A BATTERY-OPERATED 5-TUBE SUPERHETERODYNE

RADIO WORLD

REG. U.S. PAT. OFF.

The First National Radio Weekly

659th Consecutive Issue—Thirteenth Year

NOV. 10, 1934

15c Per Copy

ELIMINATING NOISE FROM RECEPTION

SIMPLEST TYPE AUDIO OSCILLATOR

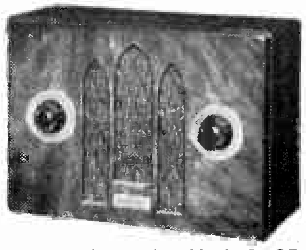
HAM NEWS AND CIRCUITS

A 2-TUBE UNIVERSAL SHORT-WAVE RECEIVER

110 kc to 20 mgc Wired Set Complete with RCA Tubes $16.64

HERE is a tuned-radio-frequency model DIAMOND OF THE AIR for covering from 110 kc to 20 mgc, therefore truly all-wave, and costing you only $16.64. And if you don't want such wide wave coverage, say, want only short waves, or only the broadcast band, the cost is even less. The difference is due to the cost of extra coils, that's all. The Series 1040 DIAMOND OF THE AIR is just the thing for those who want real reception at low cost, and who are willing to use plug-in coils, because in that way the cost of constructing the set is kept down. The results are of a high order.

This model uses one 25Z5 rectifier, one 43 tube, one 44 tube and one 77 tube. And the wired receiver is supplied completely equipped, ready for operation, with four RCA tubes and built-in speaker, in cabinet.



The series 1040 DIAMOND OF THE AIR is an all-wave instrument contained in an attractive midget cabinet and has tuning control and volume control. By using adapters operation may be enjoyed on 6-volt d-c supply, on 32-volt farm lighting systems, or on 220 volts a-c or d-c. The standard model is for 90-120 volts a-c operation, any commercial frequency, or on 90-120 volts d-c. Shipping weight, 8 lbs. Net price, complete, in cabinet, wired....$16.64

Extreme pains have been taken to make this inexpensive all-wave DIAMOND OF THE AIR a truly worth-while product, despite the exceptionally low cost. We believe that it is the lowest-priced all-wave receiver in the world. And we know that users are fully satisfied with results. The instrument is really high grade.

Some examples of how pains were taken: The speaker used is a real dynamic. The broadcast-band coverage is from 540 to 1,710 kc, complete coverage, and even into some police frequencies. Antenna is built in. There is provision for phonograph or earphone attachment. The steel shield cabinet is of burl walnut Bakelite finish. The receiver is made to function well on 90-120 volts of any commercial frequency, i.e., 25, 40 or 50-60 cycles. The filtration is so good that operation on even 25 cycles is entirely satisfactory.

This receiver is sold only in cabinet, wired, and complete. No separate chassis is obtainable.

The adapters permit operation on automobiles, boats, farm light plants, steamships, etc.

Model 1040-A. 4-tube universal wired receiver, complete with four RCA tubes, and coil for the broadcast band only; contained in attractive midget cabinet; dynamic speaker; phonograph connecting posts. Shipping weight, 8 lbs. Net price....................**$10.77**

Model 1040-B. Same as above, except that four coils are supplied for the short waves only, 1,500 kc to 20 mgc. Shipping weight, 8 lbs. Net price......**$14.68**

Model 1040-C. Same receiver, with broadcast coils, also low-frequency coils (to 110 kc) and short-wave coils (1,500 kc to 20 mgc). Shipping wgt., 8 lbs. Net price **$16.64**

ADAPTERS

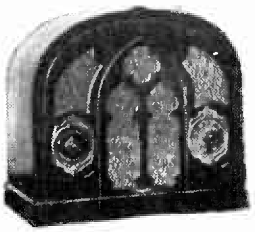
Auto adapter, complete with suppressor, Cat. 1040-ATAD **$7.35**

32-volt Farm Light Plant Adapter, Ct. 1040-FLPA **5.40**

220-volt adapter for ac-dc use, Cat. 1040-220..... **.88**

540-1,900 kc Set for AC Operation $12.91

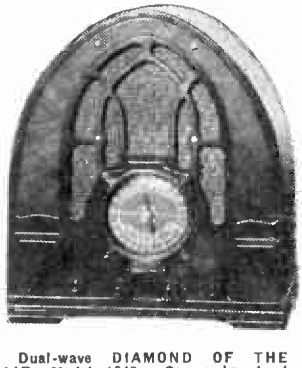
FOR those who are interested only in the broadcast band we have a splendid ac t-r-f model DIAMOND OF THE AIR that tunes from 540 to 1,900 kc, and therefore gets some police and amateur calls as well; that has frequency-calibrated and illuminated airplane dial; and that can be bought, complete with tubes, all wired and ready for operation of its self-contained dynamic speaker, at only **$12.91** net, for 50-60 cycles a.c., 105-120 volts. Model 1041-DL, at left, and Model 1041 at right, are the same sets except for cabinets. Not only may the receiver be bought already in its cabinet, but separately as a wired chassis, with speaker and tubes (less only cabinet). Besides, there is a model for 25 cycles a.c., 90-120 volts, and another for 220 volts a.c., 50-60 cycles. This is a tuned-radio-frequency receiver, five-tube model, using two 6D6, one 6C6, one 42 and one 80 It will be noticed that the economical and electrically strong 6-volt series tubes are used in the receivers proper. The primary power consumption is 55 watts. Not only is this a fine receiver, but it is made right, and every attention has been paid to detail. The airplane type dial is frequency-calibrated, so that the frequencies are read directly. There is provision for phonograph connection. The cabinet is walnut. And the performance, from the viewpoint of sensitivity and electricity, is adequate even for exacting needs, despite the sensationally low price, only **$12.91** net. This price admittedly seems out of all reason, compared to satisfactory performance, and yet the answer is found in the great popularity of this particular model. And, just as a hint, it makes a dandy and appreciated gift.



Take your choice between the Model 1041-DL five-tube t-r-f broadcast DIAMOND OF THE AIR in a de luxe Gothic cabinet (shown above) at 59c extra, net price $13.50, or exactly the same receiver in the oblong cabinet illustrated at right.

The oblong cabinet in which the 1041 is housed. The complete receiver, with speaker and tubes, costs only $12.91 in the cabinet illustrated above. The price is F.O.B. Sandusky, O., which applies to all prices quoted. See notice at bottom of this advertisement. Study the lines of the two cabinets into which the same chassis is put and select the one that better suits your living room, parlor, bedroom or den.

DUAL-WAVE DIAMOND OF THE AIR



Dual-wave DIAMOND OF THE AIR, Model 1043. Covers broadcast band and also one short-wave band, 55 to 18 meters. Equipped with automatic volume control, manual volume control, airplane illuminated dial calibrated in frequencies, tone control, wired and supplied in Gothic cabinet with five RCA tubes; 50-60 cycle, 105-120-volt operation. Model 1043. net price F.O.B. Sandusky, O. $18.80

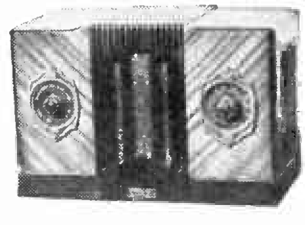
THE most popular receiver today is the dual-wave type that covers the broadcast band and one short-wave band. On that one short-wave band are found the most important foreign stations. The coverage of the Model 1042 receiver is: broadcast band (550 to 1,500 kc) and short-wave band (5,500 to 16,000 kc). Therefore the short waves are tuned in from 18 to 55 meters, and that is the band on which the most important foreign program transmitters are working. Anybody who has not had his taste of short-wave reception will do well to be initiated with either of these two dual-band receivers. Model 1043 is illustrated at left, and is a superheterodyne for foreign and domestic reception. There are also the following valuable features: built-in antenna, frequency-calibrated dial, separate short-wave switch (no plug-in coils), dynamic speaker, figured walnut cabinet with figured Oriental overlays And the price of Model 1042 (at right) is only **$18.21** net, F.O.B. Sandusky, O. (Shipping weight, 10¾ lbs.)

Model 1043, illustrated at left, has an airplane frequency-calibrated and illuminated dial, and besides can be obtained for battery operation and 32-volt operation It is a superheterodyne of the switch type, covering the broadcast band and 18 to 55-meter short-wave band. It has automatic volume controle and tone control. It is for 105-120 v. 50-60 cycle operation. Primary power consumption 60 watts; shipping weight, 175 lbs. Net price **$18.80**

Same as above, except for 25-cycle operation, order Model 1042-25. Net price **20.27**

Mattery model (less batteries). Model 1042-B........................ **18.80**

32-volt model (for farm lighting plants; a.cfl operation). Model 1042-FLO **23.52**



Dual-wave DIAMOND OF THE AIR. Model 1042, in a handsome oblong cabinet, 11⅜ inches wide by 7½ inches high by 6¼ inches front to back. This covers the broadcast band and also one short-wave band by switching, 55 to 18 meters The net price of the illustrated model is $18.21. The chassis, speaker, tubes may be obtained (complete less cabinet), by ordering Model 1042-CH @ $14.97. A 220-volt adapter may be obtained at 88c extra. The receiver is a superheterodyne and provides splendid results both on the broadcast band on short waves.

Ten Years of Experience Behind These Sets

The factory is at Sandusky, O., and all prices quoted are F.O.B. factory. You pay the transportation charges from Sandusky in all instances. You may select what carrier you desire and we will ship according to directions. Otherwise shipments will be made by Railway Express Agency. In asking for shipment by other means, please add transportation cost to the prices quoted. Express shipments are sent collect for the amount of the transportation charges. You will get receivers of the very highest type backed by 10 years' experience in making radio receivers. Remit to New York office full amount of net prices. If C.O.D. shipment is preferred, send 25% of net prices. Shipment will go C.O.D. for balance, at 2% above quoted net prices.

GUARANTY RADIO GOODS CO., 145 West 45th Street, New York, N. Y.

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THIRTEENTH YEAR

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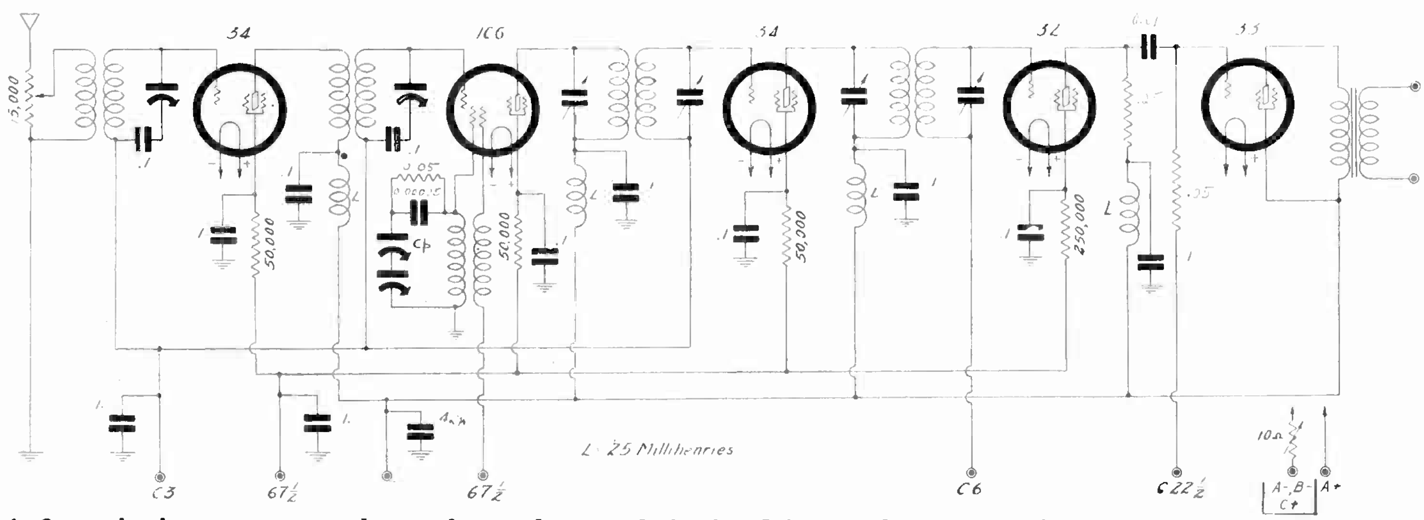
Braden's Battery Set

Experimenter Makes Hit with "Trickless" Circuit

By Leonard L. Woods



A five-tube battery-operated superheterodyne as built by John Braden, except that he used a 1A6 inseead of the 1C6. The set worked very well on his boat, in the clubhouse and elsewhere, getting semi-distant stations on a short stretch of aerial. It is of course well suited to home use.

THE majority of the radio audience finds pleasure in listening to the broadcast talent of our stations by means of receivers that are plugged into the 110-volt lighting circuit. This practice is a most convenient one and is a real improvement over the past practice of using batteries. Accordingly, one is likely to forget that there are occasions when the 110-volt lighting circuit is absent and an independent power supply is necessary. Under these circumstances the dry battery offers distinct advantages and it is of use to utilize a circuit with tubes that can be run economically on dry cells. Such a circuit is of value in the field, or on a boat, where power is obtained through batteries. The diagram at the head of this article has been tried and was found to be true to its expectations.

Tubes Used

The superheterodyne circuit is generally accepted as the best all-around circuit and we accordingly start from that point. Since this set is to be powered from batteries which have the bad habit of losing their energy after some use and require replacement after a time, it is important that this set be economical in its use of current.

This involves a limitation in the number of tubes and for best results consistent with this requirement and effective output, it was decided to use five tubes: one r-f stage, one pentagrid converter, one i-f stage, one detector and a stage of audio-frequency amplification.

It was with these notions in mind that John Braden, of 113½ East 31st Street, New York City, set about designing and constructing such a set. He is now desirous of proclaiming its virtues to all of you who feel the need of a set that will give results despite the absence of an unlimited power supply.

No Tricks Tried

He states that the steady current drain of such a set is in the neighborhood of 0.75 ampere total, which results in reasonably long life of the battery supply. Using three 45-volt B batteries connected in series to furnish the maximum of 135 volts applied to the plates of the tubes, and two No. 6 (1.5-volt) dry cells with a suitable dropping resistor in series for the filaments, the power supply should not need replacement for six months or so of average use.

The circuit on this page is the one that Mr. Braden built and selected as the permanent one, after he had tried other circuits, like the one printed on the following page.

He owns a boat on which it is his delight to cruise in Long Island Sound during the summer months, and on his boat he got semi-distant stations with no difficulty whatever, using only a short length of wire as aerial, for instance, tuned in Baltimore, Cleveland, Boston, etc.

It was at the New York Athletic Club that he mused about the accomplishments of this little receiver, although stating modestly that it was just a standard hookup, with no tricks or experiments introduced.

"Trick circuits are fine for experimenting, and I get a lot of fun out of them, but when you want a small battery set for results, you have to stick to standard practice, and that is all I have done," he said.

Coil Information

The coils used at the radio-frequency level were of standard commercial manufacture, with an inductance of 230 microhenries. On 1-inch diameter tubing 127 turns of No. 32 enamel wire are wound. The tuning condenser may be from 0.00035 mfd. to 0.0004 mfd. Then the oscillator has an inductance of 110 microhenries, and consists

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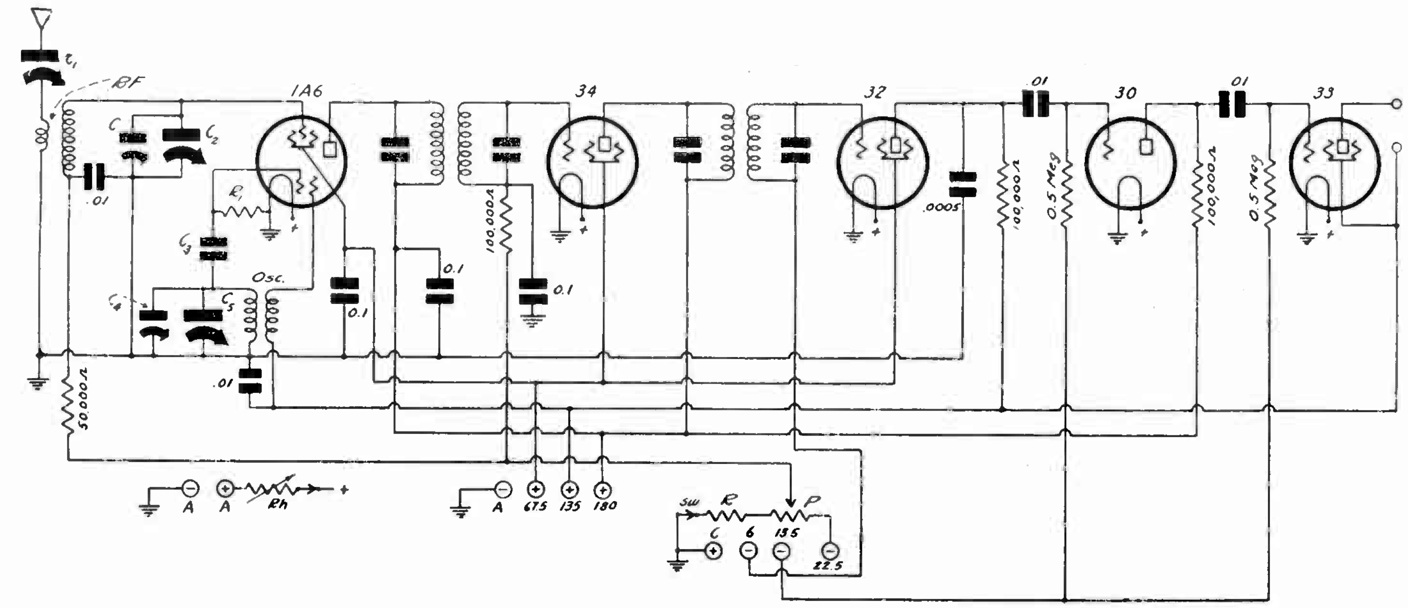


This type of circuit was not found so suitable, although it too has five tubes. The reasons are set forth in the text.

of a secondary of 67 turns of No. 32 enamel wire. The intermediate coils were of the mica-dielectric-condenser tuned type.

