MODERN RADIO

EDITED BY ROBERT S. KRUSE

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Number 7 January 20 cents

"Hoptoads"

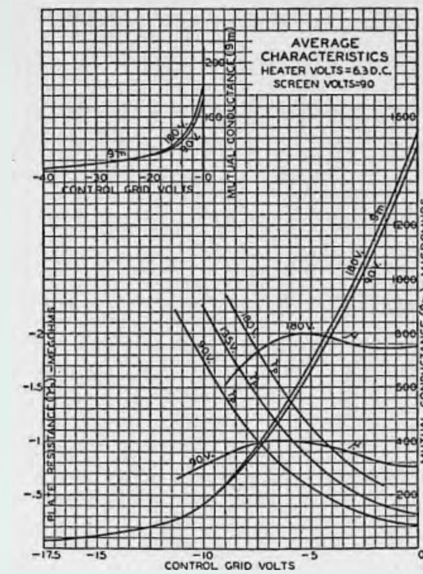
With the exception of Henry Ford's Model B, nothing has been so much rumored and so little seen as the r-f. pentode. Just the same—it now seems to have arrived in the form of the RCA-239, which appears to have many parents, to wit the Ballantine-Snow variable-mu tube (types '51 and '35), the

THE 239
VARI-MU
A-C. AND D-C.
R-F. PENTODE

audio output pentode (type '47) and the automobile-type 6 volt heater series of tubes—at least the new tube shows similarity to all of these.

The filament and heater are of the auto-type, with the pleasant ability of those tubes to stand mistreatment as to filament voltage and mechanical shock. Inside the tube resembles the '47 audio output pentode, having an input grid near the cathode, a high-voltage screen-grid outside of that and a low-voltage or "cathode" grid near the plate. The last is connected to the cathode and as in other such pentodes its purpose is to prevent secondary emission, hence it is called a "supressor". The construction is of the non-uniform sort required to produce a variable-mu tube; note in the curves how gradually the mutual inductance approaches zero as the bias is increased, also that in the table 40 volts bias does not produce cutoff!

The tube permits doing in the radio stages the same thing that we are now doing in the audio '47 audio tubes, that is to work the plate at a voltage as low as that of the screen. Without the supressor-grid this would be impractical from nearly every consideration; with the supressor (or cathode) grid we have a screen-grid tube that will work decently at 110 volts—which is "somethin'" for automobile, rural and 110 volt d-c. sets.



Tentative Rating and Characteristics of the 239.

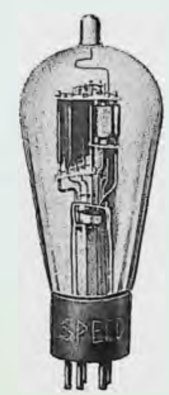
Heater Voltage			6.3	Volts D. C.
Heater Current			0.3	Amperes
Plate Voltage	90*	135	180	Volts Maximum
Screen Voltage, Maximum	90*	90	90	Volts
Grid Voltage, Variable	—3*	—3	—3	Volts Minimum
Plate Current	4.4	4.4	4.5	Milliamperes
Screen Current	1.3	1.2	1.2	Milliamperes
Plate Resistance	375000	540000	750000	Ohms
Amplification Factor	360	530	750	
Mutual Conductance	960	980	1000	Micromhos
Mutual Conductance at —30 volts bias	10	10	10	Micromhos
Mutual Conductance at —40 volts bias	very small, but not zero			

Interelectrode Capacitances	
Effective Grid-Plate Capacitance	0.007 uuf. Maximum
Input Capacitance	4 uuf.
Output Capacitance	10 uuf.
Overall Dimensions	
Length	$4\frac{3}{16}$"—$4\frac{11}{16}$"
Diameter	$1\frac{9}{16}$"
Cap	0.346"—0.369"
Bulb	S-12
Base	Small 5 Prong

* Recommended values for use in receivers designed for 110 volt d-c. operation.

A HEXODE?

It has long been a favorite notion of European designers to put several triodes into one bulb—sometimes even including the coupling devices! This general idea is now offered in the United



TWO TUBES IN ONE BULB!

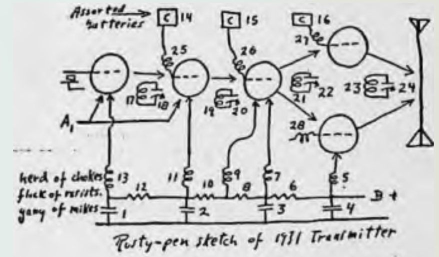
SPEED'S "TRIPLE TWIN"

States by the Cable (Speed) organization in the form of a tube called the "triple-twin", because it is a twin triode. The appearance of the tube is evident from the photograph; the smaller structure being of the general type familiar in the '27 tube, while the larger flat plate is the second stage and resembles the '45 and '50 tubes. The tube is intended to be used as a two-stage audio amplifier, in a rather curious circuit in which the cathode-bias resistor of the small tube is at the same time the grid-input (or coupling) resistor of the larger triode. The two elements named are tied together inside of the bulb. This gives a species of direct-coupled amplifier. The tube is a hexode—anyway we think it is a hexode, the Greek grammar, and cooking mystify us.

Being a two-stage tube the gain is naturally high—above that of the '47 tube. This holds for the arrangement used as a two-stage audio amplifier, and if one devises a circuit to prevent r-f. overload of the second triode it should be possible to use the twin-triode as a "detector-and-one-step".

Now what's the Greek word for "seven"? That ought to carry us through 1932.

STARTLING CRYSTAL NEWS



Here we have a 1931 crystal transmitter. It has 5 tubes, 6 coils, 17 resistors, 19 bypasses, 4 quarts of chokes, and a herd of other junk too numerous to list. We can't even count the adjustments. It works most of the time —but what a thing!

How would you like to sell most of it and use the rest to build a very simple transmitter, with but 3 adjustments, to give the same result? Wouldn't that be great—even if you had to THROW AWAY most of the hardware and crockery?

Very well—WATCH "MODERN RADIO"!

Anti-Noise Antennas

By L. W. Hatry, Associate Editor

YOU WIN

This revised reprint is in response to the insistence of readers who were unable to obtain the first issues of "Modern Radio".

An anti-noise antenna is one designed to minimize local crackles and buzzes generated in the lighting and telephone circuits of any town by the operation of all sorts of switching devices, by defective contacts and by motor brushes and the like.

The simplest of anti-noise antennas is a long aerial—if properly placed. Because of the general conviction that long aerials aggravate noise the idea may as well be properly shellacked before going any further. With obsolete 1, 2 and 3 tube regenerative receivers a short aerial DID reduce both noise and interference. Those antique sets had little selectivity except such as was due to

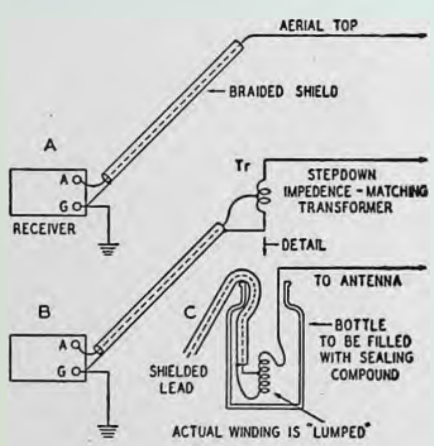


Fig. 1

regeneration; a small antenna lowered the general input level (noise and signal together) and thus caused the user to run up his regeneration. The resultant improvement in selectivity decreased interference greatly and noise somewhat. Furthermore, the regenerative grid-leak detector was easily blocked by noise-splashes and this too could be partly avoided by using a small antenna and reduced input level. Obviously neither of these reasons for reducing the antenna applies to present receivers.

Where is Noise?

Man-made electrical noise dies off very rapidly as one goes away from lighting, power, telephone and trolley wires—a fact easily shown by walking about the neighborhood with a portable receiver. One therefore needs only to extend the ordinary antenna into a comparatively quiet region to have improved the signal-noise ratio. The extension in no way reduces the noise pickup (noise collecting ability) of the original antenna; but it does something equally good by INCREASING the signal pickup, while leaving the noise-pickup unchanged. The larger signal permits one to turn down the volume control on the set to reduce its sensitivity to perhaps 1/5 of the previous value, and to reduce the noise in the same ratio. The noise is in fact reduced so much that many a bitterly-complaining set owner has been changed into one who heard no noise.

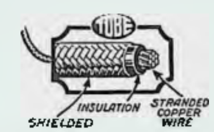
Since the long aerial is frequently sufficient, begin by stretching the noisy small antenna to 200 or 300 feet—not necessarily in one span but turning as necessary to avoid power and telephone wires, also houses wired without conduit. Observe that a long aerial can change other things besides the noise. In several cases interference from a strong high-frequency local broadcasting station was reduced because the original antenna had been near-resonant to the station. Of course a loading coil would have done that, but would not have suppressed the noise. On the other hand a very long aerial can aggravate cross-talk in receivers using '24 type r-f. amplifiers. The cure for this is a wave-trap tuned to the local signal, but the cure is not necessary in a well-designed modern receiver equipped with variable-mu tubes.

Certain locations have only one quiet direction—up! This is the problem of the city apartment-house square, where wiring is all about. Only height offers real hope of quiet; height and a trick leadin.

Trick Leadins

Special leadins for anti-noise aerials are all arranged to have no pickup of either noise or signal. They can be led through a noisy space without difficulty. This leaves the antenna top (unshielded) as the sole source of the signal. If this top has been properly placed outside the noisy space improvement is automatic.

The simplest of the special leadins is that shown in Fig. 1A. It is a rubber-covered wire (without cotton or silk) over which is a metal braid to be grounded at the receiver. The losses in such a leadin are rather high because the leadin



is, in effect, a soft-rubber-insulated condenser. This loss may be anticipated by simply using a lot of signal—which is to say a very large aerial. One may also use a very neat remedy suggested, I believe, by Mr. W. F. Cotter.

