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RADIO WORLD

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The First National Radio Weekly

661st Consecutive Issue—Thirteenth Year

TREASURE-SEEKER CIRCUITS

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MICRO-WAVE ANALYSIS

SHORT-WAVE MEASUREMENTS USING BROACAST STATIONS' CRYSTALS

NOV. 24
1934

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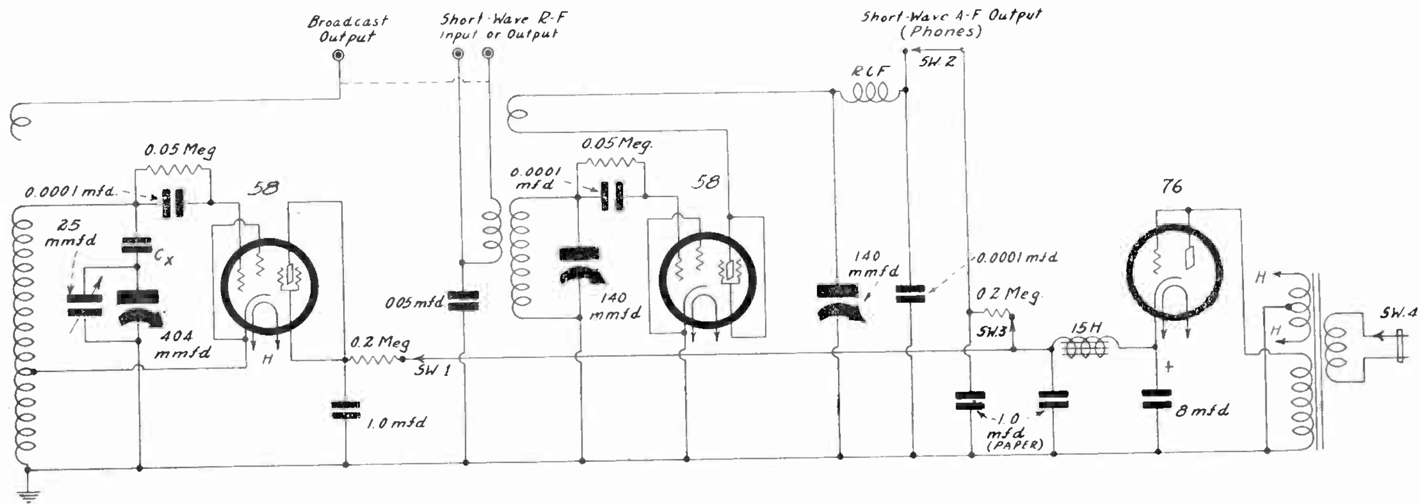
Short-Wave Measurements

Broadcast-Band Generator Used With Combination S-W Receiver and Sender

By Herman Bernard



A broadcast-band generator, at left, and a short-wave "geneceiver," at center. A simple rectifier is shown. The combination is used for coil winding for short waves, also calibrating.

NUMEROUS experimenters get lost in the forest of frequencies in the short-wave region. A method used by the author in connection with suitable matching of coils and condensers for short waves for receiver and generator use will be described.

The set-up consists of a broadcast-band generator, a short-wave geneceiver (combination generator and receiver), and a rectifier.

By using a frequency-calibrated dial, commercially obtainable (No. 333-A), and a coil of 250 microhenries, also a commercial product, tapped at 35 microhenries, the broadcast-band device can be direct-reading, which simplifies matters a great deal. If this small investment is not desired, then one may set up any coil-condenser system for covering the broadcast band, and get numerous points on a 0-100 dial, and draw a curve on cross-section paper, relating frequencies and dial settings. Then the curve would be consulted every time a reading of the dial is taken.

The short-wave system may consist of whatever condenser is to be used, and whatever coils are to go with it. These coils may be of the plug-in type. Or it may be desired to make one's own switch type coils. Usually for short waves alone, with 0.00014 mfd., there would be four coils, or for 0.0001 mfd. there would be five coils.

The two generators will not couple of themselves. This has been tested experimentally. The broadcast coil may have a few turns of wire over its secondary, to be used for the capacity effect, and thus an output condenser in reality is created. One terminal of this extra winding is left free, the other is connected to the work circuit. In general the first connection will be to a broadcast receiver, either to calibrate the broadcast-band generator, or to coincide the scale with the generation.

Alignment

For aligning the broadcast-band generator with direct-reading dial, start at the high frequency end and tune in on a receiver the highest-frequency station out of which you can get a peep. Verify the frequency of this station. With 0.02 mfd. in the series circuit, as diagramed, adjust the 25 mmfd. trimmer until at the generator setting equal to the station frequency you get zero beat. Then turn the generator toward maximum capacity and beat with a station at 560 to 610 kc. If the frequency reads too high, decrease the 0.02 mfd. capacity, if too low, increase it.

For checking low-frequency values, if one has numerous higher-frequency stations to select from, 1,100 kc up, when such stations are heard, note them for the high frequency, then turn the generator dial to greater capacity and the next squeal will reveal a generation of half the frequency of the station's wave, in other words, the second harmonic of the generator is beating with the station. This method helps if you are to run your own calibration. In the pre-calibrated scale only the two ends need be tied down. The rest takes care of itself.

If Cx, the series padder, needs adjustment, make that change but then go back to the

(Continued on next page)

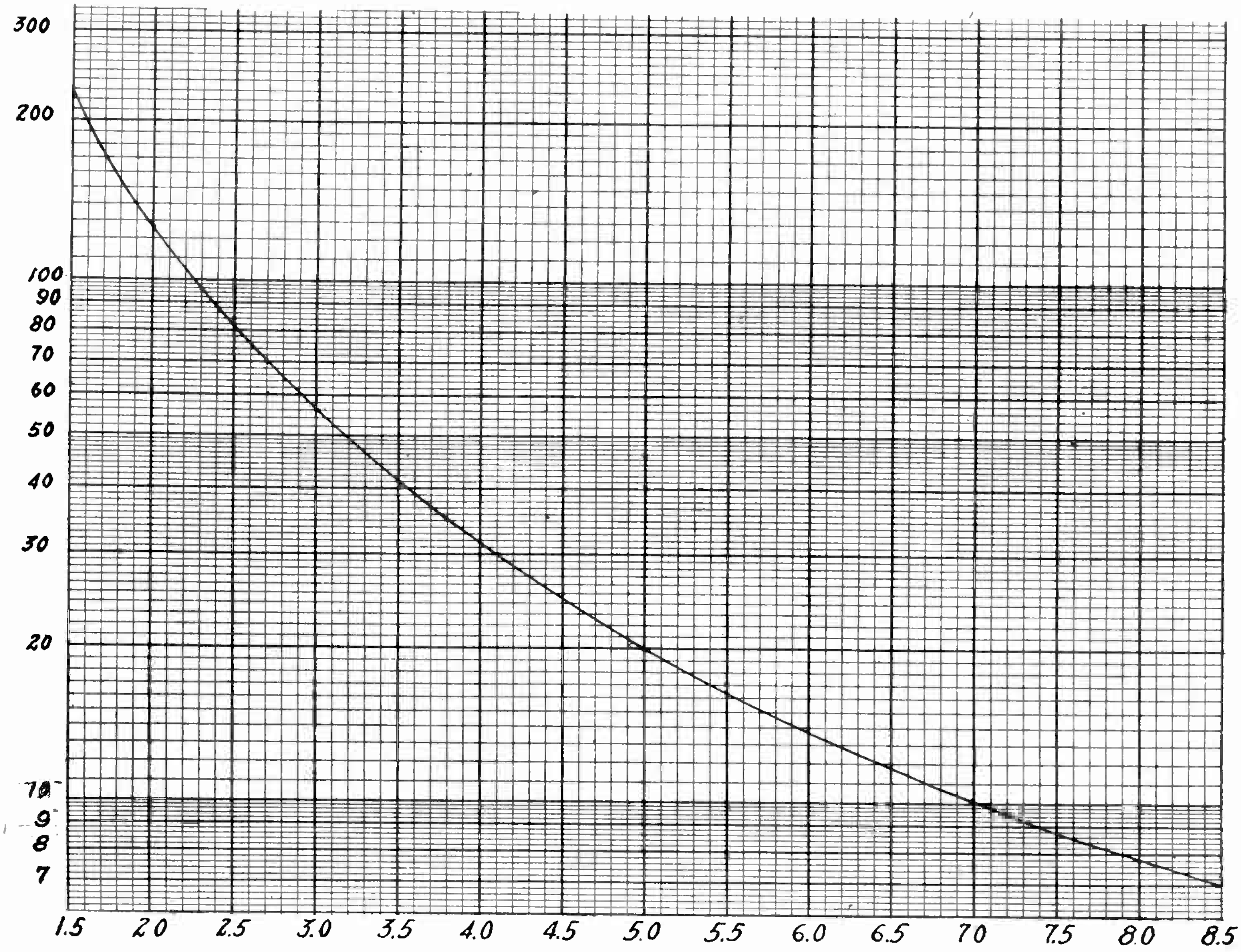


Chart relating inductance in microhenries (vertical) with frequencies in megacycles (horizontal) for a capacity of 50 mmfd.

(*Continued from preceding page*)

high-frequency test point, which may have been 1,250 to 1,500 kc, and readjust the parallel 25 mmfd. condenser.

The short-wave generator, now under discussion, has a combination input and output circuit for radio frequencies, also an earphone position. No phone outlet for the broadcast band was provided, because a receiver is to be used, and if there is any choice, it should be a tuned-radio-frequency receiver, as with this type there is virtual assurance of only one response for one frequency, and no confusion due to local oscillator and its harmonics.

The tubes in both instances are 58's used as triodes. The calibrated dial was scaled on the basis of triode use. Moreover, the conductance is higher for the triode hookup, and this is of value in a generator, especially in view of the use of a limiting resistor.

Stability of Frequency

Of course, the short-wave section may be used as a one-tube receiver, when the throttle condenser is adjusted. But the throttle condenser is kept at maximum capacity for all generator purposes. A possible exception is for the highest-frequency band, when a phase shift may set in, and just the opposite hold, so for this band, note just what the position of this condenser should be for used generation all over the dial, and accurately duplicate this position each time the generator is worked as such. If this is not done, the calibration of the short-wave device for this band would become rather meaningless.

Both of the generators are very stable. The large limiting resistors in the plate-return legs account considerably for this stability, since the resistance is practically constant during any period of operation. Since the requirement for frequency stability is that the total circuit operate as a pure resistance, when the far greater part of the resistance is a limiting resistor the constancy is high. Of course the amplitude is less, and in some rare instances there may be failure of oscillation at the highest-frequency band, or part of that band, in the short-wave adjunct, so in that instance reduce the limiting resistor until its value is consistent with oscillation at all settings.

Often the short-wave coils are of the two-winding type, but the absence of a pick-up winding can be compensated for by inserting a few turns of wire inside the coil form and bringing them out to the posts.

Operation Directions

As for the operation of the device, since the broadcast-band generator is calibrated in frequencies, the frequencies resulting from working the short-wave set may be measured. However, we would rely on that measurement principally for terminal frequencies, that is, highest and lowest in any band, and for the actual tuning curve of the short-wave system, all bands, would prefer to use station frequencies in conjunction with the broadcast generator. In that way all our measurements are on the basis of a crystal-controlled circuit as primary standard, that is, the station carrier. The method is called "beating up" in respect to frequencies, or "beating down" in respect to wavelengths.

Therefore the first problem is to determine the terminal frequencies. Set both generators going, couple one to the other, by means of a wire from "Broadcast Output" to the high side of "Short-Wave A-F Input or Output." If a multiplicity of responses is heard in the short-wave audio output, phones inserted of course, then the coupling is too strong, so instead of just a wire joining the two posts, cut the wire and wrap several turns of both together without conductive coupling. This provides a small condenser effect.

Measuring Frequencies

Taking the lowest-frequency coil, turn to maximum condenser capacity in the short-wave system, start tuning the generator from highest frequency toward lower frequencies until the first response is heard in the phones, and note the frequency. Then slowly turn the broadcast generator knob until the next response is heard in the phones, short-wave end unmolested. Note the frequency of the second scream. Strike the difference between the two frequencies read. Divide this difference frequency into either read frequency, and the unknown is this factor multiplied by the *other* frequency read. E.g., if the two frequencies read are 1,200 and 800 kc, the difference is 400 kc, and the unknown is (800/400) 1,200, or 2x1, 200=2,400 kc.

Then turn the short-wave knob to the smallest condenser capacity, highest frequency, and go through the same process. For a 0.00014 mfd. condenser the highest frequency should be about 2.4 as great as the lowest frequency. Whatever the frequencies determined, divide the highest by the lowest to get the frequency ratio; use

(*Continued on page 21*)

Straight-Frequency Line

Obtained by Using a Parallel Padding Condenser

By Harvey Sampson

THERE are so-called straight-line frequency condensers on the market, but not sufficiently close to a straight line to be useful for precision measurements. That is, the curve tends to bend a little, always near the minimum capacity end, sometimes also at the other extreme. Besides, the straightness of the line is more or less related to the circuit used, or, to put it differently, the same shape of tuning curve does not apply to all circuits.

Some may find a straight line valuable. For instance, if the line is truly straight, and the frequency ratio of the tuning is known, then when the frequency of one position is known the positions for other frequencies within the ratio are known. The dial position for the particular frequency should be ascertained either on the basis of degrees of a circle or other even gradations. Another advantage is that a true vernier system may be introduced, for the dissection of difference into much smaller differences becomes a linear matter. Only on the basis of such frequency linearity can the dissection on the true-vernier basis be applied to frequency.

Tuning Ratio Decreases

The frequency should decrease proportionately to the increase in the square root of the capacity, for straight frequency line to apply. Therefore, using a straight capacity line condenser, it is only necessary to put across it a sufficiently large but critical fixed condenser to introduce this rate of capacity change in respect to angular displacement of the dial, or change of frequency, when a coil is considered also. The coil may have any value, as only the magnitude of the frequency is affected thereby.

With the inclusion of the necessarily large parallel fixed capacity, the ratio of tuning is reduced. Normally a ratio of around 3 to 1 or somewhat larger obtains, with the commercial capacities now popular, say, 350 to 404 mmfd. or so.

The tuning ratio will shrink to around 1.5 to 1, and may even go lower than that. However, one resultant benefit is that if a generator or receiver is to be built there will be total bandspread, although the number of coils required to cover bands will be increased.

Making a Start

Using the General Instrument 404 mmfd. condenser, approximately midline, a model popular in signal generators, the parallel capacity was applied in the signal generator using the 335 scale, and the result was approximately straight frequency line (the preferable term), although the spreadout was greater at the lower than at the middle frequencies, and tended to become slightly larger at the high-frequency end than around the middle of the dial scale. However, the parallel condenser was only 100 mmfd.

No particular parallel capacity can be stated just now, but for the condenser under consideration it would have to be more than 500 mmfd. for a certainty. The concern at present is to reveal the method of introducing this parallel capacity so that the straight line does result, even without one knowing actually what the parallel capacity should be or is, or what the frequencies are. Also, the method is applicable to several other makes of condensers, as the tuning curves do not differ so much.

The requirements are a generator of frequencies and a receiver that may be tuned to frequencies much higher than the highest that the generator produces. The highest receiver frequency should be at least five times, and preferably around ten times, as high as the highest generator frequency. Then set the generator going at its lowest frequency, couple it to the receiver, and tune the receiver to some frequency near its high-frequency extreme. It is the receiver that has the condenser we shall pad. If the broadcast band is used, then tune the receiver to around 1,500 kc, and have a generator that produces around 50 kc. It is not necessary to know the generator frequency or the receiver frequency, but it is well to be sure that the receiver is tuned to a much higher frequency.

Now, if the receiver consists of an oscillator, with earphone output, there will be beats between the two devices, due to the harmonics of the fixed low frequency mixing with the fundamentals of the variably-tuned receiver-oscillator. The only circuit difference between the two may be that earphones are in the higher-frequency device.

Inequality Shows Up

Now, the low-frequency generator is left at one frequency position, but the receiver-oscillator is tuned to lower and lower frequencies, and a 0-180 or 0-100 dial is used. Assume that some harmonic of the low-frequency generator produces a response at 5 on the receiver-oscillator dial, another response at 10, another at 18, another at 30, 48, another at 70 and the last at 100. Since the low-frequency generator is unmolested, different harmonic orders of the same fundamental frequency cause responses in the receiver, hence these harmonics are separated by equal orders of fundamental, or there are equal frequency differences, that is, the receiver-oscillator numerical readings are for equally-spaced frequencies. The spacing or difference is equal to the fundamental of the generator. If the fundamental of the generator is 50 kc then the responses in the receiver are 50 kc apart.