The volume control is a 15,000-ohm tapered type, with the slow change of resistance at the ground end.

1A6 and 1C6

The plate legs have r-f chokes, the inductance of which is not critical, 10 to 80 millihenries, and while two of the screens in the tuner have 50,000-ohm limiting resistors, the second detector tube has a resistor of 250,000 ohms in this position. The detecting efficiency, and particularly the tone, are better that way, he found. The condenser bypassing this resistor should be as large as practically obtainable, and no value therefore is shown on the diagram, but 4 mfd. would not be a bit too large. Of course if you want to build the circuit and haven't a spare 4-mfd. condenser you can put in a one-mike.

In the diagram of the set he built, the maximum voltage is not marked or identified. It is, as stated, 135 volts, and the post for it is between the two posts marked 67.5 volts.

The 34 tube as the r-f amplifier has a remote cutoff characteristic. So has the new pentagrid converter, the 1C6. Originally he used the 1A6. The 1C6 has twice the emission. This is not so important for broadcast-band work, so if you have a 1A6 you may substitute that without any changes in the circuit whatever, except that the 10-ohm rheostat would be set to a position of slightly more resistance than required for 2-volt establishment for the 1C6. This is because the filament current for the 1C6 is about twice that of the 1A6. Also this may be a reason why some would prefer the 1A6, because if economy of current consumption is an impotrant consideration, as it would be for use of the set on a boat or at camp, or even in some homes, then the 1A6 should be selected.

The 34 tube is used as the sole intermediate-frequency amplifier, while the 32 is the seocnd detector, worked in negative-bias style, with a 6-volt battery furnishing the bias. The actual bias is the sum of the battery voltage and the drop in the rheostat, or 7 volts, as the datum is the negative filament.

Output Circuit

A minus, B minus and C plus represent one connection, as shown at right. The output transformer is such as to suit a magnetic speaker—therefore, a speaker that requires no separate excitation, which would be power-consuming under the circumstances—and the impedance looking out of the transformer is around 4,000 ohms.

In the circuit there is used a three-gang condenser. In a previous circuit a two-gang condenser was used, and still five tubes maintained, as there were two audio stages. It was found that if the fifth tube, so-called, were used for r-f amplification the gain was at least as great, and to boot there was more selectivity, so it was found advisable to build the circuit according to the first diagram.

The intermediate frequency used was 465 kc, but 175 kc may be used instead, if desired, with no change save that the inductance of the oscillator secondary would be higher, and is so provided in commercial coils. An inductance of around 180 microhenries will prove satisfactory. The padding condenser Cp for 465 kc should be adjustable from 350 to 450 mmfd. and for 175 kc adjustable from 800 to 1,300 mmfd.

Careful Alignment

"In the alignment of any intermediate channel extreme care should be taken," said Mr. Braden, "but particularly in the case of a small battery-operated set, as the sensitivity may be reduced 25 per cent. by just the slightest mistuning of the intermediate channel.

"Therefore it is imperative to use a signal generator, and have it set at a weak value of output, that is, considerable attenuation introduced, so that the point of exact resonance will be readily deermined. In tuning the intermediates, first tune the plate circuit condensers, then the grid circuit condensers, and never molest the plate-circuit condensers after the grid-circuit ones have been tuned."

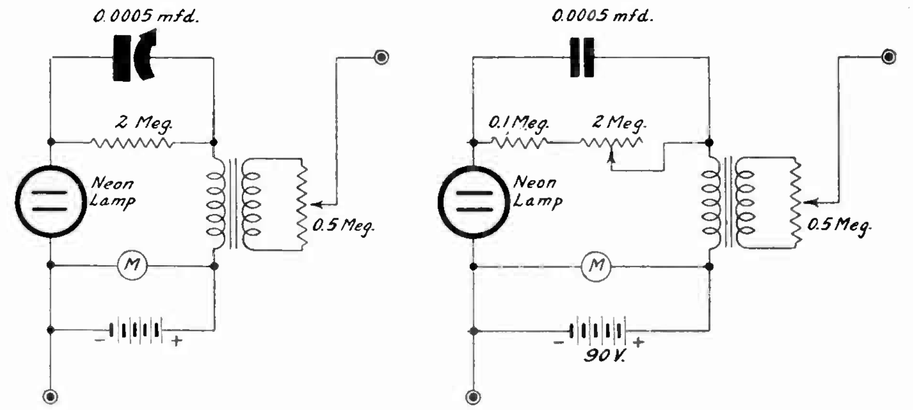
Some Audi Oscillators

Neon Tube Used, Condenser Varied in One Instance, Resistor in the Other

By Jack Tully

THE neon lamp makes a suitable audio oscillator. In fact, it can be made to oscillate at frequencies in the radio realm, perhaps to around 100 to 150 kc. But for audio purposes it is easy to get it to oscillate. All that are needed are a properly related series circuit, consisting of a resistor and condenser in parallel. This method is shown in the two diagrams. At left a variable condenser is used to change the frequency, the resistance being fixed. At right a variable resistor is used to change the frequency, the condenser being fixed.

By selecting suitable constants the audio range can be covered nicely. With 2 meg., in a circuit across which there were 110 volts of d.c., the 0.0005 mfd. capacity was large enough to reach the lowest frequency desired, but if any one wants to go lower, he may use a higher capacity or a higher resistance.



Circuit diagram of the Federal Short-Wave Receiver. This corresponds to the pictorial diagram on the immediately preceding pages.

Used as Hour Clock

The circuit at left stopped oscillating before the minimum of the condenser capacity was reached. By that time also, the oscillation was above the audio range. When this stoppage takes place it is necessary to turn the condenser to higher capacity than that used when stopping occurred, to restore oscillation. So, a small fixed capacity may be put across the variable, to establish the circuit well below the highest possible frequency of oscillation. This may be around 20,000 cycles, which is a higher frequency than normally would be used, anyway. The circuit can be made to oscillate, if the condenser is large enough, at a much lower frequency than most persons would want, a fraction of a cycle a second. There is an upper limit of frequency, as stated, but perhaps there is no lower limit. One circuit set up, and used as an experimental clock, oscillated once an hour.

The wave form changes as the frequency, or amplitude, changes. The amplitude is not constant for all frequencies. It is more constant with the condenser across the resistor, as shown, than when the condenser is across the lamp. Also, by the circuit method, the intensity of oscillation is many times larger than if the condenser is across the lamp. The frequency is only trivially different whether the condenser is across the lamp or across the resistor.

One of the "problems" is to couple the audio circuit to the work circuit. Normally the neon device would be used as a source of audio-frequency feed to an audio amplifier. There will be enough output for that, and also for coupling to a radio-frequency oscillator, for purposes of providing modulation of various frequencies. There is at least no danger of overloading the r-f generator.

Lamp Current Small

A transformer may be coupled to the circuit, as shown. A ratio of about 1 to 1 would be satisfactory, and an output transformer as used with magnetic speakers would prove all right. If there is a stepup ratio, the smaller winding should be in series with the lamp circuit and the larger one used for the output.

When a transformer or earphones are included, the frequency of generation is changed a bit. Also, the flatness of the response curve will depend a good deal on the transformer and earphone characteristic. However, the transformer primary will not suffer loss of inductance, because there is no high current through the primary. The lamp current is exceedingly small, a few microamperes.

Any type of neon lamp may be used that has no limiting resistor built in. Even types with the resistor built in can be made to oscillate, especially if the extra resistor is made larger than 2 meg. Oscillation may exist with 2 meg. used with such a lamp, but it is aided when the extra resistor is large compared to the limiting resistor, which generally runs from around 100,000 to 250,000 ohms or so, for the usual voltages. The wattage rating of the lamp does not matter. That is, it may be of smallest wattage. The one actually used is possibly the smallest wattage neon lamp made, being rated at 1/25 watt. That would mean 4 microamperes, but the lamp wattage dissipation in the present use is much smaller, as by far the greater drop is in the limiting resistor.

Frequency Stability

An attenuator may be included. The type shown is any high-resistance potentiometer, 500,000 ohms or more, and the pointer may be connected to B minus. This is about as close as one can come to a constant-impedance device, using a simple potentiometer. If the arm is not grounded the volume may change in respect to center position of the arm, rising when the arm is moved away from center in either direction.

The circuit can be made to work on as low as 90 volts, and that is a handy voltage to obtain from B batteries. The voltage changes the frequency, so if any calibration is run, the voltage should be measured on the basis of that calibration, the voltmeter left in circuit.

Any device that changes its frequency considerably due to changes in terminal voltages is necessarily unstable, and in that sense the neon-tube oscillator is unstable. The corrective is to make the terminal voltage a constant. Then the practical stability is pretty good, but it depends on the resistor retaining its resistance value, and the usual grid-leak type of resistor can not be expected to do that. However, as a trial, an ordinary 2-meg. resistor may be used, and the condenser varied.

The variable high resistance will not keep its resistance, but due to age and use will change, so the variable may well be the condenser. Then if one desires to make a permanent audio oscillator he may use a wire-wound resistor. A non-inductive type is preferable.

Plotting a Curve

An ordinary dial, reading 0-100, may be put on the variable condenser, and earphones connected across the output. For a start, known frequencies may be compared by ear for purposes of calibration. One method is to connect the a-c line to the field of a dynamic speaker and hear the 60-cycle hum. The resonances at 60, 120, 180, 240, etc., cycles will be heard plainly, and the curve may be plotted accordingly, the ear acting as detector.

A better way would be to put the line frequency, a small voltage value thereof, into an harmonic-producing vacuum tube, such as one hooked up in grid-leak-condenser fashion. Then the line frequency may be weakly coupled to the output of the neon device, as by small capacity, and the phones placed in series with the B battery. Harmonics are detected by listening.

In whatever position the phones are included during calibration, they must be retained when the calibration curve is consulted, unless they are replaced by an equal impedance. Mere substitution of a resistor equal to the d-c resistance of the phones is not enough.

Audio frequencies may be obtained from broadcasting stations, by picking up a station very weakly in a receiver, as by using a short antenna, or a small condenser in series with any antenna, and beating an harmonic of an oscillator of the signal-generator type, except that the r-f oscillator should have no modulation, and should be d-c operated, or, the equiv-

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(Continued from preceding page)
alent, have a well-filtered a-c supply. A-c on the plate will not do in this instance.

Stations Used

Suppose one has an oscillator of the low radio-frequency type and beats the sixth harmonic of 95 kc with a station frequency of 570 kc. Then if one turns the receiver to pick up a station on 660 kc, leaving the signal generator undisturbed, there will be a beat heard here, too, because the seventh harmonic of 95 kc is 665 kc, and the beat of this seventh harmonic is 1 kc removed from 660 kc, so what is heard is 1,000 cycles, and this may be used as a basis. So, by selecting other stations, and other harmonics of other generator fundamentals, local stations being used as standards, the audio tones can be computed.

It is necessary almost completely to remove the modulation of the station carrier, but weak coupling accomplishes this sufficiently. The beat then can be heard even if the program is inaudible. So it is perhaps well first to get the station tuned in, using stronger antenna coupling, then reduce the coupling until the station can not be heard, and then pick up the beat with an harmonic of the unmodulated oscillator.

Of course some may have friends who possess a beat frequency oscillator and will resort to the honored practice of borrowing this, for purposes of comparison and calibration. Others, with musical training, can get a gretty good approximation by ear, although that is never quite reliable, no matter how expert one may consider himself to be. Another method is to use a tuning fork, particularly one of a relatively low audio frequency, and have it driven by a vacuum tube that produces harmonics.

Tube for Measurement

The usual comparative method is to put both the output of the circuit to be calibrated, and the source of the frequency standard, into a vacuum tube, and measure the plate current. When the needle shows maximum deflection the frequency of the unknown is equal to the frequency of the known. In some hookups the maximum deflection means minimum current, in others it means maximum current. For leak-condenser operation of the vacuum tube the needl swings toward low readings for resonance, for self-bias or fixed bias by the method that omits leak and condenser the needle swings the other way.

Metropolitan Opera On Air Christmas Eve

A new sponsor, a pharmaceutical concern, will put up not much less than $400,000 for the privilege of attaching its name and credit to the broadcasts of the Metropolitan Opera Company this season. The programs will continue for the opera season and will be sent over a coast-to-coast chain.

Better acoustical results are expected this year, in view of the improvement in microphones. A bullet-type microphone, combining the features of the velocity or ribbon type, and the dynamic type, will be used. It has a semi-focusing effect that subdues background noises.

The first air performance this year will be on Christmas Eve, and the program will be sent out by the National Broadcasting Company. This is the most expensive sponsored broadcast. Last year another company paid $375,000 to gain commercial benefit from the broadcasts. The cost depends considerably on the number of stations used.

Killing O

A New Viewpoint Looki

Serious Impedime

By Harvey

INTERFERENCE is of three general sorts: (1) due to stations overlapping or beating, or to insufficient selectivity in the receiver even if the stations are not close enough together to beat; (2), radio-frequency static; (3), audio-frequency static.

Static may be considered as stray pulses originated by nature or by man, especially in his use of rotating devices. In general, static may be defined simply as noise. The frequencies are heterogeneous. A motor may be sparking, an ignition coil may be exciting the ether for hundreds of yards, a vibrator or an X-ray machine may be grinding out its interference to radio. And then there are the mysterious factors called line noises, which somehow become classified as audio-frequency or acoustical interference, although there must have been a great deal of misconception concerning these in the past. It has seldom been true that doing something to the line at the connection to the receiver plug helped much, that is, in an acoustical sense.

An Aspect of the Line

Consider the line for what it is, a conductor of the energy supplied by the power company. If any acoustical interference were communicated to the receiver certainly the hum of the line would be heard. The receiver itself has filter circuits that reduce the hum frequency to something like 5 per cent. of its original value. Higher audio frequencies, such as are heard as interference, would be trapped out practically completely.

Radio frequencies, however, are not foreign to the line. Surely the line is a ratable antenna. It has capacity and inductance, the prime requisites, and it even has radiation resistance. Therefore it is quite possible for the line to be a source of interference, not so much as a conductor of noises in the audio-frequency region, but as a system close to ground, where the radio-frequency voltages that are noise-modulated abound, and so the line becomes a transmitting antenna. As a receiving antenna at the set end the line cord may be considered dead because grounded. There is no radio-frequency voltage at the chassis. The r-f current may be enormous, but the voltage is what counts, and is practically zero.

Therefore it is not ridiculous to consider having the line cord shielded and shield grounded, so that radio-frequency interference conducted along the antenna formed by the line wiring is not radiated in the room where the leadin is brought to the set. The grounded cable method is practically standard for the submerged wiring, to wit, the use of BX cable, but when one connects a line cord from set to outlet he does not resort to shielding, so may invite some trouble.

Mercury-Vapor Rectifiers

The B filter and rectifier may be considered as shorting radio-frequency interference introduced into them. It is true, of course, that there can be some pick-up by the B rectifier, so that it will act as a detector of radio waves, but the output is shorted. What does happen in the rectifier sometimes is that an oscillation is set up, and radiation takes place from the tube through the static field, hence the rectifier may act as a trigger to start similar oscillations in other tubes in the set, or produce a gurgling noise, as with the 82 and 83 tubes. However, this vice is recognized and is corrected by the insertion of radio-frequency chokes, one in each plate leg, inductance about 1 millihenry. The tube then does not become a relaxation oscillator or any other kind of an oscillator, and reception is quiet. Indeed, the mercury-vapor tubes are quieter in operation than the 80 or the 25Z5.

As is well known, the mercury-vapor tubes have a negative resistance characteristic, meaning that the current decreases as the voltage increases, hence the danger of oscillation.

When there is radio-frequency voltage in the line cord that acts as a transmitting antenna, it is possible to trap it out somewhat by insertion of radio-frequency filtration in the line. This method is shown in the diagram. The coils are wound on separate cores and are not inductively related to one another. The filter capacities need not be as high as shown.

"Feeding Through the Line"

Obviously if the line cord acts as an antenna, the place to put such a filter is at that point where the grounded covering of the line wires ceases and the receiver's a-c cord connects. This means that the filter should be between the outlet and the plug of the line cord. It is well to have the filter in a shielded container and ground the shield, also shield the line cord and ground that shield.

Particularly if the receiver is very sensitive does the radiation, or really reradiation, from the a-c cable of the set cause trouble. The fact that this line is a radiating antenna was ascertained when the trouble of "feeding through the line" was experienced with some signal generators.

How can a radio frequency feed through the line and get anywhere into the set through a power transformer, for instance? The capacity in the transformer is enough for bypassing purposes. Besides, the audio filter is there, too, the hum-squelching circuit, for if hum of 60 or 120 cycles is filtered out, why not the far higher frequencies of radio?

Easy Proof

It became quite obvious, after some experiments, that the oscillation from the generator did not "feed through the line," in the sense that the oscillation is backed into the set through the power transformer and B filter, but it is true that the a-c cable acts as a transmitting antenna. The proof is easy. When the aerial is removed from the receiver nothing from the generator can be heard in the set. When the aerial is restored, the feeding through is restored. Therefore the receiving aerial is picking up the radiation from the unintentional transmitting aerial.

