinary things in our lives are concerned. For example, in a series of measurements taken in the laboratory, engineers have reported an average error of only 3 parts in a million. In ordinary terms, this is equivalent to 1 inch in 5.26 miles, a very small deviation, to be sure.

130-Centimeter Wave Worked 50 Miles

West Hartford, Conn.

Radio history is again being made in an unpretentious frame house located on a hilltop at the edge of the residential section of this city.

Two and one-half years ago on this spot pioneer communications work in the amateur development of the ultra-high frequency region in radio was carried on. Here was located the base station from which experimental work was done by the headquarters staff of the American Radio Relay League, with temporary field stations located throughout southern New England, as well as with airplanes in flight between Boston and New York.

The ultra-short-wave region, then virtually unexplored, now occupied by thousands of amateur stations and used by police and television as well as other services, was largely developed in the rooms on the upper floor of the old colonial house.

Developing Directional Array

Now, the group of experimenters working in its environs under the leadership of Ross A. Hull, is striking out toward new fields of accomplishment. A directional antenna array has recently been perfected with which it is possible to communicate reliably, day in and day out, with stations in the Boston area, more than 100 miles away. The previous best distance from this point during three years of operation was 35 miles, with ordinary apparatus.

The League's station, W1AL, has already achieved what are believed to be two world records in ultra-short-wave communication in the neighborhood of five meters. Its two-way contact with W1XR, the Mt. Washington observatory station up in New Hampshire, a distance of nearly 200 miles, is the longest known contact between ground stations on this wavelength. W1XR has been heard at Bar Harbor, Me., some 300 miles away. This record exceeds even that for reception from an airplane at high altitudes, yet the station is only 360 feet above sea level.

In addition to these accomplishments at 5 meters experiments have recently been conducted on still shorter wavelengths in the vicinity of 130 centimeters, achieving reliable communication between a fixed and mobile station over distances of up to 50 miles. This is believed to be the first such test successfully conducted.

Walking-Stick Possibilities

The results open up an entire new vista of radio technique. The directive antenna employed, instead of occupying many feet of space as do antennas on even five meters, is so small it can be accommodated on the roof of an automobile. It can be aimed like a gun, and its beam is relatively sharp.

The imagination soars at the prospect of, for example, carrying a walking stick, opening up spines of wire along its sides like an umbrella, pointing it at a friend many miles away, and holding conversation. Yet the work of the amateurs shows such a thing to be a not even remote possibility.

Short Waves Held Way to International Amity

Urging Europe and the United States to iron out their many difficult issues by presenting their divergent points of view to each other by short-wave radio, Larry E. Gubb, president of the Philco Radio & Television Corporation, at a luncheon to foreign correspondents at the Bankers Club, New York, said that "diplomats will be ineffectual and leagues of nations worthless until the people of the world arrive at a more neighborly understanding of one another."

DeForest's Victory on Feedback Is Deplored By Some Engineers

The final decision of the United States Supreme Court that Dr. Lee DeForest, and not Maj. Edwin H. Armstrong, is the inventor of the feedback circuit, is not entirely suitable to radio engineers. Some of them have publicly voiced disagreement with the decision, among them Prof. Michael Pupin, former president of the Institute of Radio Engineers, and Prof. Louis A. Hazeltine, inventor of the Neutrodyne. Prof. Pupin hails from Columbia University, where Armstrong, studying as a lad, found what could be done with feedback, and where he is now a professor, having succeeded William H. Morecroft. Prof. Hazeltine hails from Stevens Institute of Technology, across the Hudson from Columbia University.

The sentiment of radio engineers in favor of Armstrong's contention that he was the feedback inventor has long been known. Now Prof. Pupin states that the opinion of the Supreme Court, by Justice Cardozo, makes the point that a vital consideration was whether DeForest actually varied the frequency of oscillation. The opinion stated that "the pitch, that is, the frequency, was altered by varying the plate voltage, which means that the frequency could be varied at will." Recently the court modified this to state that the court understood that the plate voltage change varied the frequency, the court saying it depended on DeForest's statement that it did. The engineers state that a simple demonstration in court would prove that plate voltage change would not constitute tuning, or change the frequency except trivially, as a showing of the instability of the generator. Dr. Pupin says the court permitted DeForest to add oral testimony not backed up by any notation in his notebook, and that frequency control would mean adjustment of inductance and capacity, which Armstrong accomplished, and DeForest, it is said, did not.

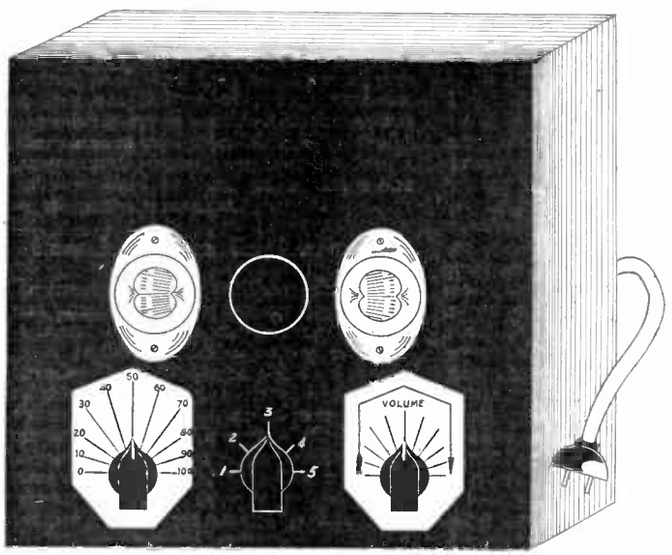
Decimal Multiplication of Frequency Scale

(Continued from preceding page)

gether for more capacity and more inductance.

The high-frequency coil consists of 8 turns of No. 22 enamel, spaced about the wire diameter, the required inductance of 2.2 microhenries being obtained by closing in on the spacing. The tickler has 4 turns of fine wire, spaced 1-16 inch from the secondary. The o.d. is 1 inch.

For making the adjustments the high-frequency end of the generator is to be preferred, in these two instances. The first test may be made on the broadcast band, as stated, for the 1,400 to 1,500 kc range. But a receiver that will respond to between 4,000 and 5,000 kc should be used for closer adjustment at a tie-down frequency where the inductance is, so to speak, of almost controlling importance, since the circuit and tuning condenser capacity already has been decided and can't be changed. Hence for the high-frequency adjustment, at around 15 mgc, a receiver that responds to that frequency is necessary.



Front view of the 333-AB signal generator. The combination percentage modulation control and modulation on-off switch, applicable only to d-c use, is at left. The coil switch is at center. At right is the combination attenuator and a-c switch.