Numerical Differences

It will be noted the numerical differences in arbitrary units were 5, 8, 12, 18, 22 and 30. The frequencies are crowded at the high frequency portion of the receiver, but become progressively more and more spaced as the frequency is lowered. Since the crowding is too great at the high-frequency end, more parallel capacity will spread out the frequencies in respect to their dial position.

Now say that the readings are 1, 17, 37, 62, 90. The differences are 16, 20, 25, 27. We are much closer. But as the differences are still smaller near the high-frequency end, a little more fixed capacity is to be added across the tuned circuit, until the dial differences are the same, e.g., 10, 50, 90. Since the frequency ratio will be contracting, fewer reponses will result. This is additionally true because the receiver frequency is being lowered throughout by the extra fixed capacity across the tuned circuit.

Compensation

Since the fundamental range of the receiver has been lowered, if one desires to use the same generator as standard, he may put a smaller coil in the receiver, to get more responses, for better checkup, as only four points would be insufficient. The spacing of the points should be even, but the responses in the oscillating receiver should be around 15. To the same purpose a fixed condenser may be put across the generator to lower its frequency, particularly since we do not have to know the frequencies either of the generator or receiver. All we are interested in for the while is the equality of spacing for responses.

Receiver Frequencies

After the number of responses has been made sufficient, and the low-frequency end and middle of the dial all subscribe to the requirements, it may be found that there is lack of linearity near the high-frequency end of the dial. If the spacing there is too great, still more capacity is needed in parallel, and if the spacing is too small, less parallel capacity. However, if the low-frequency end and middle are upset, as they may be, then return to the status quo, follow through to the highest receiver frequency consistent with equal spacing, note the numerical setting, and resolve to end the calibration there. In this way only a small percentage of the possible frequency coverage is omitted, anyway.

Now it is necessary to measure the receiver frequencies, which may be done by using the standard generator, which is calibrated of course, making the measurement by use of fundamentals directly, or fundamentals by their harmonic responses in the receiver. The harmonic technique was summarized for practically all accurate methods in the October 5th issue.

Using Harmonics

Using a fundamental of the standard generator, measure one receiver frequency. It is possible to complete the curve from this sole datum, but if cross-section paper is used, the decimal or half-decimal separations do not readily result, so turn to a known low frequency of the generator and the responses in the receiver will be in steps of the fundamental.

Trouble-Shooting Gadget Designed by Two Authors

An ingenious gadget to assist servicemen in trouble-shooting has just been designed by A. A. Ghirardi and B. M. Freed, authors of a forthcoming publication on "Modern Radio Servicing." This gadget is now on the market.

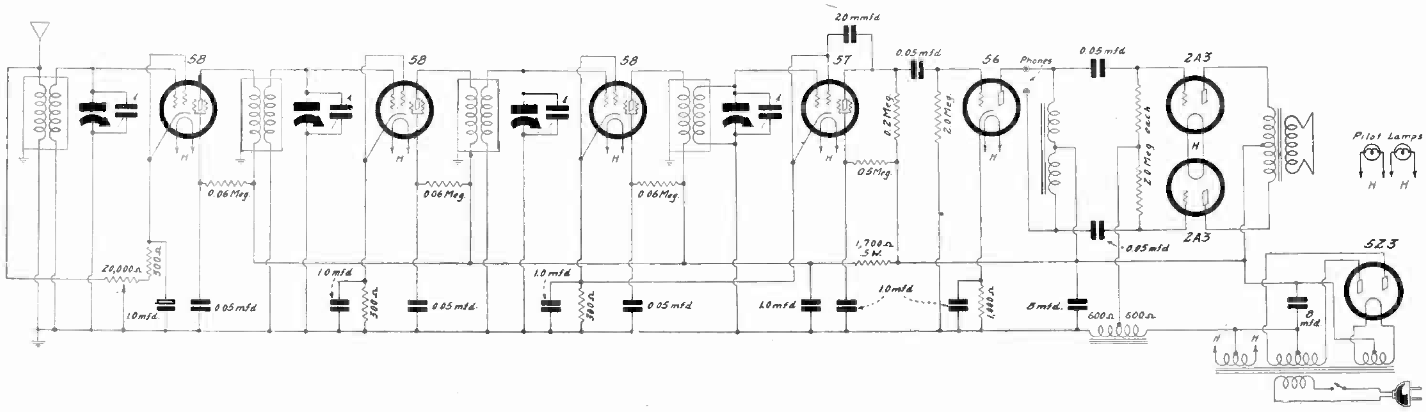
According to the symptom detected by the serviceman, the gadget lists according to source 275 possible troubles in the receiver. Six general types of symptom are shown: Hum, weak, noisy, inoperative (no signals), intermittent reception, fading, oscillation and distortion. The trouble sources are classified according to whether their location is in the power unit, receiver circuits proper, tubes, reproducer, antenna ground, A battery (if used), B battery (if used) and general.

The gadget is being sold by Radio & Technical Publishing Co., 45 Astor Place, New York, at 25 cents.

An 8-Tube T-R-F Receiver

Proponents of this Type Circuit May Well Follow this Model

By Herman Bernard



For those who prefer the tuned-radio-frequency type of receiver here is an eight-tube model for the broadcast band only.

THE tuned-radio-frequency receiver has its followers, although in commercial sets the superheterodyne is practically the exclusive choice, except for midget sets not worthy of much attention.

The advantages of the t-r-f set are that it is quiet in operation, is not over-selective and therefore affords an r-f channel free of injurious effects on tone, and is very easily balanced. For the experimenter engaged on measurements using either broadcast, or lower frequencies by harmonics, the added advantage of absence of repeat responses due to oscillator presence in the set and strong receiver harmonics is important.

Broadcast Circuit

As shown the circuit is intended only to cover the broadcast band. It is practical to go to higher frequencies by switching, but the method is simple, and any desiring to use switching may do so. Coil data for all frequencies will be found in the table on page 6, under "Radio-frequency Coil," of the square-root-of-10 group. After the first intermediate short-wave band there may be trouble due to oscillation, even when shielded coils are used. The primaries at all hazards for the bands above the intermediate short-wave group would consist for this set of only two or three turns, at the most, and for the smallest coil, even less, although it is admittedly troublesome to handle the situation for any high frequencies.

Uses Four-Gang Condenser

The coil system for the broadcast band consists of four commercial shielded units, with shields grounded, primaries alike, and wound over secondaries. If higher frequencies are to be covered, primaries for such purposes would not be wound over the secondaries but beside them. Any who wind their own broadcast coils may either follow the data in the specified coil table, with primaries adjoining secondaries, if preferred. This does not make much difference for the broadcast band, except that the coupling is somewhat looser when the primary is not over the secondary.

There are three stages of tuned-radio-frequency amplification and a tuned input to the detector. This requires a four-gang condenser, and it is possible with the commercial model used to cover from a bit below 540 kc to above 1,700 kc; in fact, response near 2,000 kc was gained. This requires that the trimmers be removed from the condenser, and the set so wired that equal capacity is thus introduced or maintained. However, to reach 1,700 kc the trimmers may be left on the condensers.

The r-f tubes are 58's and the detector is a 57. It is excellent practice to get the 57 bias from the preceding r-f tube, for then a low value of biasing resistor serves the detector circuit, and the obstructive effect, or degeneration of audio frequencies, is circumvented largely, and the 1.0-mfd. bypass condenser certainly removes the degenerative effects at radio frequencies.

Better Sensitivity and Tone

The detector circuit is somewhat special therefore, having been worked out by the author for a receiver published more than a year ago, when it was a novelty indeed to show a negative bias of around 3.5 volts on the 57. The tube data sheets and specification charts all showed bias for detection adjusted on the basis of 0.1 milliampere plate current, but then the bias was close to 5 volts through the large recommended resistor. The two objections found to this by the author were that the high bias was not nearly the most sensitive nor best-toned operating point, and naturally would not be, at so near cutoff of plate current, and that a very large condenser was required across the enormous biasing resistor, some 50,000 ohms, serving only that tube.

No Plate-Leg Chokes

Later the official specifications for operation of the 57 as detector were changed in the direction of lowered bias, and so a detector circuit once rather a novelty now appears as rather orthodox as to bias voltage, although not necessarily as to the method of obtaining that voltage.

Instead of using r-f plate-leg chokes and condensers from hot side to cathode or ground, large bypass condensers are used across the cathode biasing resistors, in the cathode legs of the radio-frequency and detector tubes. Since the plate and screen, and even suppressor, currents unite in this resistor, the cause of oscillation is largely centered there, and if the impedance is made low enough, the principal cause of squeal trouble and instability is removed. For an intermediate amplifier this safeguarding capacity has been found to be 2.0 mfd., and in-

LIST OF PARTS

Coils

Three shielded radio-frequency transformers, for nominal 350 mmfd. tuning.
One high-impedance center-tapped audio choke, or a regulation push-pull input transformer.
One power transformer: primary, 115 volts; secondaries, 2.5-volt, center-tapped, 10 amperes; 5-volt, center-tapped, 2 amperes; 350-0-350-volt a.c.
One dynamic speaker, with output transformer for 2A3's; field coil tapped at 600 ohms, with total field resistance not exceeding 1,500 ohms.

Condensers

One four-gang tuning condenser, with trimmers built in.
Two 8 mfd. electrolytic condensers.
Six 1.0-mfd. paper bypass condensers.
Six 0.05-mfd. paper bypass condensers.
One 20-mmfd. mica fixed condenser.

Resistors

Three 300-ohm pigtail resistors.
One 1,000-ohm pigtail resistor.
One 1,700-ohm, 5-watt resistor.
One 20,000-ohm potentiometer with a-c.
Three 60,000-ohm pigtail resistors.
One 0.2-meg. pigtail resistor.
One 0.5-meg. pigtail resistor.
Three 2.0-meg. pigtail resistors.

Other Requirements

One chassis (commercially obtainable).
One frequency-calibrated airplane dial (commercially obtainable).
Four grid clips.
One a-c switch.
Three knobs (one for dial, one for potentiometer, one for a-c switch).
Five tube shields (for all save push-pull pair and rectifier).
Antenna-ground binding post.
One UY socket for speaker plug.
Two 3.3-volt pilot lamps.
Eight tubes as follows: three 58's, one 57, one 56, two 2A3's, one 5Z3.
One a-c cable and plug.

cidentally is recommended to any who have squeal trouble at the i-f level, but here we have a t-r-f set, at higher frequencies than any i.f., and 1.0 mfd is sufficient.

Watch the Bias

The capacity bypassing the screen resistors is not critical, 0.05 mfd. being adequate, and even smaller capacities serving nicely. However, any who have larger than 0.05 mfd. may use what they have.

The screen voltage is dropped from the B feed of the r-f amplifier by 60,000-ohm resistors. If the B feed here is 250 volts, then the screen voltage as read on a voltmeter of 2,000 ohms per volt resistance, scale 300 volts, would be 100 volts, closely. It is not very important that the screen voltage be just 100 volts, rather it is more important that the negative bias be 3 volts for these r-f tubes, including the first tube when potentiometer is all the way over toward the limiting resistor.

The reason for citing the cathode-resistor drop rather than the screen voltage as controlling is that the plate current depends on the screen voltage and not on the plate voltage, with this type of tube, and the negative bias therefore will be wrong, perhaps considerably so, even with 60,000 ohms in the screen leg, if other elements of the intended proportion are not present. Therefore the negative-bias test is recommended, and the screen voltage may be adjusted to yield the 3-volt biasing. Lowering the screen resistor increases the negative bias.

The detector tube screen, however, has a 500,000-ohm resistor, which is roughly three times the value of the load plate resistor, and made so because the currents in the two circuits are about in that proportion. Therefore the effective screen voltage is practically the same as the effective plate voltage in the detector, a favorable operating condition. It is not the maximum sensitivity point of operation, but if the sensitivity were pressed beyond that used, the detector would overload quickly, that is, would not withstand so much carrier input.

Selectivity Question

It is never intended that the input be a very husky one to the detector, certainly not exceeding 3 volts. The detector feeds a 56 tube that works into a push-pull 2A3 pair, and it is possible to load up both the 56 driver and the push-pull pair. However, the volume control is located in the first r-f stage, serving to reduce input as well as to increase bias, for purposes of attenuation, and therefore this control alone is used for making sure that none of the subsequent tubes is overloaded.

The danger of overload begins to arise at the third r-f tube, and carries on to detector and both audio stages, as it is rather necessary to design a t-r-f set in this fashion, as no sacrifices can be introduced. Hence no automatic volume control becomes practical.

It is well known that with t-r-f the question of selectivity is important. Any who have observed the comparison between selectivity curves of superheterodynes and t-r-f sets must have noted the marked difference. In fact, no t-r-f set ever made, so far as the author knows, came up to the selectivity of a six-tube properly-designed tuper. So it is not for selectivity that a t-r-f set is built, and yet since there is nothing to spare on this score, every effort should be made to keep the selectivity as high as practical. And when the goal is reached, the selectivity will be satisfactory for general use.

No Grid Current Wanted

Therefore no grid-leak type detector, or diode detector, is used. Both types draw current. In fact, they are the same. A grid-leak detector is nothing but a diode-biased triode, etc., the leak being the audio load resistor, the condenser across it the detector bypass condenser, and the grid-to-cathode circuit the anode-cathode circuit of the rectifier. Hence this type is more sensitive, as the rectification takes place in the grid circuit, and the triode, etc., is the amplifier. With plate bend detection there is no amplifier. The tube serves as detector and that is all. But the tube does not draw current from the input circuit; that is, no part of the radio-frequency power is used to "run" a leak or a load resistor. Any grid current in the detector is accidental and not intentional.

Resistance Coupling

The detector is resistance-coupled to the driver. In the 56 plate leg is a center-tapped audio coil. This may be the primary of a push-pull output transformer intended for secondary connection to a low-resistance voice coil, 8 ohms, etc., the secondary not used here. Or, if one desires to use the formal push-pull input transformer he may do so, and omit the two 0.05-mfd. stopping condensers and two 2.0-meg. grid leaks in the 2A3 grid circuits.

The output to the dynamic speaker is standard. Since semi-fixed bias is used, the speaker primary may have a somewhat larger impedance than ordinarily recommended for the 2A3's, say, around 5,000 ohms.

The two pilot lamps are shown, because late model airplane dials have two lamp brackets, so upper and lower sections of the scale are independently illuminated.

The B Voltage

The rectifier and filter are standard. The filter choke is the speaker field, in the negative rectifier leg, and the voltage drop across this choke is large. If the set draws 100 milliamperes, there would be 60 volts negative bias derived from that part of the choke between tap and ground, and if the rest of the choke has a d-c resistance of 600 ohms, then the total drop across this reactor is 120 volts. This requires that the d-c output be 420 volts, of which 60 volts to the right on the choke are "lost," the 60 to the left serve as bias, both are cumulative, and besides these 120 volts at least 300 more volts are needed for the plates of the output tube, hence total 420 volts. This is about as close as one would desire to come in establishing a working voltage wherein electrolytic condensers rated at 500 volts are used.

Hence between ground and B plus are some 300 volts, and as the prior tubes take 200 volts to 250 volts, the 1,700-ohm resistor will apply a suitable voltage, nearer 250 volts. As some 30 milliamperes will flow through this resistor, the wattage rating should be 5 watts. The actual wattage dissipated is only about 1.5, but it is not wise to rely too much on the ratings of resistance manufacturers, and doubling or trebling the resistor rating is good practice.