A Detour On Transmission Lines

Since the losses in a low-grade condenser go down very fast as the voltage is lowered we can reduce the losses in our rubber-covered leadin if we can reduce the r-f. voltage in it. This may be done by using a very simple, small step-down r-f. transformer at the top end of the lead as suggested at Tr in Fig. 1B (dimensions later). The signal is then sent along the shielded leadin at LOWER voltage and HIGHER current. The idea may be simplified by thinking of the antenna as a high-impedance signal-generator (the top) tied to a low-impedance transmission line (the shielded lead). One will see the necessity of matching impedences by some step-down device. Similarly at the receiver end of the line we must step up again to work into the high-impedence grid circuit of the first tube. The second transformer can frequently be avoided as will be shown later.

The Antenna Transformer

As a good start, here are the dimensions of a step-down transformer to work out of a 100 foot top, and into a 35 foot shielded leadin.

Total turns—150 of No. 30 D. S. C., lumped on a 1" tube and connected between antenna top and the shield of the leadin (see Figs.).

Tap—90 turns from grounded end, to be connected to the leadin wire (inner conductor).

Different shielded wires require minor changes in this transformer. Considerable changes in length of either top or leadin also require changes. In practice, with leadins up to 50 feet long the tap should be made at ½ to ¾ of the way up from the grounded (shield) end of the winding. By adjusting the total number the best response can be thrown into different bands as desired, using antenna harmonics for high-frequency work on very large antennas. For broadcast re-

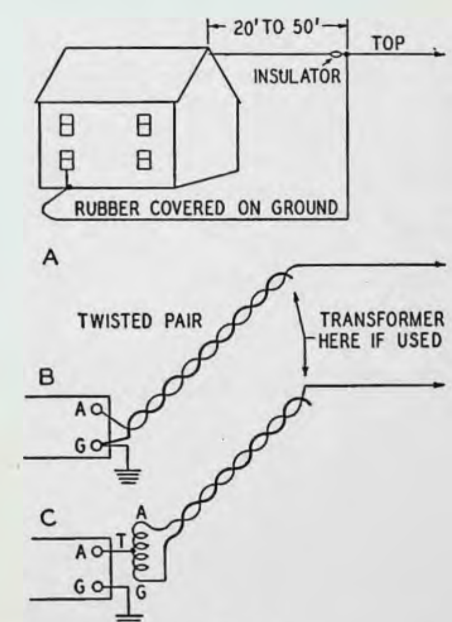


Fig. 2

ception the coil is so wound that (with everything connected) the system will have a resonance point (very broad) around 600 or 700 kc. Long wave (low-frequency) stations will be greatly aided by this resonance, while the droop at higher frequencies is well compensated for by the better sensitivity of most broadcast receivers at 1500 kc.

Simulating the Shielded Leadin

It is possible to simulate the shielded leadin with ordinary wire. In no case is the effect as good as with shielding.

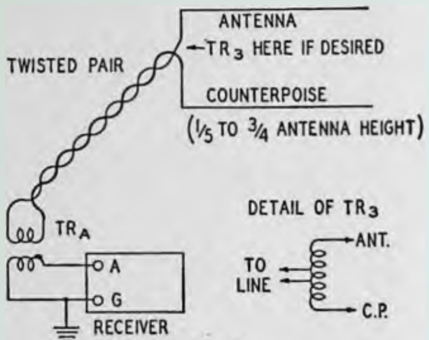


Fig. 3

In Fig. 2A the lead is dropped to the earth and follows it through the noise area to the house. Where this is sufficient a long aerial with an ordinary leadin should be as good or better.

A second imitation is the twisted leadin of 2B. The dead wire is supposed to run at exactly opposite polarity (180 degrees out of phase) to the live wire and the two are expected to cancel each other's pickups, leaving only the top pickup. The success of this scheme is indifferent. A variation of the twisted leadin is shown in Fig. 3. Unless the top can be made quite long there should be a matching transformer TR3 at the top—the requirements in that regard being no different than in the simpler system described before. These antenna-counterpoise systems necessarily must fit into the yard or onto the house and accordingly are rather uniform in size so that for broadcast purposes TR3 may in all cases have 150 to 160 turns of No. 34 D. S. C. lumped on a ¾" form. Taps for the downleads are provided 8 or 10 turns on each side of center. Since neither antenna nor counterpoise may be grounded a second transformer MUST be used to feed into the receiver. This second transformer TRA works into the original antenna coil of the receiver and as this is a low impedance we have a 1-to-1 transformer, meaning a pair of 30-turn windings scrambled on a 1" form, one over the other. A few receivers use special input windings in the form of a small honeycomb coil intended to resonate the antenna at about 500 meters (600 kc.). TRA in that case may need to have from 50 to 200 turns in its secondary. One must cut and try until the response of the receiver is satisfactory over the band.

One warning — antenna-counterpoise systems MUST NOT ENCLOSE THE SOURCE OF NOISE. Put both or neither on the roof.

The Receiver End of the Line

Practically all receivers which tap the antenna directly into the first tuned circuit will work satisfactorily without a step-up transformer when used with a shielded leadin under 70 feet. Above that one may use a step-up transformer

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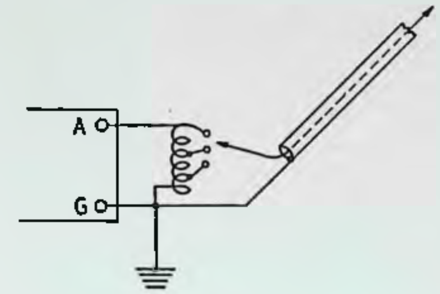


Fig. 4

which has 30 turns of No. 30 D. S. C. lumped on a 1" form and connected across the input posts of the receiver. Taps at 15, 20 and 25 turns from the ground end may be provided for the connection of the leadin wire, the right one to be found by trial. Fig. 4 shows the circuit.

The Worthless Waterpipe

There isn't any use in keeping noise out of the antenna post and letting it get in by the ground post. Grounding to a waterpipe is equivalent to connecting to a noise-reservoir. A large network of pipes radiates about the neighborhood and is everywhere surrounded by noisy house wiring. Noisy devices, such as the telephone, are grounded on these pipes. A good independent ground tends to end this noise-input. The best benefit cannot be gotten from the special antennas and leadins unless this precaution is taken.

Simplified Coil Matching

Though old commercially the following two coil-matching schemes may save some experimenter aggravation and time.

When matching single-layer coils a quick and simple way of adjusting the inductance is by crowding turns together on the low-voltage end (the end farthest from the grid) as shown in Fig. 1. This can be done easily by

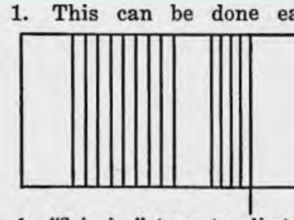


Fig. 1. "Spinning" turns to adjust a coil.

turning the coil and holding a dull knife or a nail file against the turns. Commercially the adjustment is made while the coil is connected in the test circuit, but for experimental work it is satisfactory to adjust and try alternately. The scheme is satisfactory when working in ordinary broadcast-range tuned circuits, or with high-frequency circuits not having much more than 1½/1 tuning range. For continuous-range high-frequency tuners it generally does not work out well unless there is no intention of ganging tuning controls. The reason is that crowding turns also raises the coil capacity, so that the slope of the tuning curve is changed.

When matching intermediate-frequency tuned circuits one frequently uses the small honeycomb or universal coils. Such small wire as is used in these coils is unhandy to cut, solder and test, particularly if the coil-maker had the bad taste to use enameled or silk-

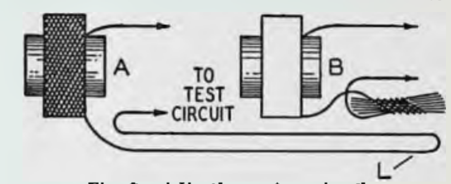


Fig. 2. Adjusting universal coils.

enamel wire. Much closer rough adjustments can be made before turn-by-turn cutting is started if one proceeds approximately thus:

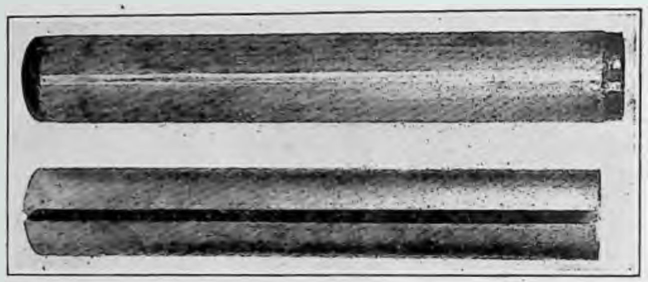
1. Connect up the original coil and get a rough idea what proportion of the turns are to come off. For example if the circuit tuned to half the proper frequency the inductance is 4 times the proper value and it is quite safe to take off at least ⅓ of the turns.

2. Before cutting pull the loose wire into a long narrow loop as in Fig. 2A, then double back repeatedly and finally twist as at B. This removes most of the inductance of the unwound portion and permits a fair rough-check on the remaining coil.

3. Repeat until only about 10% high, then cut off the twisted wire and repeat procedure of 2, removing only about 3 turns each time. When within 5% or so start turn-by-turn adjustment as usual.

The Crystal's Rival—Part 2

Pursuing somewhat further the non-crystal frequency-control method of our December issue we herewith show a feed-back coil which appears to work satisfactorily with tubes up to ½ kilowatt rating. It is wound on a sort of bakelite stovepipe 32 inches long and 3⅞ inches outside diameter—tho neither dimension is important. The winding is of 29 inches long in one layer of No. 22 d. c. c. which was treated with a mixture of beeswax, paraffin and rosin after winding. For convenience in ex-



THE COIL

THE SHIELD

perimenting a path was scraped along the entire length of the coil so that we have—a single slide tuner!