Simple Formula For Decimal System

A method of using the decimal system for frequency scale multiplication can be developed without missout and without much overlapping. A tuning ratio with a condenser of 0.00035 mfd. up, no trimmer, or small trimmer, can develop more than 3.2-to 1-frequency ratio. Use only a 3.19-to-1 ratio, starting at maximum capacity, and select coils accordingly. E.g., 54 to 172.26 kc, 170 to 5,423 kc. Decimals, 540 to 1720 kc. 1700 to 5.420 kc, 5,400 kc to 17.200 kc, 17,000 to 54,200 kc.

Radio University

ANSWERS to Questions of General Interest to Readers. Only Selected Questions Are Answered and Only by Publication in These Columns. No Correspondence Can Be Undertaken.

Overmodulated Generator

A SIGNAL GENERATOR that I built causes two frequencies of generation, one a bit removed from the other. That is, if I want to tune a channel to 465 kc, I can turn the generator to one position, and then to another position slightly removed, and in both instances will I get a response in the channel, with a quiet spot between the two generator points. I am using an audio transformer in a separate-tube modulator circuit, coupled to the grid of the radio-frequency generator. Your kind assistance in curing this trouble will be appreciated.—I. K.

The trouble is due to over-modulation, that is, the radio-frequency generator is modulated more than 100 per cent. The modulation should be kept low. About 30 per cent. would be ample. More than 100 per cent. modulation is simply a form of distortion. This distortion results in the double peak that you complain of. Therefore reduce the coupling. One way to accomplish this is to put a resistor of around 250,000 ohms in series with the feed from audio oscillator to radio oscillator. Coupling to the grid of the generator, however, is not the best practice. Try the resistor in series with the modulator to the plate of the r-f generator, and of course using a blocking condenser in series, to prevent shorting the B voltage. When the percentage modulation is sufficiently reduced the trouble will disappear.

* * *

A Limiting Condenser

IN THE CONSTRUCTION of a simple receiver, since I desire to reduce the line voltage to a value for filament excitation, may I not use a condenser instead of a limiting resistor? I would like to try this as an experiment, anyway. What, if anything, is the objection? And does the system work at all?—R. E. C.

Yes, the system works. The condenser offers a resistance to the current, and by proper selection of the value the reduction can be made just right. For use with the usual a-c line voltage, and a 60-milliampere filament type tube, try 0.1 mfd. in series with the line. One objection is that the system does not apply to "universal" practice, for on d.c. there would be no voltage on the filament. Another point worth considering is that accidentally the condenser may be discharged, and this discharge may flash the filament of the tube. The resistor is the safer method, but as a piece of experimental work, the condenser may be tried. The filament voltage may be measured with a meter that draws small current, such as the rectifier type a-c meters, which are really 0-1 d-c milliammeters, with rectifiers of around 5,000 ohms resistance in series. If a meter that draws much current is used, this current will not flow through the condenser when the meter is removed, and so the "measurement" would be of small value. With the right meter, build up or cut down the limiting capacity until the filament voltage is just right.

* * *

Dead Spots

FOR UNIVERSAL USE is the switch type short-wave set practical? I have the switch and can build the coils. What shall I do if I encounter dead spots, as I am told there is danger of them? Will the 76 make a suitable rectifier? Should grid be tied to cathode, as recommended in tube books?—U. C.

The switch type system is entirely practical. Since all the coils are permanently in place there may be some interaction between them, in that one coil and the stray capacity associated with it may act as a trap at some frequency, and another similar coil-condenser combination as a trap at another frequency, and dead spots appear. These often may be eliminated by series antenna condenser adjustment, so this condenser is shown as variable, and should be accessible to the front panel. The 6C6 tube serves well as the detector, while the 76, with grid tied to plate, serves as the rectifier. The filter capacity should be large. The screen and plate potentials may be equal. The 0.05-meg. series resistor common to both screen and plate circuits is a stabilizing agency, because the screen voltage tends to rise when the plate current tends to fall, and therefore the plate current is maintained fairly stable. This is true because the plate current depends largely on the screen voltage in this type of tube. Build the set and if you encounter dead spots, arrange to short out one coil after another (in the unused section of the moment) to discover which coil is causing the trouble. Sometimes the short itself will cause a dead spot at one frequency while curing it at another, therefore a shorting section of the switch, meaning another deck, may be used, to short out all unused coils, and this is a special switching arrangement. Then a series switch may be used to open the short when circumstances require. This is a makeshift, but the system does work, which is important.

* * *

Special Dynatrons

CAN NOT the tubes not recommended as being suitable for dynatron purposes still be used in that manner? What change would have to be made from the standard connections?—O. C.

Yes, a tube with an exponential characteristic, or in general the suppressor type tubes, where suppressor is independently accessible, may be used for dynatron purposes by tying the suppressor to the screen. Then the screen voltage is made critically higher than the plate voltage, until the negative-resistance characteristic appears. This may be checked because as the B voltage on either element is increased the current will decrease. The condition obtains in practice only when the plate circuit is tuned, of course. The grid may be grounded.

* * *

Carrier Spotted

RECENTLY you stated that a short-wave regenerative detector will bring in any station that any big set will bring in. Is this really true?—L. W.

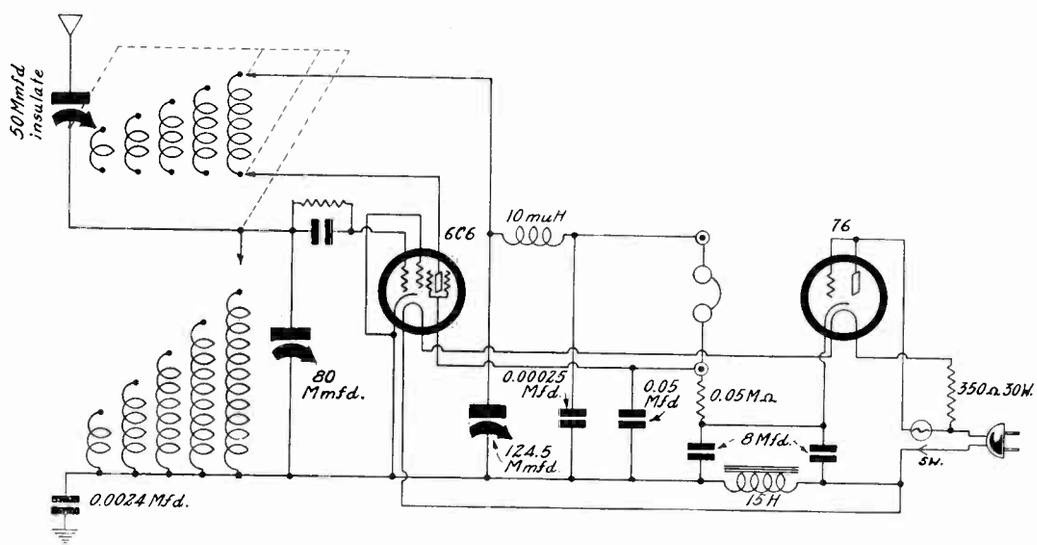
We did not state just that. The small set will yield a response, but you may not hear the program. The presence of the carrier can be detected, at least.