The diagram shows the necessary parts, excepting four grid clips, dial, tube shields, knobs, and shielded wire, etc. If there is any r-f squealing it may be necessary to use shielded wire for the overhead grid lead, but in that case, to prevent introduction of much capacity, the type wire with a thick serving of insulation, usually cotton over the tight-fitting rubber, should be used, and while it is not most beautifying to have half-inch diameter shield on these leads, the purposes intended are better served. The sheath or outside covering, of course, is grounded

Special Programs on Two Days to Come from VK2ME

A special short-wave radio program from Australia, dedicated to the District of Columbia, will be broadcast on Sunday, November 25th, by VK2ME, operating on 31.28 meters from 5:15 to 6:30 a.m., EST. This will consist of music and short talks. This same station will send three programs, dedicated to three different communities, on December 9th. The first, dedicated to Honolulu and Alaska, will be heard in this country from 2:15 to 3 a.m., the second, dedicated to the Province of Ontario, will be heard here between 6:30 and 7 a.m.; and the last to New Brunswick and Nova Scotia will be heard here between 7 and 7:30 o'clock in the morning. All three programs will be on 31.28 meters.

Wave Directed by Graphic Control by KYW Operator

A visual indication of the direction of the radio waves from the new KYW station in Philadelphia will be available at all times as a result of a new development by Westinghouse engineers. In addition to indicating direction, small push buttons permit the operator accurately to adjust the radio beam from the station control room. The device is called a "graphic meter panel" and is set into the station wall along with seven other panels for controlling the radio transmitter. This is the first time in the history of radio broadcasting that such a device has been installed as part of transmitter control equipment.

A cathode ray tube similar to that used in the latest television developments is mounted on the panel near the center so that its fluorescent screen comes flush with the panel. On this screen various waves and patterns are reproduced which the engineers can convert into terms of radio beam direction. The signals that produce the patterns come directly from the bases of the four 245-foot vertical antenna masts used at the new station. They are conducted back to the graphic meter panel through special underground circuits. At the base of each antenna there is a motor-operated tuning equipment which is controlled from the push buttons on the graphic meter panel in the control room. By using these push buttons the operator adjusts the phase relationship of the current being delivered by the transmitter to each of the antennas, and determines the direction of the radio beam.

The panel also contains four radio-frequency ammeters that indicate the radiating current present in each of the four antennas. In addition, two recording meters at the top of the panel continuously record on a moving tape the voltage delivered to the radio station from the power lines and the power consumed by the output amplifier of the transmitter.

The graphic meter panel alone measures 84 inches high and 28 inches wide and is finished in aluminum to conform with the appearance of the six other panels of this control board.

Ovenless Crystal Developed

New Method Is Self-Constant, Though Slab Is Paper-Thick

THE tip of a flag pole serving as an antenna, hollow wires which, like water pipes, carry electricity without leaking, a quartz crystal scarcely thicker than a hair which acts as a control by vibrating 5,000,000 times a second, and operation in a wave band so remote from atmospheric disturbance that a bolt of lightning would cause only a barely audible click, are among the features of the radio system which has just been placed in operation by the Police Department of the City of Newark.

The system operates on 30,100 kilocycles, an ultra-high frequency being within a new frequency band tentatively assigned for police radio work by the Federal Communications Commission. This frequency is about 20 times higher than the medium frequency band regularly assigned for police work and which is used by most police radio systems now in operation.

So popular has radio proved for police service that in certain sections of the country few channels in the medium frequency band remain unassigned. Hence the Commission's decision to open up new frequencies for this service.

Freedom from Static

Operation on an ultra-high frequency, as embodied in this Newark system, possess certain advantages for municipal stations. Freedom from atmospheric disturbance is one. Newark motor patrolmen listening to their receivers will not be troubled by static, thunderstorms or other types of interference which are ordinarily picked up by receivers in the medium frequency bands.

As the wave length to be used determines the length of the antenna, the extremely short waves used in the ultra-high frequency system mean proportionately shorter antennas. In the Newark system a short upper section of the 100-foot flag pole on the National Newark & Essex Bank Building serves as a very efficient antenna. To operate in the medium wave a longer antenna is necessary. The shortness of the antenna makes possible construction of transmitters which are mobile. Should Newark authorities at any time decide to establish two-way radio service, transmitters could be installed in police cars thus enabling the motor patrolmen to talk to headquarters as well as receive.

Ultra-high frequency waves have characteristics which prevent their being picked up over as great distances, unlike longer waves, and consequently broadcasts made over ultra-high frequency systems confine themselves to smaller areas. A city as near as Albany, for instance, could probably use the same frequency as Newark without interference.

Refined Apparatus

In adopting this system, the City of Newark is taking a leading part in opening up the new sector of radio channels for police work throughout the United States. The medium frequency bands assigned for police work extend roughly from 1,600 to 1,700 kilocycles and from 2,300 to 2,500 kilocycles. These comparatively narrow bands are in many parts of the country completely occupied with police assignments.

The ultra-high frequency band ranging from 30,000 to 42,000 kilocycles embraces a range of 12,000 kilocycles within which a far greater number of police assignments may be made. The separation between ultra-high frequency channels, however, is very narrow and requires apparatus of great refinement, stability, selectivity and reliability to be successfully used. While a few communities have already tried ultra-high frequencies, Newark is a leader in putting in operation equipment of such design. The example it has set will no doubt result in making police radio available to many other communities which at present have not been able to obtain assignments in the limited number of channels existing in the medium bands.

The Newark police radio system, purchased from the Graybar Electric Company, was designed by Bell Telephone Laboratories and manufactured by the Western Electric Company, most of the work being done at their plant at Kearny, N. J.

Small in Size

The entire transmitting apparatus is contained in a single cabinet, 7 feet high and 1 foot, 9 inches wide. The transmitter draws its power directly from the power circuits of the building. Mercury-vapor rectifier tubes transform the alternating current into direct current of the proper voltages. Three tubes amplify the voice currents and there are four stages of amplification for the carrier or radio frequency.

A quartz crystal of new type holds the transmitter on its assigned frequency with extreme accuracy. This tiny crystal, perhaps the most vital part in the system, is ground to paper thinness by skilled craftsmen using delicate machines. When so ground it has the characteristic of vibrating under electrical impulses at exactly one-sixth of the carrier frequency or about 5,000,000 times per second and thus establishes the fundamental frequency of the transmitter. Hitherto the best crystals available have required the use of heating devices to maintain their operating temperature within the narrowest practicable limits. As a result of extensive research by Bell Telephone Laboratories, it has now become possible to manufacture crystals which do not require the complications of these accessories to achieve the desired constancy of oscillation frequency.

A series of vacuum tubes multiplies the electrical oscillations of the crystal until they reach 30,100 kilocycles.

Concentric Transmission Line

From the transmitter a "concentric" transmission line runs 100 feet to the roof of the building. This line consists of two copper tubings, one within the other, the outer being a little less than an inch in diameter and the inner somewhat smaller than a pencil. This one is held precisely in the middle of the outer by spaced rings of insulating material known as Isolantite. The outer tube is bare of insulation, coming directly in contact with bricks, plaster, etc., and acting as ground.

The unique design of this transmission line makes it "water tight" as far as electric current is concerned. The entire electrical field is concentrated within a small space, none escaping beyond the outer tube. There is no loss of energy by radiation.

This line enters the bottom of a hollow steel flag pole which rises 100 feet from the roof of the building. The line runs up the inside of the pole to its tip. Projecting from the tip is a brass tube 22 feet high. The inner tube of the transmission line also projects from the tip of the flag pole, parallelling the brass tube about 7 feet. This sets up an electrical effect which prevents current from surging back into the transmission line and maintains a uniform current in the line. The remaining 15 feet of the brass tube, about 600 feet above street level, become the actual antenna or radiator, being half the length of the radio wave.

The receiving sets are of the 6-tube superheterodyne type. They are 6 by 7 by 10 inches in size, including the loudspeaker.

Tuned Vertical Antenna Improves 'Plane Beacons

The Department of Commerce, continuing to aid airways, recently purchased a quantity of Westinghouse antenna tuning units to improve present radio beacon service. The units will prevent skyward radiation of signals.

Such use of antenna tuning is the result of recent developments. It was found that when using older types of antennas for these radio beacon stations, a considerable quantity of the radiated energy was directed skywards at night, and on being reflected from the sky, caused interference with the original wave traveling along the ground, so as to make flying the course at times uncertain. By installing four vertical antennas for each station, it has been possible to eliminate to a large degree the amount of signal radiated skywards, thereby avoiding the original difficulty. Each vertical antenna requires a tuning unit located at its base. Completely foolproof, the tuning unit is enclosed in a sheet aluminum house, with ingenious ventilation to prevent water, bugs, or other foreign matter getting inside to cause short circuits.

The radio beacon service, as established by the Department of Commerce, has provided well marked air lanes between all the principal cities throughout the country. Any radio-equipped plane can fly these air lanes and be accurately guided by the radio beacon signals. The radio stations supplying these radio beacon signals have a range of from 100 to 250 miles and are so arranged that their signals overlap, thereby providing a continuous course for the pilot.

Two Multivibrator Circuits

Measurement Device is Rich in Harmonics

By Lester F. Wallin

RADIO propagation is intimately tied up with oscillators. For signals to radiate successfully, very high frequency alternations are required and thus the radio-frequency oscillator in its various forms was invented. To render these signals intelligible, they have to be modulated with a varying frequency that is audible. This gives rise to the audio-frequency oscillator in its various forms.

Yet anoher type of oscillator is useful in the production of many frequencies at the same time, for measurement and calibration purposes. Such a generator of oscillation of numerous frequencies is the multivibrator. The feature of this device is that it produces an alternating current very rich in harmonics. It can thus be very useful in the calibration of wavemeters.

Theory of Circuit

The circuit diagram of the multivibrator as devised by Abraham and Bloch, the Frenchmen who invented the device, is depicted at left and it will be noted that the circuit possesses no inductance. All four resistances should be approximately equal and of 50,000 ohms in value. The condensers, C, are equal in value, the capacity of which, will determine the fundamental frequency generated by the multivibrator, partly affected by the resistance, according to the approximate formula:

$$f = \frac{1}{(C_1 + C_2)R}$$

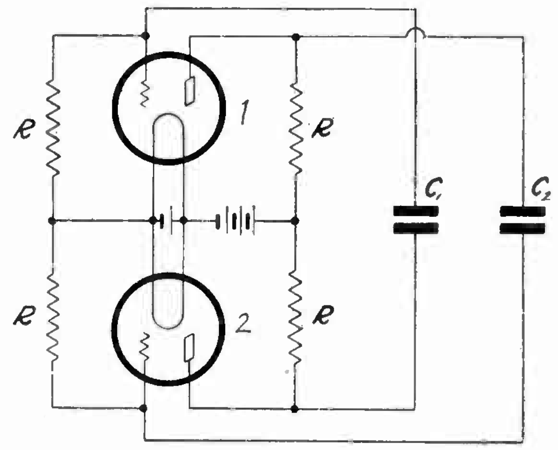
where C is in farads, R in ohms, and f in cycles.

A theory as to the operation of this pair of tubes in such fashion can be stated as follows. If the plate current of tube 1 in diagram at left should increase, the plate potential would decrease, causing condenser C_2 to discharge with a consequent reduction in grid potential of tube 2. Thus, the plate current of tube 2 will decrease and the plate potential will rise, causing the grid potential of tube 1 to rise also and still further augment the first rise in plate current of tube 1.

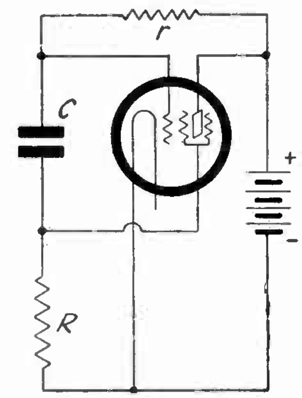
This process will continue until the plate current in tube 1 reaches the saturation point and the current in tube 2 falls to zero, when the process tends to reverse itself and repeat the cycle for tube 2. This will be maintained as long as the circuit is energized, at a fundamental frequency determined by condensers C_1, C_2 and R.

Single-Tube Circuit

Recently Barth-van der Pol devised a form of multivibrator that utilizes one screen grid tube. The circuit is shown in Fig. 2. It will be noted that a positive bias is placed on the control grid of the tetrode slightly lower in value than the plate potential, as regulated by resistance r, and that here also no lumped inductance is present. However, it was determined that some inductance was necessary to obtain conditions essential for the maintenance of oscillations and that the inductance of the grid lead containing C was sufficient for this purpose. Accordingly, should such an oscillator fail to maintain its oscillations, it would be appropriate to vary the length of this lead. The fundamental frequency for such a



The multivibrator devised by Abraham and Bloch is a convenient way of generating an alternating current rich in harmonics.



The multivibrator of van der Pol has only one tube.

multivibrator is approximately equal to the product of C and R.

A major use of the multivibrator is in the measurement of frequency. Its value in this respect and its superiority over other methods of frequency measurement is eloquently testified to by the fact that all the monitoring stations of the Federal Communications Commission are equipped with multivibrator units for checking the frequencies of the many radio stations in the United States and elsewhere.

These units consist of eight five-watt tubes to form four separate Abraham-Bloch arrangements for the production of four separate fundamental frequencies: 100 cycles, 1,000 cycles, 10 kilocycles, and 90 kilocycles. These frequencies will have their attendant rich supply of harmonics to form a mess of frequencies that will heterodyne any given signal frequency.

Crystal Control

The constancy of these frequencies to form trustworthy standards is maintained through the agency of a temperature-controlled piezo crystal oscillator which drives the multivibrator unit at 30 kilocycles. The temperature control is achieved by two temperature chambers, one inside the other, with the crystal in the inner one. A thermostatically-controlled heater operated from an 8-volt storage battery supply, mounted inside the oscillator unit and outside the crystal holder, maintains proper temperature on the crystal itself. A second thermostatically-controlled heater, operated from the 110-volt a-c or d-c supply, mounted inside the oven and outside the crystal oscillator unit, maintains proper room temperature. Thus a constancy of temperature on the crystal unit is obtained with the attendant constancy of frequency output from the crystal, which in turn renders the output of the multivibrators constant.

Accordingly in this manner, through the agency of the multivibrator, the Government is afforded a convenient means for enforcing the frequency allocations by precision check-up .

Constants for Both Multivibrator Circuits

The following constants are derived from the formula for the two-tube multivibrator:

Frequency	*R*	*C*
10 cycles	50000 ohms	1.0 mfd.
100 cycles	50000 ohms	0.1 mfd.
1000 cycles	50000 ohms	0.01 mfd.
10000 cycles	50000 ohms	0.001 mfd.

The following apply to the one-tube multivibrator:

Frequency	*R*	*C*
10 cycles	1 megohm	10 mfd.
100 cycles	10 megohms	10 mfd.
1000 cycles	10 megohms	100 mfd.
10000 cycles	100 megohms	100 mfd.

Note: It should be borne in mind that these values are approximate only and that experiment would be necessary for more exact calibrations.

Amateurs Are Active At Long Race Courses

Amateur radio is being found at an increasing number of sporting events these days, particularly of the amateur variety. For several years, radio amateurs have provided communications at the National Air Races and the National Soaring Meets. According to reports reaching the headquarters of the American Radio Relay League, during the last summer these activities were expanded to include regattas and motorcycle runs.

Amateur radio is highly useful in any event where there is a long course to be run and observers are stationed at intermediate pylons, checking stations, official barges, etc. And the hams get a big thrill out of doing the work.

They report to the judges' stand or paddock by short-wave transmission and thus the crowd is kept informed of what it can not see.

An Analysis of Micro Waves

Big Opportunity for Experimenters in Region Where Formulas Can't Be Used

By Leonard C. Fuller

THE term micro waves is in general attributed to waves measured in centimeters. The first notable example of their use was in the Dover-Calais experiment, when 18 centimeters was the wavelength. This was a step deeper into the higher frequencies or shorter waves than had been taken when waves of a few meters were used in telephonic communication in the Hawaiian Islands, where the terrain and static made other forms of short-distance communication difficult.

It is generally accepted now that the distances that can be covered is small, the same view as held in the beginning of experiments. For a while it was thought that distances up to 170 kilometers or so could be accomplished, for Marconi had done something along that line, but now he points out that the optical distance is the extreme of dependable service. There is something of the erratic about attainment of greater distances.

The optical range is taken as the distance of the horizon, or the extreme of the line of sight. Therefore some greater distance than 25 miles can be accomplished by elevating the antenna, for that has the effect of extending the horizon.

Antennas on Skyscrapers

Experiments on a few meters have been made in and about New York City by television engineers, with greater than the horizon distance covered, and there has been some voice communication, too. The transmitting antennas are atop lofty buildings.