The high-powered tube at W1FG usually causes the monitor to turn blue and fill up with sparks, hence a frequency control experiment was instead made with the oscillator of a radiophone transmitter using a '10 tube in the oscillator position, a '10 frequency doubler thereafter, then a '10 modulated-amplifier and finally the 500 watt tube, tho no power was put on that. (Past experience shows that this tube does not react on the oscillator.) Using the oscillator as a moderately good Hartley-type affair the frequency shifted about 500 cycles when the plate voltage was reduced 50%, and about 120 cycles when the plate voltage was applied to the doubler-buffer and the modulatee—there ought to be such a word. The oscillator was then converted into one of the resonance-wave-coil feedback type by merely removing the grid clip from the tuned circuit and attaching it to a "prod" which could be run along the bared place on the coil, one end of which was connected to the plate of the tube thru a mica stopping condenser. This isn't the best way of doing the thing, by any means, but even so the frequency shift for 50% change in plate voltage dropped to something like 250 cycles. Since the tuned plate circuit showed a disposition to retain frequency control, the regular "tank" was next replaced by a high-L-Low-C affair as shown in another photograph. Immediately the frequency-shift for 50% change in plate voltage dropped to somewhat less than 60 cycles, and the shift due to throwing plate voltage off and on the two following tubes dropped to some low value difficult to determine, but apparently about 5 cycles. All of this was done at an oscillator wavelength of 320 meters, the intention being to double into the top amateur band, where the frequency shifts just mentioned would of course become 120 cycles and 10 cycles—which is the same percentage stability. Since there is no good reason for 50% voltage changes on the oscillator the shifts should be much under 200 cycles in the worst cases.

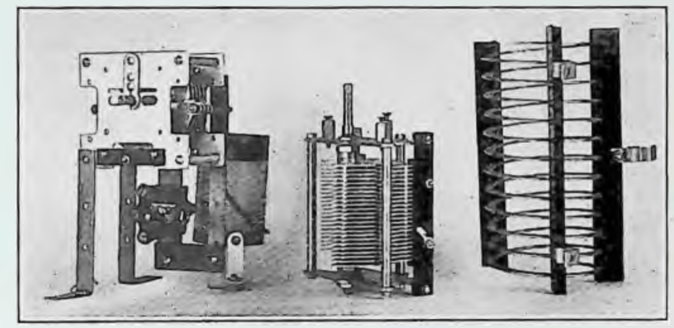
Now of course this all refers to sudden shifts, not to drift. The time for running tests here was by no means adequate, but by referring a harmonic of the oscillator to one from a broadcasting station which is alleged to be unusually free of drift (and seems to check consistently against various standards) it was found that in a half-hour warm-up period the drift was scarcely noticeable! This refers to the warming up of the tube and its plate circuit, for the large feedback coil changed not at all. Next an electric stove was directed at the resonance coil and a considerable drift, estimated at about 12000 cycles was pro-

duced by the time the wax began to run off the winding. This does not come under the heading of normal operation by any means, nor does the coil acquire any such temperature when run with the 500 watt tube. The drift would accordingly appear to be quite well down, even where no precautions are taken.

Incidentally, with the coil named, and at the wavelength of 320 meters the grid was excited by attaching it at a point 13 inches removed from the end connected to the plate. When a nearer voltage-peak was used the frequency

Left—
LOW C TANK

Right—
ORDINARY
HIGH C TANK

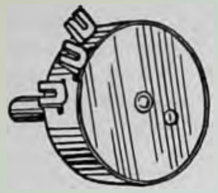


control was materially poorer, and when using one 21 inches from the plate tap it was even better than above. This is to be expected as the total shift of a given peak with change in wavelength is directly proportional to the number of bumps between it and the plate-connection. A further slight improvement was possible by removing the plate point from the end of the coil and attaching it a ways in from the end. Application of the copper shield which appears in the photograph nearly wiped out the hand-capacity effects but to avoid shifts caused by mechanical vibration the shield had to be tied down tightly with a wrapping of cord. The losses thereupon became too high and a thick layer of waxed paper was interposed. The much increased distributed capacity caused a larger number of standing waves to appear and it was expected that the lesser distance between peaks would improve the frequency control. This did not take place—rather the reverse. Suspecting that the losses were still too high the waxed paper was next replaced by a spiral of dry cotton cord about ⅛ inches in diameter. This did what was expected.

The open-line (see December issue) is of course still very attractive but presents some mechanical difficulties in the ordinary house. It has been suggested that a two-wire line such as used in the circuits of Fig. 4 (December) could be wrapped around the house on standoff insulators, and it is a fact that for 80 meter work the lengths fall out just about right. Unfortunately the outside of the house is exposed to wind and the wires vibrate. This produces the saw-going-through-a-thin-crate note that was heard from WIK whenever the alternators were running and vibrating the building. In one location very acceptable results have been possible by running the line into the attic, taking a turn around it and coming back down stairs. However it was felt that this was a special case, and it must also be admitted that the stability was not any better than that reported for the long coil—while the slightest vibration played hob with the thing. More will be said about these systems later. Meanwhile we await the experiences of our readers.

REINARTZ $2.85 OSCILLOSCOPE

John L. Reinartz, well known for his receiver and transmitter circuits has devised a most ingenious oscilloscope of the simplest construction. The story will appear in "Modern Radio" for February; reserve your copy! YOU CAN BUILD THIS OSCILLOSCOPE IN AN EVENING AND SEE YOUR MODULATION, YOUR FILTER RIPPLES AND SURGES, YOUR KEYING, YOUR RECEIVER OUTPUT—and NOTE THAT WE SAID $2.85—not $285.



Simple Volume Control

in Amateur and Broadcast Receivers—Part 2

By L. W. Hatry, Associate Editor

Part 1 of this paper explained in detail how an ordinary reverse-taper 15,000 ohm potentiometer may be used to provide volume control for any ordinary shortwave or broadcast receiver. It will be recalled that in most of the circuits discussed the control resistor handled r-f. current only. We now turn to some types in which a d-c. voltage is controlled.

Control by Change of D-C. Voltage

Voltage-governing controls operate by changing, (1) screen voltage, (2) cathode bias, (3) plate voltage, (4) filament voltage. This may be done automatically or manually. The automatic volume controls will be left for a later paper.

1—Screen-voltage control, whether used alone as in circuit 15 of Fig. 1, or in combination with an antenna-input control as in 17 is seldom satisfactory against strong signals because of screen-overloading and cross-talk and should be replaced by circuits 1, 3, 4 and 5. If this is done as explained in Part 1. The original control is left at maximum. If the screen control cannot be replaced because of instability or a trick antenna circuit replace the old control with an equal or higher resistance, which may be nearly anything from 5,000 to 50,000 ohms, depending on the arrangement of the B supply. It is simple to find out whether a high-resistance voltmeter shows the proper range of screen voltage.

2—Cathode bias control is shown in its simplest form in circuit 6 and in combination with antenna-input controls in circuits 7 and 16. The 75,000 ohm regular taper potentiometer is correct for one tube and may be used for several. In manufactured sets one finds scores of kinds which give no better control—better senseless originality than no originality at all! It takes about 13 volts cathode bias to cut off a '24 tube. This can (almost) be provided by a high cathode resistor but the 30 volts required to cut off '35 and '51 tubes is hardly obtainable in this way. A much better scheme is that of Fig. 3, which raises the voltage across the control resistor by putting through it some current directly from the B supply. Suppose that we intend to use a 5000 ohm

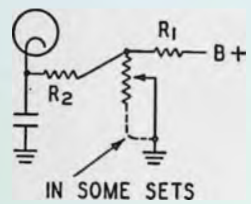


Fig. 3

control and to take the current from an 80 volt point on the B supply. To produce 13 volts across a 5000 ohm control we must put about 2.6 Ma. through it. At 80 volts this requires a total resistance of 30,000 ohms, and as we already have 5,000 in the control R1 must be 25,000 ohms. Similarly it is easy to calculate the series resistance needed to draw enough current through a 7,500, 10,000 or 15,000 ohm control so as to produce 30 volts across it. Usually the supply will need to be taken from some point in the B system which is at 140 to

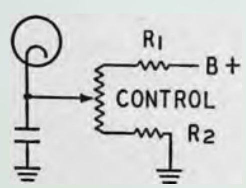


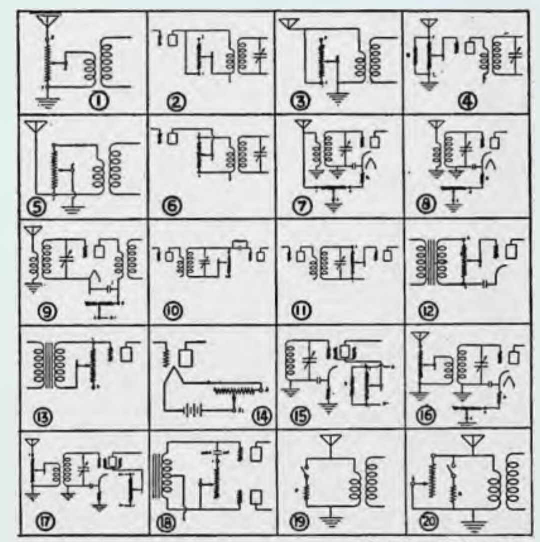
Fig. 4

250 volts "above chassis". The current which is "bled" through the control should be either considerably larger (3 times or so) than the plate current or else much smaller (¼ as much).

There must be a provision in all cathode controls to prevent reducing the bias to zero when turning the control to "full on". This is done by the resistance R2 in Figs. 3 and 4. In Fig. 3 it should be about 250-350 ohms for one tube and half as much for two. In Fig. 4 use whatever value is needed to produce 1½ volts across it (use high resistance voltmeter) when the control is turned to full on.

3—Plate voltage control (circuit 9 of Fig. 1) is inexcusable with modern tubes. The circuit of diagram 6, though not controlling d-c. voltage, can also be condemned as it ruins the selectivity of the associated tuned circuit, which can also be said of circuits 6, 10 and 11. They should be replaced by the circuits discussed in Part 1, which at least protect the first tube from overload. Study the wiring before cutting into it—nothing should be changed in some sets, such as the Fada 70.