* * *

Interference from Motor

THERE IS A MOTOR of some sort in my locality that is setting up interference. I know that the frequency it generates is low, because there are repeat points in my sensitive, frequency-calibrated re-

(*Continued on next page*)



When the three-element tube is used as B rectifier, the grid should be tied to the plate, and not to the cathode, as otherwise with plate connected to cathode one element, the conventional grid, would be called upon to pass much more current than ever was intended that it should pass.

THE AMATEUR ORACLE

Conducted by M. K. Kunins

Misplaced Licenses

IN MOVING RECENTLY I misplaced my radio operator and station licenses. Can I consider myself licensed and continue operating my amateur radio station?—L. C. F.

The radio regulations prescribe that all licenses be displayed on the wall of the transmitting room at all times that the transmitter is in use. It will consequently be necessary for you to obtain duplicate licenses from the office of the Federal Communications Commission that issued your original license. In your application for a duplicate license it is necessary for you to include a sworn statement attesting to the manner in which your license was lost. The Commission will then consider the facts and decide whether you will be issued a duplicate license. Until you display valid licenses on the wall of your shack you may not use your transmitter.

* * *

What the Bands Are

I HAVE JUST received my amateur operator and station licenses and am in doubt as to which frequency I can use. Is it permissible to operate on any frequency I may choose that is included within the bands specified in the regulations?—J. B. H.

The Federal Radio Commission has assigned certain bands of frequencies for the exclusive use of amateurs. Any frequency within the limits of these bands may be chosen for your transmissions as specified below, if you are going to use radiotelegraphy only:

1715 to 2000 kilocycles
3500 to 4000 kilocycles
7000 to 7300 kilcoycles
14000 to 14400 kilcoycles
28000 to 30000 kilocycles
56000 to 60 kilocycles
400000 to 401000 kilocycles

If you expect to use radiotelephony, you may use only certain of these bands, dependent on the grade of your license. If your license is either Class B or C, you may operate a radiotelephone transmitter in only the following bands:

1800 to 2000 kilocycles
28000 to 28500 kilocycles
56000 to 60000 kilocycles
400 to 401000 kilocycles

Should you have a Class A license, you may utilize the following bands in addition to those ust enumerated:

3900 to 4000 kilocycles
14150 to 14250 kilocycles

Television, facsimile and picture transmitters are restricted to the following bands, which of course may be used for other purposes:

1715 to 2000 kilocycles
56000 to 60000 kilocycles.

Non-Licensed User

MAY I ALLOW my brother, who is not a licensed operator, to talk over my phone transmitter?—C. J.

Section 214 of the Federal Communications Commission's regulations states that persons other than the licensed operator may use a licensed transmitter, provided it is not a telegraph transmitter, at all times that the regularly licensed operator is present. Therefore it is permissible for your brother to speak over the microphone of your phone transmitter provided you are present and make the necessary adjustments.

* * *

Records on Air

I HAVE HEARD amateur stations transmit phonograph record programs. Is this permissible?—L. C. W.

Amateur stations are forbidden to transmit entertainment and since a complete phonograph record rendition followed by another might be so construed, it is wise to use discretion in this regard. It is allowable to use music for test purposes, only.

* * *

Meaning of "W"

WHAT IS the significance of the letter W that is prefixed before all amateur call letters?—E. L.

The International Radiotelegraph Convention of 1927 set aside sets of letters, known as intermediates for each country engaged in radio transmission. The United States has been given the letters W, N and K for this purpose. It has been the pleasure of the Federal Communications Commission to restrict the amateurs to the letter W. In like manner, Canadian amateurs are required to use the intermediate VE before their call letters. A list of all the intermediates together with the countries to which they are assigned may be obtained from the Government Printing Office in Washington, D. C.

Sideband, Carrier Suppression

Many interesting experiments may be performed with sideband suppression. One of the simplest ones is to suppress one sideband and send the other out with the carrier. It is possible also to suppress both the carrier and send only the sidebands, a beating oscillator at the receiving end taking the place of the carrier not received, and enabling reception. The sidebands modulate the local oscillator, hence detection must follow, for practical results.

Table For Use Of Generator Harmonics

The following table gives the frequency of the unknown, as that of a station being tuned in, or a receiver to be measured at a given setting, in terms of specific fundamental values, based on harmonic measurements, where the harmonics are used of a 100 to 200 kc fundamental range, calibration 1 kc. By moving the decimal point the results may be applied to higher and lower fundamentals and unknowns:

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

RADIO UNIVERSITY

(*Continued from preceding page*)

ceiver. These I attribute to harmonics. May I not trap out the fundamental, and also the harmonics, one by one? What is the measurement technique?—I. D. C.

Since the receiver is frequency calibrated, note the lowest frequency in the set's span at which the interference comes in, then the next higher frequency, and subtract the lower from the higher. The interference originates on approximately this difference in frequency. The approximation is due to the possibility of inaccurate calibration. The check can be extended by using numerous consecutive responses to the interference, counting the responses, noting the total difference between highest and lowest frequencies read, and dividing by a number 1 less than the number of responses. A trap circuit at this determined frequency might help. The series of traps for all response points suggests the necessity of some other method of approach.

Turner's New Crystal Set Passes Through Needle Eye

Rufus P. Turner, of Boston, has built a crystal set of such minuteness that it may be passed back and forth through the eye of a fine sewing needle while in operation. Connected to a pair of headphones, the little receiver picks up broadcast music.

Turner previously constructed a similar set on a straight pin. This set is on exhibition at the Chicago Century of Progress Exposition. To defend his championship against Francis Whittemore, of Weston, Mass., who built a radio on the point of a pin, and William Maida, of Baltimore, who placed one in the eye of a needle, Turner brought out and demonstrated his latest set that passes through the needle eye.

All the miniatures built by the ingenious Bostonian have been pictured in the "Believe-It-Or-Not" and "Strange-As-It Seems" cartoons.

Station Sparks *By Alice Remsen*

"EYES" FOR YOUR EARS

NBC HAS PROVIDED SOME EXPERT "EYES" at the gridirons so that listeners may visualize football for themselves. These "eyes" belong to Graham McNamee, radio's pioneer sports announcer; Don Wilson, who played guard for four years at the University of Colorado; George Hicks, who played football in high school; William (Bill) Slater, who is headmaster of Adelphi Academy for Boys in Brooklyn, and Bill Stern, stage director of Radio City Music Hall, who played quarterback for four years at Pennsylvania Military College. These boys know all about football and undoubtedly will broadcast a very intelligent "man's-eye-view." . . . November 12th will take Joe Cook away from the Colgate House Party, but only temporarily; Joe must concentrate on rehearsals for his new Broadway show, which, incidentally, will provide him with his first straight dramatic role. . . . Emily Post is back on NBC air-waves. Each Sunday at noon, Mrs. Post will explain over an NBC-WJZ network her creed of inexpensive beauty for every home. . . .