The very high frequencies are not standardized as to classification, therefore the terms used are somewhat confusing. There is a proposition before engineering bodies to create standards for these and other purposes, so that ultra frequencies, quasi-optical waves, micro waves, etc., will have some significance. One method finding favor is to use the metric system of terminology, so we would have centimeter waves, meter waves and the like.

One of the drawbacks to experiments by those not connected with laboratories has been that special tubes are needed. Recently a tube has been announced that opens the field wider to home and shop experimenters, the so-called acorn tube, which is said to oscillate at a wavelength as low as 0.5 meter. This is equal to 50 centimeters and therefore the tube may be said to be operable in the centimeter region.

Quite a Difference

In handling such high frequencies or low waves it is necessary to amend low-frequency practice. A wire two or three inches long would be called short for 10 mgc, but at 600 megacycles it would constitute an appreciable inductance as well as a capacity. A frequency may be changed 10 per cent. by moving a connecting wire a distance so small that it is hard for the eye to appreciate the physical change. But the electrical system records it.

The question of impedances then introduces an arresting aspect. An antenna less than half an inch long might be more than one wavelength. An antenna capacity of the order of 1 mmfd. would become large. In fact, antennas with capacity of fractional micro-mike is used. At these frequencies practically anything of finite length, breadth or thickness has appreciable inductance and capacity. The frequencies are so high that formulas can not follow them, and empirical methods must be used.

Much Expected of Hams

This makes the field most attractive to the experimenter. He is at his best when a mathematician cannot outpace him with pencil and paper. The measurement of the constants on which the mathematician depends for his calculations being difficult and sometimes so approximate as to be really impossible, the cut-and-try expert holds sway. No doubt the hams will add a great deal to micro-wave technique, just as they did so much to develop the science in the lower frequencies, albeit at short waves. For when we speak of low frequencies in respect to micro waves and the like, we still include pretty high frequencies in the "low" classification.

The bulk of ham activity at higher than normal frequencies has been in the 56 megacycle band. Thus the transceiver came into vogue for the "5 and 10" group, meaning waves between 5 and 10 meters. The device used constituted a transmitter when a switch was set at one position and a receiver when the switch was set at the other.

Super-regeneration has been the vogue, but with the new tube it is possible to get away from super-regeneration, which has sensitivity and broadness as advantages in this region, but has some disadvantages, including the interference from the interrupter frequency.

The super-regeneration method consists of having an initially regenerative detector into which a lower oscillating frequency is introduced, so that the detector tube is prevented from spilling over, by the interruptive action of the second frequency. The best sensitivity is developed when the interrupting frequency is low, and it was an audio tone, years ago. This of course was a nuisance, as the drone in the phones was constant, and a part of the total modulation, mixed with any signal being brought in. Later the frequency was made higher, so that it was just above audibility, but there was some sacrifice involved.

Super-Regenerator Noisy

Just as regular broadcast receivers can be made so sensitive that the noise level is high, so with any sensitive system, including the super-regenerator, the noise level is obnoxious. Not only the possibility of hearing the interrupting frequency but also the inevitable circuit noises and shot-effect noises constitute trouble.

Nevertheless pretty good results have been obtained with super-regenerators, and the general idea is prevalent that the super-regenerator is as yet the only circuit for these high frequencies. However, the statement is based on the absence of knowledge of the operation of the new tube, which tube may spell the end of super-regeneration, and permit the development of circuits that can be controlled satisfactorily, are stable, and also quiet in operation. Nobody ever contended seriously that the super-regenerator was quiet.

May Swell Ham Ranks

The idea of putting a very small transceiver in a car has proved attractive to hams. Indeed, as there is more room, by far, on the very high frequencies, hence crowded channels do not deter newcomers, and there may be a burst of activity in the direction of new-found hams.

The advance in the number of licenses issued to amateurs has been steadily going on during the depression, until now there are about 50,000 licenses issued, but if the micro waves catch on, as they well might, because of the large ether territory open to the hame in this region, the 50,000 may be greatly exceeded.

There might even be some effort to obtain licenses of the third class, outside the ham category, where passing the code test is not a requirement, although then a specific frequency assignment is made. Hams, however, may operate, with certain restrictions, anywhere in the bands allotted to them.

Use of Tubes in Industry Told by Westinghouse

An illustrated 217 page zincograph pamphlet, presenting a fundamental treatment of the operation and application of electronic tubes in industry, is offered by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

The treatment is non-mathematical, starting with electronic phenomena and the mercury arc, passing to high-vacuum tubes and the grid-glow family, thence to photo-responsive electronic devices and cathode-ray tubes and ending with the specific technique of a variety of applications. Throughout the pages there is adherence to all the fundamental material introduced about electronic phenomena and the circuits built around them. The purpose is to show how these physical properties can be put to practical use in industrial objective of manipulation and control.

As a supplement to the above course, a "Manual of Experiments" is issued. In this series of twenty-four tests, the apparatus needed, method of setup, procedure to be followed, and results to be obtained, are fully explained.

This parallels the course of study and demonstrates the types and characteristics of the various electronic tubes described. The two form a very complete schedule in this subject of both classroom and laboratory work. Advertising and propaganda have been carefully avoided so that the material can be used as an accurate and unbiased text.

Coil Data for All-Wave and Short-Wave Supers

By Warren C. Lennox

COMPUTATIONS have been made for a coil system for an all-wave superheterodyne, 540 kc to above 17,000 kc, using 465 kc intermediate frequency in one instance and 175 kc in the other, applicable to condensers of commercial ratings of 350 mmfd. or somewhat higher, and also a coil system for 0.00014 mfd., for both i. f.

For the lower frequencies the computations will hold, but for the higher ones some experimenting has to be done, because of the uncertainties of stray capacities and inductances due to the location of parts, wiring, etc.

1-Inch Diameter

The winding diameter was taken as the form diameter, or 1 inch outside, and all data are for close winding. Any spacing would require a little more wire. The data are given for tuned secondaries, assumptively in the grid circuit. The primaries would be on a 1-to-4 turns ratio, ⅛-inch separation when the ratio holds for the two low-frequency coils and is increased for the others as need be.

For the instance of the larger tuning condenser an oscillator minimum capacity of 50 mmfd. is assumed. This may be achieved in any instance by a trimmer, preferably of the air-dielectric type, as that will stay put. Therefore the r-f minimum capacity always will be lower than the oscillator minimum.

Trimmer Capacities

Trimmers across r-f tuning sections, other than oscillator, do not matter so much as to kind, hence the compression type of condenser as found on the commercial capacitances may be used. In the instance of the 140 mmfd. tuning system, often, with junior or midget types, there is no trimmer built in, therefore air-dielectric types would be used across both oscillator and r-f sections. In the 140 mmfd. instance the oscillator minimum was taken as 35 mmfd. The r-f minimum will be adjusted to something less.

It is handy to put a small manual trimmer across the r-f section, front-panel located, then the fixed type may be omitted. Also, by this method the oscillator minimum need not be changed, band for band. By the other method, of including some fixed capacity across each individual oscillator coil, for each band, the air-dielectric trimmer is set for correct capacity by obtaining maximum response, the condenser is turned to slightly less capacity, just a bit, remember, and then two insulated pieces of hookup wire make up the difference. One end of one wire is connected to grid terminal of coil, equivalent end of other wire to grid return, and twisted together until the response is restored to what it was. Some binder is put on the twisted wire to prevent any shifting. A couple of inches of wire should be enough, say, for around 6 mmfd.

Inductance Factors

The r-f inductances was selected on the basis of a capacity ratio of 10, which is safely obtained from the run of condensers commercially rated at 350 to 404 mmfd. For the 140 mmfd. example the capacity ratio was taken as 5. The respective frequency ratios are approximately 3.15 and 2.24. Hence for the r-f coils, when the inductance for the low-frequency coil is known, the required inductance for succeeding coils is known. The factor 1/10 applies to 220 microhenries, and 1/5 to 64 column of the table below shows this reduction by 0.1 and 0.05.

In the all-wave table, based on the square root of 10, the actual condenser taken into consideration had a maximum of 404 mmfd. The minimum can be established as required by screwing down the compression trimmers for r. f. The 140 mmfd. case is covered by the square root of 5. No computation is required in using the table.

For Frequency Ratio $\sqrt{10}$

Megacycles	Radio-frequency Coil	465 kc Oscillator Coil	465 kc Padding	175 kc Oscillator Coil	175 kc Padding
.54- 1.7	220 muH, 115 t. 32 en.	110 muH, 68 t. 32 en.	400 mmfd.	140 muH, 81 t. 32 en.	1,710 mmfd
1.7 - 5.4	22 muH, 24 t. 32 en.	14.5 muH, 18.5 t. 32 en.	2,325 mmfd.	17 muH, 20 t. 32 en.	2,790 mmfd.
5.4 -17	2.2 muH, 8.6 t. 18 en.	1.7 muH, 6.4 t. 18 en.	none*	2.2 muH, 8.6 t. 18 en.	none*
17 up	0.22 muH, 2.3 t. 18 en.	0.22 muH, 2.3 t. 18 en.	none*	0.51 muH, 3.5 t. 18 en.	none*

For Frequency Ratio $\sqrt{5}$

Megacycles	Radio-frequency Coil	465 kc Oscillator Coil	465 kc Padding	175 kc Oscillator Coil	175 kc Padding
1.6 - 3.55	64 muH, 4.7 t. 32 en.	59 muH, 45 t. 32 en.	190 mmfd.	50 muH, 40 t 32 en.	795 mmfd.
3.55- 7.92	12.8 muH, 24 t. 22 en.	10 muH, 20 t. 22 en.	1,435 mmfd.	10.5 muH, 21 t. 22 en.	none*
7.92-17.75	2.56 muH, 9.6 t. 18 en.	2.56 muH, 9.6 t. 18 en.	none*	2.56 muH, 9.6 t. 18 en.	none*
17.75-39.75	0.51 muH, 3.5 t. 18 en.	0.51 muH, 3.5 t. 18 en.	none*	0.61 muH, 3.5 t. 18 en.	none*

**Where no series padder is used the r-f and oscillator parallel trimmers are adjusted near the high-frequency end of the band for balance*

How to Use Time-Zone Chart

The DX fan (distance station listener) is once more in his prime, now that all-wave receivers have become the vogue. It is vital in this connection to know the time of day or night existing at the distant point. The Time Zone chart of the World on following two pages will be of great utility for this purpose.

It will be noted that the map comprises 24 one-hour zones, longitudinally constituted, which are labelled plus or minus, according to whether they are east or west of the Greenwich meridian. These divisions are regularly spaced over water but deviate somewhat on land, due to physical and political considerations.

Plus and Minus

The zones lying east of the meridian are known as minus zones since in each of the the zone number must be subtracted from the local standard time to obtain Greenwich time. The zones lying west of the meridian are known as plus zones, since in each of them the zone number is added to the local standard time to obtain the equivalent value in Greenwich time.

Foreign Time in Local Time

For an example, let us assume that at 9 p. m. Eastern Standard Time we hear PK3JL in Java. We wonder what time it is in that country at that moment, and proceed as follows: 9 p. m. may be designated at 21:00 on the basis of a 24 hour clock. It will be seen that New York City is in zone plus 5. Accordingly, 21:00 plus 5 equals 26:00 or 2 a. m. in Greenwich. It is seen that Java is in zone minus 7. It has been stated that in minus zones, the zone number must be subtracted from the local standard time to obtain Greenwich time. Accordingly, if we have Greenwich time and desire to get the local standard time in a minus zone, it is necessary to add the zone number to the Greenwich time, which gives 2:00 plus 7 equal to 9:00. Thus, it has been found that when it is 9 p. m. Eastern Standard Time here, it is 9 a. m. Standard Time in Java.

On the other hand, the hours of operation of a distant station may be known and it is desired to ascertain what local time corresponds so that he correct local time to listen may be found. The procedue in such a case may be as follows: HJV at Vatican City operates at 11 a. m. Italian Time. Vatican City is in zone minus one; therefore the corresponding Greenwich time is 11:00 minus one or 10:00. Referring this to New York City in zone plus five reveals that the time in New York City is 5:00 a. m. (10:00 minus 5 equals 5:00).

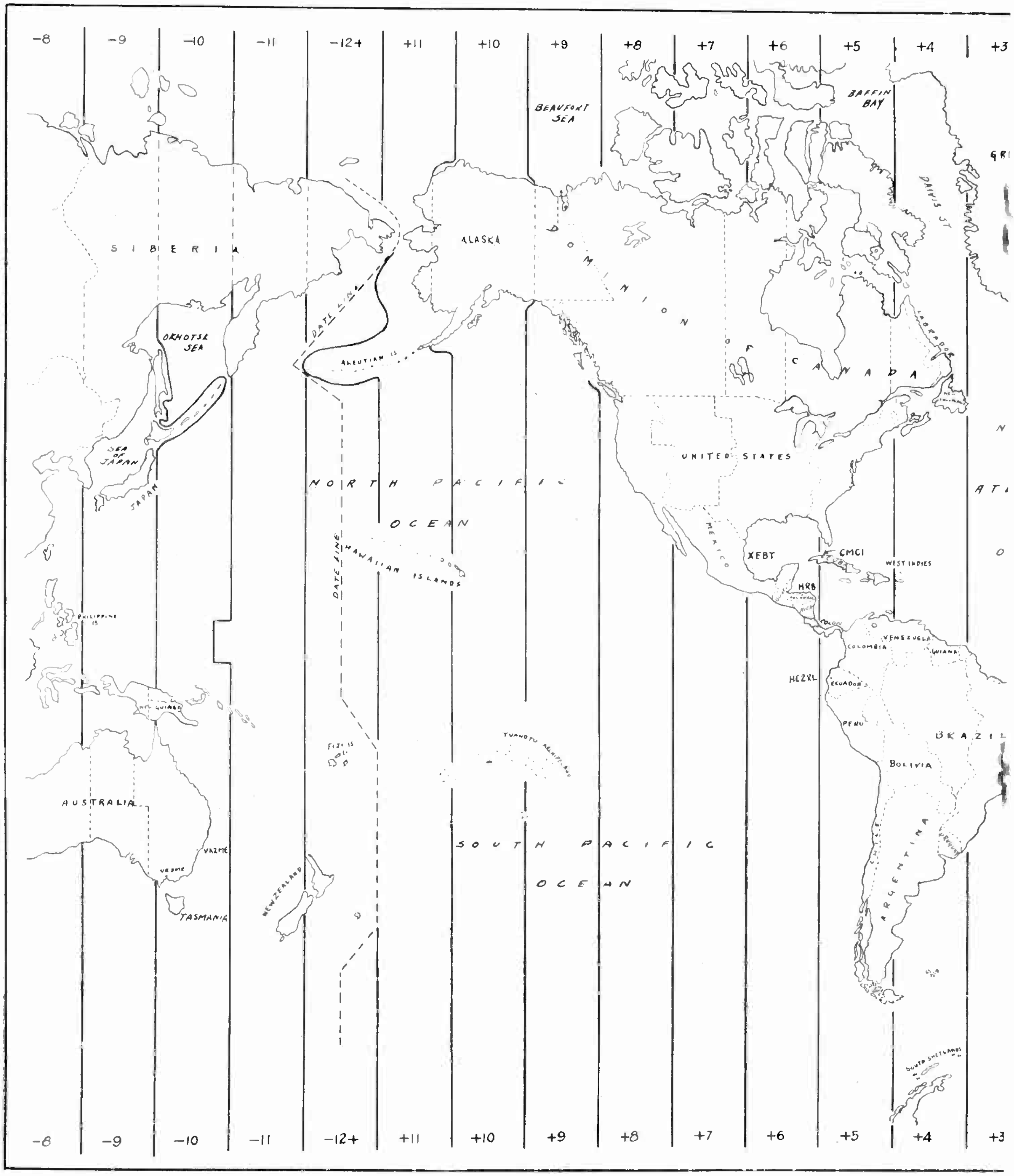
In this manner, the local time for any point on the globe may be obtained.

First Announcer Elected to Congress is Karl Stefan

Karl Stefan, chief announcer of WJAG at Norfolk, Nebr., was elected to Congress from the Third Congressional District.