Hence the method of shielding the a-c

ff Noise

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nt to Reception

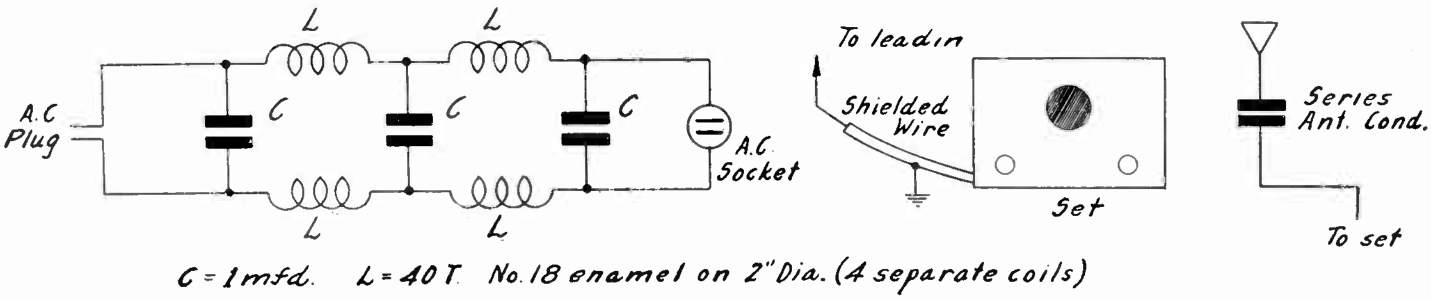
Sampson

pacity, or simply by physically shortening the aerial.

Purposeful Mismatch

When the capacity is small the higher radio frequencies are favored by the condenser effect of the antenna, because the impedance is suitable for these higher frequencies, and a mismatch for the lower and interfering ones.

The type of noise being discussed, referring to origins from rotating devices particularly, and these are the most troublesome, does not as a rule fare well in conjunction with any tuned circuit. The impedance of a tuned circuit is right



Shielding the a-c cord and grounding the shield helps to reduce noise caused by pickup by this cable, and re-radiated to the leadin. A series antenna condenser helps, and should be of small capacity, or the physical length of the aerial may be reduced.

cable is suggested for stopping noise from coming in, noise here meaning radio-frequency voltages that are modulated by heterogeneous sound that the receiver picks up as r.f. and amplifies as such, detects and then amplifies as mere noise, that is, audio values.

The motor interference is particularly obnoxious, sounding like that type the amateurs call "hash." How anything revolving at a slow speed, compared to radio frequencies, can generate radio frequencies, may seem mystifying, but the emanations from sparking and the like are of all sorts of frequencies, most of which die down quickly, except for one radio frequency, which becomes the strong interfering carrier.

It is interesting to measure the frequency of the interference. Usually it will be found to be of a low value of radio frequency. If one has a frequency-calibrated receiver, including a receiver for which one has calibrated his own tuning curve, the frequency of the interference may be measured as the frequency differences between consecutive points on the receiver dial where the noise is heard. That is, the noise is tuned in as if it were a station, and repeats itself along the dial, growing weaker and weaker as the frequency to which the receiver is tuned is increased. This gives us an idea that harmonics have something to do with the trouble.

Use of Wave Trap

Suppose the noise is heard at 550 kc, again at 600 kc, again at 650 kc, again at 700 kc, etc. Any one difference will measure the frequency of the interference carrier. This frequency is 50 kc. If one has not much faith in the accuracy of the calibration of the receiver, he may register the frequency at the lowest extreme of the receiver, count the number of responses due to the noise, note the highest frequency at which the noise is plainly heard, and striking the difference between these two extreme frequencies, divide the difference by 1 less than the total number of responses counted. The answer will be the frequency of the interference.

It then becomes practical to instal a wave trap in the antenna circuit tuned to just that frequency, and either trap out that frequency entirely, which close tuning of the trap will do, or reduce the noise very materially. It may be possible to eradicate it entirely, or have the reduction apply all along the line, almost to the noise-disappearing point.

Author's Theory

This would tend to confirm a theory of the author's that much of this interference is due to a single carrier of low radio frequency being brought in with much strength and intensity, the repeat points of interference when tuning through the dial scale being due not to the generation of harmonics by the interference device—for there is no reason to assume that the harmonic relationship originates there—but due to the receiver itself generating the harmonics.

The shock excitation of the first tube is enough to do the trick. The resultant harmonics then become subject to tuning, amplification, etc., in the subsequent cascade of the receiver the same as would any other input. This theory has been given some test attention and has been found not to be unwarranted, to say the least.

Lessened Input

Since it has been found that noise carriers are most productive at lower levels than the aerial, it follows that the leadin will be troublesome, unless shielded. This shielding may consist of the use of shielded wire, shield grounded, but the insulation between the conductor and the wire must be thick to reduce the loss to ground due to the capacity effect, or a transmission line may be used, the theory of which is that crossed wires, or parallel tuned wires, neutralize the pickup. The crossed wires are familiar in the transposition-block system. The tuned wires are familiar to hams as the Zepp antenna, where the feed to antenna proper is through a series condenser, and an equal series capacity is in series with the neutralizing feed. At top the neutralizing feed is simply connected to one side of an insulator, the other side of which goes to one terminal of the aerial. At bottom both wires are connected to an r-f output transformer.

It will be found that as the input to the set is reduced that the noise is reduced. This tends to confirm the origin of noise to a considerable extent on low radio-frequency carriers, for practically all reduction of input spells reduced antenna capacity, the equivalent of introducing a series capacity. This may be done by actually introducing such a capacity for the frequency of resonance, and as this is not the frequency of the interference, unless by an harmonic order and quite by accident, when a station is tuned in this type of noise suffers relative abatement. Then there is another help, the strength of the signal heard from the station improves the ratio of signal to noise. After all, it is the ratio that is desired to be built up. Lessened input can be tolerated on the basis of quiet and enjoyable reception resulting.

Suppose that a motor originates a noise carrier, and that the first tube is shock-excited, generates harmonics, and some of these harmonics fall at frequencies equal to those of local stations. Now we have a more baffling case.

Beat Interference

First, if we have killed off the pickup from the leadin, and if we have reduced the input so that the higher radio frequencies are favored, which means the stations get a break, we have built up the relative value of the signal from the station compared to the noise, and still might well enjoy the program. If also we have trapped out enough of the interference carrier, despite its low frequency, we can safeguard the first tube from shock, avoid the harmonics, at least the serious effects thereof, and go blissfully about our pleasant business of listening to a program in comfort.

As to interference caused by stations beating, if this is due to stations on adjoining channels overlapping, there is no remedy save to cut in a tone filter to remove the frequency of the interference from the speaker output. This filter may be anywhere in the audio circuit. Otherwise, if the receiver is not selective enough, and the stations really do not beat, but their programs come in together, the remedy is to make the receiver more selective. A variably tunable wave trap will get rid of the interferer. This type of trap, the rejector model, must be loosely coupled to the antenna, and is very selective and effective. If at one position of the trap the interference is killed off, while at another the desired station is made louder, the trap is too closely coupled. The slightest possible coupling, let us say, is just about right. The object of the trap is to reject, this time, and not accept, so reduce the coupling. One turn of wire around the antenna binding post may be strong coupling from this viewpoint.

Checking Ham Waves

Frequency Meter Has Voltage Control for Constancy

By Russell H. DeJonge
W8DIB, Zeeland, Mich.

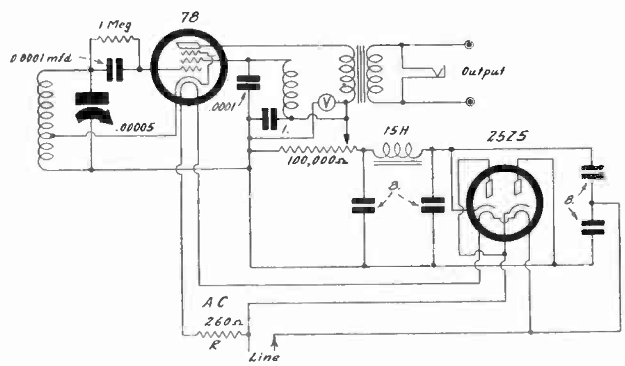


FIG. 1

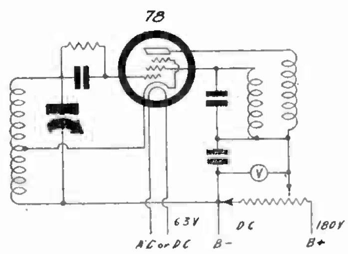


FIG. 2

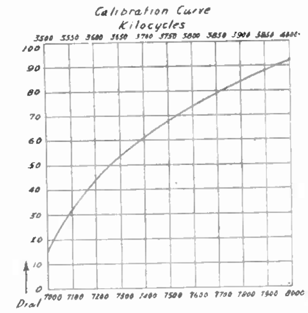


FIG. 3

The same fundamental freqeuncy meter, at left for a-c operation, at right for battery or other external voltage supply. At right, a typical calibration curve.

SINCE government regulations require an amateur to operate within certain limits, or in certain bands of frequencies, adequate and reliable frequency-checking equipment must be possessed by the amateur. The regulations require that before each transmission, no matter of how short a duration, the operator must check his frequency and see that he is positively within the band of frequencies allotted to amateur radio.

Not because my transmitter needs such checking equipment but because the regulations require frequency-checking equipment have I constructed the checking apparatus in conjunction with my transmitter, W8DIB. Mine is a crystal-controlled, temperature-regulated transmitter which maintains a frequency more constant than any frequency which does not utilize temperature control.

The frequency meter I built is an electron-coupled, shielded oscillator with output fed either to an audio-frequency amplifier or directly to a pair of headphones. The circuit is the one shown in Fig. 2. It has a 78 tube which is a radio-frequency pentode.

Battery or A.C. Operation

I have drawn two circuits. One obtains its A and B voltages externally for amateurs who do not have available the alternating current but instead use B and A batteries. However, I use this circuit and derive my power from a power pack which supplies the correct voltages. The fundamental frequency meter circuit is identical in both instances. The difference concerns only the power source.

Since only the alternating-current model uses a power unit I shall first describe its functions. The power line is fed through a switch to the filament and rectifier circuits as can be seen in Fig. 1. No power transformer is used in this unit. The filaments are excited by the part of the line voltage dropped across them. The excess voltage is "lost" in the series resistor. The type 25Z5 tube is incorporated as a rectifier, of the voltage-doubling type when it is used in the accompanying circuit. The condensers are all of the 8 mfd. high-voltage type. After the voltage is "doubled" and rectified it is filtered by means of the choke and condenser method.

The voltage in this circuit varies directly with the line voltage, which in some instances varies 10 per cent. This would make the frequency meter very inaccurate, because the frequency read varies according to the potential applied to the plate circuit. To compensate for this variation I have inserted a manual stability control which can and must be adjusted to a certain value read on the voltmeter inserted across the plate circuit. When this value, generally 150 volts, is kept constant the frequency stability is good.

Plug-in Coil Used

Now as to the frequency meter in detail. It uses a tube-base diameter plug-in coil of 44 turns of No. 30 enamel wire. The variable condenser is of the straight-frequency line type consisting of three plates. A type 78 super-control radio-frequency pentode is incorporated in an electron-coupled oscillator circuit. The entire unit is shielded with thick aluminum or copper.

If the unit is turned on, when the transmitter is emitting a signal no noise or interference should be heard in the output device which might be either headphones or a speaker with its associated amplifier.

Then the condenser is varied until at one point a clear signal or whistle is heard. Upon further turning the condenser, a point is reached where the signal drops in pitch to about 500 cycles and then begins to get higher again, as tuning is continued. At the position of the lowest pitch the signal is resonant with the signal of the transmitter. The dial setting is read and the frequency is computed from the frequency conversion graph which is drawn according to the following procedure.

A station whose frequency is known, preferably a marker or standard frequency station, is tuned in on a short-wave receiver. The frequency meter is tuned until its signal beats with the carrier being received by the set. This reading is marked, as well as readings of several other stations throughout the band. When several of these points are located a calibration curve can be drawn, the limits of the band carefully marked so one may keep his rig in the amateur band as required by the Government. A typical calibration curve for the frequency meter is given in figure three.

Other Uses of Device

In order that this frequency meter may be used in other bands or at other frequencies than the ones in the 80-meter band I have also listed other frequencies which this oscillator or frequency meter is calibrated for, without the addition of any parts.

The frequency meter is handy in locating stations on a schedule at a certain frequency by the same procedure. Let us take a typical example. Let us say you have a schedule with W8DB on 3883 kc. You set the meter at 3883 according to the curve. Next turn the transmitter on and adjust the master oscillator to 3883 if you desire to work at this frequency. Adjust the receiver to 3883 too.

Shut your frequency meter off and stand by for him at the specified time or if you prefer you might give him a call because he might be listening for you to call first.

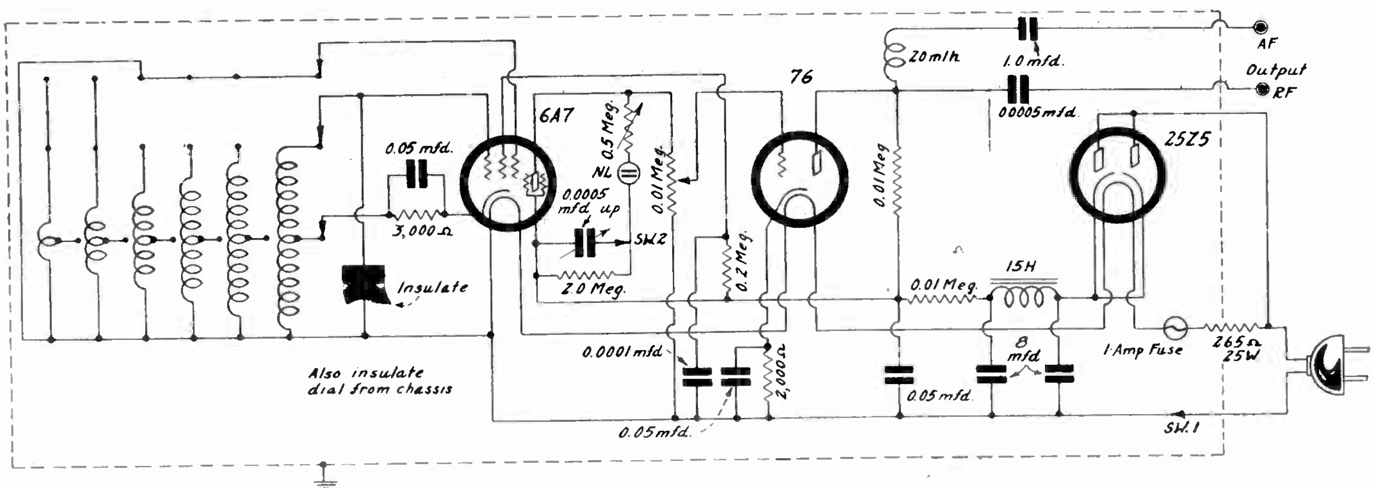
British Use Different Technical Radio Terms

When a Britisher speaks of a valve he means just what we mean when we say a vacuum tube. Also when he refers to an accumulator he is talking about a storage battery. The use of high-tension and low-tension to distinguish high voltage and low voltage is also the rule in England, so much so that H. T. and L. T. appear in a great deal of technical text.

Repetition of a Scale

For Higher Frequencies for Any Tuning

By Herman Bernard



Two scales only are used for 54 kc to 30 mgc.

PERSONS who build their own signal generators find it easy enough to calibrate the intermediate frequencies, and the broadcast band, using methods described in the September 15th, 22d and 29th issues of Radio World, but perhaps encounter some difficulty in short waves, for fundamental calibration. Therefore it strikes them that some method should be practical whereby the calibration run for the low-frequency scale might be used for high frequencies. This can be accomplished, and has been tried up to about 5 mgc. The fundamentals of the two low-frequency bands were multiplied by 10.

When a tuning condenser is worked across a coil there is developed a frequency ratio. This is equal to the maximum frequency divided by the minimum frequency. Say that the maximum is 500 kc and the minimum is 250 kc. Then the frequency ratio is 2. Also the capacity ratio can be computed, for it is the square of the frequency ratio. Hence in this instance the capacity ratio is 4. Also we can find out the descending or ascending order of inductances required for known frequency or capacity ratios.

Required Inductance Ratios

If the inductance for the band from 500 to 250 kc is 400 microhenries, then the inductance for the next higher frequency band is 400-4 or 100 microhenries, and for a next lower band, 125 to 250 kc, the required inductance would be four times that for the previous band. Hence for next succeeding lower band multiply the inductance for the present band by the capacity ratio. For next succeeding higher frequency band, where the inductance for a present band is known, divide the known inductance by the capacity ratio.

While this information is valuable as a guide, it is not practically conclusive. Standard precautions do not permit the use of the entire spectrum of frequencies that a condenser may tune through, when connected to a coil. For instance, suppose an airplane dial is used that has readings on upper and lower semi-circles. There must be a little separation between the upper and lower arcs, on the same circumference, otherwise their joining at the terminals would prove confusing. Moreover, the capacity change right near both ends of the condenser is usually erratic. At the high-capacity extreme this is due to the "end effect" whereby not all of the rotor is completely engaged in the stator, and at the low-capacity extreme wiring capacities become strongly effective at high frequencies, if the condenser is calibrated to its very terminal, and besides if an oscillator is built, it may become a bit wobbly in this region.

The Critical Frequency Ratio

In practice, therefore, not the full sweep is used. However, assuming a condenser of 0.0035 to 0.0004 or so mmfd., a frequency ratio of 3.5 is easily obtainable, if there is no trimmer or only a small trimmer.

We may select a low-frequency range on two bases: first that the lowest frequency will be low enough for all present needs, and all future needs, so far as a seeing eye can judge the future; second, that the terminal frequencies, and ratio, be such as to enable us to build succeedingly smaller coils to track the calibration of two low-frequency bands. All may be done handsomely as follows:

First, determine that critical ratio will enable the introduction of a decimal system, then select the lowest frequency and have the coil of the right inductance to strike that lowest frequency with not quite all the condenser capacity in use. The critical ratio—critical only in a mathematical sense—is 3.1485. Since we shall desire to multiply the impending scale by 10 later on, let us select a critical frequency that will suit the purpose. Now, 50 kc is 1/10 of the lowest broadcast frequency. So we select 54 kc as the terminal frequency. Later on we shall multiply by 10 to have the desired 540.