Twin volume controls (as in circuits 16 and 17) were born of the easy overloading of the '24 tube—and of inadequate care in wiring layout, as mentioned in Part 1. The general data of Fig. 1 fit most receivers but there are exceptions such as the Victor 32 which requires abnormally low resistances and the Radiola 48 which requires such high resistances that there must be a metal static shield between! Infrequently one meets a combination of an antenna con-



Courtesy Electrad.

Fig. 1
REPRODUCED FROM PART I
FOR CONVENIENCE OF REFERENCE

CIRCUIT	RHEOSTAT USED	SETS NOW IN USE WHICH EMPLOY THE CIRCUIT
1, 2, 3, 4, 5, 6, 7,	15,000 ohm reverse taper	133
8 and 9	75,000 regular taper	60
10, 11, 12, and 13	500,000 reverse taper	67
14	10 ohm regular	52
15	50,000 ohm uniform 15,000 ohm (Antenna)	31
16	Twin 50,000 ohm (Cathode) 15,000 ohm (Antenna)	no data
17	Twin 50,000 ohm (Screen)	no data
18	1 megohm	no data
19	1 to 60 ohms (See text)	no data
20	15,000 ohm reverse taper, (R is as in 19)	no data

trol and an audio-shunt control (combine circuit 12 with 1, 2, 4, 5 or 7). The antenna control is usually sufficient.

4—Filament control of volume when out with the 201A tube. That's that.

Other Types of Controls

Audio controls such as 12 and 13 appear in modern receivers with automatic volume control. The correct control is specified in Fig. 1, but lower resistance values may be used in emergency. Circuits 19 and 20 represent one type of local-distant switching circuit, but the result depends on the input transformer and the wiring layout. One must cut and try. Other local switches simply disconnect the antenna, allowing some signal to get in through the switch capacity, or a shunt consisting of two wires twisted together. In a few cases a tuned circuit is opened to reduce efficiency.

Circuit 18 is the best form of tone control. The proper capacity will be found to lie between .0025 and .01 while the resistor may be between 500,000 and 1,500,000 ohms maximum.

The main point of all this talk is that a stock of just 6 volume controls will fit every job of the experimenter and will satisfy 9 out of 10 of the repairman's customers—only the 10th man is forced to say that you delayed him—the rest build business.

Saving Transmitter C Batteries

By Robert S. Kruse

Nearly all of the amateur transmitters that have been looked at lately, especially those using voice, were swarming with C batteries in various states of decay. In nearly every case a grid leak would have been as good, cheaper, and less inclined to pick up undesired r. f. voltages. Thus in Fig. 1 the grids of the first three tubes are being fed a steady stream of r. f. power and hence

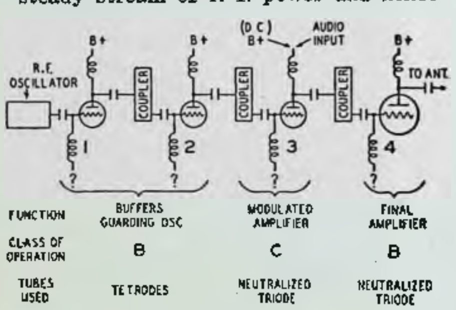


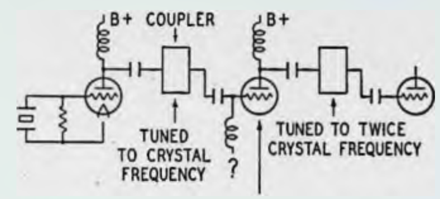
Fig. 1

a gridleak will provide a steady bias. The grid of the last tube is NOT being operated with a steady r. f. input, therefore a gridleak at this point would be quite wrong for there would result a wandering bias tending to wash out the modulation. This is the place for a C battery, plus a good bypass and a choke or two to make sure that the r. f. doesn't ramble through the battery. A perfectly good heavy-duty Burgess 45 volt block has been made to explode in about 30 minutes after being put into an unprotected bias position.

In passing—just what's the excuse for amateur radiophones using an r-f amplifier (so-called "class B") after the modulated tube? The thing is about the most inefficient yet invented, considered in either watts or dollars. More of this will be said in "Modern Radio".

A grid leak provides no bias unless there is a grid current. The preceding tube must swing the grids widely enough to ensure picking up electrons, and thus producing a grid current whose flow through the leak causes the desired voltage-drop. Putting it differently, the grid must be swung so widely that it will accumulate a negative charge whose magnitude is limited by providing a leak through which it may run off. From this it must be reasonably evident that if the r-f. input to a tube were to stop the bias would disappear with the possibility that the grid and plate may start dripping down the stem of the tube because of the increased plate current—and the incident will not help the filament. Some provision must be made for such accidents. One possibility is to provide enough C battery to keep the plate current from going to more than perhaps twice normal, but that is not attractive because one is again filling the set with batteries. Better possibilities

are to provide a circuit breaker in the plate supply lead of the LAST tube which is working with a grid-leak. This is the tube most likely to be injured and therefore in most need of protection. A quick-acting fuse is nearly as good IF it can be gotten at a rating that will blow when the bias resistor (grid leak) of the tube is short-circuited. A better arrangement is to rig up a relay with a back contact, that is a contact which



UN-NEUTRALIZED FREQUENCY DOUBLING TRIODE BUFFER

Fig. 2

"makes" when the relay is NOT pulled up. The plate current of the last leak-biased tube is run through the windings of this relay and the 110 volt primary current of the plate-supply system is put through the contacts as shown in Fig. 3. The rheostat R is a shunt; it is adjusted to a setting which will cause the relay to pull up promptly when the leak of the last leak-biased tube is shorted. The "front" contact then lights the lamp momentarily, the relay drops back and the whole action is repeated. The result is a flickering light that is sure to attract attention to the fact that the oscillator is out—or at least "down". No constants can be given because of the wide variety of relays and plate currents.

Another arrangement that demands more batteries than seem necessary is the customary buffer, using either a tetrode or a neutralized triode. Both of these things can be biased by a leak but if the r-f. input stops the tetrode is hard to protect—especially the screen. This can be avoided at a saving in batteries, usswords and $$$$ by using a frequency doubling triode buffer, Fig. 2, which needs no neutralizing. When working with batteries this sort of thing requires some fiddling—when working with a leak-bias it is the simplest buffer ever made. For instance a 210 with a 25,000 to 40,000 ohm leak and with 300 to 500 volts on the plate will give enough second harmonic output to drive another 210 or a 203A with lots of margin to spare—always provided one avoids the so-called "High C" plate circuits which are very ineffective in a frequency doubler—not to speak of wasting power. The plate

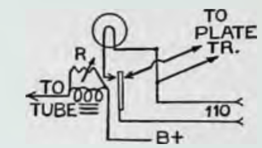


Fig. 3

tank of the tube should have between .0005 and .00015 of capacity and a good many turns of No. 24 (or thereabouts) double silk (or double cotton) covered wire wound on a moderately decent insulating tube. Copper tubing doesn't belong in this tank.

As a general rule—look in the technical data leaflets for the proper grid-leak values for "class C" tubes. These values are correct for both oscillators and tubes-to-be-modulated. Other r-f. amplifiers can use 50% more, while frequency-doublers should have from 2½ to 4 times the value given.

Why the Thermogalvanometer?

Just why do we keep on buying the bothersome thermogalvanometer when at the same price it is possible to get a thermo-milliammeter which doesn't call for use of a slide rule, curvesheet, or prayerbook? Must be a survival of the old days when we used decremeters to determine whether a spark transmitter would be broad enough to cover everything, or sharp enough to blanket only those waves between 300 and 1,000 meters.

Does Bill Hay use the stuff himself?

Each dog worries about his own fleas. From this coast the key thumps of commercial east-coast stations sound worse than the Japanese interference.

Curing Interlocking

By interlocking is meant a tendency for changes of tuning in one circuit to cause changes of tuning in another circuit supposed to be independent of the first. In shortwave receivers of both the double-detection sort and the kind having a stage of tuned r. f. ahead of a regenerative detector it is frequently found that the detector tuning changes greatly whenever the other tuned circuit is adjusted. This is called "interlocking" and is a genuine nuisance. It can usually be blamed on a wiring detail identical in nature with those described in the "Metal Chassis" article appearing in the first two issues of "Modern Radio."

tector tuning when the r. f. stage is tuned.

Fig. 3 shows the tuned circuits completed independently, and grounded at but one unavoidable point—the condenser rotor. Here two paths exist but as neither is a part of a tuned circuit the harm is inconsiderable. If the two condensers can be insulated from each other altogether we have the condition of Fig. 4, but that is gained at the sacrifice of single control. Ganged condensers almost necessarily use a metal shaft, making Fig. 4 impossible.

Rewiring after the manner of Figs. 3 and 4 will also frequently cure metal panels of hand-capacity effects which

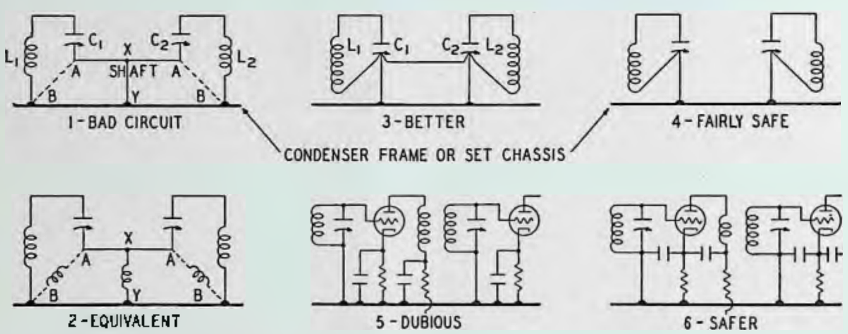


Fig. 1 shows the wrong wiring. First consider the solid lines only. The two tuned circuits L1C1 and L2C2 are completed via the shaft of the gang condenser and the condenser "bathtub" or the metal chassis of the set. Thus the part of the circuit marked XY is common to both tuned circuits and they are coupled together, as is made more plain in Fig. 2. How can they avoid interlocking? If the tuned circuits are completed back to the condenser rotors as suggested by the dashed lines AB of Fig. 1 things have been improved, but not cured. The wires AB have some resistance and some reactance and are after all merely shunts around the troublesome XY circuit. This sort of wiring is frequently found in manufactured shortwave receiving sets. Changing it in the ways suggested next will considerably reduce the changes of de-

have been causing the detector to stop oscillating or to change beatnote whenever the panel is accidentally touched.