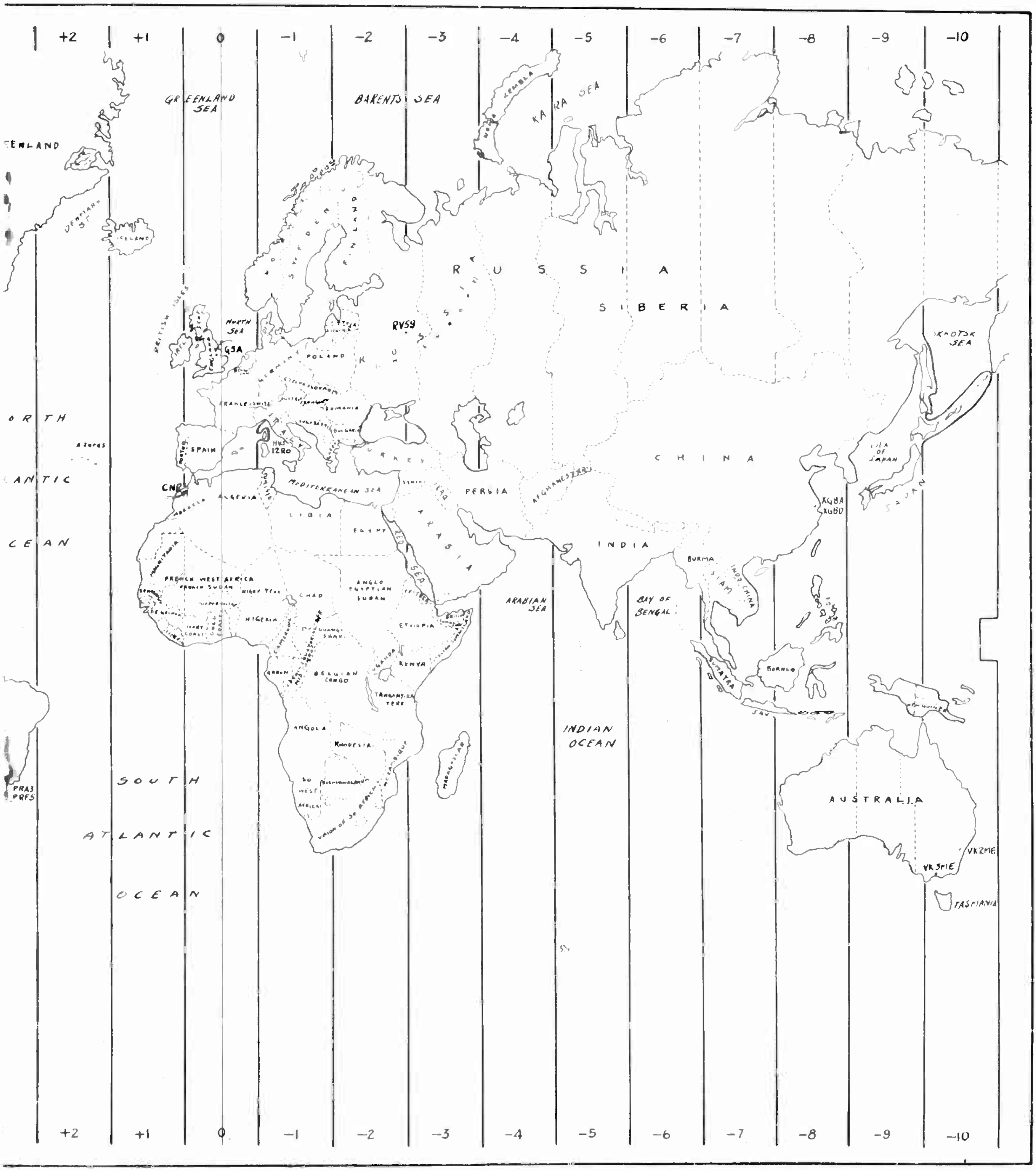
A Republican, he withstood the Democratic landslide and carried every county but one. He got two-thirds of all votes cast.

TIME ZONE CHAR



[See Explanation

T OF THE WORLD



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This Way to Amateur Tickets!

Requirements for Code and Technical Knowledge to Pass Examinations

By M. K. Kunins
W2DPS

Formerly Examining Officer and Inspector in Charge at Buffalo (N. Y.) Office of Federal Communications Commission.

SPRINKLED through the nineteenth century were many sporadic, independent efforts to dabble with a new phenomenon that would permit a communication system without connecting wires. These endeavors were made in almost all countries and by many men, culminating in the experiments of Hertz and Marconi which marked the end of the classical era and the beginning of the practical work of perfecting this new agency. Curiously enough, the beginning of the twentieth century coincided with the beginning of this new era so that the twentieth century may well be known as the Radio Age.

The publication of the experiments of Marconi by the press all over the world set people thinking and slowly evoked a practical desire to duplicate these achievements. In this fashion was the amateur radio operator born. In this environment, the amateur radio operator had little to learn from others but much to learn from himself and thus he became an experimenter, trying to duplicate Marconi and then to improve results.

The Metamorphosis

It wasn't very long before Marconi's efforts were improved upon by the amateurs, who, in their cumulative way, found various little kinks in the new art of wireless, as it was known then. These little discoveries tended to make wireless transmission more reliable and less of a toy. This endeavor to improve continued unabated until the World War and resulted in the metamorphosis: spark transmitter to coherer detector to magnetic detector to crystal detector to Alexanderson alternator to arc transmitter to diode detector to audion detector to vacuum tube transmitter.

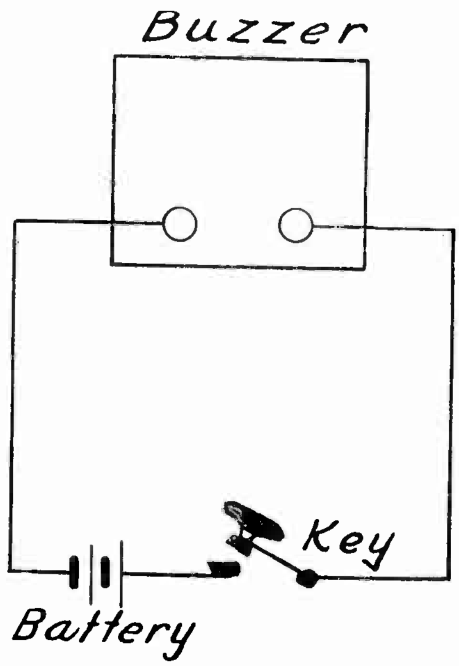
During this period the Government had not recognized any need for regulation of wireless stations because of the relatively small number of such enthusiasts. In those days, the desire of an individual to engage in wireless communication with his neighbors (for the ranges were only a few miles) caused him to build his own equipment without any formalities, for no license or other authority was necessary. What a situation! Take any frequency (it was wavelength then) you wanted; use any power you cared for; operate however, whenever, and whatever you wanted. Today is most certainly a far cry from that!

The World War was responsible for the temporary stifling of the amateur's work. The exigencies of war obliged the government to close all private wireless stations, causing the amateurs to mark time.

Aided War Activities

However, the Government found a remarkably well-trained force, all ready made, for the communications service in the army and navy, and the amateurs found their curtailment really an enhancement. This was so since the Government felt an accentuated need for a reliable wireless communication system, and put all sorts of equipment and facilities in the hands of our erstwhile amateurs who advanced the art in this fashion at a terrific pace.

The year 1919 is memorable—both because the World War came to an end and also because the Government's ban on radio stations was lifted. Immediately, the amateur blossomed forth again. This time his vigor was renewed by his communication experiences during the war and the results showed a startling improvement over the pre-war days despite the shut-down of private stations. The war thus was responsible for furnishing radio practice with a decided impetus that would not ordinarily have been the case. From that day to this the amateur radio operator has steadily progressed and has advanced the art most creditably. It is into this advanced practice that our embryo ham desires to plunge.



To practice the code, a high-frequency audio buzzer should be connected in series with a battery and a telegraph key.

The Amateur Tradition

To appreciate most completely the factors constituting hamdom, it is necessary for our would-be ham to study the amateur's traditions, and his technical and legal obligations. His historical aspects have been briefly treated in the foregoing words but a more detailed study will provide one with a more completely vivid appreciation of the reasons for various curious practices. Such a complete picture is achieved from reading the files of radio magazines 'way back to the dim "dark ages." It is a most interesting and intriguing pursuit which, though it is tedious in its consumption of time, rewards the reader with an inner knowledge only appreciated by the oldtimers. Such an experience would reveal the manner in which radio developed and indicate the possible trend for the future.

When the traditions are understood, it is time to study the technical aspects of this game. This involves two parts: the acquisition of an ability to sound-read the International Morse code at a minimum speed of 10 words per minute (five characters to the word) and an understanding of the theory of radio. To be able to read code proficiently requires hard, persistent study and actual practice with the characters.

Example of Grouping

This is made most easy by putting the characters in similar groups and studying the groups separately, one at a time, progressively. Such groupings may be arranged as follows:

Group One:	E	.
	I	. .
	S	. . .
	H	. . . .
Group Two:	T	—
	M	— —
	O	— — —
Group Three:	A	. —
	U	. . —
	V	. . . —
Group Four:	N	— .
	D	— . .
	B	— . . .
Group Five:	R	. — .
	K	— . —
Group Six:	G	— — .
	W	. — —
Group Seven:	C	— . — .
	Y	— . — —
Group Eight:	F	. . — .
	L	. — . .
Group Nine:	X	— . . —
	P	. — — .
Group Ten:	Q	— — . —
	J	. — — —
	Z	— — . .

After learning a group it is best to have words containing the letters of that group sent slowly by another person so that the learner may attempt to decode them. Some words utilizing the letters of Group One are: his, she, he, is, etc.

Thus, group by group, the code is slowly mastered by persistent practice. Once a speed of about ten words per minute is attained, the ability to read faster messages comes more easily. It is wise to be capable of receiving about fifteen words per minute before appearing for the license examination because of the possibility of nervousness during the test.

Preliminary Equipment

For the purpose of studying the code, a telegraph key, battery and buzzer should be connected up as shown in Fig. 1. Best results are obtained from a buzzer with a high-pitched tone.

Too much concentration upon the code might cause one to lose interest, just as "All work and no play makes Jack a dull boy." Accordingly, it would be wise to intersperse code practice sessions with some research into the theory of radio. Of course, the degree to which this is done will depend upon one's initial knowledge.

It will be assumed that the subject is a rank beginner. As such, he must study the elements of electricity to achieve a solid understanding of the meaning of such fundamental terms as volt, ampere, watt, coulomb, erg, etc. It is an unfortunate commentary upon many hams that they have only the faintest idea of the principles underlying radio phenomena, because of their having slighted the study of electricity in order to rush their license. Therefore, really to become proficient, obtain a book on the principles of electricity and study such things as statics; resistance, inductance and capacity; batteries; motors and generators; etc.

Learn the Rules

It is especially important that Ohm's law should not be slighted. Also learn how to compute the resulting values of resistance, inductance or capacity when such units are connected in series, parallel or series-parallel. When the elements of electricity are grasped sufficiently, then start studying the radio aspects of electricity. This will involve coupled circuits, vacuum tubes, oscillation, detection, modulation, etc. The serious amateur will find plenty of work in this field.

When one has mastered the technical aspects of radio and has achieved linguistic ability in the telegraph code, the next step is to become acquainted with the Governmental requirements in the form of the Communications Act of 1934 and the rules and regulations of the Federal Communications Commission. This information is obtainable from the Government Printing Office in Washington, D. C. (Treaty Series #767 @ 30c.; Treaty Series #777A @ 10c.; Communication Act of 1934 @ 5c.; Rules and Regulations of Federal Communications Commission @ 45c.)

One should especially be acquainted with the regulations pertaining to the amateur, contained in these publications.

First Step

Here it will be found that an amateur operator and station license will be issued to any American citizen, regardless of age, creed, color, sex or education, who can pass the code test involving the applicant's ability to send and receive the International Morse code at a speed of not less than 10 words per minute and a written test of the applicant's technical knowledge of amateur radio apparatus, both telegraph and telephone, and his knowledge of all the provisions of the radio law that affect the amateur. The code test's passing rating requires at least one minute's perfect copy out of a five-minute transmission which, if achieved, renders the applicant eligible to be tested in theory, the passing mark of which is 75%. The first step in applying for this examination is to secure the appropriate application blanks at any one of the offices of the Federal Communications Commission.

List of Offices

The offices are listed below:

District *Address*

Headquarters: Washington, D. C.
1—Custom House, Boston, Mass.
2—Federal Building, New York, N. Y.
3—Gimbel Building, Philadelphia, Pa.
4—Fort McHenry, Baltimore, Md.
5—Custom House, Norfolk, Va.
6—Post Office Building, Atlanta, Ga.
7—Federal Building, Miami, Fla.
8—Custom House, New Orleans, La.
9—Prudential Building, Galveston, Tex.
10—Federal Building, Dallas, Tex.
11—Rives-Strong Bldg., Los Angeles, Cal.
12—Custom House, San Francisco, Cal.
13—New Courthouse Bldg., Portland, Ore.
14—Federal Office Bldg., Seattle, Wash.
15—Custom House, Denver, Col.
16—Federal Building, St. Paul, Minn.
17—Federal Building, Kansas City, Mo.
18—Engineering Building, Chicago, Ill.
19—Federal Building, Detroit, Mich.
20—Federal Building, Buffalo, N. Y.

on any of the days set aside by each individual office for amateur examinations. This form is usually filled out in the examining office at the time of its acquisition and the test is taken directly upon its completion.

It should be noted here that examinations are periodically held on special occasions at the following additional points: Cincinnati, O., Cleveland, O., Columbus, O. (from the Detroit office); Des Moines, Ia. (from the Chicago office); Nashville, Tenn. (from the Atlanta office); Oklahoma City, Okla. (from the Dallas office); Pittsburgh, Pa. (from the Buffalo office); San Antonio, Tex. (from the Galveston office); St. Louis, Mo. (from the Kansas City office); Schenectady, N. Y. (from the New York City office); Washington, D. C. (from the Baltimore office); Winston-Salem, N. C. (from the Norfolk office).

Who Gives Code Exam

Should the applicant live at a distance greater than 125 miles airline from an examination point, he may write the Washington office for the applications pertinent to the Class C grade of amateur license, if he doesn't wish to travel to the point of examination. This license is equivalent to that obtainable by personal appearance, except that only individuals living at great distances from examining points (more than 125 miles airline) are eligible.

The code part of the examination for this license is to be given the applicant by some licensed amateur who will swear to the applicant's ability to pass the minimum code requirement. The theoretical questions are filled in and returned to Washington by mail, where they are checked and graded. If found satisfactory, a Class C license will be issued which is revocable for a regularly issued license when an opportunity for personal examination is given the licensee. As a precautionary measure, it is wise that the applicant makes quite sure of his ability to pass the examinations before making application since failure disqualifies the applicant for a period of ninety days before he may be re-examined. The old adage of "Haste makes waste" is very applicable in this connection so that if you want to save time and start operating as soon as possible: Do your studying before the examination and not afterwards.

Now that we have our licenses, we can engage in the operation of an amateur station upon any of the amateur bands that are stipulated in the regulations.

Excellent Hobby

The wonderful opportunities for developing an absorbing hobby can be vividly appreciated when it is realized that an amateur station may use his equipment for regular hamming, rag-chewing, experimenting or message handling with either telegraphy; telephony; television; facsimile; remote control of boats, vehicles; etc. What an array of interest-provoking fields! The only precaution to be exercised in this endeavor is that all efforts be confined to amateur and non-commercial channels. There is therefore little room for wonder at the great number of amateur radio operators in the country. And the quantity is increasing by leaps and leaps from year to year. Now is the time to get into the swim before an oversupply results in stricter requirements.

High Humidity Facilitates 5-Meter Transmissions

West Hartford, Conn.

That atmospheric humidity, or some accompanying factor, has a pronounced influence on the performance of ultra-high frequency radio waves in the neighborhood of five meters has been discovered as a result of recent research work at the headquarters laboratory of the American Radio Relay League.

According to Ross A. Hull observation of transmission conditions between the West Hartford laboratory and various observation points in New England over a period of three months has indicated that there exists a relationship between the humidity of the air and the performance of these ultra-short waves.

As a result of these investigations, it can now be predicted with fairly good assurance that when the humidity is high—short of actual rain—in the atmosphere between two points, communication will be very much better than when the air is dry. The reliability of contact can thus be predicted in advance. In this discovery lies the secret of much of the work that the League's station, W1AL, has been doing of recent months. All existing world's records for transmission and reception on the ultra-high frequencies have been shattered, the latest conquest being the very difficult contact between Hartford and New York City and Jersey points. The terrain in lower Connecticut and upper New York is particularly unfavorable for long-distance 5-meter work.