Application of Method

As stated, the critical ratio has been determined, therefore apply it. The low-frequency extreme, a bit less than maximum condenser capacity considered, is 54 kc, so, applying the critical ratio, the high-frequency extreme of this band would be 3.1485 x 54 or 170 kc.

We bear in mind that the first scale, which is now assumed calibrated, goes beyond 170 kc sufficiently for overlap purposes, and therefore we may start the second scale at 170 kc and, applying the critical ratio 3.1765 we obtain the other terminal frequency as 540 kc. We notice that the high-frequency end of this band is ten times as high in frequency as the low-frequency end of the first band, while the low-frequency end of one band equals the high-frequency end of the other. Thus, we first obtained 54 to 170 kc, and now we have 170 to 540 kc, since we need calibrate only up to the desired frequency, 540 kc.

We have 54 to 170 kc calibrated, also 170 to 540 calibrated, and we are ready to start with the broadcast band.

Select the Right Coils

All we need do is put in the right coil, and compensate for capacity, and we may read the extremely low-frequency band, 54 to 170 kc, and multiply the reading by 10, using the same calibration, for 540 to 1,700 kc. Likewise, having finished with the broadcast band, with a terminal frequency of 1,700 kc, we may start with the intermediate short-wave band, 1,700 to 5,400 kc, this time multiplying the second scale by 10, and if we wanted to continue using the same scales, introducing factors of 100, we could put in the correct coil and compensating capacity for 5,400 to 17,000 kc, and the correct coil for 17,000 to 54,000 kc (17 to 54 mgc). It is doubtful if there would be any oscillation much above 30 mgc, but at least the coils can be selected properly, so that the previous scales would be tracked by the generator, to the extinction frequency, within the 1 per cent average accuracy of the generator.

So it can be seen that the decimal system works out, yielding coverage from 54 kc to 54 mgc, at least on paper. The system has been authenticated up to 5,400 kc, but not doubt could be practically applied farther. The broadcast fundamentals tracked the lower frequency scale to 1 per cent., and the intermediate short-wave fundamentals tracked the second lower fundamental scale even better than

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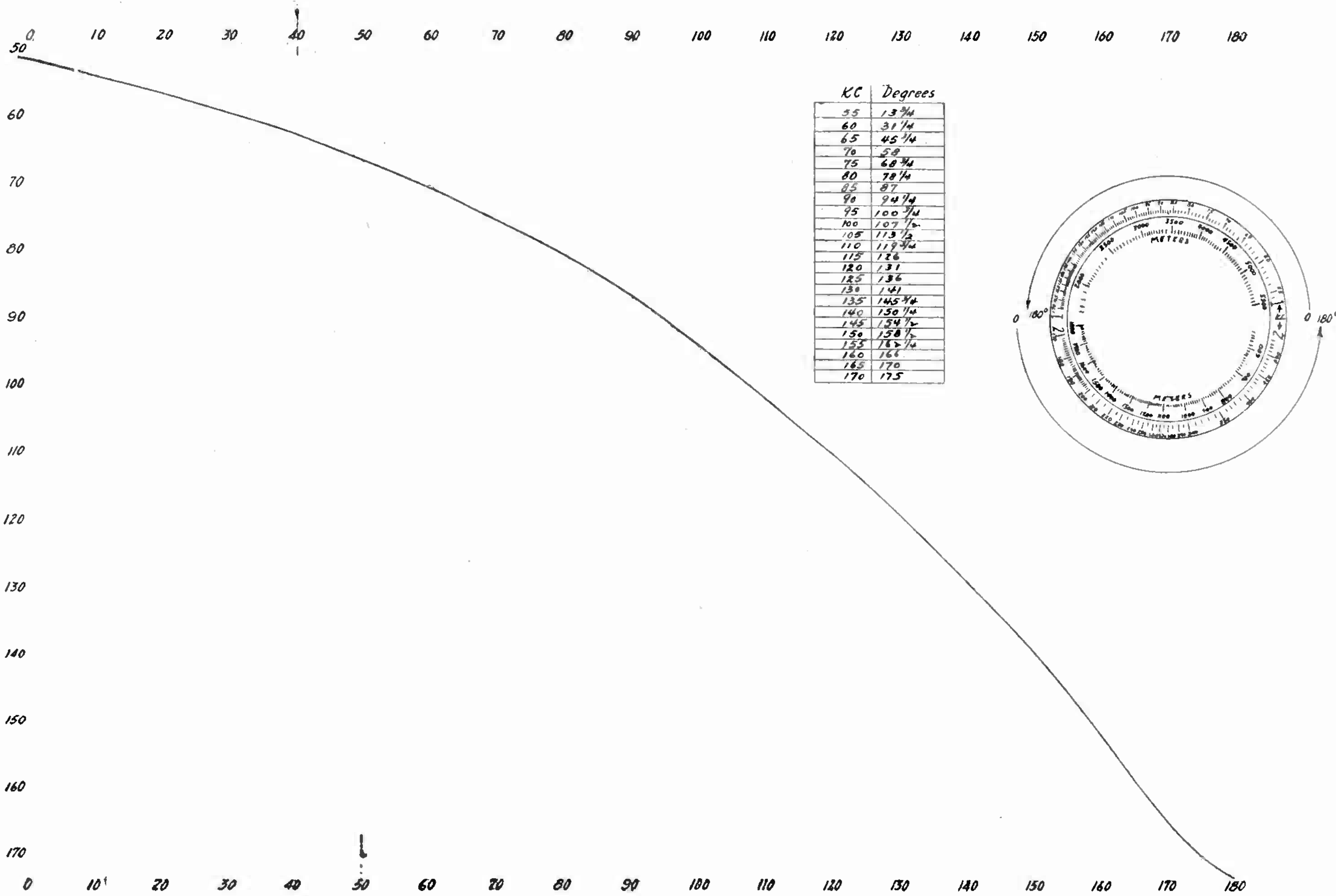


KC	Degrees
55	13 3/4
60	31 1/4
65	45 3/4
70	58
75	68 3/4
80	78 1/4
85	87
90	94 1/4
95	100 3/4
100	107 1/2
105	113 1/2
110	119 3/4
115	126
120	131
125	136
130	141
135	145 3/4
140	150 1/4
145	154 1/2
150	158 1/2
155	162 1/4
160	166
165	170
170	175

The lower frequency tuning curve, using a 404 mmfd. variable condenser and a total secondary inductance of 22.5 millihenries. The calibration was registered on a dial, 54 to 170 kc.

that. The only problem that arises, assuming no intention of trying to get oscillation at frequencies higher than those readily generated by the tube, is one of accuracy, and that necessitates accurate inductance selection, and capacity compensation, rather than any special regard for the vagaries of tuning at the higher frequencies.

Contracting the Ratio

That these vagaries exist is well known. The ratio changes a bit. But the change is small, compared to the practical accuracy obtainable. Thus 1 per cent. accuracy in the lowest-frequency band might mean 1 kc difference, whereas when the calibration for this band is multiplied by 100, to read around 10 mgc, the frequency difference allowable between generator and its calibration is 100 mgc. Within this limit the grid phase shift and other such considerations need not be taken into account.

The practical case will be worked out on a two-scale basis to 30 mgc. However, some may desire to give attention to the fact that as the frequencies increase the crowding increases, or the frequency difference for a linear equality on one scale becomes ten times as great, and possibly a hundred times as great, and some concession might be made.

The method of reduction may be either of introducing a series or a parallel capacity in the tuned circuit, or a combination of series and parallel capacity, but the parallel capacity method is preferable for two reasons: first, that the capacity is obtainable from the tube, in a permanent and reliable form, and is in vacuum; second, that at the very frequencies where the amplitude of the generation tends to decline, the method that adds to the capacity also adds to the trans-conductance, for the method consists of cumulatively using an otherwise disregarded grid of the tube.

Capacity Increased

Experiment proved that if the pentagrid converter tube, e.g., the 6A7, has Grid No. 1 used for oscillator grid, Grid No. 2 for oscillator plate, screen for effective plate, and conventional plate for electron-coupled output, the normal amplifier control grid No. 4 connected to ground, the suppressor being an equivalent capacity neutralizer. But if Grid No. 4 is tied to Grid No. 1, the increase in capacity is substantial. The ratio declined from an actual one of 3.6 in an experimental hookup, to one of 2.6, and as reduced ratio was desired for frequencies above 5 mgc., switching on this amplifier grid served the purpose admirably.

We may compute what the difference in capacity amounts to, since we have known ratios, and it so happens we know the maximum capacity of the condenser alone (404 mmfd.). The minimum capacity of the condenser is not known, but a value of 20 mmfd. will be assigned to it.

From 12 to 46

Taking the example of the ratio of 3.6 to 1, the known (and one estimated) values are: frequency ratio, 3.6, capacity ratio, 13, closely, condenser minimum, 20 mmfd. If the capacity due to the tube, wiring, adjacency of coils to metal, etc., is Cx, then we have its value from the relationship:

$$\frac{404+Cx}{Cx+20}=13$$

$$404+Cx = 13\ Cx+260$$
$$12Cx = 144$$
$$Cx = 12 \text{ mmfd.}$$

This capacity included the tube capacity which capacity alone could be read from a tube manual, but we are trying to find out certain facts for ourselves.

Now we connect the amplifier grid (No. 4) to the oscillator control grid (No. 1), and we find that we get a frequency ratio of 2.6. This is a capacity ratio of 6.76. Now we can solve for Cx, the total circuit capacity, including tube, etc.:

$$\frac{404 + Cx}{Cx + 20} = 6.76$$

$$Cx = 46 \text{ mmfd.}$$

So the grid connection changed the circuit capacity from 12 to 46 mmfd., and all the change took place in the tube capacity.

Now for all-wave generator purposes we may write down the frequencies as follows:

Calibration A, 54 to 170 kc, and 540 to 1,700 kc.

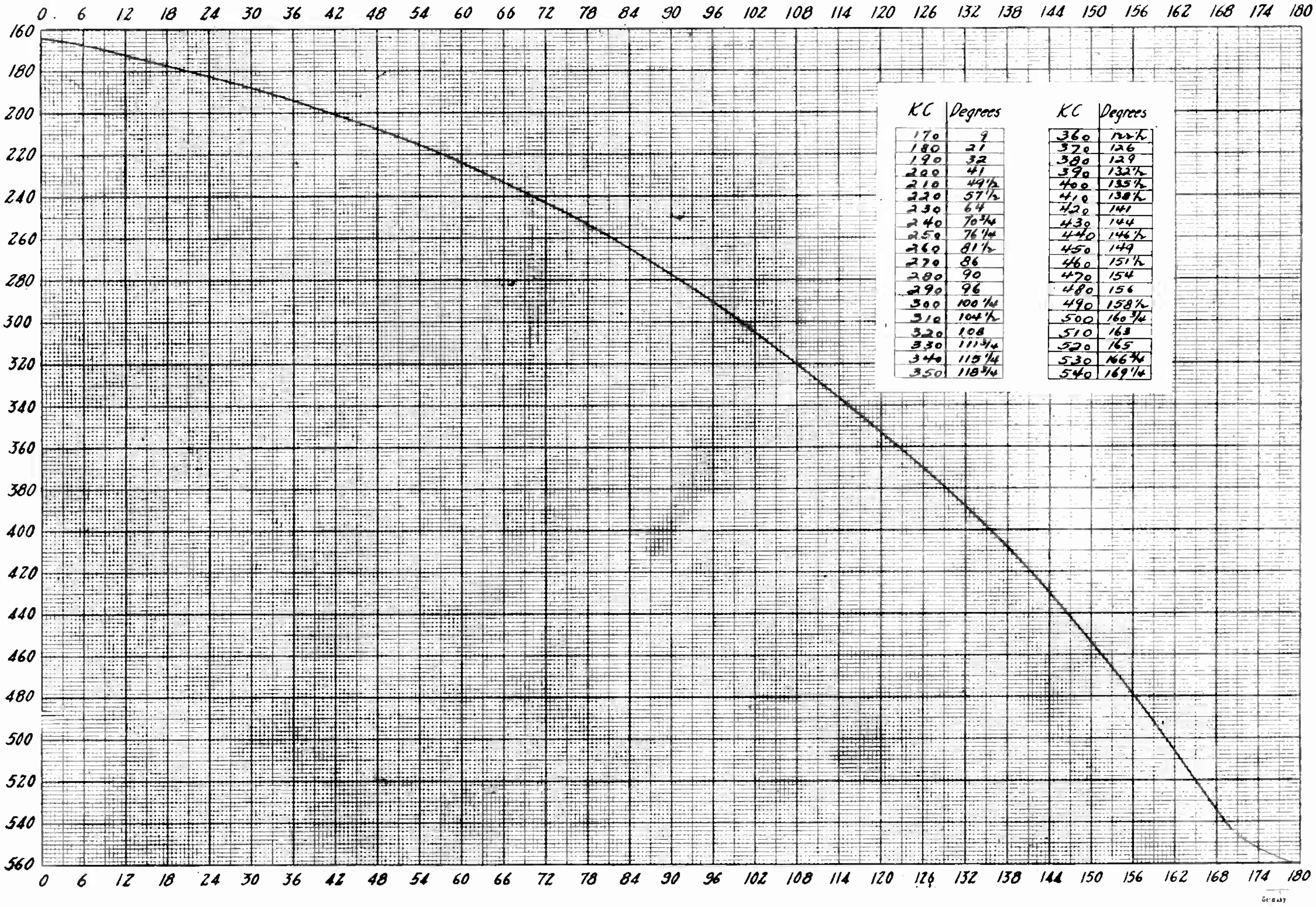
Calibration B, 170 to 540 kc, and 1,700 to 5,400 kc.

For continued use of the same scales multiply A by 10, B by 10, A by 100 and B by 100 or add two new calibrations as follows:

Calibration C, 5,000 to 13,000 kc.
Calibration D, 13,000 to 33,800 kc.

Frequency and Wavelength

In other words, the system goes down to 9 meters, if the two high-frequency ranges are independently calibrated and scaled. There is a bit of overlap obtainable between the 13,000 kc terminals due to the actual ratio being just a trifle higher than 2.6.



KC	Degrees	KC	Degrees
170	9	360	122½
180	21	370	126
190	32	380	129
200	41	390	132½
210	49½	400	135½
220	57½	410	138½
230	64	420	141
240	70¾	430	144
250	76¼	440	146½
260	81½	450	149
270	86	460	151½
280	90	470	154
290	96	480	156
300	100¼	490	158½
310	104½	500	160¾
320	108	510	163
330	111¾	520	165
340	115¼	530	166¾
350	118¾	540	169¼

This curve is for the effective plotting, 170 to 540 kc. The same condenser is used. The inductance is 2.2 millihenries.

Thus we have provided four different calibrations applicable to six bands, and for certain types of dials, or for any calibration curves, the equivalent wavelength values may be inscribed in meters, so that determinations may be made in frequencies in kilocycles (or by dividing a result by 1,000, frequencies in megacycles), and also in wavelengths in meters. For the two scales used twice, only two metrical equivalents are used, one for each, and when a read frequency is to be multiplid by 10, a read wavelength is to be divided by 10 because as the frequency is higher the wavelength is proportionately lower.

Coil and Condenser Data

The coil used for the inductance values stated in the captions under the curves were honeycombs, and the condenser was one manufactured by General Instrument Company, maximum capacity 404 mmfd., trimmer omitted. For the 54 to 170 kc and 170 to 540 kc fundamental ranges no trimmer absolutely was necessary, but two pieces of insulated flexible wire attached to grid index of the switch, and line, respectively, about 1 inch long each, twisted together, were included permanently. This capacity applies to all bands. This was included simply to have a small capacity adjustment for a high-frequency setting in the lower-frequency band. No extra adjustment was made for 170 to 540 kc.

However, when the broadcast band coil is used, extra capacity is necessary, because the distributed capacity of the far fewer turns is less, if this coil is a honeycomb, as it may be. The same system is used, of twisting two pieces of insulated wire together, about 3.5 inches of wire for each being necessary, and again adjustment made at a high frequency, say, 1,400 to 1,500 kc. This capacity is across this coil alone. The more the wire is twisted together the greater the capacity. Excess wire may be snipped off.

Capacity Sealed

This improvised type of condenser for trimming stays put, and it is practical to put one on each coil at no expense. The capacity is made permanent by using a little sealing wax or "liquid solder" to hold the wires in place. Also the insulation will not slide if adhesive is thus put on.

While a particular condenser of not altogether usual capacity was used, approximately the same calibration will hold for similar condensers that have a midline characteristic. The usual so-called 0.00035 mfd. condenser has a capacity of around 0.000375 mfd., and there is enough leeway to reach the low-frequency extremes of both calibrated bands even if some other condenser of this general type is substituted. Any trimmer that is on the condenser itself should be removed, particularly as it is of the compression type, and may not hold its capacity.

Two-Scale Model

In the circuit diagram two take-offs are shown, one for audio frequencies, the other for radio frequencies. For a variety of audio frequencies the condenser across the neon lamp modulator's fixed limiting resistor may be a 0.0005 mfd. variable. This feature may not be desired generally, so a fixed condenser would be substituted.

High-Frequency Option

Also, the diagram is so constructed that the final two bands would be subjected to reduced ratio of tuning, requiring a separate calibration. This method is shown simply for those who want to follow it. A commercial model oscillator uses the grounded connection permanently for Grid No. 4, hence only a two-deck, six-position switch is needed, instead of a three-deck six-position switch as shown in the diagram.

And then of course the two scales are followed for all bands. Multiply one after another by 10 in the first instance and by 100 in the second instance. Also, besides frequencies in kilocycles, wavelengths in meters are a part of the airplane-dial calibration, so results may be obtained either in wavelengths or frequencies, and all on fundamentals.

Condensers for Filtration

Sometimes filtration is greatly improved if, when the circuit has electrolytic condensers in the B rectifier filter, a paper-dielectric condenser is put in parallel with the electrolytic next to the rectifier. Also, at the end of the rectifier filter it is advisable to put a mica dielectric condenser, or, failing in that, a paper one, of as high a capacity as practical, since sometimes the electrolytics do not present a sufficiently low impedance to the radio-frequency currents. When this is true, some r.f. may get into the rectifier tube and cause odd noises in a receiver.