FEET ON THE PEDALS AND FINGERS ON THE KEYS

The addition of the two-piano team of Peggy Keenan and Sandra Phillips to the schedule makes the list of piano duos now performing on NBC networks one of the most imposing in the history of broadcasting. The list includes Ohman and Arden, Pollock and Lawnhurst, Al and Lee Reiser, Gould and Shefter, Banta and Rettenberg, Holman Sisters, Platt and Neirman, Harding Sisters and Keenan and Phillips. . . . There is a new psychology series now being heard each Wednesday at 2:30 p. m. over an NBC-WEAF network and it is proving very interesting. It is conducted by Dr. Joseph Jastrow, who is a past president of the Psychological Asociation and for many years a lecturer at the New School for Social Research in New York. . . . Have you been listening to those fireside talks given each Sunday night over WJZ at 10:30 p. m.? If not, you are missing something of great importance. This series, which was opened on October 14th by Dorothy Canfield Fisher, brings to listeners such eminent persons as Upton Sinclair, Perch Crosby, Senator Arthur Capper, Norman Hapgood, Gene Tunney, and Hendrik William Van Loon. The broadcasts take the form of informal fireside discussions of philosophy, economics, politics, education, sociology, and civilization in general. . . . Cameron King, veteran sailor and adventurer who won the acclaim of radio listeners for his "salty" descriptions of the America's Cup yacht races over NBC, has been retained by that organization to give a series of broadcasts, and so, if you tune in on the NBC-WJZ network every Tuesday at 10:00 p. m. you'll hear King's Scotch burr relating tales and adventures of the seven seas. . . . Another new program is that of the Musical Book Column on Mondays at 4:00 p. m. over an NBC-WEAF network. Harry Hansen, literary editor of the New York World-Telegram, discusses books, with a musical background supplied by an orchestra under the direction of Joseph Littau. . . . And am I glad to report that Senator Ford is back on the air!! Well, rather! The Senator is an old favorite of mine. He is now writing and appearing in a series of sketches caller "The Grummits," each Monday and Wednesday night over an NBC-WEAF network at 11:00 p. m. . . .

CHARLIE KING MAKES HIS BID

And Charlie King, of musical comedy fame, is also making a bid for radio popularity in his first regular series of broadcasts, every Sunday at 9:45 p. m. over WJZ. Starred with Mr. King is Peggy Flynn, better known to theatregoers under her stage name of Peggy Bernier, who is making her radio debut. . . . If you like light classical music a good bet for you is Rudolph Bochco, popular concert violinist, who is doing a series of recitals over WEAF every Sunday morning at 11:15 a. m. Bochco is accompanied by Alexander Stock, who has appeared with him in concert work. . . . Borrah Minnevitch and his Harmonica Rascals, one of the nation's most unique musical organizations, is being heard for a limited time each Tuesday at 6:35 p. m. over WJZ from the NBC Chicago studios. . . . Station KYW, owned and operated by the Westinghouse Electric and Manufacturing Company, will become the basic Philadelphia outlet of the NBC-WEAF coast-to-coast network when its new transmitter goes into operation about December 1st. KYW, one of the country's pioneer stations, operated previously in Chicago, is being moved to Philadelphia under authority of the Federal Communications Commission.

"GUMPS" FOR CBS

And now the "Gumps" are to be heard over the Columbia Broadcasting System, starting Monday, November 5th. It will be a five-times-a-week broadcast, sponsored by the Corn Products Refining Company, 12:15 p. m. Mondays through to Fridays. You will heard all those delightful old characters, Andy and Min, their son Chester, Uncle Bim, and the maid Tilda, created by Sidney Smith in the cartoon series which has been a popular newspaper feature for seventeen years. . . . Arthur Murray and Earl Oxford has postponed the premiere of their new series. The program, sponsored by Pinaud, Inc., will open on December 1st, WABC, at 6:00 p. m., and will continue each Saturday thereafter. . . . Little Jack Little is back on the air with his one-man show again, this time with a sponsor, the Pinex Company; three times a week. Sunday, Wednesday and Fridays at 1:30 p. m. Jack will continue to direct his own orchestra. . . . Seven nations will take part in an elaborate international Armistice Day broadcast on November 11th, at 4:15 p. m. over a nation-wide Columbia network, bringing a message of peace to the people of North America from leading statesmen here and in Great Britain, Canada, Brazil, Greece, Japan, and Czecho-Slovakia. . . . An interesting program is that of Cobina Wright's hour-long entertainment each Wednesday at 9:00 a. m. WABC and network. Mrs. Wright presents prominent figures in the fields of literature, music and art, plus popular radio artists, with music by Mark Warnow's Orchestra. . . . Because of the greatly increased requirements of the fall and winter season, the Columbia Broadcasting System has added a second Radio Playhouse to its studio line-up. The new unit, formerly the Avon Theatre, is located in West 45th Street, just off Times Square, and is known as the Columbia Forty-fifth Street Radio Playhouse. It will be used for the staging of several large commercial programs, and will accommodate an audience of seven hundred and fifty persons. . . .

TALENT ON THE ABS

The third major network, the American Broadcasting System, is getting along nicely, thank you. Several new features have been added to their schedule, including Kay Thompson, singer from California, Tuesdays and Thursdays, 8:45 p. m.; Gloria Grafton, a protege of Noel Coward and Cole Porter, Mondays, Wednesdays and Fridays at 7:00 p. m.; George Reid, and his one-man minstrel show, Mondays and Saturdays, 7:30 p. m.; Theo Karle, operatic tenor, each Sunday at 6:30 p. m.; Ed Smith, and his "Top o' the Mornin' " each morning except Sunday at 9:00 a. m.; A. M. Sullivan and a new poetry program, Mondays at 7:15 p. m.; and, of course, we mustn't forget our own Vaughn de Leath, the original radio girl, Mondays, Wednesdays and Fridays at 9:15 a. m. . . .