This work on the part of the headquarters staff of the League, the national organization of transmitting radio amateurs, is the latest development in a research program of ultra-short wave work begun in 1925 and actively carried on since 1930, which has resulted in the opening up of a valuable new field in radio for the use of amateurs, police, television, and many other and diverse radio services.

Ham Messages Save Day As Power Line Breaks

With telephone and telegraph wires down and all other radio facilities disabled because of broken power lines, amateur radio operators in Ilwaco, Astoria, and Portland, Ore., stepped into the breach and handled news reports and messages during the progress of the recent storm on the Pacific Coast.

For eight hours V. L. Saari, E. N. Swan, and other amateurs labored to bring in the scattered news. Their most important job was covering the distress of the steamship Floridian, off the Oregon coast.

GRID EFFECTIVENESS

The effectiveness of the grid as a control element in the vacuum tube is determined by its relative distance from the filament with respect to the plate and also, to a smaller degree, by the pitch of its winding.

THE AMATEUR ORACLE

Address Questions Concerning Amateur Regulations and Technique to M. K. Kunins (2 Dps), Technical Editor, Radio World, 145 West 45th Street, New York, N. Y.

Decibel Notation

RECENTLY came into contact with the unit known as the decibel. Would you please clarify for me the haze surrounding this term?—T. H. K.

The decibel is a unit expressing the logarithmic ratios of power, voltages, or currents in an electrical system. Its magnitude is obtained from these formulas:

$$\text{number of decibels} = 10 \log_{10} \frac{P_1}{P_2}$$

$$\text{number of decibels} = 20 \log_{10} \frac{V_1}{V_2}$$

$$\text{number of decibels} = 20 \log_{10} \frac{I_1}{I_2}$$

It can be seen that this unit involves the ratio between two powers, voltages or currents and as such can be made to indicate the gain in an amplifier or the loss in a pad or other attenuating device. Computation with these formulas for the simple case where the input power, voltage or current is equal to the output value shows that the ratio of the output over the input is equal to one. The logarithm of one is zero and ten times zero is still zero. Accordingly, when the input and output of an electrical system are equal, there is zero decibel gain or loss in the system. Correspondingly, the number of decibels of gain or loss in other instances may be ascertained by substitution in the foregoing formulas. In this manner, if the level at a particular point in a circuit is accepted as a datum, the number of decibels of gain or loss above or below this datum may be conveniently expressed, for any other part of the same system. This is very handy for comparison purposes and gives a direct quantitative value for any such system's amplification or attenuattion. It should be understood that a mere statement of the gain or loss in a communication channel does not in itself assure us of the circuit's goodness. The circuit, for instance, may pick up a great deal of noise so that a strong signal is "down in the mud." In the case of the high frequencies, the signal may be fading very rapidly so that the gain is variable; also, distortion may be present, and this cannot conveniently be expressed by a statement of gain or loss in decibels. The decibel notation is not suitable for all kinds of work in communication systems, and in fact it is strictly of most use only in assessing the gain or loss of a system whose noise level is reasonably constant throughout. As a radio system is a combination of high and low power apparatus and has a variable noise level, the decibel notation should be applied with care and discarded where not suitable. A further precaution should be exercised in the use of the second and third formulas inasmuch as these hold true only when the input and output impedances are the same in phase and in magnitude. In land line work, the impedances are very often matched, so that the current and voltage equations may be used, however the limitations should be understood for other cases where the impedances are not matched.

* * *

Amateur Station Log

WILL YOU PLEASE advise what are the necessary requirements regarding the content of an amateur station log?—L. M. N.

Section 386 of the rules and regulations of the Federal Communications Commission states that all amateur stations shall keep an accurate log of station operations, in which shall be recorded:

(1)—The date and time of each transmission.

(2)—The name of the operator, together with a statement as to the nature of transmission.

(3)—The call letters of the station called.

(4)—The input power to the final stage of the transmitter.

(5)—The frequency band used for each transmission.

(6)—The location of each transmission.

If the input power remains constant or if only one individual operates the station or if the location of the transmission remains unchanged, a single statement at the top of each page will suffice in lieu of repeating this information for each transmission.

* * *

Regulations on Portables

MY UNDERSTANDING of the regulations regarding the operation of a portable amateur transmitting station is hazy. Please explain the requirements of the government for such operation.—E. M. B.

The primary rule to be observed regarding the operation of portable amateur transmitting stations is that the local Federal inspector shall be notified in advance of each new location of your transmitter. This notification may be made by letter or other means and should indicate the station call letters, the licensee's name, the dates of proposed operation, and the approximate locations, as by city, town or county. An amateur station so operating shall not continue longer than 30 days unless further notice is served on the inspector in charge of the district in which operation is to take place. In addition, the operator of a portable station must transmit his call in a special way when out of his own district as follows:

W1ABC W1ABC W1ABC de W2DEF W2DEF W2DEF bt3 bt3 bt3 K. It will be seen that a second district portable station is calling a fixed station in the first district from a location in the third district. And, of course, appropriate entry into the station log should also be made regarding the changed location. These special regulations are in addition to the regular rules and accordingly the ordinary rules should not be slighted.

* * *

No Cutoff

IS IT POSSIBLE to bias a tube to cut-off when the cathode resistor biasing system is used?—F. M.

The cathode resistor biasing system is satisfactory for the automatic application of a negative bias to a vacuum tube by virtue of the fact that the plate current is made to flow through it to create a drop of potential across it, useful for biasing purposes. Thus, if a tube is theoretically biased to cut-off by this method, the plate current is reduced to zero and the drop across the resistor becomes zero. This of course results in a condition that does not furnish cut-off and the purpose is defeated. Therefore, with the automatic cathode resistor biasing arrangement, it is not possible to achieve cut-off conditions.

* * *

Type of Antenna Feed

I CANNOT DECIDE as to which type of antenna to use for my transmitter. Will you please indicate the relative merits of current-feed and voltage-feed antenna?—J. H.

The choice of an antenna is determined by the physical conditions existing at the station. Should the location of your lead-in be such as to be best taken off the end of your antenna, you should calculate for a voltage-fed Hertz. On the other hand, if the most practical point to connect your lead-in is in the center, base your calculations on a current-fed Hertz. Either of these antennas will give good results if properly designed and constructed.

* * *

Messages for Others

A FRIEND of mine who operates an amateur radio station claims that he is authorized to send a message for me to any point in the world. Can he really do so in competition with established commercial communications offices?—H. K. B.

An amateur radio operator is licensed by the Federal Government to operate an amateur radio station provided it is used for amateur purposes only. Monetary or other reward for the transmission of messages is not permissible. Many hundreds of messages are handled by amateur stations daily to all points of the globe with texts that would not ordinarily be classed as competitive with existing commercial communication channels.

* * *

Beam Transmission

I SHOULD LIKE to experiment with parabolic reflectors. Please indicate the

A. C. Used on Transmitter Tubes, Hum Bucked Out

Alternating current is now applied directly to the filaments of radio transmitting tubes in the same manner that it is applied to the tubes in receivers. This is the result of a recent development by Westinghouse engineers in connection with the new KYW station in Philadelphia.

All other large radio stations use motor generator sets to convert alternating current into direct current for use on the tube filaments. The use of alternating current has not been possible in the past because of the noise and hum it has produced in the radiated wave of the station. A new device called the "Magnetron Suppressor" has been developed and through its use the effect of the alternating current is completely neutralized. The Magnetron Suppressor is a device which puts current of the right phase and amplitude into the power amplifier of the radio transmitter to neutralize the hum and noise produced by the use of alternating current on the tube filaments. The device is mounted on a small panel and forms part of the equipment in the control room of the new station.

This important change in radio practice results in a great saving of transmitter cost and maintenance. The reduction in noise and space requirements are additional features. It is predicted that many radio stations will consider this method of operation in connection with new designs of radio apparatus.

general theory involved in the design of such an antenna.—P. K.

The theory of the parabolic reflecting antenna is similar to the principle involved in the parabolic reflector of a searchlight which concentrates the light rays of an incandescent bulb in one direction. In both cases, the source of the rays is located at the focus of a parabolic surface so that those rays which would ordinarily be transmitted in all directions are concentrated in one direction. In the case of a radio antenna, however, the matter is not so simple, since the wavelengths involved are much longer than those met with in light. The difficulty incurred is that the dimensions of an antenna should be multiples of a half wave, so that with even the short wavelength of 20 meters, an antenna wire would be at least 32 feet long. Should it be desired to communicate with stations in all directions such an antenna would be rather unwieldy in size and difficult to manage. Accordingly, such an antenna ordinarily is not used on amateur frequencies lower than about 56 megacycles. In the 56-mgc. band the half-wave antenna need only be about eight feet in length. With this dimension, it is more readily possible to build a rotatable reflector that would not be unwieldy in size. For this band, an antenna wire about eight feet long (which will vary slightly depending upon manner of feed and character of surrounding objects) is placed at the focus of a parabolic network of wires of about the same length (slightly longer due to no loading) and parallel to it. The size of the parabola is determined by the fact that the distance from the antenna wire to the nearest reflector wire should be one-quarter wavelength or about four feet away. It can be seen that these dimensions are about the maximum limit in comfortable size.

It is a distinct loss that the parabolic reflector cannot be adapted on these standards for lower frequencies, since such antennas will greatly reduce the congestion on these bands. It is obvious that if a transmitter concentrates its energy only in the one usable direction for a particular transmission, the transmitting operator benefits by a marked increase in power in the useful direction while the many receiving operators that do not care to listen to his chatter will benefit by the removal of that extraneous energy which only forms disturbing interference. It can thus be seen that the development of a rotatable parabolic reflector for the lower amateur frequencies offers a genuine blessing to hamdom. It would be equivalent to a material widening of the amateur spectrum. A suggestion for a starter in this direction might be attempted as follows. The unwieldy factors involved in reflectors at the lower frequencies are those due to the necessity of maintaining half-wavelength conditions on the length of antenna and reflector wires and the necessity of maintaining multiples of quarter-wavelength distances between antenna wire and each individual reflector wire. These fundamental requirements are unavoidable but there might be other means of attaining these ends. The physical length of an antenna might be shortened by loading coils. Accordingly, a fascinating field for experiment would be to tabulate the constant necessary for such coils for varying degrees of efficiency of the antenna to radiate an electromagnetic wave. In other words, the experimenter might determine for a given constant frequency how different loading coil sizes (number of turns, spacing of turns, size of wire, diameter of turns, etc.) affect the radiation of energy from an antenna wire when inserted in its length as part of it. Numerous experiments in this direction will serve to indicate clearly to what extent an antenna wire might be loaded before its radiation ability is nil. Should it be found that the length of an antenna wire for 40 meters (which sholud ordinarily be about 65 feet long for half wavelength) might be reduced to ten feet without appreciable loss in radiation, a discovery will have been made that might revolutionize the problem of radio interference. At 40 meters, the one-quarter wavelength spacing necessary between reflector and antenna wire is also unwieldy, in spite of the foregoing experiments. A suggestion for the lessening of this dimension might also be possible, as follows. The reason for placing the reflector wire a multiple of one-quarter wavelength from the antenna is that this positioning of the wires will allow the radiated wave from the antenna to strike the reflector wire at just the correct instant to result in a maximum incremental effect in the radiation in the direction in line with the wires and toward the antenna and a maximum decremental effect in the radiation toward the reflector. Thus the directivity is accomplished. It can be seen that this involves correct phase relationship between the antenna and reflector waves. Another way of accomplishing this phase relation would be to energize the reflector wires directly, instead of by induction. This method allows control of the phase relation between reflector and antenna, so that the quarter-wavelength requirement may be discarded. This is another field that requires a great deal of experiment, and, if accomplished, would represent a genuine advance in the field of radio communication, since as a result of such work it might be found that rotatable parabolic reflectors (or other types of reflectors, for that matter) might be reduced to practical sizes at even the broadcast frequencies.

* * *

Getting a License

WHAT IS the procedure to be followed by a beginner to secure an amateur radio license?—F.T.R.

Amateur radio operator and station licenses are issued under the jurisdiction of the Federal Communications Commission. The Commission has ruled that anyone capable of passing certain tests may become licensed unless the applicant is an alien. There are no other restrictions. A child would be eligible for license, provided, of course, that he or she could write intelligibly enough to pass the examination. This examination is composed of two parts, first, a test in the international telegraph code at a speed of 10 words per minute; second, a test of the applicant's knowledge of technical and legal aspects of radio work as met by the amateur radio operator. Preparation for the code test may well start with the acquisition of a table showing all the characters, and the constant practice with a buzzer and key till the necessary speed is acquired. For the second test, you should visit your local library and consult the various texts on radio and learn the theory well. It is imperative that the elements of electricity be studied first before radio is at all investigated since a good electrical foundation is necessary for an intimate understanding of the principles of radio. A copy of the regulations of the Federal Communications Commission should also be obtained from your local office of the Commission. When you have become sufficiently competent you may then seek an appointment for examination at this same office. Then, if you pass, the license is yours and you may then start out upon one of the most interesting of hobbies.

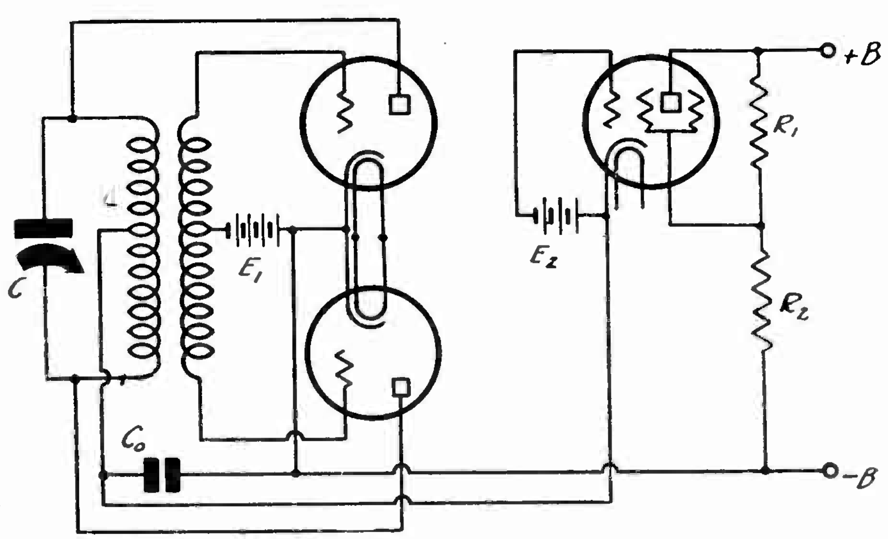
* * *

Space Charge Differentiated

WHAT IS the difference between the space charge connection and screen grid connection of the four electrode tube?—P.M.

When the signal input to a four-electrode tube is connected to the inner grid and filament, the connection is known as the screen grid connection. In this case, the outer grid is at a slightly lower positive potential than the plate. When the signal input is connected between the outer grid and the filament, the connection is the space charge connection. Here, the inner grid is connected to a positive potential, somewhat lower in magnitude than the plate voltage.

A Novel Arrangement for Push-Pull Oscillator

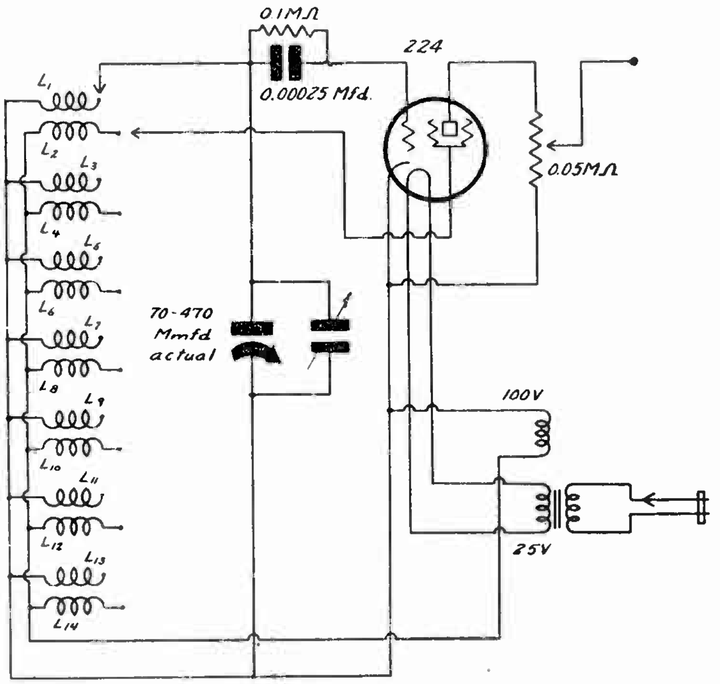


Push-pull circuit driving a screen-grid control tube.