A "SAFETY-FIRST

Regenerative Detector, Audio Stage,

By Edw

GIVEN a certain task to do in working out a circuit, a designer will go about it much as if it were entirely new, although it may be more than ten years old. The reason is that he has to build up a background of proven performance for what he shall offer to his employer, and he has to search only his own experience.

True, he may be guided a great deal by what is in the back of his head, based on what others have learned, which to him is theoretical information, and also it may be true that what he turns out is pretty much the same as what others have been turning out recently. Nevertheless, when he has finished and says, "This circuit works well," he has fulfilled his mission and has satisfied a want.

A slipup on just the smallest item—smallest from one viewpoint—may prove serious indeed. Those who endeavor to build the device may experience trouble. Well, the present circuit is familiar enough, but it has been investigated practically just as if it were the newest heaven-born idea, and it may be followed with safety.

Novelty or Performance?

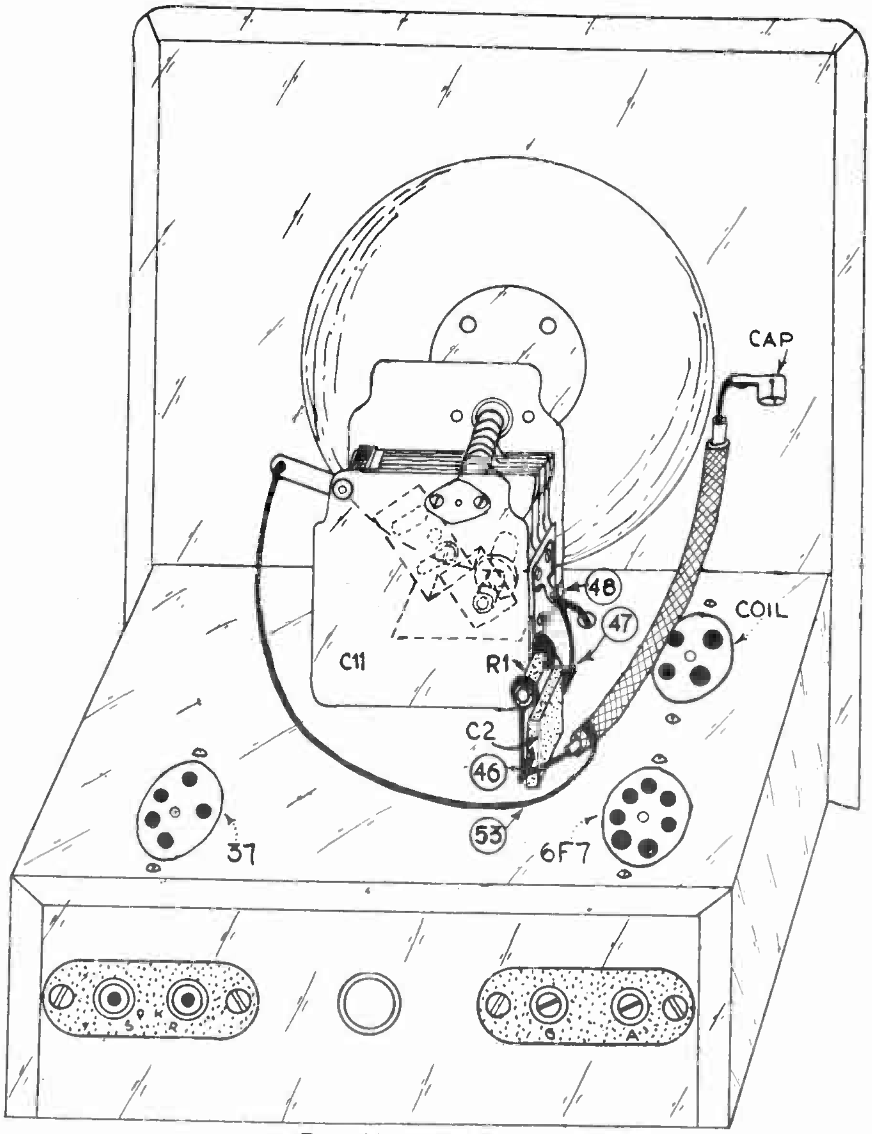
Not only is the circuit a regenerative detector, audio amplifier and rectifier for a-c and d-c operation, for short-wave reception, but fundamentally it goes back to the earliest days of radio, despite the newer type tubes and some refinements that late practices make possible. It is a familiar friend, but I wonder how many prospective builders are more interested in circuit novelty than in performance? And how many are ready to string along with a pretty theory for short-wave practice? For short waves the rule is: the simpler the better, the older the safer.

There are certain platitudes that have to be recorded as a matter of tradition. One is that the greatest economy of initial cost, upkeep and life attach to the regenerative detector for short waves. Another is that the series antenna condenser is of inestimable importance. Its correct setting permits regeneration where otherwise this great and imperative aid would be missing. Another is that the regeneration control is not critical, and the fourth is that some locals can be heard on the speaker with contented volume.

Well, the statement that the regeneration control is not critical is entirely untrue, platitude though it may have become in the technique of presenting circuit patterns. That one about adequate speaker reception on two effective receiving tubes is another one of those things. Let us get down to the few words that have to be said about such a circuit as this.

Layout is Important

One is that the parts layout is of some consequence, hence by presenting a pictorial diagram, with the perspective of the most important view, we offer the simplest method of permitting the constructor to follow this pattern. He may fix up his own panels and other things



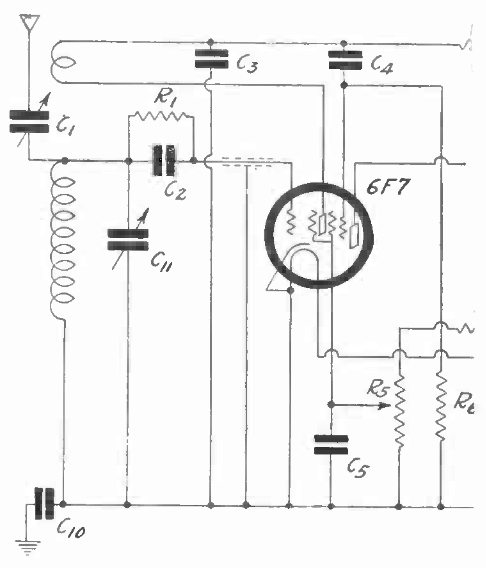
REAR VIEW

to subscribe to these physical conditions. Or he might want to buy a commercial kit—to be honest about it—that is offered under the name of the Federal Short-Wave Kit.

To spend any real money for the few, simple and uncostly parts necessary to build this receiver would be a mistake. I don't see how any one could do it even if he tried hard. A few dolars will permit the building of a circuit that gives splendid earphone reception of short-wave stations, foreign and domestic. And to bring in the stations well—have a dandy short-wave set—at small expense, it is necessary to use plug-in coils. Yes, they are a bit of a nuisance, but only a bit, because there is only one coil for each band—five coils to cover from 550 to 15 meters—and one may stay on one band a long time, and probably will.

Eccentricity

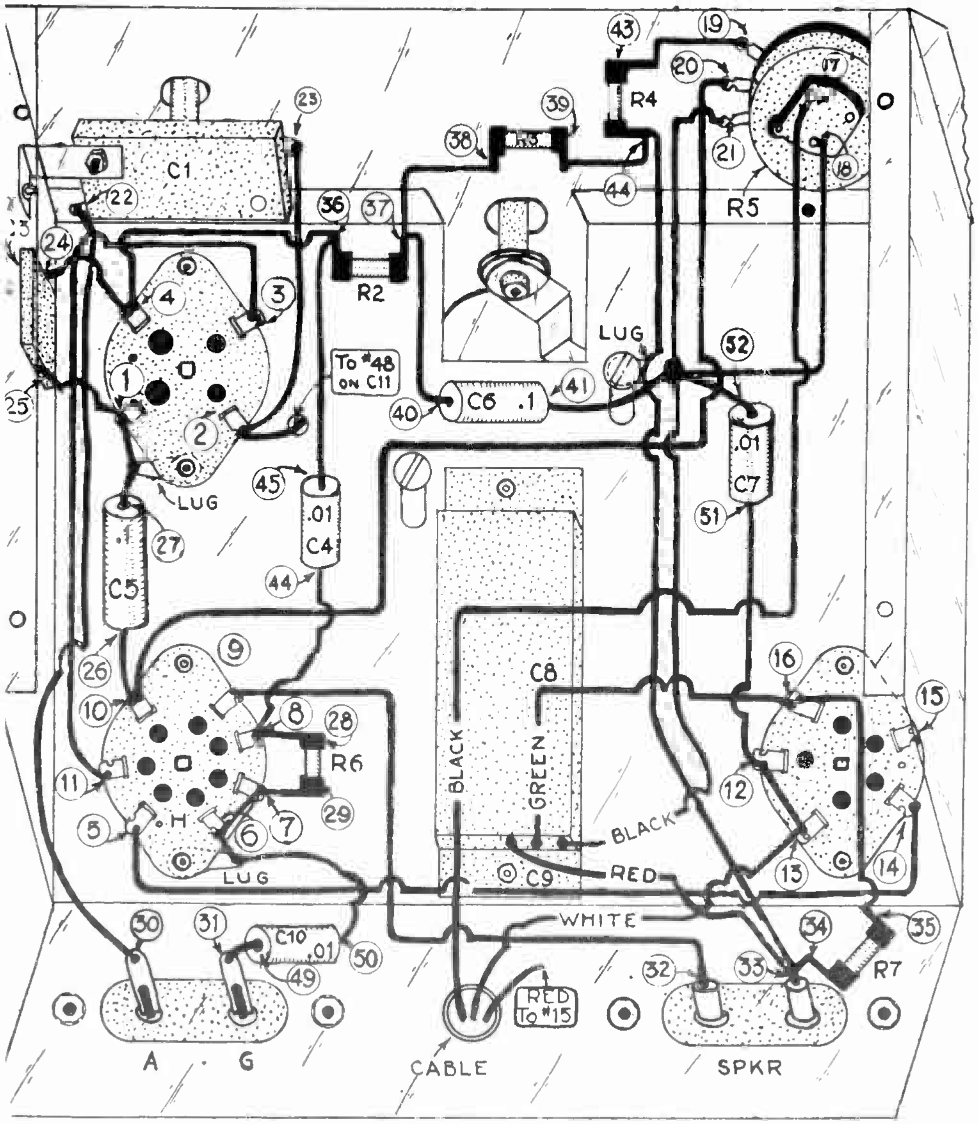
On short waves it is almost necessary to do this, because you tune in at a particular time, and even if you are to spend



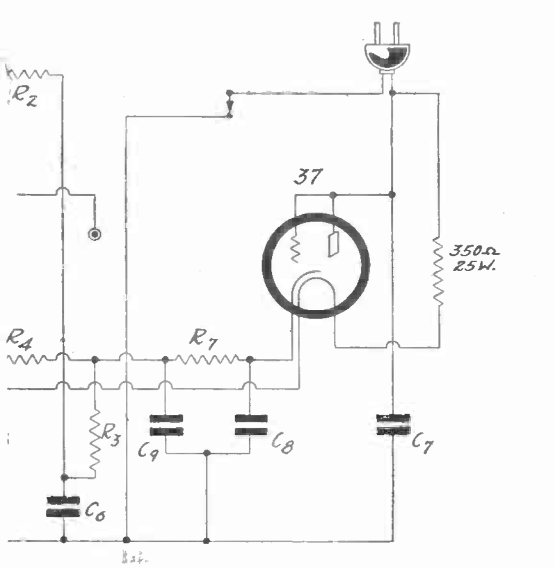
" ALL-WAVE SET

in One Envelope, and a 37 Rectifier

ırd Cohen



BOTTOM VIEW



two hours listening, the reception will be better on one band during that period than on any of the others. That is because certain waves travel best at certain times of the day and night. In general, daylight listening coincides with best results on highest frequencies, and nighttime listening to best results on lower frequencies.

The directions need apply only to mounting the parts and a few other little things. If there had to be much discussion of building the set the work scarcely could be as simple as intimated, or the time devoted to reading the directions would be greater than the time required for the actual construction.

Mounting Directions

Mount the front panel to chassis as shown. Now take C11 (variable condenser) and rest it on the chassis in order to center dial angle, so that it protrudes through center hole on panel. Remove condenser and tighten angle into place. Place dial on to condenser shaft, and force bottom of dial into small copper discs on the drive shaft. Adjust dial for rigid position. Push condenser plates all the way in. Turn dial so that zero (0) is in vertical position. Now tighten dial set screw. Mount condenser on chassis as shown. Mount volume control (R5) as pictured. Use the two hex nuts supplied. Before mounting, one goes on about three quarters the way, after pushing shaft through front panel, tighten up with the other nut. Now mount C1 on to small angle on side of chassis as shown. Be sure that the brass shaft in protruding, does not touch the chassis, but clears the hole. Next mount the Electrolytic condenser (C8-9). Now pass the long cable through hole in back of chassis, and study "Bottom view picture." You will note that each part is marked with a number and letter combination as: C8, R7, etc. On the parts list, these combinations show you what color condenser or resistor to use. Starting at connection 5, follow the heavy black lines, and connect them to the place indicated, using of course the wire provided. Where you see a resistor or condenser in the line, connect in the proper one and make the correct connections with a good soldered joint. Do not let any of the exposed wires touch the chassis except where a ground connection is to be made. This is indicated by the word lug.

Broadcast Coil

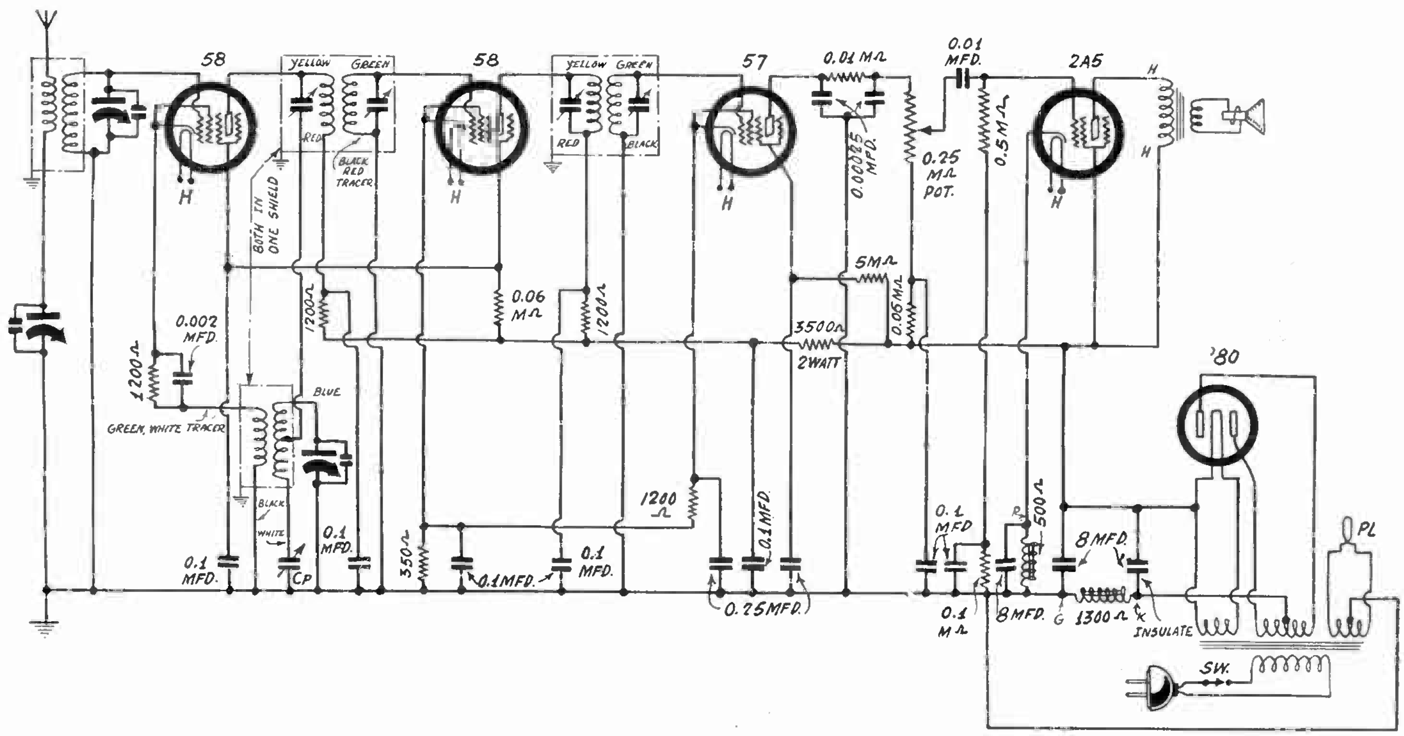
When the set is wired, plug the broadcast coil in to the four hole socket. Connect the antenna (one of about 100 feet), and insert the tubes in their proper sockets. An external ground is not essential. If one is to be used, do not touch it to the chassis. Insert the earphones, and plug the cable in to the socket. Turn on switch. This is incorporated on the volume control. In about 30 seconds the tubes will heat. If set is used on d-c and does not play, reverse plug in socket. Careful tuning will bring in the stations on the broadcast band. After learning to tune the set, try the other coils, for the various short wave stations.

Tubes used are: one 6F7 and one 37.
Coil with most wire—200 to 550 meters.
Coil next in winding size—115 to 200 meters.
Coil next in size—57 to 115 meters.
Coil next in size—33 to 65 meters.
Coil next in size—15 to 36 meters.