STUDIO CHATTER

Frank Parker, NBC tenor, loves to clown. One night he joined forces with the Staten Island ferryboat's strolling musicians. Parker covered the boat with them, singing "O Solo Mio." All that the high-salaried tenor's impromptu concert netted him was one thin dime and two coppers. . . . Vladimir Brenner, NBC staff pianist, was a child prodigy in Czarist Russia before the world war and a favorite of the monk, Rasputin. Brenner fled the country in fear of his life after the revolution. . . . David Ross, Andre Baruch and Harry Von Zell play ping-pong between program assignments. . . . Grete Stueckgold's pets are two long-haired daschunds, one of which has won eight blue ribbons in dog shows. . . . Frank Crumit, too, is a dog fancier, taking much pride in his kennel of Boston terriers. . . . Elmer Feldkamp, saxophonist and baritone soloist in Freddy Martin's band, is a graduate of Villa Nova College, but did not play in a college orchestra or sing in the glee club while he was there. . . . Willard Robison once played piano in a Salina, Kansas, movie house. . . . Eddie Cantor and family leave for London, England, early in December.

A THOUGHT FOR THE WEEK

WHO WANTS TO BE EDUCATED, ANYWAY? This seems to have been about the size and scope of the question discussed recently in Washington by M H. Aylesworth, president of the National Broadcasting Company, when he appeared before the broadcast division of the Federal Communications Commission. Mr. Aylesworth, being an educated man and withal a student of public trends, did not, of course, say that nobody wants to be educated but did declare that listeners-in want entertainment first and education a long way afterwards.

He seemed to be in accord with the sentiments expressed in letters from John Erskine, Professor of English at Columbia; Dr. Nicholas Murray Butler, president of the same institution; Alexander Woollcott Henry L. Mencken and George Jean Nathan, all of whom declared that education was all right so far as it goes but that it must not go too far, especially when it displaces actual entertainment. Even Dr. Walter Damrosch, who surely cannot be accused of being a lowbrow, said that he viewed with dismay the idea of any arbitrary allocation of more time allowance for purely educational programs.

All of which indicates that the old matter of a new censorship is hovering in the shadows when the question of forced lengthening of the pedagogical type of program is being considered. As for dear old Mr. and Mrs. Public and the, of course, younger members of the family, there isn't the slightest doubt that they want to be entertained before being forced to add to their sum of book knowledge.

Dealers Demonstrating High-Fidelity Receivers

High-fidelity receivers, new this season, are being demonstrated by dealers in comparison to the usual run of sets, and customers are being asked to make their own choice. The list of high-fidelity all-wave sets is usually over $200.

Braille Handbook Aids Blind to Become Hams

Opportunity for extending technical information about radio among the blind so that they may become amateur radio operators has been created by the Braille Department of the New York Chapter of the American Red Cross.

The Department has completed the transcription of "The Radio Amateur's Handbook," published by the American Radio Relay League, into nine Braille volumes, complete with more than 100 diagrams, and plans to make it available to blind radio students through the New York Mercantile Library. The transcription was made by Ethel and Helen R. Hendricks, working for the Braille Department of the Red Cross, of which Mrs. Richard F. Armstrong is director, and Mrs. Donald M. Forgan is assistant director. The diagrams, which are regarded as the first made in Braille of complicated and technical radio circuits, were transcribed by Mrs. Armstrong.

The transcription was undertaken following a suggestion from Gerald B. Sharrer, a blind business man of Liverpool, N. Y. Mr. Sharrer had mastered the Morse code, a requirement of the Federal Communications Commission for an amateur radio operator's license, and desired the opportunity for the further study of radio. The one comparatively small handbook made nine Braille volumes. Three have been sent to Mr. Sharrer and the remaining six have now been completed. As he finishes his study of the different volumes, they will be put into library circulation for general use.

The handbook is widely known as an authoritative and practical work on the construction and operation of amateur radiotelegraph and radiotelephone stations. It is published by the national association of American amateurs, which has its headquarters in West Hartford, Conn. Presupposing no previous knowledge of radio on the part of the reader, the handbook starts with the fundamentals of electricity and progresses logically to a complete exposition of present-day practice in the construction and operation of amateur radio stations.

Amateurs have among their close conversational friends persons they have never seen, in distant states, and even in foreign countries. The blind radio amateur therefore would be at no disadvantage in participating in the friendly contacts enjoyed by thousands over the ether waves.

Radio Club's Party Gets Guests from 36 States

When friends travel from thirty states, from Mexico, Brazil and Puerto Rico, to attend a housewarming, when their numbers total 1300 in all—well, that's a housewarming indeed.

Such was the houswarming of amateur radio station W9PZ, the Lakeside Radio Club, located on Sheridan Road a mile and a half north of Lake Bluff, Ill., suburb of Chicago. Heralded over the air lanes of the nation days in advance, with a widespread but none the less cordial invitation to all of America's 40,000 radio amateurs, offering an attractive program of entertainment and refreshment, it is not surprising that so many folk attended to quaff the future of the new station.

As early as 9 a.m. the rustic estate of Thorne Donnelley, president of the Lakeside Radio Club, which has its acres sprinkled almost equally with chickens and antennas, was crowded with guests. One, Louis Falconi, W5ZA, had driven continuously for 36 hours with his wife and child from Roswell, New Mexico, to get there in time. Dr. James B. Hard, X1G, had flown up from Mexico City. R. Bartholomew, K4SA, had arrived from Puerto Rica via New York and Hartford.

From the headquarters of the American Radio Relay League in West Hartford, Conn., came Clark C. Rodimon, W1SZ. "Buck" Taylor, W4LU, one of the unique characters of amateur radiotelephone, was up from Signal Mountain, Tenn. J. D. Slaughter, W4MU, and the whistle heard nightly from Maine to California, and his partner Bill Stuart, W4BDB, both of Cleveland, Tenn., were there—as were more than a thousand other amateurs.

The program ranged from exhibition golf shots and tennis matches to serious technical discussions.

Transmitters came in for their share.

Turner-Pangborn 'Plane Sends Code to Amateurs

Hartford, Conn.

Radio amateurs were given the opportunity to shoot at a new world distance record for radio communication with aircraft during the MacRobertson International Air Race from London, England, to Melbourne, Australia.

Aboard the ship being flown by Colonel Roscoe Turner and Clyde Pangborn, the American entries, there was a complete radio station, operated by Reeder Nichols. In addition to the usual aircraft communications, this station communicated with amateurs all over the world on frequencies of 6210, 8280, and 12,420 kilocycles. When the plane got into trouble at Allahabad, India, losing hours hunting the landing field, messages were sent saying the fliers expected to crash, but they landed in the field safely, with 100 gallons of gas, ten times more than they thought they had.

The unique feature of the event was the fact that Nichols tried to contact stations at his exact antipodes all along the route flown by the Boeing 247D. Thus when he swung into the southern hemisphere near Australia he was at exactly the other side of the world from many American stations, and it was expected that at least one contact was established under such conditions that the maximum terrestrial distance separated the two stations.

Amateur members of the American Radio Relay League throughout North America were busily tuning in.

The American entry finished third.