Almost obvious from the foregoing is the advantage of the circuit of Fig. 6 as compared to the one of Fig. 5 when working at high frequencies. If there is any lack of clarity in the matter it will be of aid to read the chassis story previously referred to—but please look below!

L. W. H.

PLEASE!

Don't ask for copies 1 and 2 of "Modern Radio"—there ain't anymore. No. 5, November, is the earliest available.

Sending for the benefit of a particular receiving station is called point-to-point transmission, according to which broadcast receiving seems to be pointless.

The Resistance-Capacity De-Coupler

A device that is much used in present receivers, both shortwave and broadcast, but has not received much publicity, is the resistance-capacity filter for radio and audio frequencies, such as shown in Fig. 1. This simple arrangement makes the bypass condenser enormously more effective. For example, suppose that we are working with a 200 meter signal and the condenser C1 has a capacity of .01 mufd. At this fre-

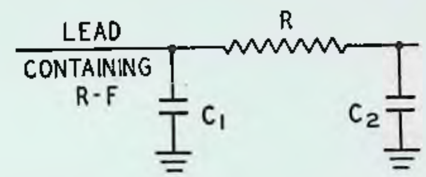


Fig. 1. The resistance-capacity filter. At radio frequencies the parts have the values given in the text for '24 plate circuits or screen circuits. Where a c-bias lead is to be filtered the condensers remain unchanged but the resistor is 100,000 ohms. For audio work 1 microfarad condensers are useful but even .01 is made useful.

quency the reactance of the condenser (in other words the opposition it offers) toward currents flowing through it is about 10 ohms. Connected across the condenser we have the resistance R and the condenser C2 which we will assume to be of 1,000 ohms and .01 mufd. respectively. As the radio frequency current flows through C1 the voltage is, of course, produced across it and this voltage obviously divides between R and C2. Since R is a 1,000 ohm device and C-2 is a 10 ohm device it is clear that the voltage across C2 is only 10/1,000 or 1/100 of the voltage across C1. Thus this combination is ONE HUNDRED TIMES as effective a filter as C1 alone and just as effective as a 1 mufd. condenser. Practically it is **much more effective than the 1 mufd.** condenser since that would have a much higher inductance and likewise would increase the probability of an undesirable resonance in the tuning range. The plate current of most screen-grid tubes is so small

that the plate voltage drop in the resistance is less than 5 volts. In the broadcast range it is occasionally necessary, especially in transmitters, to avoid this resistance by using an r-f choke in place of the resistor R.

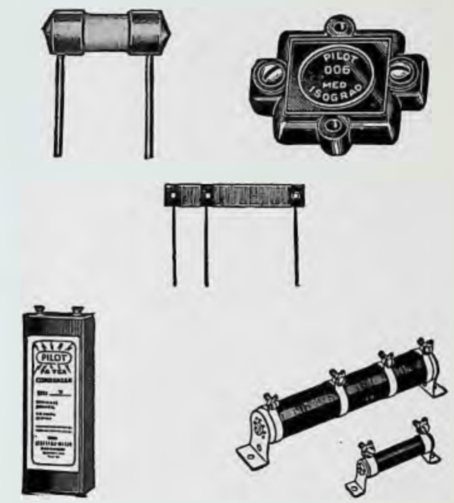


Fig. 2. Standard parts may be used. The International Pilot and Chicago Telephone supply-parts shown suggest useful forms.

These affairs are so simple and compact that they may be used liberally in experimental work, just to prevent a large waste of time in chasing mysterious feedbacks.

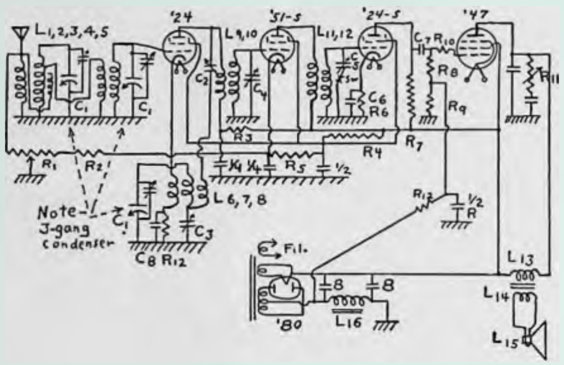
After a receiver has been completed one or more of these resistors will sometimes be found unnecessary but it saves grief to start with all of them in place.

R. S. K.

Remember when using 2 volt tubes that the average 2.5 volt dial-light consumes from 500 to 600 ma. whereas the tube needs but 60. Leave off the dial-light unless you want to add the current consumption of eight to ten tubes. A dial-light absolutely must not be used with the Eveready Air-cell battery as it is designed to run at not more than .75 ampere and does better on less.

An Autodyne Superheterodyne

"Superheterodyne"—which in plain United States means a double-detection receiver—has always meant a lot of tubes. Perhaps too little attention has been paid to an ingenious 4-tube double detection circuit used in the Majestic Model 15B chassis.



C1—Ganged tuning condensers with trimmers.
C2—Trimmer of first I. F. primary, also acting as coupling to r-f. coils.
C3—Series trimmer for oscillator.
C4—Trimmer of first I. F. secondary.
C5—Trimmer of second I. F. secondary, disconnected with switch in "local" position.
C6—I. F. cathode bypass.
C7—Audio coupling. .01 mica.
C8—Cathode bypass, .0009.
R1 and R2—Volume control, 10,000 ohms, and 350 ohms.
R3—Decoupling resistor feeding first detector, 2,000 ohms.
R4—30,000 ohm dropping resistor.
R5—"Bleeder" feeding volume control, 25,000 ohms.
R6—Second detector cathode bias resistor, 40,000 ohms.
R7—Second detector plate feed and coupling resistor, 300,000 ohms.
R8—Audio grid coupling resistor, 300,000 ohms.
R9 and R12—Audio bias voltage divider, .2 and 1 meg.
R10—r-f. grid-filter resistor, 100,000 ohms.
R11—Tone control.
R12—First detector cathode bias resistor, 10,000 ohms.
L1, L2, L3, L4, L5—Tuned input system.
L6, L7, L8—Oscillator coil system.
L9, L10, L11, L12—I. F. coils.
L13, L14—Output transformer feeding moving coil L15.
L16—Speaker field used as filter choke.

the detector to a signal and at the same time keep it oscillating at a frequency 175 kilocycles (175,000 cycles) removed from that tune This is done in the Majestic set by use of two independent tuned circuits—one of which invites the desired signal into the tube, while the

It ordinarily takes at least 5 tubes to make a double-detection receiver—to wit:

One audio tube,
Two detectors,
One oscillator,
One intermediate amplifier.

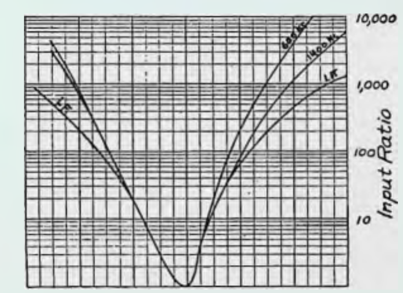
To do the thing with 4 tubes clearly means that one tube must lead a double life. From the diagram one may see that the detector is equipped with an astonishing number of connections, which leads to the suspicion that it must be the two-function tube. So it is, being both detector and oscillator, or in other words an autodyne detector.

Where the Rub Comes In

It is easy to make a detector oscillate —but it is quite another trick to tune

other attends to the business of oscillating. The coils L1, L2, and L3 are the antenna coupler. L3 is the tuned coil of this arrangement and is tapped into the primary of a second tuned transformer, L4-L5. The whole thing is what was once so passionately advertised as a "band-pass input" by several advertising departments whose names we don't remember. In plain radio-language this is dual-preselection, made necessary by the distressing ease with which a '24 detector overloads. In order not to aggravate that tendency, the volume control leaves the detector tube alone and controls by shunting the antenna coil, and by changing the bias of the intermediate-

frequency tube which is of the Ballantine-Hull variable-mu sort (Majestic type G-51-S) and therefore unworried by such operations. Now we have the signal in the input grid of the detector and need only to mix with it the 175 kc. off-tune oscillation. This oscillation is provided by the coils L6, L7 and L8 which are a tuned r-f. system operating 175 kc. off-tune. The coil L6 is the feedback coil and has been placed in the cathode-lead to avoid confusing the tuned input system. Coil L8 couples the plate to the oscillator tuned circuit L7, which has the usual series and shunt adjustment condensers. The series one (C3) is in turn shunted by a combination consisting of the coil L8, the primary of the first I. F. transformer (L9) and the I. F. trimming condenser (C2)



Selectivity curves. The curves are shown in the usual manner, the lowest point being at resonance and the two extremes 30 kc. off to either side. The height of the curve indicates the ratio in which input must be increased to maintain the same output which was obtained at resonance. This is, of course, an indication of the degree of discrimination against unwanted signals.

connecting them, thence through the bypass condenser to chassis—which completes the circuit back to the other side of the series oscillator trimmer. It will be seen that I. F. primary trimmer (C2) serves also as a coupling between the oscillating feed-coil L8 and the detector plate. Because both the oscillator and the I. F. system make use of the oscillator trimmer C2, the two adjustments are not independent, though the choice of sizes is such as to make the interlocking small. The plate supply of the detector comes through the I. F. primary, which may be regarded as an r. f. choke, if one wishes.

From here on everything is orthodox except for the local-distant switch SW, which operates to detune one of the I. F. circuits and thus drop the efficiency. The tubes used in the I. F. and second detector sockets are peculiar in their manner of shielding. Instead of being enclosed in the customary cans these tubes are metal-coated by means of a Shoop spray-pistol. The metal-coating is connected to the cathode. Thus the tube shield is "off ground" by the amount of the r-f. drop through the cathode bypass. This appears to do no harm as may be seen by looking at the curves herewith. In several sets it has been found possible to replace the second detector with a plain '24 with a material increase in response—and sideband cutting to indicate that regeneration has been introduced. The spray-shield thus appears to justify itself.