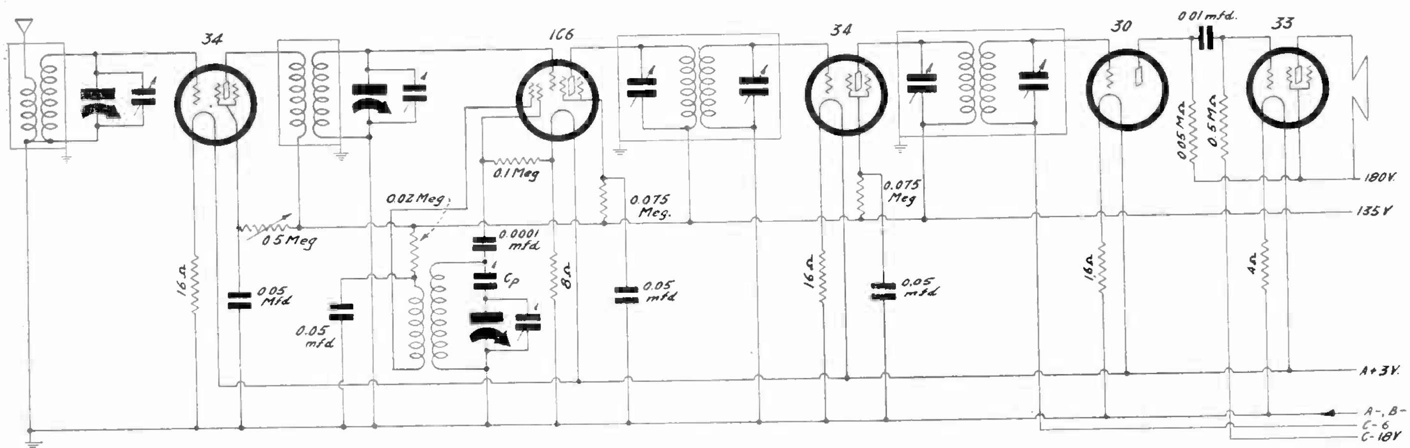
The diagram code is as follows for constants, the resistors in color code:

C1—Antenna tuning condenser.
C2—Mica condenser white spot.
C3—Mica condenser green spot.
C4—.01 tubular condenser.
C5—.1 tubular condenser.
C6—.1 tubular condenser.
C7—.01 tubular condenser.
C8 & 9—Electrolytic filter condenser.
R1—Yellow—black—green.
R2—Brown—black—yellow.
R3—Brown—black—yellow.
R4—Green—black—orange.
R5—Volume control and switch.
R6—Brown—black—green.
R7—Blue—black—red.
C10—.01 tubular condenser.
C11—Main tuning condenser.

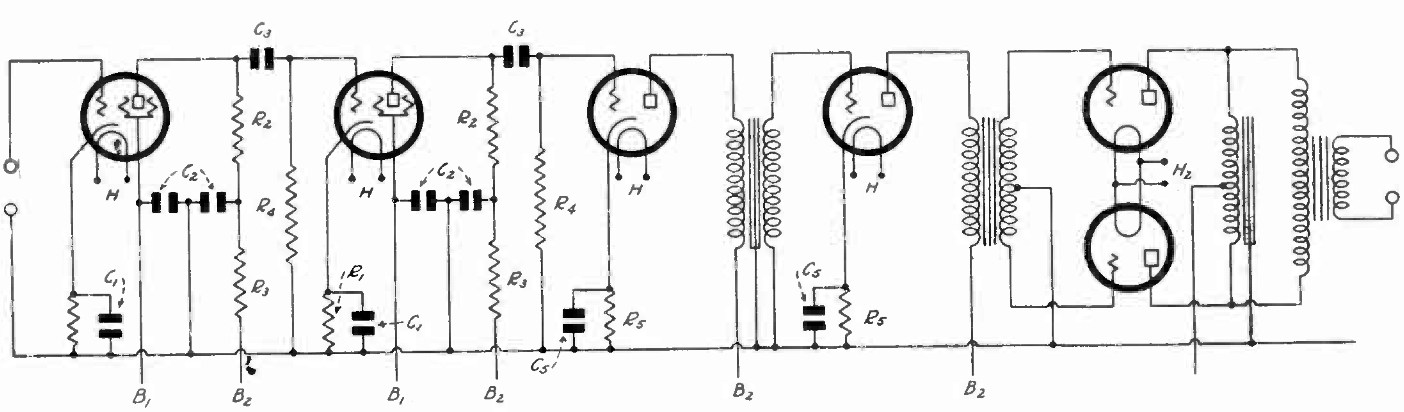
Standard and Super-Standard Circuits



If the 58 tube is to be used as modulator-oscillator, this circuit is usually followed. Whether there will be a stage of t-r-f ahead or the extra gang section used for improving the selectivity without that tube, as shown, is a matter of individual choice. The first i-f transformer and the oscillation transformer usually are in one shield.



For battery operation of 2-volt tubes this superheterodyne may be followed. It is just as simple as it can be, and its performance is good.



In some instances very high audio gain is needed. A case in mind is that of a heart-beat amplifier for medical practice. Another example is that of the pre-amplifier for insensitive though faithful microphones. Problems surround the construction of such a circuit, but here is how one medico-radio expert solved them.

THE AMATEUR ORACLE

Conducted by M. K. Kunins

Suffers Sparking

I'VE RECENTLY completed the construction of a transmitter for the amateur bands. When it is in operation, with the transmitting key depressed, I hear a crackling noise in the transmitter. Is that normal or is there something wrong? —R. J. W.

Assuming that you have connected the parts together correctly, it is probable that you hear sparks jumping across overloaded points in the circuit. This, of course, is not normal and should not occur in a correctly-constructed set. It is recommended that you seek the location of the sparking in the set in a darkened room and replace the part at fault with one better able to withstand the voltage. Sparking may be caused either by a poorly insulated part (defect in manufacture) or it may result from the use of a part that is overrated in regard to its ability to withstand certain maximum voltages. If the poor insulation is the case (recognizable by comparing the manufacturers rated voltage with a voltmeter reading across the part), you should replace the faulty piece of apparatus with a new one that is in good shape. If over-rating is the cause you should make replacement with a part of higher voltage rating, about 50% higher than the highest voltage in the circuit where the part is connected. Sparking usually may be found between plates of the tank condenser, between tube leads in a defective stem, between plates of defective fixed condensers, etc.

* * *

Key Clicks

MY HAM TRANSMITTER causes key clicks in the broadcast receiver of a neighbor whose aerial is quite close to mine. What is the best treatment of such a trouble?—S. B. M.

When a receiving antenna is quite close to that of a transmitter, shock excitation will result and the best remedy is relocation of either the transmitting or receiving aerial. Try to arrange the aerials in such a way that they are mutually at right angles. It is not very effective to try key click filters in such an instance when two aerials are so close together.

* * *

5-Meter Licenses

I'VE HEARD that Federal radio operator licenses are not necessary for five-meter band transmissions. Is this true? —B. G.

The Radio law provides that licenses are necessary for all radio transmitters whose signals extend beyond the border of a state. Since nothing is mentioned regarding signals that do not extend beyond the borders of a state, some might infer that licenses are unnecessary in such cases. However, it is foolhardy to engage in transmission without a license on this premise since radio waves travel great distances despite low power, and weak signals may be made to boom through a sensitive receiver. Therefore, should sensitive ears hear your unlicensed signals beyond the borders of your state, you have become an offender in the eyes of the government and can be prosecuted as such.

* * *

Litz Wire on 5 Meters

I'VE BEEN TOLD that if I wind the coils of my 5-meter transceiver with Litz wire, I would get better results. What is Litz wire and would it help as suggested?—J. N. F.

Litz wire (an abbreviation of Litzendraght) is nothing but stranded wire, the individual strands of which are insulated from each other. On frequencies as high as those encountered on 5 meters it would be more efficient to wind your coils with this wire. This is so since high-frequency currents are impeded in their flow by what is known as skin effect in addition to normal resistance and reactance. This skin effect is the tendency of these currents to flow on the outermost surface of the wire with little or none flowing through the interior section which is equivalent to reducing the cross-section of the wire and increasing its resistance. By paralleling many fine insulated wires, as in Litz wire, this tendency is minimized and greater efficiency is realized. However, Litz is not without its drawbacks. In using Litz wire, it is necessary to be careful not to break any of the strands and also the ends of each strand should be connected together to the terminal lug so that the effect of each strand is utilized. Litz wire is not recommended for ordinary amateur bands since at those frequencies the gain in efficiency is not commensurate with the added cost and trouble associated with Litz wire.

* * *

License Renewal

MY AMATEUR OPERATOR and station licenses expire shortly. Will it be necessary for me to be re-examined for a new license in order to continue my station?—R. T. G.

Licenses may be renewed if such request is made to the Washington office of the Federal Communications Commission sixty days prior to the expiration date of the licenses sought to be renewed. This request takes the form of a completely-executed application blank, obtainable either from Washington or your local Commission office, together with a statement from several licensed amateurs attesting that you have worked them during the past three months.

* * *

Skip Distance

WHY ARE my 40-meter signals not audible about 100 miles away while they are very clearly received as much as 500 miles away?—G. H. F.

This apparent discrepancy is the prankish result of what is known as skip distance. The high frequencies seem to act in this manner due to the fact that the ground wave is attenuated quite rapidly up to about 30 miles or so and is inaudible beyond this distance. However, the sky wave has hit the Heaviside layer and bounced back to earth about 500 miles away. It is this sky wave that is heard at the greater distance though your ground wave is inaudible there.

* * *

Easy to Become Licensee

WHAT ARE the requirements to be fulfilled to obtain permission to operate an amateur radio station?—A. S. F.

Permission from the United States Government in the form of an operator and station license must be obtained if the station is to be within the borders of territory within this country's jurisdiction. This license may be obtained by passing a simple test in code and theory at any of the branch offices of the Federal Communications Commission, provided you are not an alien. There are no sex, age or other limitations.

* * *

Fringe Howl

MY REGENERATIVE RECEIVER howls when generation is increased to the point of oscillation. How may this be remedied?—T. J. H.

This howl may be eliminated in most cases by shunting each audio-frequency transformer with a resistance of value between 25,000 and 100,000 ohms.

* * *

Wants More Pep

WHAT WAYS can I use to increase the strength of the signal from my transmitter, other than increasing the power input to the tubes?—D. H. N.

Most obvious is a general check-up of every part to see that each is efficient in operation. When this is the case, you know that the transmitter proper is at its best. However, this alone does not promise a good signal. It is necessary to have an efficient means for converting this electric current into electromagnetic waves with as little loss as possible. Therefore a check-up of the antenna and coupling to the antenna is necessary. When this is adjusted for greatest efficiency, the station is performing its best. Still another step may be taken if it is not desired to spatter your signal in all directions. You may utilize the concentrating properties of directional antennas, similar to the action of the reflector behind a searchlight lamp. With this means, it is possible to multiply your signal strength many times without changing any of your transmitter adjustments.

The Twelve Equations Expressing Ohm's Law

$W =$	EI	I^2R	$\frac{E^2}{R}$	
$E =$		IR	$\sqrt{WR}$	$\frac{W}{I}$
$I =$		$\frac{E}{R}$	$\sqrt{\frac{W}{R}}$	$\frac{W}{E}$
$R =$	$\frac{E}{I}$		$\frac{E^2}{W}$	$\frac{W}{I^2}$

E = Voltage, I = Current in Amperes, W = Watts, R = Resistance in Ohms

Ohm's Law has been referred to many times. However we believe that this fundamental law cannot be over-emphasized, as almost all electrical theory is based on it or its derivations. Many people know the law only as Voltage (E) equals Current (I) times Resistance (R) and do not realize that there are really twelve equations which may be formed using the four factors W, E, I, and R.

Thus knowing any two of these factors the other two may be readily calculated. For instance, assume that a 1,000-ohm resistor has a voltage of 110 volts across it. What is the current through the resistor and what wattage must the unit dissipate? By looking at the table above we see that I equals E divided by R: therefore the current in our resistor will be 110 divided by 1,000 or 0.11 amperes. The wattage will be E^2 divided by R or 12,100 divided by 1,000 which is 12.1 watts. Any other problem involving these factors can easily be solved, it being only necessary to select the equation which shows the unknowns in terms of the known factors.

—Ohmite News.

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.

C-Bias Supply

AS I AM ABOUT to build an audio amplifier of 15 watts power output, using 2A3 tubes, I am asking whether you recommend that a C-bias supply be installed, operated from a separate rectifier, and whether this rectifier may be a 25Z5, a 37, a 56 or similar tube?—I. C. S.

The C-bias supply of the general type you mention is a distinct improvement and should be included. We believe it will become more or less standard in a few years in all high-class receivers and power amplifiers. However, the tubes you have in mind will not do, for the following reason: When the set is turned on the plate voltage is instantly applied to the power tubes, but the bias voltage is not, since the heater type tubes take several minutes to reach full emission, and at the very instant of excitation voltage being supplied, have practically no emission. Thus for a brief spell the power tubes might have 350 plate volts at no bias, which is dangerous to the power tubes. Gradually the bias begins to appear, but this is not enough. The bias must be of the trigger-action type, hence a filament type tube must be used as the rectifier.

* * *

How Many Speakers?

IS IT A FACT that the high fidelity sets have two speakers, and a filtered output, so that the highs are struck from the output that is fed to the low-frequency dynamic, and the lows are trapped from the circuit fed to the high-frequency speaker or tweeter? Can not high fidelity be achieved with a single speaker?—J. S. C.

There are as yet very few high-fidelity sets on the market and the commercial sets of this type tend to run toward a single speaker. Either method works. Probably it is true that the two-speaker method is less expensive, because for one speaker to handle the full band width of the modulation, it has to be made exceptionally well. The frequencies passed by the high-fidelity sets are from around 30 cycles to 7,500 cycles. As yet there is little broadcasting of high-fidelity modulation, but that is no objection to having a receiver that covers the very wide acoustical range. In fact, the programs as sent out now by the stations sound much better on the high-fidelity sets. The special modulation intended for bringing into full play the capabilities of the advanced receivers are on experimental channels 20 kc apart, from 1,500 to 1,600 kc. With very scarce exceptions, in the past receiver manufacturers have not turned out excellent tone-quality sets. It may even be said that this is the first year that a commercial worth listening to has been on the market. There would be an exception or two to this broad statement, as really high fidelity was present in at least one receiver of three years ago, to our knowledge. It was a tuned-radio-frequency set, too. The range was about 50 to 8,000 cycles, with flat characteristic.

* * *

Three-Winding I-F Coils

WHAT IS the object of the new intermediate-frequency transformers with three windings?—E. D.

The object is to establish a sort of band-pass filter channel, the third winding being so constructed and adjusted that it neutralizes the double-peak tendency of the usual tuned method. Thus the full modulation width may be passed, even if the modulation runs from 30 to 7,500 cycles, or covers a wider band.

* * *

Shielding

WHY SHOULD NOT an insulator be a good shield, since an insulator is something that offers a high resistance to the current?—T. C.

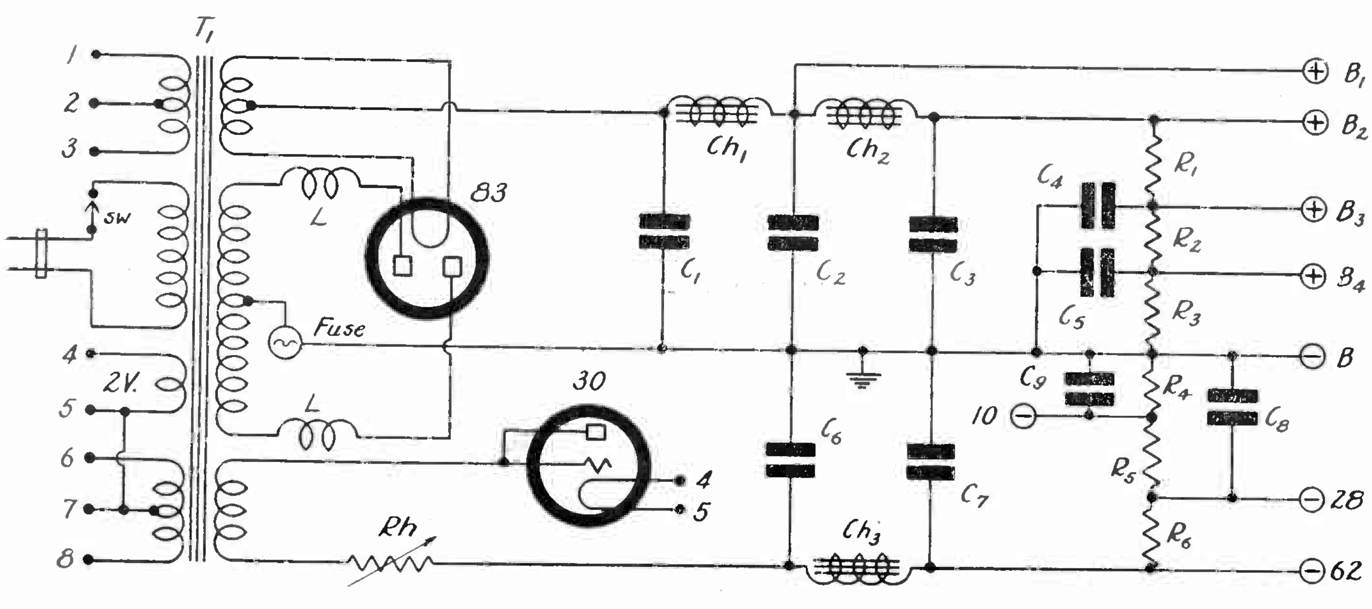
An insulator is as nothing to a magnetic field. The insulator will not pass direct current, but we are dealing with alternating current when we talk of shielding, or at least with static electricity in some instances. This is electricity at rest, or standing electricity. The best conductor of electro-magnetic waves is the best shield, briefly, because it is best able to confine the field within the shield, by conducting the current to ground potential where the field is to be cut off. Some forms of silver are supposed to constitute excellent shields, copper is known to be splendid, while aluminum, good also, is most commonly used, because it does the work well and is inexpensive.