A push-pull oscillator is useful for the production of oscillations in which the even harmonics are suppressed. It also produces a generous amount of power that can be utilized for various purposes in different amounts dependent upon the adjustment. Here we have the special case of a driven screen grid tube. Since this tube is connected between the plates and the cathodes of the push-pull tubes, it offers a flexible arrangement for the smooth and fine control of the oscillator's power output. Such a unit might be set up in the laboratory to constitute a variable standard of power, the screen to arm of a potentiometer.

Radio University

ANSWERS to Questions of General Interest to Readers. Only Selected Questions Are Answered and Only by Publication in These Columns.



Seven-band signal generator. The tuning ratio is cut down by use of a parallel condenser, set once and left thus. The capacities resulting are such as to yield a frequency ratio of 2 to 1. Therefore the frequencies are carried to the highest at which the tube will oscillate.

Triode at High Frequencies

WHAT IS the highest limit in frequency to which the ordinary three-electrode tube will go when acting as an oscillator?—L. B. V.

Internal capacity of the tube elements and the inductance and capacity between wires of the external circuit tend to prevent the ordinary three-electrode tube from oscillating at frequencies higher than about 150 megacycles (2 meters). To obtain higher frequencies, the Barkhausen-Kurz method of generating oscillations is used. This scheme generates oscillations of frequencies depending on the electronic motion within the tube. Such effect is accomplished when the grid of a triode is maintained at a high positive potential and the plate has a small negative potential or zero potential impressed upon it. The effect of these potentials is as follows: an electron leaves the filament and is attracted to the grid. However, the grid is constructed in the form of a wire spiral with wide spaces between turns. Accordingly, the electron passes through this space and continues on to the plate but is there repelled by the negative potential and returns to the grid, attracted by the high positive potential. Should the electron again pass through the spaces of the grid it will oscillate about the grid until it is pulled into the grid. This oscillatory action will be of high frequency since it is dependent upon the enormous speed of the infinitesimal unit. It can be easily seen that variation in the grid potential will have a marked effect upon the frequency generated by such a circuit. With a grid potential of about 150 volts, a wavelength of about 70 centimeters (about 4,250 megacycles) has been obtained.

* * *

Tuning Ratio of 2 to 1

WILL YOU PLEASE give me some guidance regarding the construction of a modulated a-c operated signal generator, with electron coupling and a tuning ratio of 2 to 1 in frequency, using a condenser of around 400 mmfd. actual?—P. L.

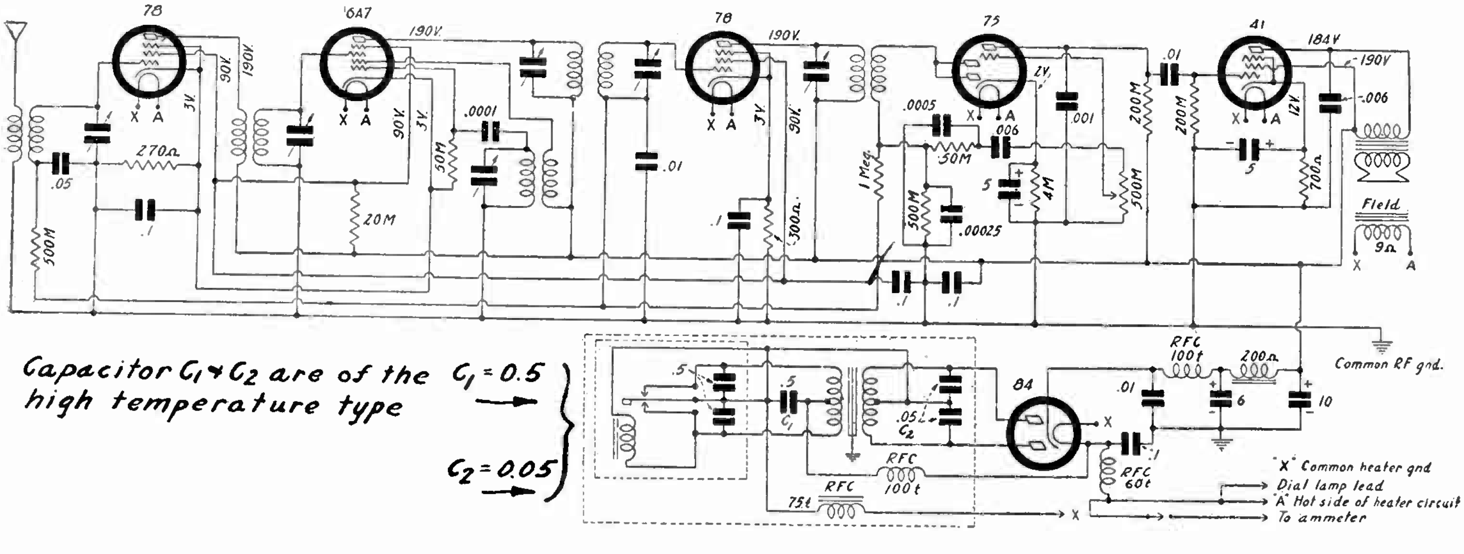
Across the tuning condenser put a variable that has around 90 to 100 mmfd. maximum, and adjust the capacity until around 70 mmfd., when the 2-to-1 ratio will prevail. If you will use suitable inductance you can strike 100 kc at maximum capacity and pick up no other response until near the low-capacity end of the tuning. Then the ratio is 2 to 1. The 224 tube is used in electron-coupled fashion, as requested, and the modulation is always present, due to a.c. on the plate.

* * *

Auto B Eliminators

CAN YOU distinguish between the two different types of devices used for avoiding the inclusion of B batteries in automobile receivers?—K. L.

A battery current is passed through a coil across which are two condensers. The discharge of one condenser through a coil drives the armature of a vibrator to one of two contact points, and the discharge of the other condenser through the coil drives the armature to the other of the two contact points. On account of the phase relationship the action is alternating, that is, the armature moves first to one side, then to the other, and this making and breaking of contact causes the excitation of a transformer that is connected to a rectifier tube. Hence a.c. is delivered to the tube. Rectification may be done in full-wave fashion, as in the illustrated example of a vibrator. The rectifier tube is the 84. The output is used for supplying the B voltage. It is necessary to use radio-frequency choking, as well as the usual audio filter, to get rid of interference. The other method, or motor generator system, operates on an entirely different principle, as the name implies. The A battery current is made to turn a motor. This motor turns the shaft on which is impounded another armature that generates the alternating current. Hence a rectifier is needed for this purpose, too. A third method, not used much on car sets, is that of the rotary converter, which consists of one armature and one field. The armature has commutator on one end and rings on the other. D. C. is fed to the commutator end and a.c. taken out of the ring end.



A vibrator unit is used in this automobile receiver. In general, there are two types of B-eliminator devices for car sets. One is the vibrator and the other is the motor-generator.

License Renewals

MY AMATEUR LICENSES expire within two weeks. What is the procedure for obtaining other licenses?—B.M.V.

You should apply to your local office of the Federal Communications Commission for the necessary renewal application forms. This application should be executed completely as indicated and forwarded to Washington together with three statements from three licensed amateurs attesting to your having worked their stations over the air during the last three months of your license term. Included in this statement should be names, addresses and call letters of each station together with frequency band used, and time and date of transmissions. The Commission desires that such applications be forwarded sixty days prior to the expiration date of licenses. Since but two weeks remain before your licenses expire, it is conjectural whether you will be issued renewal licenses prior to the expiration date of your licenses. Should licenses expire before you received renewed licenses it will be necessary for you to refrain from operating your station until you again possess valid licenses.

* * *

Call Letter Assignment

WHAT IS THE MANNER in which call letters are assigned to amateur stations, Is there any significance to two letter calls?—L.J.H.

Call letters are assigned to applicants in rotation by the Federal Communications Commission in Washington. No deviation is made from this rule, contrary to the beliefs of some individuals. Likewise, two letter calls do not indicate superiority nor inferiority in stations since many beginners strike it so that their applications occur when a two-letter call has been given up by another licensee upon its expiration and obtain two letter-call by applying at the propitious moment.

Radio Treasure-Hunting Is Making Some Progress

The mention of treasure to the average man immediately sets his imagination aflame and he becomes quickly interested. This is a heritage acquired during childhood when almost everyone has read of the exploits of Captain Kidd and Long John Silver and others. Other treasure hunts that are not as ephemeral as those of the fairy books involve the location of hidden natural deposits of gold or other valuable metals or minerals. Prospecting for this treasure is fraught with more possibilities of success and cannot be categoried as pipe dreams.

Such treasure hunts are of common occurrence in the western part of the United States and are very often successful. However, the method of seeking this treasure is quite primitive. The prospector either digs aimlessly for what might eventually bring him wealth or he sifts the sands of a river bed for deposits of the shiny metal. This is obviously rather inefficient and backbreaking.

Radio is commonly looked upon as being a medium of communication solely. Other applications, however, are possible. Radio has been used to cure disease, to boil milk, to perform surgical operations and to control vehicles from a distance. Now, it is proposed to harness the marvels of radio to the purposes of the prospector. Details and circuits will be printed next week, issue of December 1st.

Interference

BESIDES the inter-station interference always possible on any set, what is the other form of interference, peculiar to the superheterodyne? Is much audio-frequency static experienced?—K. L.

In superheterodynes another form of interference arises, where the set is tuned to one frequency, and the interference is caused by a station differing from this frequency by twice the intermediate frequency. Example: Set is tuned to 1,000 kc. I.f. is 465 kc. The local oscillator is at 1,465 kc. The interference is caused by some ether disturbance, real or phantom station, 930 kc. lower, or 70 kc. On short waves the example is more pronounced. The receiver, say, is tuned to 10,000 kc, the interference is due to ether disturbance, real or imaginary station, on 9,535 kc. The "imaginary" station or phantom is any carrier, static, station, noise-carrier or whatnot. The remedy is to have more pre-selection in the tuner, or reduce the input to the set, which is an equivalent increase of selectivity. The audio-frequency type static, that is, noise without carrier, is rare. For such static to exist it must be almost practical to hear it with "bare ears." Not quite of course, yet the idea strikes at the root of the rarity. Nevertheless many "noise-eliminating" devices have been offered that helped very little, and were based on the theory of a plenitude of a-f static.

* * *

Tube Differences

PLEASE ENUMERATE the essential differences between the triode, tetrode and pentode type tubes.—G.G.B.

As is evident from the names, the triode, tetrode and pentode tubes have three, four and five electrodes, respectively. In the triode, the filament is centrally located with the grid surrounding it and the plate around the grid. In the tetrode, the construction is the same, except that an additional grid is place l in between the first grid and the plate, and outside the plate, so that the plate is screened on its inner and outer surfaces. The effect of this additional grid is to reduce the inter-electrode capacities materially. The additional grid also serves to minimize the space charge about the filament. In the pentode, still another grid is introduced between the plate and the screen grid. This pentode grid or suppressor grid, as it is commonly known, sometimes is internally connected to the midpoint of the filament and has no external termination, though the external connection is present in the 57, 58, 6C6 and 6D6. The suppressor tends to reduce secondary emission effects from the plate by screening the plate from the attraction influence of the positive screen grid. Thus, the pentode minimizes the various defects that surround a three-electrode vacuum tube.

MARCONI ON MICRO WAVES

Marconi said that he had successfully used micro waves for much longer distances than the optical range, achieving even 258 kilometers on 60 centimeters, but he modified previous findings as follows:

"My later investigations of these waves have brought to light not only their own well-known erratic behavior, but also a definite seasonal effect that so far limits their commercial use to about the optical range."

(*Continued from page 4*)
this ratio in later tests as a check, as the ratio will not change much from band to band, and if there is any change, the ratio should slightly increase as the frequency of the band increases. For 0.0001 mfd. tuning condenser the ratio should be around 2.15.

Terminal Frequencies

Having established the terminal frequencies, one knows whether there is too much or too little inductance on the secondary, and whether the tickler is too small. If oscillation does not exist all over the band, more tickler turns are advisable. If the lowest frequency is too low, secondary turns will have to be removed, until the right number is selected by cut and try. A rough estimate may be made for small changes by treating the number of turns as proportionate to the frequency. If the frequency is to be increased or decreased 10 per cent. the number of turns should be increased or decreased 10 per cent. Ordinarily, frequency is proportionate to the square of the inductance, and the inductance proportionate to the square of the turns, but for small changes to the inductance and the turns are directly proportionate to the frequency, approximately.

Therefore we may make a system terminate at the low-frequency end just where we desire, and may measure the high-frequency end.

Once we have ascertained the terminal frequencies we have an idea of the location of the intervening frequencies. For instance, assume that the desired low-frequency end is 1,600 kc. This frequency itself may be obtained from the frequency-calibrated dial on the broadcast oscillator, and so we turn the broadcast oscillator to 800 kc and get the response again, due to second harmonic of 800 kc equalling 1,600 kc, the fundamental to which the short-wave circuit is tuned.

Registering Tuning Curve

Now from 800 kc up we use broadcasting stations, as far and as best as we can obtain them. Suppose that there is a station on 810 kc. We couple the output of the broadcast generator to a broadcast receiver, and establish zero beat, and then, using as little coupling as necessary between the broadcast output and the short-wave input, we slowly turn the dial of the short-wave device, until the pitch of the squeal that has been present due to beating between broadcast generator and station is varied.

The object is to lower the frequency of the pitch as much as possible by use of the short-wave tuning, and though it is not possible to accomplish a great change, it is practical to switch off the broadcast set, and use the beat between the two generators, for registering the exact point. Thus we proceed along the line until we get to 1,600, when we are using the second harmonic of that for defining 3,200 kc, and for higher frequencies turn back to 800 kc on the broadcast generator and use third harmonics, of which only a very few would be useful or possible in the intermediate short-wave band.

Since the broadcast-band generator is calibrated, and is accurate to 1 per cent. or better, it may be assumed that this could be used without reference to stations, after the coincidence has been established, which is true, or it may be assumed that the accuracy is less than stated, hence stations are used, which is not true, for the stations are selected only because it is best to use the highest form of standard. The stations' expensive crystal-control transmissions, with all the refinements that go with efforts at constancy and stability, such as temperature ovens, are a real value and treat to the experimenter, who should not pass up the station-beating method for any other within ready attainment.

Moreover, the frequency-calibrated dial has another great advantage, in that if, due to poor selectivity in the receiver or to unfamiliarity with all the dial settings of stations, one is at loss to tell quickly what the frequency of the station is, one may read the frequency from the broadcast generator, and allow the 1 per cent. leeway. For instance, for 1,400 kc the generator may be 14 kc off. Yet the frequency is known nearly enough to permit obtaining dial points on the short-wave outfit for the station. These dial points are correct only in relation to some particular frequencies, and therefore are written down for all frequencies of 10 kc difference within the accuracy percentage of the generator, or 20 kc difference to play safe. Thus, for the dial positions obtained for an assumptive 1,400 kc station, write down frequencies of 1,380, 1,390, 1,400, 1,410 and 1,420 kc. When the curve is drawn for frequencies actually verified which is the correct frequency for numerous dial numbers, the semi-dubious case will reveal itself, for the frequency, and its harmonics will fall on the curve. The off-curve frequencies may be neglected. These should not be bothersome at all. That is, practically every one runs into off-resonance positions, and these are lightly ascribed to "experimental error." They don't change the net result.

Approximate Data for Close-Winding, 1" Diameter

No. 32 Enamel Micro-henries	Turns	*No. 28 Enamel* Micro-henries	Turns
250	127	20	26
200	100½	15	21.5
150	85	10	16.5
100	64	9	15.5
90	59	8	14¼
80	55	7	13¼
70	50	6	12
60	47	5	10¾
50	40	4	9.5
40	35		
30	29		
20	22.5		

NOTE: In broadcast band, 175 kc, padding condenser for series connection in oscillator may be 850 to 1,350 mmfd.; for 465 kc and thereabouts, 350 to 450 mmfd. For higher-frequency bands the padding condenser, same i. f., is larger roughly in proportion that the low-frequency terminal of the oscillator is higher.