The selectivity curves herewith were made from a stock set and seem to indicate that a rather ticklish job has been very well carried out.

The sensitivity of the set tested varied from 60 microvolts at 550 kilocycles to 20 microvolts at 1,500 kilocycles—which would sound even better if stated on the "microvolts per meter" basis. The figures are then 15 to 5 microvolts!

R. E. L. EQUIPMENT

The Radio Engineering Laboratories of Long Island City, N. Y., offer a multiple switch called Cat. No. 269 which is equivalent to a highly insulated 4-pole-double-throw knife switch but does not depend on hinge or jumper contacts.

It should be useful for a variety of circuit shifts, including wavechanging. The list price is $12.50.

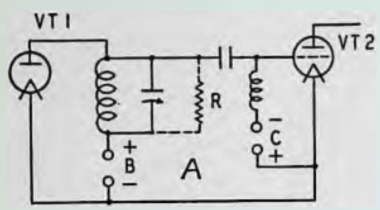
Tank-Circuit Resistors

As an Aid to High-Quality Transmission

By Robert S. Kruse

In broadcasting, and other high-quality voice transmitters, most of the tuned plate circuits (the so-called "tanks") have radio-frequency resistors connected across the coil, or in series with it.

If we consider diagram A as a portion of the radio-frequency system of a radio-

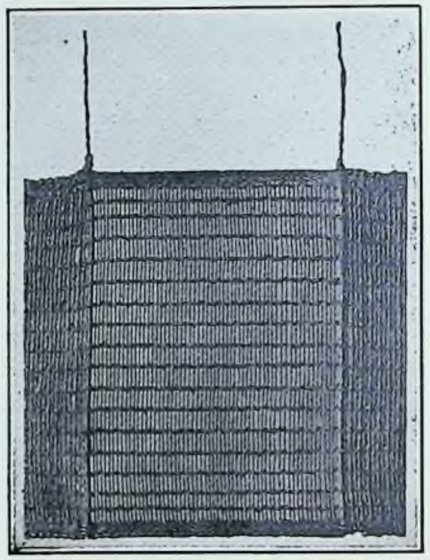


The Use of Impedence-stabilizing Resistors

telephone transmitter it will be seen that the LC circuit provides whatever selectivity there is between the tube VT1 and the tube VT2. Should this selectivity be excessive there will be a tendency to "cut sidebands"—in other words to reduce the higher pitches and with them the intelligibility. In most amateur stations there are not enough tuned circuits AFTER the point of modulation so that this is serious, but another very good reason exists for tank resistors.

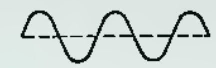
Impedence, Instability

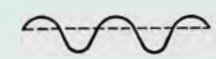
Suppose we consider the LC circuit of VT1. Radio-frequency power is fed into it by the tube and is used up in two ways—the heating of the coil L, and the swinging of the grid of VT2. The resistance of coil L is fixed and does not concern us, but the load provided by the grid of VT2 is not at all steady—and that's our story. IF we were to run VT2 so gently that it drew no grid current, practically no power would be required from the LC circuit. This is the so-called "class A" type of amplification, and is rarely used in r-f. amplifiers. Usually they are run with grid current—i.e. as "class B" amplifiers, for the sake of increased output. This calls for wide swings of the grid, and causes grid-current during the top of the "plus" swing. Now a grid current represents power—and the power comes from the LC circuit! Thus we have a curious load—it takes virtually no power to swing the grid of VT2 in the negative direction, but it takes power to swing it "plus". This lop-sided load causes the un-modulated carrier wave in the LC



An "Ohmspun" resistor suitable as an r.f. load. Asbestos thread is the warp, resistance wire the woof. The inductance and distributed capacity are low, the aircooling good. The units come in values from 46 to 1000 ohms. The lower-resistance ones will dissipate about ¼ kw. while those above 230 ohms will dissipate 100 watts each. Tapped Units are available as are racked series and parallel groups. Makers, The States Co., New Park Ave., Hartford, Conn.

circuit to lose the form shown in diagram B and to take on the form shown at C. The plus peaks are flattened—which is to say we are generating 2nd and 3rd r-f. harmonics. This isn't too bad because the following tuned circuits will materially reduce any such r-f. harmonics—but that isn't the whole tale. If we now attempt to plate-modulate VT1 in the usual manner we expect the carrier to be swung upward and downward in the same ratio. This expectation will not be fulfilled, for when we try to modulate upward the grid-load increases sharply on limits the upswing, while when we modulate down it stays small

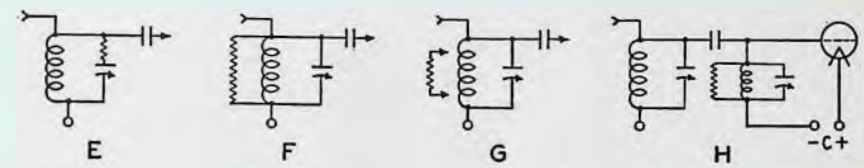




and the expected decrease takes place. Thus we "cut the positive audio peaks".

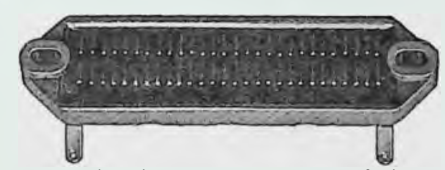
What to do About It

There are two obvious things to do about this. One of them is to replace VT1 with some very large tubes working



in push-pull, getting rid of a part of the difficulty by reason of the lower loading of the large tubes and depending on the push-pull arrangement to equalize the load on the two halves of the cycle to some degree.

A much cheaper remedy is to add R across the LC circuit, giving it a low enough resistance so that it will waste 7 to 10 times as much power as is drawn by the grid of VT2. The unsteady grid load is thus "swamped out" by a larger steady load. A simple way to determine



A "Plaque" resistor suitable for high frequency work. A resistance wire is wound in a sort of progressive figure 8 form and then laid into a miniature porcelain trough and sealed with vitrified enamel in the usual Ward Leonard manner. Rating 40 watts, obtainable tapped or untapped 100 or 5000 ohms. Makers, Ward Leonard Electric Co., Mount Vernon, N. Y.

roughly the power-consumption-ratio of R and the grid of VT2 is to put an r-f. meter in series with R, figuring that the watts consumed in it are:

.7 (plate volts of VT1) (current through R)

which ordinarily comes a bit closer than figuring from the value of R, since that may change with the frequency and location. The power drawn by the grid of VT2 can be approximated well enough for the present by measuring the grid current (when the carrier only is going through the system) and saying that the grid power is:

(grid current) (grid bias volts)

Measure both currents in amperes. If the grid watts are more than perhaps 1/7 of the watts in R, reduce the resistance of R if it is a short to L, increase if it is in series with the L.

A resistor of some type should evidently be associated with every "tank" after the modulated tube. Where a plate tank and grid tank both are used the latter had better be given the resistor. Plate tanks closely coupled to an antenna are usually loaded sufficiently and need no additional R—but the rough check just described will make sure. When the watts-consumption of the resistor is high enough the "lop-sided" r-f. current will again be of good wave form, but smaller voltage, as suggested in diagram D.

Just how the resistance load is attached is not too vital. Diagrams E, F and G show common schemes for either plate or grid tanks.

(See Page 17, December)

The Allied Arts

WHAT AILS HOME RECORDING?

By
Perry O. Briggs

The shortcomings of present-day home recording are so obvious that the reaction of the buying public is one of keen disappointment. I will attempt to show just what a radio manufacturer is up against when he attempts to put a decent recording outfit on the market.

First of all we must have a microphone capable of responding equally to all sound frequencies; in technical language the microphone must produce a constant ratio of a-c. output voltage to applied sound pressure between 30 and 8,000 cycles. The cost of such a microphone is AT PRESENT prohibitive.

Secondly we have the audio amplifier. The commercial audio amplifier, used in high-grade recording shows little change in gain between 20 cycles and 10,000 cycles. In home recording one is ordinarily compelled to work with the audio end of a broadcast receiver, which usually has little response below 100 cycles and none at all above 5,000. Even so, if there were no other difficulties we would have mighty nice records.

Third is the recording head or cutter. We should have the performance of a high-grade cutter such as shown at the top of this column.

Herein is the greatest of the stumbling blocks. The cutting head is essentially an a-c. motor—that is to say an electro-mechanical device which converts electrical energy into EQUIVALENT mechanical displacement. The difficulty is in the word "equivalent". Let us follow the commercial process through and see what that word means.

Commercial records are made in soft wax; the cutting stylus actually removes a long shaving of wax from the blank which is rotating under it at record speed. The result is a continuous groove of precisely pre-determined width and depth, cut in the form of a spiral across the face of the wax disc. When voice currents actuate the armature of the cutter the groove is made to waver sidewise.

After this cutting the soft wax disc is sent to the process plant which by a very specialized procedure makes a hard record with an identical groove on its surface. This is the groove in which the needle of the pickup runs during reproduction. The needle is thereby sub-

TROUBLE AHEAD?

jected to the same displacement that the recording cutter went through, only now we have a driven member instead of a driving one—a generator instead of a motor. The armature of the cutter, you will remember, derived its mechanical motion from the variations of a magnetic field which variations were occasioned by an alternating-current input, in the reproducer we have the inverse; the pickup armature is driven by mechanical force and delivers at its terminals a voltage whose wave-form SHOULD correspond to that of the driving groove. Now it happens that the voltage generated in the coil of the pickup (like that of any a-c. generator whatever) depends on the ampere turns and the *number of lines of magnetic flux which are cut per second.* Thus our little alternator, to give the same performance at all frequencies must be so made that it will deliver the same a-c. output voltage whenever the armature is moved at the same velocity—regardless of whether the movement is through a small amplitude at high frequency, or through a large amplitude at low frequency.