* * *

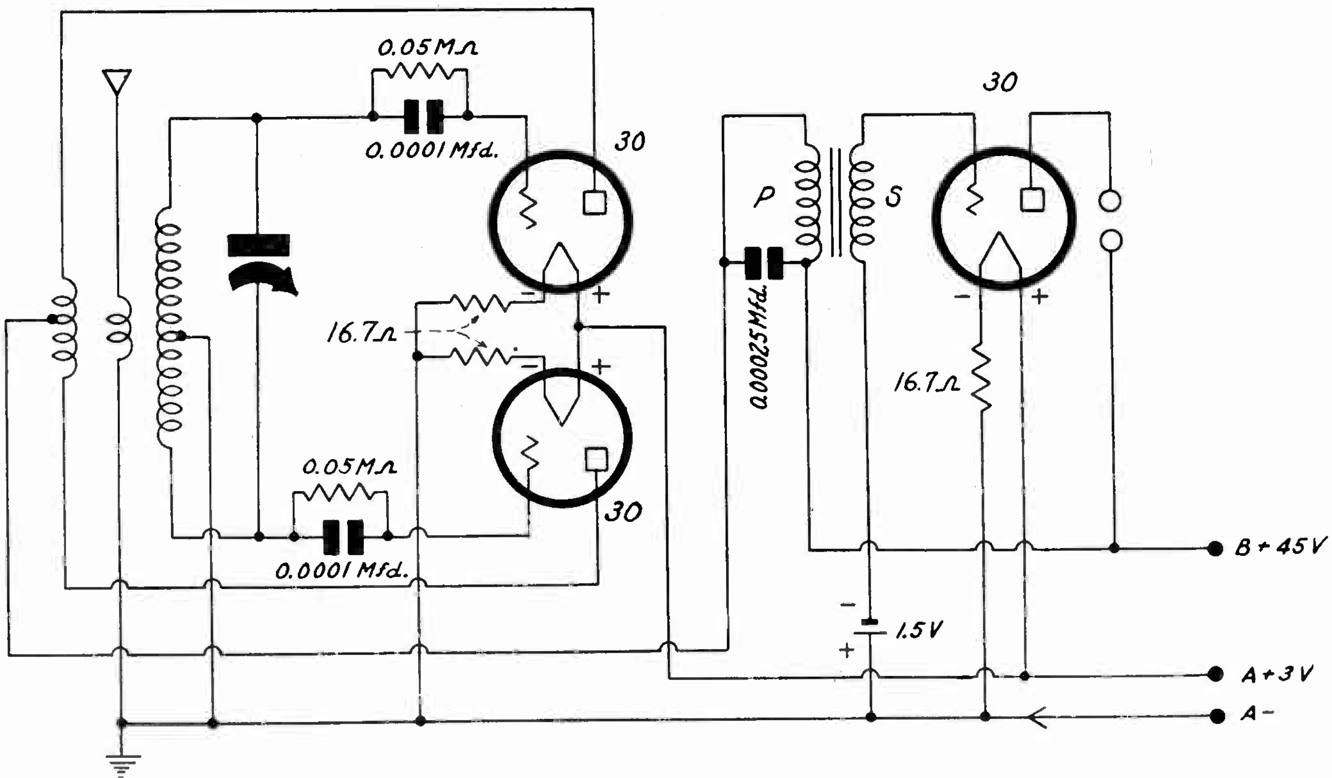
Coil Capacity

DOES A HONEYCOMB coil's distributed capacity depend on the number of turns at all, assuming sensible coil proportions, or is the case like that of the solenoid, where the distributed capacity is said to be independent of the number of turns, for axial lengths not greater than the winding diameter?—I. D. S.

A honeycomb coil's distributed capacity seems to depend on the number of turns, unlike the case of the solenoid that you cited. Previously we had believed that the distributed capacity of a honeycomb coil decreased as the number of turns was increased, because the effect was that of the capacities of turns being in series. This now appears to be an error, from calculations we have recently made, and which have been verified empirically. Probably there has been a general misconception about the capacity effect of one turn on another, in respect to solenoids and honeycombs as well. It had always been supposed that these capacities could be treated in orthodox manner, but this now appears to be an exploded assumption, since it has been found that the circulating current is non-uniform. That is, the current between turns of a solenoid near the center is different than the current between turns near or at the ends, and in a honeycomb probably the same is true. Hence the individual adjacent turn capacities can not be considered in parallel, as with equal capacity per turn there would be equal current through each capacity, or uniform voltage drop across each condenser thus formed, and equality does not exist. Nor can the turns be treated as capacities in series, for if they were equal capacities, for then the same current would flow through the series condensers,



Method of using a C-supply rectifier. The 30 tube is the C-rectifier and the 83 is the B-rectifier. A filament type tube must be used for C-rectifier so that the negative bias is instantly applied when the circuit in general is turned on. A separate filament winding for the 30 tube is necessary. Filament center is grounded (B minus), and is positive. Hence voltages below B minus are negative, therefore the negative bias arises.



For balanced detection, sometimes called push-pull detection, the circuit may be used as shown for a regenerative device, which here feeds a 30-tube audio amplifier stage. Users of this method report that it is quieter on short waves than the more conventional hookup and is well worth the extra tube that is required.

whereas it has been shown not to be the same. The test we made with a honeycomb consisted of using one of 1,000 turns and another of 300 turns, with the same tuning condenser and circuit. The frequency ratio was 3.19 for the large inductance circuit and 3.37 for the small inductance circuit.

* * *

Spotty Reception

MY SET WORKS erratically. Sometimes it plays well. Other times the volume changes considerably. This is not due to fading, as the trouble arises also with strong locals. I have tested the tubes and they are all right. I had other sets in this location that did not develop this trouble.—K. L. C.

Change in the intensity of the reception may be due to a swinging aerial. Notice particularly on a windy day or night if the trouble is pronounced. Since sometimes you have unmarred reception, if this takes place on a calm day or night, tighten up the slack on the aerial, and have the leadin tautly affixed to stand-off insulators. If a first-class transmission line is used as leadin, meaning one that does not contribute pickup, then any trouble of the type you report, due to the leadin, would be eradicated. Aside from the antenna considerations, the trouble might be due to a poor connection, an open grid return, or, in the case of a superheterodyne, a very unstable oscillator, such as the dynatron. For improving the stability of an oscillator put a resistor of 50,000 ohms or so in series with the plate return, and bypass this resistor to ground or cathode with a condenser of 0.0001 mfd. or somewhat higher capacity, but not of the order of microfarads. Also try a 1.0 mfd. paper condenser next to the rectifier.

* * *

Neutralization

IS IT NECESSARY to use neutralization in modern receivers? I know that generally the answer is that this procedure is not necessary. But I built a set, and though it has the super-control tubes in it, there is oscillation nevertheless. I have tried reversing the connections to r-f coils, on the assumption that the phase shift would cure the trouble, if inductive feedback was the cause. But evidently it was not the cause, as the oscillation persists. Hence I assume the feedback is resistive or capacitative. I was thinking of using neutralization, if capacity is the trouble.—I. K.

The neutralization method is not necessary. At best it was never too good, in our opinion. The theory of neutralization is that a bridge is constructed, two equal ratio arms consisting of capacity, in one instance the tube capacity, in the other the equal neutralizing capacity. Therefore the net flow of current, due to opposition of direction, through a common impedance would be zero. The two other equal ratio arms are inductive. It is well known that neutralization marred selectivity, and it therefore introduced resistance. Perhaps it did little more than mistune the circuits. Certainly the test, with excitation removed from filament, and with condenser adjustment until no signal came through the "dead" tube, was consistent with mistuning as well as with neutralization. The late tubes are intended to dispense with any need for this method. The tube capacities are extremely small. The effective capacity is still more greatly reduced in the suppressor type tubes. It is hard to say just what causes the feedback in the given instance, in the absence of fuller details. It is certainly true that if the circuit is not atrociously laid out that a ready remedy for relief from the oscillation trouble is to use much larger bypass condensers across the biasing resistors, say, 2.0 mfd. Also, if necessary, although it should not then be necessary, r-f chokes in series with the plate legs, bypassed by 0.1 mfd. or so to ground or cathode, will eliminate any remaining vestige of oscillation. It is assumed the tubes and coils are shielded and shields grounded. Also, at the i-f level, if the set is a super, the leads from coil shields to grid caps should be of shielded wire and shield grounded. This grounding can be done to a lug fastened down by one of the holding screws of the coil's condenser mounting. At the r-f or oscillator level care in using shielded wire should be exercised, because of the large capacity effect. The wire at this level should be surrounded by thick cotton stuffing, and the conductor center be at least ¼ inch from the sheath.

* * *

Lower Intermediate Frequency

CAN THE INTERMEDIATE FREQUENCY be changed in a receiver so that the noise level will be lower, although the gain is maintained high, and all without making the set a squeal factory, due to the two local oscillators?—P. L.

Yes, the intermediate level may be changed, and if each local oscillator is closely shielded, weakly coupled to the intended circuit, and not coupled elsewhere by accident, especially the local oscillator for reducing the frequency, the set can be made to behave quietly, without multiplicity of squeals. For instance, the tuner may feed a single stage of intermediate amplification at 465 kc, and then an other oscillator is coupled weakly to this amplifier-detector, and if the new frequency of generation is 400 kc, a suitable output for a 65 kc amplifier chain is obtained. However, second frequencies as low as this are not used now. Possibly they will be. The superheterodyne started as a set having low intermediate frequencies, around 30 kc, and the frequency was increased until now even 480 kc is used for some allwave sets, and 1,550 kc for some converters, where the 1,550 kc is obtained from the broadcast receiver. The example you state is the same in principle as that of a converter working into a superheterodyne, e.g., the signal frequency, F1, is lowered from its short-wave value to a second frequency, F2, which is at the tuner level of the set, and in the set this tuner level is lowered to F3, e.g., 465 kc or some other similar intermediate frequency. There is no more reason for squeals in the case you cite, of the changes taking place in the parts in one cabinet, than in the other example, where the same fundamental circuit is distributed between two cabinets.

Station Sparks *By Alice Remsen*

MANY HAPPY RETURNS!

ANNIVERSARY celebrations have been in order lately. Molasses and January, also known as Pick and Pat, have been working together for six years as a team, and the Landt Trio and White have begun their seventh year as an NBC radio attraction. Jolly good luck, boys! May you all be together many more years! . . . Gertrude Hitz, sister of Elsie Hitz, NBC dramatic star, has returned to the microphone after more than a year's absence from the air. She will be heard frequently in dramatic roles with the Eno Crime Club series. . . . Robert Simmons has replaced Frank Parker with the Revelers Quartet. Parker was forced to give up his role of leading tenor with the famous quartet because of increasing demands on his time for solos in commercial and concert work. Simmons has been heard on NBC network programs for a number of years. He is a straightforward and unaffected singer. . . . Vic and Sade, human sketch of small-town life, which has entertained NBC listeners for more than two years, are now on the air over both NBC-WJZ and WEAF networks east of Chicago under the sponsorship of Proctor and Gamble, makers of Crisco. They are heard daily, except Saturday and Sunday, over on NBC-WJZ network at 1:30 p. m., and over an NBC-WEAF network at 2:45 p. m. Which only goes to prove that good sustaining programs should never despair, because one never can tell when a sponsor may be lurking in the offing. Vic and Sade waited two years. . . . But "One Man's Family" has them beaten; they were on the air three years before attracting a sponsor. Now this typical American family may be heard each Wednesday at 10:30 p. m. under the sponsorship of the makers of Kentucky Winners cigarettes over an NBC-WEAF network. . . .

WHITEMAN'S GRACEFUL ACT.

Ambitious youngsters will be glad to hear of the Elfrida Whiteman scholarship established by Paul Whiteman as a memorial to his mother. It is a scholarship for composers, and consists of two years at a musical college or institute, a weekly income of twenty-five dollars during the school term, and the Elfrida Whiteman medal. To gain this the young composer must be an American, and must submit an outstanding composition, fully orchestrated, in a contest to close at midnight, February 1st, 1935. The winning composition will be selected by a committee of judges who will announce the decision on March 31st, 1935. Should the winner not be in a position to accept the course, he will be presented with the medal and a five hundred dollar cash award. In this event, a second prize of a one year scholarship will then be awarded. Entrants are requested to submit their compositions to the Elfrida Whiteman Scholarship, care of Paul Whiteman, Park Central Hotel, New York City. . . . There was another scholarship of a different kind offered by Anne Seymour, star of the NBC Grand Hotel programs. This was for blind actors, and it was won by Marian Hotch of Chicago. The scholarship consists of a full year at the Goodman Drama School and at least one role in the Coast-to-Coast broadcast of "Grand Hotel," and personal coaching in microphone technique from Miss Seymour. . . . Meredith Willson, general musical director of the NBC San Francisco studios, has written a composition with the rhythm of the Morse code as its motif. It is in three movements and scored in such a manner that experienced telegraph operators can read the Morse code message as transmitted in sharps and flats by the musicians. Willson will introduce it shortly on a new program which he has started over NBC networks on Tuesdays at 5:00 p. m. . . .

NBC BOYS ON PARADE

The NBC Pafe Boys will present their third "Brass Buttons Revue" on Saturday, November 10th, at 6:00 p. m. over an NBC-WJZ network. More than sixty guides and page boys will demonstrate as radio entertainers, singers, comedians, continuity writers, and directors. There will be a chorus of fifty voices, singing original compositions by Larry Shay, of the NBC music department. There will even be sound effect technicians—yes, sir; Robert Lamke and William Hoffman will man the noise department. . . . Ernest Cutting is still bringing out promising talent on his "Airbreaks" program, each Friday at 1:30 p. m. over an NBC-WEAF program; and by the way, this is just a reminder that Ernie Cutting was the first in the field with a radio amateur program; several others of its kind are now on the air, but Cutting had the first brilliant idea, and anyhow—imitation still is the sincerest form of flattery. . . . The advertising firm of Batten, Barton, Durstine and Osborne has anounced that it will award a cup for good announcing each year among the network announcers whose programs are audible in New York City. "By good announcing," explains Roy S. Durstine, vice-president and general manager of B. B. D. & O., "we mean sincerity, accurate diction, naturalness, persuasiveness, a lack of mannerisms and absence of those curious inflections which belong to an unknown language in a world which doesn't exist." Five executives of the advertising agency will make the decision, and the first cup will be awarded shortly after January 1st, 1935. Thereafter, a similar cup, inscribed with the winner's name, will be given during the first month of each year. . . .

ANOTHER LOVELY LADY

Columbia has snared another beautiful lady, who is also a sweet singer, Countess Olga Albani, who made her CBS debut with the Isham Jones Orchestra on November 6th. . . . Everett Marshall has returned to his "Broadway Varieties" minus a pair of tonsils, so if his voice sounds unusually clear these Wednesday nights, you'll know the reason. . . . Bill Adams, the "March of Time" mimic, says in the Columbia Quotes: "I believe achieving a convincing impersonation is largely a mental matter. If I can think like the man I am impersonating, I can get a truer likeness than by merely reproducing voice inflections. Actions speak louder than words when I'm preparing for an impersonation. When I visit a newsreel for material, each toss of the head and each characteristic motion means more to me than actual voice quality." And Will Rogers says: "Talking once on the radio, where there's no big audience, is harder than doing ten performances of a stage play or making a whole picture." . . . and goodness knows Will, that's true! . . .

STUDIO NOTES

Although Edgar Guest, the Household poet, lives practically on the first tee of a golf course in Detroit, he never gets time enough to play. . . . I've lived eight years next to a tennis court and never had time to play—and that's a fact! . . . Harry Kogen, NBC orchestra leader, is a chess enthusiast. He even plays games with friends out of town, postal carding moves back and forth via the U. S. mails. . . . Jimmy Melton's private cook book is about to be published, with cartoons of Jimmy as a cook. . . . Ray Heatherton's young cousin made his debut as a radio actor on a "Castles of Romance" program recently. The script called for a Mexican shawl maker and a peanut vendor; the embryonic actor played both parts. He said "Si, senor" and "Muy Bueno, peanutta" very convincingly. . . . Lew Brown's new show, "Calling All Stars," will have three Columbia radio stars in its cast: Everett Marshal, Gertrude Niesen and George Givot. . . .

Paul Whiteman introduced his niece, Dorothy Atkins, to the air recently over the ABS network, from WMCA, New York. Dorothy's mother is Ivy Livingston, sister of Mr. Whiteman's actress wife, Margaret. . . . Three little college girls out of the West, with only a few months' radio experience behind them, are heard in their own arrangement of popular songs over WMCA and the ABS network each Saturday at 7:45 p. m. They are Jan, Jude and Jerry sorority sisters in Kappa Alpha Theta at the University of Oklahoma. . . . Bob Haring is doing some good things on WMCA these days. Bob is the musical director of the new network. One of his very finest programs is "Moods in Melody" each Sunday at 8:00 p. m. Bob conducts the thirty-one piece orchestra, and is assisted on the program by Dorothy Atkins, niece of Paul Whiteman; Helen Board, soprano; Crane Calder, baritone; the Harmonettes, a girl trio, and the American choir. Take a listen; it's worth it! . . . Harry Hershfield, celebrated newspaperman and raconteur, whose ideas, serious and not so serious, on almost anything you can mention are known to hundreds of thousands, is heard over the ABS-WMCA network five days a week, Sunday through to Thursday, at 7:45 p. m. . . .

YOU MIGHT LIKE THEM

Heart Throbs of the Hills, Sundays, 6:00 p. m. WJZ. . . . The Spotlight, Mondays, 10:30 p. m. WOR. . . . Gene and Glenn, each week-day, 7:15 p. m. WEAF. . . . Footlight Echoes, Wednesdays, 9:00 p. m. WOR. . . . Al and Lee Reiser, Thursdays, 9:45 p. m. WOR. . . . March of Time, Fridays, 9:00 p. m. WABC. . . . Saturdays, the Roxy Revue, 8:00 p. m. WABC.