Hammarlund Announces Midget Air Condenser

Hammarlund Manufacturing Company, 424 West Thirty-third Street, New York City, announces a midget, Isolantite based, air-dielectric padding and tuning condenser, particularly useful in marine, aircraft and police work. The largest of the type, 100 mmfd., measures only 1 7/32 in. by 15/16 in. by ½ in.

Except for its minute size, it resembles the larger of the air condensers electrically, mechanically, and optically. Brass rotor and stator plates of 0.015 inch thickness, spaced the same distance, are employed. A phosphor bronze spring plate affords perfect rigidity. Every other metal part is brass. The device provides constant capacity under varying conditions of vibration, temperature and humidity. It is principally intended for short-wave or ultra-short-wave work, or for tuning i-f transformers, trimming r-f coils, and gang condensers, antenna tuning, fixed tuning of r-f coils, or for tuning plug-in coils. The approximate capacity per air gap is 4 mmfd.

Amateur, 73, Aids British Government

West Hartford, Conn.

An amateur radio station operated by a 73-year old Canadian physician is one of the British Empire's most valuable outposts in strife-torn China, according to a letter received at the American Radio Relay League headquarters here.

Dr. William Malcolm, health officer of Chefoo, Province of Shantung, tells of some of his services to the British Legation in the letter:

"We have frequently been of aid to individuals, officials and private interests in establishing communications during the trying times when normal methods were disrupted."

His most recent feat was the transmitting of first word to the British Legation of the S. S. Shuntien piracy at the mouth of the Yellow River, last summer. His services in this instance were invaluable to the officials concerned.

A number of messages have been handled to and from the British fleet in Chinese waters. Dr. Malcolm has received an official expression of gratitude from the British Navy for his services in this connection.

His station, AC3MA, the only amateur station in Shantung Province, has been on the air consistently for nearly seven years, and has been in communication with every part of the globe.

MUSIC OF GREAT COMPOSERS HEARD

The Master Music Hour, over a WEAF network, presented the Gordon String Quartet and Henri Deering, pianist, assisted by Fillippo Ghignatti, oboe; Augustin Duques, clarinet; Frank Corrado, horn, and Abe Reines, bassoon, in an all-Beethoven program on Oct. 16. The same hour brought Henry Hadley as guest artist on Oct. 19 with the Musical Art Quartet, Lilian Buckman, soprano, Harry Kaufman, pianist, and Sasha Jacobsen, violinist, in music by American composers.

CBS to Open Second Theatre as a Studio

Because of the greatly increased requirements of the fall and winter season, the Columbia Broadcasting System has added a second Radio Playhouse to its studio line-up. The new unit, formerly the Avon Theatre, is located in West 45th Street just off Times Square, in New York City, and will be known as the Columbia Forty-fifth Street Radio Playhouse. It will be used for the staging of several large commercial programs and will accommodate an audience of 750 persons.

The theatre, built in 1920 and operated as the Klaw before it was renamed the Avon, has been extensively remodelled for radio production. It was chosen for its excellent acoustical qualities, and even greater perfection along this line has been obtained through the installation of a "shell" stage setting. The shell is flanked by reflecting "baffles" above and at each side of the stage, which project all sound waves to the back wall before they reach the microphone.

This process insures a perfect microphone pickup by eliminating standing sound waves, excessive cross-wall reverberations, and dead spots in the studio.

The stage box at the right of the auditorium has been remodelled into a control booth, and the box on the left has been converted into a client's room. The control booth marks a step forward in studio high fidelity equipment. A console type mixer and control cabinet with independent controls for eight microphones occupies the forward part of the booth. It contains complete switching facilities for the broadcasting and monitoring of programs and central controls for a "house" telephone system.

Among the programs already scheduled to be broadcast from the Forty-fifth Street Radio Playhouse are: "Music by Gershwin," Sundays at 6:00 p.m.; "The Big Show" with Block and Sully, Gertrude Niesen and Lud Gluskin's Orchestra, Mondays at 9:30 p.m.: "The Camel Caravan," with Walter O'Keefe, Annette Hanshaw and the Casa Loma Orchestra, Tuesdays at 10:00 p.m.; "Melodiana," with Vivienne Segal, Oliver Smith and Abe Lyman's Orchestra, Tuesdays at 8:30 p.m.; "Everett Marshall's Broadway Varieties," Wednesdays at 8:30 p.m.; and the Roxy Revue, Saturdays at 8:00 p.m. More will be added.

KYW to be NBC-WEAF Philadelphia Outlet

KYW, owned and operated by the Westinghouse Electric and Manufacturing Company, will become the basic Philadelphia outlet of the NBC-WEAF coast-to-coast network when its new transmitter goes into operation about December 1st, Richard C. Patterson, Jr., executive vice-president of the National Broadcasting Company, announced.

KYW, one of the country's pioneer stations, had operated in Chicago, but it was moved to Philadelphia under authority of the Federal Communications Commission. Its transmitting equipment is of the newest and most advanced type. It operates on a frequency of 1,020 kilocycles with a power of 10,000 watts.

When KYW becomes the basic NBC-WEAF network outlet for Philadelphia, Mr. Patterson stated WLIT and WFI, which together now form the NBC-WEAF network outlet on a time-sharing basis, will be combined to become the basic Philadelphia transmitter for the NBC-WJZ network.

The KYW studios will be located at 1622 Chestnut Street. Leon and Isaac D. Levy will furnish the local programs for the station, subject to the policies and supervision of Westinghouse and National Broadcasting Company, while all network programs will be furnished by the National Broadcasting Company.

The first program to emanate from the studios of KYW was on the afternoon of November 11, 1921. Mary Garden, operatic star, was the station's first guest, when she appeared during a broadcast from the stage of the Chicago Civic Opera. Others heard from KYW were Al Jolson, Phil Baker, Madame Schumann-Heink and Irene Bordoni.

The station has been heard afar.

Japanese Unit Elected to World Amateur Union

West Hartford, Conn.

The election to membership in the International Amateur Radio Union of the Japanese Amateur Radio League was announced at Union headquarters here. The Japanese body has been the organized representative of amateur radio in that country for the past five years.

The I.A.R.U., a federation of the national amateur societies of twenty-five nations, has been in existance for nearly ten years. It is recognized at international radio conferences as the spokesman of organized amateur radio, representing 60,000 licensed amateur radio stations in all parts of the world.

The countries represented in the Union are the United States, in which the headquarters are maintained at the offices of the American Radio Relay League, Italy, Canada, Czechoslovakia, Germany, Denmark, Irish Free State, Colombia, Mexico, Netherlands, Netherlands Indies, New Zealand, Norway, Poland, Great Britain, Portugal, Belgium, France, South Africa, Finland, Sweden, Spain, Switzerland, and Australia.