Looking back at our recording cutter we now see that it becomes necessary that this device be capable of actuating its cutting stylus at constant velocity when a constant a-c. voltage is applied to its terminals, no matter where in the audio range the frequency of that voltage may lie.

Practically these things cannot be strictly true. In a commercial recording cutter such as pictured herewith; the stylus DOES respond correctly between about 6,000 cycles and 240 cycles; if the applied voltage is kept the same, the velocity of the cutting stylus remains constant, which is to say the amplitude increases as the frequency is lowered. Below 240 cycles the amplitude no longer increases in direct proportion as it should and the relation becomes logarithmic instead of linear. While cutting soft wax the motional impedance of the cutting head is negligible as the moving parts are fully damped by oil or an artificial transmission line of rubber tubing.

Now Then—

In home recording much of the foregoing is untrue. First, the standard pickup is not a good cutter; it fails to respond below 100 cycles or above 4,500 cycles. Secondly it is required to work on an aluminum or celluloid blank instead of a soft wax one and the motional impedance of the pre-grooved celluloid is enormous. Assuming everything else to be perfect the combination produces a record wholly lacking in genuine (fundamental) bass, and in all pitches above 3,000 cycles.

At a little extra cost some set manufacturer will eventually develop an inexpensive cutting head to compensate for the deficiencies of home recording blanks and the result will be an outfit that should create a renewed interest in this form of home entertainment. The means of doing this are clearly understood. However, it is a reasonably safe bet that he must equip his machine with a lead-screw to carry the cutting head across the blank, not depending on dragging it across by a ready-made groove which will unavoidably obstruct the action of the cutting stylus.

Thank God for ignorance. I don't know how to say "six" in Greek and therefore can't worry about the tube that will come next after the pentode.

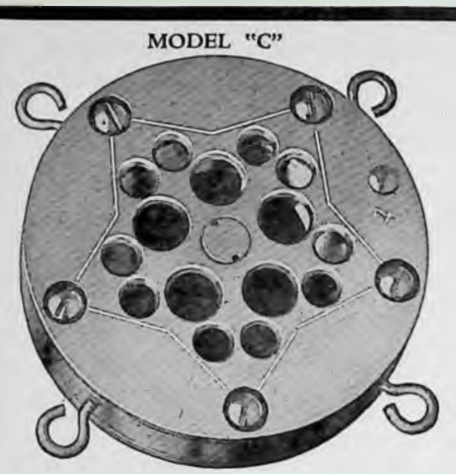
Let us not be too cynical—there is still a lot of simple faith in a country that continues to buy metal flush-tank balls to use for antennas.

Remote control will begin to amount to something when the radio audience is able to use it on the advertiser. Meanwhile a shotgun can be bought from Montgomery Ward for $6.89; and rock-salt is very cheap.

Will someone please explain why an "equitable" system of radio allocation puts so many broadcasting stations into one-quarter of the country? I mean, will someone please explain it so as to be both clear and credible?

Speaking of temperature—the heat in these paragraphs is internal and does not come from overloading the Frost resistors used for spacers.

Went fishing last summer and had wonderful luck. The very first day right in the deepest part of the lake the portable receiver fell overboard.



"Short Circuits"

Felix's new book "Television" says—"KDKA was no more the pioneer broadcasting station of the world than was the first automobile equipped with a self-starter, the first automobile."

Automobile radio receivers are claimed to be restful. Yesterday we left ours on and this morning the car battery was sound asleep.

Mr. R. B. Bourne has told me of an instance in which excellent 20 meter transmission was accomplished with a very long antenna hung so low that the wild deer kept tearing it down by running into it. A special type of such antennas will be described later.

The University of Texas Bulletin No. 3114, by J. P. Woods gives a detailed discussion of the subject "Calculating the performance of vacuum tube circuits used for the plate detection of radio signals". Copies may be obtained from the Bureau of Engineering Research, The University of Texas, Austin, Texas.

The Portuguese are a polite people. A letter from a concern in Portugal soliciting an order for goods concludes, "Please await thanks". That, we think, is a great improvement on the presumptuous "Thanking you in advance".

Capper's Magazine.

What ails the amateur 40 meter band is exactly what ails broadcasting, lack of an effective authority to limit transmission.

"Only a lunatic could be an optimist in New York."—*Dr. Stephen Wise*

How many of our readers have heard of "The Three Double Crossers" and know what they are doing?

You can say one thing for the worm; when it gets ready to turn it doesn't hold out a hand to confuse you.—San Francisco Chronicle.

OUR ABSENT EDITORIAL PAGE

The August issue of "Modern Radio" carried an Editorial Article by Mr. Harold Johnson. It appeared because it was good.

Examination of some 200 copies of various radio magazines printed in the last seven years disclosed just five editorial pages which seemed to be worth while.

That is why the Editorial Page will be infrequent in "Modern Radio".

IN MINDANAO—THE MILLENIUM

Mr. Henry E. Neibert of Milbuk, Mindanao, P. I., gives us a picture of broadcast reception at Milbuk—N. B. C. and Columbia please study!

"Radio Saigon, a short distance from Saigon, Indo-China, sends daily programs on 49 meters with about 12 kilowatts radiation. From this station comes a nightly treat. It has an orchestra of some 30 Frenchmen, all accomplished musicians. Four soloists among them are first prize winners at the Paris Conservatory of Music—piano, violin, 'cello and saxaphone. There is no suggestion of any form of advertising—all music. It is like sitting in an opera house in Paris. During the early part of the evening—Annamite music is played. During this portion of the time we tune in on Javanese stations, Siberian, Australian or other shortwave stations, some being almost always available.

KZRM,—of Radio Corporation of the Philippines sends on 485 meters. Their programs are principally "catch as catch can" from cabarets etc., and jazz of the most indifferent sort. They often rebroadcast U. S. programs which keep us cognizant of soap, cigarettes, automobiles and sardines.

The Russian stations are powerful and play fine music—when they play music—but it is used only to sugar-coat the Bolshevik pill of propaganda. They try to live up to the diagnosis made by the Hon. Elihu E. Root, that their chronic complaint is that there are 180,000,000 orators in Russia. The big virtue of radio is that a turn of the dial cuts out the yap."

I have heard that there are many good reasons for amateur CQ calls. Name one.

The Value of a Guess

Weird noises that come and go with the weather and range from cackles to high squeals, are sometimes caused by leakage to the metal chassis, particularly at terminals that are soldered, and through spaghetti lying on metal. This sort of thing is especially common at high frequencies and in broadcast receivers with automatic volume control. It is rather hard to locate unless one has some way of measuring insulation resistance. It is not satisfactory to rely on the ear for "The ear has no memory and is a liar to boot". Professional radio engineers began to measure some years ago, and the swarm of funny circuits died overnight. Service men began to use set analyzers, ohm meters and output meters some time ago—and are much better service men. Most amateur set makers have not begun to measure but are still relying on the ear because the cost of measuring apparatus seems too high. We hope to do something definite about this, and in the next few issues of "Modern Radio" to show that measurement is neither as costly nor as difficult as "measuring by ear".

WANTED

The Editor of "Modern Radio" will appreciate information as to the address of Messrs. L. J. Perkins, Walter F. Kannenberg and C. B. Graves.

THE BAZAAR

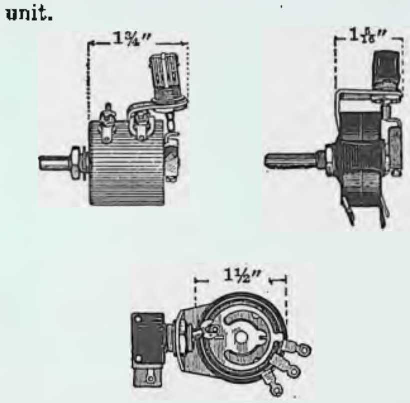
Please abide by these rules:

1. 6c per word, payment with ad.
2. Ads for an issue must reach us the first of the preceding month.
3. Used, reclaimed or surplus items must be so described.
4. Please PRINT your name and address.
5. We reserve the right to refuse any part of an ad.
6. Ads designed to stand out cost extra. 7c a word all capitals, $1.50 an inch for unfilled space.

NEW FROST RESISTORS

The Chicago Telephone Supply Co. (Frost) of Elkhart, Indiana, offers several groups of new resistors, each available in a wide variety.

The 70 series is of the type using a composition resistor with a continuous resistance curve of any desired shape. These may be had with or without a built-on switch of either S. P. S. T. or S. P. D. T. type. A self-cleaning metallic sliding contact is used which is stated to work with a rather high unit pressure but with such small friction that after 100,000 full-scale operations the action has improved slightly over that of a new unit.



The 20, 40 and 70 Series may be had in single or tandem form and with or without switch.

Armored resistors.

Where the requirements as to shape of resistance curve or leakage-resistance between terminals are unusually severe the 40 series is offered instead. These are somewhat larger and use a flexing-disc type of contact.

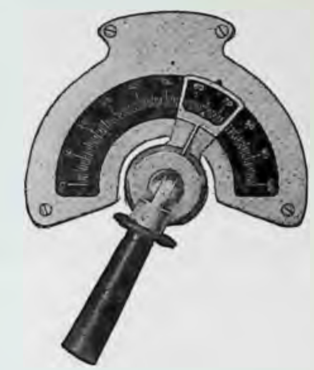
A new wire-wound series, called series 20, is also offered. Special attention has been paid to smoothness of operation.

Armored fixed resistors have also been added to the line.

Obtunded intellects prevent us from understanding why the Institute of Radio Engineers works out excellent standard symbols but does not use them in its own proceedings.

R. E. L. DIAL

A locking tuning control and dial is also offered under the designation Cat. No. 276. The locking action is by means of a cam which pushes the dial hub against the panel and places a pull on



the shaft of the tuning unit. A scale and a blank calibration arc with a second indicator are provided.