A THOUGHT FOR THE WEEK

HERE'S THE GOOD NEWS ALL AT ONCE: Crosley Radio Corporation showed a net profit of $412,942 for the six months ending Sept. 30, alter the usual deductions for royalties, depreciation, Federal taxes and other charges against a net profit of $169,805 for the corresponding period last year. Sales for six months ending September 30 this year total $8,401,651, against a sales total of $4,633,578 during the same period in 1933.

If that isn't Grade A No. 1 news, what's your idea of good news?

Baritone Songs Range From 1 to 7 Minutes

Fleetwood Jefferson, baritone, has a standing repertory of 80 songs, and lists the number of minutes it takes to sing each of them. Mr. Jefferson, heard with Wilbur Hatch orchestra over KNX, and with Sanella Orchestra over KMTR, finds the longest are two at 7 minutes apiece: "Pagliacci" Prologue and "Bards They Sing." "Irish Lullaby" is the shortest, one minute.

A list of the 80 songs, and the time it takes to sing each, can be obtained by writing to him at 1310 North Marengo Avenue, Pasadena. Calif.

FIRST REVISION BEING MADE OF '30 STANDARDS

Unusual activity on many engineering problems is noted under the direction of Dr. W. R. G. Baker of Camden, N. J., chairman of the RMA Engineering Committee, and Chairman Virgil M. Graham of the RMA Standards Section. The new plan of promulgating radio industry standards through a general, large standards committee has been inaugurated. The first meeting of the General Standards Committee will be held November 12th at Rochester, New York, during the annual convention of the Institute of Radio Engineers. Coincident there will be a general meeting of radio engineers on the large problems of radio interference, to which engineering representatives of all RMA members are being invited.

Smaller Tubes Expected

Although the "acorn" tube recently brought out is restricted to amateur and experimental use, it is thought by many that if small tubes such as these can do as much as large tubes, where only voltage gain is desired, at some distant day small tubes will be used in broadcast receivers.

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.*

Bonham Radio Co., 121 Elm St., Bonham, Texas
A. E. Potter, R.1, Scottsboro, Alabama
Robert Thompson, Box 382, Mystic, Iowa
Howard F. Barrows, 134 Main Street, Bridgewater, Mass.
Joseph E. Dill, 118 Venable Hall, University, Va.
Klase Cox, 619 Davis St., Fort Wayne, Indiana
Hamilton McLaskay, 117 8th Ave. S., Nashville, Tenn.
Donald A. Berglund, 4858 Commonwealth, Detroit, Mich.
Alfred Noyyne, 3757 Ward Street, Chicago, Illinois
Karl W. Wilson, 16219 Monica Avenue, Detroit, Mich.
John Onusconage, 438 East Front St., Atlas, Penna.
W. F. Onder, 3725 Louisiana Ave., St. Louis, Missouri
C. A. Provost, 1905 W. Commonwealth Ave., W. Alhambra, Calif.
Ed. J. Peacek, Koehler Hotel, Grand Island, Nebraska
Swen Petersen, P. O. Box 870 Stockton, California
Alexander Pacelt, 1552 Buena Vista West, Detroit, Mich.
Mason E. Redman, 1822 West 108th Place, Chicago, Ill.
Basil F. Ramey, 10108 Cedar Ave., Cleveland, Ohio
C. W. Raine, 35 Euclid Ave., Maplewood, New Jersey
L. F. Reiner, 1328 SW. 14th Street, Miami, Florida
C. A. Robinson, 24 De Kalb Ave., White Plains, N. Y.
John J. Smith, Cottekill, Ulster County, New York
W. W. Swanson, First National Bank, Highmore, S. D.
Olan N. Sheffer, Stafford, New York
Edw. H. Sproles, Box 72, Gary, West Virginia
William Stage, 664 - 10th Avenue, N. Y. C.
Ross Williams, 325 Redington Ave., Troy, Penna.
Geo. M. Miller, Asst. Secy., Board of School Trustees, 590 Hamilton St., Vancouver, B. C., Canada.
Basil F. Ramey, 10108 Cedar Ave., Cleveland, Ohio.
L. David Stephenson, 508 Hillsboro St., Raleigh, N. C.
Ed. Fullwood, 404 N. Main St., Hereford, Tex.
Ben C. Sheldon, 10530 Draper Ave., Los Angeles, Calif.
W. E. Gray, 208 West 10th St., Lamoni, Iowa.
R. G. Willoh, Room 19, Custom House, Norfolk, Va.
E. J. Miller, 538 Ringgold St., Mt. Auburn, Cinnati, Ohio

Forcing Education on Air Opposed by Trade

Washington.

Views of Radio Manufacturers Association, Inc., in the general broadcasting inquiry of the Federal Communications Commission were presented by Paul B. Klugh, of Chicago, chairman of the RMA Legislative Committee and a director of the Association.

Opposing efforts of an educational group demanding a special and large assignment of broadcast frequencies for educational programs, Mr. Klugh declared that no special interest should be given special privileges in radio broadcasting.

That the broadcasters are responsive in giving the public what it desires in radio programs was asserted by Mr. Klugh. Public satisfaction, the RMA spokesman declared, has been registered by the immense investments of the public in radio, amounting to between four and five billion dollars since 1922, and estimated to show sales of 4,000,000 sets alone in 1934.

Declaring that radio is a general service, presenting the utmost variety of programs, Mr. Klugh opposed any special allocation of broadcast facilities to any special interest.

"If a certain definite percentage of wave channels, facilities or time is arbitrarily allocated to any of the four grand divisions of broadcasting, namely, entertainment, education, religion or information," said Mr. Klugh, "it will be a great mistake and will do much to diminish the popularity of radio and its acceptance to listeners. Allow the broadcasters to determine from the public's definite reactions just what should constitute their programs."

General satisfaction of the public with broadcast programs is indicated by the sustained and now increasing demand for radio apparatus, according to the RMA spokesman. At the present time it was said that the radio industry is involved in a "complete upheaval of its products due to the overwhelming demand by the public for short-wave receivers which can be put in the average home and receive foreign broadcast directly."

That the vast radio industry with capital investments of over $250,000,000 and 150,000 persons engaged in manufacture and distribution of radio is dependent on satisfactory broadcasting, covering all varieties of programs and features, Mr. Klugh stated.

N. Y. Hotel Aids Amateurs in 5-Meter DX Tests

The recent successful tests on long-distance 5-meter transmission conducted between the headquarters of the American Radio Relay League at Hartford, Conn., and the testing laboratory of James Millen, Middleton, Mass., have encouraged a group of New York amateurs to undertake an extensive venture.

The Garden City Radio Club, affiliated with the American Radio Relay League, is unique in that it has no officers, no dues and no regular meeting nights. More than ninety per cent of the members of the club, in addition to being regularly licensed amateur radio station owners, are also licensed aviators. Among the members of the club are Frank Hawks and Al Williams.

The club has just concluded arrangements with the Hotel New Yorker to supply the equipment for a new setup in 5-meter communication and arrangements have been made to instal beam arrays on the northeast and the southwest corners of the roof. The transmitters and receivers will be in the hotel's radio room on the forty-first floor.

The negotiations for this set-up were concluded by Arthur H. Lynch (W2DKJ), representing the Garden City Radio Club, and Eli. M. Lurie, chief radio engineer for all of the hotels under the Ralph Hitz management. Preliminary tests made with a standard National 5-meter portable transmitter and receiver have shown that the hotel is well located for this new form of communication, even on extremely low power, over the entire metropolitan area.

Mr. Lynch says that the first long-distance tests to be undertaken will be conducted with the Hartford Headquarters of the American Radio Relay League and it is hoped that within a reasonably short time the regular communication links between Washington, Baltimore, Philadelphia, New York, Hartford, and Boston will be established. The station at the New Yorker (W2DLG) will work with amateurs.

Boost-Sales Campaign Inaugurated by Industry

A national sales promotion campaign for the radio industry, in the interest of distributors, dealers and also broadcasters as well as manufacturers, has been launched by Radio Manufacturers Association, Inc. The campaign will be in charge of a special RMA committee of which Powel Crosley of Cincinnati is chairman.

The radio manufacturers' national program is an outgrowth of the previous Five-Point Plan considered by the RMA and the Radio Wholesalers Association. The RMA Board decided on tthe immediate national program, financed and conducted by the manufacturers, to start in November and continue vigorously through the Winter with future plans for enlargement and continuance through 1935.

KYW Uses Cathode-Ray Tube to Spot Distortion

Distortion in radio programs will be guarded against at Westinghouse's new KYW station in Philadelphia, by a cathode ray device mounted in the control room of the station. On the 7-inch face of the tube green figures of odd shape and dimensions appear, which, when analyzed, tell what is going on inside the big transmitter.

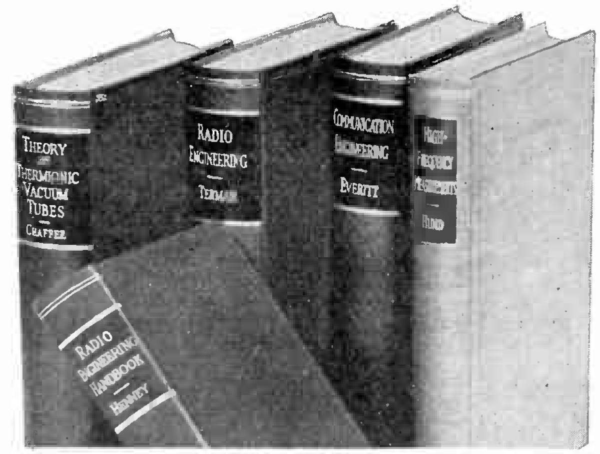
A "chronovolter" unit is associated with the cathode ray oscilloscope by means of which all frequencies, whether radio or audio, are observed as stationary patterns on the face of the cathode ray tube. Distortion can be detected from the shape of the figures. Through a simple calibration process, the height of the figure is used to determine percentage of modulation in the transmitter.

In operation, some of the current of the wave to be observed is sent through a "multivibrator" tube. The multi-vibrator tube is arranged so that its output can be adjusted to any multiple of the input frequency by simply turning a control dial. This multiple frequency is then used to control the "saw-tooth" oscillator which makes the beam of the cathode ray tube move rapidly right and left. In this way, the rate at which the beam moves back and forth horizontally is kept in synchronism with the wave under observation so that a stationary figure will appear on the oscilloscope tubes.

Tax Receipts Increase 48.6% over 9 Months

Substantial increase in radio sales are recorded by government reports of excise taxes collected on radio and phonograph apparatus. For the nine months ending September 30th, 1934, the 5 per cent. excise taxes on radio and phonograph apparatus totaled $2,209,399.90, an increase of 48.6 per cent over the similar nine months period of 1933, during which collections were $1,487,123.84.

Radio excise tax collections during August, 1934, were $229,681.76 as compared with $125,865.08 during August, 1933. The official Government figures, just released, of September collections register another large increase. During September, 1934, the radio excise tax collections were $305,291.91 as against $147,930.49 in September, 1933.



REAL LOSER IN WORLD SERIES WAS ARISTOTLE

By DR. ROBERT M. HUTCHINS
President, The University of Chicago

Educational broadcasting has been subjected to the charges that claims of minorities have been disregarded, the best hours have been given to advertising programs, the hours assigned to education have been shifted without notice, censorship has been imposed, experimentation has been almost non-existent, and the financial support of educational broadcasting has been limited and erratic.

Although I should not go so far as H. L. Mencken in condemning the entire American public as boobs and morons, I am ready to admit that most of them have as little interest in educational programs as I have, though for different reasons. Still I suppose even Mr. Mencken would concede, in his saner moments, that there is a large minority in this country eager to use the great new device that science has given them to continue their education. When all the Chicago stations of one company devoted all of every afternoon to the World Series a lecture course broadcast from my University suffered serious dislocation. When I protested mildly to one radio executive he gave what he thought was a complete answer by asking:

"How many people are there in Chicago who would rather listen to the Humanities course at the University than to the World Series?"

I did not deny that the overwhelming majority of my fellow-citizens would prefer hearing about a current home run to learning of the relatively remote accomplishments of Aristotle and Augustus.

Course Interrupted

I did assert that some of them had entered upon the course in the simple faith that it would be given four days a week at the same hour, and that to disrupt this program because the listeners were few was to disregard the claims, if not the rights, of this minority.

The appeal of the advertiser of soap and tooth paste must be to the great unwashed. Their constant association with these advertisers has apparently created in broadcasters the delusion that a mass audience is the only audience. I admit that there is no use in broadcasting a program to which no one listens. But the radio cannot pretend, as all broadcasters pretend it is, to be an educational instrument if the sole test of every program is the number of people gathered around the receiving sets. Insistence upon this standard means that educational broadcasting must be confined to the most popular presentation of the most ephemeral topics. In other words, insistence upon this standard may mean that educational broadcasting will cease to be educational at all.

The pressure upon the stations to make money has frequently forced the shifting or even the cancellation of a non-paying program as soon as a paying client could be discovered for the time.

Volunteers Do the Work

Educational broadcasting has to be carried on very largely by volunteers. They sacrifice their time and effort without any compensation except the feeling that they are participating in a good cause. Few things have done so much to dishearten these people as the cavalier way in which carefully prepared plans have been pushed around in the interest of increasing station revenues.

It is impossible to develop educational broadcasting in this country with the present organization of radio unless the broadcasters will guarantee the time that has been allotted to it. In the last year or so marked progress has been made, particularly by the chains, in dealing with this crucial problem. That it is crucial any one will agree who knows the infinite labor that goes into the construction of an educational series and the catastrophe that is caused by an arbitrary change of plans.

One cannot escape the impression that broadcasters have used so-called educational programs either for political reasons—to show how public spirited they are—or as stop-gaps in the absence of paying material. This has resulted not only in the frequent change of hours, but also in the donation of the poorest hours. It is natural, particularly in times like these, that the best hours should be sold; they bring the best price. But the hours that are best are best because most people are not free at other times. The finest educational programs in the world will not diffuse much education if the people who want education are occupied earning a living while the programs are on the air. If radio is to perform its educational function under private management the stations must guarantee time, and good time.

Needs More "Time"

Education must also have more time. The proportion of the broadcasting day devoted to education in the United States is far smaller than in England. I cannot believe that there is less need or even less demand for education here than there is abroad. The only conclusion is that our system does not do for education what has been found desirable and necessary elsewhere. The sacrifice of any time to education, assuming it could be sold, involves, of course, the loss of revenue. But as long as the American people cannot obtain from radio the essential services they require there will be profound dissatisfaction with it, and this must eventually lead to consequences far more serious than a slight reduction in income.

PROGRAMS CALLED VERY INFERIOR

By BRUCE BLIVEN
Editor, "The New Republic"

In advocating that we should put an end to the ceaseless flow of oral garbage into our homes which the radio at present provides, I am not suggesting that we should slavishly imitate the experience of any other country. I happen to believe after a good deal of first-hand experience that radio broadcasting in England is much better than in the United States; but I am sure that if we set to work really to reform broadcasting, we should be able to produce something better than exists anywhere else in the world. Certainly, being Americans, we should try.

I remember the days, fifteen years ago, when radio broadcasting was just making its appearance. At that time, we were all tremendously excited about the marvelous possibilities of this new force, which we believed would have the utmost usefulness, as a musical instrument, as a means of education and information, as a device for political debate. So far as America is concerned, these promises have not been fulfilled. What it does in the realm of serious music is a disgrace. What it does in the field of education is pitiful. What it does in the field of news is, broadly speaking, nothing. Our friends, the newspaper publishers, have effectively stopped all this work.

To be sure, an opponent of my views can bring forward a few good programs, most of them lasting the conventional fifteen minutes. It is like saying of a beautiful woman that she appeared in a white dress only part of which was dirty. Radio as at present constituted has driven away all persistent listeners except the morons—if you don't believe this, ask your friends. The rest of the population will never come back until they are assured that turning on the idle set will not be the equivalent of letting off a stench bomb in the family living-room.

'Phone Wires as Aerial Pass Out of Picture

Some years ago telephones were used as antennas for their capacity effect. A metal plate under the phone base served as one of the condenser plates. Thus a string of wire was connected to the set through a series condenser. The telephone company never liked this idea and the fad soon disappeared and never was revived.

TONE QUALITY HEARD AT LAST

By WALTER DAMROSCH

My first symphonic concert over the radio was given nine years ago. A few months before this I had made up my mind that after forty-two years as conductor of the New York Symphony Society I was entitled to reduce my public activities somewhat. This could only be done by retiring from that job, as it entailed four symphonic concerts every week for twenty-five weeks and innumerable rehearsals besides. But fate turned me into another direction which opened a new and marvelous world to me.

Most of you will remember the microphone and loudspeaker of those days. The results were far from perfect. The different instrument of a symphonic orchestra could not be clearly defined. The overtones which mark the difference betwen a clarinet and a flute, a bassoon or a horn were not indicated with sufficient clarity to enable the listener to get a wholly satisfactory impression from radio transmission.

But there was something fascinating to me in the mere idea that such music as I produced in a studio of the National Broadcasting Company could be heard by millions of people all over the United States, and I had the conviction that this was but the beginning and that American engineers would continue to perfect this new instrument more and more. This happened, quickly, and with wonderful results.

The improvement in microphones, loudspeakers and receivers which now enables some of the most delicate and subtle tone vibrations to be carried thousands of miles by radio and to be reproduced with great fidelity at the other end, has naturally brought about a constantly growing interest in the finer pleasures which real music can give.

Whereas nine years ago, the bulk of the music which one heard on the radio consisted of the cheapest forms of jazz and very tentative efforts of an educational character, we have today quite a formidable demonstration not only of the higher forms of music including symphony concerts by all the great orchestras of the country, but also opera broadcasts from the Metropolitan Opera House and the Chicago Opera, choral performances and chamber music, besides the charming lighter operas of Strauss and Sullivan. Am I satisfied with these results? Not a bit of it.

"I must be cruel, only to be kind:
Thus bad begins, and worse remains behind."