THOSE SETS FOR YOUR HAT

Many laymen become interested in portable crystal sets, especially when told that a set in the vacant space in your hat (not under your hat) will contain the receiver and give results. The enthusiastic "inventors" fail to say that not even a mouse may stir, otherwise the "interference" will drown out the reception. Also, only one station may be heard, or perhaps two or three at once, as there's practically no selectivity.

Don't Kick—Just Grin!

By Roland Burke Hennessy

When the rain is wildly pouring
And the street is full of pools—
Don't kick—just grin!
When the other folks are swearing
Like a lot of angry fools—
Don't kick—just grin!
When the wet has dampened ardor
And the sky has doused its face
When the birds have flown to shelter,
And your crew has lost the race,
When your little wife tells you
That there's trouble on your face—
Don't kick—just grin!

When your news-stand loses custom
To a new man down the street
Don't kick—just grin!
When you get a chance just tell him
That you're game from head to feet—
Don't kick—just grin!
When the folks are all a-grumbling
'Cause their business needs a nurse,
When your customers are kicking
In a manner grim and terse.
Then you tell them in your own way
That things really could be worse—
DON'T KICK—JUST GRIN!

(*The American News Trade Journal*)

General Electric to Make Its Sets in Bridgeport

Bridgeport, Conn.

Announcement was made by the General Electric Company that the manufacture of radio receivers would take place at the local factory and that production would start the first of the year.

General Electric radio engineers have been busy for many months developing a new and novel line of receivers. This has been done in the company's research laboratory, commonly known as "The House of Magic," in Schenectady, N. Y., until August 1, when this engineering corps was moved to Bridgeport, thus centralizing all branches of the industry here. The sales organization has been located here for several years under the direction of B. C. Bowe.

1935 Model ALL-WAVE DIAMOND OF THE AIR!

TABLE MODEL

8 TUBES! 5 BANDS! A. V. C.!

CONSOLE MODEL

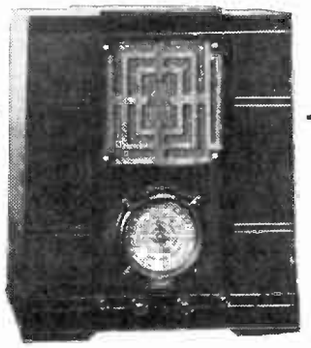


Table Model All-Wave Diamond, using the same 8-tube chassis and tubes as the console model. Wired, complete, with eight tubes. Shipping weight 28 lbs. Order Cat. 1008-T. Net price, F.O.B. Sandusky, O.—$32.05

TO get away from the conventional and ugly cabinets in which table model receivers have been housed in the recent and remote past we have just obtained an entirely new design, 14½ inches wide, 10 inches wide, 9½ inches front to back, to house our 1008 chassis, the finest all-wave 8-tube superheterodyne receiver made. The performance is exactly the same, as between the console model and the table model.

The selection of one model or the other will depend considerably on whether you have some mantel or end table or the like on which you'd prefer to place a physically smaller cabinet (but the same-sized set), or whether you have the room for the large console, 21 inches wide, 36⅛ inches high, 12 inches front to back. We have gone to great pains to obtain two models that do not differ in performance, and that yield the maximum that radio has to offer to-day, so that space and artistic requirements can be met to the fullest, along with maximum performance.

The table model is Cat. 1008-T, shipping weight, 28 lbs., wired, in cabinet, complete with eight RCA tubes; net price (shipped from Sandusky, Ohio)—

$32.05

The wired chassis, with speaker and tubes (no cabinet) can be purchased by any who care to use a cabinet they have. See price at right.

WHENEVER a person wants to buy a particularly fine receiver he usually feels he has to pay a particularly high price for it. Ask almost any one what kind of a set he would want and the answer would be: "An all-wave a-c set, of course." He might prefer a console model or a table model, but he would want band selection by switching. The only drawback, perhaps, is that, times not being so prosperous, he hasn't the price of such a fine instrument. But we point to something new and startling in radio merchandising—the production of a de luxe, superb all-wave set, 150 kc. to 22 mgc. (2,000 meters to 13 meters), at the inconceivably low prices of $45.57 net for the console, and $32.05 for the de luxe table model. These two cabinets are illustrated herewith, and the same superheterodyne chassis is used in both.

These prices are absolutely net, and represent complete wired receivers, **equipped with RCA tubes throughout,** and securely packed.

The low prices would not mean a thing unless these receivers were of first quality and excellence, unless they had great sensitivity and selectivity, so that foreign short-wave stations and domestic broadcasts could be tuned in with enjoyable volume and steadiness, and unless the tone was marvelous. These new **DIAMOND OF THE AIR** All-Wave Receivers, in the two models illustrated, are quality products of the highest attainment, enthusiastically indorsed by leading radio engineers, who blink with amazement when told the selling price, in view of the outstanding performance.

As a check on whether care has been taken to make this receiver outstanding, note that the low-frequency band is included. Now, an all-wave set may mean almost anything, but when you are told that the low-frequency extreme is 150 kc., and that the highest frequency tuned in is 22 mgc. (13 meters, mind you!) then you can realize that painstaking craftsmen spent long hours getting the instruments right, so that they would cover frequencies that sweep from one end to the other of program and other bands.

And there is sufficient overlapping between bands, as you turn the gentle band-selector switch, to prevent missout. And moreover, the programs come in with steadiness and clarity, for there is a highly-effective automatic volume control, to correct for fading and to prevent blasting when tuning from station to station.

Exceptional care has been taken in prevention of image interference, and the wisest experts who have given this receiver critical attention admit that the pre-selection is abundant.

Another interesting technical point: This set runs cool. The 6-volt series tubes are used—wise choice indeed—because the elements of these tubes are stronger than those of the 2-volt series, and the power consumption in the heater is considrably less. And yet there was no skimping. The primary power consumption is 80 watts.

Nor does the dial have mere arbitrary numbers on it, 0-100 for instance, as found on what we term "unfinished" sets. This receiver has the very latest illuminated airplane dial, with frequency calibration for each of the five bands, so is direct reading in frequencies, and besides has a double pointer so the benefit of wide spreadout on the scale is derived from both semi-circles. Close vernier tuning is provided.

There is a manual volume control, a tone control and provision for phonograph or earphone connection.

And the speaker? A heavy-duty 8-inch diameter-cone dynamic speaker that is a fitting climax to an expert design and assembly.

$45.57

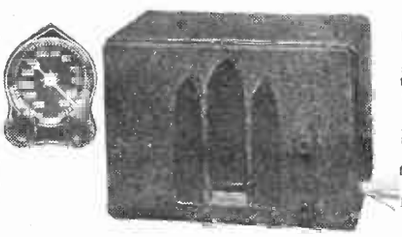
The 8-tube, high-gain, all-wave (150 kc. to 22 mgc.) Diamond of the Air wired chassis, 50-60 cycles, 110 volts; with the powerful dynamic speaker and the eight RCA tubes, may be purchased (no cabinet). Order Cat. 1008-CH. Net price, $28.52.