Intelligence Test for Sea-going Ops

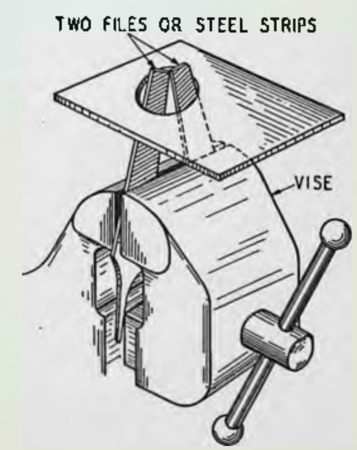
Question: After calling a coast station 59 times you still hear no answer; what would you do?

Answer: Turn on the receiver.

Question: What part of the transmitter is most likely to cause trouble?

Answer: The nut that holds the transmitting key.

—The Key Wagger, Seattle.



A reamer for meter-holes in aluminum and insulating panels.

THE STAFF OF "MODERN RADIO"

Collectively the staff of "Modern Radio" has:

- Designed six successful receivers.
- Designed and built 30 transmitting stations.
- Contributed to every major American radio magazine.
- The articles have been reprinted in all principal countries of the world.
- Has operated 40 commercial, broadcast, amateur and experimental stations.
- Had 24 years' experience in radio retailing and jobbing.
- Had over 26 years' experience in radio service work.
- Has participated in many sorts of radio experimental work.
- Has had 75 years total experience in radio transmission.

"MODERN RADIO'S" ANSWER FACTORY

How?—What?—Where? Who?—When?

A—Letter with one question (see note below) ....$ .50
No charge for small incidental pencil sketches.

B—Additional questions, each...... .25

C—Schematic circuit diagrams such as battery-driven receivers with not over 5 tubes, transmitters with not over 4 tubes, antennas (other than beam types), switching schemes of ordinary complexity, and all metering, and power circuits of reasonable simplicity, where constants are not necessary or can be given simply.. .75

D—Matters such as given under C, where all constants are desired.... 2.00

E—Socket power receiver circuits—without constants 1.50

F—Socket power receiver circuits with all constants 3.00

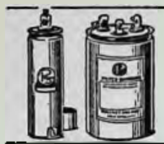
G—Transmitter diagrams of greater complexity, bibliographies, operating instructions, analysis of complex operating difficulties in apparatus, and other questions not covered by the above will be estimated on receipt of a clear and complete statement of the problem.

NOTES

1. Keep a copy of your letter, including diagrams, numbering questions 1, 2, 3, 4 and lettering diagrams a, b, c, d. The answers will refer to these letters and numbers.
2. The right is reserved to return remittances for any questions which it is impossible to answer. The reason will be stated.
3. No attention will be paid to radiograms, telegrams or letters (other than those under class G) which are not accompanied by a remittance. Please use money order—loose cash may not arrive.
4. Address letters, "Modern Radio", 101 Allyn Street, Hartford, Connecticut.

Coming in Modern Radio

THE UNPROFITABLE CLASS B AMPLIFIER
THE REINARTZ OSCILLOSCOPE
SIMPLE MODULATION METERS
HIGH-GRADE NOTHINGS
THE TYPES OF AMPLIFIERS EXPLAINED MORE SIMPLY
TUBE-SAVING TRANSMITTER LAYOUTS



ELECTROLYTIC CONDENSERS

In single, double and triple units

FIXED RESISTORS

Wire-wound Tubular
Flat Strip—Flexible
Grid Leaks

FILTER BLOCKS

The Standard of the Industry
Built to specification

VARIABLE RESISTORS

Carbon Volume Controls
Wire-wound Volume Controls
Rheostats—Potentiometers

BY-PASS CONDENSERS

In stock in all usual capacities

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Audio Transformers
Power Transformers
Standard Choke Units

UNCASED PAPER CONDENSER SECTIONS

For repair work
Ask about the special Polymet Condenser Repair Kit

COIL WINDINGS

All Types of coils, except radio frequency, built to specification

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World's Largest Manufacturers of Radio Essentials

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Replacement Audio Transformers

Style of All Replacement Types (See right.)

PUSH-PULL OUTPUTS

1—247 into voice-coil of Dynamic. . List $4.00
2—247's into voice-coil. . . . . List $3.50
1—245 into voice-coil. . . . . List $3.50
2—245's into voice-coil. . . . . List $3.50

As illustrated on left, excellent for midgets. Larger transformers, cased, $6, $8 and $12 List according to grade—tone.

Sizes for one or two 250's, 210's, etc., from $3.50 to $12 List. Sizes suitable for high-grade or public address amplifiers as well as all kinds of repair work.

Also transformers for working into magnetic speakers from any of above tube combinations at $3.50 and up. Sizes for 112's and 171's in stock at similar list prices.

Optional Style of 3-1 A. F. and P. P. Inputs

OTHER AUDIO TRANSFORMERS

3—1 replacement A. F. $2.25
Push-pull input transformer. $3.50

Above transformers available in styles of both illustrations, specify, at List Prices given.

Cased transformers—3-1 at $2.50, $4, $5, $6.50, $10 List.

Push-pull inputs cased at. $6, $10, $12
Push-pull interstages. $12

Grades for all purposes.

MICROPHONE TRANSFORMERS

Single-button . . . . $ 5
Double-button $10
Double-button best $20

Exceptionally complete line of Audio Transformers of all types. Usual discounts from above List Prices to service-men, dealers, amateurs and experimenters. Prompt service. Polymet, Pilot, Thordarson, Sangamo, Amertran.

Also replacement chokes 25-150 ma., power transformers for all tube combinations, including 250's, 281's, 484's. List Prices from $1.50 on chokes, $4.50 on transformers. Transmitting power transformers stocked. All types of filter condensers, etc. Try us—we have it.

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866 GUARANTEED $2.85

THE LARGEST EXCLUSIVE MAKERS OF MERCURY VAPOR TUBES

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MERCURY VAPOR RECTIFIER TUBES

	FILAMENT		PLATE		PRICE
TYPE	VOLTS	AMPS.	VOLTS	AMPS.	
*866	Heavy	Duty	7500	.6	$ 4.50
866B	5	5	7500	1.2	6.00
281	7.5	5	7500	.3	3.50
872	5	10	7500	2.5	12.00
875	5	12.5	15000	2.5	20.00
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We Build mercury vapor rectifiers to order ranging from one volt, one ampere, to 30 amperes at 20000 volts.

* This tube is the finest of its type on the market and is positively guaranteed to outlive any two ordinary 866 tubes.

Send 20% with order. Balance shipped C. O. D. We charge postage or express with balance. Dealer discounts for quantity only.

ODEON MANUFACTURING CO.

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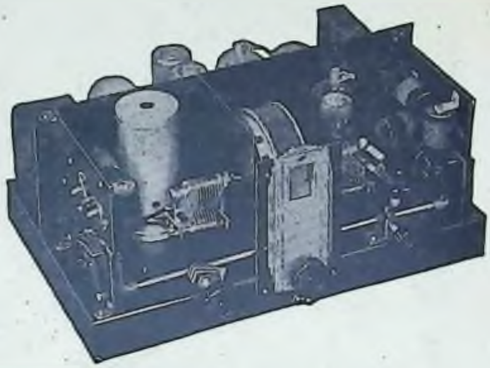
WATCH FOR OUR ANNOUNCEMENT PRESENTING TRANSMITTING TUBES

Most Powerful Made !

NATIONAL

NC-5 SHORT-WAVE CONVERTER



Attach the NC-5 to any broadcast radio in 10 minutes and bring in short wave broadcasts and code from all over the world.

PLENTY OF AMPLIFICATION

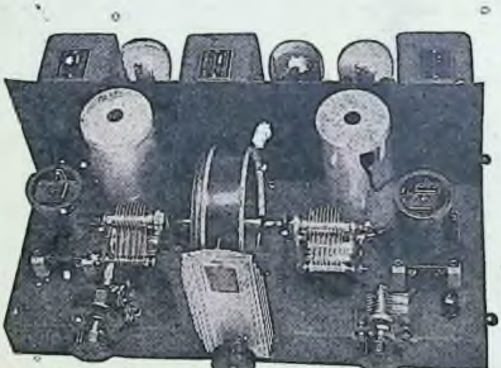
New harmonic tuned input circuit combined with two additional amplification stages gives the NC-5 a real punch.

HIGH SIGNAL TO NOISE RATIO

The new NATIONAL Company design keeps down background noises and brings up the signal to full power. No plug-in coils. A new coil-switching system gives perfect results for converter use without plug-in coils. The main reason for its success is R-39, the special low-loss molding material of the Radio Frequency Laboratories, developed especially for National Company.

OTHER ADVANTAGES

Single control tuning in circuits "track" each other accurately. Automatic change in color of dial light indicates which coils are in circuit. Attractive—Compact. Standard Model in metal cabinet. De Luxe Model in inlaid mahogany case. Has own built-in Power Supply. R. C. A. Licensed.



NATIONAL SW-5 THRILL-BOX

"Neatness, Precision, Good Results", so says one owner. Others say: "Truly a masterpiece in the SW field" . . . "What a kick this set has" . . . "5 continents and 23 countries received". (Names on request.)

FEATURES OF SW-5 THRILL-BOX

Range 9-2000 meters. Extremely high signal to noise ratio. True single-knob tuning. Special 270° Type S. E. Tuning Condenser makes gang-tuning possible on the short waves. Equipped with standard set of 4 pairs of R. F. Transformers 15 to 115 meters on forms of genuine NATIONAL R-39. Other ranges available. Uses new UX 235 Variable-Mu Tubes, giving improved sensitivity and less critical operation. Made in low-drain battery model and A. C. broadcast model with 245 tubes in push-pull. Supplied with separate humless A. C. Power Supply. R. C. A. Licensed.

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( ) Please send me complete information and prices on your new NATIONAL NC-5 Converter.
( ) Please send catalog sheets on the improved SW-5 THRILL-BOX.
( ) I enclose 50c (stamps or coin) for your 64-page Handbook of Short-Wave Radio, describing in full the latest and best short-wave receiving circuits, adapters, meters, etc.

Name. . . . .

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MR-1-32