Switch-Type Coils

When the first or lowest-frequency coil is completely calibrated the next one is used, and so on, as the broadcast-band generator will be satisfactory, for its harmonics, up to 20 mgc or more. However, the coupling may have to be increased between the two generators as the frequencies of the short-wave system are increased, because as the harmonic orders become very high, the harmonics are weak. One should not regard weak responses as objectionable, as they make for accuracy. Also, one must be prepared to tune with extreme care, as it is much easier to pass over a beat at these high frequencies than to pass over a weak short-wave broadcasting station.

The foregoing discussion had to do considerably with inductance alteration to match plug-in coils with a condenser, and calibrate the s-w tuning. However, switching is becoming more popular, and the system is therefore more important as enabling one to wind his own coils for this purpose.

Inductance Formulas

Inductance formulas help somewhat, but as the frequencies become high all inductance formulas more or less become worthless, as the frequency depends so greatly on capacity, and somewhat on resistance, and the total capacity and resistance are not known. Hence the cut-and-try method works where the other practically fails.

Smaller Wire Diameter

Perhaps the better way to proceed for the switch-type arrangement is to select the highest frequency band. If 1-inch diameter tubing is used, or any diameter around that, 4 turns of No. 18 enamel wire may be closely wound as a secondary for a switching system, applicable to the station-carrier level and also to the oscillator, even if the i. f. is as high as 480 kc, and no matter how low the i.f. is.

Ratio Shifts

When the lowest-frequency reached is obtained—and the ratio of frequencies, minimum to maximum, will be a bit less than for coils not closely associated with chassis or other metal—the object is to wind the coils for the next lower frequency band. Smaller diameter wire may be used now, say, No. 20 or 22, for the secondary, and enough turns put on until near the minimum capacity of the tuning condenser to be used, the frequency generated is the lowest frequency obtained in the previous instance. And so on one goes along until he comes to the end of the coil system.

Of course equal coils may be considered acceptable for the highest and even the second highest frequency band, signal-carrier level compared to oscillator level, but as the frequencies to be tuned in become lower, the oscillator coil has to have a smaller inductance than the tuner coils. This is because the intermediate frequency becomes a ratable percentage of the signal-level frequency, or that percentage of difference between the oscillator and the signal-carrier frequencies becomes considerable.

Oscillator Coils

Those mathematically inclined may follow the directions for establishing the oscillator secondary inductance as printed in the October 27th issue. That is the method of commercial practice. Another method, for the non-mathematicians to follow, is to assign a minimum capacity for the oscillator, for these lower frequencies where padding becomes imperative, and 50 mmfd. may be selected. Thus the inductance is attained for 50 mmfd. The frequency is equal to the highest at the signal-carrier lead plus the intermediate frequency. The inductance values for 50 mmfd. minimum for various frequencies may be obtained from the chart herewith. Some data for close winding, to attain selected inductance values, are tabulated, so that one may have an idea of what about how many turns will be needed. Too many would be preferred to too few, because it is easier to remove turns. In the regions discussed the inductance formulas will hold. But it should be noticed that the oscillator minimum has to be built up, which may be done in the parallel padding capacity. The series capacity values are adjustable, and some indicative limits also are tabulated.

The small power transformer used has a 1-to-1 ratio, to supply the high voltage, as around 100 volts are sufficient. The other winding is for the heaters.

WCOA and WOC Added to the Columbia Chain

WCOA, Pensacola, Fla., and WOC, Davenport, Ia., have been added to the Columbia Broadcasting System. There are now 102 outlets associated with the chain. Seven years ago, the original Columbia network consisted of 16 stations.

WCOA is owned by the Pensacola Broadcasting Company and operated by the San Carlos Hotel on 500 watts. The frequency is 1340 kc (233.7 meters).

WOC carries Columbia programs on a permanent basis. This station operates on 1420 kc (211.1 meters) and is owned by the Palmer School of Chiropractic.

Station Sparks *By Alice Remsen*

HOW VIVIENNE SEGAL FIURES IT OUT

IT HAS LONG BEEN A MOOT QUESTION as to whether the stage is a necessary training ground for radio. Vivienne Segal, who starred in Broadway musical comedies and now sings for radio listeners on the Waltz Time programs over NBC, doesn't think so. She cites her own case as an example. After spending years as a successful stage star, she came to radio—on trial. During the first weeks she had to forget almost everything she had learned in the theatre. . . . Of course, this is true in many respects, for one does not rely on stage tricks or mannerisms to get a song or a speech over the radio, but the stage training acquired during years of practical work is a great asset in radio. At least, so I have found. The ability to portray different characters may be an innate gift with some people, but when this gift has been acquired through practical experience it is more sure. The little gadget—radio—may scare seasoned artists of the stage for a while, but after they have learned to respect the limitations of radio—the difference between professionals and non-professionals is very much apparent—I think you will find that almost all the really succesful radio artists have had, at one time or other, professional stage experience.

B. A. ROLFE, EAST AND DUMKE IN NEW "EARLY BIRD" SERIES

A song and a smile will be offered as a national eyeopener when a de luxe music and comedy program of the type heard heretofore only in the evening hours is broadcast three mornings a week over an NBC-WEAF network at 7:45 a.m., E.S.T. B. A. Rolfe and a 30-piece orchestra, together with Eddie East and Ralph Dumke, two of radio's most spontaneous funmakers, will bring the country to its feet each Tuesday, Wednesday and Thursday morning with a 45-minute program of songs that everybody knows and good, wholesome humor of the kind that is easy to take in the early morning hours. . . .

CANADA TO RADIO CITY

The appointment of R. M. Brophy, veteran radio executive, as assistant manager of station relations of the National Broadcasting Company, is announced by Richard C. Petterson, Jr., executive vice-president of the company. Mr. Brophy, who resigned his position as assistant general manager of the Canadian Marconi Company to join the NBC, has been connected with broadcasting since 1920, the year of the industry's birth. . . . The most unusual pipe organ in the world is nearing completion in one of the big NBC studios in Radio City and will be heard by network listeners at an early date. Specially designed for broadcasting by Aeolian-Skinner in cooperation with NBC engineers, the new three-manual instrument will reproduce an almost unlimited variety of orchestral effects while matching in beauty of tone and flexibility of operation the organs of the greatest cathedrals. The new NBC organ is being installed in studio 3B, one of the largest Radio City studios. Its three keyboards of 61 notes each, and its 20 pedals, magnetically operate 1024 pipes which are housed in a special organ loft at one end of the studio behind two sets of shutters, also electrically controlled. Chimes, which can be played on all three manuals and by the pedals, and a harp also are included in the banks of stops on each side of the console. Every combination of string and woodwind orchestral effects can be produced at a touch of the fingers, the many sets of couplers and plungers beneath the keys of each manual permitting instantaneous variation of the thousands of effects and combinations. . . .

TIE UP WITH CBS

Radio stations WCOA, Pensacola, Fla., and WOC, Davenport, Iowa, have been added to the Columbia Broadcasting System. There are now 102 outlets associated with the chain. Seven years ago the original Columbia unit network consisted of only sixteen stations. . . . Broadcasts to and from the Byrd Antarctic Expedition which have been heard over a coast-to-coast WABC-Columbia network since November, 1933, will be continued on Wednesdays at 10:00 p.m. EST, under a contract renewal with the General Foods Corporation. . . . An intimate, confidential song style and agile fingers are the characteristics of Bernie Dolan, smiling maestro of the piano, who murmurs cosily to listeners of the ABS-WMCA network four mornings a week. You may hear this clever chap on Monday, Tuesday, Thursday and Friday, at 9:45 a.m. . . . Timely addresses by the most successful persons in many fields of endeavor will be broadcast during the series of weekly luncheons of the famous Broadway Cheese Club, which will be presented each Monday at 2:00 p.m. over the ABS-WMCA network. Meeting for years in their sessions at the Friars Club, the members of the Cheese Club are recruited from among the leading newspapermen, critics, press agents, producers, cartoonists and performers. Prominent Americans who are and have been members are Marc Connelly, George Gershwin, Former Mayor James J. Walker, of New York, Morrie Ryskind and Kelcey Allen. Harry Hershfield, commentator for the American Broadcasting System, has been the president of the Cheese Club for ten successive years. . . .

STUDIO NOTES

Because Danny Cahill, night elevator operator in the CBS New York studios, knows so many radio celebrities by their first name, some autograph seekers now are asking for his signature. . . . Gracie Allen, who is always talking about her little blue hat, has dozens of hats, but not one of them is blue. . . . Roxy, head man of the CBS "Roxy and His Gang" broadcasts, can't read a note of music, yet he conducts the large orchestra and chorus on his programs. He has been in the business so long that he knows music thoroughly without being able to read the notes. . . . Bradley Barker is the very appropriate name of the man who makes animal sounds on CBS programs. . . . Buddy Rogers, of the CBS "Family Theatre" program, will go to England soon to make a movie. . . . Vladimir Brenner, NBC pianist, was a child prodigy in Czarist Russia and a favorite of the monk, Rasputin, before the world war. He fled the country in fear of his life after the revolution. . . . Phil Baker, the Armour Jester, of the NBC networks, each year sends one Christmas card to a recipient previously unknown to Phil. He grabs a telephone directory, opens it at random, puts his finger down on a name, and sends the card to that name. This procedure has produced some weird results, such as a pickle factory, a steel mill, a taxidermist and a Chinese laundryman. . . . George Burns and Gracie Allen will pack their duds and hurry out to Hollywood about the middle of this month to start a new picture. . . . On Nov. 2, Myrt and Marge celebrated their third year on the CBS network.

A Thought for the Week

"STEPHEN FOSTER died a pauper," says Nathan Burkan, the New York legal expert in copyright matters in the reply of the American Society of Composers, Authors and Publishers handed to the Federal court to the charge that the ASCAP as an organization has formed a monopoly in restraint of trade. This, of course, refers to what everybody in show business and radio knows—the fact that this most carefully formed and run concern really does control the situation as no other power ever has before in the history of copyrights.

Mr. Burkan gives the other side of the picture by declaring that the late Victor Herbert, because of the protection afforded him and his work by the society now under fire, was able to build up a fortune. Of course, Mr. Burkan does not bring out that a really extraordinary difference between the two men is found in the fact that Mr. Herbert was a good business man as well as a real composer, whereas the well-remembered Stephen Foster was neither, even though his songs have left their imprint on our country's music and its literature and traditions.

Now, let's see what the august justices of the Federal court will have to say on the subject. Incidentally, it will mean a lot to the song writers and publishers and perhaps as much—if not more, should their august worships so decide—to the broadcasting interests wherever the International Copyright Act is functioning.

"YOUR ANNOUNCER IS:"

HOWARD CLANEY:—A product of Broadway who joined NBC's announcing staff in 1930. Art is his hobby, an interest inherited from his parents. A native of Pittsburgh, Pa., and an alumnus of Carnegie Institute of Technology.

MILTON CROSS:—The calm spot in a center of activity, Milton is big, easy going and slow talking. NBC's senior announcer from point of service, he probably is best known for his work with the Metropolitan Opera broadcasts.

NEEL ENSLEN:—Is a graduate of Ohio Nniversity and the possessor of degrees in both piano and voice. Qualified for a berth on NBC's announcing staff without previous experience. One of twelve members of the original American Opera Company.

BEN GRAUER:—Slightly of build, Ben is the midget of NBC's announcing staff in size only. Prefers extemporaneous announcing and yacht races. His first professional appearance was on Broadway while still a college student. He was a child movie star, too.

GENE HAMILTON:—Exponent of the guitar and boxing, but his real interest is in announcing. Born 30 years ago in Toledo, Ohio, and claims to have lived in no one place more than two years. Served NBC in Cleveland and Chicago before coming to New York recently.

ALOIS HAVRILLA:—Whose home town is Pressov in the Balkans, made his debut as a singer in Bridgeport, Conn., when only seven. Tried to enlist in seven branches of service during the World War, but rejected because of poor eyesight. Is married and a veteran announcer.

GEORE HICKS:—Was picked from 200 applicants as announcer for NBC's Washington, D. C., studios. He is six feet tall and weighs 160 pounds. He has seen much of the world as a seaman from a freighter deck. Twenty-nine years old and married.

John F. Rider's Vol. IV
Perpetual Trouble Shooter

SERVICING during 1934 will be more complicated than at any time during the past 14 years of radio activity. Volume IV is your means of combating the numerous highly scientific problems of design introduced by the receivers sold during 1933.

"I do not hesitate to say that Volume IV is the most important of all the manuals I have issued. Volumes I, II and III found their place in the servicing world as important aids to the service man . . .

"Volume IV is destined to be more than just an important aid. . . . It will be a vital necessity. . . . I am firm in the belief that because the contents of Volume IV cover the most scientific and complicated radio receivers ever produced in the history of the radio industry—its ownership will mean the difference between success and failure when servicing the 1933 crop of radio receivers. John F. Rider."

Volume IV has in it 1040 pages in the loose leaf binder; about 20 pages in a separate supplement and the index, covering all of the manuals, totals about 40 pages, making a grand total of approximately 1100 pages.

The binder used in Volume IV is identical to that employed for Volume III. It is loose leaf employing the finest of materials. Aligner bar "instant removal" mechanism is employed.

Volume IV, Price $7.50, postpaid

Also:

Volume I, Rider's Perpetual Trouble Shooters Manual	$7.50
Volume II—Does not duplicate Vol. I	6.50
Volume III	7.50
Rider's Combination "3 in 1" Manual, now ready (Vols. I, II and III)	21.50
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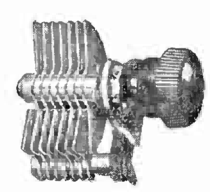

NEW STAR MIDGET CONDENSERS

Choice of 15 and 25 mmfd. maximum. Single hole panel mount.

Here is your opportunity to get the latest product of Hammarlund, a Star Midget condenser. Send $1 for 8 weeks subscription and get any one condenser free. Select the desired capacity.

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Generator with Amplifier Stage

Prompt Shipment Absolutely Guaranteed!

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

Besides the more general purpose of lining up superheterodynes at intermediate, broadcast and short-wave levels, and peaking tuned-radio-frequency sets, it may be used as an all-wave Station-Finder, constantly modulated. Dual Measurement and Combination Use make this Signal Generator most valuable.

The fundamental frequencies and wavelengths are direct-reading. There are no charts to strain the eyes. The dial is accurately calibrated and the Signal Generator accurately adjusted. These fundamentals are: 83 to 99.9 kc. (1 kc. separation); 140 to 500 kc. (5 kc. separation); 540 to 1,600 kc. (10 kc. separation); 1,400 to 5,000 kc. (20 to 50 kc. separation); 3,010 to 3,600 meters (25 and 50 meter separation).

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

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

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

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

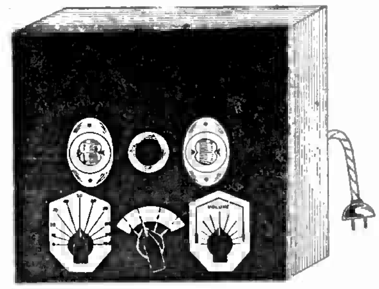
Model 333-A (shipping weight, 7 lbs.)

List Price $40.00

NET PRICE $19.95

Model 333-AB, wired, tested; 3 tubes. 5 bands, to 16 mgc. $21.95

THREE TUBES!



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The book includes a trouble chart which gives at a glance the probable cause of most radio troubles.

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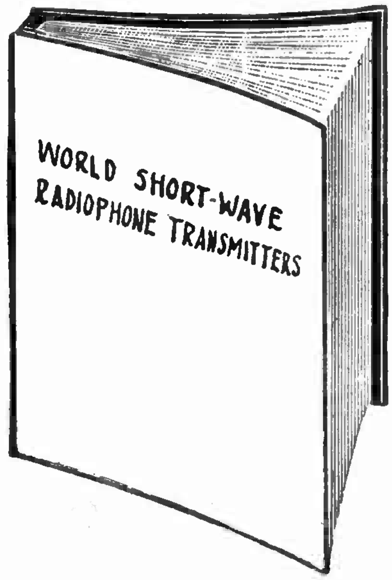

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