The All-Wave Diamond, 150 kc. to 22 mgc. (2,000 to 13 meters), in its distinctive modernistic console cabinet of genuine burl walnut, curly maple front, artistically carved overlays. Extra large baffle and powerful heavy-duty 8-inch dynamic speaker. Wired, equipped with following RCA tubes: one 6A7, two 6D6, one 75, one 76, two 42's, and one 80. Cat. 1008-CON. Weight, complete, 37½ lbs. For 50-60 cycles, 110 volts. Shipping weight, 51½ lbs. Net price, F.O.B. Sandusky, O.—$45.57

6-TUBE DIAMOND AUTO SET, $23.52

OUR previous model Auto Set was so good that the model was not changed in three years. Now at last it has been improved upon, certain mechanical refinements introduced, and tubes of somewhat higher efficiency included. Some of these tubes were not manufactured until recently. Also the set now has a.v.c.

Our 1009 Auto Radio is a six-tube superheterodyne set, using one 6A7, one 41, one 75, two 78's and one 84, and tunes from 540 kc. to 1,600 kc. It is a one-unit receiver, ruggedly built for long life, and is equipped with a dynamic speaker. It has an illuminated vernier airplane type control. The manual volume control and lock are one combination. The power consumption is 4 amperes.



No B batteries required. There is a B-eliminator built in.

This is one of those fascinating auto sets that has single-hole mounting provision, and therefore is a cinch to install. There are only two connections to make: (1), to the ammeter; (2), to the aerial.

The remote tuner is, of course, supplied with the set. And the spark plug suppressors and commutator condenser are supplied, also.

The size is 8¾ inches wide, 6 inches high, 6¼ inches front to back. Shipping weight is 18 lbs.

Order Cat. 1009, wired, in cabinet, complete with six RCA tubes.

Net price (F.O.B. at Sandusky, O.)—$23.52

ALL OUR DIAMOND SETS EQUIPPED WITH RCA TUBES

We can supply receivers, either in wired-chassis-speaker-tube combinations (less cabinet), or in table or console model cabinets, to meet special voltage requirements. For instance, if you do not have 50-60 cycle, 110-volt a.c. you could not use the standard chassis, No. 1008-CH. So if in doubt, inquire of your lighting company as to the frequency and voltage of your supply. We can furnish the 8-tube all-wave chassis with or without cabinet, for 25 cycles, 110 volts, (add the number 25 after the catalogue number of the standard model) at $1.50 extra, or can supply the 8-tube all-wave model for 220 volts, 50-60 cycles, at 60c above the 110-volt model prices (add number 220 after the catalogue number).

DUAL-BAND SETS

We have a dual-band set for a-c operation, available in wired-chassis-speaker-tube form, and also in a table model Gothic cabinet. The frequencies covered by this receiver are (a) 550 to 1,500 kc; (b), 5.5 to 16 mgc. Coil switch changes bands.

The design is a five-tube superheterodyne, using one 6A7, one 6D6, one 75, one 42 and one 80, a.v.c. is included. The illuminated airplane dial has kilocycle calibration, direct reading, with double pointer. A dynamic speaker is supplied. Primary watts power, 60 watts.

Wired chassis, dynamic speaker, five RCA tubes; for 50-60 cycles, 110 volts; shipping weight, 15.5 lbs. Cat. 1010-CH. ..... **Net price—$15.58**

Same as above, but in a Gothic two-tone walnut French cabinet. Shipping weight, 17.5 lbs. Cat. 1010-G. ..... **Net price—$17.59**

We can supply the above for 25 cycles at $1.50 extra. Add number 25 to the catalogue number. Or, for 220 volts a.c., 50-60 cycles, add the number 220 to the catalogue number, and increase price 60c net. ($16.18 and $18.19)

The receivers advertised on this page are expertly designed, engineered and manufactured, and are not to be outclassed by any receivers offered at anywhere near the prices quoted. Thousands of delighted customers attest to the superior excellence of these receivers. Moreover, prompt shipments are made, and the most courteous and fair-minded treatment accorded to customers. The factory is at Sandusky, O., and transportation charges will be on the basis of shipment from that point. You may select any carrier you like, and notify us which way to ship. Otherwise all shipments will be sent by Railway Express Agency. In all instances you pay the transportation.

All prices quoted are on the basis of remittance with order. If C.O.D. shipment is desired, send 25 per cent. with order, and shipment will be made C.O.D. for the difference. The net price on merchandise ordered C.O.D. is 2 per cent. higher than the remittance-with-order prices quoted.

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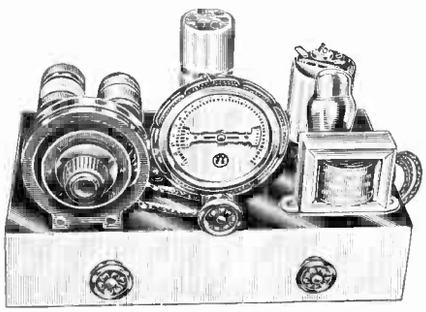

A compact and efficient assembly marks this short-wave, converter obtainable in kit form or as wired model.

Wired Model.....$9.95 **Kit of 2 Tubes**.....$2.25

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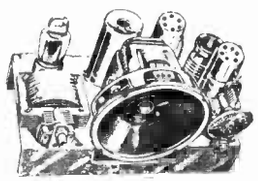

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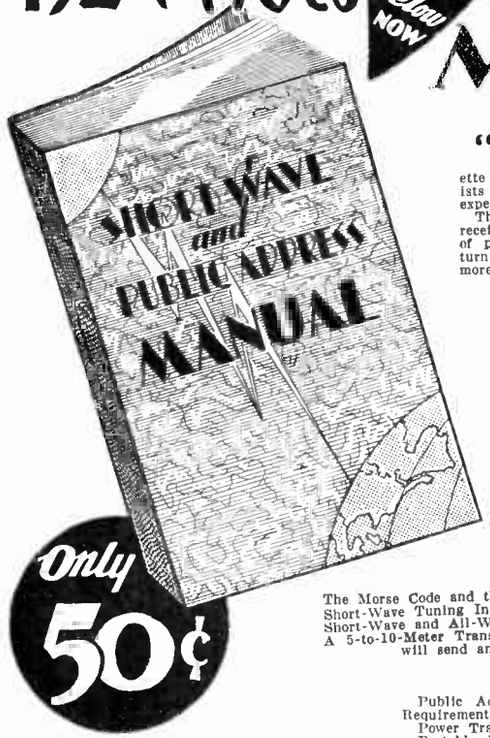

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